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SHIPBUILDING

Defense, Emission Mandates, Offshore Wind drive business

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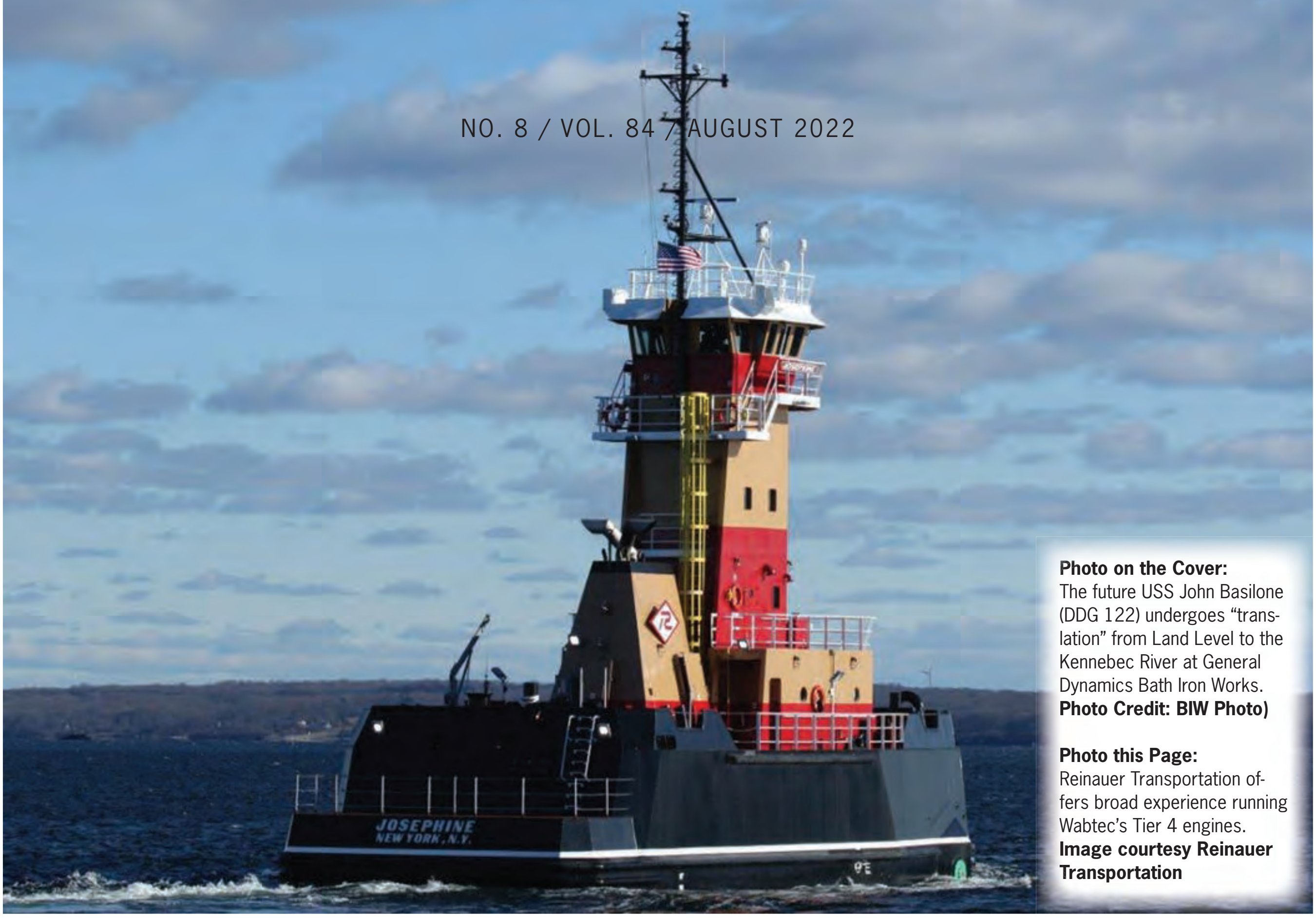

Photo on the Cover:
The future USS John Basilone (DDG 122) undergoes "translation" from Land Level to the Kennebec River at General Dynamics Bath Iron Works.
Photo Credit: BIW Photo)

Photo this Page:
Reinauer Transportation offers broad experience running Wabtec's Tier 4 engines.
Image courtesy Reinauer Transportation

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Authors

Daly

Ewing

Goldberg

Lewis

Lund

Lundquist

Maslin

Stoichevski

van Hemmen

Daly
After graduating with a BSc. in Physics, Joey Daly joined VesselsValue as a Maritime Analyst.

Ewing
Tom Ewing is a freelance writer specializing in energy and environmental issues.

Goldberg
Murray Goldberg is CEO of Marine Learning Systems, maker of MarineLMS.

Lewis
Philip Lewis is Director Research at Intelatus Global Partners. He has market analysis and strategic planning experience in the energy and maritime sectors.

Lund
Captain Randall Lund is a Senior Marine Risk Consultant at Allianz Global Corporate & Specialty. He has 25 years experience as a Marine Surveyor and 21 years as a Marine Accident Investigator.

Lundquist
Edward Lundquist is a retired naval officer who writes on naval, maritime and security issues.

Maslin
Elaine Maslin is an offshore upstream and renewables focused journalist, based in Scotland.

Lander
Karl Lander is the Director, Regulatory Compliance and Outreach at Armach Robotics. He joined Armach following 4+ years with Greensea Systems, where he was Director, Hull Robotics.

Stoichevski
After a honing the media campaign of Norwegian green group Bellona (current fuels advisors to the European Commission), William Stoichevski began working for the Associated Press. William lives and works in Oslo.

van Hemmen
Rik van Hemmen is the President of Martin & Ottaway, a marine consulting firm that specializes in the resolution of technical, operational and financial issues.

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CONTACT INFORMATION:

Email: mrcirc@marinelink.com
Web: www.marinelink.com
t: (212) 477-6700
f: (212) 254-6271

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I must admit, the last two years of business travel sabbatical have presented a welcome break after traveling the world to maritime exhibitions, conferences and shipyards for nearly 28 years. Getting back to the business of travel, starting with Nor-shipping in Oslo in April and many trips in between, has been somewhat of a struggle to regain that ‘work/travel’ balance that I thought was previously handled seamlessly.

As we gear up to send our team next to the SMM in Hamburg, Germany – which by early indications looks to be a solid return to normal – I had a recent trip out for the day, a trip that was less than 60 miles from my house, that clearly illustrated the high-value of the in-person connection.

Last month I spent a day in New London, CT, at the U.S. Coast Guard Research and Development Center to visit with Commander **Dan Keane** and his team. The full report on this will be in the September 2022 ‘Marine Design’ edition of *Maritime Reporter*, but the day spent interviewing Commander Keane, followed by a “lunch and learn” session with more than 30 of the Center’s team has given me months of material to work on. Every topic found in our pages – autonomy, decarbonization, digitalization, maritime safety, cyber security (and the list goes on) – is being worked on at speed at the USCG R&D Center, and I had an unprecedented opportunity to informally connect with many of the sector experts that are making it happen.

In this edition, our shipbuilding annual, there was certainly no lack of material, as shipyards globally are firing on all cylinders, driven by demand for new ships and boats in emerging sectors like offshore wind; traditional sectors like military that have been coming back strong for years, fast-tracked by Russia’s invasion of Ukraine earlier this year; and emission reduction mandates that have ship owners of every size, shape and locale questioning the best decisions to make today to future proof their fleets for the inevitable tightening of emission reductions to come.

Starting on page 34 Tom Ewing takes a close look inside the U.S. shipbuilding market for a gauge on how fast, how far the burgeoning offshore wind market will drive shipbuilding business to our shores. While there have been – and will be – many stops and starts, it will be difficult to stick the offshore wind genie back into the bottle, and it should remain a driver for many years to come.

On the military side Edward Lundquist looks at how shipyards are adapting to help the Navy and the U.S. Coast Guard recapitalize their fleets. Money is being invested across the country, particularly at the yards tasked to build some of the biggest and most complex warships on the planet. His story starts on 28.

Finally, we have a pair of features looking at the emission reduction mandate: William Stoichevski gives a complete breakdown of latest battery and electric options starting on page 22; and I recently visited Wabtec’s modern diesel engine manufacturing plant in Pennsylvania for a close look at its Tier 4 ready engine that does not require the addition of urea. The day spent with the Wabtec team – and a follow-up interview with **Chris Reinauer**, who has deployed eight of the medium speed powerplants across his fleet – offers a compelling argument to look at the Wabtec solution.

Gregory R. Trauthwein
Editor & Associate Publisher
trauthwein@marinelink.com

MARITIME REPORTER AND ENGINEERING NEWS

MARINELINK.COM

HQ
118 E. 25th St., 2nd Floor
New York, NY 10010 USA
T +1 212 477 6700; F +1 212 254 6271

FL Office
215 NW 3rd St
Boynton Beach, FL 33435-4009
T +1 561 732 4368; F +1 561 732 6984

CEO
John C. O'Malley
jomalley@marinelink.com

Publisher & Editorial Director
Greg Trauthwein
trauthwein@marinelink.com

Offshore Energy Editor
Bartolomej Tomic
tomic@offshore-engineer.com

Science & Technology Editor
Tom Mulligan
tom.mulligan@marinelink.com

Production Manager
Irina Vasilets
vasilets@marinelink.com

Production & Graphic Design
Nicole Ventimiglia
nicole@marinelink.com

Corporate Staff
Manager, Marketing
Mark O'Malley
momalley@marinelink

Accounting
Esther Rothenberger
rothenberger@marinelink.com
212-477-6700 ext 6810

Manager, Information Technology Services
Vladimir Bibik bibik@marinelink.com

Circulation
Kathleen Hickey k.hickey@marinelink.com
212-477-6700 ext 6320

Sales
Vice President, Sales
Terry Breese
breese@marinelink.com; +1 561-732-1185

Advertising Sales Managers
National Sales Manager
Lucia Annunziata
annunziata@marinelink.com;
+1 212-477-6700 ext 6240

John Cagni
cagni@marinelink.com; +1 631-472-2715

Frank Covella
covella@marinelink.com; +1 561-732-1659

Mike Kozlowski
kozlowski@marinelink.com; +1 561-733-2477

Gary Lewis
lewis@marinelink.com; +1 516-441-7258

International Sales
Scandinavia & Germany
Roland Persson
Orn Marketing AB, Box 184 , S-271 24
Ystad, Sweden
roland@orn.nu; +46 411-184 00

Germany, Austria & Switzerland
Tony Stein
tony.r.stein@btinternet.com
+44 1892 512777

United Kingdom, France, Italy & Spain
Paul Barrett
Hallmark House, 25 Downham Road, Ramsden
Health, Essex CM11 1PU UK
ieaco@aol.com; +44 7778 357722

Founder:
John J. O'Malley [1905 - 1980]
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Tip #38

Building Your Own E-Learning Modules

Have you ever considered building your own course library? Why not? It is surprisingly simple, surprisingly inexpensive (possibly even cost-saving), and the advantages in terms of relevance, effectiveness and professionalism are enormous.

There are good reasons to consider building your own content. First, your own content is always going to address your specific training needs directly. Off-the-shelf content will instead be much more generic by necessity, relevant in places, and not applicable in others. Your own content will also be much more familiar to your employees – with familiar systems, familiar environments, and familiar faces. This will improve engagement. Additionally, the act of building your own content will engage employees and small working groups in the "business" of training, creating a higher degree of training buy-in and a culture of pride, safety and professionalism. And the great news, which is a surprise to many, is that creating your own training content need not be expensive.

As a provider of learning technologies, we have many customers who have chosen to build their own learning content. In each case, they have created a high-quality library of content for their specific use which directly addresses their training needs. If you have read the preceding few Training Tips for Ships articles, you saw that simple media such as text, images, audio and video are highly appropriate for most training needs, are simple to put together, and will produce excellent results if done with a small degree of planning and care. While they may lack a "fancy" factor, they need not lack effectiveness nor the ability to engage trainees. In fact, because they will present directly relevant information that is specific to the crew's context and experience, they are often more engaging and more effective.

Moreover, the creation of this content will, itself, engage your crew in advancing safety. It is your internal experts who know your vessels, understand your systems, and who have developed your protocols that will be at the forefront of defining the training requirements and the training materials. It will be your deckhands, mates and captains who will help vet the material for relevance, correctness and clarity. And when the images are taken and the videos recorded, it will be your crew who's smiling faces are seen demonstrating tasks or safety procedures in the very work locations where the trainees will ultimately operate. Those new stars will become ambassadors for the training program. All of this will result in more respect for training, and a higher degree of professionalism. We have seen this over and over.

© Tierney/AdobeStock

So, what is needed to get started? First, we need to choose a content creation tool that has the smallest possible learning curve. There are many options but a great place to start is with PowerPoint. PowerPoint is adept at handling all of our basic media types: text, images, audio and video. A number of our customers use PowerPoint to great effect. Even so, to some degree the tool is itself secondary. The key point is to reduce the friction to getting started, so use what you know and like. You can switch at any time as you become more experienced.

Next, it is important to follow some simple rules supporting the creation of effective learning materials. It is not hard, and we will cover those in an upcoming edition of Training Tips for Ships. But don't worry, even if you make a mistake here or there, the fact that your materials are clear, relevant and familiar will ensure they are effective. Additionally, since you have control of the materials, you can update and redeploy them any time at all should a mistake be discovered, or an improvement be suggested. Do not be afraid to make mistakes – you will learn and develop increasingly refined courses along the way.

The final big question is how much work is all of this? There is indeed a cost in that someone appropriate in your organization will have to devote their time to the initial creation of your courses. But once the core set of courses are done, it is just a matter of regular maintenance and update. Thus, the time required will diminish to a base level over time. And since the courses will be yours to deploy as you see fit, there is no annual cost to subscribe to an off-the-shelf course library. Thus, in addition to the improved engagement and relevance, there could also be a cost saving.

Hopefully this gets you thinking. We will discuss what it takes to succeed in more detail in upcoming editions of Training Tips for Ships. Until then, keep well and sail safely.

The Author

Goldberg

Murray Goldberg is CEO of Marine Learning Systems.
Email: Murray@MarineLS.com

"I was country when country wasn't cool"

These Barbara Mandrell lyrics are a fitting introduction to Tom Risley, Director of Energy Programs, Life Cycle Engineering (LCE), an engineer who has a long and distinguished history working with 'Alternative Fuels' in the maritime sector. With LCE's deal earlier this year with MarAd to study carbon capture and sequestration in the U.S. maritime industry, Risley and his team can bring this experience to bear to help propose solutions to an extremely complex challenge.

By Greg Trauthwein

As regulators globally eye emission reductions from the maritime sector, Risley, who has spent a career on the topic of 'alternative fuels' in maritime, is succinct: *"It's complicated."*

Starting in the 1990s, Risley was working in a Navy program examining exhaust emissions, when NOx was the primary area of concern. But in opening Pandora's Box, other elements of emissions – namely particulate matter – surfaced with better insight on PM's impact on human health. "So progressively, as people become more aware of health and environmental issues surrounding exhaust emissions, what I call the perfect fuel – petroleum fuel – came under attack."

MARITIME REPORTER TV
Watch the interview with Tom Risley @ bit.ly/3PL6nVG

While he credits the work at the IMO MEPC level, with the new Energy Efficiency Index and SEEMP program conspiring to help dramatically monitor and reduce overall emissions, he said "those will not bring the IMO 2050 50% reduction."

So the environmental gauntlet has been thrown, and going forward it is probable that emission reduction mandates will grow ever more strict, with timelines condensing.

"It's complicated, because the maritime industry is about 2.6% of the CO2 emissions for the world. The air industry is about 2.8%; (and in fact) everything we do on earth generates greenhouse gas emissions," said Risley, noting that "I just read 0.3 grams of CO2 for every email you send."

His point: As all industries move toward decarbonization, there is a growing push for renewable fuel sources, and simply put there are not enough 'green energy' sources to fill everyone's needs.

Enter Carbon Capture

While carbon capture and storage has just recently gained steam in the maritime sector, Risley says the technology is mature as "the Department of Energy has had programs for over 25 years." Typically, for marine space, you would capture and sequester the CO2 on the ship until it could be offloaded. If you look at that in of itself, what it means is you have to add equipment to the back end of the system, at the exhaust system," said Risley. "Many operators are familiar with this from the sulfur scrubbing side of the house. But (the amount of) CO2 in the exhaust stream is a much greater (than sulfur). So you're now talking about capturing a significant amount, and the first challenge is most of these systems aren't marinized." The second challenge to integrating shipborne carbon capture and storage equipment is the ship itself, as additional equipment takes up space and volume otherwise reserved for revenue generating cargo, ultimately impacting the size, shape and seaworthiness of the vessel.

"Corollary to this second challenge is the fundamental science and chemistry behind this," said Risley. "When you burn a pound of fuel, you get three pounds of CO2," which delivers an obvious storage conundrum.

Adding further to the complexity is the addition of equipment to the ship adds weight, too, which means additional energy required to move the ship, in turn generating more CO2.

"The final challenge is, of course, what do I do with the CO2 when I've captured it?," said Risley. He said the Department of Energy is putting resources and action on the infrastructure front, but 'when' becomes a key question. This is on top of shipowners making the difficult choice regarding the fuel of the future for their fleet.

"So the idea, when I spoke with MARAD about this, was that somebody ought to be looking at the back end, just to put the pieces together so that you can have a choice. Front end, back end, are there things that can be done," said Risley.

The Project

Because of how complex the decarbonization issue will be for the maritime industry, Life Cycle Engineering's Risley and Process & Equipment Development Corporation (PEDCO) proposed to MARAD examining reducing GHG from a slightly different angle. What if, instead of modifying all of the systems and relying on the shore-side infrastructure systems to come online, the problem is worked from the exhaust end of the system? What if Carbon Capture and Carbon Storage could be a quicker solution for the short-term (while research and development continues for the hydrocarbon systems) and even part of the long-term solution for those vessels that may never be able to convert? This is following the U.S. Department of Energy's current funded initiatives to immediately begin to reduce GHG emissions through Carbon Capture and Sequestration. The scope of work being conducted for MarAd includes:

- LCE and team members will evaluate the opportunities and technologies available for onboard carbon capture and storage as an alternate methodology to decarbonizing marine vessels. The objective is to gather and prepare a review of the carbon capture and storage technologies that are under development worldwide.
- Using this technology review as the baseline, feasible technology insertion concepts will be prepared applying these technologies to identified vessel types. A screening tool will be developed to refine the applications and down select the best fit of technology for the vessels.
- LCE will form a stakeholder group

comprised of vessel operators, technology companies, and interested government entities that will meet to discuss technology, applications, and ongoing efforts worldwide.

- A techno-economic analysis will be performed to provide an estimate for a cost in $/ton CO2 removed. In addition, capital costs of the carbon capture and storage system, energy costs/penalties, and other operating and maintenance requirements will be identified.

The Way Forward

To many, the notion of carbon capture and storage is particularly confounding as there is yet to be a clear path on the next fuel that will serve the maritime industry. As much as a technological one, it's a logistics question for operators, asking "where do I get the fuel, and what's it going to look like on my vessel? The same thing would apply for Carbon Capture and Storage, as operators ask "Where do I store it? How do I store the CO2? How do I get rid of it? That's a piece that has to be evolved."

Logistics is one bit, financing a whole other matter. "I've continue to hear of a potential of carbon tax," said Risley. "A carbon tax is interesting because I'm effectively paying to emit CO2. I've heard numbers around $100 a pound," which essentially is a tax of $300 per ton of fuel. Finally, there's the matter of equipment, which today has not been built. With so many questions on the fuel and now, potentially, the size, shape and operation of the Carbon Capture and Storage equipment, the result is a paralysis to effectively do anything.

Finally, Risley points out that while legislation is indeed a driver, increasingly larger players in the shipping market … "the Amazon's, the IKEA's" … are becoming a larger driver with their own decarbonization goals dictating ultimately with which companies they will partner. "Everyone wants to know what your greenhouse gas emissions are."

The situation is "frenetic" said Risley, as policy makers envision a future and sets targets, which is great. "The problem is, they're skipping so many steps and they're making decisions based on those skipped steps to say '*Just do it.*'"

Meet Tom Risley

Tom Risley serves as Director of Energy Programs at Life Cycle Engineering (LCE). His background in alternative fuels began early in his career as a port engineer for an inland waterways towing company, then continued while working with Navy diesel programs at Westinghouse Electric Corporation, John J. McMullen Associates, Alion Science and Technology, and now at LCE. Tom is a graduate of the United States Merchant Marine Academy with a Master of Science in Energy Resources from the University of Pittsburgh.


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Flipping Small High-Speed Powerboats

By Rik van Hemmen

Naval Architects can predict many things with great certainty. But the sea is an unpredictable task master and there are still a number of areas where it is difficult to get a technical handle on the problem. High speed planing boat stability is one of those areas. Planing hull design is incredibly complicated and dynamic behavior is actually more difficult to predict than the dynamic behavior of airplanes. *(Let me say it again: Aerospace engineering (I am one) is sandlot compared to Naval Architecture)*. Meanwhile thousands of high-speed planing hulls of thousands of different designs and configurations are operated daily. Most of the time things are fine, but every now and then a high-speed planing hull operator finds himself up side down, and occasionally does not live to tell the tale. I have been called in on a dozen or so of those incidents and the full cause can only occasionally be determined. (And full disclosure; I also designed a planing hull that capsized during testing.)

Undoubtedly speed is a factor and often it may have something to do with the turning of the vessel, but that does not answer the central question as to whether it was a design problem, an operator problem or a maintenance problem. I have dealt with boats flipping up to 45-feet in length and as slow as 20 knots and in my experience there have been the following realistic causes:

1. **A design that strays from the state-of-the-art and is not fully evaluated**
2. **A design that is modified and becomes unstable**
3. **Force instabilities**
4. **Use of the vessel outside the "normal" performance envelope**
5. **A design that is inherently unsafe, but still built**

There is also another possibility, which is lack of proper operator training, but this is a white wash argument since, in my evaluation of these matters, nobody has ever been able to define "proper operator training."

Technically I have seen a number of different instabilities that have resulted in capsizes. They are often related to the configuration of the vessel.

There is "tripping a chine", which is a sudden inversion from a coordinated turn running on the inside chine to the outside chine. This may not always result in a full capsize, but can be so violent that the vessel occupants will be severely injured within the vessel or will be throw out of the vessel. I have seen tripping of chines on modern stepped hulls, modern deep V hulls, modern low V hulls and even modern RIBs.

Then there is "hooking the forefoot", which relates to boats that have a relatively deep forefoot, run relatively flat, and catch the forefoot in the water during a turn where this becomes a pivot point that will spin the boat out. Again, it may not result in a full capsize, but it is quite violent and will often result in serious injury and death. Tripping and hooking can also occur in combination with each other, with equally devastating results.

The last category I call "the slow death roll". This in many ways is the most troublesome and is simply a case where a vessel starts a turn and just keeps rolling to the inside of the turn until it capsizes. Strangely, the death roll does not necessarily occur at full speed or even unusually high speed. It may simply occur on a vessel that has been happily doing its thing for years and then one day decides to flip over with a normal load at modest speeds. I have seen this phenomenon on more slender, more classic planing boats, and especially on retro designs that use more powerful engines (and larger props) at lower speeds. On racing boats it can occur at higher speeds.

Option 5, a design that is inherently unsafe, mostly relates to its top speed. Up to 30 knots (and let's say over 24 feet) one can reasonably expect to be able to purchase a vessel that stays on its feet even when erratically maneuvered. Meanwhile, it is no secret that anyone can purchase a powerboat that will run in excess of 80 knots. At projectile speeds like that, one can expect things to go wrong when destabilizing forces raise their ugly head. In those capsizes I will generally point out that accidents are to be expected in the same way that accidents are to be expected when racing cars. That does not mean that slower speed vessels cannot be inherently unsafe.

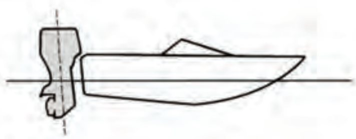
Causes 1 and 2 are a classic case of a designer or builder trying to achieve something by adding a clever fin, or hull steps, or changing the hull center of gravity, or adding horsepower to "enhance" the performance. One can do this, but such "novel" changes require thorough testing. Strangely, such thorough testing rarely occurs.

ABYC has made an effort at developing the H-26 performance testing method for planing hulls, but, so far, I have yet to encounter a capsized vessel where such testing occurred, and, quite frankly, I have yet to see the results of such tests on any one high-speed production planing boat.

The ABYC tests are a great start and often they can also reveal cause 3; force instability problems. Force instabilities occur when a propeller suddenly ventilates or a rudder becomes ineffective in certain conditions. These issues will always be unpredictable at the design stage, and can also occur in their own form in airplane designs, which is actually why airplanes require so much testing.

The ABYC tests are unlikely to identify all instability modes, since some instabilities could be the interplay of a number of subtle variations that do not occur during the ABYC test sequence (changing throttle settings during turns or unusual loading configurations), but if the boat becomes squirrelly at any one point in its performance envelope, the designer/builder can either modify the design, reduce the ability of the user to get into that part of the performance envelope, or provide a clear wheel stand warning not to enter that part of the performance envelope.

That warning is similar to the reduced speed warning provided on road signs in turns on country roads, or the Do-Not-Enter portion of a performance envelope of an airplane. Those of us who have operated outboard or outdrive powerboats may or may not know that in the engine manual there is generally a warning like this:



Bow Down
Too much trim-in causes the boat to "plow" through the water, decreasing fuel economy and making it hard to increase speed. Operating with excessive trim-in at higher speeds also makes the boat unstable. Resistance at the bow is greatly increased, heightening the danger of "bow steering" and making operation difficult and dangerous.

This behavior can be described as bow hooking at higher speeds. Meanwhile in the industry at large, capsizes due to chine tripping are often described as having been caused by making a hard turn while the engines are trimmed out (bow up) and engines should be tucked in (bow down) when making a hard turn. Yes, those are contradictory instructions, and certainly would not allow a user to figure out how to operate the vessel. Regardless, I have never seen any of those warnings on the wheel stand of high speed powerboats. Therefore, it is impossible to argue that a vessel is operated outside its "normal" performance envelope since no performance envelope has been provided. Until the industry takes responsibility, performs proper tests, and provides reasonable warnings, blaming the customer makes little sense.

For each column I write, ***MREN*** has agreed to make a small donation to an organization of my choice. For this column I select the American Boat and Yacht Council Foundation. They try to make things safer. *https://www.abycfoundation.org/*

Energy Efficiency Indices

By Joey Daly, Cargo Analyst, VesselsValue

$$EEXI = \frac{\left(\prod_{j=1}^{n} f_j\right)\left(\sum_{i=1}^{nME} P_{ME(i)} \cdot C_{FME(i)} \cdot SFC_{ME(i)}\right) + P_{AE} \cdot C_{FAE} \cdot SFC_{AE} + \left(\left(\prod_{j=1}^{n} f_j \cdot \sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{neff} f_{eff(i)} \cdot P_{AEeff(i)}\right) C_{FAE} \cdot SFC_{AE}\right) - \sum_{i=1}^{neff} f_{eff(i)} \cdot P_{eff(i)} \cdot C_{FME} \cdot SFC_{ME}}{f_i \cdot f_c \cdot f_l \cdot \text{Capacity} \cdot v_{ref} \cdot f_w}$$

Decarbonization is the greatest challenge facing the shipping industry today. The effort to reduce emissions and environmental impact extends to all sectors and players and will leave no one in the industry unaffected.

The IMO's effort to decarbonize shipping is a numbers game. The goal, as stipulated in the Initial IMO GHG Strategy, is to reduce the average CO2 emissions per transport work by at least 40% by 2030, compared to 2008 levels, and to pursue a 70% reduction by 2050.

The introduction of the EEXI is part of the IMO's latest attempt to achieve this goal. EEXI stands for Energy Efficiency Existing Index and is based on a previous IMO metric EEDI, the Energy Efficiency Design Index. It calculates a theoretical level of carbon efficiency based on a vessel's design, estimating the CO2 emissions per ton mile from engine specifications, fuel type and energy saving devices.

For every vessel above 400GT, an EEXI must be calculated and submitted – and it is no simple calculation.

The summarized formula pictured above gives an idea of the complexity. Vessels with EEXI values that exceed IMO limits will not comply with EEXI regulation. This calculation will need to be performed individually by technical managers and class societies across the shipping industry and what's more, results will not necessarily be made public. The key to transparency is access to the right data. With access to a comprehensive vessel and transactional database, we can begin analyzing fleets and sectors, and piece together what the EEXI will really mean for shipping. In this article we will share some of VesselsValue's findings, visualizations, and analyzes, to show just how important analytics are in the race to decarbonization. Shipping is a big industry, and to build a clear picture of its dynamics, you need big data. VesselsValue has made it possible to 'Scale up' the EEXI of an individual vessel metric to a sector-wise reflection of fleet carbon efficiency.

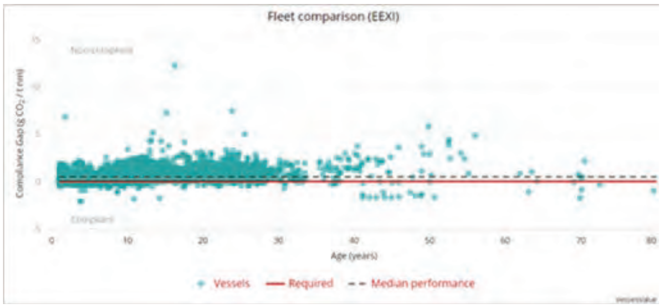


Figure 1: Source VesselsValue

Figure 1 above shows a calculated 'compliance gap' for every bulker, in the VesselsValue database that has a calculated EEXI value. A 'compliance gap' is determined as the difference between the Attained and Required EEXI. It is plotted against vessel age to build up a compliance profile of the entire bulker fleet and shows that the majority (87%) of the bulker fleet are not compliant with the regulations.

With the correct mathematical infrastructure and methodology, we can go further than simply plotting a distribution, we are able to model the tangible effects of the regulation on the vessels and on their owners' pockets.

As an example, we can look at Coal Carrying Capes between 203,000 DWT and 212,000 DWT, sometimes known broadly as Newcastlemaxes.

Figure 2, below, shows areas of high Newcastlemax activ-

Figure 2: Source VesselsValue

ity. The red area in the North West Australia is centered on the port of Newcastle, the vessel type's namesake.

EEXI estimations show that it's likely about 60% of vessels of this type will not be compliant with EEXI. In order to achieve compliance, these vessels will need to limit their maximum engine power, by undergoing an Engine Power Limitation (EPL) procedure. By working backwards through the EEXI equation, we can calculate the percentage engine power reduction needed to reach compliance for every non compliant Newcastlemax, or the EPL percentage. For some older tonnage, this is as high as 17% to 18%. Using the widely accepted cube law relating speed and power, we calculate that the average non compliant Newcastlemax will need to reduce its speed by c.6% as a result of EPL. This speed reduction may have a direct effect on how much vessels can earn on the charter market, with slower operating vessels experiencing lower earnings. **Figure 3**, to the right, shows that vessels built after 2015 are, on average, compliant with EEXI regulation. This suggests that fleet carbon efficiency is improving, and IMO regulation may be having the desired affect.

Conclusion

To improve something, you need to start by measuring it, and for shipping to reach its decarbonization targets, transparency is key. The analysis in this article is just a small example of the insights available with access to the right data.

Currently, the majority of the bulker fleet is not compliant, and achieving compliance may jeopardize earnings potentials or require ship owners to install new technology onto their vessels. Vessels that are already compliant, however, will have better prospects, incentivizing the development of a more efficient and environmentally friendly fleet. Analytics can help make the IMO's decarbonization regime more transparent and more efficient and help all those involved beat the numbers game.

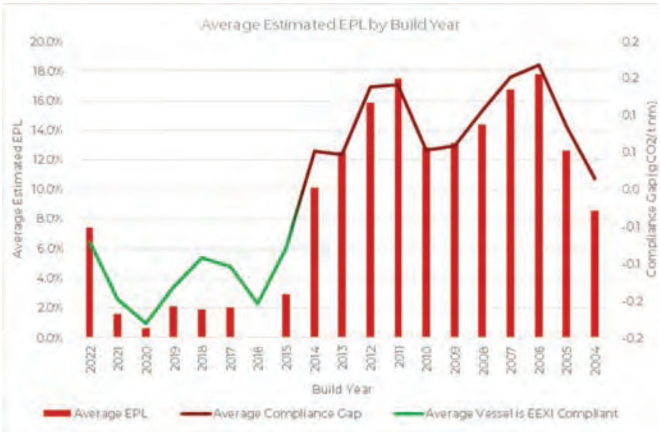


Figure 3: Source VesselsValue

Proactive In-water Cleaning

Microfouling and the first step to decarbonization

In the April 2022 edition of *Maritime Reporter & Engineering News*, Armach Robotics discussed how its autonomous robot could operate on a ship's hull, but only touched on the value this technology can bring. Armach's hull crawling autonomous robot (named the Hull Service Robot, or HSR) was developed to proactively address biofouling on ship's hulls.

But Why?

Simply put, biofouling is a problem. And the earlier it can be addressed, the better. The maritime world has known biofouling to be a problem for over a thousand years, and has been steadily evolving how to deal with it. The focus has largely been on macrofouling - barnacles, weeds and grasses - the really easy to see ugly stuff. Modern approaches include the use of anti-fouling and fouling release coatings, as well as reactive cleaning methods. These coatings can be effective in slowing the appearance of macro-fouling on vessels, and when their effectiveness is diminished, reactive cleaning takes place. But these established practices fail to address the issue of microfouling, or the earliest, slimy, stages of fouling development on the vessel.

Microfouling will start to appear on a surface within hours of immersion, and will increase over the coming days and weeks until, if left alone, it eventually becomes macrofouling. The rate at which this happens is highly dependent on numerous factors - water temperature, sunlight, nutrients in the water, coating system, currents, vessel speed etc - but the reality is there is going to be some level of microfouling present. And microfouling matters.

Microfouling increases drag on the hull. It may be slimy and slippery, but it is less hydrodynamic meaning greater fuel consumption and more greenhouse gas (GHG) emissions than a clean hull. The IMO recently published a preliminary report indicating that a thin layer of slime, half a millimeter thick covering approximately half the hull, can increase emissions as much as 20-25%. With an IMO goal of a 40% reduction in GHG emissions by 2030, addressing microfouling alone can move vessels closer to achieving that goal, lessening the criticality of other complex emissions reducing technologies.

To minimize the impacts of microfouling, the growth needs to be removed early and often. The challenge has been how to do this in a way that is economical, non-disruptive to the ship's schedules and not detrimental to the ship's coating system. More frequent use of traditional cleaning methods is not feasible, as the cumulative cost is very high, would require taking time away from the operational schedule, and since traditional cleaning methods are targeted for macrofouling and are very aggressive, they risk significantly damaging the paint if used regularly on microfouling.

Armach's HSR is designed to overcome these challenges. It is purpose built for proactive cleaning. Its small size and autonomy greatly reduce the infrastructure necessary to deploy and operate the system, reducing operating costs when compared to traditional systems. In fact, multiple HSRs can be deployed simultaneously, and be overseen by only one operator, allowing for complete coverage of the hull during a typical in port period. The small topside footprint required minimizes disruption on the pier and will enable cleaning operations to occur concurrent with other import activities.

Armach's HSR is specifically designed for removal of microfouling - the soft brushes it uses are engineered to remove slime without damaging the coating system. Long term testing has shown no damage or accelerated wear to coatings, and in some instances has resulted in a smoother coating system than at application, improving hydrodynamic efficiency.

The benefits of a proactive cleaning approach extend beyond the emissions reductions and not-insignificant fuel sav-

Armach's Hull Service Robot (HSR) is designed for removal of microfouling: the soft brushes it uses are designed specifically to remove slime without damaging the coating system.

Image courtesy Armach Robotics

ings. Ship hull biofouling has been identified as a significant vector for invasive species. More specifically, macrofouling is the threat. Macrofouling organisms are mature and able to reproduce, and if released in a new environment, can potentially colonize and threaten the local ecosystem. Microfouling, on the other hand, consists of either immature organisms that are of no threat if dislodged, or are pelagic in nature and either ubiquitous or are of no concern to the littoral, port environments. A proactive cleaning regimen will ensure that a vessel never leaves port with more than the earliest stages of growth, allowing it to arrive at the next port in a similar state.

Now as countries start enacting more stringent regulations, such as Australia's recent *Australian biofouling management requirements*, participation in a proactive cleaning program will become more beneficial as vessels will be able to demonstrate they have been recently cleaned.

With many vessel owners looking for ways to extend the time between dry dock maintenance periods, Armach's proactive cleaning solution can aid in increasing the life of the coating system. Removal of macrofouling can often result in damage to the coating system. A proactive regimen using soft tools can help ensure the coating system, and particularly the anti-corrosive component, stays intact longer, reducing the risk of corrosion issues to the hull.

And finally, all proactive cleaning conducted by Armach will result in the provision of imagery documenting the before and after condition of the hull, at a minimum. This will be covered in greater detail in the final article in this series, but will ensure vessel owners are provided with an unprecedented amount of information on the condition of their vessel's hull.

The Author

Lander

Karl Lander is the Director, Regulatory Compliance and Outreach at Armach Robotics. He joined Armach following 4+ years with Greensea Systems, where he was Director, Hull Robotics.

Climate Change Challenges for the Shipping Industry

By Randy Lund

With 90% of global trade moved by sea, shipping is a major contributor to climate change. The International Maritime Organization (IMO) estimated that the industry's greenhouse gas emissions grew by 10% between 2012 and 2018, while the industry's share of global anthropogenic CO2 emissions grew slightly to almost 3%, about the same volume as Germany. It also forecasts that 'business as usual' could see emissions increase by up to 50% by 2050 due to the growth in shipping trade.

The race to decarbonize shipping is now underway. In 2018 the IMO called for a 40% cut in greenhouse gas emissions (compared to the 2008 baseline) across the global fleet by 2030, and at least a 50% cut by 2050. Last year, the IMO also adopted short-term measures aimed at cutting the carbon intensity of all ships by at least 40% by 2030. However, these targets do not go far enough, and the IMO plans to revise its greenhouse gas strategy by 2023.

© Michele Ursi/AdobeStock

The EU, which is aiming for climate neutrality by 2050, says it will set greenhouse gas reduction targets for the maritime transport sector (shipping emissions represent around 13% of the overall EU greenhouse gas emissions from the transport sector). Last year, the U.S. also set out its plans to reduce greenhouse gas emissions by around 50% by 2030, which included the transport sector. Nine big companies including Amazon, Ikea and Unilever have pledged to only use zero-carbon ships by 2040.

Achieving the IMO's 50% cut in emissions, let alone the more ambitious targets required to meet the Paris Agreement goal of limiting global warming to well below 2 degrees Celsius will require huge investment in alternative fuel and more efficient shipping. The scale of investment required to meet the IMO 2050 target is estimated at $1-1.4 trillion. To fully decarbonize shipping would require a further $400m of investment over the next 20 years.

A growing number of vessels are already switching to liquefied natural gas (LNG), while a number of other alternative fuels are under development, including ammonia, hydrogen and methanol, as well as electric-powered ships. Cargo vessels and tankers are also experimenting with wind power, using kites, sails and rotors to supplement traditional propulsion. Wallenius and Alfa Laval, for example, have proposed a car carrier that uses wings and a specially designed hull to reduce emissions by as much as 90%.

While there are plenty of innovative ideas on the drawing board, there is not yet an obvious technical solution available that will get the industry to 2050. The shipping industry needs to make use of alternative fuels and technology to start reducing its emissions right away.

Decarbonization will transform the shipping industry's risk landscape. As the industry plots its course through the transition, it will need to ensure risks are contained within acceptable limits. As we have seen with the development of container shipping, there can be unintended consequences with innovation.

The introduction of low-carbon alternative fuels also brings a number of risks. A growing number of vessels are being built or converted to run on liquefied natural gas (LNG) and biofuel, including some large container ships. Further ahead, a number of projects are underway to test a range of alternative fuels, including ammonia, hydrogen and methanol, as well as onboard carbon capture technology. Maersk, for example, is to run eight methanol-powered container ships from 2024.

In January 2020, the International Maritime Organization (IMO) introduced a new lower limit on sulfur content in shipping fuel. The development of new fuels such as hydrogen and ammonia will take time, so in the meantime ship owners are being encouraged to switch to existing lower-carbon fuels, like LNG and biofuel. The first large bulk carriers to use LNG entered service in 2022 while LNG powered RoRo vessels and tankers are under construction, LNG group SEA-LNG says 90% of new car and truck carriers that will enter the market in the coming years will be dual fuel LNG. CMA CGM is to test biofuel on 32 of its container ships this year.

The decarbonization of the industry will require big investments in green technology and alternative fuels. It is essential that the transition to low-carbon shipping does not create new risks with unintended consequences.

The Author

Lund

Captain Randall Lund is a Senior Marine Risk Consultant at Allianz Global Corporate & Specialty. He has 25 years experience as a Marine Surveyor and 21 years as a Marine Accident Investigator.

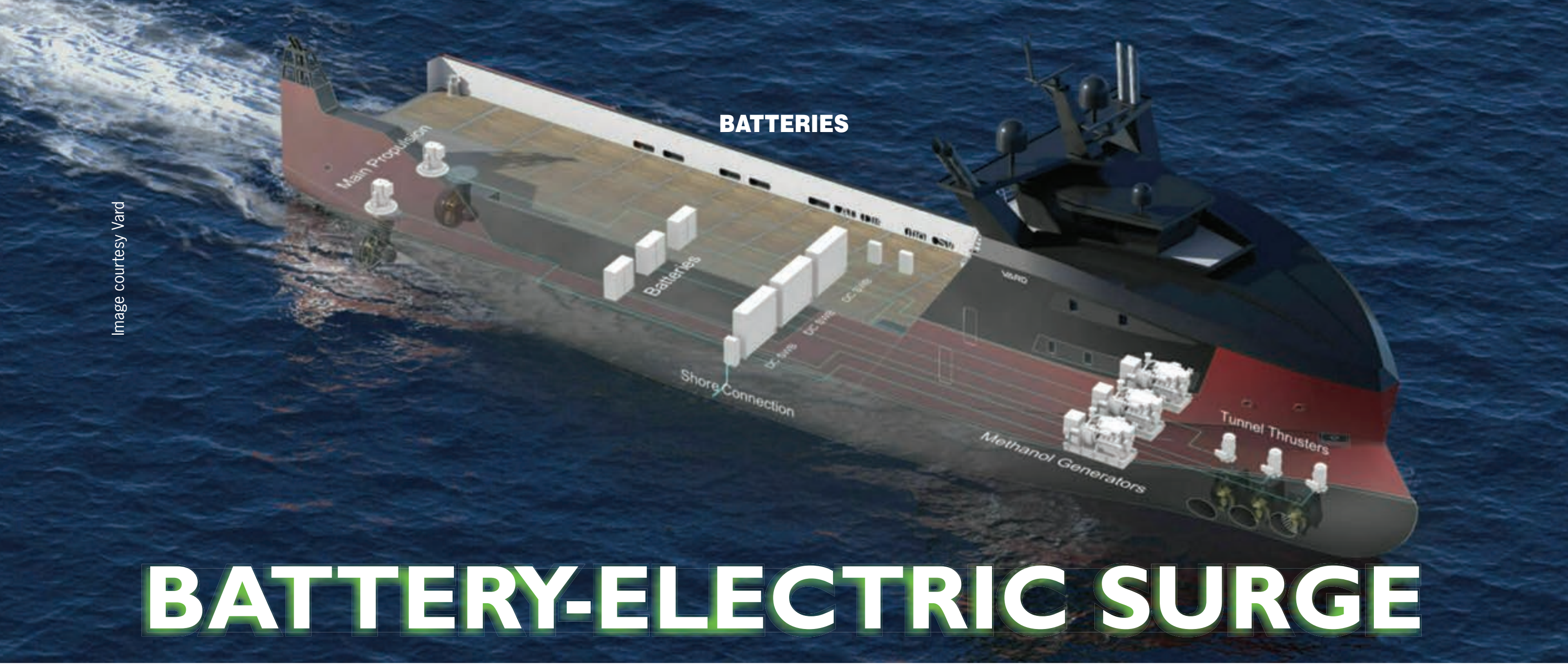


Image courtesy Vard

BATTERY-ELECTRIC SURGE

ESS Scales Up

Ask the right government department in any G7 state and you'll find funding to put battery power for your vessel. Beyond funds, new battery makers and system integrators are ironing out safety issues, and a growing number of giga-sized cell factories offer hope that costs will fall for marine energy storage, as Energy Storage System (ESS) choice grows. Efforts are also underway to recycle rare earth elements and to augment or greenify staggeringly high plant electricity inputs.

By William Stoichevski

Apart from funding, the drivers of change include constraints on shipping in Emissions Free Areas like the fjords of Norway, German ports, the EU's Climate Agenda, the UN's climate protocols and IMO rules.

In that mix are the grid operators of wind parks insisting on clean-sailing for service vessels, including, for some, a fuel cell to convert air and hydrogen into propulsive and hotel power or to recharge batteries. In the mix, too, is a brand-new ESS supply chain. When this writer wrote of Siemens robots assembling marine batteries in Norway (three years ago), battery-management software (BMS); the cells and module stacks, drives and electrical switching seemed apart from each other. Today, cell makers either have their own or a vendor's BMS, and integrators a choice of ESS.

"Heat" issues

The BMS is key, as the whole, emerging sector behind marine ESS still wrestles with the causes of perplexing battery fires, or thermal runaway (TR). A battery's own electro-magnetic interference, or EMI, might be a cause and, if so, then BMS offers some hope of total control while itself having to be immune to EMI.

If cell chemistry is to blame, then BMS might not be enough since, as one expert wrote, "each particle of active material is unique" and might not be totally controllable. So, more stable cell chemistries — the "next-generation", semi-solid Lithium-Ion cells — offer stability gains over earlier, less viscous chemistries.

While captaining a battery-powered vessel requires the safe BMS control software, there are, again, different types. An ABB source tells us that many of their battery suppliers have developed their own BMS, and confirms that "This is because each system must be tailored to the Li-I cells used in the system, as well as the specificity of Marine Classes." BMS tech and each supplier's software will affect battery control and safety, the ABB source says, adding that "(only some battery) suppliers are working on a preventative detection method to avoid thermal runaway." Yet, "Each cell (or pair of cells) must be monitored for voltage and temperature, so if the system detects a rise in temperature with some changes in voltage, with the help of a proper software detection algorithm, the battery string in question can be "isolated". If done early enough you can prevent the TR."

Shift Clean Energy

The man behind many of the world's first lunges for marine ESS still advises cell-maker hopefuls on two continents. After founding Corvus and PBES, Brent Perry now helms Shift Clean Energy, a company taking an integrative approach to battery-stack-making with in-house BMS software for its patented Shift hardware and the knowhow to have predicted the TR fires and explosions associated with air-cooled batteries and seen aboard ferries, car and cargo carriers.

Shift adds its Lithium NMC principal chemistry and BMS to the existing standard of venting for temperature and toxins-shedding. Shift has its own cell-barrier design for stacked cells. The Shift answer to TR is to run coolant around each cell.

"Our liquid cooling system is patented and delivers the most effective cooling available on the market today," he says, adding that "It delivers fire protection at the cell level, as well as fire detection at the cell level." The result is "laboratory-like control" of cell temperatures and ideal lifetime cell performance.

Perry had once cautioned that lab-like control via close-in cell cooling was necessary, or else TR could set in. His words have been heeded, in part, and recent safety incidents and reports out of Norway have vindicated the Shift tech. For ship owners, the Shift advantage is safety and a range of energy densities and high-quality cells designed for continuous use. The company's own Cellular Compression Technology offers "the lowest ageing values in the industry", or a system of cells that decay "up to 20 percent" less than standard cells.

Interference

The EMI generated by the battery system will also interfere with other components, our ABB source says. It will affect all equipment connected to it. EMI testing needs to ensure that the battery's EMI emissions are within limits.

All ABB equipment aboard battery-powered ships will work with battery systems that have passed the DNV-CG-0339-2021 tests for electromagnetic compatibility. For an ESS supplier, this ought to be key to acceptance with just about all systems integrators and owners. Shift is understood to have this plus the

TR certification IEC 62619:2017 from its days as SPBES. "Our product offers significantly longer life, a battery system that cannot produce a fire (due to built-in detection and prevention)."

Shift adds to that its OnWatch energy management system, a bespoke integration of ESS and ship that manages the battery and its cells' voltage, temperature, charge and discharge without pause, including at delivery, where "it's the only system we found to have all power terminals on when running but no voltage or power at the module level during delivery, installation and service".

Space and weight

You can't have batteries without onboard space, says Fiskerstrand business development boss, Gustav Johan Nydal. The Norwegian ship designer is behind several recent vessel designs, where owners wanted ESS aboard.

"No ship has unlimited space," says Nydal, a mechanical engineer, before adding that the designer always puts "sufficiently big room for ventilation" aboard their ships. New, containerized solutions work, he says, for high-speed vessels that have little time or opportunity for charging, and little space below deck. "Most of what we have designed have a battery room, with batteries piece-by-piece. Conversions for (containerized batteries) are faster, but apart from that I don't see any benefit." Nydal says Fiskerstrand puts "two or three" battery makers on a list for ship owners and their shipyard to decide what battery to install. "Several are good. We have no preference." As for their weight: "We're not concerned about weight. That's only for highspeed vessels," not the ferries of 10 to 12 knots that Fiskerstrand designs, including a recent order of five for Oslo harbour and three commuter ferries with large battery packs.

Batteries are best for short distances, where there's enough power to charge batteries when the ship is quayside. "We've sort of set a limit. If the sail distance exceeds 45 minutes to an hour, then the battery size will likely be so big that you should consider other sources."

Perry admits that while the Shift system offers "weight-space savings in power-energy applications" the Shift batt-stacks "tend to be on par or slightly heavier than our competitors, at least until early 2023, when we will deliver a battery that is about 15 percent lighter than our current offering."

Britishvolt's EASy claim

Another cell and battery "stack" maker is Germany's EAS which, after a merger this summer with UK-based Britishvolt, will continue to offer a tested ESS for a range of vessel types.

Britishvolt has attracted at least one marine industry investor (Scorpio) and will target a "next-generation" UK-derived marine ESS. However, EAS products will likely be the Britishvolt marine offering for some time to come.

EAS's trademark EASy Marine battery is somewhat modular, if cylindrical, with its roundness touted for being able to fill dead space where a classic rack system would need dedicated space. "It is therefore particularly well suited for refits," says EAS managing director, Michael Deumeyer. He claims the EAS solution offers "the highest power per volume on the market".

Like Shift, EAS has its own "safety case" to make, with its exec calling the EASy-Marine tech "safer" than conventional marine batteries. "The combination of the highest safety cell chemistry LFP with the cylindrical cell format is an extremely safe design. It is hardly possible to get into the state of thermal runaway. This would require a high level of abuse."

He continues: "We are sure that the EAS' marine solution is the safest graphite-anode-based system on the market. In TR testing, a certification body's testers reportedly called the resulting TR "the most benign ever experienced".

"No fire. No flames. And, of course, no propagation from cell to cell," he adds. It is understood that Britishvolt will use whatever BMS EAS or its vendors have to offer.

EST Floattech

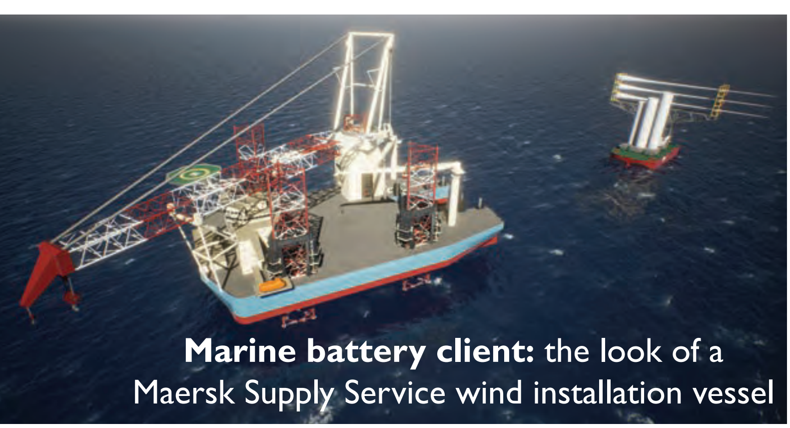
Another provider of marine ESS to the German market is Netherlands-based EST-Floattech. In a year, two sales managers and a project manager in Hamburg have landed battery pack orders for inland waterways vessels, government pilots and "the first of several" upcoming orders from a Southeast Asian offshore wind vessels operator.

The grown client list affirms a claimed safety track record, and sales manager Josefin Lindt confirms, "The diverse funding options for sustainable propulsion systems from the EU and German federal and state governments stimulate ship owners to choose for hybrid or zero-emission newbuilds."

Like Shift, EST-Floattech have an in-house developed BMS software integrated "to assure safe delivery and charging of power". This writer failed to determine how it does that, whether by monitoring and controlling anodes and cathodes or by other means. However, 10 years of sailings on EST Floattech batteries attests to a level of reliability. Their proven battery module, Green Orca 1050, is certified by "Hanseatic" class standard bearer, DNV.

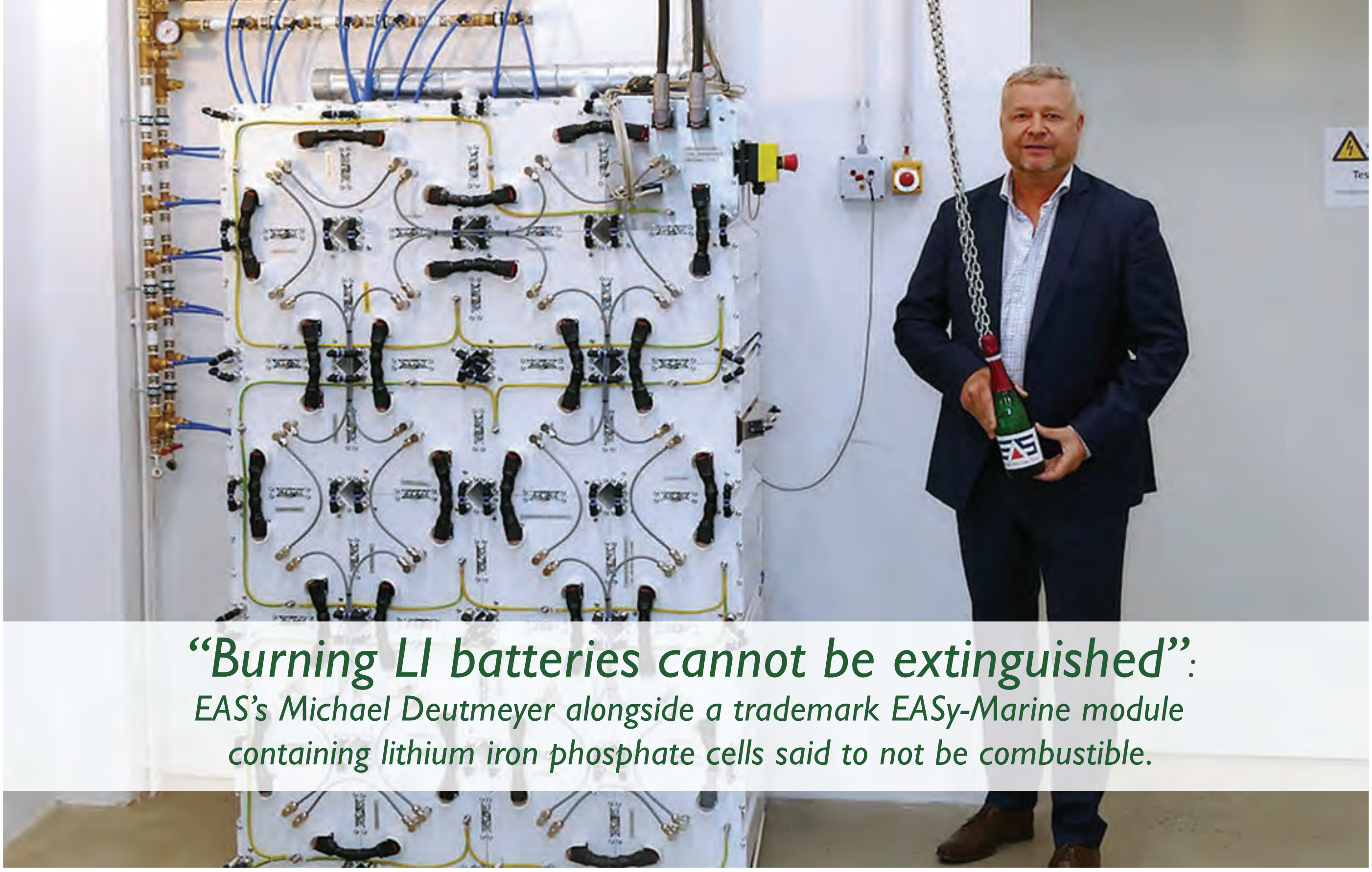
Freyer Battery

We looked at Shift to show how far battery makers may have



Marine battery client: the look of a Maersk Supply Service wind installation vessel

Image courtesy: Maersk Supply Service



"Burning LI batteries cannot be extinguished":
EAS's Michael Deutmeyer alongside a trademark EASy-Marine module containing lithium iron phosphate cells said to not be combustible.

Image courtesy: EAS/Britishvolt

After founding Corvus and PBES, **Brent Perry** now helms Shift Clean Energy, a company taking an integrative approach to battery-stack-making with in-house BMS software for its patented Shift hardware.

Photo Credit William Stoichevski

to go to become "integrated" enough to be sure about safety.

Norwegian-American "newcomer," Freyer Battery, may not be out to "integrate", but it is out after scale, with a whirlwind build-up to gigawatt size, at least on paper. The newly formed but rapidly grown entity has hurriedly hired in Japanese car-industry battery gurus — Freyer mainly aims to serve the auto industry — and has struck supply agreements with suppliers and potential clients. The future form of its marine offering can only be guessed at, but its build-up to battery production is noteworthy for being in lockstep with Britishvolt and, in Sweden, with Northvolt, as well as a pact with Maersk to test "end-to-end logistics" solutions.

Like Shift, Freyer has secured deals for future supplies of lithium and cobalt cells from Asia (Japan), although a US JV with 24M will target 50 GWh of batteries in "various sizes and chemistries", said its CEO, Tom Jensen, who aims to produce high-energy-density lithium cells. Mineral supply deals with mining outfits Glencore (Britishvolt for cobalt), Elkem (Freyer for anode active materials) and Indonesian VKTR suggest chemistries — and therefore BMSs — could change.

Gigawatt plant

Ship owners might also need to show their batteries are "largely" recycled. In Norway and Britain, at least, it has been decided that the miner knows best how to dispose of used mineral elements.

As climate rules tighten, zero-emissions battery production could become a thing. If it does, Freyer's super sales advantage will be batteries produced in pristine Mo i Rana using hydropower. That's no small achievement for a giga-factory hoping to produce 25 GWh a year in installable power and then from a 2-phase, 32 GWh giga-factory. Jensen said at a Pareto webinar in January that global battery demand would reach 5,300 GWh (mostly vehicles) by 2030, with some 670 GWh in ESS demand. Freyer targets 43 GWh of cell production by 2025 and 83 GWh by 2028. "We believe demand will outstrip supply by 2025," he said.

Freyer's Mo township will have to provide 200 to 3,000 GWh a year of electricity to power a first battery plant. Similarly burdened, Britishvolt's Gigaplant 1 in the Welsh highlands, and No. 2, in The Midlands, will use solar panels to augment the staggering amount of electricity battery supremacy will require.

They'll also be trying to outdo Freyer Battery's 0 kg per KWh by driving "embedded carbon out of the supply chain" at its Indonesian supplier, BV. "It is BV's aim to get the carbon content of its battery production to 25kg/KWh from a global average of 93kg/KWh. Freyer, meanwhile, will market their cells as "the world's most environmentally friendly" batteries.

Who's in what

Existing ESS makers, system integrators, yards and electric drive makers that can integrate batteries are picking up customers in all segments.

EST-Floattech has its new OCTOPUS series of batteries nearly ready for deployment to expand from its base of 200 "workboats and submersibles" to "river cruisers and platform service vessels". They'll require system integrators to make new installs safe and optimized. Their modules are serviced from the front and said to be easy to control. EST-Floattech packs "are easily extracted" for servicing.

While several ESS makers claim peak-shaving perks — power returned to or delivered from the battery when needed — hybrid-electric drive train makers make it work. Electric drive integrator, Danfoss Editron, is busy in July 2022 with an order for a 24-meter, French government buoy-laying vessel with two electric motors powered by 150 kWh batteries. Danfoss Editron, too, controls its system with "sophisticated software". So, the electric drive makers, too, have their IP in-house and have to consider EMI.

Yard as integrator

Then there are the yards with "electro" prowess, like VARD Elektro, who install battery power. A look at their order book reveals batteries installed in several segments, including an autonomous vessel where ESS would have to be extra reliable. VARD jobs are reminder that battery systems charge on DC power and are controlled by DC controls.

It may be on ferries — the large European Ropax ferries — where hybrid ESS might be best suited. The battery packs — as Fiskarstrand's Nydal says — have to be oversized, but Stena's three RoRo ferries ordered this summer will, at 11.5 MWh, be the largest propulsion systems and hybrid vessels ever seen. The new Leclanche Navius MRS-3 ESS will be aboard, with Wartsila claiming they offer size and weight advantages and many of the paragon characteristics described above: BMS for every module; water-cooled. The Navius 3 will ship in 2023 and will also be aboard Scandlines' 10MWh PR24 zero-emission freight ferry.

No application ceiling

The size of vessels sporting ESS has only gotten larger. Oil rigs? Check. Maersk has done that and now intend to put them on a wind installation vessel (see next issue). Boskalis is retrofitting offshore vessels to battery for hotel power and standby modes. The first oil tanker (Asahi Tanker) with an ESS onboard has already bunkered-up a MOL car carrier

Tugs, eco-product tankers, car carriers, high-speed ferries with people and cars aboard … nothing can stop electrochemical innovation — except repeat, fast-spreading fires aboard vessels reported, now, nearly everywhere.

"If the industry does not learn, eventually they will not be able to offer a solution. The regulations are only going to get stiffer. Battery suppliers cannot survive if they hope third party systems will ensure the safety of their products. That is the responsibility of the battery suppliers if they expect to be long term partners to the industry."

Image courtesy: Britishvolt

Image courtesy: Freyer Battery

Giga-battery factories:
Britishvolt's above and Freyer below

Shipyards Adapt to help Navy, Coast Guard Recapitalize Fleets

By Edward Lundquist

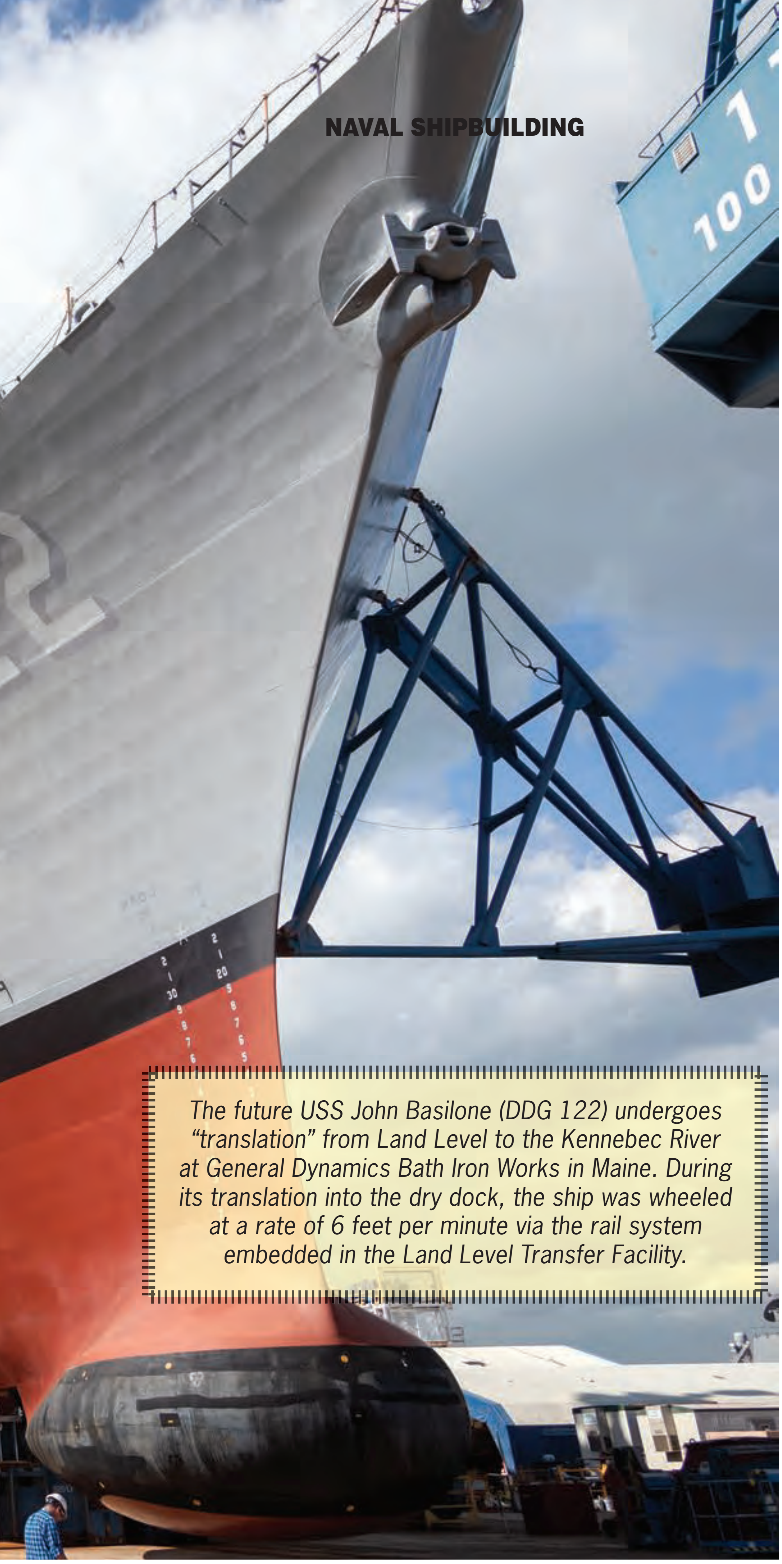
BIW Photo

U.S. shipyards are making improvements to building ships for the Navy and Coast Guard today and in the future. In some cases, it means phasing out one class of ship and getting ready for the next. Or, it can be a drastic make-over.

The yards include mid-tier yards all the way up to very large facilities devoted exclusively to warships. The ships range from the 353-ton Fast Response Cutter to the 100,000-ton nuclear-powered aircraft carriers.

Fincantieri Marinette Marine in Wisconsin is transitioning from its Freedom-class littoral combat ship production line to building the new Constellation-class of guided missile frigates. In the interim, FMM is also completing four multi-mission surface combatants, based on the Freedom-class design, for the Royal Saudi Navy.

Bollinger Shipyards of Lockport, La., delivered the 154-foot Legend-class Fast Response Cutter (FRC) USCGC Douglas Denman to the U.S. Coast Guard in May. Douglas Denman is the 49th Fast Response Cutter (FRC) delivered under the cur-



The future USS John Basilone (DDG 122) undergoes "translation" from Land Level to the Kennebec River at General Dynamics Bath Iron Works in Maine. During its translation into the dry dock, the ship was wheeled at a rate of 6 feet per minute via the rail system embedded in the Land Level Transfer Facility.

rent program of 64 cutters—and Congress has appropriated funds for two additional FRCs beyond the 64.

Austal USA's all-aluminum parallel production lines that are producing littoral combat ships and expeditionary fast transports have been augmented with a steel production capability. Since October of 2021 Austal USA received contracts to build two steel towing, salvage and rescue tugs, with a contract for two more issued on July 22), with construction of the first starting on July 11. Austal USA also received a contract to build an auxiliary floating drydock for the Navy.

But the investment really paid off when the Mobile-Ala., yard won the competition for phase II of the Coast Guard Offshore Patrol Cutter (OPC). This will provide up to 11 of the 360-foot 4,500-ton cutters.

Eastern Shipbuilding Group (ESG) of Panama City, Fla., was the original OPC prime contractor. Although they were expected to build the first ten OPCs, ESG's shipbuilding facilities were damaged following Hurricane Michael in October of 2018. The shipyard submitted a request for extraordinary relief to help the facility recover and the people return to work. Subsequently, relief was granted, but limited to the first four hulls in the OPC program. The Coast Guard announced that the OPC program would be restructured to include a competition for a new contract to build subsequent OPCs. That award went to Austal USA.

HII is constructing the 1,092-foot, 100,000-ton Gerald R. Ford-class aircraft carriers and Virginia-class attack submarines at its Newport News Shipbuilding NNS) in Virginia

The first, USS Gerald R. Ford (CVN 78), was commissioned in 2017. The next three—Precommissioning Unit (PCU) John F. Kennedy (CVN 79), PCU Enterprise (CVN 80) and PCU Doris Miller (CVN 81), are under construction. NNS is also building Virginia-class attack submarines .

SUBMARINES

General Dynamics Electric Boat (EB) Electric Boat and NNS are building the Virginia class fast attack submarines (SSNs) in a teaming arrangement. "We build different portions of each ship and alternate final assembly at our respective yards," said EB spokesman Daniel McFadden.

The sail, stern, bow, habitability, machinery spaces, and torpedo room are assembled at NNS, while EB's Groton, Conn., and Quonset Point, R.I. facilities are building the engine room and control room. The shipyards take turns building the reactor plant and the final assembly, outfitting and delivery.

"Currently there are 13 ships in various stages of production. The next delivery from Electric Boat will be the Hyman G. Rickover (SSN 795)," McFadden said.

The Virginia-class construction has progressed in blocks, with the boats having successively more capability or built with more efficiency. The Block III submarines were being built with a pair of multipurpose Virginia Payload Tubes

Austal USA of Mobile, Ala., began construction of the Navajo-class Towing, Salvage, and Rescue Ships (T-ATS) on July 11. The company was awarded a contract for T-ATS 11 and 12 in October 2021, and two more on July 22, 2022.

Austal USA image

(VPT), which replaced the single purpose cruise missile launch tubes. Block V variants are longer so they can incorporate the new Virginia Payload Module (VPM).

The lead ship, USS Virginia (SSN 774), was commissioned in 2004. The newest, USS Montana (SSN 794), was commissioned in June of this year. Sixteen more are under construction or authorized, divided between the two yards.

The Navy plans to build 12 Columbia (SSBN-826) class ballistic missile submarines (SSBNs) to replace the Navy's current force of 14 aging Ohio-class SSBNs. While both NNS and EB are expected to build the new subs, EB is the primary contractor and all boats will be assembled, tested, launched, and delivered at Groton.

General Dynamics has invested $1.85 billion in infrastructure improvements and expansion at Electric Boat to support the Columbia class production. "This involves new buildings and tooling for hull module construction at its Quonset Point, Rhode Island, facility, a 200,000 square-foot assembly building at the Groton, Connecticut, shipyard, a custom transport barge for the Columbia modules, and a floating dry dock now under construction by Bollinger Shipyards," McFadden said.

HII's Ingalls Shipbuilding division is building National Security Cutters for the Coast Guard, Arleigh Burke-class guided missile destroyers, and San Antonio class amphibious ships and America-class assault ships in Pascagoula, Miss. That includes the 844-foot, 45,000-ton future USS Bougainville (LHA 8), as well as three San Antonio-class amphibious transport dock ships (LPDs). The yard is transitioning from the Flight I LPD to Flight II, with the new variant having enhanced war fighting and survivability capabilities, improved command and control capabilities, stealthy design elements, and several quality of life improvements; plus it more affordable to replace the Navy's 12 aging Whidbey Island/Harpers Ferry (LSD-41/49) class landing ship dock (LSD) ships. Richard M. McCool (LPD 29) is the final Flight I LPD, while Harrisburg (LPD 30) will be the first Flight II. Both are under construction, soon to be joined by Pittsburgh (LPD 31)

Ingalls has delivered nine Legend-class national security cutters to the Coast Guard. The 10th, Calhoun (WMSL 759) was christened in June and scheduled to be delivered early next year. The 11th, Friedman (WMSL 760), started fabrication in May 2021. Ingalls is the sole yard building the NSC, LPD and LHA.

Ingalls is also one of two shipyards building Arleigh Burke-class guided missile destroyers (DDGs). According to a news release, "Frank E. Petersen Jr. is the 33rd destroyer Ingalls has built for the U.S. Navy, with five more currently under construction at Ingalls, including Lenah Sutcliffe Higbee (DDG 123), Jack H. Lucas (DDG 125), Ted Stevens (DDG 128), Jeremiah Denton (DDG 129) and George M. Neal (DDG 131)."

Jack Lucas is the first of the new Flight III DDGs, incorporating a new and more capable SPY-6 Air and Missile Defense Radar (AMDR).

General Dynamic's NASSCO yard in San Diego is continuing to build the John Lewis-class of fleet oilers (T-AOs) and Lewis B. Puller-class of Expeditionary Mobile Bases (ESBs).

The 50,000-ton, 746-foot John Lewis-class of class of fleet replenishment oilers will eventually comprise twenty ships and will replace the Henry J. Kaiser-class replenishment oilers now in service.

- USNS John Lewis (T-AO 205) – delivering this year
- USNS Harvey Milk (T-AO 206) – launch and christened on 11/06/2021
- USNS Earl Warren (T-AO 207) – christening and launch scheduled for later this year
- USNS Robert F. Kennedy (T-AO 208) – under construction
- USNS Lucy Stone (T-AO 209) – under contract
- USNS Sojourner Truth (T-AO 210) – under contract
- John L. Canley (ESB 6) – christened June 2022
- Robert E. Simanek (ESB 7) – under construction

NASSCO spokesman Brian Jones said the company is making the San Diego yard more productive, efficient and competitive.

"We've invested in more automated production equipment and modern welding technology like our Thin Plate Panel Line. The cutting-edge facility uses hybrid laser arc welding and numerically controlled robots to mill, seam and weld steel panels in a highly automated production line. These features improve capacity, quality, accuracy, cycle time and produce lighter, more energy efficient ships. In addition, upgrading our blast equipment and smaller accuracy control tools have enhanced our shipbuilding process with less demand on our workforce," Jones said.

General Dynamics Bath Iron Works spokesperson Julie

The first Offshore Patrol Cutter, USCGC Argus (WMSM 915) takes shape at Eastern Shipbuilding Group's Panama City, Fla., shipyard. The Coast Guard plans to build 25 OPCs.

ESG photo

Rabinowitz said her yard has 10 ships in its backlog, including the last of the Flight IIA ships and the newer Flight III variants. "Currently, seven ships are under construction. DDG 122 John Basilone was translated and christened in June, and all backlog ships have been funded by Congress.

- Flight IIA: Carl M. Levin (DDG 120) – John Basilone (DDG 122),– Harvey C. Barnum Jr. (DDG 124), and Patrick Gallagher (DDG 127).
- Flight III: Louis H. Wilson Jr. (DDG 126), William Charette) (DDG 130), Quentin Walsh) (DDG 132), John E. Kilmer (DDG 134) – Richard Lugar (DDG 136) – and J. William Middendorf (DDG 138).

According to Navy officials, the service is committed to a smooth and successful transition from DDG 51 to DDG(X) starting around FY 2030. The transition will preserve the critical shipbuilding and supplier industrial base by executing a collaborative design process with current DDG 51 shipyards and transitioning to a proven limited competition model between these shipyards at the right point in ship construction. Both Ingalls and BIW are expected to build DDG(X).

Photo courtesy Blount Boats

OFFSHORE WIND: A Rising Tide Lifts Shipyard Markets

By Tom Ewing

Offshore wind took big strides in the first half of 2022 across a number of critical fronts, from public policy to private sector, corporate investments. These moves portend big impacts for US shipyards.

On the private sector side, Crowley and ESVAGT, in June, recommitted to build Jones Act compliant service operation vessels (SOVs) for US offshore wind (OSW). Crowley is the U.S. based maritime, energy and logistics company. ESVAGT is a Danish company which pioneered the SOV concept in Europe; their know-how is now important for US projects.

The companies will design, develop and deliver wind-dedicated, US flag vessels. Crowley will be owner and operator. Both companies will share in project financials.

Jeff Andreini, vice president, Crowley Wind Services, commented that "Crowley will help propel the continued growth of maritime and logistics solutions to help solve the nation's vessel capacity demands in a responsible and sustainable way."

A Growing Fleet

The Crowley-ESVAGT agreement is not a one-and-done event. Consider:

- In May, Gladding-Hearn, based in Somerset, MA, announced start of construction on a 24-seat crew transfer vessel (CTV) for Patriot Offshore Maritime Services LLC. This is Gladding-Hearn's first CTV project. The all-aluminum high-speed catamaran, designed by Incat Crowther Design, has a length overall of 88.5 ft., beam of 29.5 ft. and draft of 5.6 ft. The vessel will operate year-round to support the Vineyard Wind project 15 miles from Martha's Vineyard. The wheelhouse, with windows on all sides for nearly 360-degree visibility, will be located on the second deck.
- In March, Edison-Chouest Offshore announced construction of the first Jones Act compliant SOV for Orsted and Eversource.
- Just as significant, perhaps more so, was the announcement, also in March, from Virginia's State Corporation Commission (SCC) that Dominion Energy's (DE) Charybdis project is in the public interest. DE announced construction of the Charybdis, the nation's first domestic offshore wind turbine installation vessel, a year ago – in June 2021. Because of public utility and ratepayer issues, however, the SCC's review was required. This impacts projects all along the Atlantic. The Charybdis will be used for DE's 176 turbine Coastal Virginia Offshore Wind project, 27 miles from Virginia Beach, and it will be chartered for other Atlantic projects. Keppel AmFELS, in Brownsville, TX, is constructing the $500 million Charybdis.
- Finally, a very recent OSW commitment was the June 30 ribbon cutting in Providence, RI, where Dutch maritime construction giant Boskalis opened an American office to serve as "renewables hub." While this isn't 'shipyard' per se, Boskalis' work will require vessels. Boskalis was awarded three contracts for foundations, scour protection, transport and export cable scopes in the northeast. Boskalis will be performing monopile and substation transport and installation works and scour protection works for Ørsted-Eversource's South Fork, Revolution and Sunrise wind farms.

Photo courtesy Eastern Shipbuilding Group

"We are ready today to support design and construction of large offshore wind vessels, and we look forward to supporting vessel operators with high quality assets."

Joey D'Isernia, President, ESG

These developments align with the latest forecast from Intelatus, the consultancy and business intelligence firm tracking US wind markets. In its July Report Intelatus writes that the US "continues its journey to deploy 30 GW of offshore wind by 2030 and 110 GW by 2050." The firm cites new

Photo courtesy Blount Boats

BOEM offshore leasing activity for California, and additional auctions in the South Atlantic, the Gulf of Mexico, Oregon and Maine. The Eastern Shipbuilding Group President Joey D'Isernia forecast estimates that $205 billion will be required to bring this all onstream.

[As this report is concluded in mid-July BOEM announced a *regional* environmental review of six New York Bight wind lease areas; BOEM's first multiple site analysis.]

Demand and Supply

For a ballpark picture of how OSW is impacting America's shipyards, *Maritime Reporter & Engineering News*, in May, sent questionnaire to shipyard executives across the space. Among respondents, each yard said it is active in this emerging supply chain, although some yards are more advanced than others. Minimally, all respondents are actively bidding to build vessels, ranging from service operation vessels (SOVs), wind tower installation vessels, OSW support vessels and CRTs. One west coast company said it is closely watching developments on the Atlantic to be ready when Pacific projects and markets catch up. This yard is already building vessels for European wind projects.

The scope of these preparatory moves is made clear in comments from Eastern Shipbuilding Group (ESG) which seeks to build large, complex OSW vessels. explained that the company has shifted and refocused efforts at one facility to be used for government vessels. Two other facilities will specialize in OSW vessels. New infrastructure includes launch-way upgrades, upland bulkhead upgrades, construction platen expansions, and waterway deepening. D'Isernia and his team expect significant growth, including construction of SOVs, installation vessels and other support vessels, e.g., feeder barges, and

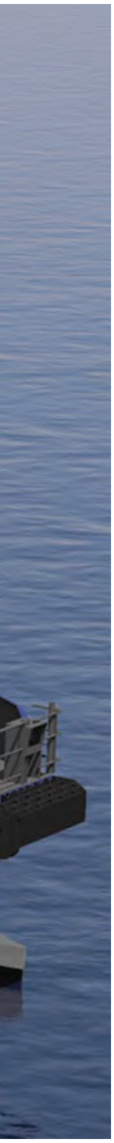


Photo courtesy NJ Wind Institue Development

New Jersey is undertaking a series of concurrent activities to advance OSW, particularly in education and workforce development.
Jen Becker, NJ's Managing Director, Wind Institute Development

construction vessels. D'Isernia commented: "We are ready today to support design and construction of large offshore wind vessels, and we look forward to supporting vessel operators with high quality assets."

On the workforce side ESG launched an initiative to promote workforce development, recruitment, and retention. We seek "a long-term sustainable environment for the personal and professional growth of our employees," D'Isernia said. Additionally, ESG has supported start-up and funding for 12 CTE (Career Technical Education) programs to establish a steady pipeline of new shipbuilders."

Marcia Blount, President of Blount Boats based in Warren, RI. Blount Boats built the first OSW vessel – Atlantic Pioneer – in 2016 and a second boat, the Endeavor in 2021.

Blount sees a bright future in OSW, and today has four CTVs under contract. The company seeks to build at least three per year for the next five years, hopefully longer. Her company seeks contracts in all wind energy regions.

In an interview, Blount said safety and fuel efficiency are critical features for CTVs. Employees have to move safely, in high seas, from the vessel to a worksite. She is taking a close look at MARAD's recent announcement that would designate OSW vessels as "vessels of national interest."

Policy: Building the Market

There was big news on the public sector side the same day as the Crowley-ESVAGT announcement: DOE announced a new Federal-State Offshore Wind Partnership, establishing an extensive set of initiatives to deliver on President Biden's goal of 30 GW of OSW by 2030. The Partnership includes:

- A new federal-state agreement with eleven east coast states to take on regional issues such as transmission, interconnection, fishing and workforce.
- Advancing the "National Offshore Wind Supply Chain Roadmap." DOE plans a July workshop for stakeholders to help develop the Roadmap, due for release later this year.
- Priority financing for OSW vessels. MARAD will designate OSW vessels as "Vessels of National Interest," which gives priority to OSW vessel funding applications. This designation will help US shipyards modernize and help shipowners with new or retrofit vessel projects.

MARAD was asked about program scope, i.e., will it include all vessels? A spokesperson replied that, yes, "all vessels which are primarily constructed or reconstructed for use in the construction, service, or maintenance of wind farm facilities. It is intentionally broad and includes costs for construction of new vessels as well the costs for modification or reconstruction of existing vessels to convert them for use in wind farm facilities."

It's worth noting the alignment between DOE's efforts and the recent discussions and ideas that emerged at the International Offshore Wind Partnering Forum (IPF), in April, in New Jersey. The Forum was hosted by the Business Network for Offshore Wind and as one indicator the Forum itself testifies to momentum in OSW. Consider: attendance in 2021 was 1500. This year almost 3,000 attended from nearly 800 businesses and 25 countries. Speakers included NJ Governor Phil Murphy, US DOE Secretary Jennifer Granholm and BOEM's Director Amanda Lefton.

A key Forum message: public-private partnerships are critical to advance OSW and renewable energy. One Forum takeaway: policymakers need to keep their attention on creating the conditions necessary to bolster OSW; public policy and grants are vital to leverage private OSW investments. DOE's and

Photo courtesy Blount Boats

Warren, RI-based Blount Boats built the first OSW vessel – Atlantic Pioneer – in 2016 and a second boat, the Endeavor in 2021. Marcia Blount sees a bright future in OSW, and today has four CTVs under contract. The company seeks to build at least three per year for the next five years, hopefully longer.

Marcia Blount, President, Blount Boats

MARAD's moves closely align with that recommendation.

State-level Progress

New Jersey has taken out-front positions on a number of critical steps. Last September the South Jersey Port Corporation announced that German-based EEW Group will replicate its German monopile factory at NJ's Paulsboro Marine Terminal, a $250 million project. The site will produce monopiles for Orsted's Ocean Wind 1 and 2 projects and for EDF/Shell's Atlantic Shores project. Talks are underway about supplying other Atlantic OSW projects.

The Paulsboro work is on track for producing monopiles in 2023, Lee Laurendeau, the CEO of EEW American Offshore Structures, wrote in an email. The circumference welding building is substantially complete with equipment being installed now. The coating building is enclosed and expected to be finished by end of the year.

Jen Becker is NJ's Managing Director, Wind Institute Development. She described a series of concurrent activities to advance OSW, particularly in education and workforce development.

This summer Gloucester Community College will offer training in submerged arc welding and marine painting.

In May, education officials announced funding for new wind turbine technician training programs, a joint project with the State's Economic Development Authority, Cumberland County Technical Education Center, Gloucester County Institute of Technology and Rowan University as well as labor unions and Maersk Training. The Wind Turbine Technician certificate program starts in January 2023. An Associate of Applied Science degree program starts in September 2023.

Additionally, Becker said NJ is funding an OSW scholarship program at four research universities. Candidate selection, expected to include 25 students, is underway now and will conclude by fall.

New York

Last March Equinor and bp announced agreement on a $250 million project to transform the South Brooklyn Marine Terminal into an OSW hub, making the 73-acre one of the largest OSW ports in the US.

An Equinor spokesperson said site investigation is underway now to facilitate engineering design. Construction permits should be final 2024. Initial work will include staging, marshalling and pre-assembly of the wind turbine generator components starting with Empire Wind, likely in 2026.

Importantly, the companies are also readying a project office, slated to open this year, in Sunset Park, Brooklyn, adjacent to SBMT. The office will be the hub for Equinor and bp's regional operations, including for the Empire and Beacon Wind projects. The companies are in the process of developing community and work agreements and mapping out training and identifying the skill sets required for work at the Terminal.

American Bureau of Shipping *A Close Focus on Wind*



Photos courtesy ABS

Left to Right:

Wei Huang, Director of Global Vessel Market Sector
Keegan Plaskon, Director, North American Reg. Business Development, Offshore Vessels
Elizabeth Kretovic, Director, Offshore Wind Business Development, North America

ABS was asked for its perspectives on the pacing of US wind projects and about the metrics that indicate the heft and momentum required to meet new energy deadlines.

Wei Huang,ABS Director of Global Vessel Market Sector, said the U.S. shipyard market has demonstrated strength and capability. "We are underway," she said, "building the smallest crew transport vessels (CTVs) up to the largest with a wind turbine installation vessel (WTIV) with ABS supporting Class across all vessel sizes." She noted challenges, including availability of certain vessel construction materials and long lead times for machinery components. Domestic production incentives may help. She suggested that the creation of regional economic hubs for vessel construction, retrofit and maintenance near wind energy areas "may focus overall system maturity faster in the early adoption of clean or alternative fueling infrastructure."

Wei cited other big picture issues:

- Concerns about a limited pool of US-licensed, -qualified, and -eligible offshore mariners, which may be compounded because the US market will compete with rebounding global operations. One idea: promotion of OSW programs that enable hybrid certifications for mariners from alternative branches of the industry (such as veterans and fisheries) may alleviate mid-term pressure.
- OSW support vessels will lead the adoption of alternative fuel supply resources. This should complement other maritime and transportation needs, moves that, Wei said, could "further encourage decarbonization, leveraging and maximizing the utilization of existing infrastructure – a win/win transcending maritime markets."

With reference to vessels and shipyards Wei mentioned the following projects as important indicators of supply chain build out:

- *Great Lake Dredge & Dock's contract with Philly Shipyard for a subsea rock installation vessel;*
- *Edison Chouest Offshore's service operation vessel;*
- *Keppel AmFels' Charybdis construction;*
- *Two new feeder barges and two diesel-electric hybrid tugboat units by Kirby Offshore Wind for Equinor and bp's New York projects.*

ABS Class

ABS was asked about US DOE's new Federal-State partnership: the right move? Why? **Keegan Plaskon** is ABS Director, North American Regional Business Development, Offshore Vessels. He said that due to vessel costs in the $550-$600+ million range, and the construction time required "the project commitment is critical before securing such investment with a sufficient chartering payback pipeline." He said next steps are defining "some of the key risks in financing the larger CAPEX vessels" to see where public/private partnerships can best help.

Plaskon said that if OSW vessels moved to low carbon operations this could "impact across the full lifecycle of an OSW project." He said ABS is using new analytics now to measure and report on complete carbon impacts and preparing that data for federal reporting.

Workforce is another metric. "We are tracking a number of key initiatives that States are driving in coordination with Federal government agencies," said **Elizabeth Kretovic**, ABS Director, Offshore Wind Business Development, North America. These include tax incentives to support wind component manufacturing, port enhancements as well as workforce development through labor agreements and university partnerships. Kretovic noted that several U.S. maritime training facilities are now members of the Global Wind Organization (GWO). She said this will ensure "training is in place in time for construction to commence offshore." Kretovic noted further that project developers and engineering and procurement contractors are establishing wind-related university internships. "All these initiatives," Kretovic commented, "are coming together not only to lower costs but to establish an industry and associated supply chain based on safety and minimizing risk."

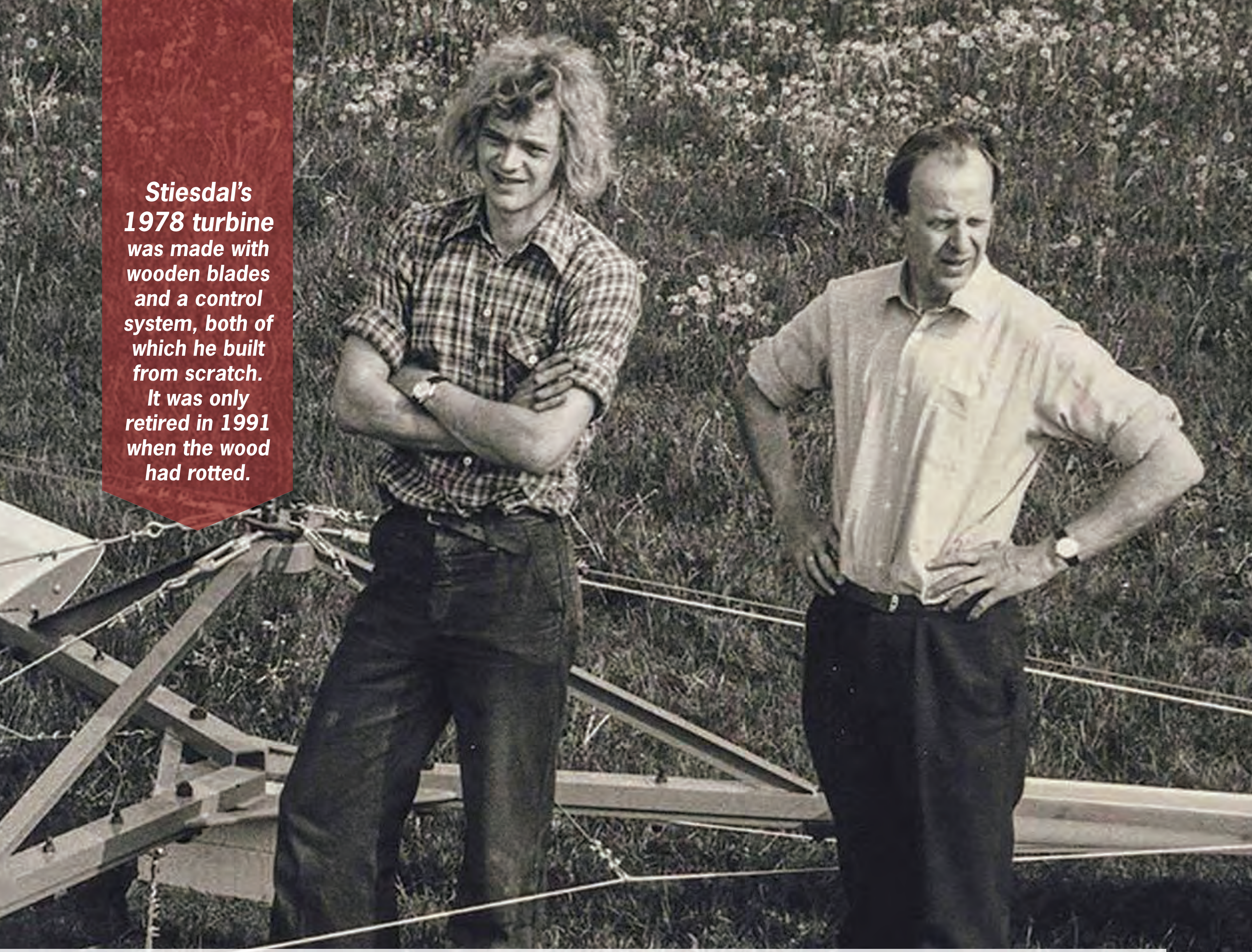
– By Tom Ewing

CTO IN FOCUS: HENRIK STIESDAL

WIND POWER PIONEER HENRIK STIESDAL BUILT HIS FIRST WIND TURBINE IN 1978. IT WAS ONE OF DENMARK'S FIRST STEP TOWARDS BECOMING A WIND ENERGY POWERHOUSE, WITH STIESDAL REGULARLY AT THE HELM. HE'S NOW GOT WIDER CLIMATE INITIATIVES IN HIS SIGHTS, INCLUDING INDUSTRIALIZING FLOATING OFFSHORE WIND.

By Elaine Maslin

Photos on spread courtesy Stiesdal A/S



Stiesdal's 1978 turbine *was made with wooden blades and a control system, both of which he built from scratch. It was only retired in 1991 when the wood had rotted.*

By 2021, a total of 35 GW of offshore wind had been installed across the world. To meet global climate targets, the International Energy Agency (IEA) says that another 80 GW of it needs to be built per year by 2030. Henrik Stiesdal expresses this target another way: "We need to do twice what we did in the past 30 years, per year, by 2030."

It sounds daunting, but this is an industry that has surprised many. Since Henrik built his first wind turbine in 1978, he has seen turbine rating grow by a factor of 1000 and growth is continuing. There are limits, but also opportunities and urgency.

Henrik Stiesdal is familiar with many of the challenges involved. He is one of the wind industry's major pioneers. The turbine he built in 1978 was one of the first. It was a horizontal axis, three blade turbine dubbed the "Danish concept", which, after the design was sold to Vestas in 1979, kick-started and then dominated the wind industry.

From 1988, Stiesdal was CTO of Bonus Energy, which built the first offshore wind farm, Vindeby, offshore Denmark in 1991. When Siemens Wind Power bought Bonus in 2004, he became its CTO before "retiring in 2014" and then setting up Stiesdal A/S in 2017. Throughout, his focus has been solving problems. The first was to alleviate the pressure of energy price increases at his parents' farm following the 1973 oil crisis with that very first turbine. Then, along with others, he started to see it as a national energy challenge. Since the late 1980s, it's been increasingly about addressing the global climate challenge.

Offshore Wind Firsts

One of the first major milestones was the first offshore wind farm. Building offshore had been talked about for well over a decade before Vindeby took shape, using 11, 450 kW Bonus turbines designed by Stiesdal's engineering department at Bonus. "Another milestone was when we built Middelgrunden outside Copenhagen in 2000," says Stiesdal. "At 40MW, this was the world's biggest wind farm using (20) 2MW turbines." But it was also unique because it was the first to use turbines designed for use offshore. Until then, modified onshore turbines had been used. The offshore turbines had better climate control, but they were also bigger than any permitted for on-

Photo courtesy Stiesdal A/S

HENRIK STIESDAL

"The doubling time in offshore has been around eight years over the last 10 years. That's a very fast pace and this race for the biggest isn't good for anybody. That will set some limits to how big turbines will get."

shore at that time.

They were also the first with a new feature, condition monitoring, using accelerometers in strategic positions on the main components to aid health monitoring of the turbines. "It meant you could do preventative maintenance much better than you could do before," he says. "That was when we 'digitalized' turbines. They all had remote monitoring before that, but the real digital step was condition monitoring."

Going Mainstream

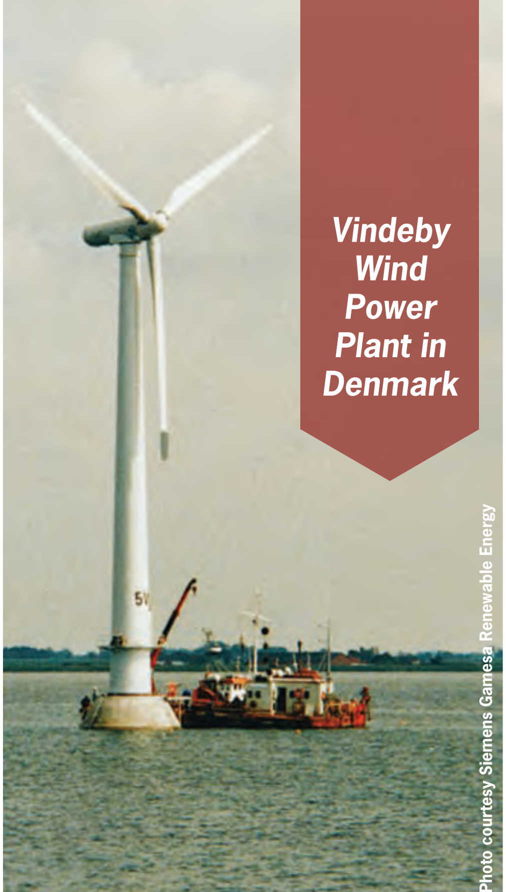
Another less tangible milestone came in 2012. Until then, investors' risk management teams typically didn't ask much about wind resources or technology, but often more "irrelevant" questions, such as about the risk of a tsunami in the North Sea or if a tanker could take down an entire wind farm. "They had to be convinced to invest in offshore wind," he said. "Then, almost overnight, from 2012-2013, that changed. From 2013 onwards, the question was 'Do you have another project we can invest in'. Suddenly it had become mainstream with low or moderate risk."

It's been a remarkable growth story, one that few would have been able to predict. But, in light of today's climate urgency, could more have been done? Yes and no, he says. The 'no' is a technical no, related to the scale-up rate of turbine size and capacity. "You can accelerate to a certain extent, but (for example) you cannot develop the big machines without having done the smaller machines and understanding what you're doing," says Stiesdal. "Some, in the US, Germany and Sweden, tried early on to do big machines from the start. They didn't work very well and they had internal design features that weren't realistic for industrial production. It wasn't the right way to go. The right way to go was to develop incrementally, as fast as you could."

The supply chain also has to be ready, he says. "In 1989, we launched a turbine that was much bigger than what we had done before." Bonus jumped from a 150kW turbine to the Bonus 450kW – the biggest in the market at the time. But while technically successful – the first offshore wind farm, Vindeby, was built using it – it was not commercially successful for several years. "It had been too big compared to what the supply chain could cope with," says Stiesdal. "There wasn't a gear box manufacturer that could manufacture the volumes needed or if they could they were too expensive, because it would be a niche product. We figured out that you shouldn't leapfrog more than what others could catch up with."

Growth limits

There are also some limitations around how big the industry can go, he says. Today, 15 MW turbines are lined up for projects and 20 MW machines are being discussed. There's a trade-off between the cost benefits of serial production and cost escalation when bigger devices mean more specialization and bigger vessels, etc., says Stiesdal. "There is some room for further size increase, but not that much," he says. "The doubling time in offshore has been around eight years over the last 10 years. That's a very fast pace and this race for the biggest isn't good for anybody. That will set some limits to how



Vindeby Wind Power Plant in Denmark

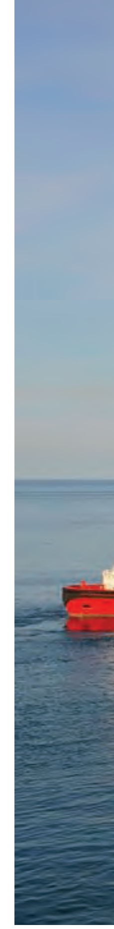
Photo courtesy Siemens Gamesa Renewable Energy

Danish wind giants

Vestas (originally an agricultural equipment manufacturer) and Bonus Energy (created by an irrigation system manufacturer, which was bought by Siemens in 2004), helped make Denmark a wind energy powerhouse, not just within Denmark, but globally. By 1985, about 85% of the total installed wind in the world was in California and about half of that capacity had been delivered by Danish manufacturers, notes Stiesdal.

Stiesdal A/S' TetraSpar was installed late last year and has so far had 59% capacity.

Photo courtesy Stiesdal A/S



big turbines will get."

However, volume wise, "We've not done enough and we're not doing enough," says Stiesdal, and that's largely to do the governments of the world choosing not to take the climate issue as seriously as they should have done, he says. "They should take action with the same urgency as they did through the Coronavirus pandemic," he says. "It's like the tragedy of the commons. You had common areas around villages that were not tended properly because they were everybody's and therefore nobody's. It's not about research. We know what we need to do. We don't have a technology challenge, we have an implementation challenge. We have a long tradition of growth. But we need society to assist us with good port facilities. With easy planning, with good infrastructure for turbine delivery and receipt of all the power that we will deliver."

Targeting floating

Stiesdal is targeting that delivery with his Stiesdal Offshore, a division of Stiesdal A/S, which he set up in 2017. It's targeting floating offshore wind, harnessing the experience Henrik has gained over the past 40 years, not least around mass production. While turbines are now mass produced, with the cost benefits involved in that, foundations are still built using the fabrication methods used in oil and gas and shipping, which aren't suited to mass production and involve too many man hours and port space to achieve the volume that will be needed, he says. That's a limiting factor.

"If you look at the biggest shipyards in Europe, they can build 30 maybe 50 floaters in a year. Even with 20MW turbines we might be able to get anywhere from 500 – 1,000 MW out per year from such a shipyard. But there are very few that can do that. That's why we've developed an industrialised approach."

Stiesdal's TetraSpar

Stiesdal's first floater, the TetraSpar, was installed off Norway late last year with a 3.6 MW Siemens Gamesa turbine. It features a keel that is ballasted offshore, to enable assembly in low-draft ports. A turbine tower manufacturer used to automated mass fabrication of tower sections, Welcon, was used to produce the structure's tubular braces and tank sections. These were then easy to transport and simply pinned together, Meccano-like, with no welding, at a Danish quayside. Total net assembly time was 2-3 days, compared with typically 2-3 months for welded structures, says Stiesdal. The company says this approach could reduce manufacturing time by 85-90%. The structure was then floated and towed-out to 200 m water depth offshore Norway last year. Since it was commissioned, late November, to the end of April, it's recorded a 59% capacity factor. Despite a few small niggles, that's still above the 50% average for offshore wind, says Stiesdal.

Targeting 15MW

However, the next Tetra floater will host a 15 MW turbine and be on a semisubmersible substructure, due to the (undisclosed) shallow water depths it's been ordered for. For Sties-


The Hywind Pilot in 2009

Photo courtesy Statoil (Equinor)

dal, the topology or design of the substructure isn't important. "What's important is that you have a floater that can be manufactured large scale," he says. With that 80,000 MW/year goal, scale is the target, especially for countries where's there's not shallow water acreage to build on, such as California, as well as Japan and Korea, where the shelf is limited. But it will also grow in areas such as the US east coast, as developers move into deeper waters.

Stiesdal thinks turbine manufacturers can keep up with the growth rates targeted. "In Bonus, we grew 40% a year from 1989 to 2001 and that was very demanding. But we did it and there's not much difference." He also thinks there's enough global steel production to meet an annual 80 GW/year build out. Copper could be a challenge for subsea cables, but aluminium could be used and there's plenty of it, he says.

Growth markets

So there's a lot to play for. While today's projects are relatively small pilot scale projects, it looks like it's not going to be long before this industry gains some momentum. Stiesdal expects floating wind to start getting big in the 2030s, although still not anywhere near volume of bottom fixed. Then, by the 2040s, it could come into its own and maybe even start to nip at fixed bottom volumes. "But predictions about the future are notoriously difficult," Henrik cautions. Stiesdal's own growth plan has many projects, with significant numbers of GW to be built before 2030, he says. Watch this space (global governments and planning systems willing!).

Image courtesy Reinauer Transportation

POWER PLAY

With shipowners pressed to upgrade machinery to meet strict new emission targets, there's much confusion with chatter surrounding 'decarbonization' and 'future fuels', solutions that don't exist today – and may not exist in mass for another generation – cluttering the conversation. Enter Wabtec, formerly GE Transportation, which today offers a Tier 4 compliant engine with no need for urea. Is it the cheapest propulsion solution on the market? No. But the Pennsylvania-based engine builder mounts a compelling case for its 250MDC diesel engine based on performance, fuel efficiency and lifecycle costs.

By Greg Trauthwein

Offering a power solution that is proven across industries, and compliant with the highest environmental regulation with the bonus of accomplishing this without the extra cost and hassle of a urea treatment system would seemingly make Patrick Webb's job easy. But seemingly that's not the case.

"There's confusion around EPA Tier 4 emission requirements and decarbonization," said Webb, a maritime industry veteran who serves as Wabtec's Global Senior Sales Director, Marine, Stationary and Drill Group. "Where the EPA is focused on lowering pollutants that cause serious health issues, the media seems to be focused on lowering carbon. Also, there is very little real availability of different renewable (fuel sources) across the US and around the world."

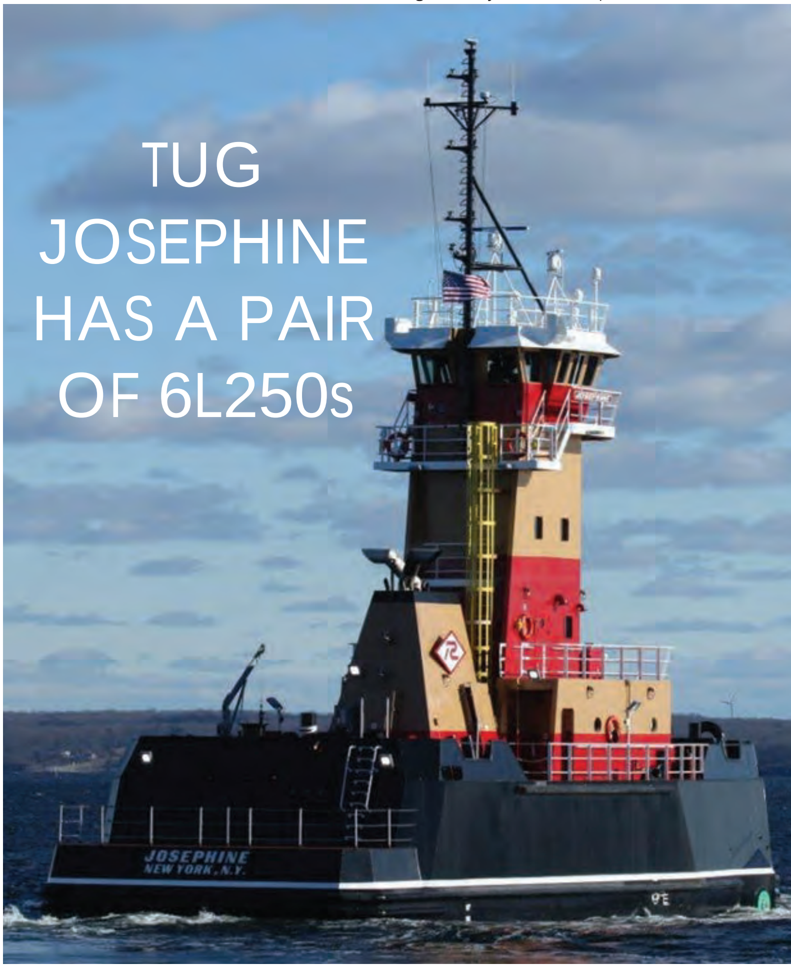
Webb and his team at Pennsylvania-based Wabtec are eager to share the story of the company's medium speed, EPA Tier 4 compliant engine, which today has more than 100 engines installed in vessels, representing an aggregate of more than 1,000,000 cumulative hours running. "Wabtec has an awesome, proven solution that allows vessels to operate at the extreme EPA Tier 4 emission level, without any need for urea, but many customers are still fighting to try and find ways to avoid this emission standard," citing recent examples where operators – commercial and government – choose to install a larger number of smaller horsepower engines to effectively circumvent Tier 4 emission standards. "There is a lot of talk about cleaner emissions, but behind the scenes, there has also been efforts to avoid cleaner emission and the perceived cost and hassles of this next level of emission control."

Despite the challenges, Wabtec has enjoyed measured success in recent years. "Wabtec Marine Diesel has transitioned from a near 0% market share in the U.S. before EPA Tier 4 rules came out," said Webb. "Six years later, the Wabtec Tier 4 Marine Diesel has captured nearly 50% of these new engine sales in the 1.7MW to 4.5MW powerband. This success is in large part associated with the fact that Wabtec Marine Diesel is the only engine of its type that can achieve the strictest emission standards with no need for urea."

THE ENGINE

The L250/V250MDC diesel engines from Wabtec meet U.S. EPA Tier 4 and IMO Tier III emission standards with advanced exhaust gas circulation (EGR) and without the need to use urea. The omission of urea is a particularly important designation. "The Wabtec advantage with its Tier 4 engine starts with the fact that there is no urea needed, meaning that you don't have to allocate the space for the extra equipment needed for the tanks and storage of urea; and also, from the cost of ownership," said Matthew Hart, Platform Leader, Marine & Stationary Power Systems, Wabtec. "The Tier 4 250MDC product is EGR-based, with increased robustness designed into the power assembly, two-stage turbocharging and high-pressure fuel injection. It's about fuel efficiency too, and its impact on the total cost of ownership." While the Wabtec team is quick to admit that the 250MDC is not the cheapest engine on the market, according to Hart. When all is taken into consideration there is a payback period of approximately 18 to 24-months.

Image courtesy Reinauer Transportation



In addition to the hardware, Wabtec has built into the engine a sensor array that is common for its rail customers, and is now starting to make headway in the marine industry. "These are digital engines," said Hart. "That comes with increased capability for onboard diagnostics on the Tier 4 engine, there's improved diagnostics because of all the sensors that are related to Tier 4 emissions control.

According to Hart, the rail industry is more advanced in the collection and use of data, with modems on the locomotives that continuously stream data. "We have a global performance optimization center that collects that data and sends out recommended actions. It's a little bit of a different service structure in the locomotive space, but we're looking at how we can expand that on the marine side."

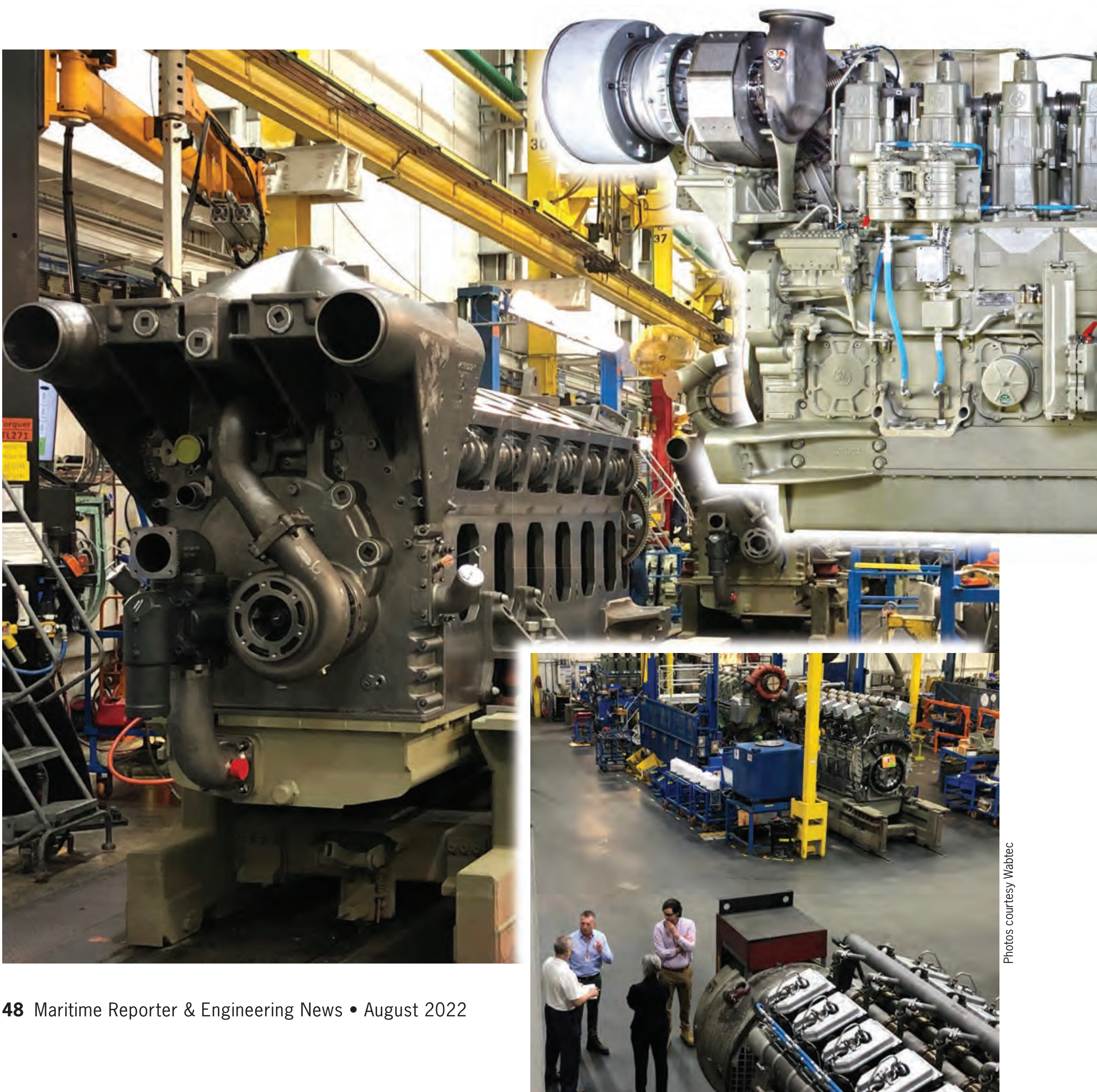
He noted that data connection on the marine side is the tough part. "Vessels operate everywhere, and a lot of times without connectivity, so there's a more manual step of making the data accessible and then processing it."

Ultimately, he and the Wabtec team hope to help the maritime industry transition from calendar-based to condition-based monitoring, "so it's not just the diagnostics of when something fails, but we move ahead to predictive maintenance, saying 'Hey, you should change this part, change this filter because we're seeing this trend on the engine."

While some companies may be hesitant to share data, Peter Twichell, Director, Project Management, Marine Customer Support, said that increased data share and analysis can help support owners to increase their uptime. "Uptime is critical in the maritime industry, and in our experience, they've been very supportive," said Twichell. "We really don't have much pushback from the client when we ask for log files if we explain it in regards to troubleshooting or predictive management, particularly if we can identify and fix an issue faster."

PUT TO THE (REINAUER) TEST

Christian Reinauer, Reinauer Transportation, perhaps better than anyone, can deliver insight on the long-term value of the Wabtec Tier 4 solution. Reinauer operates a fleet of ATBs and tugs out of NYC, with a total of 24 barges and 23 Tugs. Of that fleet, Reinauer has four Senesco Marine-built tugs of three

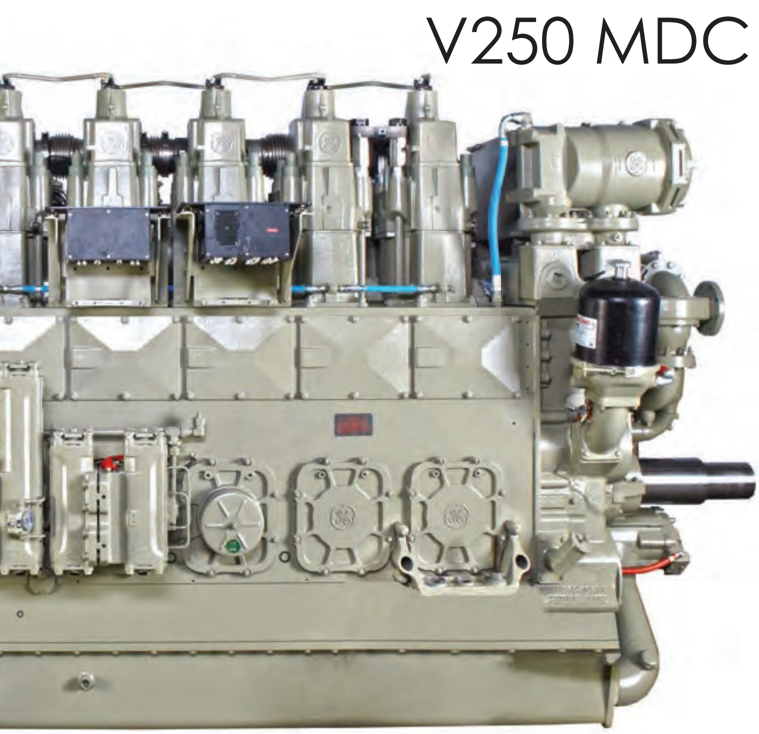


Photos courtesy Wabtec

classes using the Wabtec 250 series engines: Bert Reinauer with 2x 12V250; and the Josephine, Kristy Ann and Janice Ann Reinauer, all with 2x 6L250.

In discussing the rationale behind the selection of Wabtec, Reinauer said, “We had built a fleet of vessels using MTU 16V4000 series, and with the Tier 4 requirement MTU did not have an approved solution to offer.”

So Reinauer started looking at the full range of engine offerings from all manufacturers, it settled on the Wabtec design with the omission of urea as a major selling point. “We felt the EGR design was a good choice since it had been around for awhile,” said Reinauer. “The DEF solutions required considerable exhaust system design, which we really didn’t have room for, as well as approximately 8% of the vessels capacity dedicated to the storage of DEF. DEF fluid is somewhat caustic to metals so the tanks would have to be specially coated to handle it, which down the road would be a maintenance headache.”



Reinauer also said that maintenance needs to be performed on the catalysts, “which again made designing in for ease of maintenance a headache and additional cost to overhaul. The (Wabtec) engines were more expensive up front and more difficult to install but at the end of the day we have a better economy and crew comfort for the life of the vessel.”

Even in the best of conditions, there are learning curves and technical hiccups when integrating new machinery across a fleet, and Reinauer was not exempt. “We have only had a few issues of any real consequence: a few EGR coolers and valves which (our) engineers can swap themselves; a water pump and a seawater pump; a few engine power supplies and sensors. Otherwise, according to Reinauer, parts have been installed based on scheduled maintenance.

Reinauer Transportation is known in maritime circles as a long-term player operating quality tonnage with a penchant to attract and retain the technical talent it needs. “Support, in the beginning, was a little tough to figure out, but with most OEMs support, we find that we are our best first option,” said Reinauer. “We train our engineers, supply them with all necessary spare parts and only call on their techs for additional support.”

“Some owners run the engine and work through our channel partners for regular maintenance and repairs, focusing their attention on other aspects of running their business,” said Twichell. “Then you have customers like Reinauer that are independent. If one of their engines needs a field modification, Chris Reinauer will say, ‘Just send us the part and instructions, we’ll install it. We know what we’re doing.’”

Image courtesy Reinauer Transportation

"AS LONG AS THE ENGINES WE OPERATE ARE MODERN AND WELL MAINTAINED AND OUR HULL FORMS ARE FAIR, THERE ISN'T A MORE EFFICIENT MEANS OF TRANSPORTATION..."

– Christian Reinauer, Reinauer Transportation

As anyone running ships can attest, keeping the machinery running is one part of the equation, keeping the machinery running while maintaining profitability is another matter, particularly as fuel prices have spiked in recent months. "We see very good fuel consumption and extremely low oil consumption which is one of the ways they can get to Tier IV emissions without aftertreatment," said Reinauer. "Serviceability is very good, not as simple as an EMD but they have their advantages in other areas with regards to Tier 4."

FUTURE FUELS AND EMISSIONS

Reinauer Transportation, like many owners, is faced with difficult choices in regards to choices made today that will impact its costs and operations in the future. Chris Reinauer likes to keep it simple: "As long as the engines we operate are modern and well maintained and our hull forms are fair, there isn't a more efficient means of transportation. Some people think Zero Emissions are right around the corner but unfortunately, that's all you hear coming from certain political circles. I agree we need to move forward but batteries are not the answer especially when you consider the energy used to produce them. Hybrid vessels should be used where transits are shorter and local emissions tend to be higher. Ferries are a wonderful application for this as well as ship docking tugs, vessels that are not pulling or pushing 24 hours a day," said Reinauer. "We on the other hand do not have that luxury and need the most concentrated amount of energy to run at full power for up to a week in some cases. CNG is making inroads but the infrastructure for us to use it is a decade or further away," citing the lower energy density and the need for larger fuel tanks as primary drawbacks. "We continuously look at the development of alternative fuels, and most likely in the next 10 years we will start implementing (them) somewhere in our fleet."

Wabtec operates a pair of manufacturing plants in Pennsylvania: one in Grove City, its primary, 440,000-sq.-ft. manufacturing facility, and a sister plant about an hour away in Erie, a facility mostly dedicated to locomotive engine remanufacturing. "Other than castings and forgings, which are sourced, it's a full manufacturing, assembly and final engine testing plant," said Twichell.

TUG KRISTY ANN HAS A PAIR OF 6L250s

Image courtesy Reinauer Transportation

With a cumulative 650 manufacturing employees split between the two plants, Wabtec typically builds about 1,500 engines per year, primarily for locomotive as well as marine.

In addition to engineering a strong product to start, Wabtec fully realizes the power of a qualified dealer partner network, or 'Channel Partners' as Wabtec calls them, according to Tamara Gromacki, VP, Marine, Stationary Power and Drill Business. Wabtec monitors its channel partner performance closely, and "if we see that they may be struggling in some service area, Pete Twichell and his team will go in and try to help them increase their skillsets." Becoming and remaining a Wabtec channel partner is not in perpetuity, as contracts generally run for a year or two, and the renewal process looks at their cumulative skillsets and personnel to ensure that the organization maintains the ability to serve the end customer, remaining "the right fit for Wabtec."

While the main manufacturing facility has been around since 1971, it's virtually a new and modern plant courtesy of a 2017 transformation via General Electric "Brilliant Factory" program, with upgraded machinery – including NC machining, laser etching, laser welding, robotic cell and full emissions testing as well – plus new lighting and paint.

With its in-house test beds, Wabtec is able to experiment with a full range of technologies and fuels to ensure that its engines are not only ready to meet the challenges today but to effectively future-proof the engine for changes coming. The

"THE WABTEC ADVANTAGE WITH ITS TIER 4 ENGINE STARTS WITH THE FACT THAT THERE IS NO UREA NEEDED."

– Matthew Hart, Platform Leader, Marine & Stationary Power Systems, Wabtec

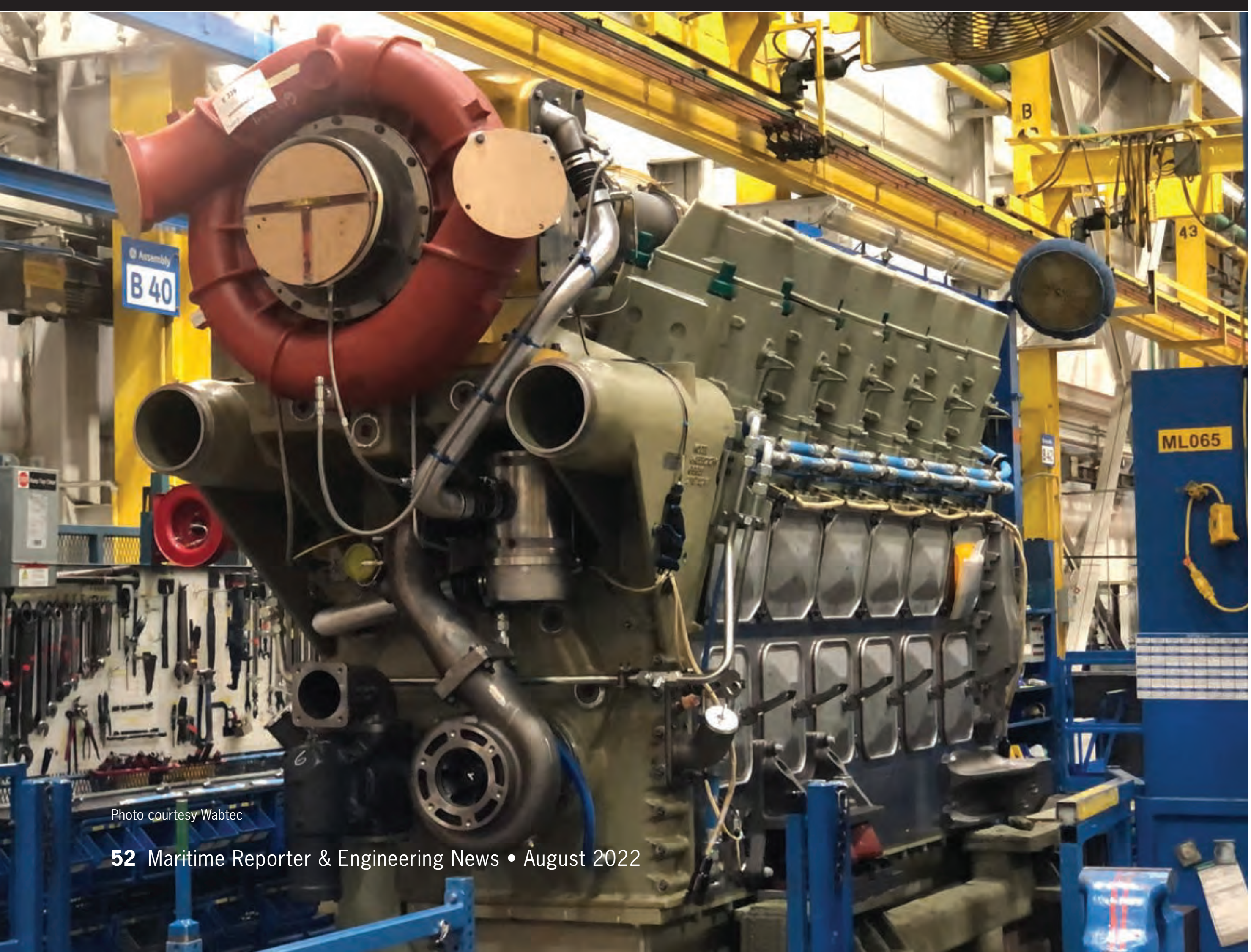


Photo courtesy Wabtec

future fuel conversation is a pervasive one throughout Wabtec, and according to Hart it breaks down into two groups: one would be biofuels, biodiesel and renewable diesel; the second one would be the lower, no carbon fuels: hydrogen, methanol and ammonia. He said that renewable diesel is the most immediate "drop in."

"You'll hear from a lot of renewable fuel suppliers that this will have the most immediate impact, however, it's quite expensive and needs to be subsidized to be a cost-effective solution. But, for a luxury provider or someone who's really making a dent in their carbon emissions, it's a fantastic option," said Hart. "So, we're looking at running on 100% renewable diesel, and the biggest interactions there are on the fuel system, the elastomers and filtration, making sure that everything's going to operate reliably. There definitely are maintenance impacts for some of the biodiesels, and we're looking at doing the durability testing and the field testing with some of our vessel owners and channel partners to fully validate

Flipping over to the low and no carbon fuel options of hydrogen methanol ammonia, Hart goes back to the real estate axiom of 'location, location, location,' noting that choice will be driven largely by where an owner is located and operates and pending the fuel access in specific locales. "Hydrogen seems to be a little bit more conducive to a stationary or land-based access point. Methanol and ammonia seem to be a little bit more what the marine industry is favoring, and what we're seeing too, is the industry somewhat being fragmented still on what substitution rates want to be included. So, you may not be able to run 100% hydrogen or 100% methanol or ammonia."

Ultimately, the future fuel question lies outside of the engine room and across the entire vessel, as variable energy densities will demand significant vessel design modifications for tanks and additional machinery.

KEEPING THE "DIGITAL ENGINE" CYBER SECURE

As ship and boat owners increasingly adopt the promise that digitalization promises to deliver – from condition-based monitoring and maintenance and engine and voyage optimization – the potential peril of cyber-attacks must be considered, lest a vessel have its propulsion mains shut down, putting vessel, crew and environment in harm's way.To that end, the Wabtec team worked diligently to obtain ABS CyberSafety Service Provider Certification.

"Wabtec created a vulnerability report and analysis according to the requirements of ABS CyberSafety Volume 7," said **Mike Taylor,** Technical Leader, Marine & Stationary System Engineering, Wabtec. "This report is a comprehensive examination of the control system, listing out access points, the topology or architecture of the system, and an analysis of potential vulnerabilities within the system."

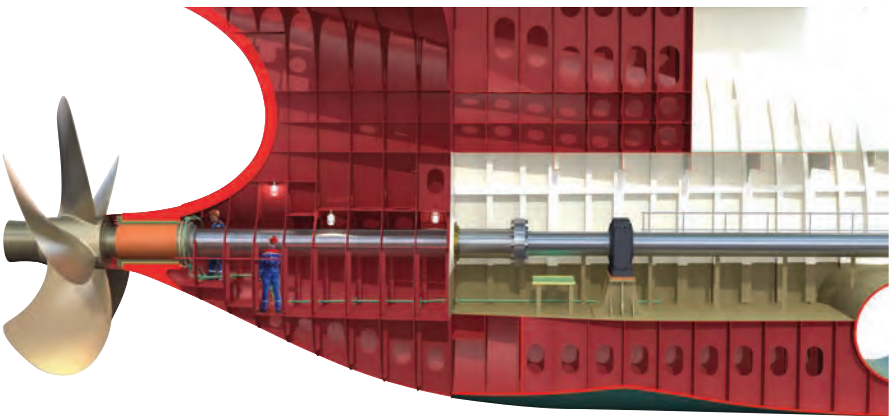
Wabtec provided extensive documentation regarding internal risk management, policies and procedure, change management and configuration control, as well as details about the Wabtec Incident Response Team, said Taylor. In addition, it designed and presented Cybersecurity Training to all relevant employees. To get the Service Provider PDA with ABS, Wabtec conducted a Type test with the classification society in attendance, as well as a Cybersecurity Audit, to demonstrate that the Wabtec ECS-4 Control System meets the ABS Equipment requirements, according to Taylor. Finally, Wabtec prepared and presented a Cybersecurity Tabletop Exercise, an exercise designed to educate and get participants thinking about potential cybersecurity hazards and courses of action.

"We're trying to reduce the number of penetration points and make sure that we're not propagating any part of a cyber security concern as these vessels are extremely complex. The engine is just one piece of it and there are many access points to the vessel to be able to get into the engine. We want to make sure that we try to have a buffer between any other penetration points, which might be available in another third-party system that could potentially penetrate our system, as well. As an example, all our software loading is through a software tool that Wabtec has developed, to get rid of cyber threats through USBs."

WATER LUBRICATED BEARINGS ENABLE THE "STERNTUBE-LESS SHIP"

With the advance of seawater-lubricated polymer-based propeller shaft bearing, the traditional role of the sterntube is revisited.

By Pat Wheater



The sealed sterntube has long been an essential component to ships at sea, the aft seal providing protection from water ingress while oil leakage is prevented from the sterntube. But with the advent of seawater lubricated bearing systems, pollution risks associated with oil-lubricated systems are eliminated, begging the question: do we still need the sterntube?

The results from joint research project involving Thordon Bearings, Shanghai Merchant Ship Design & Research Institute (SDARI-CSSC), National Technical University of Athens (NTUA) and ABS indicate that a ship's sterntube can be omitted to make better use of the available space. According to the research parties, by reconfiguring the sterntube space with a shorter shaftline and by moving the engine further aft, operational costs can be reduced, cargo capacity can be increased and the vessel's environmental footprint greatly improved.

The primary focus of the collaboration was to rethink the internal aft part of the vessel (the intervention does not alter the external structural design of the ship or the stern in anyway), which in a traditional powertrain has a crankshaft driving a long shaftline, with the sterntube providing a cylindrical casting which contains the forward and the aft seals, sterntube bearings and lubricant (oil).

The new arrangement is dubbed the Thomson SternSpace (TSS) after Thordon's innovator George A. (Sandy) Thomson, who in 2019, won the Elmer A. Sperry Award for leading the innovation for advanced water-lubricated shaft bearings through the application of polymeric compounds.

In effect the TSS redeploys the interior space around the propeller shaft to allow access not only for physical shaft inspections but also for actual bearing replacement while afloat, thus eliminating the need for costly removal of the shaft and propeller in drydock for most vessel types. This is a revolutionary development because this was not previously possible.

"Maintenance becomes much easier, allowing for problems to be tackled as they arise rather than having to wait to reach drydock," said Anthony Hamilton, Technical Director, Thordon Bearings. "Class surveyors can gain access for shaft inspections by entering the Thomson SternSpace and a lot of the shaft installation and operational challenges completely disappear."

Thordon and ABS estimate that, in a case of an aftmost bearing replacement due to damage or complete failure, a two-week re-alignment job that is estimated to cost more than $100,000 in drydock and labor fees can be done in a single day afloat. When you take the zero lubricating oil requirement into account, the overall OPEX savings are significant.

"We moved the engine further aft, making the shaftline shorter so that we didn't need a forward sterntube bearing anymore to support the shaft, as it was short enough," said Dr. Chris Leontopoulos, ABS Director, Global Ship Systems Center. "We replaced the aft white metal sterntube bearing with a seawater lubricated Thordon COMPAC bearing, and we removed the sterntube casting altogether, thereby, creating a previously non-existent dry chamber, accessible for inspection purposes. Adding an appropriate torsional vibration damper on the forward part of the engine eliminated the barred speed range."

The Barred Speed Range (BSR) is an area in the speed range of the vessel, where the torsional vibration is so high that vessels must accelerate or decelerate quickly through this range, to avoid damage to shaftline components. The torsional vibration damper reduces the vibration shear stresses and when eliminating the BSR, it enables the full RPM range of the vessel to be used for maneuverability purposes, reducing fuel consumption by cutting out the need for pronounced speed changes. This also eliminates concerns with vessel speed limits in certain environments, such as the Great Lakes.

To ensure the design met ABS requirements, Finite Element modelling of the powertrain was undertaken to evaluate the impact of a shortened shaft line on vibration and shaft alignment, including criteria, such as the engine flange shear force bending moment envelope under all operating conditions.

EEXI

It is, perhaps, the improvements to the Energy Efficiency Existing Ship Index that makes the development a game-changer. Essentially, the concept creates an entirely new compartment onboard: the TSS – a space that has never existed before. This "revolutionizes the traditional sealed propeller shaft," said Hamilton. "The space is designed into virtually all vessels, where an oil-lubricated sterntube is traditionally exposed to seawater for cooling. With a seawater-lubricated shaft, the space still exists but it essentially becomes an inspection and maintenance space. Moving the engine aftward creates additional cargo space for the same vessel footprint and therefore improves the vessels' EEXI."

By removing the sterntube, shifting the engine further aft and shortening the shaft line, the research partners found that Energy Efficiency Existing Ship Index (EEXI), a technical efficiency regulation that introduces new limitations on the amount of CO_2 emitted by a vessel per capacity tonne mile, could also be improved.

"The new arrangement better supports simplified compliance with environmental-focused regulations, such as the EEXI and enables more efficient use of the engine's propulsive power, since the whole RPM range of speeds is available for continuous operation," said ABS' Leontopoulos. "It enables owners to easily consider an Engine Power Limitation (EPL) if required, to comply with Carbon Intensity Indicator (CII) power output requirements."

The design interventions also offer potential for increased cargo. While the decrease in shaft length may not make a significant difference to the cargo carrying capacity of a containership – because the boxes are of a standard size – a 2.5m (8.2ft) reduction in engine room space would increase the cargo space aboard a bulk carrier or tanker.

To reap the benefits, the length reduction should be such that one bearing can be removed from the shaftline without affecting shaft alignment or vibrations compliance," said Leontopoulos. "Only water lubricated bearings of this type when combined with the TSS chamber and a short shaftline offer these unique advantages altogether in terms of maintenance, OPEX and the zero-pollution risk.

Pivoting key to Breaux Bay Craft Longevity

In the 65 years, since Roy Breaux, Sr. founded Breaux's Bay Craft and on down through three generations, the yard has built more than 1700 hulls. Through the regular expansion and contraction of the oil industry, it learned to pivot from market demand to market demand.

As the oil industry in the Gulf of Mexico moved farther offshore, the demand for larger and faster crew boats was met by Breaux. The fine-hulled aluminum crew boats grew to 125-ft. vessels powered by up to five 700 hp Cummins KTA19 engines, then, the boats grew to 145 by 28-ft. with four Cummins KTA38 engines delivering 5600 hp total and a 30-knot speed. In 2008 they delivered the 180 by 30-ft. red-hulled, fast-supply vessel, Miss Lauren powered by four Cummins KTA50 mains each delivering 1800 hp.

Even then, there were uncertainties on the horizon. While some demand continued for new and repair work, the company began to pivot. They built passenger vessels, yachts, and patrol boats, each designed to the needs and demands of the individual customer and launched into Bayou Teche near Loreauville Louisiana.

With more than 1700 boats advertising the name over the years, there have been some significant one-off vessels designed and built by the firm. Builders often note that ship's pilot organizations can be the most particular customers due to their own massive experience in the maritime world. Breaux Bay recently gained international attention with the largest, 90-ft., all aluminum pilot boat built in the US for the Sabine Pilots of Texas. After one year in operation, it currently has over 70,000 nautical miles under the keel.

This month, June 2022, they have sea trialed and delivered a 70 x 19.5-ft. pilot vessel to Aracor, Inc. of Port Aransas, Texas. Designed in-house, in consultation with the pilots, the vessel features a next-gen Generation Inverted Deep-V Bottom.

Pilot boats are all weather boats, designed for sea keeping and speed. The new boat, Aransas Pilot III, is all of that. The hull design gives her excellent handling in heavy seas, and her propulsion package assures plenty of speed. A pair of Cummins QSK 38M1 LTAC engines each delivering 1400 BHP at 1900 rpm are coupled to Twin Disc MGX 6620A, 2.09:1 gears. These turn 4.5-inch Aqua Tech shafts and Ni Bral 39.5-inch by 50-inch props. This power is selected to give the 70-foot boat a speed of 27 to 30 knots.

Auxiliary power is provided by a pair of 36 KW Northern Lights Single Phase generators with sound enclosures. Tankages on the Arransas III, include fuel: 2500 gallons, water: 150 gallons, and lube oil; 110 gallons.

Comfort is enhanced with ride compensating seating for up to 12 pilots in Nor Sap Model 1600 and one Model 1500 Imtra Corp for the pilot boat captain. Onboard accommodation is provided for two crew with head and treatment plant by Ahead Sanitation Systems. Bridge electronics include multiple Furuno radars with 19-inch LCD displays. Two M605 VHF Radios, 1-FA170 AIS supplied by DBS Electronics, Inc. of Bridge City Texas. The steering system is electric over hydraulic with dual electric pumps and an auxiliary, engine-driven, pump for backup supplied by Gulf Coast Air and Hydraulics, Inc.

Flooring is by Plastek, sound insulation by Mascoat Marine DB and DTM and Engine Room Overhead Insulation by Insulations Inc., Fixed CO 2 System by Herbert S. Hillar. The bilge system includes a 110V electric pump manifold to each compartment with 12V and engine drive pump for back up. The pilot boat is also fitted with Humphree Interceptors with Active Ride Control, and a Side Power SE 300 - Bow Thruster.

In the Shipyard

Latest Deliveries, Contracts and Designs

HTV Seaway Swan joins the Seaway 7 Fleet

Seaway 7 took delivery of a new semisubmersible heavy transport vessel. The company entered into a bareboat contract with United Faith for its new build vessel MV Xin Qun 3, renamed Seaway Swan. Seaway Swan is a 50,000 DWT Heavy Transport Vessel (HTV) with an open stern and large deck free from obstructions. This addition to Seaway 7's HTV fleet will further extend the company's capacity to load larger and longer cargoes such as XXL monopiles, and modules that would typically need to be skidded on and off the vessel over the stern. The Seaway Swan is suitable for float-over operation projects, feeder duties alongside installation vessels, and offshore (subsea) construction support, due to its Dynamic Positioning (DP2) capabilities. The vessel was built by Qingdao Beihai shipyard, part of the CSSC group. Following sea trials earlier this spring, Its maiden voyage will commence later this summer when Seaway Swan will transport four large Ship-to-Ship cranes from their pick-up point in Qingdao, China to Alexandria, Egypt for discharge in September.

The vessel is registered in Norway and carries the Norwegian International Ship Register (NIS) flag.

Photo: The Interlake Steamship Company

Mark W. Barker: First New US Laker in 40 Years

The newly built Mark W. Barker, the United States' first new Great Lakes bulk carrier in nearly 40 years, has embarked on its maiden voyage from Fincantieri Bay Shipbuilding in Sturgeon Bay, Wis. The River Class self-unloading bulk carrier is believed to be the first ship for U.S. Great Lakes service built on the Great Lakes since 1983. Measuring 639 x 78 ft. and 28,000 DWT, the ship will transport raw materials such as salt, iron ore, and stone to support manufacturing throughout the Great Lakes region.

It was designed jointly by The Interlake Steamship Company, Fincantieri Bay Shipbuilding (FBS) and Bay Engineering, complete with advanced vessel and unloading systems automation. Major partners for the project included: American Bureau of Shipping (ABS); Cleveland-Cliffs, Bay Engineering (BEI); EMD Engines; Caterpillar; EMS-Tech, Inc.; Lufkin (a GE Company), Kongsberg and MacGregor.

Dry Dock Conference Set for September

The tenth International Dry Dock Conference is scheduled to take place in Virginia Beach, VA, September 22-23, 2022.

The tenth International Dry Dock Conference/ Advanced Training Forums is scheduled to take place in Virginia Beach, VA, September 22-23, 2022. Organizers of the annual event contend that while the drydock industry has not evolved as quickly as others due to the unique nature of the business, there are many technical advances which offer promise in making the drydocking industry faster, safer and more efficient. This forum brings together the industry for two-days of in-depth discussion and experience sharing.

Presentations given by various experts in the field will cover unusual and problem drydockings, new advancements with dry docks and heavy lift.

2022 Conference topics include (topics are subject to change):

- Dry Dock Construction - Conception Through Delivery
- Dry Dock Equipment
- Drydocking/Undocking Accidents
- Drydocking/Undocking from the Vessel Operator Perspective
- Emerging Dry Dock Technologies
- Floating Dry Docks - Civil/Structural Design Aspects and Applications
- Heavy Lift Operations - USS Fitzgerald and USS McCain
- Management of a Dry Dock Start-up
- Ship Loading Issues for Drydocking
- Special Drydock Access Systems
- Unique Drydocking Operations - One Vessel on Two Dry Docks
- US Navy Drydocking Program
- Vertical Lifts

The conference will be held in person, but if unable to travel to Virginia Beach to attend, the 2022 Dry Dock Conference/Advanced Training forum is also available via live stream Webinar.

Visit **www.DryDockTraining.com**

Keppel AmFELS delivers LNG-Fueled MV George III

Image courtesy Pasha

Hawaii-based Pasha Hawaii took delivery of a new liquefied natural gas (LNG)-fueled containership from Brownsville, Texas shipbuilder Keppel AmFELS. The 774-ft. George III is the first of two new ‘Ohana Class containerships to join Pasha Hawaii's fleet, serving the Hawaii/Mainland trade lane. It is said to be the first LNG-powered vessel to fuel on the West Coast and the first to serve Hawaii. Its capacity is 2,525 laden TEUs. The ‘Ohana Class vessels are named in honor of George Pasha, III and Janet Marie, the late parents of The Pasha Group President and CEO George Pasha, IV, marking three generations of service to Hawaii.

General Dynamics NASSCO wins $600m Contract



Image courtesy NASSCO

General Dynamics NASSCO won $600 million in U.S. Navy contract modifications for long-lead-time material to support construction of the seventh and eighth ships in the John Lewis-class fleet oiler (T-AO) program, as well as the sixth ship in the Expeditionary Sea Base (ESB) program.

The contract modifications for long-lead-time material provide $500 million for T-AO 211 and 212, and $100 million for ESB 8.

In 2011, the Navy awarded NASSCO with a contract to design and build the first two ships in the newly created Mobile Landing Platform (MLP) program, the USNS Montford Point and USNS John Glenn. The program evolved, adding the USS Lewis B. Puller, USS Hershel “Woody” Williams and the USS Miguel Keith, USNS John L. Canley and the USNS Robert E. Simanek (ESB 7), configured and renamed as ESBs. ESBs are highly flexible platforms designed to support multiple maritime-based missions, including Air Mine Counter Measures (AMCM), Special Operations Forces (SOF) and limited crisis response. Acting as a mobile sea base, the 784-foot ship has a 52,000 square-foot flight deck to support MH-53, MH-60, MV-22 tilt-rotor and H1 aircraft operations. Following the delivery of the first five ships to the U.S. Navy, the sixth ship, the USNS John L. Canley, was christened on June 25. The USNS Robert E. Simanek (ESB 7), the seventh ship, is currently under construction.

In 2016, the Navy awarded NASSCO with a contract to design and build the first six ships in the next generation of fleet oilers, the John Lewis-class (T-AO 205), previously known as the TAO(X). Designed to transfer fuel to U.S. Navy carrier strike group ships operating at sea, the 742-feet vessels have a full load displacement of 49,850 tons, with the capacity to carry 157,000 barrels of oil, a significant dry cargo capacity, aviation capability and up to a speed of 20 knots. The first ship, the future USNS John Lewis (T-AO 205), is scheduled for delivery later this year. The future USNS Harvey Milk (T-AO 206), the future USNS Earl Warren (T-AO 207), and the future USNS Robert F. Kennedy (T-AO 208), are currently under construction.

Tech Files

The month's best technical innovations

Volvo Penta

Moteurs Baudouin

Cortec Corporation

D13 Expands IMO Tier III Range

Volvo Penta has expanded its marine IMO Tier III range with new D13 solutions. This expands the range of marine commercial Volvo Penta D13 IMO III solutions for IPS-1200, IPS-1350, D13-900, and D13-1000. Each package exceeds the IMO III standards. The Volvo Penta D13 IMO III package upgrade boasts a power output of up to 735 kW for inboard and auxiliary applications and is approved for E3 and C1 cycles. The reduction in NOx and hydrocarbon (HC) will decrease from currently permitted levels of 5.6 g/kWh down to 2.0 g/kWh. The SCR (Selective Catalytic Reduction) system can be installed in either a vertical or horizontal position.

The 6F21

Moteurs Baudouin has designed the new 6-cylinder 6F21, a 12.5-liter engine producing up to 735kW/1000 hp. The 6F21 includes a strengthened engine structure to withstand high torque and a higher cylinder pressure well over 200 bar. A two-stage turbocharger system is also fitted on the engine, along with two intercoolers, and a high-end common rail system, operating at 2200 bar. Every 6F21 engine complies with IMO II and EPA III standards, with IMO III and EPA IV following soon. The 6F21 is available in three duty ratings with continuous compact power. Power output at intermittent duty is 599 kW/815 HP and 662 kW/900 HP at light duty.

CorrVerter for Rusty Surface Prep

Sandblasting, water blasting, and labor-intensive grinding are common methods of restoration and surface prep for rusty metal parts or structures. However, these techniques are sometimes prohibited or not preferred for a variety of reasons. To address this need, Cortec offers an easy but effective surface prep alternative to abrasive blasting or grinding in the form of CorrVerter Rust Converter Primer.

CorrVerter is a fast-drying, water-based one-component primer for rusty surfaces. It contains a unique formulation of chelating agents combined with a high solids waterborne latex that has extremely low water vapor permeability.

ESAB

L.S. Starrett Co.

Aurmarine

ESAB Launches InduSuite

ESAB launched InduSuite, a brand-agnostic portfolio of software applications designed to revolutionize workflow, quality, and business performance, to help fabricators and manufacturers improve operational efficiency. InduSuite offers three key benefits for mixed fleet customers: simplicity for accessing data and documents with an easy-to-use interface; real-time insight into performance, traceability and workforce accountability; and an unprecedented level of control over metal fabrication operations.

Deep Cut Hole Saws

L.S. Starrett Co. offers an improved version of its Starrett Deep Cut Bi-Metal Hole Saws with a distinct variable pitch tooth design, featuring a pattern of seven different progressive teeth called NVP Tech. This new tooth pattern helps delivers fast, aggressive cutting action, enabling more cuts in less time. Designed specifically for cutting thicker material and feature a high performance tooth material with extra Cobalt for enhanced heat and wear resistance. These saws have a hole depth of 2 inches (51mm) and are ideal for cutting metal or tubes with a wall thickness of more than 1/8 inch (3mm).

Methanol Fuel Supply System

Auramarine invested in the development of one of the industry's first Methanol Fuel Supply Units. Suitable for both two-stroke and four-stroke engines, the units can be adapted for the conversion of existing engines to dual-fuel methanol operation. The units ensure the safe delivery of methanol from the service tank to the Master Fuel Valve, regulating the flow, pressure and temperature of the methanol to meet the engine's specific requirements. The system actively maintains the supply pressure within the specified tolerances during load changes and filters the fuel to prevent impurities from entering the engine.

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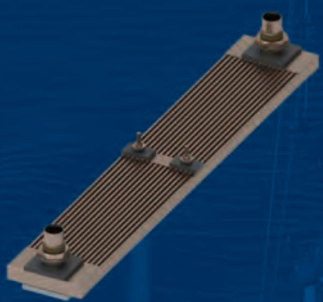

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