May 2022

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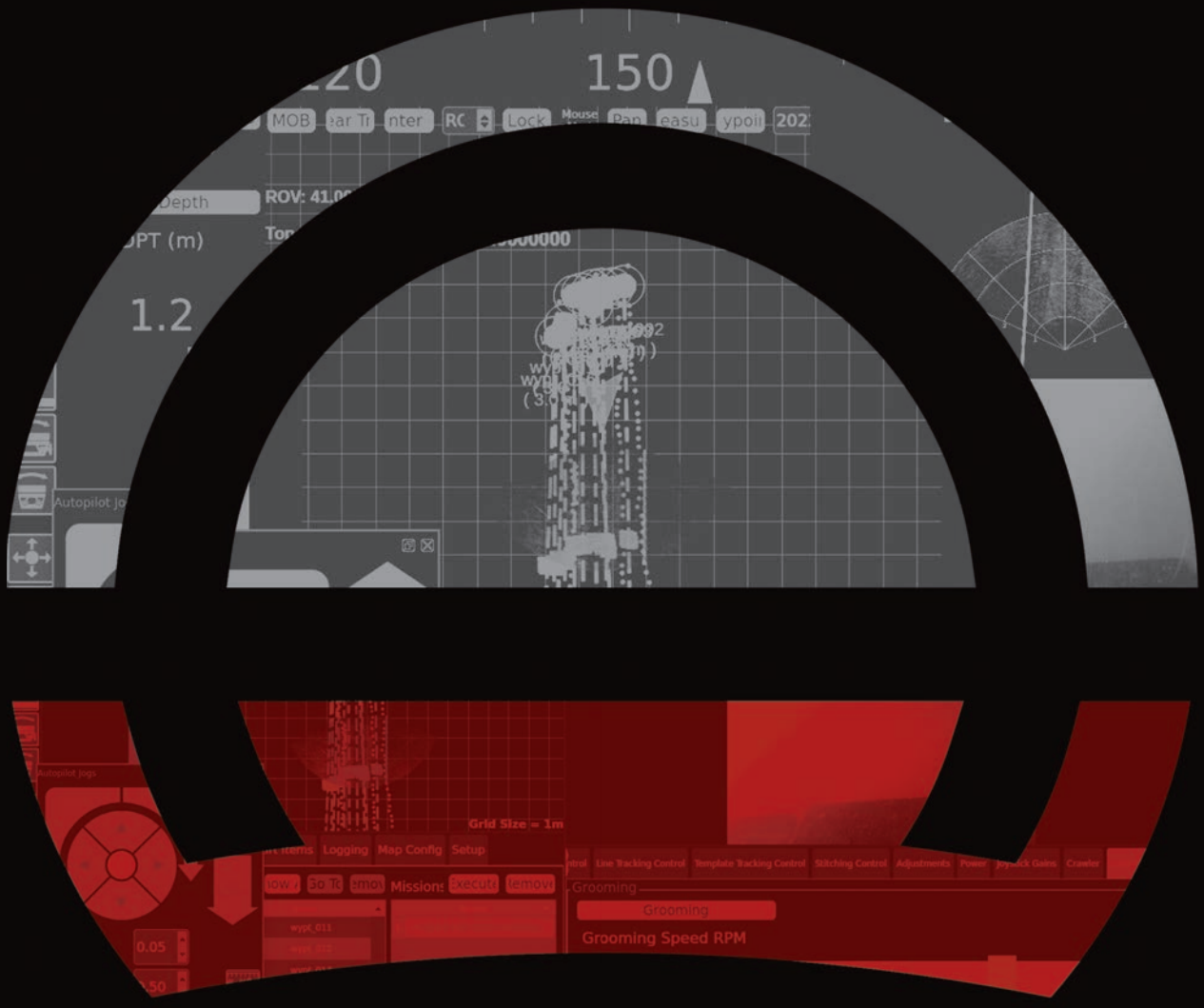
NO. 5 / VOL. 84 / MAY 2022

On the Cover
Source: Greensea Systems

Ammonia Fueled Tanker
Illustration: Courtesy Breeze Ship Design

Features

Departments



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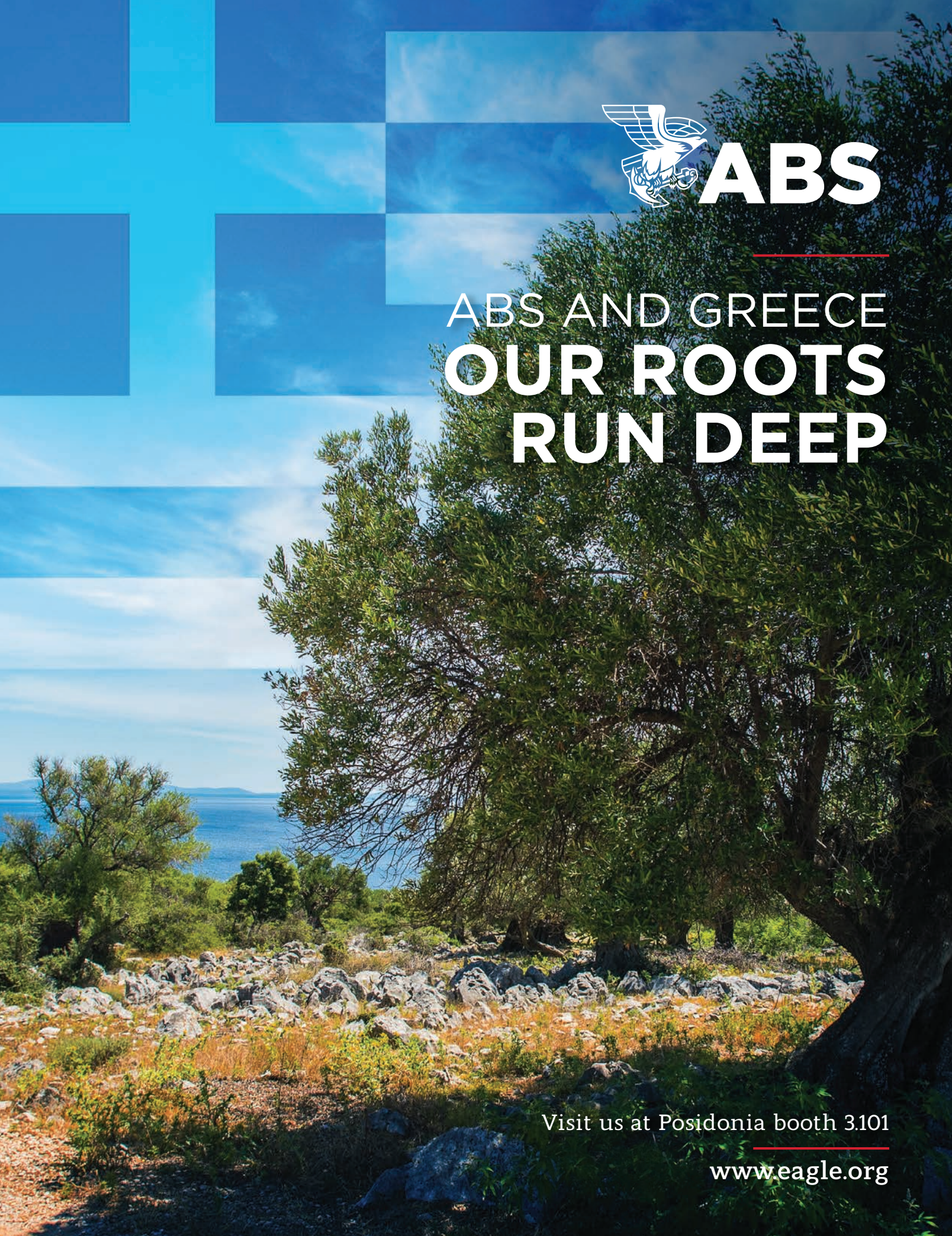
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What, exactly, does 'green marine' mean to you? As media covering this industry since 1939 – myself personally since 1992 – the 'green marine' mantra has been bandied about seemingly forever, and until most recently, mainly as a marketing slogan rather than true, positive action toward improving one's carbon footprint. (In fact, if you're reading this title in its paper format delivered by truck or plane, you might want to consider switching quickly to the electronic delivery method as it just might count positively for your company on the carbon credit ledger … you never know!)

I write this from Houston and the 2022 Offshore Technology Conference. While the OTC is, understandably, a mere shadow of its former self – a rough guesstimate of about one-third of its former self – what's most striking to me from the *'Energy Capital of the World'* is the plethora of signs that the offshore oil and gas industry is now touting "decarbonization" and "new energy" solutions.

'Green Marine' is all around us, and while the mantra gains volume and pace, the fact is that still today the maritime sector operates mostly as it always has: burning diesel fuel to deliver the bulk of the world's goods from point A to point B, hands-down the most effective and environmentally kind means to deliver masses of goods globally. But change is underway.

This month I am pleased to welcome Oslo-based journalist **William Stoichevski** back to our pages. William is a long-tenured and seasoned energy journalist, and I asked him to deliver 'the future fuels manifesto' which examines the wide variety of future maritime fuels under consideration, with insights on the pros and cons of each. Everyone reading these pages knows all too well that there is no single silver bullet solution to the emission reduction mountain ahead, but that doing nothing is no longer an option, particularly if your company is intended to be a long-term player in this space. His story starts on page 24.

Featured on this month's cover is **Ben Kinnaman**, founder and CEO of Greensea Systems and recent spin-off Armach Robotics. I have known Ben and the Greensea brand for more than a decade, and per previous cover story coverage in sister publication *Marine Technology Reporter,* he is a man on a mission to not only build a growing and successful business, but also an innovator with … as the headline on page 34 says … a *Technology Heart and a Maritime Soul*. Armach Robotics was created to be a Robotics as a Service solution to provide shipowners globally with a clean and efficient hull. While charting the path and pace of any start-up is uncertain, Kinnaman and his mission were perfect fodder for coverage, as he and his growing team embody the legions of inventors and innovators, dreamers and creators that will undoubtedly play a role – small and large – in the global maritime industries push toward both digitalization and decarbonization.

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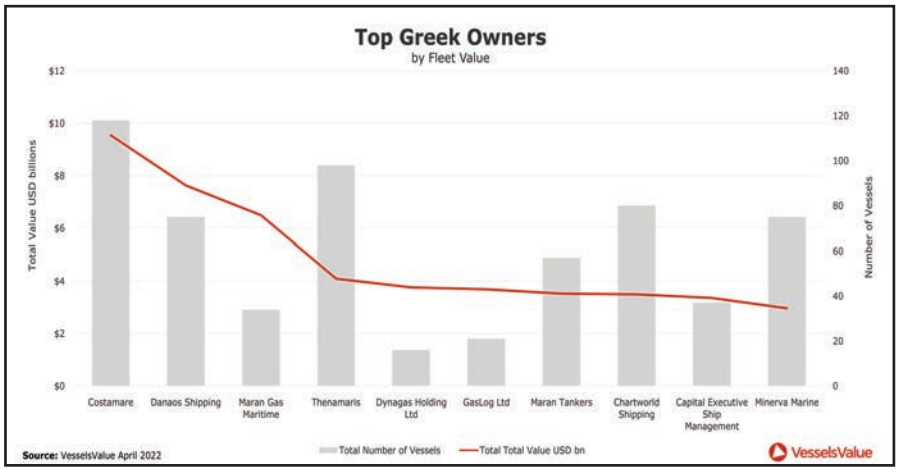
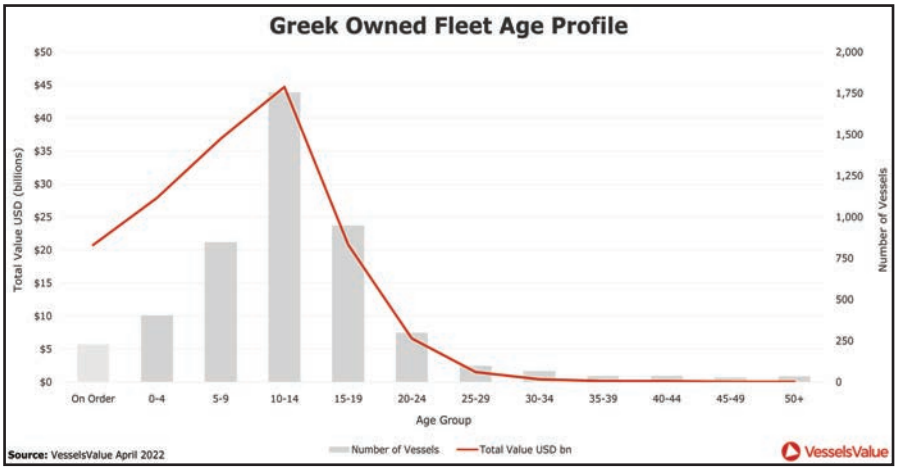
Greece

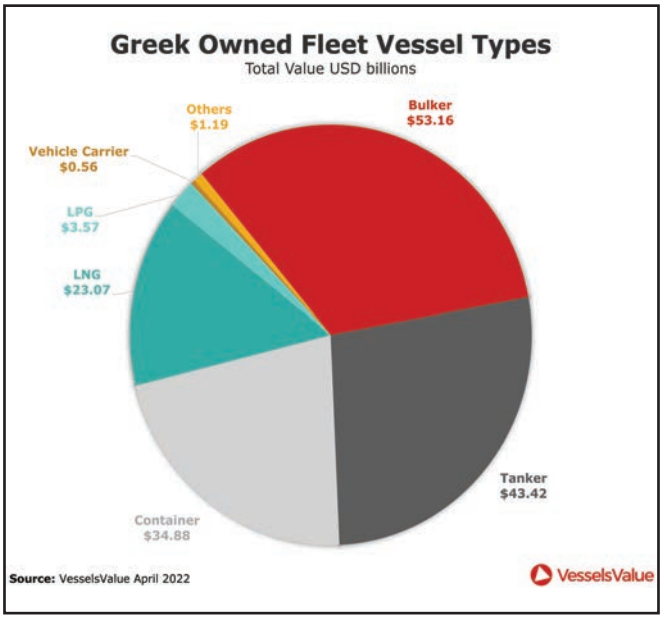
As the maritime world eyes a return to Posidonia in Athens, Greece early next month, we explore here the latest statistics on Greek shipowners, courtesy of input from our friends at Vessels Value.

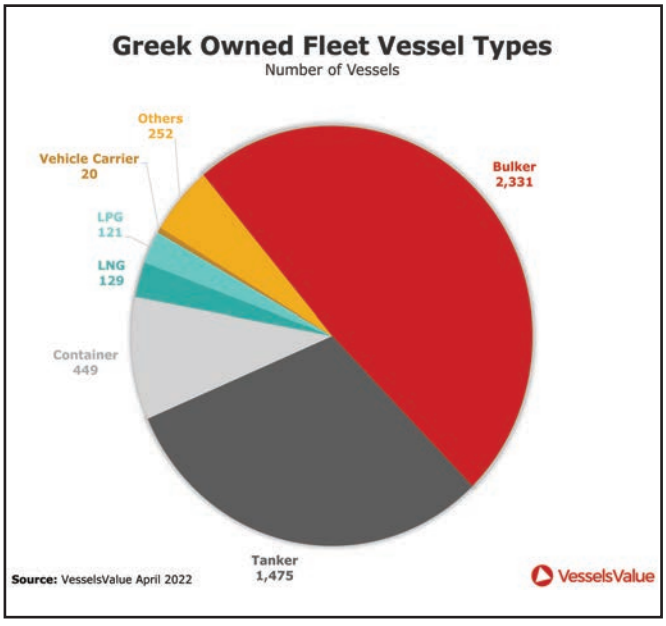
Greek Second Hand Purchase History

	Sale Date	# of Vessels	USD m
2020	Jan	30	$630
	Feb	13	$212
	Mar	7	$120
	Apr	10	$218
	May	13	$314
	Jun	26	$405
	Jul	23	$371
	Aug	18	$225
	Sep	32	$405
	Oct	42	$654
	Nov	34	$453
	Dec	33	$510
2021	Jan	40	$711
	Feb	44	$673
	Mar	42	$828
	Apr	35	$721
	May	40	$652
	Jun	43	$957
	Jul	44	$942
	Aug	14	$526
	Sep	19	$383
	Oct	29	$587
	Nov	32	$1,293.0
	Dec	29	$791.7
2022	Jan	27	$511
	Feb	23	$483.8
	Mar	39	$981.4
	Apr	18	$360.1
	Grand Total	**799**	**$15,917**









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What Goes Around Comes Around

Sale of Ex-Sanko Energy Firming AHTS Values

By Robert Day, Head of Offshore, VesselsValue

Those who are old enough (or young enough) to remember Justin Timberlake's poignant lyrics, 'What goes around, goes around, goes around, comes all the way back around', will appreciate their significance and relatability to the offshore oil and gas market.

On that theme, it appears a vessel very close to my heart, the AHTS previously known as Sanko Energy (now Ena Shogun), has come 'all the way back around.'

News is filtering through the market that Eastern Navigation (Singapore) has sold the vessel five years after purchasing it from Sanko Steamship in early 2017.

So why does this vessel resonate with me? Well, from a professional perspective, it was my first analyst experience of a sale that went against everything established market experts thought about values and sale prices. It also set off a chain reaction for other distressed AHTS sales, truly illustrating how poor the offshore market was, and many point-blank ignored or refused to accept the situation.

In January 2017, Sanko Steamship was keen to exit the troubled offshore market and therefore took the executive decision to sell its remaining AHTS vessels - the Sanko Energy (16,315 blt 2011 Keihin), Sanko Brilliance, and Sanko Baron (12,228 blt 2009 Keihin). First up for sale, and the subject of this article, was the Sanko Energy AHTS.

Sanko Energy AHTS was marketed for sale at $10 million, which even by 2017 standards was considered a very low asking price, compared to other sales candidates and general valuation opinion. Sanko Energy AHTS was to cause further disruption to the market when around a month later its asking price was reduced by 50%. This was a truly remarkable asking price for an AHTS that was just over 5 years old.

Many within the industry described this reduction as a one off, a sale to be ignored and not representative of the actual market. Others blamed the unit's lower specifications: the fact the Japanese had written the book value down to zero, its poor fuel consumption, or because it was considered a forced bank sale. In any case, the vessel was sold to Eastern Navigation (Singapore) for $5.8 million. The day before the sale, VV valued the vessel at $6.8 million.

In any softening market, there is always one defining sale where the achieved price is often a lot lower than the market perception. In our case, it was the Sanko Energy. However, we must remember that VesselsValue is a transactional-based model, and we cannot base ourselves on one data point alone. So, when the en-bloc sale of 11 Very Large AHTS for $75 million from suffering Hartmann Offshore to Breakwater Capital occurred, it supported our valuations and reinforced these new prices were not a one-off or something to be ignored. Sales are outlined in table below and associated VV values.

What goes around, comes around

Recent market rumors suggest that Eastern Navigation Singapore has sold the Ena Shogun for $13 million to Chinese interests likely to be engaged in the Chinese domestic offshore renewables market. VV value for the vessel today is $10 million. This represents a $7.2 million cash gain from their original investment of $5.8 million in 2017.

There are a few offshore owners who can claim to have made

☐	19 Oct 2017	UOS Challenger	AHTS (Very Large	16,320 BHP	200 BP	2009	8.39	Fincantieri Anc	6.28	BBB	Breakwater Capital	Hartmann Offshore
☐	19 Oct 2017	UOS Columbia	AHTS (Very Large	16,320 BHP	211 BP	2009	8.04	Fincantieri Anc	6.58	BBB	Breakwater Capital	Hartmann Offshore
☐	19 Oct 2017	UOS Discovery	AHTS (Very Large	16,320 BHP	205 BP	2010	7.67	Fincantieri Anc	6.74	BBB	Breakwater Capital	Hartmann Offshore
☐	19 Oct 2017	UOS Endeavou	AHTS (Very Large	16,320 BHP	201 BP	2010	7.61	Fincantieri Anc	6.73	BBB	Breakwater Capital	Hartmann Offshore
☐	19 Oct 2017	UOS Enterprise	AHTS (Very Large	16,320 BHP	197 BP	2010	7.30	Fincantieri Anc	6.87	BBB	Breakwater Capital	Hartmann Offshore
☐	19 Oct 2017	UOS Explorer	AHTS (Very Large	16,320 BHP	198 BP	2010	7.60	Fincantieri Anc	6.72	BBB	Breakwater Capital	Hartmann Offshore
☐	19 Oct 2017	UOS Freedom	AHTS (Very Large	16,320 BHP	199 BP	2010	7.31	Fincantieri Anc	6.89	BBB	Breakwater Capital	Hartmann Offshore
☐	19 Oct 2017	UOS Liberty	AHTS (Very Large	16,320 BHP	203 BP	2010	7.32	Fincantieri Anc	6.92	BBB	Breakwater Capital	Hartmann Offshore
☐	19 Oct 2017	UOS Navigator	AHTS (Very Large	16,320 BHP	204 BP	2010	6.98	Fincantieri Anc	7.13	BBB	Breakwater Capital	Hartmann Offshore
☐	19 Oct 2017	UOS Pathfinder	AHTS (Very Large	16,320 BHP	199 BP	2010	7.02	Fincantieri Anc	7.06	BBB	Breakwater Capital	Hartmann Offshore
☐	19 Oct 2017	UOS Voyager	AHTS (Very Large	16,320 BHP	202 BP	2010	7.08	Fincantieri Anc	7.06	BBB	Breakwater Capital	Hartmann Offshore

Vessels Value

those figures on asset play over the last 5 years. Eastern Navigation timed the market perfectly, both from a purchasing and selling perspective. The cherry on top is that Eastern Navigation has been working the vessel at various intervals since purchase, and thus generating positive cash flow - likely with a lot lower debt levels, if any, compared to their fellow offshore owners who built or bought at the peak of the market.

The vessel's most recent major project was from December 2019 to May 2021 for Lantana Services Sdn Bhd. Ena Shogun primarily supported semi-submersible drilling rigs for a Bruneian oil company under a one-year contract that contains options for additional work. The vessel was managed by Vroon Offshore Services Singapore.

Comparable Recent Sales

On December 9, 2021, Solstad sold 16,005 bhp, 2006-built Far Stream and Far Sword vessels. While the original price guidance was $8.5 million, the sale price was actually $6.5 million.

On October 22, 2021, the 2001-built, 16,823 bhp, vessel Far Scout was sold for $3.5 million.

Both these sales caused a firming in asset value when they occurred, and the recent sale of the Ena Shogun will be fed into the VV model and values will increase accordingly.

Market Tightening

The consensus is the large AHTS sector is tightening, and the number of available large AHTS units is quickly diminishing, while inquiries are increasing. This sudden tightening is a product of vessels being sold out of the offshore sector, thus reducing overall fleet numbers, China purchasing large numbers of vessels to service their growing renewables market, and a lack of any meaningful newbuild orders since c. 2014.

Finally, larger owners have sent significant numbers of older AHTS assets to the demolition yards as part of their overall fleet renewal program, i.e., Tidewater and Solstad. Market rumors suggest that several owners are increasing their asking prices for large AHTS based on all the above.

Future Outlook

VesselsValue expects the large AHTS market and values to continue firming throughout 2022, and it looks like it could be a pivotal year for the sector. After 5 years of low asset values and distressed market conditions, many within the industry will certainly be hoping that 'what goes around, does indeed come all the way back around' and finally see some positivity returning to the market.

Future Fuels & Lubes: Where Chemistry & Digitalization Meet

Lubmarine's Technical Director, **Nikolaos Kotakis***, explains the essential role of lubricant chemistry and technology to better support shipping's decarbonization journey.*

OEMs and engine lubricant providers are acutely aware of the operational challenges that shipowners face. The lubrication of engines requires numerous and flexible solutions. We are committed to ensuring there is industry understanding that developing lubricating solutions, which are suitable in today's new world, is more complex than simply tweaking existing tools.

The role of digitalization

Data and digitalization is increasingly a core strategic focus with current, reliable, timely and trusted data a growing requirement. Data on how lubricants work has helped customers improve the operational performance and integrity of their engines 24/7. Lubmarine have developed new ways in which information is obtained from product data that provides its customers with a deep-dive in to how they use lubricants versus engine cleanliness, operating parameters, and engine wear damage protection.

The best way to reduce emissions is to reduce energy consumption. One of the areas of key discussions is around the new build market with operators wanting to tap into extensive lubrication knowledge to support their project planning. In addition to discussions around fuel strategies and how this will impact the lubricant market and engine lubrication management, wider developments in the shape of increased focus on digitization to support customers is an increasing focus.

Operational excellence is key. New digital tools will further help vessel operators and owners across the optimization, monitoring, analysis and interpretation aspects of their lubrication management strategies. Engine condition, engine load, fuel type, running hours and temperature help to gain real insight in to how engines and their lubrication perform.

Awareness on using advanced engine oil lubrication with the marine fuels of the future is important for the shipping community to seize added value opportunities, and importantly meet their environmental challenges head on.

For a vessel operator, managing the procurement pressures of day-to-day operations onshore and offshore can be complex and exhausting.

An example to simplify the process is Lube-On-Time, a digital order and management platform from Lubmarine. It provides users with confidence in how to manage their lubricant stocks, supplies and ordering overcoming delays. It allows for easy optimization of a company's procurement process through product information, price inquiries and ordering. Users can even enquire on product availability for every port to help gain the information needed to make fast and effective procurement decisions.

Lube-On-Time helps you select where and when you want your delivery of lubricants, and even track the status of orders 24/7 while dealing direct with Lubmarine's customer service team. All in one tool.

While there continues to be a vast scope for more technology-based applications in the near-future, there is value in how digitization can further enhance today's operations. The maritime sector, and shipping in particular, is one of the growing optimized industries, and with abundant opportunities for improvements through data and digital transformation. Areas ripe for a new wave of innovation include fuel efficiency, engine monitoring and efficiency, ship to shore data exchange, real-time logistics, automation and environmental impact. At the heart of this evolution is how to drive customer value across our networks as we see benefit in the enablers that help to improve customer and supply chain insight.

One of the key initiatives which should be increased is in the development of digital tools to help better support engine monitoring. By extracting more data on how engines perform and simplifying the on-board testing routines, we can gain deeper insights of the health and performance of an engine which feeds in to better and informed maintenance and aftercare.

New fuels, new horizons

Today, the amount of research into LNG as a bunker fuel is diminishing as it is fast considered a mature technology. The adoption of new fuels by the shipping industry is more likely to be driven by familiarity and how closely they resemble current operations rather than technical maturity. Part of that familiarity will be driven by the logistics and infrastructure of making new fuels available at ports around the world, so ammonia is seen as an important transition step in the progression towards the less familiar fuel hydrogen.

For lubricant development the ongoing use of multiple fuels means a cylinder oil formulation that is suitable for both old and new fuels will be required. Lubmarine, already seeing success with its Talusia Universal two-stroke engine product range, will expand that platform beyond its current compatibility and proven performance for IMO2020 compliant fuels, including LNG. The product has been validated across a range of dual-fuel engines including WinGD and MAN ES engines.

With new fuels, engine design is being pushed to the limit as parameters such as compression and combustion pressures in both Diesel and Otto cycle engines are optimized for new fuels. Lubricant formulation will adapt accordingly, but post combustion treatment also needs to be considered.

Taking a broader context

As part of an integrated, broad energy company operating across the oil and biofuels, natural and green gases, renewables and electricity markets, TotalEnergies is committed to creating multiple energy solutions that are clean, reliable, practical and above all – effective for shippings' energy needs and decarbonization strategies.

The company is actively focused on innovating new fuels, lubricants and services as well as developing the necessary infrastructure, support and training in order to help its customers make the transition to alternative fuels, ensuring they meet the environmental regulations placed upon them today and well into tomorrow as we move towards IMO 2050. To achieve this, it is increasingly leveraging its investments into renewable energies to offer an array of marine energy solutions. These wide-ranging, long-term efforts include working on various alternative, lower- and zero-carbon solutions, such as new, advanced biofuels and green hydrogen-based fuels (including e-methane, e-methanol, e-ammonia, e-hydrogen etc.)

Tip #35

Choosing e-Learning Media? It's All About Outcomes!

By Murray Goldberg, CEO, Marine Learning Systems

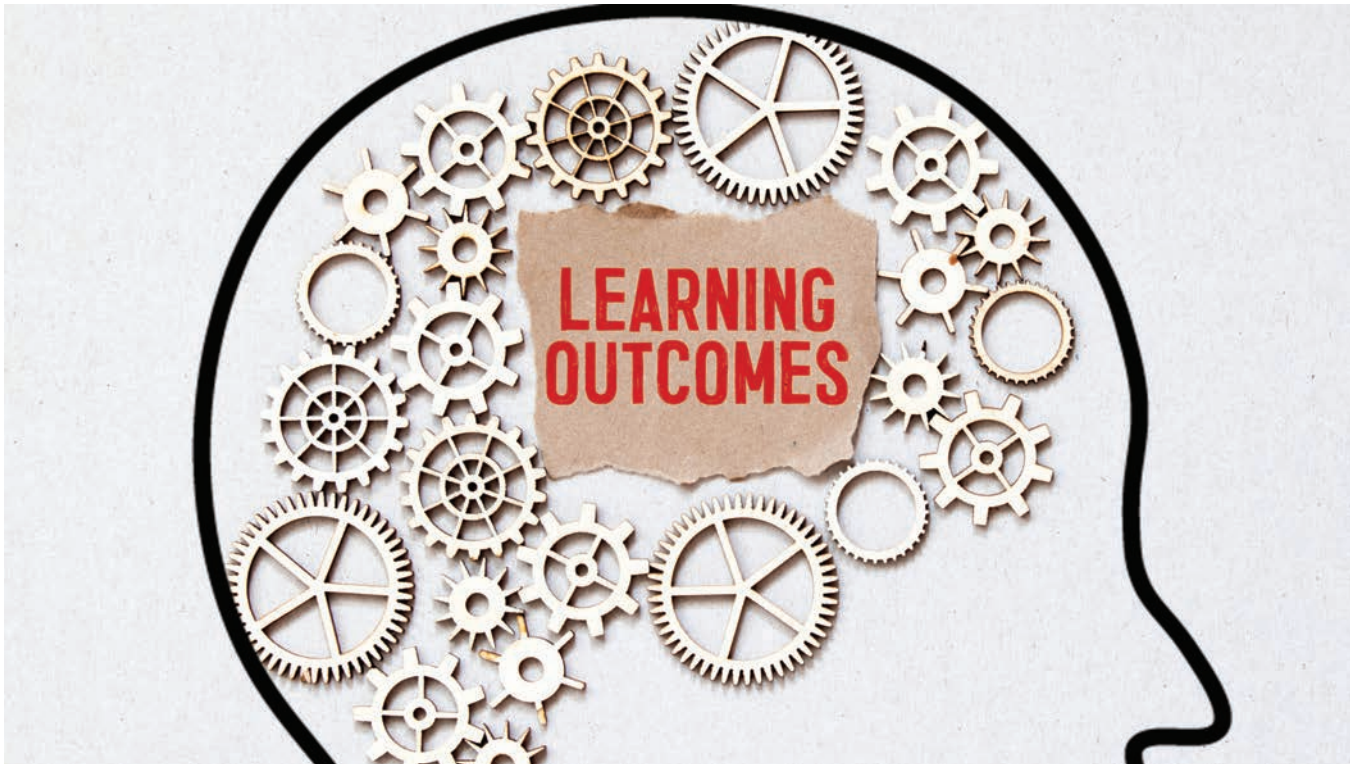
In the previous edition of *Training Tips for Ships* we discussed the choice of media for learning materials and which media would lead to the best results. Is it text? Images? Videos? Interactive exercises and simulations? All too commonly it is claimed that interactive media with fancy (and expensive) graphics will produce better learning outcomes. The reality is not nearly so simple. So, how do we choose? It's not hard.

The first question we should be asking is not one of media choice, but instead is one of learning outcomes. Do we want the trainee to internalize some knowledge or a concept? Or is it skills or reasoning we are hoping to impart? These are very different learning goals and different media types will better support some goals than others. Let's look at these in a bit more detail.

There are many ways to categorize learning goals, but for our purposes I have broken it into the following four simple categories:

1. **Assimilation of knowledge.** Here we simply have some information that the trainee needs to know. For example - what is the draught of the vessel?
2. **Understand a concept.** Here we are trying to teach how something works. This goes beyond a list of facts to yield an understanding of how, for example, a piece of equipment operates.
3. **Be able to perform a task.** Here we are trying to teach the ability to get something done, safely and effectively. Examples might be to launch a rescue craft or take a sounding.
4. **Be able to reason and make decisions.** Here we are preparing the trainee to make decisions and perform actions in response to novel situations.

Given any training we wish to do, we first need to decide which of these



categories the training fits into. Let's take donning a fire suit as one example. Which of the above applies here? Although it could be argued that teaching this competency requires the accomplishment of all four learning goals, they are not weighed equally. In this case:

- There is a reasonable amount of knowledge to learn - what the components of the fire suit are, where they are stored, how they fit together, etc.
- There is a small bit of conceptual knowledge required - such as how the suit protects against heat.
- The ability to perform the task (don the suit) is central, arguably equal in importance to the knowledge of the components of the fire suit.
- And finally, being able to reason is not a large requirement of donning a fire suit. Indeed, there may be issues encountered while donning or using a suit which take some reasoning to resolve but are unlikely the primary desired outcome.

Looking above, it seems the primary learning goals for donning a fire suit can safely be considered to be "Knowledge assimilation" and "Task performance". You can use the same process to get a general idea of the primary learning goals for any competency.

Once we understand these learning outcomes, the task of matching media to the outcomes is relatively straightforward if we understand the strengths and limitations of each. In fact, said a little differently, for each of these learning outcomes there are teaching methods (or pedagogies as it is correctly referred to) that will have strengths or limitations in achieving the desired outcomes, and in many cases the choice of media is a direct result of the pedagogy chosen.

But for our purposes we will simplify a bit and look at how media choices match up to their desired learning outcomes. This will be the topic for the next edition of Training Tips for Ships.

Until then, thank you for reading and sail safely!

Back to the Drawing Board

What is Old Can Be Green Again

By Rik van Hemmen

The use of certain technologies is rarely a stand alone decision. The switch from sail to steam did not happen overnight and they actually coexisted for over a century, where, based on available technologies, in certain applications steam was more attractive and in other applications sail was more attractive.

The eventual dominance of screw propellers over paddle wheels was not even driven by technological considerations, but rather by a tug of war between a paddlewheel propelled vessel and a screw propelled vessel. This trial was organized by the British Admiralty and occurred in 1845 between two similarly sized ships, the screw Rattler and the paddlewheel Alecto. Rattler won and most development money went to screw propellers and paddle wheels started their fade into obscurity.

It is actually very difficult to compare the effectiveness of one against the other. As a matter of fact, many years ago I came across a 1940's or 1950's SNAME paper that performed a further analysis of paddlewheels that indicated that in certain speed and draft ranges articulated paddle wheels are more efficient than screw propellers. Articulated paddlewheels are paddle wheels that allow the blades to stay vertical when they pass through the water (think in terms of mounting a Voith Schneider prop as a paddlewheel).

However, alternatives like this are not always decided on efficiencies alone. In 1845 the British Admiralty particularly liked propellers because they were harder to disable by gunfire (a flawed argument if one considers that the first naval steam ship, Fulton's 1814 Demologos, had a paddlewheel that was almost invulnerable to gun fire.) More significantly, a screw propeller is much less sensitive to a seaway and to changes in draft. I saw no reason to use paddlewheels and ignored them until very recently.

I started thinking about paddlewheels because of an upcoming event. In 2026 we will be celebrating the United States Sesquicentennial (let's call it USA250 for short). I like a party, and it made me think of the 1976 Operation Sail. That was a fun event and maybe we should organize something like it again. I live on a river in striking range of New York City, and maybe we could use the next few years to build a local replica vessel that could participate in such an event. The river was famous for three types of vessels. Shrewsbury packets, shallow draft centerboard schooners that carried people, produce, and oysters to New York City, shallow draft side wheeler passenger vessels that ran passengers between the river and New York City into the 1920's, and rum runners based on Seas Bright Skiffs that became the prototypes of today's modern recreational planing power boats. A replica on one of those could be a great way to celebrate USA250.

A replica schooner initially seemed most attractive since it touches on the earliest days of the United States and I prefer sailing over anything, but it is very difficult to get the financials to work on a USCG public sailing vessel. I also liked the idea of a rum runner, but once I started to think in terms of actual designs a "replica" side wheeler became very attractive. I put

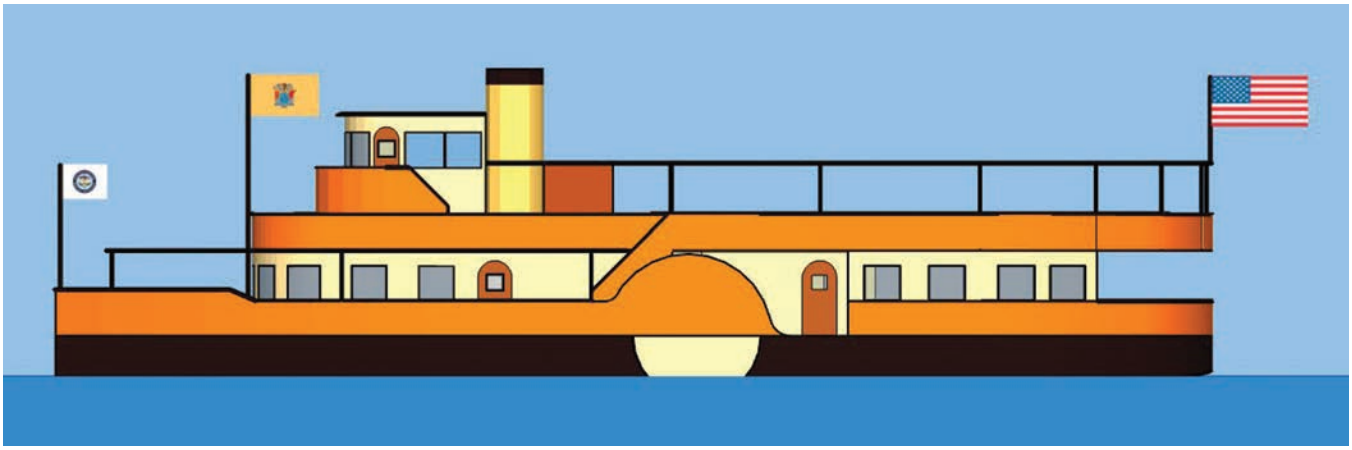


Photo courtesy Martin & Ottaway

the replica in quotes since replicas can range from totally authentic to no more than evoking the spirit of the original.

Actual totally authentic replicas are almost always disappointments. They are of very limited use and very expensive to build and maintain. Too many authentic replicas rot away in some corner of the harbor soon after their main event because they serve no further purpose. As such, I was thinking in terms of evoking the past with new technologies and materials.

And then things got interesting. In laying out a paddle wheeler, the first question is what prime mover to use. Diesel is loud and noisy, steam is very expensive and difficult to operate. Why not electric drive? Why not solar electric? And then things took off.

Side wheelers are relatively slender vessels with lots of deck space. Lots of deck space mean lot of space for solar panels. Steam vessels were very quiet and so are electric drive vessels.

One reason side wheelers fell out of favor is because the centrally located engine ate up prime real estate, but electric drive is very compact and the side wheel drive mechanism would barely intrude into the public spaces. Batteries are heavy and these boats need ballast, batteries make great ballast. And articulated paddlewheels allow shallow draft and are no less efficient than propellers in this application. A solar electric paddle wheeler would not only look like an early 1900's paddle wheeler, it would feel and sound like one too.

So maybe I want to cheat a little and still fit a standby generator for long runs, but that can be hidden anywhere below deck, and it will add to the ballast. Regardless, the boat will not carry a lot of fuel and therefore the boat will not change much in draft, so paddlewheel immersion is of little concern. The trade will be the Navesink River, Shrewsbury River and NY Harbor and Raritan Bay in good weather; perfectly fine for paddlewheels. Build it out of aluminum and it will last nearly forever or use titanium for the hull and it will actually last forever.

I had our high school intern Riley Flanagan generate a first concept. It is not optimized yet, but I like what I am seeing.

It is cute and will look great on our river, but what is really cool is that I ran some cost numbers and it is actually a viable commercial vessel. For example, the cost of construction of articulated paddlewheel propulsors would barely be higher than the cost of a screw propulsion system. As matter of fact, while this vessel would be somewhat more expensive than a "conventional" dinner cruiser, its life cycle cost would be much lower.

Once the USA250 festivities are over, this boat would be a very attractive low operating and maintenance cost passenger cruise vessel for wildlife viewing, excursions, dinner cruises, weddings or special event charters.

I doubt that a screw propelled vessel would have worked as well in this context, and what makes paddlewheels viable here is the emergence of electric and solar propulsion. What is old is now green. I suspect this is only the tip of the (global warming threatened) iceberg. Similar trends are occurring with sail and other old technologies and old concepts will re-emerge as they blend with new technologies. As engineers we should never forget to mine the past for good ideas. I mean: "Why reinvent the wheel?"

For each column I write, *MREN* has agreed to make a small donation to an organization of my choice. For this column I will make the donation to the yet to be created USA 250 Navesink River Steamer Foundation.

Fuel Tax Repeal Victory in New York State

The New York State Petroleum Business Tax (PBT), Article 13-A levies a tax on fuel consumption of commercial vessels operating on the waters of New York State. The PBT has long been a source of contention for operators of tug boats and towing vessels transiting New York State waters because of the difficulty to accurately calculate the tax due the state. This led to many long drawn out audits of vessel operators by the state, resulting in unacceptable additional taxes, interest and fines.

Over the years, multiple efforts were made by industry groups to repeal the PBT legally without success. The first attempt at a cooperative solution was led by The American Waterways Operators (AWO), in conjunction with the New York State Department of Taxation and Finance (DTF) and the towing industry developed an alternative method of calculating PBT Taxes based on a per trip tax, the PT-350 Schedule A. The "Trip Method" was adopted by many vessel operators but it did not solve the issue of accurately calculating each vessels fuel consumption while operating in New York State waters.

In June of 2018, in response to the frustration of their members, the Tow Boat and Harbor Carriers Association (TBHCA) took on the task of revising or repealing the PBT. After opening a dialogue with the NYS DTF in June of 2018, an October 2018 meeting was scheduled in Albany between the department and TBHCA leadership. The meeting kicked off an effort between industry and the state to identify the problems with the statute and make the needed changes through DTF or legislatively. The TBHCA surveyed members regarding the problems they had faced calculating the tax and in the most recent round of audits. In January of 2019 they presented the results to DTF, the TBHCA outlining the flaws in both the consumption and trip methods. After further correspondence, it was apparent that the changes needs were beyond what the scope of DTF. In a July 2019 conference call, the DTF recommended TBHCA work with the state Senate/Assembly to amend the PBT. During this time, TBHCA partnered with the AWO to work jointly on the PBT issue.

The next year TBHCA and AWO worked with the DTF in an attempt to develop a workable tax statute, and began reaching out to local elected officials to muster support for legislative change. In early 2021 it was evident that the present statute did not provide an accurate process to measure the tax due and should be repealed. AWO and TBHCA then engaged State Senators, Savino and Lanza and Assemblyman Cusick of Staten Island, requesting that they introduce legislation to repeal the burdensome PBT levied on the towing industry. AWO also arranged a meeting between AWO and TBHCA leadership and the Governor's Budget Director in October of 2021 in which it was requested that the PBT Article 13-A be repealed in the 2023 state budget.

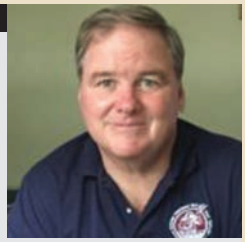
In January of 2023, legislation was introduced in the state senate and assembly to exempt commercial tug boats and tow boats from the state's Petroleum Business Tax. The exemption was also entered into the Governor's 2023 budget.

When Governor Hochul signed the state budget into law in April of 2022, it contained the PBT Exemption which will go into effect September 1, 2022. The hard work of the Tow Boat and Harbor Carriers Association and The American Waterways Operators on behalf of their members, finally came to fruition. The cooperation of the New York State Department of Taxation and Finance and the efforts of our elected officials is a testament to the ideals of government working with industry in the best interest of the citizens of the state. The marine transportation industry is vital to New York State, employing mariners and support service workers while contributing billions of dollars in state revenue. The Marine Transportation System provides vital goods and services throughout the state and will be at the forefront of our emerging offshore wind energy industry.

The Author

Bowie

John Bowie is General Manager, Vane Brothers Company. Bowie is Past Chairman TBHCA and Vice President of the Maritime Association of the Port of New York New Jersey.



Electrification: The power behind 'future-proofing'

By Edward Lundquist

There's an "electrification of the seas" happening for navies around the world.

Whether it's to achieve greater military capabilities, operational economics and efficiencies or to be better stewards of the environment.

There's a trend moving from direct mechanical drives towards more flexible electrical propulsion systems. Ships can still have the same propellers and engines, but they now have a much more flexible power system architecture that benefits design, operations and sustainment.

"With an electric propulsion system, we can connect to the same gas turbine or diesel. Any prime mover can run any load, whether it's for propulsion, the ship's electric power distribution system, or sensors or weapons," said George Awiszus, director of military marine marketing and business development with GE's Marine Solutions in Cincinnati, Ohio.

For naval applications, this trend favors larger ships as opposed to corvettes or patrol boats, because destroyers and aircraft carriers have bigger electrical loads and the need for immediate power to apply to directed energy weapons, or electro-magnetic catapults and weapons elevators.

Ships such as the USS Zumwalt (DDG 1000) class of guided missile destroyers and the Royal Navy's HMS Queen Elizabeth class of aircraft carriers are examples of ships using gas turbines and integrated electric propulsion instead of dedicated propulsion prime movers coupled directly to the shaft with large reduction gears.

The DDG 1000s, for example, have higher voltage electrical systems compared to USS Arleigh Burke (DDG 51) surface combatants.

"It's still electricity, but at higher scales," Awiszus said.

According to Nick Smith, executive technology leader with GE Power Conversion in Rugby, UK, it's the electrical grid in the middle that offers the flexibility. "You can change prime movers as the technology advances, upgrade sensors or add new weapons. Once you have established the grid in the center, you can innovate at both ends."

"We can adapt all of the current prime movers and energy sources to the grid. Today we can install an LM-2500 gas turbine on the grid. But in the future, when we have fuel cells and other green technologies, which will be electric, and they will connect. You don't have to know what that future technology is. You just have to know that it will have an electrical interface," said Smith.

Another trend is static energy storage, like batteries and capacitors, that deliver improved power density.

"Even in a combat situation at high speed, power can be diverted momentarily from propulsion to charge up energy weapons such as lasers, without slowing down," Smith said. "We can have a battery bank with a capacitor bank on top for short-term pulses, such as launching a plane from an EMALS catapult. If you've got electric grid and lose a prime mover, the batteries can provide power to the grid for a while until you can restart an engine."

Awiszus said GE's new composite enclosure module for the LM 2500 provides about 6,000 lbs. in weight savings per gas turbine package. "It's half the weight of the steel enclosures. It's cooler to the touch—25 to 50 degrees cooler--and its quieter. So it's better for the Sailors in the engine room, and reduces the ships acoustic signature providing a tactical advantage."

Awiszus said the future will bring simpler power systems. "We'll see more power-dense solutions with fewer moving parts. Instead of 20 parts, there will be 10 parts, or just five. Our ultimate goal is a single machine with nothing else--no converters, dynamic braking, resistors, or filters. The machine will directly connect to the grid--nothing else needed."

Awiszus said electrification offers the maximum flexibility for any of the future generating, weapons or sensor technologies that will come along. "It really does give you 'future proofing.' You don't have to worry about what it might look like. There could be 50 things in the pipeline, and only five might make it through to the final stage, but they'll all be electric."

Photo courtesy GE

The Blue Economy & U.S. Exporters

U.S. Commercial Service previews September 2022 export forum

The growing demand for marine technologies is generating new export possibilities for U.S. companies. To help American businesses pursue these opportunities, the Department of Commerce is hosting Discover Global Markets: The Blue Economy, in Providence, R.I., Sept. 20-22, 2022. International Trade Specialist Maryanne Burke (pictured right) leads the Marine Technology Team of the International Trade Administration (ITA). Maryanne is part of ITA's U.S. Commercial Service's global network of offices located in 100+ cities across the United States and in U.S. embassies and consulates in more than 75 markets. In the below Q&A, she shares some insights on how U.S. companies can take advantage of the Blue Economy event and agency export resources to expand their export horizons.

Photo courtesy U.S. Commercial Service

Could you give readers a snapshot of the Blue Economy event, how can U.S. companies benefit from attending?

We're seeing a new age in ocean technology, sustainability and logistics, and Discover Global Markets: The Blue Economy will highlight growing overseas market opportunities for U.S. businesses in the marine technology sector. Like no other event, the Sept. 20-22 forum brings together U.S. businesses, foreign buyer delegations, and U.S. Commercial Service marine industry experts from 20 countries. Through export counseling and business-to-business (B2B) matchmaking, U.S. businesses can benefit from market intelligence, trade leads, partnering opportunities, and potential export sales. It's an excellent venue for exporters to both grow their bottom line with export sales and improve their competitiveness by diversifying into new markets. Discover Global Markets events, held annually, focus on different industries and regional markets.

Which markets will be represented at the show?

We'll have a strong geographic presence, representing a truly global showcase. U.S. companies will gain market insights from U.S. Commercial Service industry experts from U.S. embassies around the world, including: Australia, Brazil, Canada, France, India, Indonesia, Italy, Japan, Korea, Mexico, Singapore, Spain, the Netherlands, Norway, Thailand and the United Kingdom, as well as many others. These markets represent some of the best growth prospects in the marine technology sector, offering both short and long-term industry opportunities for U.S. companies.

What are some opportunities in these countries?

Overall, marine technologies are in demand for both large-scale foreign government projects and independent, non-government organization projects. Opportunities are wide-ranging, covering port development and technologies, underwater surveillance, subsea imaging for ocean floor mapping, offshore wind ecosystems, weather instrumentation, ocean sci-

ence and exploration. Another focus is clean "smart" technology for use in marine transportation.

In many cases, growth and demand abroad is higher than in the U.S. domestic market. For example, some parts of Europe have a strong interest in port development, while in the Indo-Pacific, countries are looking for the latest technologies to monitor coastal flooding. More and more, we're seeing growing opportunities driven by evolving global trends in technology, demographics, and sustainable development.

Examples of market opportunities include:

- The United Kingdom's maritime economy is the largest in Europe, the fifth-largest in the world for U.S. goods exports and the largest market in the world for U.S. service exports. Technologies are in demand for smart ports, decarbonization solutions, and green innovations for shipping and offshore wind energy. Technology is also sought for intelligent and autonomous ships, and autonomous underwater vehicles that are sensor agnostic. For example, the Royal Navy is seeking to develop a range of fully autonomous systems for surveillance, reconnaissance and underwater data gathering, among other uses.
- Italy will invest $3.1 billion (2.8 billion euros) by 2026 to modernize its ports. These investments are part of the National Recovery and Resilience Plan, Italy's strategy to kickstart its economy since the Covid-19 pandemic. Much of this spending is earmarked to increase port capacity and will require new port technologies and services. Other funding will make ports more ecologically sustainable, or more efficient and secure through digitalization. This is in addition to $2.5 billion (2.3 billion euros) in investment already planned for the Ports of Genoa. U.S. companies with innovative solutions in these sectors may benefit from increased spending.
- India's maritime sector envisions an overall investment of $45 billion across ports, shipping, and inland waterways categories by 2030. The focus will be on improving infrastructure, efficiency, services, capacity building and logistics. It will also expand ship building and promote a safe and sustainable "green" maritime sector. By 2030, India plans to reach 140 million tons per year transiting its national waterway network. To reach this goal, the Inland Waterway Authority of India plans to develop and modernize 5,000 km of Inland Waterways. India needs state-of-the-art port and marine technologies such as equipment and services for security, logistics, vessel tracking, oil spill detection and contingency preparedness, dredging, and underwater exploration and mapping.

Could you give some insight on the business-to-business matchmaking and industry expertise at the show?

The U.S. Commercial Service is the trade and investment promotion arm of the U.S. Department of Commerce's International Trade Administration. Through our in-country presence at U.S. embassies abroad, our trade experts have in-depth market knowledge and connections to buyers of U.S. products and services, as well as market expertise in the marine technology sector. And so, we bring these skillsets to the show, along with several foreign buyer delegations.

Our value is knowing the key players and opportunities to bring U.S. businesses and prospective foreign buyers together. We do this by arranging business-to-business (B2B) matchmaking meetings based on their mutual needs and interests. Because the U.S. Commercial Service screens buyers in advance, we know they are interested in U.S. marine technologies and ready to do business. This arrangement is a real advantage for U.S. exporters, particularly for small and medium-sized businesses, compared to searching for suitable foreign business partners interested in marine technologies on their own.

Through networking opportunities, U.S. businesses will hear from original equipment manufacturers (OEMs) and prime contractors about overseas projects and their supplier needs, participate in general networking activities, and learn about U.S government export programs.

Businesses attending previous Discover Global Markets events have noted several benefits of the two-day event. Among these are the time and resources saved from having to travel to meet contacts, new leads generated, insights gained for honing export strategies, and obtaining real-time market information from experts to understand in-depth, what is going on internationally beyond what is seen in the media.

How does the business-to-business matchmaking work?

On the Blue Economy registration form, a U.S. company enters their information into a database platform about their product or service and the markets they are looking to sell to. About a month ahead of the event, participants can search the database to identify potential partners and arrange matchmaking meetings. U.S. businesses can also arrange meetings at the event. U.S. Commercial Service industry experts will also be facilitating B2B meetings on the conference floor.

What are some recommendations on how to best pursue international opportunities?

Contacting the U.S. Commercial Service is a great place to start. Our trade specialists can help develop a customized export strategy that identifies priority markets with the strongest potential for export success. For more information on our services and events, visit the Marine Technology Team website trade.gov/marine-technology-industry, or your contact your local U.S. Commercial Service office at **trade.gov/commercial-services-offices-us.**

Next-gen Electrical Solutions Today

Asbjørn Halsebakke of Yaskawa Environmental Energy/The Switch discusses the application in maritime for the company's new generation DC-Hub with its unique Electronic DC Breaker (EDCB) and Electronic Bus Link (EBL).

Your company is starting to talk about its new generation DC-Hub. Can you give an overview of this product evolution with insight on what makes it unique?

I think one of the key features with maritime products and with DC-Hub is that you need to think first about personal safety. You need to think about how to make sure that everything is in a safe mode. And if you have a critical fault, you need to disconnect. That is what we are able to do with our EBL and EDCB. With the Electronic DC Breaker (EDCB) we can disconnect a module within 10 microseconds; faster than any fuse, faster than any breaker. Anyone who has ever been onboard a vessel knows if everything goes black, that's a scary situation. By using our electronic DC breaker, one fault will disconnect only that fault. So you can continue to run your main propulsion, your tunnel thrusters (and other critical systems). But you can still have one critical fault on your main DC link.

In practical terms, what benefits does the EDCB and the EBL offer to the end user?

It is a much easier, because if you have a fault, you don't have to go down and change a fuse. You can just press reset on the bridge and try again. If it's not a critical fault, you're up and running. What is very important with our EBL is it gives

Photo courtesy Yaskawa Environmental Energy/The Switch

"That is what we are able to do with our EBL and EDCB. With the Electronic DC Breaker (EDCB) we can disconnect a module within 10 microseconds; faster than any fuse, faster than any breaker."

Asbjørn Halsebakke
Yaskawa Environmental Energy/The Switch

the possibility to introduce a new DC-Hub. When I speak with ship owners today, a leading concern for ships being built today is they know that energy sources will change during the life of the vessel, but today they don't know exactly what that energy source will be.

By having our EBL in the DC-Hub, we can connect a new DC-Hub into the system that then might have the new energy source that will come in 5, 10, 15 years down the line.

That might be a fuel cell, or it might be a new engine, or maybe it's something that we are not even discussing today. The key to the future (and maintaining a good value and long-life for the ship) is to be flexible.

Is the new DC-Hub installed on a ship today?

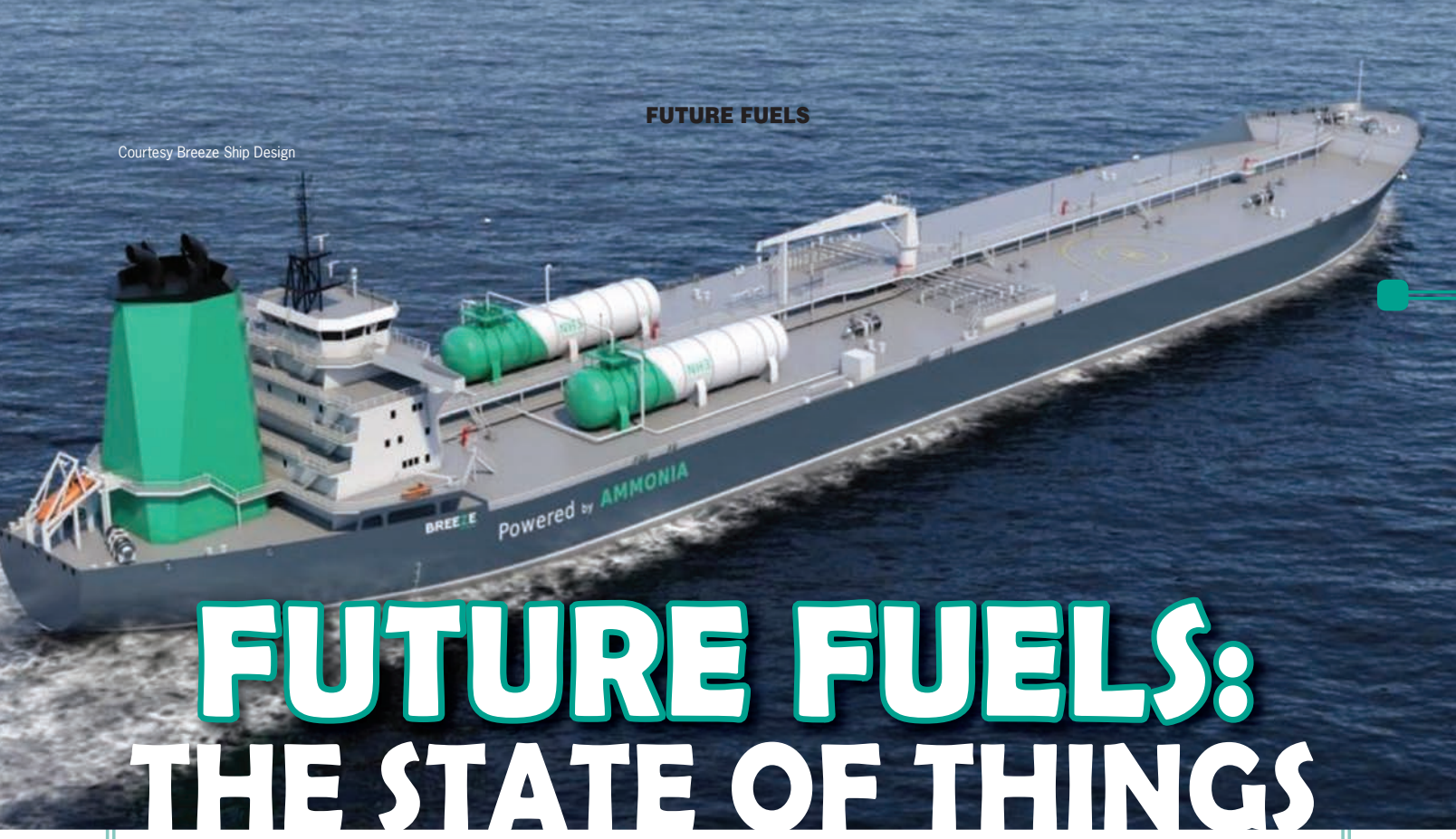
Yes, it is. The first installation we did was installed and commissioned during one of the really bad COVID periods here in Europe during the summer of 2021. We had to do a lot of the commissioning over phone. We have six more vessels coming.

When you look at the world today, where do you see the best prospects for this solution by vessel type?

It has been a quite fast development of DC-Hubs, and today almost all our offerings and all our deliverers are with the DC-Hub. I do believe that most vessels can benefit from having a DC-Hub on board.

I don't believe that all vessels should have a complete DC system, that all vessels today, where it's better to have a mix of an AC and a DC system, but the more energy source you have on batteries, on fuel cells, on variable speed engines, the better it is to have it on a DC-Hub.

So there are many vessel types that can benefit. We're seeing interest from a wide variety of vessel types, from tankers to fast passenger ferries to reefer ships; even new Navy vessels we can see are coming into the DC-Hub configuration. We believe that this makes everything a lot easier for the vessel owner to reach the goals that IMO are setting to make vessels more environmentally friendly.



Courtesy Breeze Ship Design

FUTURE FUELS: THE STATE OF THINGS

Two years of IMO sulfur cap has highlighted certain truths. Scrubbers still "decarbonize". Dual-fuel engines provide *carbon-intensity indicator* options, or CII. Certain fuels look destined for certain vessel types, and OEMs are seeing public and private money to produce new engine types and future fuels. A survey suggests "no one really knows" which future fuels will survive, or which of ammonia, hydrogen, methanol, LNG, LPG or additives-rich biofuels might dominate. Changing rules, war and tech *disruption* make following along key.

BY WILLIAM STOICHEVSKI

Drawing Board:
a Breeze Ship Design rendering of an ammonia oil tanker with storage on deck.

In just 12 years, the EU has moved from compelling the use of LNG to renouncing it in favor of battery power and then putting LNG partly back on the mantle of clean fuels. In Norway, during that time, Oslo's industrialists heavily promoted biodiesel for cars before climbing aboard the all-electric bandwagon and forcing generous financing for Teslas.

Despite the social engineering, there is now greater certainty on decarbonizing ship's engines. Under the IMO sulfur cap, ship owners have strived to comply by choosing lower-sulfur fuels or scrubbers, depending on price, says Christos Chryssakis, DNV business development manager and a decarbonization expert.

"Fuels have been available. (Not having them) was one of the concerns before 2020. This has not been the case," he says. Low-sulfur HFO and MGO were made available by refineries once at odds with shipowners over who'd pay the lower-sulfur tab, producer or end-user.

Back in 2019, Chryssakis says, scrubbers were installed on larger vessels based on an assumption that low-sulfur fuels would be pricier. It was thought that 10 to 15 percent of marine fuel consumption would, by 2022, be high-sulfur fuels with installed scrubbers.

"What happened in 2020 is that after a couple of months, we actually saw that the charter age for ships with scrubbers was higher. Then we got COVID and oil prices dropped dramatically in just a few weeks. That meant that the price differential between high- and lower-sulfur fuels was not there. Ships with scrubbers were still using high-sulfur fuel, but it wasn't making the case for more scrubber installations."

Now, with a European war underway, fuel oil prices and the price differential between high and low-sulfur is up again. "Scrubbers are very attractive again, but I don't thing we'll be seeing more scrubber installations. It's just that for those who have scrubbers, they have an incentive to keep on using them for as long as possible." So, scrubbers are attractive today, just not in newbuilds, "because people have a different focus, and that is decarbonization."

The IMO's Energy Efficiency Design Index, Phase 3, will soon enforce a 50 percent carbon-intensity cut (over 2008 levels) on any newbuild of a large containership and, by 2025, a 30 percent carbon-intensity reduction on any newbuild. So, from sulfur to carbon.

LNG

Overwhelmingly, new vessel orders in early 2022 are for new fuel types, especially LNG.

The numbers of these orders are under 500, and DNV says the amount of LNG bunkering going on relative to the fuels market is also fairly small. Chryssakis' own estimate is between two and three percent of marine fuel consumption, "But

Table 4 – Properties of hydrogen and other energy carriers [23]

	Boiling point (°C 1 bar)	*Density (kg/m³)*	*Specific energy LHV (MJ/kg)*	*Specific energy LHV (kWh/kg)*	*Energy density (MJ/m³)*	*Storage temp/pressure*	*Chemical comp.*
Hydrogen	-253	0,089	120	33,3	10,8		H_2
Hydrogen compressed		23 (350 bar)	120	33,3	5 040	Ambient 200-1000 bar	
Hydrogen liquid		71	120	33,3	8 500	Cryogenic Atm./Low pressure	
MGO	175-650	890	42,7	11,97	38 000	Ambient atmospheric	Hydro-carbon
LNG	-162	440	50	12,50	22 000	Cryogenic Atm./Low pressure	Mainly CH_4
LPG	-42	490	46,4	12,90	22 740	Amb. or Cryogenic/ Atm.	C_3H_8
Liquid ammonia	-33,3	653,1	18,6	5,17	14 100	Ambient High/Atm. pressure	NH_3
Methanol	65	780	20	5,56	36 700	Ambient Atm.	CH_3OH
Biodiesel	>130	875	37,27	11,80	32 375	Ambient Atm.	

Source: NCE Maritime Cleantech

we expect it to increase very significantly."

The sum of ships able to use LNG, LPG or methanol is anyone's guess, as their fuel type when built is unknown and because, Chryssakis says, "These are all dual-fuel vessels, so they can run on fuel-oil and they can run on LNG."

When LNG prices are high, as now, vessels could switch to HFO or MGO because they can.

"LNG will offer them benefits in terms of carbon-emissions, so they will keep getting better carbon-intensity ratings from the IMO," Chryssakis says.

"So, from 2023 (a ship's first CII), they will have a different incentive for running LNG (as from 2024 they need to show a 5% improvement over 2019 levels and 2% each year to 2026 to meet the IMO's carbon target). Many of these vessels were ordered in the last two years and they have not been built yet. They're being built as we speak. They'll arrive this year, next year and in 2024, and that's when we expect The Year of LNG."

By 2025, DNV sees the LNG bunkering market rising to about 6 million tonnes per annum, or about 3% of the marine fuel market. Ships are being ordered with LNG as their primary or dual companion fuel.

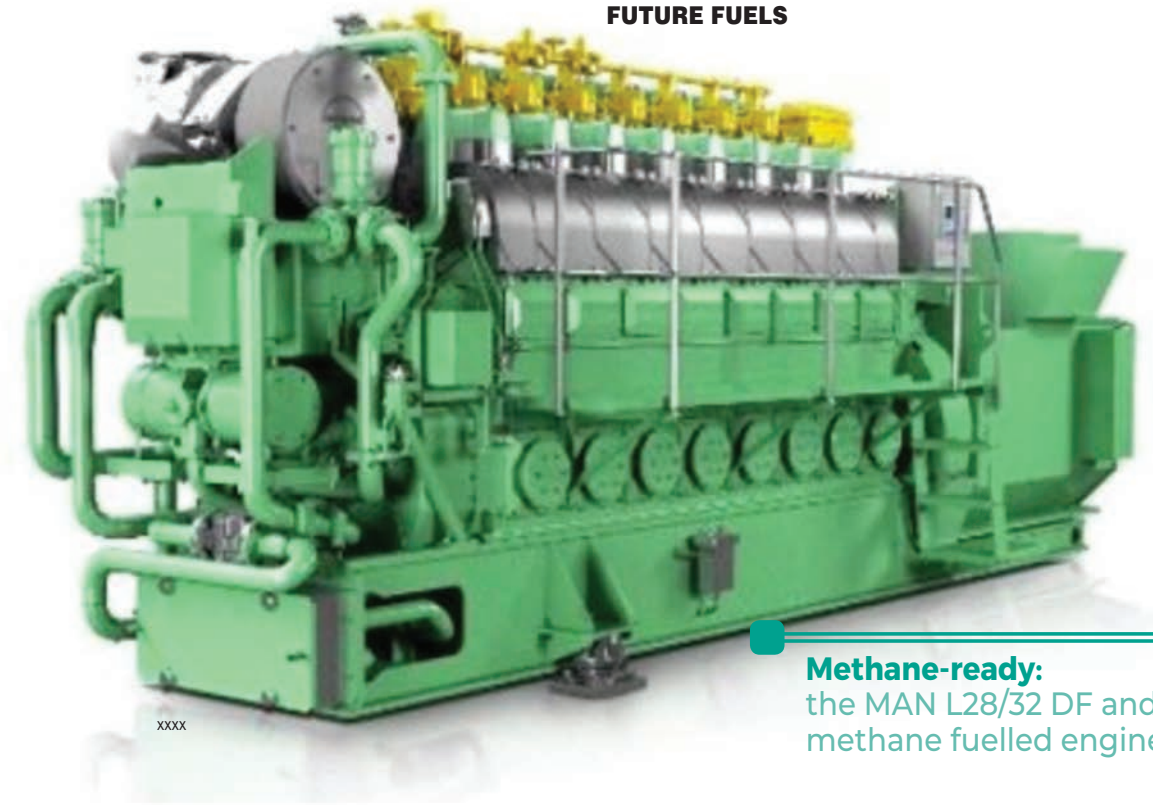
Shell LNG alone, with 50 LNG carriers chartered, has 700 ship-to-shp bunkering operations available to serve the 250 LNG vessels of size in operation and the 400 LNG vessels on order through to 2028. Already 30% of new vessel orders are said to be LNG-fuelled. Half, Shell says, are cruise liners, a third container ships and new car carriers "almost exclusively LNG-powered".

Methanol (CH3OH)

As 2021 ran its course, Class began seeing "increased interest in methanol," and OEMs began looking at its energy density of 36,700 MJ/m3, a close MGO match

Engine maker MAN is working on a number of engine types, and 2023 should see one that can run on methanol or diesel. Company exec, Thomas Hanssen, says 2021 saw "a massive order uptake of ships not using bunker as fuel", or at least not as an only fuel. He says dual-fuel has come to stay "for all segments," especially for powering smaller-bore gen sets and supplying electricity to avoid the dreaded "black ship at 2 a.m.".

Courtesy BW LPG



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Methane-ready:
the MAN L28/32 DF and L23/30 DF methane fuelled engine.

Courtesy MOL

No emissions methane oxidization on a MOL design

One of 15 LPG retrofits the VLGC

Methanol's combustion performance "might not be best-in-class", he says, but it does allow priority to be given the electrical supply in a MAN-made engine. MAN execs note that four-stroke RPMs are "10-times faster" with methanol, so you need more fuel in the combustion chamber — and a larger chamber.

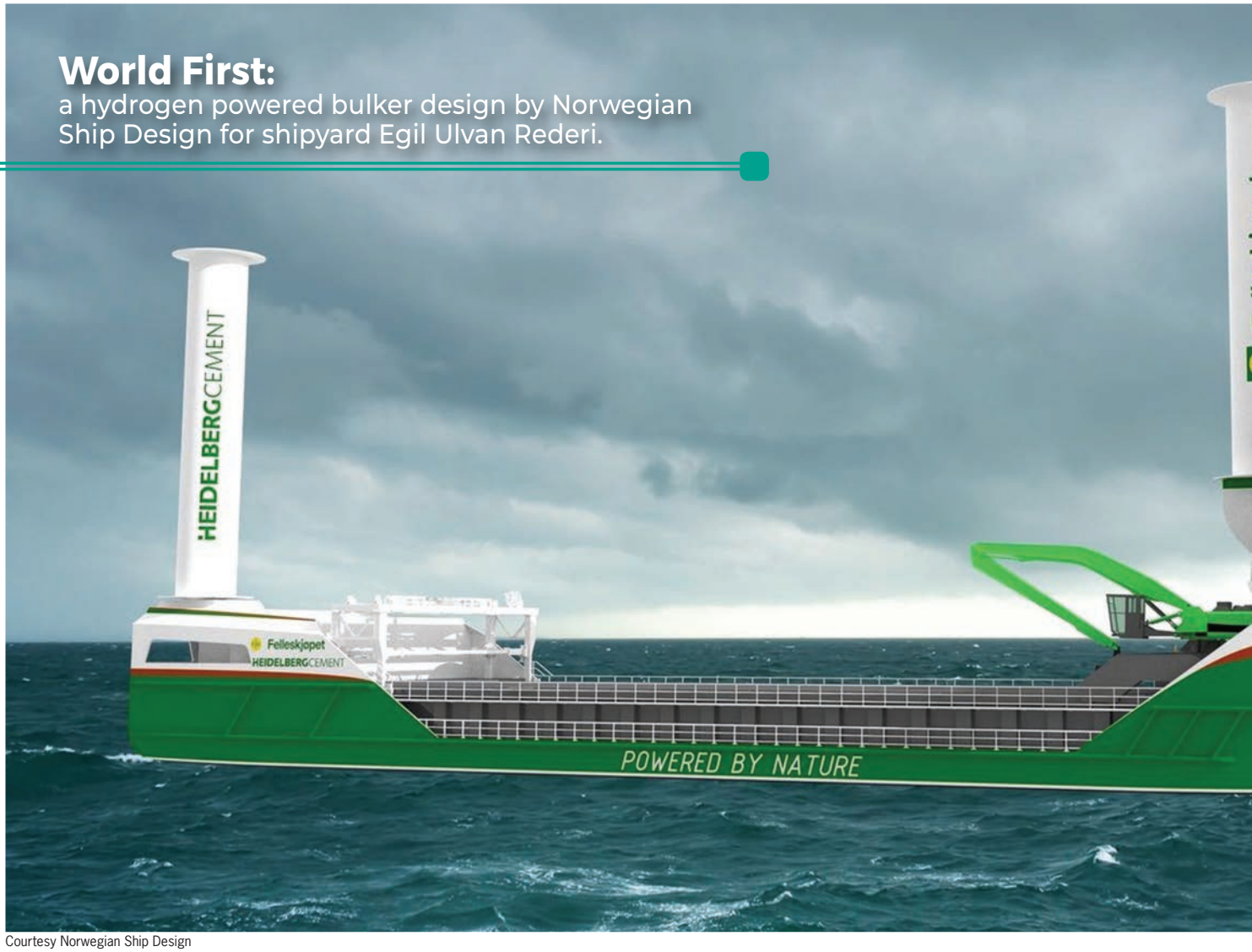
Challenges

Chryssakis says methanol has benefits, especially for crews. "From among all of the alternative fuels that we have, it's the one that's easiest to handle," he says, adding that "the CAPEX or investment for a vessel is relatively low because you don't have cryogenic or pressurized tanks".

Methanol might need more space than LNG for plant and storage, up to two-and-a-half-times more space than with fuel oil, or about what LNG needs. But, apart from room, "The main challenge is how do you produce green methanol, and if we're going to have enough green methanol when we need it, and of course at what price," the DNV expert says, a nod to the stated aim of getting methanol from renewables. Those ordering vessels with methanol-capable engines today are "trying to secure green methanol production, and what we see in general is that potential producers are trying to understand what the demand will be. So, I think it's the chicken and the egg story we had with LNG—producers are not certain about the demand, the ship owners are not certain about the supply."

DNV confirms, however, that ship owners and potential suppliers of methanol are talking volumes and filling locations. Owners know methanol will be pricier but that it'll be inline with other greener fuels. In some segments, like container shipping, charterers are seen paying extra knowing that, "In the medium and long-term, we're going to have regulations that will ask for less carbon in fuels."

In August 2021, Maersk ordered eight green methanol fueled ocean-going vessels to be delivered from Q1 2024. They also invested in WasteFuel, another California start-up mak-



Courtesy Norwegian Ship Design

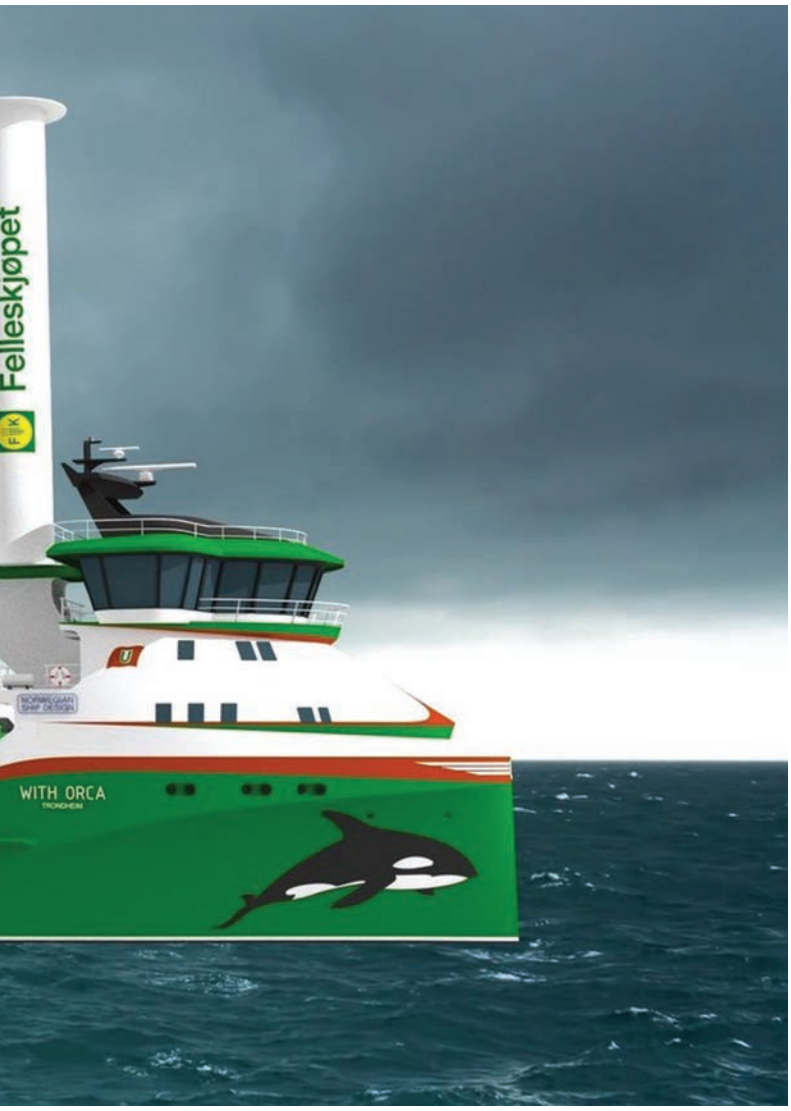
ing greener bio-methanol from waste. Waterfront Shipping also declared CH3OH "safe and reliable" before ordering six clean product tankers of 84,000 dwt.

Ammonia (NH3)

New regulations, including EU 2030 "carbon-neutral" goals set to be added to, pave the way for the anticipated use of ammonia, at least for some types of shipping.

The Continent, led by Germany, Sweden, Finland and Denmark, are putting government money into ammonia-burning programs. Leading those efforts are OEMs Wärtsilä and MAN, as they endeavour to get the most of NH3's specific energy (18,6 MJ/kg) and its lower CI measure, which is 50 % lower than for fuel oil. Wärtsilä is coordinating an EU-funded project to kickstart ammonia engine development, and the Danes of MAN are compiling the parts list ammonia engines will need.

The Wartsila-led project, Ammonia 2-4, picks up on earlier ammonia-as-an-additive combustion tests in a drive for engine concepts. As with hydrogen — the production of which is key to extracting volumes of "green ammonia" — "A powerful consortium of shipping stakeholders" wants two-stroke and four-stroke marine engines to run on the toxic gas. Ship owner MSC and Italy's National Research Council are involved, and 10 million euro in Horizon Europe research cash is in place.



Euro test bed

Ammonia is described by Wärtsilä Marine Power research GM, Sebastiaan Bleuanus, as "a main candidate in shipping's search for future fuels". Despite its hazards, engines have been run on blends of "up to 70-percent" ammonia. By 2023, a pure ammonia engine is expected.

While DNV is partner to the project, Chryssakis admits ammonia "is not ready yet". Meaningful interest in the fuel was shown from 2021, but "a lot of discussion about ammonia" has yet to translate into new engines. "We expect the first engines to become commercially available from around 2024," he says, acknowledging that the engine makers will decide. "There are still a lot of questions to be answered in regards to safety, and we're working a lot on that by assessing different designs."

MAN management in late March affirmed the DNV view, saying "Ammonia is more long-term. It's all long-term, longer-term than hydrogen".

Ammonia-aware

Modifications to engines for ammonia would have to cover a "different combustion process"; unique viscosity, including "hidden lubrication issues"; multiple and/or larger injectors due to lower energy density; more fuel in the combustion chamber and abrasiveness. "These fuels can be very aggressive," a MAN exec says, adding, "Stainless steel is needed. Engine electrical would need new parameters of control. Special welds. Piping …"

As with methanol, the availability of "green ammonia" is, for now, a curb on EU ambitions. "The ammonia we have today is not green," Chryssakis says. "It's produced mainly from natural gas. So, in order to produce the green fuel, we need to produce it from green electricity. Investments point to "two to three years" for its availability. He sees 2025-2030 becoming a test-period "similar to what we saw with LNG back in the early 2000's".

By 2025, DNV envisions a handful of vessels. "By 2030, we'll be testing the technology, we'll be testing the operations, we'll be testing the bunkering infrastructure, and if everything seems to be working well, and we build confidence in the industry, then I think it'll be around 2030 when ship owners start ordering ammonia-fuelled vessels."

One Nor-Shipping delegate confided that even if the industry gets it right, ammonia will never be trusted for passenger

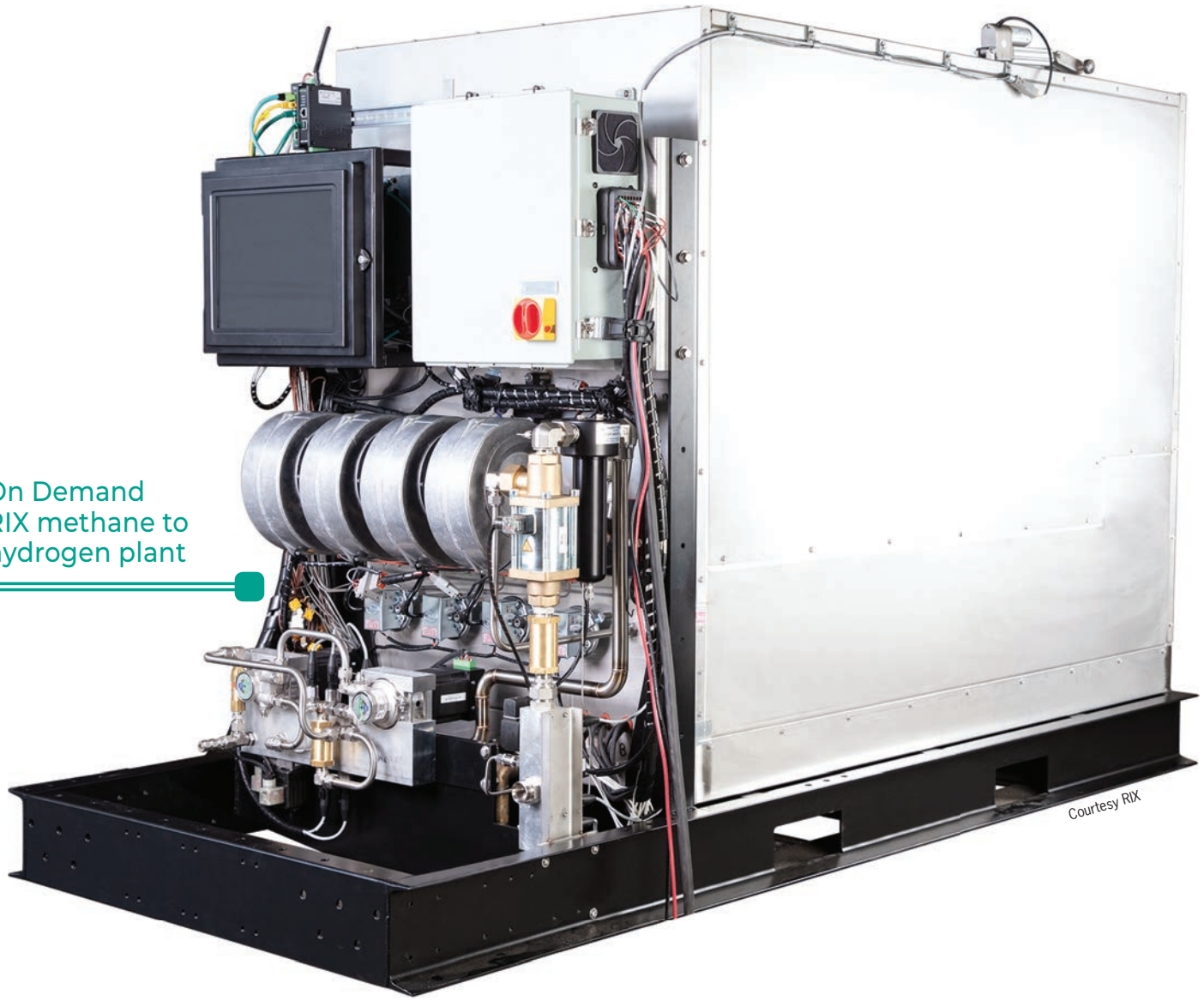
vessels. Chryssakis, too, admits "we should not underestimate it" as we endeavour to get ammonia right. That includes refuelling, and Class is involved in studies of port-area bunkering (as at Singapore's new Global Maritime Decarbonization Center).

Hydrogen (LH2)

Liquid hydrogen has its detractors, and not just for its low energy density of 8,500 MJ/m3. Opponents of the gas or its liquid variant will be vocal when it comes to passenger shipping. It will always be linked in the human psyche to flaming air ship disasters and the hydrogen bomb.

Its proponents look to the expected 2025 "launch" of an array of vessels, although it is "not considered a prominent fuel for larger merchant marine vessels", one expert says. The "launch" is associated with commercial quantities of green methanol and green ammonia derived from hydrogen. "We expect that (development) to play a significant role" in the uptake and engine development for all three of these linked fuels, he says. So, while hydrogen-fuelled four-stroke engines with gen sets are not yet on-order en masse, there is evidence and an expectation that hydrogen from electrolysis and hydrogen from natural gas is about to be more abundant.

"Tell them we have a hydrogen engine," says an Anglo-Belgian delegate to NorShipping 2022 — "and an LNG one". Indeed, the thing about hydrogen is its similarities to running LNG (lots of "plumbing"), and so the EU has had little difficulty forming the giant Hydrogen Europe consortium of companies. Pilot projects abound.



On Demand
RIX methane to
hydrogen plant

Courtesy RIX

EU rules

The EU view on hydrogen includes a focus on fuel cells and a belief that the gas makes possible "the large-scale integration of renewables". European hydrogen takes aim at net-zero 2050 by injecting more of it into heating gas; more of it from natural gas and more of it from the electrolysis of water or made into "synthetic methane" for the grid.

Proponents of green hydrogen admit its Achilles heel: massive amounts of electricity for the electrolyzers that zap it from methane or water.

European rulemaking calls methane "green" only when it powers hydrogen's electrolysis! Still, the EU wants 7 % of natural gas to be replaced by hydrogen by 2030 and 32 % by 2040. Hydrogen is to make up half of all available gas by 2050.

With 110 companies, including OEMs and research outfits, the European Commission's Fuel Cells and Hydrogen Joint Undertaking expects the marshalling of resources to yield H2-derived "synthetic methane" and electrolyzed hydrogen with its own Guarantee of Origin.

Call it low-carbon hydrogen, as ExxonMobil calls the gas from its new Baytown, Texas hydrogen refining operation, where 1 billion cubic feet per day of H2 will be captured from natural gas. The CO2 in Texas is 95-percent captured and stored underground. Will the EU allow shipboard hydrogen from Texas under its GoO plan? Or, H2 from Norway?

First projects

Hydrogen buses have been around in Norway since 2012, and back in 2003, this writer wrote that each bus would require 40 kg of H2 to travel 400 km. The grid had to supply a negligible 5 kW/h of electricity. That was the theory.

Then in 2018, the IMO pledged to cut greenhouse gas emissions 50 percent by 2050 with the first near-shore and oceangoing projects earmarked to make hydrogen a marine fuel. Fast ferries, an EU project, is also one of several Norwegian ferry projects that involve cooling hydrogen to -253 degrees Celsius.

"Nothing can compete with hydrogen for energy density (or specific energy)," a SINTEF researcher once told this writer, adding, "The challenge is to pressurize it. The containment gets heavy."

The pandemic delayed Oslo's advance from those first ferry tenders (Norled) that saw hydrogen handling and storage placed topsides. New projects, however, now include a variety of vessel types with new storage solutions.

European electrolyzers

Elsewhere in Europe, France-based Air Liquide expects to triple earnings to 6 billion euro by 2035 via EU projects aimed at getting the supply chain to produce 3 GW in electrolyzer capacity for the production of euro hydrogen.

Some do see hydrogen as ideal for long-range marine traffic, despite the energy required to liquefy hydrogen gas. For shipboard use, more liquefaction processes are said to still be needed, although SINTEF, Shell Hydrogen, Linde Kyrotechnik, WEKA, TU Dresden and Kawasaki Heavy Industries have succeeded in slashing the energy needed to make hydrogen fuel. In fact, Shell started producing "green" hydrogen in January 2022 and then assumed ownership of the Suisio Frontier, the world's first liquefied hydrogen carrier, or LHC. Unlike LPG and LNG, no hydrogen-bunkering as yet exists.

The project is understood to have proved that hydrogen from natural gas carbon-capture processes might make the most sense volume-wise, "green" or "grey".

H on-demand

The answer to complicated cryogenic storage temperature requirements might be "hydrogen (from methanol) on-demand", a conversion process offered by RIX Industries of California.

RIX offers a containment system that produces "a steady stream of high-purity hydrogen when and where needed". In combination with PEM fuel cells, megawatts of power are provided by a different onboard layout. "Instead of a traditional engine room, new ship designs may include a reformer area featuring a primary methanol-to-hydrogen system," the company says, adding, "Capacity can then be extended by capitalizing on small spaces across the ship for additional reformers and methanol tanks."

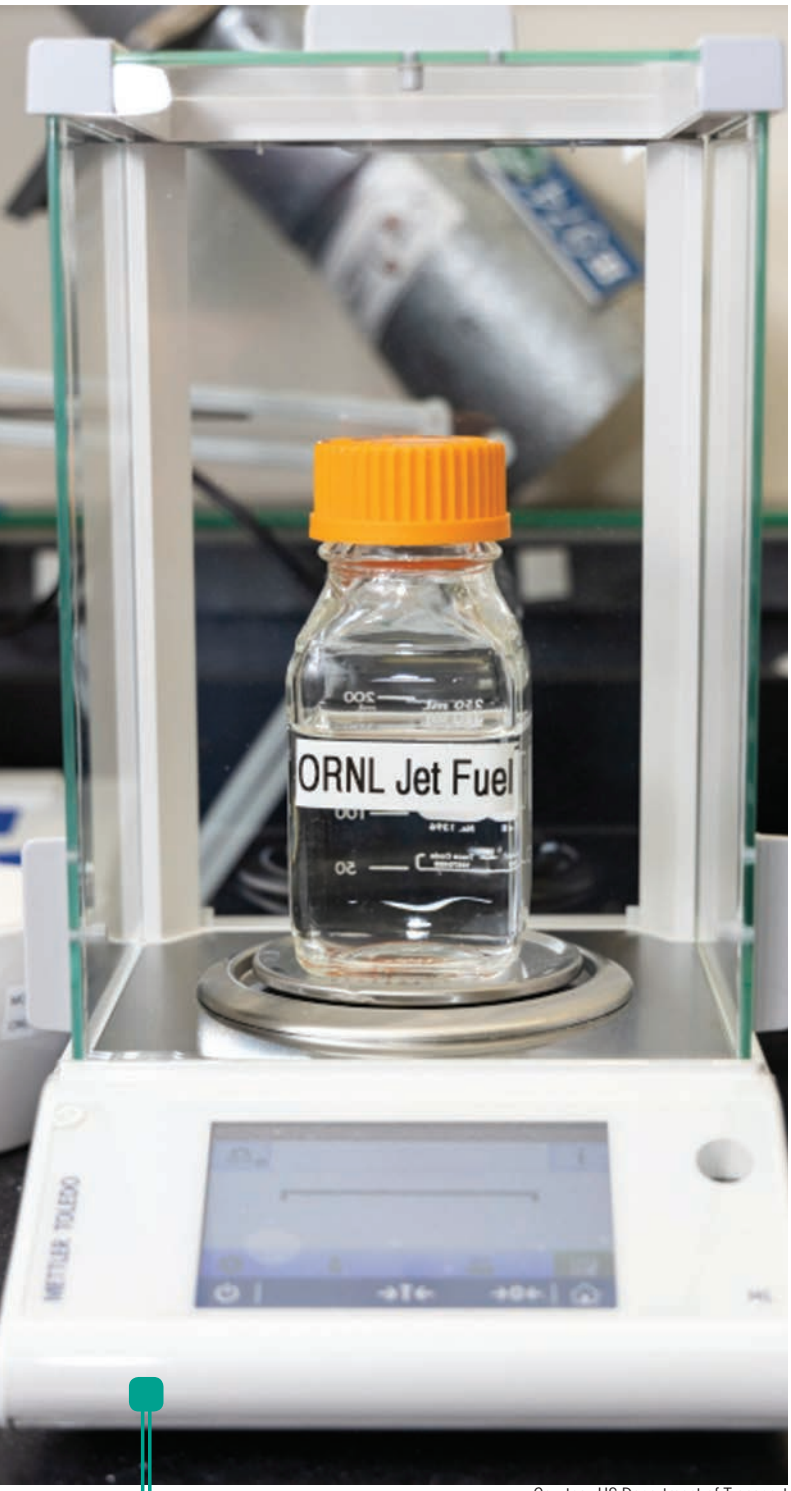
Brilliant-sounding, the EU might frown on the methanol-to-hydrogen loop, as Europe appears to be favoring methanol-from-hydrogen. Its planned Origins certificates might be a hinder. Yet, RIX appears to offer a retrofit not available in Europe. "No major retrofit of ship infrastructure is necessary to employ hydrogen-on-demand," RIX says, adding that cleaned diesel tanks can store liquid CH3OH.

LPG (C3H8)

Of all the alternative fuels, liquefied petroleum gas offers the longest range for its "higher-octane rating and efficient combustion", the World LPG Association states. LPG engines, it says, get "higher compression ratios resulting in more power and better fuel efficiency".

They point out that a slew of engine makers — Caterpillar, Wärtsilä, Niigata, Yanmar and MAN — offer low-speed and medium-speed engines of up to 1000 rpm that operate on diesel fuel or HFO by injection and are "compatible with a range of fuel sources", including LNG, CNG and LPG.

While diesel-mechanical and diesel-electric drives of from 1,020 kW to 16,000 kW (21,760 bhp) abound, the Wärtsilä 34SG-LPG is the first medium-speed engine capable of running on LPG. It is also the largest engine running on LPG on the market, the Association says. The LPG engine is not a new type, but the Wärtsilä 34SG is optimised for propane. Objec-



Courtesy US Department of Transport

Limitless feedstock:
fuel derived from methanol and air.

tions to propane appear to revolve around its sulfur content, which since Jan. 1st, 2000 has had to be 0.5 %.

As Europe's ports now demand no VOCs, LPG would seem to be the answer for being "non-toxic" if spilled, unlike oil and gas.

US ports

"There has been keen interest in (LPG), but this is only in LPG carriers," Chryssakis notes, adding, "We have not seen any other vessels taking LPG."

LPG, or propane-butane blends, is at the heart of some decarbonization efforts. LPG even inspires hope in hydrogen proponents for looking like it'll have "the same containment".

In March, the U.S. Department of Transportation released $450 million in funding to cut port greenhouse gases. LPG is described by the Department as "an available clean, powerful, dependable energy option". The money is "for refueling infrastructure", as LPG in the Act is "an emerging alternative energy source" to be used in U.S. "alternative fuel corridors" powering generators that recharge electric vehicles and, logic dictates, battery powered vessels. The Government asks suppliers to submit applications for their clean port ideas to grants.gov (by May 16, 2022).

Marine promise

In Brazil, and among the national oil companies, LPG is promoted as "likely to take over the marine fuel market" by being "clean, energy-efficient, portable" and affordable. It's the developing world's go-to fuel.

NOCs see LPG fulfilling the IMO's 2050 regulation calling for a 50-percent cut in greenhouse gas emissions (understood to be carbon-dioxide). Sourced from gas and oil, LPG's distribution and bunkering infrastructure — over 1,000 storage sites and 700 smallish LPG carriers — has been around and can be grown cheaply, as under the Biden plan.

The World LPG Association supply side guide notes that LPG emits 20 percent less NOX, 97-% less SOX and 24 % less greenhouse gas, along with 90 % less particulate matter (of interest in the Arctic). LPG is cleaner than heavy fuel oil (HFO) and at 300 MM tpa, LPG is plentiful. No cryogenic tech is needed, so CAPEX payback is quicker.

Finally, there's no end to LPG engine designs, dual-fuel companion options, hybrid drives, conversion options. Even a tri-fuel propulsion option that ignites diesel first is on-hand. LPG appeals to a whole slew of vessel types, from VLPG carriers to outboards and inboards.

Biodiesel

Running auxiliary engines on biofuels is usually what is meant by dual-fuel shipping, but the slow uptake of these energy stores at sea has been puzzling.

"We've had biofuels since the 1990's," says MAN's Thomas Hanssen. "You can select your engine with minor modifications to make it run on biofuels." With diesel shortages widespread before the Ukraine War, it has made sense to run small-bore, four-stroke engines on synthetic diesel or biogas (LNG-mixes), and to upping volumes of these stores. More engine types make more sense.

At 875 kg per cubic meter, biodiesel is about as dense as any other fuel, if nearly twice as heavy as LPG (490 kg/m3). On the energy density chart, biodiesel compares favorably with methanol and marine gas oil (MGO) but is only about as third as energy dense as LH2 (11.8 kWh/kg vs 33.3 kWh/kg). No cryogenic tanks are required, and an outfit like Light Structures can provide sloshing and other strength-vs-volume structural data to help design a vessel. "You can't just measure the frequency of sloshing events, you have to measure the severity", company CCO, Terje Sannerud says.

In Norway, biodiesel is seen as the most promising replacement for MGO or bunker oil. Additives come from agri-residues, woodchips and other fatty waste (up to 7 percent). There's no reduction of CO2 with biodiesel. It's just "carbon neutral" for using gases that would circulate if not in fuels. The EU says the "the lifecycle perspective" equates to a 50-percent emissions cut over regular diesel(!)

Efforts to expand biodiesel production are complicated by the need to transport agri-content by truck.

Electro-fuels (e-fuels)

The end of this fuels report begins with what might be the future of biofuels. Electricity prices willing, e-fuels made from "green" electricity and captured CO2 look promising. Already, around the world, public and private investments have been made in forward-looking start-ups making exciting claims.

In Norway, and elsewhere, car maker BMW has taken an interest in US e-fuels start-up Prometheus Fuels, only to see its investment pack-up and move north along the coast from southern Norway, where electricity prices are sky high (up 100-fold from pre-cables-to-Europe levels). BMW's investment in CO2-derived gasoline involves a filtration system the US-based Prometheus that separates the greenhouse gas using water and electrical power. Already Prometheus has licensed the tech to others, including in Norway, for its process converting biomass-derived ethanol to "net-zero carbon gasoline" and jet fuel.

In September 2021, Maersk Growth invested in Prometheus' obvious upside for direct air-capture technology sure to enter the energy transition's fuels mix. The shipping giant says e-fuels and synthetic alcohols made from renewable energy have "long-term scalability advantages (as in the limitless feedstock of air) compared to biobased fuels".

(Technology) HEART & *(Maritime)* SOUL

Photo courtesy Greensea Systems

"Death by a thousand cuts" is not generally used in a positive connotation, but when looking at the decarbonization mountain ahead, it is an apt analogy as there is no single solution that exists today, rather the cumulative work of thousands of modifications and innovations. The challenge ahead has and will continue to spawn innovators, such as ***Ben Kinnaman****, founder and CEO of Greensea Systems and its recent spin-off, Armach Robotics, driven by a mission to make maritime operations cleaner, greener and more efficient.*

By Greg Trauthwein

Ben Kinnaman has a solid foundation in both the maritime and technology worlds, an innovator and technologist at heart who wrote his first computer program at the age of 8, earning an undergraduate degree in Computational Physics and eventually earning his Master's Degree is in Mechanical Engineering through Johns Hopkins' Robotics and Control program. But he is also a 'maritime guy' in his soul, growing up on the Outer Banks of North Carolina, his first job at 13 working on fishing boats and sailboats, working too as an offshore and deep ocean salvage diver. Kinnaman is the founder and CEO of Greensea Systems, a software architecture firm headquartered in Richmond, VT about 15 years ago, developing technology that addressed the relationship between man and machine, integrating disparate technologies into a common operating platform, "ultimately making the operator's job a little bit easier and a lot more effective."

His company has grown by leaps and bounds, and earlier this year he launched Armach Robotics, subtly touted as "The Future of Ship Hull Maintenance," a Robotics as a Service model that melds advanced software, intelligence, robotics and navigation.

Armach Robotics is Born

Greensea Systems is a software company known for its software platform on ocean robotics primarily, but also known for its unique navigation and autonomy solutions. The latter is a core key to the Armach Robotics solution, as Kinnaman contends that keeping a ship's hull clean via robotics is not necessarily a mechanical solution, rather a navigation solution.

"A few years ago we started a program with the Office of Naval Research (ONR) developing a very accurate navigation solution for robots transiting on a ship hull for the purposes of proactive in-water cleaning the hulls," said Kinnaman. "ONR was a pioneer in the development of proactive in-water grooming of ship hulls back in the early to mid-2000s. This requires the insurance of a 100% coverage of the hulls, and to be really effective and efficient, it needs to be a robotic solution; and you can't field an autonomous robotic solution unless you have an accurate navigation solution. We have an accurate navigation technology (created working in partnership over many years with ONR). The more we began exploring proactive in-water cleaning, the more opportunity we saw."

To be clear, Greensea is not a robot manufacturer; Greensea is also not a service provider: Greensea develops software

The Armach Robotics Team


John Dunn


Rob Howard


James Truman


Alex Kern


Karl Lander


Harrison Gardner

"Team and culture is everything to me. It's critical to the success of a company, it's critical to our enjoyment of our jobs," said Ben Kinnaman, who had hand-picked the management team for Armach Robotics, including:

- **John Dunn, VP of Operations:** "John solves problems, he outworks things."
- **Rob Howard, VP of Growth and Strategy:** "He knows everybody in the industry; he knows the trends in the industry; he knows the industry from the robotics side."
- **James Truman, VP of Engineering:** "James and I have worked together since the early to mid-2000s, he and I were in graduate school at Johns Hopkins together. James and I have built a lot of robots almost two decades."
- **Alex Kern, Director, Sales & Marketing:** "Alex knows how to sell internationally and brings a lot of enthusiasm and energy."
- **Karl Lander, Senior Program Manager:** "He was the program manager (at Greensea) that led the hull navigation and technology development. He was interfaced ONR."
- **Harrison Gardner, Robotics Engineer:** "Harrison had been working at FIT, which was the academic pioneer of proactive in water cleaning."

"What we are offering ship owners is a very simple product: a constantly clean hull for a basic subscription fee. *But they also receive intelligence on the hull. After we clean we're able to produce a data product that is a geo-referenced and accurate. So, we are not a robot provider. We're not a service provider. We are a clean hull provider and we do that through a subscription method."*

solutions, partnering with other manufacturers that build robots to generate a path to market. But Kinnaman said when he went to commercialize the hull cleaning solution that he envisioned, "we couldn't find a manufacturer or a vehicle partner that was ready to achieve the level of potential that we saw. So, we spun the technology out of Greensea into a new entity called Armach Robotics, which is going forward with a complete, proactive in-water cleaning solution for ships and ship hulls based on autonomy, data fusion and intelligence."

Armach Robotics is a Robot as a Service (RaaS) company, aiming to provide resident vehicles to ships, resident vehicles to ports and harbors and vehicles to establish service providers on a monthly subscription basis.

"What we are offering ship owners is a very simple product: a constantly clean hull for a basic subscription fee. But they also receive intelligence on the hull. After we clean we're able to produce a data product that is a geo-referenced and accurate. So, we are not a robot provider. We're not a service provider. We are a clean hull provider and we do that through a subscription method."

Advancing Technology

While much of the focus tends to fall on the mechanics and machinery, Kinnaman is adamant that solving the clean hull conundrum rests with the navigation system that service as the heart, soul and central nervous system of the machine. "It's all about navigation, because if you don't have navigation, you don't have anything," said Kinnaman, saying that lack of accurate navigation results in undo wear-and-tear on coatings, with systems overworking the coating, using very large systems or cleaning reactively, not proactively.

"With an accurate navigation solution, we can enable a small, efficient robot that's going to cover 100% of the hull. It can a fully autonomous, so we get the diver out of the water. And if you have an accurate navigation solution, you also have a data product," said Kinnaman. "There are a lot of solutions in the field claiming hull survey, thickness survey, NDT coating surveys, but there's no navigation solution. So, I really question the quality of the data if you don't know where the data was taken on the ship hull. So, it all comes down to navigation. We approach this problem entirely from a navigation perspective; if you know where the robot is on the hull, you can assure 100% coverage."

The result is a continuously cleaned hull, optimized for performance, helping to minimize fuel burn and emissions.

"We maintain ship hulls today almost exactly like we maintained ship hulls when we first started sailing the oceans: we coat them with a toxic substance, we put divers in the water to scrape them clean and when the coating wears out, we haul them out and re-coat them," said Kinnaman. "There's a more intelligent way of maintaining hulls. By applying intelligence, by applying navigation, by applying autonomy, by applying data fusion and the use of robotics, we can maintain these hulls in a more efficient and more productive manner. So, we're using brains over brawn here." The cherry on top is the resulting data product, allowing ship and fleet managers to more closely monitor hull condition and act proactively, instead of reactively when and if a failure occurs.

The Value Proposition

Saving the planet provides nice headlines, but in the case of shipowners, money talks, and in fact Kinnaman suggest that there are five clear value propositions to Armach Robotics RaaS solution.

1. Fuel Savings: If you have a clean hull, you have less drag going through the water, it takes less fuel to move that ship. You're going to have a very clear fuel savings benefit, with estimates ranging between 10-20% of fuel savings by maintaining a clean hull.

2. Operational Efficiency: If you can clean on your terms, and if you can maintain your hull on your terms, you are going to realize increased operational efficiency. You can clean anywhere, anytime you can maintain your hull and you know proactively the condition of your hull. Maintenance on your terms.

3. Maintenance Cost Savings: If you're maintaining and cleaning the hull, you're going to save money on maintenance costs an extend the life of your coating.

4. Fleet Readiness. If that ship hull is clean and if the process of maintaining that hull is done within the normal day-to-day cycle and transit cycle of the ship, the ship is going to be ready for deployment more often.

5. Environmental Benefits: Kinnaman calls this "the fifth, final and perhaps most significant benefit. With a clean hull, we require less fuel to push the ship to the water, which means reduced carbon emissions. In fact he cites this as the number one motivator for him, personally, is the ability to provide a meaningful change in the impact shipping has on the environment.

While predicting the pace and direction of any company, particularly a start-up, can be perilous in the best of time, Kinnaman is confident that Armach – grounded in a solid technical core matched with regulatory mandate and market demand – is "well-positioned to be the leader of a paradigm shift in industry.

"We're at the very beginning of realizing the benefits of proactive in-water cleaning and survey," he said. "The reactive methods of maintaining ship hulls is changing, and I think that we're seeing decisions that are going to start being made by data and by intelligence versus reaction. I think five years from now, we are going to see proactive, in-water cleaning as a default method of maintaining hulls. I think that ships engineers and stakeholders and asset owners are going to be maintaining and making decisions based on the data. And five years from now, Armach will be the leader in this concept, will be the leader in hull data, we will be the leader of in-water proactive and water cleaning."

Coated for the Long Haul

By Matt Heffernan, Sherwin-Williams Protective & Marine

With protective marine coatings, a little extra insurance can go a long way. That may mean applying thicker coats or specifying more durable coatings to get you more time at sea and longer intervals between maintenance drydockings. And that's exactly what Biblia Marine Towing and Transportation did when it specified protective coatings for The Providence, a new 500-ton lift capacity floating dry dock the company had built for its operations in Savannah, Ga.

The Providence is a 120 x 60 ft. floating dry dock that Biblia will primarily use for hauling tugboats, including its own fleet and other vessels navigating local waters. It will replace Biblia's existing dry dock and serve as a primary means for pulling vessels out of the water for repairs. With the dry dock being a critical part of the company's repair and maintenance services for its own tugboats, as well as a money maker when transporting other vessels for similar service, Biblia wanted to maximize uptime for The Providence.

Looking for some added insurance to protect this lifeblood of its operations, Biblia specified an edge-retentive, ultra-high solids epoxy amine coating system from Sherwin-Williams Protective & Marine that's fit for the U.S. Navy. In fact, the coating – FastClad ER – has been a Navy staple since 2004. Yet, it had not yet been used before in the commercial marine industry as many shipyards and vessel owners considered the technology to be overspecified. These parties are used to the five- to seven-year maintenance intervals realized with traditional coatings. However, FastClad ER offers a 15- to 20-year service life – triple to quadruple that of traditional coatings – making it an excellent choice to meet Biblia's goal of extending maintenance intervals and minimizing downtime for The Providence. With the coating meeting Biblia's longevity goals, the vessel owner specified the coating system to protect its new investment inside and out.

Extending Maintenance for the New Floating Dry Dock

Biblia offers an array of marine services from shipyard repairs to barge rentals and also maintains its own fleet of tugs and barges that perform bed-leveling, dredging and dragging services throughout the waters of Savannah, Georgia; Delaware Bay, Delaware; Charleston Harbor, South Carolina; and Fernandina and Jacksonville, Florida. Stationed near the company's Savannah River facilities, The Providence will primarily haul tug boats with a maximum length of 120 feet and maximum draft of 10 feet. JMS Naval Architects from Mystic, Connecticut, developed a complete engineering and design package for the vessel that meets the requirements of the ABS Rules for Building and Classing Steel Floating Dry Docks. Conrad Shipyard constructed The Providence at the company's Morgan City , Louisiana, yard.

For hauling operations, crewmembers on The Providence fill the vessel's interior 6-foot deep pontoon ballast tanks with river water to submerge the floating dry dock below the vessel that's going to be hauled. After getting that vessel into place between the 14-foot tall wing walls of The Providence and over its submerged deck, operators pump water from the ballast tanks to raise both vessels out of the water. Maintenance crews can then repair the dry-docked vessel right from the deck of The Providence or transport it to a shipyard.

Because the vessel's ballast tanks would be frequently immersed with brackish water from the Savannah River, the design team specified the application of a coating system to prevent corrosion and damage that could otherwise lead to expensive steel repairs and longer downtime during maintenance activities. Traditional systems used to line ballast tanks are two-component, high-solids, polyamine-cured epoxies that offer roughly five to seven years of life before requiring maintenance. With Biblia requesting a more robust system that could offer longer maintenance intervals, Sherwin-Williams suggested the FastClad ER system, which is expected to last 15 to 20 years or more. This time span provides a far longer maintenance interval and will keep The Providence on the water ready to service other vessels in need of repair – and continuing to contribute to Biblia's operating income instead of sitting more frequently in dry dock itself for repairs.

Photos courtesy The Sherwin-Williams Company

Conrad Shipyard constructed The Providence at its Morgan City, Louisiana, yard using steel primed with Zinc Plate Ultra II PCP, a two-component, inorganic preconstruction zinc shop primer.

Systems like the 100%-solids FastClad ER have been predominantly reserved for U.S. Navy vessels where longer maintenance intervals are desired to reduce the overall cost of ownership for vessels. The Navy has had success with the coating, to the point of retiring some vessels with tanks that have outlasted the ships themselves.

"We were not aware of the FastClad ER system prior to this project, but I was not surprised that Biblia was looking for a longer lasting coating system for the dry dock," said David Forrest, P.E., Naval Architect for JMS. "We were happy to look at other coating systems with a track record of increased lifespan."

To help make the case for the more robust coating, Sherwin-Williams compared two approaches, noting that all parties involved would realize significant benefits with the proposed FastClad ER specification compared to using traditional coatings. First, applicators would save two coating application steps, several hours of curing time and all of the associated labor costs with the FastClad ER material. Second, the owner would realize far longer service lives.

Traditional systems require a stripe coat over welds, edges, corners and disturbed areas to build up film thickness prior to applying two full coats at 5 to 7 mils DFT for a total of 10 to 14 mils DFT, with slightly higher thicknesses on stripe-coated areas. Each coat requires time to complete the applications, as well as six- to eight-hour waits between coats. The FastClad ER system only requires one coat – and no stripe coating. It is also applied at a higher total film build of 20 to 30 mils DFT, providing additional protection.

Dialing In Coating Applications

For Conrad Shipyard, the 100% solids coating specification triggered a training opportunity for its crew. Because the shipyard's applicators were unfamiliar with spraying this type of coating, Sherwin-Williams and Graco provided hands-on training at a Mobile, Alabama, Sherwin-Williams store. Company reps helped pump operators understand how to dial in settings to enable good flow and atomization of the thick, ultra-high solids material. Sprayed in one coat at

a higher thickness than traditional epoxies, the material requires more care to ensure proper mixing and that lines and gun tips don't get clogged.

"We did not have experience with this particular system so we had some reservations as to what it would take to apply per the specification. But the learning curve was faster than we expected," said Robert Sampey II, Vice President Business Development for Conrad Shipyard. "The representatives from all involved worked together to get our crews trained up and comfortable with the application."

Pump operators and applicators easily picked up the nuances of working with the 100% solids epoxy, noting how quickly they were able to apply high film builds in a single coat. There was no difference at the gun for applicators in spraying this material other than slowing their passes down to enable the thicker builds compared to when spraying traditional systems. They were also able to touch up coatings quickly due to the product's one-hour recoat window. Inspection timing could also be streamlined, as the coating can handle foot traffic in three hours, which is much faster than the six- to eight-hour wait with traditional systems. These factors all contributed to fast shipyard throughput for Conrad Shipyard.

In addition, to streamline activities, reduce waste and save money, Conrad Shipyard used cartridge systems – featuring the same coatings they applied with equipment – for any necessary repairs or touch ups. The cartridges dispense properly mixed coating material on demand, allowing applicators to make minor touchups without having to mix small batches of coatings by hand, some of which may be wasted if applicators mix too much.

All steel was shipped to Conrad Shipyard already surface prepped to an SSPC-SP 10/NACE NO. 2 near-white metal blast cleaning and primed with Zinc Plate Ultra II PCP, a two-component, inorganic preconstruction zinc shop primer applied at 0.5- to 1.2-mils DFT. Applicators at the shipyard then sprayed FastClad ER directly over the primer after constructing the vessel, building up other coating layers on top as needed.

Inside the vessel's ballast tanks, applicators spray applied a single coat of FastClad ER featuring Opti-Check optically activated pigment (OAP) technology for better quality control. This formulation features an optional additive that provides visual feedback for applicators and inspectors. OAPs embedded in the coating will fluoresce under eye-safe ultraviolet (UV) lighting, allowing applicators to shine a light on the single-coat lining while it's still wet and easily spot coating deficiencies so they can touch them up then. After coatings have cured, inspectors can do the same, easily spotting any non-fluorescing areas that indicate a pinhole, coating discontinuity or thin area. The technology helps increase the likelihood of having holiday-free film builds, while also accelerating the inspection process.

For the exterior of The Providence's freeboard and pontoons, Conrad Shipyard applied a single coat of FastClad ER topped by a high-gloss finish using Sher-Loxane 800, a versatile, high-performance epoxy siloxane hybrid that combines the properties of both a high-performance epoxy and a polyurethane. This high-performance finish will retain the high gloss and radiant color of the vessel's Biblia Blue and Biblia Gray colors, as well as its white logo and lettering. Using this high-gloss finish was important to enhancing Biblia's image,

The deck of The Providence features 14-foot tall wing walls painted in Biblia Blue and Biblia Gray and finished with high-gloss Sher-Loxane 800.

Photos courtesy The Sherwin-Williams Company

Photos courtesy The Sherwin-Williams Company

Biblia Marine Towing and Transportation will primarily use The Providence, a new 120-foot long, 60-foot wide floating dry dock, for hauling tugboats, including its own fleet and other vessels navigating local waters.

as the company operates across the Savannah River from the city's busy entertainment district.

For the underwater hull, applicators again sprayed the FastClad ER system in a single coat at 20 to 30 mils DFT to provide the same additional protective insurance the robust coating offers on the rest of The Providence. Because the hull will be constantly submerged, the use of an antifoulant coating was also warranted. In the spirit of ensuring long-term maintenance intervals, Sherwin-Williams recommended using an epoxy tie coat to provide even stronger adhesion of the antifoulant coating. Applied at 4 to 6 mils DFT, the SeaGuard® Tie Coat gave Conrad Shipyard an extended overcoat window of four days, which meant applicators would not have to retack the coatings prior to applying the antifoulant coating if weather delays postponed applications. Traditional systems would need to be coated with antifoulants within a couple of hours.

For the antifoulant coating, applicators sprayed two layers of SeaGuard Copper Bottom Antifouling Paint #45 at 3 to 5 mils DFT each. This single-component formulation is designed for use on shallow draft vessels that sit for extended periods of time with insufficient movement and friction for an ablative antifoulant coating to be effective. Instead, the coating forms a very hard barrier that prevents marine biofouling from sticking to and growing on vessels. The coating has a moderately high concentration loading of cuprous oxide and a chemically-modified binder that only slightly dissolves upon immersion service.

Biblia's new floating dry dock, along with other upgrades and expansions for the marine services company, were made possible by a $1.3 million grant from the U.S. Department of Transportation that supported improvements at 28 small shipyards across the U.S. The company is protecting the investment of that grant money with the added insurance of the long-lasting FastClad ER coating covering nearly the entire square footage of The Providence.

Self-Indicating Tech: Anti-corrosion Certainty in an Uncertain World

In the months and years before the Covid-19 pandemic, the world was getting used to the idea of reducing its reliance on oil with more focus on liquefied natural gas (LNG). Consequently, shipyards and shipowners responded to the shift by building new or recommissioning existing LNG carriers and storage vessels.

However, reducing dependence on Russian oil and gas from much of the world market – where it was the second biggest exporter of the product – has instigated a greater scramble for alternative suppliers and a corresponding increase in demand for ships able to transport and store gas from all corners of the world.

Indeed, the decision by Germany to cancel the Nord Stream 2 gas pipeline from Russia to mainland western Europe – resulting in an EU-US deal at the end of March for the latter to start supplying billions of cubic metres of additional LNG capacity – is likely to exacerbate demand.

"We were already seeing increased demand for LNGC to FSRU conversions before the recent drastic disruption in oil and gas markets, but demand is now expected to exceed those initial expectations," says Niko Yamanoue, Director, Nippon Paint Marine (Europe).

"We are seeing increased interest in countries considering storage and regas units to supplement and strengthen existing shore-based infrastructure. But irrespective of whether owners build new, recommission tonnage laid up during the offshore downturn or convert existing LNG carriers into FSRUs or FSUs, the performance of the protective coatings specified will be key."

Certainly, the primary consideration for any conversion project is the anti-corrosion coatings used on the vessel's hull, and ballast, fuel and potable water tanks. But if the correct film thickness is not achieved during application the vessel could be susceptible to corrosion and structural failure.

It was for the internal carbon steel tanks and pipework of offshore vessels and installations that Nippon Paint Marine's unique self-indicating NOA60HS coating was certified in 2020 by the Norwegian Technology Standards Institution as meeting the requirements of the NORSOK M-501 standard.

"The NORSOK standards were developed in 1994 by Norway's petroleum industry to ensure protective coatings were suitable in offshore oil and gas environments. The addition of NOA60HS to the NORSOK M-501 approved product range marked a significant development in the structural safety of offshore vessels and installations, such as FSOs, FSRUs and FPSOs," says Yamanoue.

"As floating oil and gas storage facilities are often built to NORSOK standard, we need to offer certified coatings products. These assets are designed with much longer service intervals than conventional vessels, and an effective and reliable long-life anti-corrosive coating is crucial to their safe operation. NOA60HS eliminates the risk of anti-corrosion coatings applied with low film thickness, a contributory factor in corrosion influenced structural failure."

Yamanoue furthers that correctly applied coatings, especially to tank edges and corners, improves the structural integrity of internal spaces, providing greater protection. With NOA's unique self-indicating technology, if the coating appears transparent, then film thickness is incorrect. When it is opaque, the specified film thickness has been achieved.

The special pigmentation used in the NOA (Nippon Optimized and Advanced) range is carefully adjusted to the correct dry film thickness of the system so applicators and inspectors can see immediately if an area meets the specification or needs to be corrected.

Applied in two coats at 160µm per coat, NOA 60HS meets all PSPC acceptance criteria, is easy to clean and has low emissions of volatile organic compounds.

There is also a cost-efficiency element to a NOA application since correct thickness of the film has significant impact on the amount of time a vessel can remain on station and out of drydock, particularly important for static vessels.

A number of LNG carriers are currently operating with NOA 60HS in their ballast water tanks, with Nippon Paint Marine anticipating a rush of new orders as demand for gas ships and conversions heats up.

The same can be said of NOA10F and NOA10M, which the Japanese coatings company developed to protect the outer hull areas above and below the waterline. For newbuilding and maintenance projects respectively, the anti-corrosion paint incorporates the same self-indicating technology as all the coatings in the NOA range.

With an eye to the future use of alternative fuels, Nippon Paint Marine has also developed a NOA system to add greater protection to fuel tanks. NOA PC 700, a phenolic/novolac-based epoxy also approved by NORSOK, is re-

Photos courtesy Nippon Paint

The special pigmentation used in the NOA (Nippon Optimized and Advanced) range is carefully adjusted to the correct dry film thickness of the system so applicators and inspectors can see immediately if an area meets the specification or needs to be corrected.

sistant to a wide range of chemicals, solvents and petroleum products, including those containing xylenes, methyl ethyl ketone, methanol, caustic soda and LSA fuel oil.

Hiro Yamashita, Technical Manager, Nippon Paint Marine (Europe), says: "The addition of NOA PC 700 to our established NOA range significantly protects inner tanks from corrosion while preventing contamination. As with all NOA coatings, application is self-indicating which enables the applicator to visually confirm the correct (wet/dry film thickness has been achieved during the application process."

While a NOA application improves coating quality and helps to reduce man-hours and costs, Yamashita emphasises the importance of NOA in maintaining structural integrity.

"Correct film thickness is crucial in mitigating against corrosion risk to maintain ship structural strength," Yamashita says. "This is becoming more and more apparent with the increase in areas requiring coating and the reduction in the availability of skilled applicators. By improving corrosion resistance through more accurate coating application, offshore units are less prone to rusting early."

While various NOA products have been developed according to the anti-corrosive requirements of different parts of the ship or offshore structure, all the coatings are based on pigments that have various opacities depending on film thickness.

Since the first NOA coating was launched in 1998, some 1770 newbuilds have benefitted from NOA60 HS. NOA10M, however, has been used to repair and maintain the hulls of more than 14,000 ships of all types.

eMachine:
Scania's New Hybrid Marine Power

This is a transcendent time in the marine industry as stakeholders explore new technologies to drive efficiency gains and reduce emissions. At the end of 2022, Scania will introduce its new its new electric hybrid package, eMachine, at the Electric & Hybrid Exhibition.

The hybrid and full electric offering ranges from 150 to 230 kilowatts continuous electric power, with all hardware and intelligence included. "The package we're launching is made for making sustainable solutions easy and accessible for all our customers—current and new ones. The package allows customers to choose the electric or hybrid setup and still always receive our built-in intelligence," said Torben Dabrowski, Global E-Mobility Sales Development Manager, Scania.

The number of hybrid and electric solutions available on the market today is growing, but Dabrowski said Scania's offering boasts several features that make it unique. He described a clutching system that automatically and seamlessly allows the vessel to switch between totally diesel or full electric operations. "Either the eMachine would rev up and clutch into the diesel engine, or the diesel would rev up and clutch into the eMachine," he said.

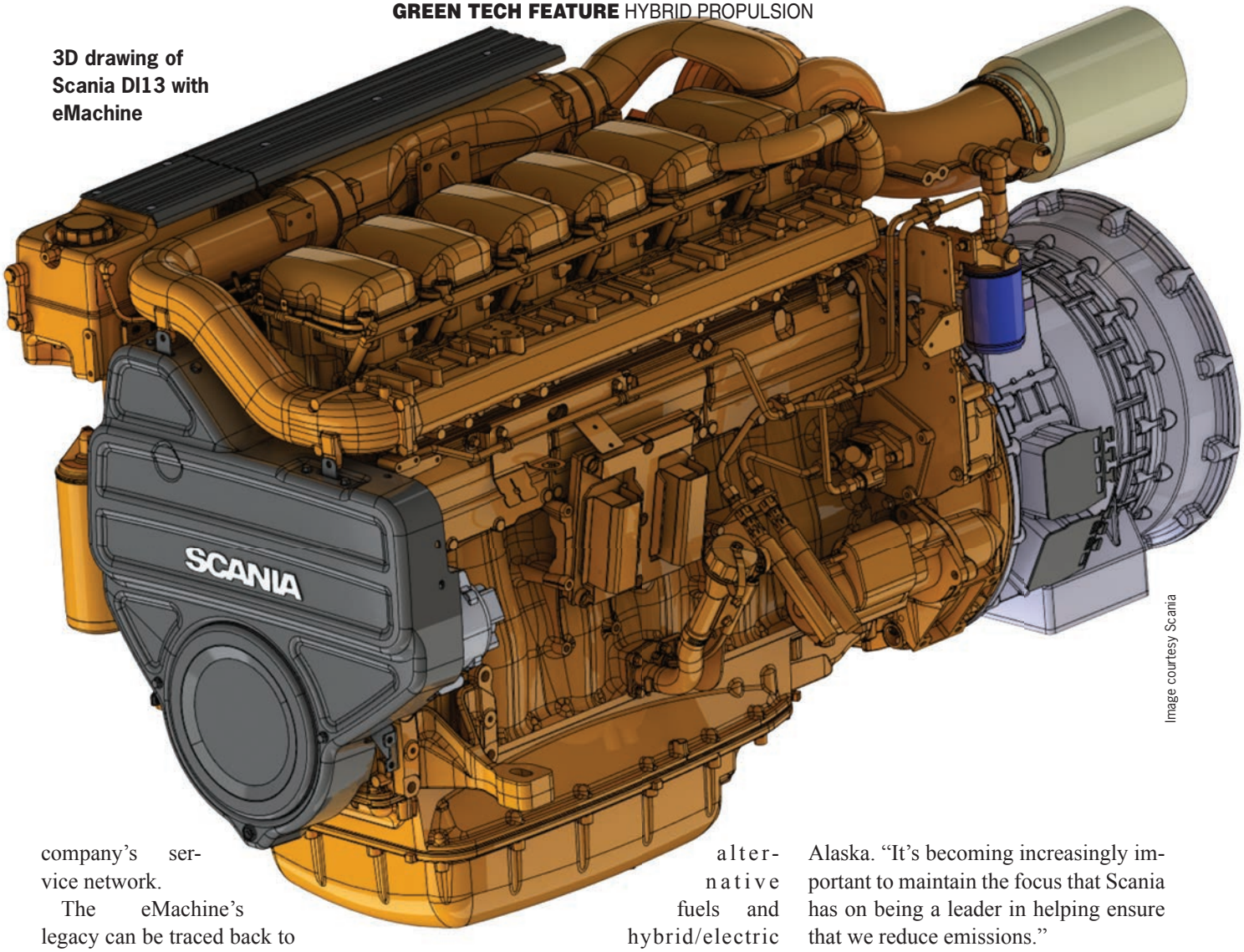
Secondly, the interface is modular and flexible, and it's the same as is used for diesel engines. "So, when we make this hybrid solution as a sandwich, you will have the same interface," Dabrowski said. "With that comes even more good things, like you could add additional eMachines to double to triple the power."

Thanks to these two features, Scania is able to control the entire solution, Dabrowski said. "You'll ask for RPM, or you will ask for torque, and we will make sure that you get that from the most reliable source at the time. You will have a big flexibility, and we will manage everything seamlessly with our power control units."

Dave Hughes, Sales Manager, Scania USA, said, "Many of the current product offerings here in the United States focus on either a parallel or an inline design, and really kind of focus on the redundancy aspect. With the eMachine and the internal clutching and the technology and design that we have, that helps us provide the inline solution while still being able to ensure that the customer is going to have the redundancy should there be an internal problem."

Hughes also noted that the entire package comes from a single source: Scania, which allows customers to better take advantage of the

Image courtesy Scania



3D drawing of Scania DI13 with eMachine

Image courtesy Scania

company's service network.

The eMachine's legacy can be traced back to Scania's truck department. "This helps to very much derive outstanding quality since we're further optimizing products that are already heavily tested and verified since they're used in those applications," Dabrowski said.

There have been others to marinize hybrid and electric products. "An intelligent marine hybrid and electric solution and a product that really has the full insight and the full solution for our customers is something totally different," Dabrowski said. "We're marinizing a solution where we control not only the eMachine, we control the batteries, we control the power electronics and auxiliary equipment, and we manage the whole system."

According to Hughes, Scania's eMachine arrives amid a big push toward alternative fuels and hybrid/electric propulsion in the U.S. He said the company is currently targeting the rapidly advancing passenger vessel market, crew transfer vessels (CTV), as well as eco tour and whale watching tour vessels in places like California and Alaska. "It's becoming increasingly important to maintain the focus that Scania has on being a leader in helping ensure that we reduce emissions."

"Everyone knows that we need to change things," Dabrowski said. "But we still need transport. We just need to do it in a much more sustainable way to be able to sustain our global healthy environment.

Inside WETT Technology for oily and black water Treatment on Ships

*Attracted by the environmental mission of Terragon Environmental Technologies, **Dr. Ramona Pristavita**, Terragon's Vice President of Engineering, discusses the operational advances and advantages that Wastewater Electrochemical Treatment Technology (WETT) offers to shipowners.*

By Greg Trauthwein

Handling a variety of shipboard waste water efficiently, effectively, is a central tenant to ship operations.

Operating in the harsh saltwater environment, with a broad spectrum of ship movements and vibrations, waste water treatment systems on ships at sea must be rugged and adaptive, able to handle a variety of contaminants while requiring minimal crew intervention and maintenance, particularly today as the duties of the seafarer are stretched thin with increasing levels of technological sophistication.

Terragon has spent more than a decade engineering, developing and delivering its WETT family of products. Terragon's patented approach that can be used to treat water for recycle or reuse and treat water for safe discharge. The WETT solution is based on electrochemistry and a design philosophy that eliminates biological treatment, disposable filters and membranes, and the need to add chemical reagents.

The WETT approach is particularly well-suited for: decentralized water treatment; situations with low to moderate flowrates; variable influent loadings and concentrations; highly contaminated wastewater; need for automated and maintenance-free operation; and the need for on/off capability.

"Electrochemistry is a very solid process," said Pristavita, who a chemist by training. "The process is not affected by dyes or certain type of cleaning products. And it's a technology that can be fully automated, that doesn't require so much operator interaction; you don't have to dose chemicals, you don't have to clean filters. It's easy to work with, easy to maintain and, in short, it's plug-and-play."

The WETT line today consists of three main products:

- WETT-O, which stands for oily water or bilge water and
- WETT-S, which stands for sewage.
- WETT-G, which stands for greywater (WETT-G is in the final stages of development)

According to Pristavita, WETT-O and WETT-S have been developed and certified by class specifically for marine applications. "It's state-of-the-art technology, very modern and easy to use with touch screens."

While optimized for maritime, the WETT line-up is equally well-suited and proven for land-based operations. "Electrochemistry is a solid process, so you can use it in different industries for different waste water streams, for greywater, for example, treatment for use in oily water. For example, we have other clients use the same technology we install on ships. It's garages, where the maintenance facilities for aircrafts and for trains. Anyone who's producing oily water for example, can use our WETT-O. The same way with the black water and sewage, anyone who's producing this type of waste waters can use our WETT-S technology."

Inside WETT Tech

Central to all WETT systems is a marinized Electrocoagulation (EC) unit which has been developed over the years to overcome the difficulties that are common to many simple EC units available commercially.

The EC unit has self-cleaning and anti-passivation features. It operates continuously and performs automated contaminant coagulation, flocculation, flotation, separation and removal in a single enclosed reactor. No polymer addition, settling or flotation tanks, or filters are required.

Typically, the EC unit removes about 75% or more of the total suspended solids (TSS) and chemical oxygen demand (COD) present in the wastewater, along with complete removal of phosphorus and heavy metals.

There are two sizes of EC unit available; a smaller one that treats at 1.0-1.5 Lpm, and a larger one that treats at 5-7.5 Lpm. Multiple EC units can be arranged in a parallel fashion to treat larger flowrates than can be accommodated by a single EC unit.

"If you install a WETT-O system, it's going to remove all the contaminants, not just the oil," said Pristavita. "So it's going to remove suspended particles, rust, dyes, nutrients, heavy metals …

everything that it's in there and can be coagulated, it's going to be removed from the waste water and it forms a foamy sludge."

That foamy sludge floats on top of the reactor and is periodically removed. Key to the WETT system is that it does not add mass in the process. "The volume of this sludge is very low. It's about 5% by volume," said Pristavita. "Because for example, if you compare with chemical coagulation, we don't add a mass of salts. We add aluminum items and the treatment can be fine-tuned for how much aluminum is needed to remove the concentration of contaminants."

Key to the WETT system is automation, as operator participation is not needed to dose the system, measure pH or clear filters.

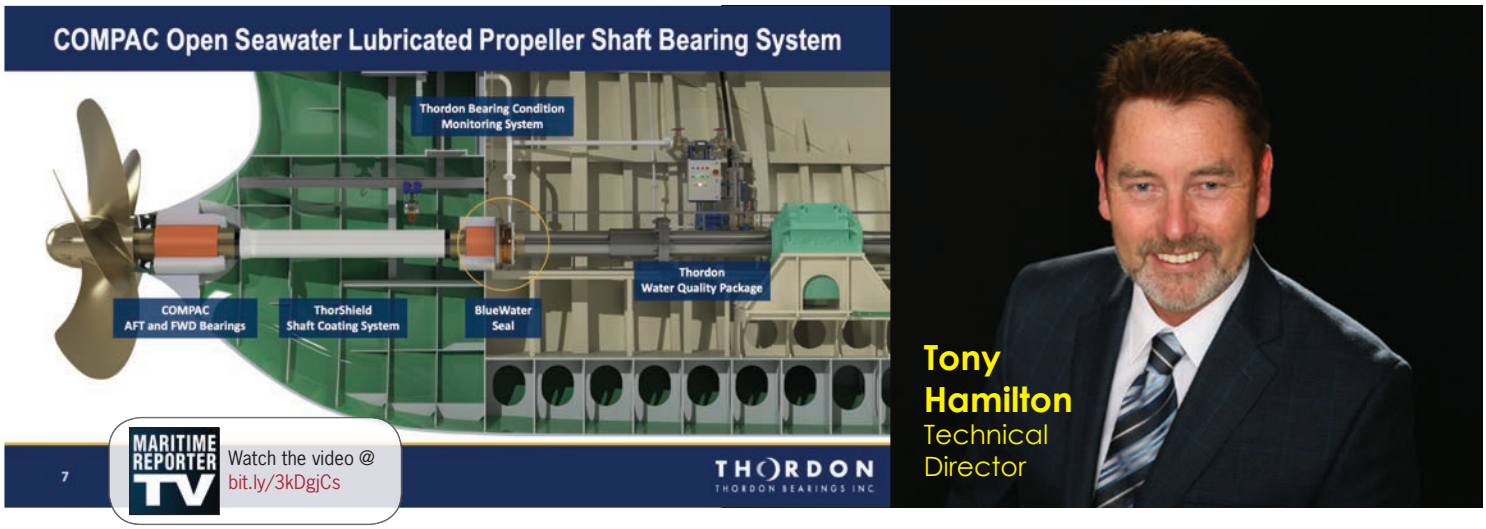
Depending on the type of WETT system deployed, treatment units are added before or after the EC unit.

"For example, on WETT-O, we have a free oil separator before the electrocoagulation unit that removes everything that can easily float or sink. Then the emulsified oil, the very small particles that cannot settle or float, are removed in the electrocoagulation unit."

For black water treatment, streams that are generally heavily contaminated with organics and viruses and bacteria, "we use for polishing, we use electrolytic oxidation and we use a special type of electrodes, which are not consumables," said Pristavita.

Each EC unit contains one pair of sacrificial metal electrodes, given the ability of the system to operate at comparatively high current densities. This simplified approach means that installation of a new set of electrodes take less than 10 minutes, which depending on system design may be required every 1-3 months.

"(The electrodes) produce hydroxy radicals, which are very strong oxidants" that essentially kill and mineralize everything in the stream. "So you are not only doing a polishing in terms of removing contaminants, but you are also disinfecting and you don't have to add any chlorine or any other disinfection products," said Pristavita. "They are robust, they remove virtually everything from the stream, they disinfect without the need to store on onboard chlorine products and you don't have to backwash filters."



Inside Thordon's **BlueWater Seal**

By Greg Trauthwein

Earlier this year Thordon Bearings debuted the BlueWater Seal, a new propeller shaft seal for the commercial shipping industry featuring a unique Safe Return to Port (SRTP) design. Tony Hamilton Thordon's technical director, takes us for an inside look.

Completing the COMPAC open seawater lubricated propeller shaft bearing system, Thordon's new BlueWater Seal is described by the manufacturer as a cost effective, commercial grade axial lip seal specifically designed for merchant shipping fleets. It incorporates Thordon's emergency SRTP capability, first used in the company's TG100 and SeaThigor – designed for the workboat and specialized naval vessel markets respectively – representing the first SRTP seal designed for the merchant fleet.

"At first glance the Thordon BlueWater Seal may look like any other axial lip face seal out there," said Hamilton. "But what makes this seal unique is its SRTP capability and revolutionary RENFORM main seal ring."

According to Hamilton, the Renform seal is a proprietary material, that varies (in thickness) both radially and circumferentially. "What that does is it provides a better pressure distribution when the seal is doing its job," said Hamilton. "So when you take a different draft, different pressure conditions, the seal adjusts to keep the ceiling face at the right pressure, minimizing wear on the material itself. That's where the longer life comes in. It also keeps the leakage rate down to minimum, zero to five liters per day."

"The Safe Return to Port is a unique feature as is the RENFORM seal, the lip seal itself," said Hamilton. "The Safe Return to Port is basically a bladder, inflated with air to about 120 PSI. It's inflated when you want to replace the RENFORM seal." The SRTP features offers two methods to replace the lip seal: at sea or in port.

"You already have a spare on the shaft, you inflate the bladder and you can fix the seal right there at sea. Or, you can motor the vessel into port," said Hamilton. That's what's unique about the material: it can take a certain amount of friction, allowing you to operate, turn the shaft while that bladder's inflated; allowing the seal to be replaced in port."

"Although we can offer the seal as an individual component, it forms a fundamental part of the Thordon COMPAC open seawater lubricated propeller shaft bearing system," said Hamilton.

The COMPAC system includes Thordon's proprietary seawater lubricated COMPAC bearings, shaft liners, ThorShield anti-corrosion shaft coating, a Thordon Water Quality Package, a Thordon Bearing Condition Monitoring System, and, now, the new BlueWater Seal.

The seal can be installed to all vessels with shaft diameters between 300mm to 1000mm (11.8in to 39.4in), and has received class approvals from ABS, LR, DNV, BV and CCS.

"This seal minimizes water leakage and dramatically improves hydrodynamic and lubrication efficiency," Hamilton said.

"The development is a real boon to those ship owners and operators looking to adopt an open seawater lubricated shaft line arrangement as the entire propeller shaft line system can now be sourced from one company."

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Tech Files

Innovative new Green Marine Solutions

EST-Floattech: A Diesel-Electric Hybrid Propulsion FiFi Vessel

Photos courtesy EST-Floattech/Flotte Hamburg

The Hamburg Fire Fighting Vessels Dresden and Prag sport diesel-electric hybrid propulsion and battery systems from EST-Floattech. After the first 100 days of operation, operator Flotte Hamburg reports it is satisfied with the two new FiFi ships. "Due to the full approval for the use of the EST battery system 'Green Orca 1050' on inland waterway vessels, which was already available at the start of the project, the first hybrid ships of the Hamburg fleet were successfully put into operation in close cooperation with Damen Shipyards and the electrical and automation project partner Royal Van der Leun," said Christof Sacher, Flotte Hamburg, a subsidiary of the Hamburg Port Authority (HPA). Flotte Hamburg, fleet manager for the more than 50 ships of the Free and Hanseatic City of Hamburg since 2017, is implementing its environmental strategy for both boats. The concept includes: the switch to low-emission fuels, exhaust after treatment for new purchases, retrofitting existing ships, innovative drive technologies and efficient ship operation. An example of 'innovative drive technologies' is the battery-buffered diesel-electric hybrid drive. The battery system for the two 35.5 x 7.8 m, 12-knot vessels sport the EST-Floattech Green Orca 1050 modules, certified by DNV, each with a total battery capacity of 315 kWh. The plug-in hybrid allows up to four hours of fully electric, emission-free travel through the port.

An important aspect in selecting the battery systems was the safety of using the lithium-ion batteries. "We apply high-quality pouch battery cells that ensure high-energy density, good heat dissipation and high-energy efficiency," said Marc Mühlenbeck, Sales Account Manager at EST-Floattech Hamburg. "In addition, two independent battery management systems monitor and control safe charging and discharging. Other safety features include a fireproof housing and a venting system in the event of a thermal runaway." This system has proven itself in practice. "Due to the user-friendly implementation of the on-board power management and the smooth integration of the batteries as a reliable backbone of the on-board energy supply, the hybrid drive has enjoyed full acceptance among the crews since the first day of operation, contrary to initial reservations," said Sacher. "In particular, the almost noiseless propulsion system when sailing electrically and the fact that a classic blackout of the ship is virtually impossible, from the basis for this popularity. In the project phase, the compact structure of the batteries as an encapsulated system and the high safety standard in terms of design and monitoring by the integrated Battery Management System were decisive."

Photo courtesy SHI/Seaborg

SHI, Seaborg Partner to develop Floating Nuclear Power Plant

Compact floating nuclear power plants are emerging as a serious contender to the world's decarbonization goals. To this end, Samsung Heavy Industries (SHI) and Seaborg signed a partnership agreement to develop floating nuclear power plants based on Seaborg's Compact Molten Salt Reactor (CMSR). The agreement includes development of hydrogen production plants and ammonia plants, able to manufactured in serial production for deployment globally.

The partnership agreement was signed at an online event by Jintaek Jung, President and CEO of SHI, and Troels Schönfeldt, co-founder and CEO of Seaborg. The aim of the strategic partnership is to manufacture and sell turnkey power plants, ready to be moored at industrial harbors and connected to the electric grid onshore.

The stable production of energy also offers a fundamental basis for production of all Power-2-X fuels, where especially hydrogen and ammonia are considered a future energy source to replace traditional fossil fuels. The design of the hydrogen, ammonia and power units will be optimized for efficient serial construction at SHI's shipyards.

The floating nuclear power plant comes as a turn-key product, ready to be moored at an industrial harbor. In the harbor, a transmission cable will be connected to the electric grid onshore. An optional solution is to place a hydrogen or ammonia production plant next to the floating nuclear power plant utilizing the CO2-free fission energy to produce hydrogen and ammonia.

Tech Files

Innovative new Green Marine Solutions

© Wärtsilä

Carnival Corporation

Wärtsilä Launches 46TS-DF Marine Engine

Wärtsilä launched the 46TS-DF medium-speed marine engine. The first order for this engine type was placed by Chantiers de l'Atlantique for Royal Caribbean Cruises in April 2021. The engines will be installed on its latest Oasis class ship 'Utopia of the Seas'. The ship is being built by the shipyard Chantiers de l'Atlantique and will feature six Wärtsilä 46TS-DF engines with Gas Valve Units, NOx Reducer SCR systems, LNGPac and Transverse Thrusters.

The overriding basis for this new engine launch is to be able to offer a future-proof solution for owners and operators to reach decarbonization targets. The Wärtsilä 46TS-DF has a two-stage turbocharging designed to deliver high levels of efficiency and power density across a wide operational range.

Wärtsilä 46TS-DF is available in 6 to 16-cylinder configurations, corresponding to a power output range of 7.8 to 20.8 MW at 600 rpm.

Carnival, Wärtsilä Cooperate on Fleet Decarb Program

Wärtsilä will deliver its new Decarbonization Modeling Service to Carnival Corporation. Initially tasked with establishing an optimal decarbonization path for the cruise ship Regal Princess the – a 330-m , 142,000-gt cruise ship built in 2014 – the project will expand to model solutions which could be applied to the entire Carnival fleet. The contract was signed in December 2021 and the project commenced in February 2022. Under the program, a digital model of Regal Princess will be created by combining operational data from several different sources. Modelling capabilities and machine-learning algorithms developed by Wärtsilä will deliver a detailed analysis of vessel operational data.

The model will be used to simulate the impact of several technologies. A specific focus will be given to E-start, Wärtsilä's patented electric smokeless start solution, as well as the Wärtsilä HY hybrid power concept with energy storage. The simulations will identify the most beneficial retrofittable solution while minimizing the required installation.

e5 Lab Inc.

World's First Hybrid-Electric Biomass Fuel Carrier

The Japanese Shipowners' Association announced that the Japanese shipping industry will take on the challenge of 2050 net zero GHG1. One of its most significant initiatives is e5 Lab Inc., a consortium comprising Asahi Tanker Co., Ltd., Exeno Yamamizu Corporation, Mitsui O.S.K. Lines, Ltd. and Mitsubishi Corporation, with the purpose of developing renewably powered commercial ships.

e5 Lab has recently unveiled ROBO-SHIP – a design for a biomass fuel carrier, powered by a fully standardized, electric propulsion system to attain zero emission operations at harbour. Built by Honda Heavy Industries Co., Ltd., the 70-m, 499-gt carrier will be equipped with ABB's complete modularized electrical propulsion package, enabling it to utilize multiple energy sources for optimized operational efficiency and emissions-free operations. Additional benefits of the system include reduced noise and vibration, lower maintenance costs, and improved steering capabilities that make pier docking and undocking operations easier.

ABB's full scope of supply includes a standard sytem package comprising the hardware for electric propulsion, including propulsion motors, DSC switchboards, energy storage batteries and generators, and ABB Ability Marine Remote Diagnostic System for continuous monitoring and remote support.

In the Shipyard

Latest Deliveries, Contracts and Designs

Aquarius Eco Handymax II: Zero Emission Handymax Bulker

The global push for decarbonization in the transport sector has predictably inspired a wave of new designs for the shipping sector, including a new 'Zero-Emission Handymax Bulker' design from the hands of Eco Marine Power, a design that incorporates renewable energy solutions, electric propulsion and fuel cells.

The ship design concept is known as the Aquarius Eco Handymax II and all the technologies currently encompassed in the design are either currently available or under-development.

The Aquarius Eco Handymax II ship design includes the integrated sail-assisted propulsion & solar power system known as Aquarius Marine Renewable Energy or Aquarius Aquarius MRE. A range of energy saving devices including an air lubrication system (ALS) have also been added along with electric propulsion & fuel cells. Aquarius MRE was granted Approval-In-Principle by ClassNK in 2021 & a further patent related to this system was applied for recently.

Photo: Ulstein

Ulstein Thor: Zero Emission Cruise Ship

Ulstein unveiled a vessel concept that it claims is capable of making the vision of zero emission cruise operations a reality. Dubbed Ulstein Thor, the 149m 3R (Replenishment, Research and Rescue) design will feature a Thorium Molten Salt Reactor (MSR) to generate electricity. This enables the vessel to operate as a mobile power/charging station for a new breed of battery driven cruise ships.

Ulstein believes Thor may be the missing piece of the zero emissions puzzle for a broad range of maritime and ocean industry applications. To demonstrate its feasibility, Ulstein has also developed the Ulstein SIF concept, a 100m long, 160 POB capacity, zero emission expedition cruise ship. This Ice Class 1C vessel will run on next generation batteries, using Thor to recharge while at sea.

'Thor' is essentially a floating, multi-purpose 'power station' that will enable a new battery revolution," said Cathrine Kristiseter Marti, CEO Ulstein.

Thorium has been identified as having huge potential for a maritime industry hunting for clean alternative fuels. MSRs work by dissolving Thorium – an abundant, naturally occurring metal with low radioactivity – in liquid salt. The ensuing chain reaction heats the salt, producing steam to drive a turbine and create electricity. Although developments on land are well documented, its potential for delivering clean maritime power has yet to be incorporated into a vessel design. Thor's charging capacity has been scaled to satisfy the power needs of four expedition cruise ships simultaneously. 'Thor' itself would never need to refuel. As such, 'Thor' is intended to provide a blueprint for entirely self-sufficient vessels of the future.

The Power ARK Project

Photo: PowerX

ClassNK signed a Memorandum of Understanding (MOU) with PowerX, Inc. (PowerX) for a collaboration on the development of the Power Transfer Vessel (Power ARK).

PowerX is carrying out a project of the first model of the Power ARK series, which is designed for transferring renewable energy in Japan's coastal waters, and this project is in the design and development stage towards a demonstration experiment and full-scale operation in 2025.

The first model of the Power ARK series, "Power ARK 100" is a 100TEU container ship specially designed for transferring renewable energy in Japan's coastal waters. Upon its completion in 2025, Power ARK 100 will carry 100 grid batteries, hence 200MWh of power. The vessel will be designed to travel up to 300km when running only on electricity and will be able to unlock long-distance, intercontinental clean power transmission when it is powered by both electricity and sustainable biodiesel fuels.

In the Shipyard

Latest Deliveries, Contracts and Designs

Emission free ship by 2030

Hurtigruten Norwegian Coastal Express partners with SINTEF to create zero emission ships for the Norwegian coast. "Our ambition is to sail an emission-free Hurtigruten Norwegian Coastal Express ship by 2030," said Hurtigruten Group CEO Daniel Skjeldam. Since the start in 1893, Hurtigruten Norwegian Coastal Express has carried local passengers, goods, and tourists between 34 ports in what is one of the world's most beautiful sea voyage.

The company is currently upgrading its existing fleet through what is one of the biggest environmental upgrade programs of it's kind in Europe, that will see CO2-emissions cut by 25% and NOx by 80%. The company aims to be a leader in sustainable travel, and Hurtigruten Norway CEO Hedda Felin makes it clear that the goal is zero emissions. "We have built our last fossil fueled ship for the Norwegian Coastal Express. When we sail the coastal route for the next 100 years, it will be emission-free, making the world's most beautiful voyage even more spectacular," said Hedda Felin.

The project includes all aspects of a new ship build program, from design, propulsion, energy and fuel to hotel operations and digital solutions. The goal is that the new ships will be emission-free to both air and sea, and sustainable from a circular economy perspective. As a partner, SINTEF will provide analysis, research and development.

"The first phase of the project has already been kicked-off and consists of a feasibility study, looking at technological and operational solutions for zero emission Hurtigruten Coastal Express ships on the Norwegian coast," said SINTEF Ocean Market Director Trond Johnsen.

In the next phase, leading maritime industry partners will be invited to participate in taking the project further towards development and qualification of innovative green ship designs and technologies.

Photo: Fabrice Milochau / Hurtigruten Norway

ClassNK AIP for Ammonia-ready LNG-fueled Panamax Bulk Carrier

ClassNK issued an Approval in Principle (AiP) for the design of an ammonia-ready LNG-fueled Panamax bulk carrier developed by Planning and Design Center for Greener Ships (GSC).

In 2021, ClassNK published its "Guidelines for Ships Using Alternative Fuels" to minimize the risks related to ammonia-fueled ships for the ships, crew, and environment by stipulating requirements for installation, controls, and safety devices. ClassNK subsequently issued an Approval in Principle (AiP) for the design of an ammonia-fueled Panamax bulk carrier developed by GSC in January 2022.

GSC describes the newly developed design as LNG-fueled but ready for ammonia-fueled. For the short-term aiming lower CO2 emissions, it will be operated by using LNG fuel. For the long-term aiming toward zero CO2 emissions, it has two scenarios; in the first scenario, it is converted to ammonia fueled propulsion systems, in the second scenario, it will keep the systems but will switch its fuel from LNG to liquified carbon-neutral methane. The ship is developed as a flexible and efficient solution to enduring the unpredictable period of fuel transition.

Photo courtesy GSC

In the Shipyard

Latest Deliveries, Contracts and Designs

Hybrid Electric Bunker Tankers

A new partnership between climate action solution provider Shift Clean Energy (Shift), SeaTech and Vitol will provide Vitol's bunker operations company, V-Bunkers, with Singapore's first hybrid bunker tankers. They will be designed by SeaTech Solutions, using Shift's energy storage systems (ESS).

This marine electrification project will see up to four hybrid bunker tankers provided to V-Bunkers, all fitted with Shift's 480-Kwh liquid cooled ESS and battery management systems. This will result in improved fuel efficiency and reduce greenhouse gas (GHG) emissions by approximately 10 percent a year.

Shift's ESS will be primarily used for peak shaving (storing energy during low power consumption for use during peak usage periods, allowing main generators to operate with a more stable load). This solution helps to optimize energy use, significantly reduce fuel and maintenance costs, improve responsiveness and reliability of power management and in turn enhances safety of operations.

Photo: Newport Shipping

AIP for Containerized LNG Solution

Marine Service GmbH and Newport Shipping announced an Approval in Principle from Bureau Veritas (BV) for a jointly developed containerized LNG solution. The 40-ft. ISO LNG Fuel Tank Container System is suitable for LNG-fueled newbuildings and retrofits of container vessels.

The LNG fuel tank container is a class approved Type C LNG fuel tank in accordance with the IGF-code and is based on German TÜV certified IMDG Container. The capacity of the tank is 31 gross tons and about 33 cu. m. of LNG. The containers have a fail-safe dry quick coupling connection and are approved for loading in up to 7 layers high stacks. The stainless-steel double-walled tank is also vacuum insulated and has up to 80 days holding time.

The concept consists of container stowage on free deck in safe area. LNG piping and venting system as well as firefighting systems are integrated in the container cell guides structure. The gas handling room is arranged adjacent to the container storage and separated from the containers by a cofferdam and fire protection means, allowing to feed low pressure and high pressure fuel gas systems for all known 4-stroke and 2-stroke dual fuel engines. A full redundant control, alarm & monitoring system for remote system operation, gas and fire alarm with interface to ships' automation is part of the system.

Battery Hybrid SOV for Offshore Wind

Designed by Royal IHC to meet the evolving needs of offshore windfarms, the battery hybrid SOV is designed to be ready for true zero emission operations by using full battery offshore charging system and alternative fuels for propulsion without sacrificing operational functionality.

To ensure effective operations, the SOV will have a fully integrated service package that includes a dynamic positioning system, a motion compensated gangway and crane, an elevator tower as well as a daughter craft with step-less boat landing. Ample space will be available for warehousing, workshops, office spaces to cater to operations, and relaxation areas for passengers.

Under the terms of the MOU, the SOV will be constructed at PT. United Sindo Perkasa, the Group's wholly owned subsidiary that operates a shipyard in Batam, Indonesia.

To facilitate the building and future operations of the SOV, the Group has also inked a memorandum of understanding with Bernhard Schulte Shipmanagement (Deutschland) GmbH & Co. which will provide ship management services for the SOV.

Dual-Fuel Methanol Tanker built in China

Photo: GSI

Guangzhou Shipyard International (GSI) began sea trials of the Stena Pro Patria, the first methanol powered dual-fuel tanker constructed in China. GSI signed the deal to build three 49,990 dual-fuel DWT tankers with Proman Stena Bulk, a joint venture between Sweden based Stena Bulk AB and Switzerland headquartered Proman in 2019, the other two ships presently under construction being Stena Pro Marine and Stena Prosperous which are due to complete this year.

GSI vice president William Zhou hailed the start of sea trials and testing of the propulsion equipment as 'a watershed moment' in the development of methanol as an alternative fuel for MR tankers. He said each tanker will significantly slash NOx emissions by using around 12,500 tons of methanol as marine fuel a year powered by an MAN dual-fuel 6G50ME C9.6 engine, without catalyst conversion.

Eco-Friendly Post Panamax Bulk Carrier M.V. Cemtex Excellence

U-Ming Marine Transport Corp. contracted with Japan's Sumitomo Marine Co. Ltd. to commission Oshima Shipbuilding Co., Ltd. to build a 99,990 DWT Post Panamax Bulk Carrier M.V. Cemtex Excellence, a ship that was christened earlier this year. M.V. Cemtex Excellence has a length of 235m, width of 40m and deadweight of 99,990 metric tons and she is the first of the 99,990 DWT Post Panamax series built for U-Ming by Oshima Shipbuilding.

Photo: U-Ming/Sumitomo

The high quality eco-efficient features and an enhanced digital operation system greatly improves the operating efficiency and safety of the vessel. The increasing size of ships reduces fuel consumption per unit cargo and lowers operating costs. In view of the industry trend towards low-speed operations, speed of navigation is optimized. The narrow streamline design of the bridge also helps to reduce wind resistance.

Maritime Safety: A New Approach is Needed

By Dr. Torkel Soma, Chief Scientific Officer, SAYFR

For years, the shipping industry has focused on regulations and procedures to improve safety. Yet shipping is still at risk of major accidents. The whole industry needs to change its focus. Ticking boxes never made anyone safer. Also, assessing culture using valid and reliable survey instruments can help to improve safety – Dr Torkel Soma, Chief Scientific Officer at SAYFR.

It has been well documented that most maritime accidents (~80%) are caused by human error. Still, most of the focus on learning is rooted in technical causes and adding procedures and checklists.

Despite this bias, many accident investigation reports pinpoint that the leadership or safety culture was the root cause of more recent accidents such as the Bulk Jupiter, El Faro, Helge Ingstad and Costa Concordia, as well as older accidents such as the Exxon Valdez, Bow Mariner, Herald of Free Enterprise and Amoco Cadiz.

Industry blind spot

The critical failures leading to the accident were in most cases known before the accident took place. This demonstrates that failures which are not handled properly may develop into critical situations and accidents. This is a blind spot because the biased focus on technicalities and "impeccable" safety inspections makes people reluctant to be open about their failures, concerns and mistakes. We at SAYFR think shipping companies, and the whole industry, needs to change its focus. Thousands of auditors and inspectors across the world are engaged by classification societies, flag and port state authorities, vetting and insurance companies and HSEQ departments. They verify that ships do the right thing and comply with technical and procedural requirements. However, ticking boxes never made anyone safer.

Cover-up culture

Also, and worryingly, there is a cover-up culture causing errors and unsafe practices. There are now so many procedures and checklists that, in some cases, it is impossible to comply with all of them. The fear of failure is driving accident statistics, and surveys reveal that 45% of seafarers admit that they regularly do not comply with procedures.

I firmly believe that human factors are key to prevent threats and failures from escalating. Yet improving safety or performance is about improving not only individuals but also the collaboration between sea and shore staff, between officers and crew and between different nationalities and cultures on board ships.

Huge potential to reduce accidents

Although this is recognized, it is not always addressed, so I believe a new approach is necessary to improve collaboration and reduce risks. Indeed, collaboration is strongly correlated with the risk of accidents and business interruption. Our experience of working on multiple projects over the years shows that it is possible to reduce the risk of major accidents by up to 75%. However, there is no quick fix to improve collaboration and implement behavioural changes through, for example, training courses. Changing the culture is key and that process takes time. To help operators improve their approach to safety, proven methodologies must be used.

Safety leadership behaviors

Put simply, it involves observing and identifying working methods on board and then working with all the officers and crew in teams and as individuals to deliver the eight-point safety leadership behaviors, namely:

- Giving feedback
- Speaking up
- Building trust
- Creating openness
- Showing care
- Facilitate learning
- Promoting teamwork
- Managing dilemmas

Experience shows that the focus on the eight behaviors work because they address the blind spot. By encouraging the participants to openly share errors, failures and concerns, they are able to break the chain of events that can lead up to a major accident. Also, this approach helps to move beyond the culture of punishment to the positive safety-enhancing culture where crew members help each other.

Culture Assessments

In order to understand how the organization culture influences safety, there is a need to use methodologies specialized for this purpose. One thing that many people are ignorant of is that a key professional competence of organizational psychology is advanced mathematics

"Understanding how organizational culture impacts safety and the use of precise forecasts that help to prevent accidents relies on unique, high-volume data."

Dr. Torkel Soma, Chief Scientific Officer, SAYFR

Image Courtesy SAYFR

and data analysis. The evaluation of organizational culture relies on interviews, observations and questionnaires applying psychometric instruments that are tailor-made to ensure valid and reliable results. The professionals drive the process while the data provides the results. As a consequence, the more and better the data on these topics, the more valid, reliable and to-the-point are the results. However not all the instruments used in the industry are valid and reliable. In a recent review of safety culture maturity instruments, only 3 of 43 instruments were valid. Indeed, there is not one single test alone that can demonstrate the validity of a survey instrument. Therefore, SAYFR has developed tailor-made psychometric instruments to assess these topics and has a database of responses from about 300 000 seafarers.

When it comes to the qualitative and quantitative tests that can be made to verify validity, the basic one is content validity. This dictates how well a safety instrument addresses a safety issue. It specifies that the survey instrument adequately covers the topic being studied as well as having sound scientific grounds and references. This is important because so many historical examples show risks that were identified well ahead of time but were not addressed. These include the Deepwater Horizon blowout, which claimed 11 lives and caused huge environmental damage, rig personnel had knowingly by-passed safety barriers. In this case, failures were identified but the root cause of the problem – i.e. human neglect, whether cultural or circumstantial – was not factored in.

Reliability through Data

Reliability of the survey instrument is also key and that is ensured statistically by use of data. Factor-analysis is a statistical method used to describe variability among correlated items in terms of a potentially lower number of unobserved variables, called factors. For our instrument, the eight factors are equal to the eight SAYFR leadership behaviours (8SLBs) mentioned above.

Moreover, predictive validity is the instrument's ability to predict something in the future such as an event, or correlations with instrument measurements made by other instruments. If an organization scores low in terms of the 8SLBs, it is a good indicator of future problems. This has been shown on a number of occasions when departments, units or suborganizations have received low 8SLB scores only to have accidents occur in the intervening time, before action was taken. Predictive validity can also be applied to solutions. When action was taken based upon a low 8SLBs score, a shipping company experienced a 60% reduction in the frequency of serious accidents, to a level which was maintained five years subsequent to the investigation. Concurrent validity and construct validity are also important elements. Concurrent validity measures the correlation between two independent measurements performed at the same time. An increase in the ability to manage failures, for example, will necessarily correlate with the number of incidents that occur. Construct validity is when a theoretical model of cause and effect – for example, do the improvements prescribed following appraisal of the 8SLBs – accurately replicate the real-world scenarios they are intended to represent? Construct validity is the ultimate validity measurement, and necessarily incorporates all other validity factors.

Cutting Frequency of Accidents

Also, it's not only the psychometric instruments that rely on data. The use of digitalization, the internet of things (IoT), sensor data, machine learning, and big data has picked up in recent years. The idea is that those with the most data can create the best analytics and forecasts. With the use of more quality data, risk assessments and worst-case scenario simulations provide reliable predictions and identify effective interventions to prevent accidents. In short, what we at SAYFR see is that the best shipowners and operators have a proactive organizational culture that goes beyond ticking the 'compliance boxes' and instead applies a collaborative, trusting approach from top to bottom in the company's organization. This also includes assessing culture using valid and reliable survey instruments. This is what really helps to improve safety.

MARITIME REPORTER AND ENGINEERING NEWS

2022 Editorial Calendar

January 2022

The Ship Repair & Conversion Edition

- Hull, Deck and Tank Coatings
- Engine Conversion & Repower
- Fuels and Lubricants
- Emission Scrubbers
- Waste Water Treatment Systems

February 2022

Government Shipbuilding

- Autonomous Ship Systems
- Bridge Technology: Satellite Communications, Navigation & Controls
- Seafarer Training & Education
- Health, Safety & Sanitization

Event Distribution:
Sea, Air, Space: April 4-6, National Harbor, MD

March 2022
E-Magazine Edition

Dredging

April 2022

Offshore Energy

- Wind Turbine Installation Vessel Technology
- Cruise & Ferries
- Marine Gears & Transmissions
- Fluid Handling Pumps and Filtration
- Heavy Lifters: Deck Machinery & Cranes

Event Distribution:
OTC: May 2-5, Houston, TX

IPF: April 26-28, Atlantic City, NJ

Seatrade Cruise Global: April 26 - 28, Miami, FL

May 2022

Green Ship Technologies

- LNG / Hybrid Propulsion: Marine Batteries & Fuel Cells
- Classification Societies
- Marine Coatings & Corrosion Control
- Water Treatement

Event Distribution:
Posidonia: June 6 - 10, Athens, Greece

Inland Marine Expo: May 23 - 25, St Louis, MO

June 2022

USCG Fleet Modernization Annual

- Fast Attack and Patrol Craft Builders
- Ride Stabilization: Pitch and Roll Control Solutions
- Water Jets, Thrusters & Propellers
- Maritime Universities & Academies

Event Distribution:
MACC: Jul 2022, National Arbor, MD

July 2022
E-Magazine Edition

Navy & Coast Guard Shipbuilding

August 2022

The Shipyard Annual

- Bearings, Seals and Couplings
- Pipes, Pumps & Valves
- Ballast Water Management
- Welding & Cutting Equipment
- Marine Batteries & Fuel Cells

Event Distribution:
SMM: September 6-9 Hamburg, Germany

September 2022

The Marine Design Edition

- Naval Architecture/Marine Engineering
- Dredging: Port Expansion and Deepening
- Material Handling Equipment
- Performance Coatings
- Shipping & Port Logistics

Event Distribution:
CMA Shipping: October, Stamford, CT

SNAME Expo: October

October 2022
E-Magazine Edition

Offshore Wind

November 2022

Workboat Edition

- Autonomous Workboats
- Workboat Propulsion
- Deck Equipment: Winches & Cranes
- Emissions: Exhaust Systems and Scrubbers
- Training and Simulation

Event Distribution:
Clean Gulf: December 2022
Int'l Workboat Show: December 2022

December 2022

Great Ships of 2022

- Naval Architecture/Marine From Sails to Bubbles: Alternative Ship Propulsion Assist Technologies
- Fluid Filtration and Separation
- Safety Equipment
- Navigation: Radar, ECDIS & Collision Avoidance
- HVAC

Event Distribution:
Surface Navy Assoc: Jan 2023

BUYER'S DIRECTORY

This directory section is an editorial feature published in every issue for the convenience of the readers of MARITIME REPORTER. A quick-reference readers' guide, it includes the names and addresses of the world's leading manufacturers and suppliers of all types of marine machinery, equipment, supplies and services. A listing is provided, at no cost for one year in all issues, only to companies with continuing advertising programs in this publication, whether an advertisement appears in every issue or not. Because it is an editorial service, unpaid and not part of the advertisers contract, MR assumes no responsibility for errors. If you are interested in having your company listed in this Buyer's Directory Section, contact Mark O'Malley at momalley@marinelink.com

APPROVED U.S. COAST GUARD MARINE SANITATION DEVICES

Environmental Marine, Inc., 711 Colyer Rd., Bronson, KY , USA , tel:(606) 561-4697, bobkenison@aol.com contact: Bob Kenison, www.envmar.com

CLEAN, QUIET, PROVEN: POWER & PROPULSION SOLUTIONS

BAE Systems, Power & Propulsion Solutions, Bldg. 14, 1098 Clark Street Endicott, NY 13760 , tel:(360) 306-2844, joseph.hudspeth@baesystems.com contact: Joe Hudspeth, www.GetToZero.com

COMMUNICATIONS

David Clark Company (Wireless Headsets / Digital Intercom Systems), 360 Franklin Street, Worcester, MA 77060, USA , tel:(800) 298-6235 , www.davidclarkcompany.com/marine

ELECTRIC PROPULSION

BAE Systems, Power & Propulsion Solutions, Bldg. 14, 1098 Clark Street Endicott, NY 13760 , tel:(360) 306-2844, joseph.hudspeth@baesystems.com contact: Joe Hudspeth, www.GetToZero.com

ENGINE ORDER TELEGRAPH

Prime Mover Controls, 3600 Gilmore Way Burnaby B.C. V5G 4R8 Canada , tel:604 433-4644, fax:604 433-5570, Michael.Combs@pmc-controls.com

INERTIAL SENSING SYSTEMS

Silicon Sensing Systems Ltd, Clittaford Road Southway, Plymouth, Devon PL6 6DE United Kingdom , UK , tel:+44 (0) 1752 723330, sales@siliconsensing.com

MECHANICALLY ATTACHED FITTINGS (MAFS)

Viega, 585 Interlocken Blvd., Broomfield, CO , USA , tel:(410) 299-6724, tj.tracy@viega.us contact: T.J. Tracy, www.Viega.us

MEMS MOTION SENSING

Silicon Sensing Systems Ltd, Clittaford Road Southway, Plymouth, Devon PL6 6DE United Kingdom , UK , tel:+44 (0) 1752 723330, sales@siliconsensing.com

METEOROLOGICAL INSTRUMENTS

R.M. Young Company, 2801 Aero Park Dr., Traverse City, MI , tel:231-946-3980, fax:231-946-4772, vsherman@youngusa.com

NAVAL ARCHITECTS, MARINE ENGINEERS

Bristol Harbor Group, Inc., 103 Poppasquash Rd., Bristol, RI 02809, USA , tel:401-253-4318, fax:401-253-2329, design@bristolharborgroup.com

The Shearer Group, Inc, 3118 Harrisburg Blvd., Suite 100, Houston, TX , USA , tel:(281) 532-2080, info@shearer-group.com

NAVIGATION AND CONTROLS

Prime Mover Controls, 3600 Gilmore Way Burnaby B.C. V5G 4R8 Canada , tel:604 433-4644, fax:604 433-5570, Michael.Combs@pmc-controls.com

PIPING SYSTEMS FOR SHIP REPAIR & NEW CONSTRUCTION

Viega, 585 Interlocken Blvd., Broomfield, CO , USA , tel:(410) 299-6724, tj.tracy@viega.us contact: T.J. Tracy, www.Viega.us

PRESS FITTINGS

Viega, 585 Interlocken Blvd., Broomfield, CO , USA , tel:(410) 299-6724, tj.tracy@viega.us contact: T.J. Tracy, www.Viega.us

PROPULSION - HYBRIDRIVE SOLUTIONS

BAE Systems, Power & Propulsion Solutions, Bldg. 14, 1098 Clark Street Endicott, NY 13760 , tel:(360) 306-2844, joseph.hudspeth@baesystems.com

SENSORS

Silicon Sensing Systems Ltd, Clittaford Road Southway, Plymouth, Devon PL6 6DE United Kingdom , UK , tel:+44 (0) 1752 723330, sales@siliconsensing.com , www.siliconsensing.com

VIBRATION ANALYSIS

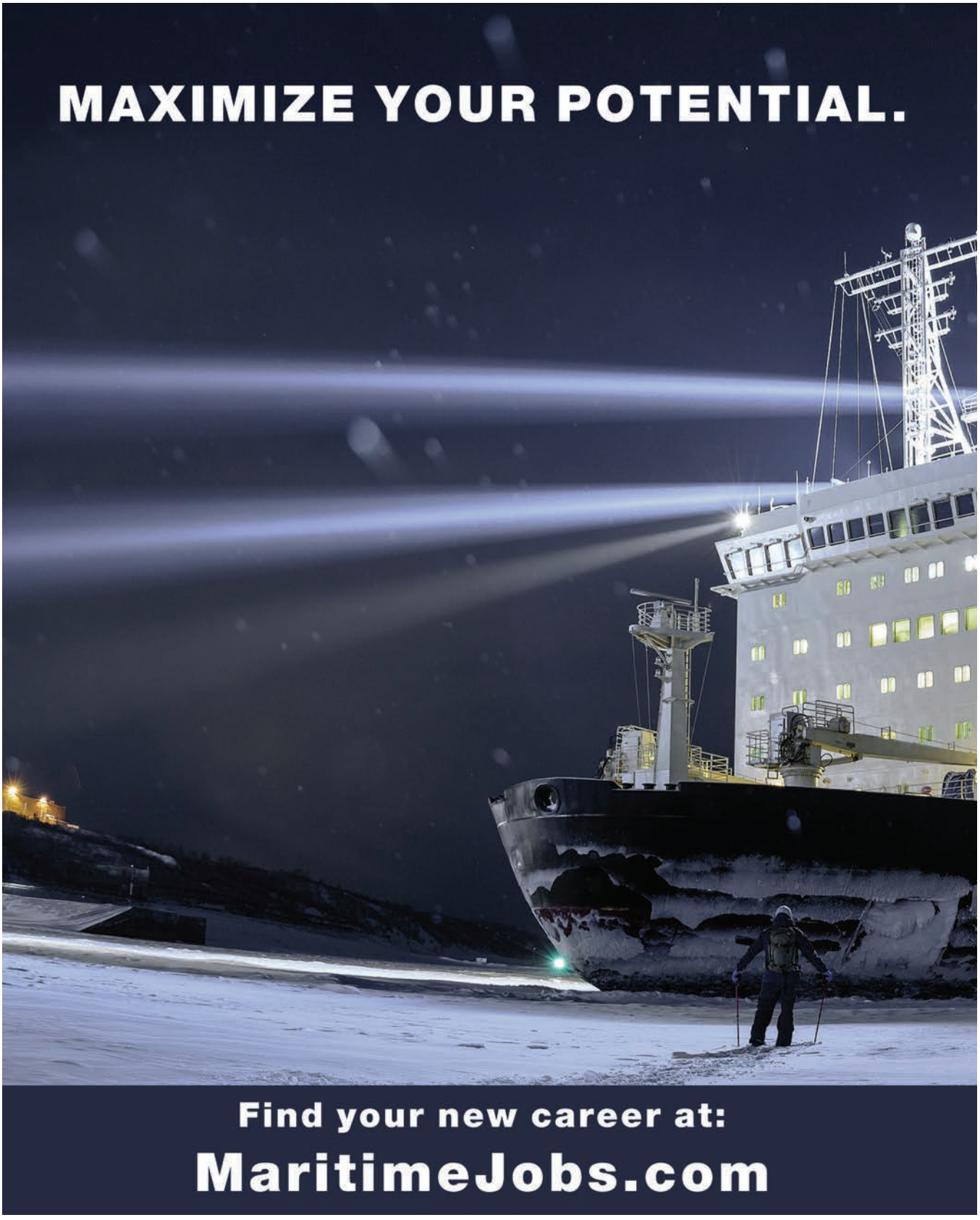
M.A.C.E. Inc., 3013 NE 12th Terrace Oakland Park, FL 33444 , tel:(954) 563-7071, rudy@mace-inc.com

WASTE WATER TREATMENT

Environmental Marine, Inc., 711 Colyer Rd., Bronson, KY , USA , tel:(606) 561-4697, bobkenison@aol.com

Employment

www.MaritimeJobs.com



Woods Hole, Martha's Vineyard and Nantucket Steamship Authority

NOTICE OF REQUEST FOR PROPOSALS TO PROVIDE A FREIGHT TRANSPORTATION SERVICE FOR THE ISLAND OF MARTHA'S VINEYARD

CONTRACT NO. 10-2022

The Woods Hole, Martha's Vineyard and Nantucket Steamship Authority (the "SSA") has issued a Request for Proposals ("RFP") from responsible and eligible proponents who wish to be considered for a license agreement to provide a freight transportation service for the island of Martha's Vineyard. Proposals will be accepted until **2:00 p.m. Eastern Daylight Savings Time on Tuesday, August 2, 2022**, at the SSA's Procurement Office, which is located on the second floor of the SSA's Administrative Offices, 228 Palmer Avenue, Falmouth, Massachusetts 02540.

The SSA has established this deadline for submitting proposals so that potential proponents will have sufficient time to submit questions and suggestions regarding the RFP after reviewing both the RFP and the documents referred to therein. The SSA asks that such questions and suggestions be submitted as soon as possible so that the SSA in turn has sufficient time to respond to them well in advance of the deadline for submitting proposals.

The SSA's hope is that the successful proponent's new freight service will become a long-term part of the marine transportation network providing the island of Martha's Vineyard with adequate transportation of persons and necessaries of life. Towards this end, although the SSA anticipates that most proponents will submit proposals to provide a conventional roll-on/roll-off ferry service to carry freight trucks and other vehicles between the mainland and the island of Martha's Vineyard, the SSA encourages the submission of proposals to provide other methods of transporting freight to and from Martha's Vineyard that might be more efficient, economical and/or ecofriendly than a conventional ferry service. If a proponent would like to submit such a proposal and is not certain whether its proposal would be considered responsive to the RFP or suitably evaluated under the evaluation criteria set forth in the RFP, the proponent should contact the SSA so that this RFP can be appropriately revised well in advance of the due date for the submission of proposals without prejudice to fair competition.

In order to receive electronic versions of the RFP and all subsequent addenda issued by the SSA to the RFP, please email the SSA's Procurement Officer, Peggy Nickerson, whose email address is **pnickerson@steamshipauthority.com**. Electronic versions of those documents may also be requested by calling Ms. Nickerson at (508) 548-5011, ext. 515, during the SSA's regular business hours.

The SSA is utilizing a RFP procurement process for this License Agreement. Under such a process, the selection of the most advantageous proposal will be based upon proposed compensation and other evaluation factors specified in the RFP. The RFP fully details the procurement process and the requirements for each proposal, and persons interested in submitting proposals for the License Agreement must comply with the provisions thereof. Unless all proposals are rejected, the SSA shall award the License Agreement to the eligible and responsible proponent who offers the most advantageous proposal to the SSA, based upon the RFP requirements and the evaluation criteria established for the License Agreement.

The SSA is soliciting competitive proposals pursuant to a determination that such a process best serves the interest of the SSA and the general public, and not because of any legal requirement to do so. The SSA reserves the right to accept or to reject any and all proposals, to modify or amend with the consent of the proponent any proposal prior to acceptance, and to waive any informality, all as the SSA in its sole judgment and discretion may deem to be in its best interest.

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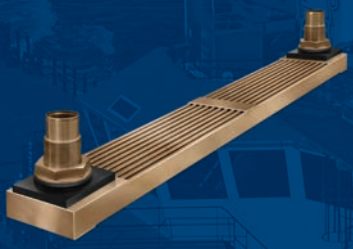

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