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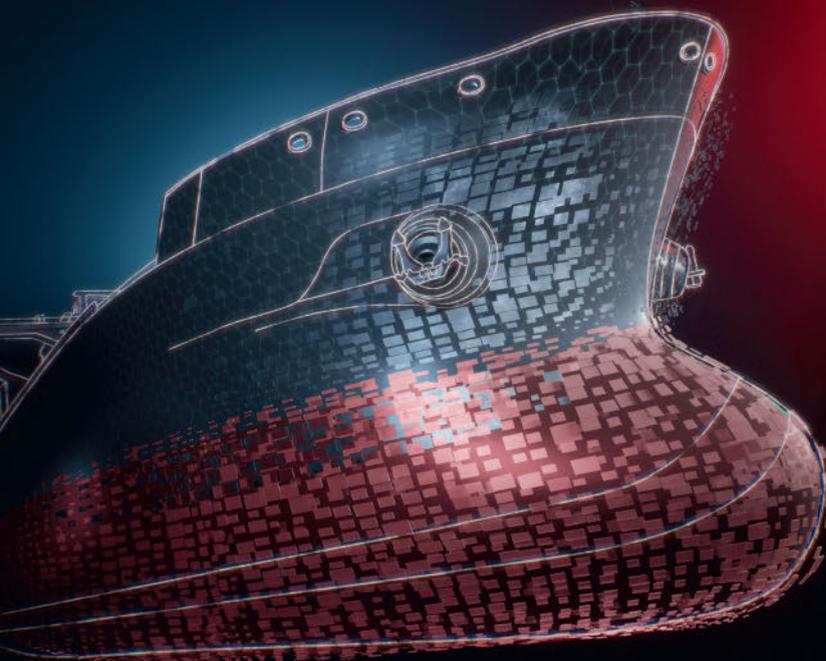
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# IS THE SUN SETTING ON THE NOON REPORT?

By **Richard Halfhide**

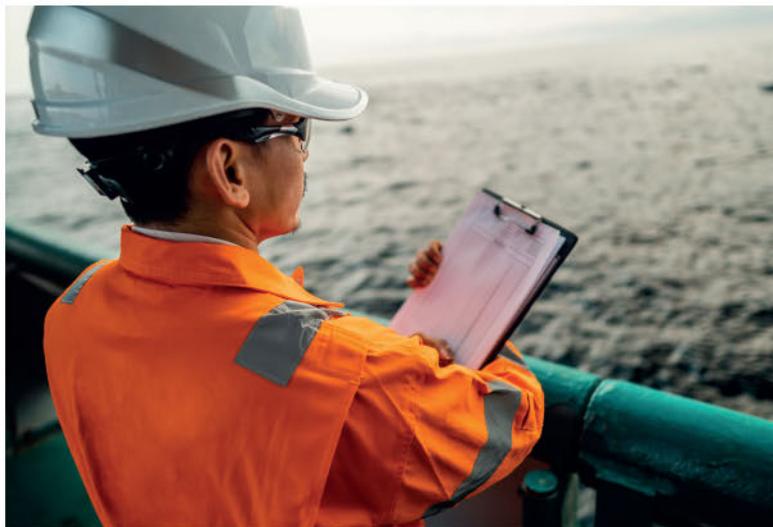
A quandary I wrestle with every month on *The Naval Architect* is how much emphasis to give to emerging technological discourse over the traditional engineering concerns of naval architecture. Maritime's rich heritage, particularly in a country so steeped in such history like Britain, is an integral part of its appeal to many that sometimes the interpolation of new themes such as cybersecurity or autonomy can feel like discordant neophilia.

There are few conventions in shipping with such a long history as the noon report, and for quite intractable reasons given that midday is the only time at which a ship's latitude and longitude can be reliably measured with the use of a sextant and chronometer. With the advent of wireless communications, and later satellite navigation, it evolved into a complex data sheet (usually assembled by the chief engineer, then sent by the master) detailing much of what a ship manager might require to assess a vessel's performance, speed and the environmental conditions under which it was making way. Although the exact parameters may differ slightly depending upon the operating company it has remained an essential tool for performance analysis.

Or is it? For several years now, and sometimes touched upon in this magazine, the value of the noon report has been called into question. After all, in an age of near-continuous data exchange between ship and shore does it really serve any practical function? That's notwithstanding the fact that manually collecting the data is enormously time consuming for the crew, particularly since different stakeholders may require different variations of the report.

In April, an industry working group named Impact Today – including EuroNav, FedNav, Cargill, Q88, Teekay Tankers, Maersk Tankers, Ultrabulk, Siglar, the Maersk McKinney Møller Center for Zero Carbon Shipping, and spearheaded by recent Danish startup ZeroNorth – published the 'Vessel Reporting and Data Quality' whitepaper. The paper posits that shipping is facing a data challenge that undermines the industry's optimisation and decarbonisation targets because of a lack of high-quality standardised data. Although the noon report serves some of this function because of their manual nature the quality of the data can vary significantly, which in turn undermines the drive towards optimisation.

Impact Today first met last year with the aim of creating a standard for measuring fuel consumption accurately, but swiftly reached the conclusion that noon reports themselves required an overhaul, both to improve fidelity and reduce crew burden. Rather it proposes a standardised holistic 'vessel report' that is suitable for all end users while also promoting a better understanding of vessel performance in anticipation of the wider



SOURCE: SHUTTERSTOCK

uptake of real-time sensors. The report notes that noon reports continue to play an intrinsic role in negotiating time charters, settling bunkers and calibrating fuel models, and that's unlikely to change, but they need significant evolution.

Parallel to that, Impact Today also wants to address the problem of data quality and validating it during the input phase, with iterative guidance for crews. Some of this would appear quite elementary, such as ensuring the reported power measurements are within the limits of the specific engines' MCR, or that all running hours correspond to normal usage and the reporting period. In total, the working group says it has developed hundreds of primary and secondary layer validations to ensure what is called "a high level of granularity".

Søren Meyer, CEO of ZeroNorth, stated: "Together, Impact Today has defined the types of data that we believe are critical to unlocking better optimisation outcomes. This white paper... calls for a new industry standard to be created for vessel reporting that will benefit the commercial performance of vessels, inform sustainability decisions, and generate better outcomes for the entire marine value chain. We welcome wider industry participation and look forward to sharing more results as this vital work continues."

Although not specifically mandated by legislation, the requirements for instruments such as the EU MRV and IMO DCS mean that noon reporting is a de facto obligation. The trouble, as ever in this industry, is that while the pacesetters can recognise the benefits to be gained from an overhaul, others will likely prefer to leave things as they are. Consequently, we're unlikely to see standardised vessel reporting any time in the near future. ■



# NEWS

## NUCLEAR POWER

### ULSTEIN GOES NUCLEAR TO SOLVE ZERO EMISSION CHALLENGE

Norway-based Ulstein has launched a nuclear-powered vessel concept it says is capable of “making the vision of zero emission cruise operations a reality”.

Named Ulstein Thor, the 149m 3R (Replenishment, Research and Rescue) design will feature a thorium molten salt reactor (MSR), energy from which will enable the vessel to operate as a mobile power/charging station for a new breed of battery driven cruise ships.

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, utilising Thor to recharge while at sea.

“We have the goals, ambition and environmental imperative to switch to zero emission operations, but, until now, we haven’t had the solution,” says Ulstein CEO

Cathrine Kristiseter Marti. “We believe Thor might be the answer we’ve been looking for. Thor is essentially a floating, multi-purpose ‘power station’ that will enable a new battery revolution.”

Thor enables replenishment of energy and supplies on site, while also boasting the technology to facilitate rescue operations, as well as conducting research tasks, she adds.

According to the Ulstein, thorium has been identified as having huge potential for a maritime industry seeking clean alternative fuels. MSRs work by dissolving thorium 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.

Professor Jan Emblemståg of the Norwegian University of Science and Technology says: “MSRs have enormous potential for enabling clean shipping. There is so much uncertainty over future fuels, but here we have an abundant energy source that, with the right approach, can be safe, much more efficient, cheaper, with a smaller environmental footprint than any existing alternative.

“From my perspective, I see this as the most viable, and potentially the only credible solution for a zero-emission fleet that can operate under commercial terms and cost levels.”



ULSTEIN THOR WILL OPERATE AS A MOBILE POWER/CHARGING STATION

## NUCLEAR POWER

### UK ADOPTS ‘NUCLEAR CODE’ FOR MERCHANT SHIPS

The UK Maritime and Coastguard Agency (MCA) has confirmed that the proposed Merchant Shipping (Nuclear Ships) Regulations will become law in the UK later this year.

These rules will bring onto the statute book the ‘Nuclear Code’ for merchant ships which forms Chapter VIII of the Annex to the International Convention of Safety of Life at Sea, 1974 (SOLAS).

The MCA, on behalf of the UK’s Department for Transport (DfT), undertook a consultation on the proposed legislation during the second half of 2021.

An overwhelming majority of responses agreed “that there

is an appetite for nuclear ships over the next 10 years with growing interest for nuclear propulsion for large ocean-going vessels” and that “it is likely that nuclear-powered ships will be seeking to trade in UK waters”.

The UK government says it intends to make the Regulations and bring them into force by autumn 2022. The Marine Guidance Note will be finalised and published at that time.

“Implementing the SOLAS Chapter VIII requirements and building strong ties with others, including the US, will increase the likelihood of UK-flagged nuclear-powered ships and reinforce the broader maritime safety regime,” the government states.



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## BULK CARRIERS

## CLASSNK ISSUES AIP FOR AMMONIA-READY LNG-FUELLED BULK CARRIER

Classification society ClassNK has awarded Approval in Principle (AiP) for the design of an ammonia-ready, LNG-fuelled 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 minimise the risks related to ammonia-fuelled ships for the ships, crew, and environment by stipulating requirements for installation, controls, and safety devices.

GSC describes the newly developed design as LNG-fuelled but ready for ammonia fuel. In the short term, the vessel will operate on LNG fuel. For the long term, GSC has put forward two scenarios: in the first, the vessel will be converted to ammonia-fuelled propulsion systems; and in the second, it will keep the systems but 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," according to ClassNK.

ClassNK reviewed the design as an LNG-fuelled ship based on its Rule Part GF incorporating the IGF Code, and as an ammonia-ready ship based on Concept Design category of its 'Guidelines for Ships Using Alternative Fuels' Annex 1.



AIP HANDOVER CEREMONY. SHINJIRO MISHIMA, REPRESENTATIVE DIRECTOR, GSC (RIGHT) AND HIROAKI SAKASHITA, PRESIDENT AND CEO, CLASSNK



GSC'S AMMONIA-READY LNG-FUELLED PANAMAX BULK CARRIER

## BULK CARRIERS

## ECO MARINE POWER UNVEILS ZERO-EMISSION HANDYMAX BULKER DESIGN

Japan's Eco Marine Power has released details of a new Handymax bulker as part of an ongoing zero-emission ship design project. The vessel design concept features a range of renewable energy solutions, energy-saving devices, electric propulsion and fuel cells.

Named the Aquarius Eco Handymax II, the design concept incorporates technologies that are either currently available or under development, according to

the company. These include an integrated sail-assisted propulsion and solar power system known as Aquarius Marine Renewable Energy (Aquarius MRE). The system received an Approval in Principle from ClassNK in 2021. A range of energy-saving devices are also featured, including an air lubrication system, along with electric propulsion and fuel cells.

Eco Marine Power says that some of the technologies featured on the design concept will be installed for evaluation purposes onboard a real-world Handymax bulker vessel later this year and that as the project develops, further technologies will be deployed.

Greg Atkinson, president and chief technology officer, Eco Marine Power, says: "The Aquarius Eco Handymax II is the result of years of research and development including shore-based and ship-based trials. The design focus is not on any one solution or technology however, but rather how various alternative power sources and energy saving devices can work together to achieve the zero emissions operation of a large ship."



AQUARIUS ECO HANDYMAX II.  
SOURCE: ECO MARINE POWER

## AUTONOMOUS SHIPS

## KR AND DSME COLLABORATE ON MASS TECHNOLOGY

The Korean Register (KR) has signed a memorandum of understanding (MoU) with Daewoo Shipbuilding & Marine Engineering (DSME) to jointly research the development of maritime autonomous surface ships (MASS) technology.

The agreement will see the two companies working together to develop autonomous operational technology to ensure the safety of the next generation of maritime transport.

DSME is developing a large autonomous merchant ship that is due to be launched in 2025. As part of its development DSME has built a ship called DAN-V to test the technology it has created based on the smart ship solution DS4. The company also plans to conduct a step-by-step demonstration of DAN-V through operational tests at sea, including equipment interwork and remote adjustment.

KR will apply its rules, cyber security certification and risk-based approval to certify DAN-V based on its digital operating data, in accordance with KR's 'Guidance for Autonomous Ships' that was enacted in 2019.

"In cooperation with KR, we are able to verify and certify a test ship equipped with autonomous operating systems based on DSME's own smart ship solution DS4. We aim to make our position solid in the future autonomous ships market," says Dong-kyu Choi, the executive vice-president of DSME's R&D institute.

Daeheon Kim, the executive vice-president of KR's R&D division, adds: "We will provide technological support to ensure the development of autonomous ship technology and advanced certification through our co-operation with DSME, acting as a cornerstone for international standardisation."

DSME IS DUE TO LAUNCH A LARGE AUTONOMOUS MERCHANT SHIP IN 2025





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# NEWS ANALYSIS

## ENGINE MAKERS VIE FOR HEADLINES

By **Malcolm Latarche**, Correspondent

Shipping has continued to be impacted by the conflict in the Ukraine with new sanctions being added regularly. Surprisingly, it was reported in April by several market sources that Russian oil exports are actually increasing despite embargoes and sanctions. However, it is Covid that is beginning once again to throw a shadow over shipping and the liner sector in particular.

As the rest of the world begins its pandemic recovery with travel restrictions disappearing almost everywhere, China has effectively closed Shanghai, the world's largest container port, as a new wave of infections has hit. Container ship congestion has been occurring now for several months and in mid-April it was suggested that one in five of the world's container fleet were waiting for a berth somewhere and a third of the affected ships were outside Chinese ports. As of 19 April, 506 container vessels were anchored off China – double the number recorded in February. There has also been a sharp decline in orders for new ships at Chinese yards in the first quarter of 2022. Whether this is another effect of Covid or merely a natural slowing down after a hectic 18 months of ordering is hard to say, but figures released by China Association of the National Shipbuilding Industry (CANSI) show that first quarter orders were down more than 42% year on year.

On a more positive note, April saw the exhibition circuit back in operation with the delayed 2021 Nor-Shipping finally taking place. Decarbonisation, alternative fuels and zero-emission ships were very much the flavour of the day in Norway although mostly in the seminars and workshops rather than on the stands in the exhibition itself. The event was well attended considering the travelling difficulties, but new product and service launches were a little thin on the ground.

However, there were announcements later in the month with the big three engine makers MAN, WinGD and Wärtsilä making most of the running. Only Wärtsilä had a new product to announce, that being its new large-bore medium-speed 46TS-DF. The DF suffix clearly indicating the engine is a dual-fuel model, but the TS is new and denotes two-stage turbocharging.

Wärtsilä says the new engine is designed with a focus on efficiency, environmental performance, and fuel flexibility signalling a new era of medium-speed marine engines. In gas fuel mode, Wärtsilä claims the engine has the highest efficiency thus far achieved in the medium-speed engine market. The engine family builds on previous models in the 46-50cm bore size and is available in six- to 16-cylinder configurations, with



WÄRTSILÄ'S 46TS-DF  
WAS OFFICIALLY  
UNVEILED IN APRIL

a power range from 7.8MW to 20.8MW at 600rpm. Already capable of running on LNG and fuel oils, it can be modified for methanol, ammonia and hydrogen. Although Wärtsilä only publicly announced the new engine this April, it has clearly been discussed with clients for longer since Royal Caribbean Cruises apparently placed an order for six of the engines for its Oasis-class ship, *Utopia of the Seas*, due to be delivered in spring 2024.

MAN Energy Systems announced it had received a new order for its ME-GI two-stroke dual-fuel engines this time for a pair of hybrid 8,000CEU car carriers ordered by Luxembourg-based CLdN. Each ship will be fitted with two MAN B&W 6S60ME-GI engines rated at 11MW. In another announcement, MAN also reported that the 1,036TEU container ship, *ElbBLUE* (ex *Wes Amelie*) has reduced its greenhouse gas (GHG) emissions by 27% by operating on a blend of synthetic natural gas (SNG) and conventional LNG, compared to LNG alone (see also p. 41-42).

During Nor-Shipping, Swiss engine designer WinGD announced that the performance of its X-DF2.0 engine technology has surpassed initial expectations in terms of fuel savings achieved. Optimised engine settings on WinGD's X-DF2.0 second-generation dual-fuel engine platform have achieved fuel savings of up to 8% in gas mode and up to 6% in diesel mode during recent tests at CMD (CSSC-MES Diesel Co) in Shanghai, China.

The company also boasted that since its launch in 2013, WinGD's X-DF engine series has become the world's best-selling low-pressure two-stroke dual-fuel engine with over one and a half million running hours to date. Building on the original X-DF engine series, the second-generation X-DF2.0 platform was launched in 2020, with the ambitious greenhouse gas (GHG) reduction targets in mind. Since that time, more than 60 engines have already been ordered. The first delivery of the X-DF2.0 is due to be in operation in 2023 onboard two newbuild car carriers. ■



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# NEWS EQUIPMENT

## SHORE POWER

### STENA LINE VESSELS EQUIPPED WITH YARA MARINE SHORE POWER SOLUTION



THE *STENA SCANDICA* WILL BE ONE OF FOUR FERRIES OUTFITTED WITH YARA MARINE'S TURNKEY SHORE POWER SOLUTION

credentials of the Stena Line fleet, as well as the quality of life for the port-side communities where the vessels will call, according to Yara Marine.

Hans Corneliusson, fleet support manager at Stena Line, says: "Connecting a single vessel to a green electrical grid when in port can reduce CO<sub>2</sub> emissions by over 5,000 tonnes per year – and this effect is multiplied across our fleet. We firmly believe that the number of ports offering shore-based power connectivity will increase in the near future and we are happy to support this change through investments in our fleet to make our vessels compatible with this technology."

Designed as a single system for easy installation, Yara Marine says its shore power solution also reduces project-related risks, such as sourcing spare parts, making it ideal for fleet-wide installations.

The company will provide aftercare services for the lifetime of the systems.

"We are pleased to use our extensive experience from planning and executing multi-vessel installations to equip four Stena Line vessels with our turnkey shore power solution, and look forward to supporting Stena Line and our other customers for the lifetimes of their installed technologies," says Yara Marine CSO Aleksander Askeland.

Norway-based Yara Marine Technologies has secured a contract to install its shore power solution onboard four Stena Line ferries as part of the Swedish shipping line's efforts to minimise carbon emissions from its fleet.

When connected to the local power grid at the port, the turnkey solution will allow these vessels to eliminate emissions and noise that would otherwise have been produced by the vessels' engines.

The solution will be installed on the *Stena Baltica*, *Stena Scandica*, *Stena Flavia* and *Stena Livia*.

The installations are scheduled to take place during the second half of 2022, which will improve the green

## WINCHES

### SERVI GROUP LAUNCHES ENERGY EFFICIENT WINCH BLOCK

Servi Group, Norway's largest producer of hydraulic equipment, has announced the addition of a new winch block with enhanced energy efficiency to its product range.

"The new Hydranor 12MB winch block is designed to reduce energy consumption and meet today's market needs within green technology," says Karl Nilssen, sales manager.

The 12MB block, designed for marine use, is built on the Hydranor 6MB's innovative design as the world's first integrated winch block with unique options for adjustments of winch performance and an innovative tension system for optimal energy efficiency, he adds.

The block has been produced with optimised design for lower internal pressure drop and lower energy consumption, and all materials in the winch block can be recycled.

Typical uses for the winch block include anchor and mooring winches, tow winches, offloading reels and crane applications, according to Nilssen.

"With a long service life, estimated to 20-plus years, modular design with all valves built in ensuring less leak points than stand-alone components, and compatibility with biodegradable hydraulic fluids, the Hydranor 12MB is designed to perform at maximum capacity in harsh environments at sea, year after year," he says.



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## WASTE HEAT RECOVERY

**ALFA LAVAL UNVEILS ORC WASTE HEAT RECOVERY SYSTEM**

Sweden's Alfa Laval has announced the launch of its E-PowerPack waste heat recovery unit, an all-in-one unit for improving a vessel's Energy Efficiency Index (EEDI/EEEXI) and Carbon Intensity Indicator (CII).

"Waste heat is a readily available but under-utilised energy source onboard. Heat in the engine exhaust gas accounts for 50% of the energy from combusted fuel, and there is additional heat to recover from steam and liquids. With the launch of the E-PowerPack, shipowners can put all these heat sources to work for savings and compliance with sustainability requirements," according to the company.

The E-PowerPack uses Organic Rankine Cycle (ORC) technology to turn waste heat into clean electrical power. By means of a liquid-gas phase change, it can generate power from both high-temperature and low-temperature heat sources, ranging from engine exhaust gas at 550°C to jacket cooling water at 75°C. It is also a modular solution, allowing units with a net electrical output of up to 100kW or 200kW to be combined in a larger system.

"The E-PowerPack is compact, extraordinarily versatile and suitable for all vessels and fuels," says Alfa Laval's

Danny Ingemann, head of global sales. "That makes it a powerful addition to Alfa Laval's other waste heat recovery solutions, which have supported energy efficiency for decades. By applying energy that would otherwise go lost, shipowners can save money, boost their environmental profile and stay competitive as regulations tighten."



ALFA LAVAL E-POWERPACK CONVERTS WASTE HEAT DIRECTLY INTO ELECTRICAL POWER

## ENGINES

**ME-GI ENGINES AT HEART OF CLDN'S RO-RO NEWBUILDINGS**

MAN Energy Solutions has been contracted by Luxembourg-based shipping group CLdN to deliver four dual-fuel MAN B&W 6S60ME-GI engines for two new hybrid, 8,000-lane-metre, roll-on/roll-off vessels.

CLdN ordered the ships from South Korean shipbuilder Hyundai Mipo Dockyard in February 2022 and the vessels are scheduled for delivery in the first half of 2025.

The two 234m newbuildings will have a hybrid propulsion system with each featuring two ME-GI engines (2 ×

11MW) along with MAN Energy Solutions' proprietary EGR (Exhaust Gas Recirculation) emissions system.

Both vessels will use 2 × 6MW electric propulsion motors to sustain a service speed between 16knots and 17knots in full-electric mode. The vessels will also be installed with 2 × 678kWh batteries and while the vessels will still have emissions during in/out port manoeuvring, shore connection is provided and will offer zero emissions in port.

The engines will also include power take-off drives (PTO). Furthermore, the shafts of the vessels will come fitted with a clutch ready to offer power take home (PTH) of 6MW.

Thomas Hansen, head of promotion and customer support, MAN Energy Solutions, says: "This order features a technologically advanced propulsion-train and having the ME-GI engines at its heart makes it a truly future-proof solution. ME-GI engines offer the industry's lowest CO<sub>2</sub> and methane-slip emissions for LNG-fuelled vessels.

"The engines' green credentials also boost CLdN's current status as among the greenest ro-ro operators in the world, while pushing its ambition to further reduce its own carbon footprint."



SCHEDULED FOR DELIVERY IN THE FIRST HALF OF 2025, CLDN'S LATEST NEWBUILDING ORDERS ARE MODELLED ON CLDN'S CURRENT 8,000-LANE-METRE SHIPS SUCH AS THE CELINE. SOURCE: CLDN



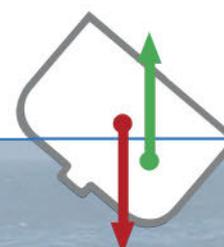
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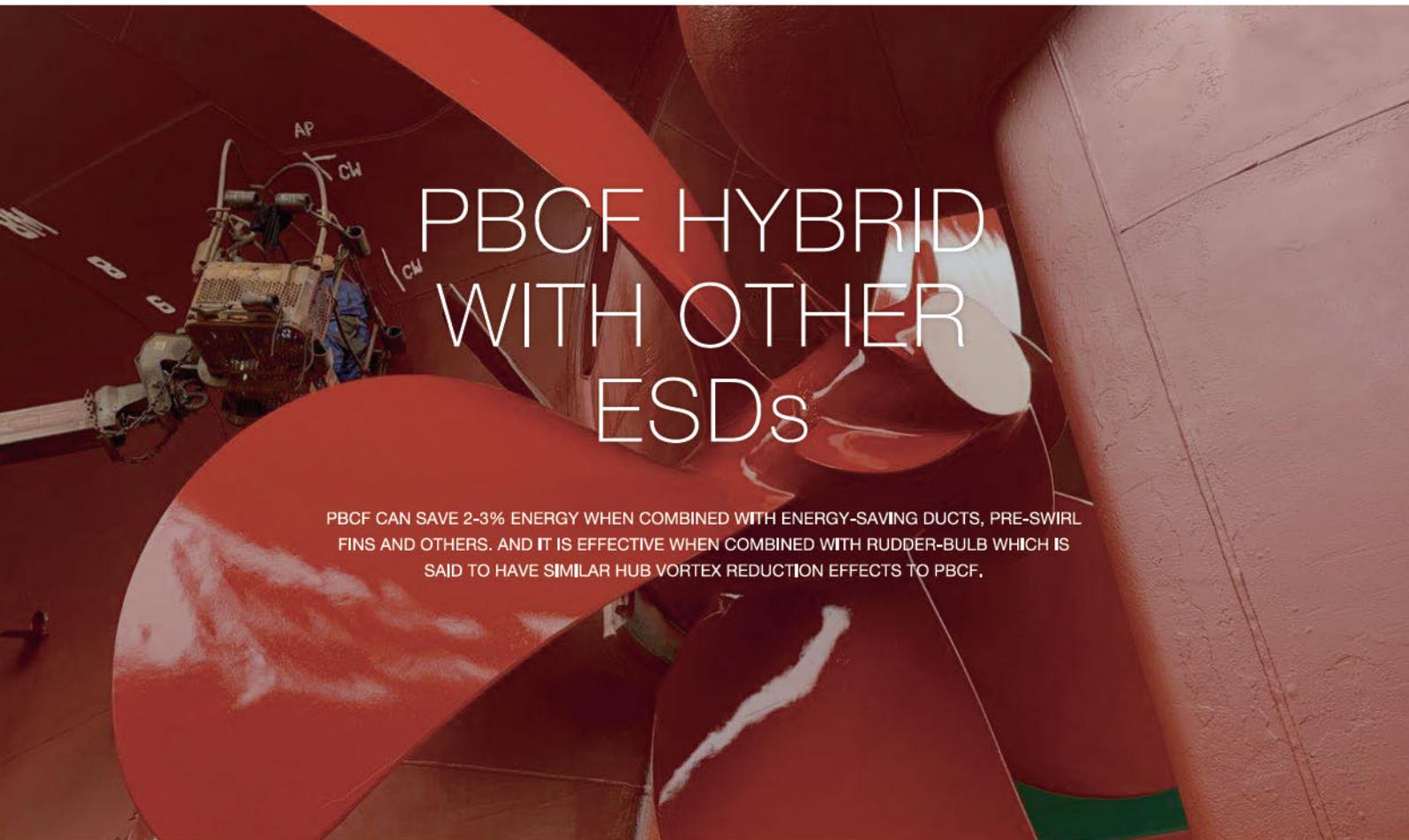
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# OPINION

## KEY TAKEAWAYS FROM WORKING ON COMPLEX PROJECTS DURING THE PANDEMIC

By **Jarkko Nurmi**, project engineer, Deltamarin

A big part of helping develop new business processes during my career has been evaluating the application of new technologies. But nothing prepared me for the rapid change forced on us by Covid-19. Before the pandemic, my colleagues and I would often discuss how digitalisation will transform our industry. Then, all of a sudden, the pandemic was upon us, with social distancing turning each of us into Little Princes (Saint-Exupéry) stuck on lonely asteroids unable to meet colleagues, clients, friends and family. We had to hastily adapt our working methods to cope with this strange and uncertain new situation. Step in MS Teams, Zoom and similar platforms – rather like the 'Picturephones' Arthur C Clark had imagined in *2001: A Space Odyssey*.

At the time, my colleague Rami Suominen was in the midst of providing approval and detailed design for the 5,100-lane-metre ropax *Superstar* for China Merchants Jinling Shipyard (Weihai) Co, Ltd (for their client Finnlines), while as project manager I was supervising the final phase of construction of Viking Lines' 65,211gt cruise ferry *Viking Glory* at Xiamen Shipbuilding Industry. Recently I spent an afternoon with Rami, who's one of our most experienced project managers, talking over the challenges we faced and how we got through them. We identified three key factors for successful execution of major projects, which could be helpful for others, not only if we encounter another pandemic, but all the time.

### 1. Productive collaborative environment

Building and maintaining a collaborative environment is essential when you work with clients of different backgrounds and cultures. You have to put a lot of effort into forging quality relationships. Meeting in person has a big influence early on, but during the pandemic we obviously couldn't travel. The challenge was all the harder with the *Superstar* project as it was just starting and that's exactly when you need to build strong foundations. Rami and his team had online meetings with all relevant stakeholders practically daily to bed in the required framework. Excellent interpersonal and leadership skills on the part of those in charge are paramount. Endless virtual meetings take much more time, but it paid off.

In my case, Xiamen Shipbuilding Industry is a long-standing client and we already enjoyed good cooperation. The health and well-being of our site team at the yard was my primary concern. Travel restrictions meant rotation couldn't go ahead as planned, with some people having to stay longer than expected. We continually kept tabs on



VIKING GLORY, DESIGNED BY DELTAMARIN. SOURCE: VIKING LINE

what was happening globally and, fortunately, there were no dramatic surprises. Thanks to Xiamen Shipbuilding Industry for their great support and to our team for their amazing flexibility.

### 2. Effective communication and meeting practices

Moving from the office to pure remote working poses big challenges. Fortunately, we were already using Teams before the pandemic, but not nearly to the same extent. It became our primary tool both for internal and external communication. We have other video conferencing systems at our disposal but using one universally accepted system was most productive. It's also much easier to identify security issues. It took some time to learn best practice, but Teams is now our 'new normal'.

### 3. Time management discipline

Time management is one of a project leader's most important duties, especially with multiple stakeholders involved. As the pandemic hit, we realised that restrictions in different countries might knock projects off beam. Keeping schedules on track was a major concern.

Luckily, we've always had good risk management procedures in place, and by extending that to a pandemic situation we were able to identify new risks and how to mitigate them. Frequent meetings with stakeholders ensured we spotted red flags and were able to take remedial action in good time.

### Surviving and thriving

While we're all still recovering from the shock of Covid-19, working life has changed for good. Remote working when practicable is here to stay. There's nothing like meeting face to face, but in the new reality we learned we can get a huge amount done online too, with problem-solving and decision-making skills leading to a positive outcome. ■



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# JAPAN

## JAPAN TAKES LEAD IN THE DEVELOPMENT OF NEXT-GENERATION ZERO-EMISSION VESSELS

By Daniel Johnson



AN AMMONIA-FUELLED AMMONIA CARRIER IS TARGETED FOR DELIVERY IN 2026. SOURCE: NYK LINE

Ahead of last November's 77th session of the International Maritime Organization's (IMO) Marine Environment Protection Committee (MEPC 77), Japan joined calls to make international shipping carbon neutral by 2050, supporting a proposal by the US, the United Kingdom, Norway and Costa Rica for IMO to raise the bar on its ambition and bring the regulator into line with other bodies pledging net-zero emissions by the midpoint of the century.

Announcing the Japanese government's policy, transport minister Tetsuo Saito stated: "As Japan aims to become carbon neutral by 2050 it has also set out a carbon neutral target for total greenhouse gas (GHG) emissions from international shipping by 2050 ... the Japanese government will also promote the development and demonstration of zero-emission ships such as hydrogen-fuelled ships or ammonia-fuelled ships, which are essential to realise the target."

The Japanese Shipowners' Association (JSA) was quick to show its full support of the policy, with its president, Junichiro Ikeda, announcing on the same day: "Today, as a current and future leader in the global shipping field, the Japanese shipping industry has committed itself to the challenge of 2050 net-zero GHG."

He added: "To rise to this challenge, there are issues that must be addressed across industries. These issues include the development of zero-emission fuels for use on ships and the establishment of global systems to supply zero-emission fuels. Cooperation with a wide range of stakeholders will be indispensable to resolve these issues."

### Vessel Development

Ikeda, who is also chairman of Mitsui OSK Lines (MOL), noted that he believed that there were two possible ways to decarbonise: to gradually convert the use of LNG fuel into carbon-neutral methane or expand the research on the use of hydrogen and ammonia fuel. In line with this thinking, Japan has decided to hedge its bets and develop a hydrogen-fuelled ship, commercialise an ammonia-fuelled ship, and develop technology to significantly reduce methane slip in LNG fuel through its 'Next Generation Vessel Development' project. Up to JPY35 billion (US\$273 million) has been budgeted for the project, which will be provided by Japan's Green Innovation Fund through the New Energy and Industrial Technology Development Organization (NEDO).

The project, which involves a number of consortia made up of Japanese shipping companies, shipyards, engine manufacturers and trading companies, as well as universities, has selected four themes for research and development: 1) Development of marine hydrogen engine and marine hydrogen fuel system (MHFS); 2) Development of ships equipped with ammonia fuel domestic engines; 3) Integrated project of ammonia fuel ship development and social implementation; and 4) Development of methane slip reduction technology for LNG-fuelled ships by improving catalysts and engines.

### Hydrogen

Work on theme one is being undertaken by a consortium that includes Kawasaki Heavy Industries (KHI), Yanmar Power Technology (YPT) and Japan Engine Corporation (J-ENG). The partners will simultaneously develop low-speed, medium-speed and high-speed engines using hydrogen as fuel and plan to have a line-up of engines that can be used in a variety of applications ready by 2026.

KHI is to develop a medium-speed four-stroke engine with a propulsion output of between 2,000kW and 3,000kW; YPT a medium-speed and high-speed four-stroke auxiliary equipment engine with an output of 800kW and 1,400kW; and J-ENG a low-speed two-stroke engine for propulsion with an output of 5,000kW. The companies will demonstrate the technology onboard ships ahead of its application, with KHI reporting that its medium-speed four-stroke engine will be demonstrated on a liquefied hydrogen carrier, the medium-speed and high-speed four-stroke engines on tankers, and the low-speed engine on a bulk carrier.

KHI is to also develop the MHFS, which will consist of a marine hydrogen fuel tank and a fuel supply system. The MHFS will be applied to the demonstration operation of medium and high-speed four-stroke engines, and two-stroke engines, after land-based tests, according to KHI.

### Ammonia

Two consortia are working to commercialise ammonia fuel, each with the aim of introducing ammonia-powered vessels by 2028, ahead of other nations. A "demonstration project for the commercialisation of vessels equipped with a domestically produced ammonia-fuelled engine" is headed up by NYK Line, J-ENG, IHI Power Systems and Nihon Shipyard. The project, which got underway in December 2021 and also involves ClassNK, will develop an ammonia-fuelled tugboat (A-Tug) and an ammonia-fuelled ammonia carrier.

NYK Line and IHI Power Systems will take responsibility for the A-Tug, with IHI Power Systems developing a four-stroke engine of approximately 1,600kW output and NYK Line designing the tugboat and establishing operation and maintenance methods. ClassNK will provide a safety assessment of the vessel. Targeting a delivery of the A-Tug in 2024, the companies are aiming to achieve an ammonia fuel mix combustion rate of 80% or higher. They plan to improve the mixed combustion rate with a view of achieving zero GHG emissions by using biofuel as a pilot fuel in the future.

For the ammonia carrier, J-ENG will develop a two-stroke ammonia fuel engine of about 8,000kW as the main engine and IHI Power Systems will develop a four-stroke fuel engine of approximately 1,300kW for the auxiliary equipment. NYK Line will be responsible for project management, ship design and legal compliance, while Nihon Shipyard will oversee hull development

and examine ship construction methods. Again, ClassNK will carry out a safety assessment of the ship. As ammonia will be transported as cargo, the vessel, which is targeted for delivery in 2026, will use the cargo and ammonia gas vapourised from the cargo as fuel during voyages. The aim is to reduce GHG emissions by achieving a maximum ammonia fuel mixed combustion rate of 95% for the main engine, and 80% or more for the auxiliary engine.

The second consortium working on ammonia fuel comprises Kawasaki Kisen Kaisha (K Line), Itochu Corporation, Nihon Shipyard, Mitsui E&S Machinery and NS United Shipping. Their focus is on the development of an ammonia fuel propulsion system and hull, as well as an integrated project covering the establishment of international supply chain for ammonia as marine fuel.

K Line, Itochu Corporation and NS United Kaiun Kaisha will be responsible for the operational demonstration of an ammonia-driven vessel. Mitsui E&S Machinery will be in charge of the development of an ammonia fuel tank and supply system, the development of technology associated with ammonia-fuelled engines, and the development of safety features specific to ammonia-fuelled vessels. The company will also conduct demonstration operations. Nihon Shipyard will develop a hull equipped with ammonia fuel tanks, an ammonia fuel handling system and safety systems.

For the integrated project, Itochu Corporation has been tasked with the assembly of an international supply chain for ammonia as marine fuel. The company states that by acquiring the upstream interests of producers around the world, it will develop a fuel procurement system and work with partners in Southeast Asia and other regions to develop fuel supply bases. ■

## METHANE SLIP CHALLENGE

With LNG expected to be one of the main fuels among international shipping's total energy consumption in the decades ahead, even if hydrogen and ammonia become widely used, MOL, Hitachi Zosen and YPT have been selected by NEDO to jointly developing technology to reduce methane slip from LNG-fuelled vessels.

The project intends to lower the environmental impact of LNG fuel engines by attaining a methane slip reduction rate of more than 70% by 2026.

The reduction will be achieved by combining a methane oxidation catalyst and engine improvements. In the design developed by Hitachi Zosen and Yanmar, the system is placed in the exhaust pipes of LNG fuel engines and generators that contain unburned methane, and methane is oxidised on the catalysts to reduce methane slip. The new technology will be demonstrated on a large LNG-fuelled coal carrier to be built by Namura Shipbuilding for MOL.

In March 2022, just a few months into the project, the companies reported that their design concept had reached a key milestone, with ClassNK awarding it an initial Approval in Principle (AiP). The award was the world's first for a methane oxidation catalyst system and confirmed that the proposed system meets the requirements of the International Code of Safety for Ship Using Gases or Other Low-flashpoint Fuels (IGF Code) and other regulations.

The partners have a view of utilising carbon-recycled methane in future applications, thus reducing greenhouse gas emissions to zero by 2050.



# CLASSNK OFFERS ACCOUNTABLE INNOVATION STANDARDS

ClassNK has added sustainability and social responsibility to its unique 'Innovation Endorsement' certification services



NYK LINE'S PCTC *SAKURA LEADER* WAS THE FIRST VESSEL TO RECEIVE CLASSNK'S DSS NOTATION. SOURCE: NYK LINE

Launched in 2020 to encourage digital technology innovations in shipping, ClassNK's Innovation Endorsement certification service expanded to include scope for issues related to the Environment, Safety and Labour in 2021. The extension confirms the way the original offer tapped into strong client demand for third-party evaluation to support future-looking commitments and further embeds Innovation Endorsement within the 'ClassNK Digital Grand Design 2030' strategy.

"Innovation Endorsement was conceived to fill an industry need for third-party certification that could enable change, where it has been clear that evaluation standards to support the spread of innovative technologies are not likely," says Mr Yoshimichi Sasaki, general manager, Digital Transformation Center, ClassNK. "Positive feedback has persuaded us to take the same approach in another challenging area for innovation."

ClassNK describes Innovation Endorsement as a non-mandatory and 'speed-focused' certification service whose primary purpose is to help front runner solutions overcome challenges that often face pioneers. The society worked alongside shipping companies and manufacturers to establish a framework designed to accelerate the deployment of new technologies, in an initiative going beyond the traditional class society role.

## Digital Smart Ship

The Innovation Endorsement programme led on to ClassNK's first 'Digital Smart Ship' (DSS) notation, granted to NYK's Pure Car, Truck Carrier *Sakura Leader*

in October 2020. Officially described by NYK as the first of the 'next-generation eco-friendly ships' in its PCTC fleet, *Sakura Leader* was also the first LNG-fuelled PCTC built in Japan.

Based on NYK's intentions and at the request of shipbuilder Shin Kurushima Dockyard, ClassNK verified the installation of the ship's digital energy management technology. Ultimately, the society's notation extended to the DSS(EE) energy efficiency function, DSS(MM) machinery monitoring and DSS(CNS) for onboard data processing and data transmission to shore.

By the end of March 2022, 76 ships had been certified as being equipped with advanced digital solutions recognised under the technology-focused version of the scheme, for which ClassNK says applications are being continuously received.

In addition to ship installations, Innovation Endorsement is used to evaluate products, solutions and companies or organisations themselves for certification. In all cases, significant progress has been made.

Products and solutions are examined and verified for their innovative functions based on ClassNK's knowledge and experience as a recognised third-party authority, with certificates issued to support their deployment. Alpha Ori, for example, has secured Innovation Endorsement for its real-time predictive maintenance system AssetAI Plus in April 2021. As of the end of March 2022, 14 products and solutions had



YOSHIMICHI SASAKI

secured certification, with a further 13 solutions under review by ClassNK's dedicated taskforce.

Certification for providers is given to organisations engaging in innovative initiatives from the early stage, with three types of certificate denoting (1) concept, (2) development, and (3) sustainable implementation.

ClassNK's first Provider Certification went to Tsuneishi Facilities & Craft Co., Ltd (TFC), as part of the evaluation of the management system behind JPNH2YDRO Co., Ltd – a joint venture formed by Tsuneishi Group and Belgian shipping company CMB which seeks to introduce hydrogen powered ferries to market. Tsuneishi Group will use JPNH2YDRO to incubate its hydrogen business, including the development of a hydrogen internal combustion engine and a hydrogen supply chain.

**Guidelines**

The maturing and broadening scope of Innovation Endorsement is supported by the revision of two relevant publications from ClassNK: Guidelines for Digital Smart Ships (Edition 2.0) and Environmental Guidelines (Edition 4.0), says Mr Yoshimichi Sasaki. As companies respond to or anticipate societal pressures by pursuing ESG management and sustainable development goals (SDGs), innovation will continue to play a vital role in resolving challenges, he says.

"We have developed class notations for innovations in environment, safety, and labour as well as on strengthening verification methodology for products and solutions, and providers. For ships, these include a framework to certify Advanced Safety (a-SAFE), Advanced Environmental Awareness (a-EA) and Excellent Living and Working environment, for example. The revised guidelines have further streamlined the scheme to certify the ships with digital and sustainable innovations."

Once more, Innovation Endorsement certification is conducted for (1) Ships, (2) Products & Solutions such as software and equipment, and (3) Providers. However, to accommodate its broader scope, the expanded Innovation Endorsement is described as "ClassNK – Innovation Endorsement Approach".

THE EXPANDED PORTFOLIO FOR CLASSNK'S INNOVATION ENDORSEMENT SERVICE

ClassNK's Environmental Guidelines (Edition 4.0) include class notations for environmental measures on ships based on Advanced Environmental Awareness notation, in addition to existing environmental notations (EA). The guidelines also include the relevance of ships' environmental measures to SDGs, in response to their growing significance in wider society.

Further indicating that the work under the Innovation Endorsement programme is itself the subject of continuous improvement, ClassNK recently revised its Guidelines for Digital Smart Ships and Environmental Guidelines. Guidelines for Digital Smart Ship (Edition 2.0) stipulating class notations for the ships provided with systems utilising digital technology have added target smart systems and established provisions for identifying smart systems by their level of technology advances.

Most recently, ClassNK granted the first of its highest 'Class S' Innovation Endorsement Provider Certification to Nippon Yusen Kaisha's (NYK) Marine Group, where 'S' denotes 'Sustainable Implementation'. The certification verifies the management methodology and systems of NYK's Remote Diagnostic Center in Manila, in developing AI-based techniques in plant monitoring and anomaly detection to ensure a higher levels of ship safety.

Class S certification indicates that the company has established and is operating a management system to enable effective innovation activity, and is solving social issues and continuously creating new value through the utilisation of ship IoT data and human resources.

"ClassNK continues striving in support of innovation, and offering our expertise and collaborative approach to work with front runners," Mr Yoshimichi Sasaki concludes. "Industry's feedback on Innovation Endorsement has been positive, and we are on the right path to provide the third-party certification for innovative technologies and initiatives. ClassNK continues to expand the scope of Innovation Endorsement certification to serve the industry and society more effectively." ■

# ClassNK Innovation Endorsement

Third-party certification of innovations and initiatives (concepts and real services)  
 Convincing stakeholders of feasibility and value of the innovations  
 Developing adequate and accountable standards for emerging tech

	Digital	Green	Safety	Labor	
<b>Ships</b> <small>Notations on Class Cert.</small>	Digital Smart Ship (DSS)	Advanced Environmental Awareness (a-EA)	Advanced Safety (a-SAFE)	Excellent Living and Working Environment (ELW)	& YOURS
<b>Products &amp; Solutions</b>	CBM, E-Log Book, Data Quality	HW/SW for Energy Efficiency	Navigation Monitoring, Alerting	Low Cabin Vibration	
<b>Providers</b> <small>- Concept - Development - Sustainable Implementation</small>	Management Optimization	Decarbonization, Environmentally Sound Facility	Fleet Control Support, Advanced Monitoring	Working Condition Improvement, Remote Hospital	



# RO-RO

## AURORA CLASS PCTCS: HÖEGH AUTOLINERS TAKES ITS NEXT STEP ON THE PATH TO ZERO EMISSIONS

By **Kari Reinikainen**, Correspondent



HÖEGH AUTOLINERS SAYS THE AURORA CLASS WILL BE THE MOST ENVIRONMENTALLY FRIENDLY CAR CARRIER EVER BUILT

Höegh Autoliners in Norway has entered into a contract with China Merchants Heavy Industry (Jiangsu) Co., Ltd (CMHI) for four fixed and eight optional multi-fuel and zero carbon-ready Aurora class vessels.

Having completed the conceptual design of the ships for Höegh Autoliners, Finnish consultant naval architects Deltamarin is now undertaking the engineering work for CMHI, including complete basic and detail design of the vessels.

Vesa Hamarila, Deltamarin senior advisor, tells *The Naval Architect*: "The Aurora class ships will be powered by marine gas oil (MGO) and LNG and prepared with readiness for operation on zero-carbon fuels such as ammonia or methanol once these become more widely available. Several other features are also included in the design to minimise the environmental footprint of the ships."

Combining economy of scale with optimised and future-proofed ship concept results in the lowest greenhouse gas footprint per transported car in the industry, and a clear path to zero-emission operation.

"Höegh Autoliners and Deltamarin have together developed a new generation car carrier concept based on the state-of-the-art technology and with emphasis on environmental features," Hamarila adds.

Work started on the project at the beginning of 2020, analysing the means and technologies to enhance the environmental performance of the future fleet aiming at a breakthrough in reaching the ambitious net zero emissions target by 2040.

"The Aurora class is designed to transport the cargo of the future. The vessel's strengthened decks and enhanced internal ramp systems enable electric vehicles on all decks and provide more flexibility for heavier project cargo," Hamarila says.

The ships have been designed by Deltamarin's digital design methods, with the objective of designing a ship that is optimised for its future operational scenarios for maximum fuel and environmental efficiency. "A core part of our digital design is energy system level simulations (energy model) for determining the ships fuel consumption and environmental footprint. For the

energy model, the operation profile for the intended service has been used to support the optimisation of the vessel," he notes.

Design includes building an accurate model of the ships' lifetime propulsion power requirements by combining ship hull to data of the surrounding environmental conditions. "After optimising the hull, the ship digital model is utilised for determining the most profitable energy saving solutions, such as innovative propulsion technologies or ship hybridisation, and for generic dimensioning and optimisation of ship systems," Hamarila continues.

Digital features, data collection infrastructure, has been taken into consideration to obtain forthcoming class notation. Extensive hull form development effort has been made carrying out tens of CFD calculations using the nuShallo and Star CCM+ CFD tools for optimisation.

The Aurora class will have DNV's ammonia and methanol ready notation and be the first in the PCTC segment to operate on zero-carbon ammonia. Together with the capacity to carry up to 9,100 cars, the Aurora class will be the world's largest and most sustainable car carriers.

"The vessel has been designed for a large field of solar panels. In addition, it will be ready for receiving high-voltage electric shore power for zero-emission operations during port stays," Hamarila concludes.

Höegh Autoliners expects to have the first two of the newbuildings in service in 2024 and the following pair a year later, marking the next step in the company's path towards zero emissions. Since 2008, Höegh Autoliners' fleet has achieved improved carbon intensity of 30% and the company is well ahead of



DELTAMARIN'S VESA HAMARILA

IMO's target of a 40% reduction by 2040, CEO Anders Enger said in the company's 2021 annual report.

**Breakbulk, high & Heavy, high-margin cargoes**

PCTCs – Pure Car and Truck Carriers – are often referred to as car carriers and in the case of Höegh Autoliners, automobiles comprise the clear majority of its freight volume. Factory-new light vehicles make up 58% of the annual total volume, followed by high & heavy cargoes (25%), second-hand light vehicles (11%) and breakbulk cargoes (6%).

However, on a scale from one to four, breakbulk has the highest margins at four points, followed by high & heavy and second-hand cars with a score of three points. The new cars business has the lowest margin at two points, the 2021 annual report shows. Against this background, it is no surprise that the high margin cargoes that offer high-margins have also affected the design.

The company's total cargo volume amounted to 14.1 million cubic metres last year. It operates a fleet of 39 ships, of which 26 are owned and 13 chartered in. Its fleet has an average capacity of 6,700CEU, the 2021 annual report said, which also showed that the largest ships in the current fleet are the four 8,500CEU Horizon class vessels. These were built in 2015-16.

"The Aurora class was designed with flexibility in mind. The vessel will have DNV's ammonia and methanol ready notation and will be the first in the PCTC segment to operate on zero-carbon ammonia. Designed for future cargo, the vessel's strengthened decks and enhanced internal ramp systems enable electric vehicles on all decks and provides more flexibility for heavier project cargo. A highly sustainable and innovative solution, which the customers have grown increasingly interested in," COO Sebjørn Dahl commented in the annual report.

Björn Rosén, vice president, Cargo Access Solutions, at MacGregor – which will supply the cargo access equipment to the new ships – comments that electric vehicles are on average heavier than traditional vehicles with combustion engines due to the large

PRINCIPAL PARTICULARS	
Aurora class PCTCs	
Length overall	199.99m
Breadth, moulded	37.60m
Draught, scantling	10.80m
Cargo decks	14
Deadweight at scantling draught	25,200t
Max. service speed	18knots
Deadweight tonnage	8,222.9dwt
Class notation	DNV +1A, Car Carrier, MCDK, ICE C, EO, NAUT-OC, CLEAN DESIGN, BWM-T, TMON(oil lubricated), BIS, COAT-PSPC (B), GAS FUELLED, *BATTERY(safety),F(C),Recyclable,*SHORE POWER, Fuel ready Ammonia (D, S , MEc,Aec ,Ti ; Fuel ready LFL (MEc,AEc,D,Ti*,Tc)



battery packs, which affects the design requirements of the decks and ramps.

MacGregor will also supply a Load Monitoring System (LMS) for the stern quarter ramp. This is a patented system that allows a temporary increase of the maximum load travelling over the ramp by utilising the auto-tension function in the ramp manoeuvring winches in combination with an enhanced control system. "This allows the ship to take on heavier project cargoes, in a safe and efficient way, without the drawback of carrying a heavier ramp," Rosén tells *The Naval Architect*.

**Fuel switch conversion best timed with dry docking**

With regard to their eventual transition to clean fuels, Kjeld Aabo, director of new technology two-stroke promotion, at MAN Energy Solutions (MES), noted in a recent statement that after modifications to the engines, tanks and auxiliary systems the main engine of these ships would be able to run on virtually any new green fuel, such as ammonia.

Jan Hoppe, head of communication and marketing at MES, noted that many components would have to be changed in a fuel switch, but to highlight the major ones, the dual-fuel components will need to be upgraded to the relevant fuel type selected and

related fuel gas supply system. As far as the time required for such a work was concerned, Hoppe said that on the basis of a test case of a LGIP conversion, any order should be placed 14 months before the first docking date.

Dry docking of the ship would not be necessary as the conversions can be carried out while the ship is alongside a berth. "However, due to the major conversion project it should be timed with the five-yearly docking to make the most of the dry docking period as the vessel will be off hire during the extended period," he pointed out.

MES is currently developing two-stroke engines that can run on ammonia and the first machine is scheduled to be delivered to a shipyard in two years' time, he added.

Hrshikesh Chatterjee, promotion manager (United Kingdom Shipowners) at MES, added that a retrofit case will always demand a substantial amount of design work, and the part of that related to the engine will be less if the detailed design and factory acceptance test of the exact size and Mk number variant already exists. "If not, the amount of design work will be more, and a test will have to be performed," he added. ■

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# SMART SHIPS

## ABS SPONSORED RESEARCH FINDS OT IS A SOFT TARGET FOR CYBER CRIMINALS

By **Richard Halfhide**

Overshadowed by the reports of collateral damage, a significant facet of the ongoing conflict between Russia and Ukraine has been the role of cyber warfare perpetrated by both sides and their allies. In April, the Ukrainian government revealed it had narrowly averted a serious cyber-attack on the country's power grid, highlighting how cyber criminals are increasingly shifting their attention from infiltrating IT networks to potentially far more damaging assaults on the operational technology (OT) and industrial control systems (ICS).

As discussed in April's edition of *TNA* ('Getting to grips with IMO's cyber resolution' p.28-29), there's a general acceptance that maritime cybersecurity is lagging behind other industries, particularly with regard to OT, and that it's becoming a matter of growing urgency as ships become more sophisticated. Also in April, IACS released its Unified Requirements E26 and E27 for cybersecurity aboard ships; these mandate that new ships contracted on or after 1 January 2024 must include solid OT cybersecurity requirements for ships and shipboard systems.

In March, global risk management company ABS Group (ABSG), a subsidiary of the classification society ABS, announced the results of a survey it had sponsored by cybersecurity research and educational group the SANS Institute: 'Threat-Informed Operational Technology Defense: Securing Data vs. Enabling Physics'. While the respondents were not restricted purely to shipping – drawing also on feedback from other industries where OT and ICS play a critical role – the survey revealed that an alarming 45% of those who took part estimated their control systems to be at high risk, with a further 15% considering the threat to be severe or critical.

### Perception gap

At the heart of the problem is what ABSG describes as a 'gap in perception' of cybersecurity risk between OT/ICS front-line teams and other parts of an organisation, with more than a third of respondents (35%) saying there was a gulf between senior management and those tasked with protecting OT systems.

"A lot of managerial teams and company execs that were interviewed didn't have the full confidence that their IT teams could do what was necessary on the OT side," Dennis Hackney, ABSG's director of industrial cybersecurity services solutions, tells *TNA*. "While there are some IT experts who can navigate cyber protection for OT, the results generally show that there is a critical knowledge gap."

Since compromising an OT system can bring about a swift



DENNIS HACKNEY

and costly disruption to operations – and cyber criminals know it – this vulnerability has become a particular area of focus, with ransomware often being the criminals' chosen modus operandi.

While ransomware can take the form of a simple phishing email designed to take the data ransom, that in itself can sometimes be a ruse to conceal an OT attack. The NotPetya virus – infamous in maritime circles for costing Maersk an estimated US\$300 million in 2017 – was initially assumed to be previously known Petya ransomware when it took down the ICS of power stations in Ukraine earlier that year, but closer inspection revealed it had actually been designed for more destructive purposes rather than purely monetary gain.

"Threat actors can use IT cyber tactics to compromise OT systems, like the Triconex hack of a few years back; by going through the distributed control system, the safety instrumented system was compromised in a way that causes a physical event." Hackney continues: "Trisis did cause a shutdown, but if the shutdown didn't occur, it could have been much worse."

Moreover, because risk assessment for IT cybersecurity tends to be skewed towards confidentiality aspects, rather than operational safety, so too are the mitigation processes (e.g. firewalls), despite the fact they aren't always applicable. "You can't apply IT safeguards like encryption to OT networks in the same way that you apply encryption in an OT network." However, on the IT side, there could be a minor delay and the user might not even notice it."

And in turn, it raises the question of how to assess and evaluate whether the cybersecurity software is even serving its purpose. "This might be the biggest problem we need to solve in this space, because assessing





# THE POTENTIAL BENEFITS OF 3D PLAN REVIEW ARE ANYTHING BUT STANDARD

By **Patrick Ryan**, senior VP, Global Engineering and Technology, ABS

Vessel designers and shipyards are increasingly looking for ways to innovate and adopt digital tools in support of measurable efficiency gains. It's a trend recognised by ABS and one we have supported through initiatives such as 3D plan review to streamline the approval workflow process, reduce project risk, save cost and increase efficiency.

With the process gathering momentum, so is interest in standardisation for exchange of 3D plans using the OCX format (see *TNA* May 2019). Standardisation is one approach and ABS is a supporting member of the coalition to develop it, however it is not the only approach. ABS envisages an 'open standards' strategy that accommodates multiple approaches and does not constrain designers and shipyards to one process. Digital innovation in CAD will eventually develop an optimal process for digital data exchange to truly flourish.

Our position is simple, we don't mind what format is used – OCX included – we will support, convert and manage data however designers want to send it and yards want to receive it. Determining that a particular standard is the 'right way' for yards to receive 3-D plans could add costs and restrict innovation if it forces them to manage production in a specific format.

Designers and builders should have the freedom to use any particular standard that suits their organisational needs. This enables the industry to be flexible, agile and allow for innovation. The key point is not to hinder innovation or anchor it to a point in time but rather let technology mature.

Safety remains our primary concern but designing and building ships requires flexibility and competitiveness. Stakeholders should not feel obliged to reject flexibility, competition and innovation to adopt a particular standard.

The risk of standardisation, apart from potentially curtailing innovation, is that the result will be one more standard among all the existing standards. In the trials and core workflow processes ABS has used with clients for 3D plan review to date, all have used standards like JT, STEP, and IGES; none used OCX. ABS can work with OCX or a different standard, but we won't insist on one or the other; we will always advise using what's best for the particular application.

Our reasoning recognises all the possibilities the future will bring. Will robotics add an unforeseen dimension, could additive manufacturing mean changes are needed to the way models are created? It's the things we don't yet know that make us wary of saying 'this should be done in that way' so early in the adoption timeline.



PATRICK RYAN

The industry is becoming familiar with using 3D disclosures, though it is still relatively new beyond a handful of early adopters. As such, more shipbuilders understand the potential, even if they don't necessarily have a full handle on which formats work best for them and whether they need full fat or lightweight versions that work in the design office, the yard or fabrication shop.

A few shipyards are fully digital on newbuilding projects, while others are at the evaluation and joint project stage. It is critical to give them flexibility rather than say 'this is what you're going to get, now go work with it'.

There are benefits for designers too. In situations where design changes are requested by Class, a standardised process could require updating and re-supplying an entire model, whereas using native CAD would mean simply changing the affected piece, potentially saving time and money. Adding repeating file conversions into the design process is a drag on innovation that we don't want to impose.

Currently, there are two planned exchanges between Class and the designer. The designer submits drawings, Class reviews and comments and the designer revises. This creates a lot of waiting time, which results in cost, schedule and project risk.

Looking further ahead, ABS is working on adopting the technology for 3D plan review into the ABS Freedom platform such that the review and comment process can be managed by Class with designers and shipyards in near real-time.

By going digital, can we manage change better, thereby moving the review and comment process up the schedule? If so, it presents a huge incremental value proposition for owners in terms of risk reduction, compliance and safety. ■



# HEMEXPO SEES COLLABORATION AS KEY FOR SMARTER, GREENER SHIPPING

By Daniel Johnson

In the evolving world of shipping, digital technology and sustainability go hand in hand. Innovations in digitalisation, automation and other 'smart' technologies will play a pivotal role in the industry's efforts to decarbonise operations and meet regulatory requirements in the years ahead.

"We are currently experiencing the fourth 'Industrial Revolution', where smarter and greener shipping is the future," explains Eleni Polychronopoulou, president of HEMEXPO (Hellenic Marine Equipment Manufacturers and Exporters). "It's a crucial time for the industry, where collaboration and new technology development are vital to addressing its challenges, improving vessel performance and meeting International Maritime Organization climate objectives."

Polychronopoulou, who has dedicated her career to the growth and development of the Greek marine equipment manufacturing industry, has headed up HEMEXPO since its formation in 2014. Under her leadership it has quickly become established as one of the leading European maritime exporter associations, playing a key role in representing Greek marine technology specialists through worldwide links with shipowners and operators, class societies and shipyards.

## New challenges, new opportunities

"Sustainability is now a key priority for our members, which has created a number of challenges. However, with challenges comes opportunities," she tells *The Naval Architect*. "We see the fastest growing market for our members as digital technologies and solutions, so it's important that we adapt to the changing needs of the shipping industry. We need to understand the digitalisation challenge and the decarbonisation challenge, and to develop solutions and products to address these challenges and ensure we remain competitive."

As part of its efforts to meet these challenges, Polychronopoulou says HEMEXPO is currently in discussions with the Greek government to set up an innovation programme that will look to develop products for decarbonisation and digitalisation. "The idea is to bring together industry, academia and other stakeholders involved in the ecosystem in order to be able to keep ahead of developments and provide solutions," she explains.

She also notes a memorandum of understanding (MoU) HEMEXPO has signed with the Hellenic Association of Space Industry (HASI) in order to benchmark and use these high-end technologies in the marine industry. Polychronopoulou sees the collaboration not only offering new possibilities in ship design, but also in data analysis and big data. It is also an important step in ensuring Greek manufacturers are included on the manufacturer lists maintained by Chinese shipyards, she says.

In March 2022, HEMEXPO and Damen Shipyards Group in the Netherlands signed a Declaration of Intent (DOI) to enhance cooperation in shipbuilding and the development of marine equipment and ship technology. The DOI formally recognises HEMEXPO's interest in presenting smart ship solutions from Greek marine equipment manufacturers to the Dutch shipbuilding market, says Polychronopoulou, and involves sharing of information about new marine equipment and shipbuilding technologies, the organisation of networking events to promote cooperation between Damen and Greek suppliers in various projects and where possible including Greek suppliers in Damen's supply chain.

The declaration comes at a time when Damen is competing for the award of the Hellenic Navy's corvettes programme. As part of the programme specific attention goes out to the participation of the Greek defence and shipbuilding industry in the construction of the vessels.

"Damen is very experienced in working with local industries, and recognises its relationship with HEMEXPO as of crucial importance," says Polychronopoulou. "And we are delighted to have signed this Declaration of Intent which will see our organisations work together on a range of projects and initiatives."

"We are always looking for new partnerships and strategic alliances worldwide and we see collaborative efforts as the best way forward during this acceleration in the development and adoption of new technologies," she concludes. ■



ELENI POLYCHRONOPOULOU, PRESIDENT OF HEMEXPO

# ONBOARD WIRELESS CONNECTIVITY HELPS MARITIME INDUSTRY FULLY LEVERAGE IOT

By **Daniel Johnson**

Having steadily built up momentum over the last decade, the era of the Internet of Things (IoT) has well and truly arrived. Thanks to the prominence and availability of wireless network infrastructure just about everything in our lives can now be made 'smart' through the use of IoT, and a multiplicity of web-connected devices are shaking up old industries with an abundance of data.

But until recently the promise of IoT and the practical reality of implementing the technology onboard ships has been technologically difficult or near impossible to provide. "A star topology like Wi-Fi works for the use in homes and office buildings, but it cannot easily deal with steel, the main construction material for the world fleet," according to maritime IoT company Scandinavian Reach Technologies (ScanReach).

The inside of the archetypal vessel is not too far away from being a perfect 'Faraday cage', which prevents wireless signals from passing through steel barriers, such as bulkheads and decks, explains the company.

One way to get around this problem involves the drilling of multiple holes throughout the ship and wiring it with cables, an approach that can be difficult to commission as it often requires days or even weeks of work by teams to run the correct wiring, possibly while the ship is out of service.

"This makes it prohibitively expensive for the majority of vessel operators to fully embrace the use of IoT technology onboard their ships and reap the rewards that come with real-time access to sensor data," says ScanReach CEO Arild Sæle.

ScanReach's solution is "the world's first wireless IoT platform designed specifically for complex steel environments". The Onboard Wireless Connectivity (OWC) platform, which has secured type-approval from DNV, can be installed within hours, even while the vessel is in operation, obtaining full onboard wireless connectivity throughout the vessel. ScanReach suggests that the return on investment can be 10 times better than for conventional alternatives.

OWC relies on a network small devices called mesh nodes – the network typically consists of between 50 and 100 nodes. These proprietary nodes use carefully chosen frequencies and protocols to communicate and pass signals to a gateway computer that can be installed in the ship's server room. The nodes can integrate with third party sensors both wireless and wired. Data collected are then passed through the mesh.

The nodes only need a power supply (no other wiring is required) and have an internal backup battery that will keep the network running for at least 24 hours in a



THE SCANREACH NODE IS THE BUILDING BLOCK FOR FULL ONBOARD WIRELESS CONNECTIVITY

blackout or emergency. The nature of a mesh network also means that if one unit fails, it won't bring down the network, with signals being picked up and passed on by other nodes instead.

"The maritime industry can now fully leverage the IoT to improve the safety, efficiency, and profitability of their fleet," says Sæle, adding that OWC can fit many use cases but really shines when it comes to retrofitting existing vessels with data collecting capabilities.

OWC is currently installed on a range of different types of vessels, acting as the backbone for a number of ScanReach solutions. The company is developing a growing range of data services that are enabled by OWC and has already launched a personal safety system for crew (ConnectPOB), a fleet data management platform (ConnectFleet), and a fuel management system (ConnectFuel).

ConnectFuel, ScanReach's most recent offering, links flow meters attached to the fuel lines to displays on the bridge and onshore, providing real-time information on fuel consumption as well as for a selected period. The technology is said to be able to assist in fuel savings.

"Reports show typical savings of around 5%, and in some cases up to 10%, could be achieved simply by giving the bridge team real-time fuel data," according to Jacob Grieg Eide, chief business development officer.

Data collected by ConnectFuel is also transferred ashore by satellite and stored in the cloud, where shore staff can view real-time consumption rates and extract and analyse the information gathered. If more specific data is needed – such as splitting main engine and auxiliary consumption, or information from individual engines – ConnectFuel can provide that if flow meters are fitted at appropriate locations in the fuel lines.

ScanReach has a range of other use cases in development, including gas and environmental sensing, vibration and condition monitoring, and emissions monitoring, concludes Eide. ■



# NAVTOR CHARTS THE WAY FOR IMPROVEMENTS IN FLEET PERFORMANCE

By **Daniel Johnson**

Faced with stringent International Maritime Organization (IMO) decarbonisation targets and looming industry regulations, not to mention initiatives such as the Poseidon Principles and the Annual Efficiency Rating (AER), the pressure is on for shipowners, ship managers and operators to understand and improve the performance of their vessels.

"Effectively managing the performance of your fleet delivers the ability to reduce fuel consumption, decrease OPEX, cut emissions, meet environmental and charter party goals, and comply with regulations," comments Jacob Clausen.

## Charting success

Clausen is vice president, operations, at Norway-headquartered NAVTOR. Until recently, the company was best recognised as a leading force in the provision of innovative e-Navigation solutions and navigational products and services for the maritime sector. NAVTOR's Pay As You Sail (PAYS) ENC service and e-Navigation solutions, NavTracker, NavBox and NavStation, have helped the firm establish a worldwide network of subsidiaries and distributors since opening its doors in Egersund in 2011.

However, last year the company announced a bold move into the realm of fleet management and performance optimisation with the launch of its total ship operations platform, NavFleet. Hot on the heels of that announcement was the acquisition of US-based vessel analytics and performance specialist Tres Solutions. "Our slogan had always been 'e-Navigation made easy', and we had always been known as an e-Navigation company," says Børge Hetland, NAVTOR CCO. "But NavFleet and the acquisition of Tres have taken us into a new business area."

Developed over two years in collaboration with key shipowners, NavFleet offers performance optimisation and decision support based on real-time integrated data from vessels, fleets, offices and other sources already present within the NAVTOR product ecosystem. Using the company's cyber-secure certified gateway, NavBox, and cloud computing resources, remote teams are able to access data relating to, for example, vessel sensors, weather, passage planning, route optimisation, engines and fuel consumption.

Performance optimisation is a key NavFleet selling point, with the ability to benchmark, troubleshoot, refine and share best practices across fleets, while solving individual vessel issues. For example, if a shoreside team knew what rpm should produce a speed of 10knots in good weather conditions, vessel engines could be set accordingly and ongoing speed monitored. If speed doesn't meet expectations a hull performance issue could be identified, with biofouling producing frictional drag, hampering performance, and impacting on fuel



NAVTOR CCO BØRGE HETLAND

consumption and efficiency. NavFleet can deliver this insight, according to Hetland.

The system also supports automation of key reports, including mandated EU MRV/IMO DCS reports. Other reports, such as noon reports, can be sent directly from vessels using the software and accessed from anywhere through the application.

In addition, NavFleet's real-time monitoring capabilities help office-based teams determine if vessels are falling short of key performance indicators (KPIs) or deviating from passage plans, facilitating swift remedial action. This ability makes it easier for owners to adhere to the covenants in charter party agreements and potentially avoiding performance claims.

## Beyond the horizon

"In shipping today it seems like there's always something on the horizon, another report or regulation, or a new concern, making navigating the future more unpredictable," says Clausen, who also heads up NAVTOR's Denmark operation.

To this end, NavFleet is very much a dynamic product. "It will not have an end state because we listen to the customers and include new functionalities, new features, both based on regulatory demands but also on the customers' demands," he says.

With the new Carbon Intensity Indicator (CII) regulation set to enter force on 1 January 2023, NAVTOR has recently equipped NavFleet with CII tools to help customers navigate their decarbonisation journey. The features in the latest release support proactive planning and monitoring compliance with required CII reduction targets mandated by IMO, according to Clausen. The new tools include: a fleetwide overview of vessels' CII rating; voyage analysis based on CII rating; simulated emissions and CII rating for a voyage itinerary and speed instructions; and simplified ESG reporting based on new data extract types. ■



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To further investigate The Royal Institution of Naval Architects and Maersk Mc-Kinney Møller Center for Zero Carbon Shipping (MMMCZCS) have partnered to offer a conference that will provide a platform to discuss the scalability of current technologies and policies that will transform the shipping industry.

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# HEAVY LIFT

## CHIPOLBROK'S TAIXING IS WORLD'S BIGGEST HEAVY-LIFTER



TAIXING WAS THE FIRST IN A SERIES OF FOUR VESSELS

Like a number of heavy lift and project cargo specialists, last year multipurpose operator Chipolbrok (Chinese-Polish Joint Stock Shipping Company) saw an opportunity to diversify into container shipping as that sector struggled to find tonnage to meet a burgeoning market. But while the Shanghai-based company has said it will continue to keep its options open for the future, perhaps the bigger splash was made by the delivery last December of what is claimed to be the world's largest multipurpose heavy lift vessel.

Built by Chengxi Shipyard, the 62,000dwt *Taixing* is the first in a of four new vessels for Chipolbrok. The second vessel in the series, *Herbert*, was delivered in February 2022 with two further sister ships, *Pilecki*, and *Yong Xing*, due to follow later in the year. The fleet are intended for carriage of solid bulk cargoes, IMSBC code cargoes, steel coil, package/general/project cargoes, paper pulp, container and long piece cargoes; and expected to serve on the Asia-America trade routes where there is heavy demand for oversized project cargo such as wind turbines.

Measuring 199.9m in length, with a 32.26m beam and vertical bow form, the vessel was designed by the Shanghai Merchant Ship Design & Research Institute (SDARI) and has been built with a single continuous deck with forecastle and poop. The accommodation, as well as the bridge and propulsion machinery, is located aft. In total, *Taixing* has five holds double-bottomed and double-skinned, the 40m longest of which is specifically intended for project cargoes. Four of the holds are box shaped and all have strengthened tank tops for heavy cargoes. The ship has pontoon type tween decks that can be employed in all five holds. Total bale capacity is 73,000m<sup>3</sup>. The flush hatch covers

allow for a length of 160m and some 5,000m<sup>2</sup> of space for deck cargoes.

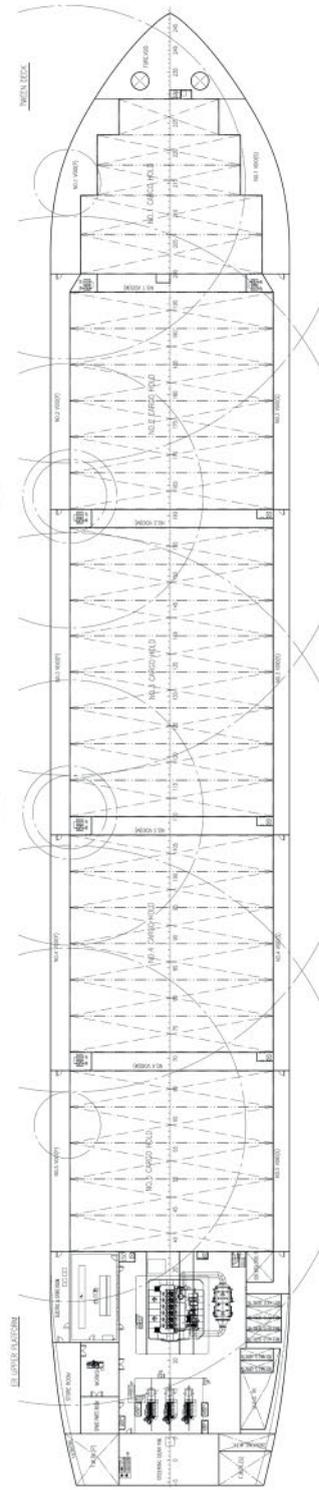
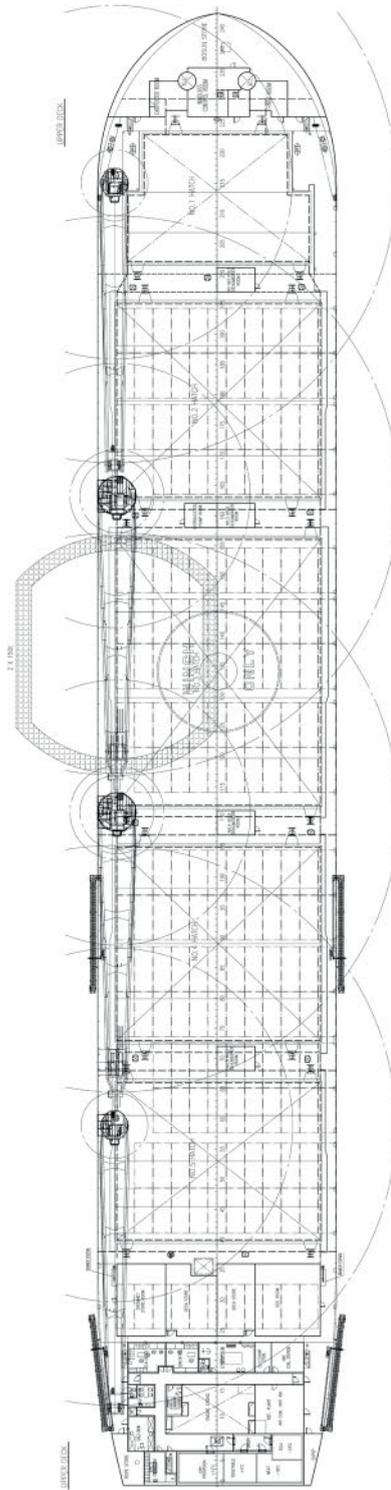
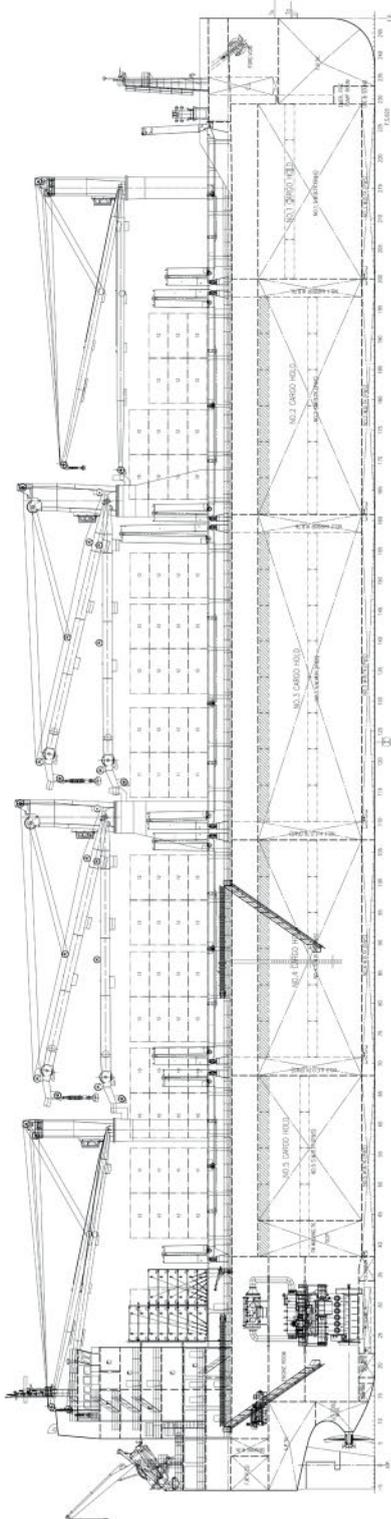
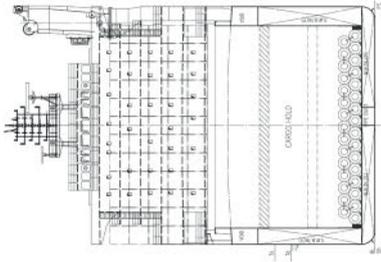
Cargo handling is facilitated by four MacGregor deck cranes with a 38m outreach, and the two 150tonne capacity cranes located either end of Hatch 3 can work in tandem to lift 300tonnes. The other two cranes have safe working loads of 45 and 60tonnes.

The ship's power and propulsion system comprises a six-cylinder MAN B&W G50ME-C9.6 engine producing 8,000kw@83rpm. This drives a 6.9m diameter fixed pitch propeller to give a service speed of 14.5knots. To achieve Tier III NOx compliance, the engine makes use of high pressure selective catalytic reduction. A Blue Ocean Shield ballast treatment system allows for worldwide operation, having type approval from IMO and USCG. ■

Full data for *Taixing* and more than 40 other vessels can be found in RINA's *Significant Ships of 2021*. For further details please visit: [www.rina.org.uk/sigships.html](http://www.rina.org.uk/sigships.html)

PRINCIPAL PARTICULARS TAIXING	
IMO number	9930909
Length	199.90m (loa); 196.50 (lbp)
Breadth	32.26m (moulded)
Cargo holds	5
Bale capacity	73,000m <sup>3</sup>
Cargo cranes	4
Propulsion system	1 x MAN B&W G50ME-C9.6
Moulded depth	19.3m
Design draught	11.3m
Deadweight	62,000dwt
Service speed	14.5knots
Capacity	26 persons
Flag	Hong Kong
Classification society	DNV & CCS
Owner	Chipolbrok
Shipbuilder	CSSC Chengxi Shipyard Co., Ltd
Designer	SDARI

GENERAL ARRANGEMENT OF TAIHING



# FUELS AND LUBRICANTS

## FUELS AND LUBRICANTS: THE SMART DRIVERS IN HELPING DECARBONISE THE MARITIME INDUSTRY

By **Nikolaos Kotakis**, technical director, Lubmarine



LUBMARINE AND TOTAL ENERGIES MARINE FUELS ARE INVESTING HEAVILY IN FINDING THE OPTIMUM BALANCE FOR TOMORROW'S CYLINDER LUBRICANTS

There is no doubt that these are transitional times for shipping. When we look at emissions, the IMO 2020 Global Sulphur Cap, which limited the sulphur in fuel oil used onboard ships operating outside designated Emission Control Areas to 0.50% m/m (mass by mass), was a bold step towards the reduction of polluting air emissions from shipping.

Engine cleanliness is essential in this new operating regime. It requires high-level in-depth technical awareness, support and solutions for all ship operators and OEMs to ensure they implement the right lubricants and fuels strategy – and are using the right combination of solutions to operate successfully.

As the demands for cleaner energy solutions continue to increase, it becomes ever more important that we prioritise the things that really matter. For lubricant development the use of multiple fuels means a cylinder oil formulation that is suitable for both old and new fuels will be required.

With new fuels, engine design is being pushed to the limit as parameters such as compression and combustion pressures in both Diesel cycle and Otto cycle engines are optimised.

The base number (BN) – used to quantify acid neutralisation capability – has always been the key discriminating factor for cylinder oils, but in this new environment it is nothing more than a small part of the equation. New refinery processes and fuel blend stocks used to produce VLSFOs, that could lead to engine condition challenges, can only be tackled effectively with innovative chemistries. While existing lubricant oils are designed to achieve the reliability of engines running on today's conventional low-sulphur fuel oils, lubricant formulation is constantly adapting to match modern engines design.

Consideration is not just limited to the sulphur content of the fuel used, but importantly the engine characteristics, emission control and energy saving systems, and the operating conditions which enables solutions to be created to help further reduce CO<sub>2</sub> emissions.

Lubmarine, already seeing success with its Talusia Universal two-stroke cylinder lube oil, will expand that platform beyond its current compatibility and proven performance for IMO 2020 compliant fuels, including LNG. The product has been validated across a range of dual-fuel engines including WinGD and MAN ES engines.

Of key importance in working with new low-carbon and low-sulphur fuels is keeping the lubricant's ash content low to ensure that the latter will not generate deposits in cylinder spaces. Detergency, a particular additive profile, ensures that the cylinder lubricant is matching the needs of the engine and the fuel in a way that is not overly aggressive but not under-performing either.

In line with TotalEnergies' climate ambition to get to net-zero by 2050 together with society, Lubmarine and TotalEnergies Marine Fuels are developing multiple low- and zero-carbon marine fuel and lubricant



NIKOLAOS KOTAKIS

solutions to help advance decarbonisation across the industry. Nevertheless, there remain many outstanding questions and issues across the new fuels supply chain that require the mobilisation of the entire ecosystem to hurdle and to solve.

What is clear, however, is that shipping will continue to face changes with initiatives that deep dive further into smarter energy efficiencies, emissions and greenhouse gas targets, as industry's knowledge and experience of new fuels evolve. With engine technology continually evolving, we all need to remain agile to find efficient and cost-effective solutions to the challenges shipowners face in the lead up to 2030 and 2050.

Everyone has a part to play in the transition to a cleaner, better performing industry including the role data and digitalisation can make in creating smarter ways of working. Lubmarine is fast-tracking its use of digital technologies to help advance solutions for cleaner fuels, improved lubrication and engine monitoring.

What we see ahead is an exciting journey that we need to shape for our customers by helping them choose the right solution with the right level of technical support based on the operational needs of every vessel of their fleet. It is a period in our time which represents incredible evolution, and it's exciting. ■

## SEDIMENT STILL A PROBLEM FOR VLSFO

By **Richard Halfhide**

The introduction of the 0.5% Global Sulphur Cap for marine fuels on 1 January 2020 represented one of the biggest changes to impact merchant shipping in modern times. It was a time of deep uncertainty for shipowners and in the majority of cases they were presented with two options: either install exhaust gas cleaning systems – scrubbers – onboard their vessels that would remove the sulphur content from the exhaust before it could enter the atmosphere, or switch from using high sulphur content Heavy Fuel Oil (HFO) to the recently developed Very Low Sulphur Fuel Oil (VLSFO) blends that would comply with the new restrictions.

Despite concerns about the cost and availability of these new fuels – and IMO's sulphur mandate coming five years earlier than originally expected – the switch went far more smoothly than many had predicted. Today around 60,000 vessels, or 70% of the global fleet, operate on VLSFO. However, shipowners soon discovered, sometimes at a considerable cost, that VLSFO sometimes presented more insidious problems.

To give one early example, in May 2020 fuel testing company Veritas Petroleum Services (VPS) said it had identified more than 40 instances of vessels sustaining serious engine damage which, although caused by

calcium deposits arising from additives in the cylinder lubricating oil (CLO), was caused by the CLO being poorly matched to the lower sulphur content of VLSFO.

This served as a warning to those who hadn't heeded advice that the new fuels have markedly different characteristics to HFO, with particular handling requirements. These problems are often exacerbated by incompatibility between fuel blends, which can lead



SOURCE: SHUTTERSTOCK





VLSFO IS SIGNIFICANTLY LESS VISCOUS THAN HFO (PICTURED). SOURCE: CREATIVE COMMONS.

the provenance of the fuel they are bunkering without proper testing. Furthermore, it's important to remember that while bunkering price reporters typically lump all 'VLSFO' under a single category for simplification, different blends can vary significantly in their chemical composition and viscosity.

Many VLSFOs have a paraffinic base, but naphthenic and aromatic bases are also commonplace. Given the high risk of incompatible blends, the commingling of fuels is strongly advised against without rigorous testing.

### Thermal stress

Brendan Cuffe, Brookes Bell's director of UK (Marine Engineer), tells TNA the wide range of VLSFO viscosities – he's seen as low as 10 or 11 centiStokes (cSt at 50°C) – puts increased onus on the ship's engine room staff to ensure the purifier is correctly configured for the fuel they're dealing with. "Purifier inlet temperature is normally varied in accordance with the viscosity. Whereas pre-2020 fuels were typically high viscosity and required heating to temperatures as high as 98°C for purification, you may not have to heat VLSFO as much. If you do, you could risk potentially thermally stressing a fuel unnecessarily," he explains.

to sediment and sludge formation. Even fuels that apparently meet the specification for ISO 8217 have been found to have stability problems that give rise to operational issues.

Nearly two and a half years after the introduction of the Sulphur Cap, the novelty surrounding VLSFO may have waned but those concerns surrounding it don't appear to have dissipated. In January 2022, research published by Singapore-based fuel testing facility CTI-Maritec suggested that 3.9% of VLSFO fuel samples taken in 2021 failed to conform with the Table 2 test requirements of ISO 8217 including the margin applied to the recipient in accordance with ISO 4259 (the monitoring requirements for petroleum and related products). This equates to an off-spec total roughly similar to that of the previous year.

### Step change

Marine technical and scientific consultants Brookes Bell is among those that has been actively highlighting VLSFO quality issues. Speaking to *The Naval Architect*, David Moore, a fuel chemist with the company, points out that VLSFO has been something of a step change from the blending of more traditional residual marine fuel oils.

He explains: "Gone are the days when you'd see an RMG 380 always blended up to a viscosity and density limit. When I was working in an oil refinery, blending large batches of high sulphur fuel oil you would use three or four blending components, the cheapest of which were the most viscous and highest density ones that you would 'cut back' to meet the limits for those parameters. With the new fuels it would be fair to say we're not entirely certain where refineries get their blendstocks and blending components from these days."

The fuel supply chain is notoriously opaque, making it difficult for shipowners to be completely confident about

Thermal stress, or overheating, is a potential vulnerability of VLSFO, but it can be a fine line between under- and overheating. The aforementioned CTI-Maritec research also cited cold flow issues due to wax formation and cat fines due to reduced purifier efficiency. It should be noted wax appearance temperature is not one of the Table 2 characteristics covered by ISO 8217. Moore suggests that the low viscosity often found in these fuels, a stark contrast with the treacle-like consistency of HFO, may be lulling operators into a false sense of security that there's no need to heat it to the same extent. Given that such heating may add to operating costs the temptation for such thinking is self-evident.

Because many VLSFOs are paraffinic this means they generally have a higher pour point than HFO. The standard procedure onboard vessels is to heat fuel 10-15°C above the pour point to mitigate the risk of cold flow, but in the case of VLSOs this is sometimes not sufficient to keep all the waxes dissolved. Although tests do exist for measuring the so-called wax appearance temperature – when wax crystals begin to



WAX FORMATION IS A PERSISTENT PROBLEM WITH PARAFFINIC FUELS, AS MANY VLSFOS ARE. SOURCE: WILHELMSSEN

appear – they are not currently part of the ISO 8217 testing procedures.

### Sediment

Consequently, it becomes a fine balance before the fuel runs the risk of asphaltene sediment fall out and sludge formation that are the commonly reported symptoms of the instability caused by heat stress. Although sedimentation was known to be a problem prior to the Sulphur Cap's introduction, Cuffe identifies it as perhaps the single biggest problem to arise post 2020.

ISO 8217 determines that the sediment limit after thermal or chemical ageing should be 0.10% by mass as assessed by the application of the Total Sediment Potential (TSP) and Total Sediment Accelerated (TSA) testing protocols. However, the precision of these methods is relatively poor and the accuracy of these tests has regularly been called into question.

"You need to have a sediment of 0.16% m/m or higher to be able to say as a receiver on the basis of a single analysis that you've got an off-spec fuel," says Cuffe. "The highest I've seen has been 0.6% but as a marine engineer I would never even consider trying it as it's doomed to failure. We've seen ships where they're having to clean the purifiers every few hours, whereas normally they could go for weeks. On others they've had to dig the sludge out of the sludge tanks under the purifiers, or hoods on purifiers have burst because there has been so much sludge built up."

The saving grace of sludge and sediment is that generally they don't reach the engine, simply because they've already caused handling problems already. While compromised purifiers will require additional replacement parts, the biggest cost is lost time if a vessel has to make an unscheduled bunker call to replace the off-spec fuel.

Another issue that Cuffe highlights as a factor in sediment formation is the shelf life of the fuel. Brookes Bell's own research has found that often the most recent fuel tank to be filled is the last to be used, this may mean that a marginally unstable fuel batch that originally fell within limits when stemmed may not be used for several weeks, by which point sediment problems have developed.

Unfortunately, while some research has suggested an average shelf life of around three months, the rate of deterioration is on the whole highly unpredictable. It's another stark difference from the days of high sulphur RMG 380 fuels, which might sit unused for months with little to no negative impact.

### An onboard problem?

So, do these stability and sediment problems reside with the VLSFO blends themselves or the onboard handling of the fuel? Steve Bee, group commercial & business development director for fuel testers VPS, tells *TNA* that in his company's experience, while VLSFO stability is an ongoing concern, it appears to be less so at the point of delivery.



VPS SAYS ONLY 0.6% OF ALL VLSFOS IT TESTS EXCEED THE SEDIMENT LIMIT. SOURCE: VPS

"At that point, the majority of the fuels appear to meet the ISO 8217 specification of TSP<0.10%. In fact, the latest data show only 0.6% of all VLSFOs tested by VPS at the point of delivery exceed the 0.1% level," he comments.

Echoing the views of Brookes Bell, he adds:

"Unfortunately, the issues regarding fuel stability normally occur after delivery, with some fuels exhibiting destabilisation, many within a few of weeks of being onboard. This can, in part, be attributed to the handling, storage and general fuel management of fuels. Store the fuels in too cold an environment, then there is a significant risk of wax precipitation from the fuel but storing the fuel at too high a temperature can result in thermal destabilisation.

"Therefore, getting a satisfactory balance is the key. Testing such as Wax Appearance Temperature (WAT) testing, TSP/TSA/TSE, even Reserve Stability Number (RSN), can all provide helpful information in avoiding such issues."

While VLSFOs may have been an expedient remedy of sorts for the industry in curbing sulphur emissions, they have brought with them a need for increased vigilance, and more stringent testing, both ashore and onboard. But perhaps it's also important to remember these fuels are still in their relative infancy and likely to undergo further improvements. Moore notes that instances of one potential problem area, catalyst fines, appear to be greatly diminished due to the types of blending components now being used.

But in conclusion, perhaps one should keep in mind the motivation behind sulphur abatement in the first place: to improve our environment. A study conducted in 2016 by the Finnish Meteorological Institute and presented to IMO projected that not only would the Sulphur Cap cut emissions by some 8.9 million metric tonnes annually, but an estimated 570,000 deaths from lung cancer, cardiovascular disease and other respiratory illnesses would be avoided as a result. No good deed goes unpunished, but it's a small price to pay. ■



# ENVIRONMENTAL LEGISLATION

## NATURE CALLS FOR SUSTAINABILITY TO BE BUILT-IN TO PROTECT OUR OCEANS

By **Lars Nupnau**, business development manager, RWO

Sustainability is now a top priority for shipowners and designers, and this is particularly the case in the cruise and passenger ship industry where a growing number of guests bring highly developed environmental sensibilities onboard.

Consumers are also increasingly better informed on the impact shipping is having on the planet: passenger service providers may be measured by standards set in domestic lives on energy consumption, recycling or on opting for plant-based detergents.

A recent survey conducted by travel agency network Virtuoso\* found that 82% of respondents wanted to travel more responsibly in the future, with 70% agreeing that sustainable travel enhanced the experience. Half of respondents ranked a strong sustainability policy as "very important" when choosing a hotel, cruise line or travel company.

Ship emissions represent a central consideration for cruise lines. However, today, expectations go beyond holding owners accountable, with guests now wishing to play an active role in environmental protection, whether through responsible towel laundering, recycling, or investing in reusable water bottles.

### Regulating Change

While not a conversation starter at the buffet, sewage management is increasingly important for ship

operators because guests witnessing the majesty of nature have a strong preference not to cause it direct damage. Also referred to as black water, sewage contains a myriad of hazardous pathogens, bacteria, viruses, and chemical nutrients which are harmful to human and marine life.

However, like many areas of concern for the marine environment, regulation remains the most consistent means of controlling whether, where and in what form sewage can be discharged.

IMO MARPOL Annex IV regulates the discharge of sewage waste from ships. Annex IV prohibits the discharge of sewage into the sea unless the ship has an approved sewage treatment plant in operation, or the sewage being discharged into the sea has been broken down and disinfected using an approved system at a distance of more than three nautical miles from the coast.

However, the 2016 resolution MEPC.227(64) introduced Special Areas and entirely prohibited the discharge of sewage from passenger ships within these areas unless the vessel has an approved sewage treatment plant that also removes chemical nutrients.

Chapter 4.2 of the resolution states that, if a vessel is intending to discharge sewage effluent in Special



EXISTING ADVANCED WATER TREATMENT SYSTEMS CAN BE CONVENIENTLY UPGRADED TO THE NEW CS-MBR STANDARD

Areas, the treatment system must meet the nitrogen and phosphorus removal standards.

The Baltic Sea is currently the only Special Area under these regulations and as of 2021 applied to all new and existing passenger ships operating in this area. However, from 1 June 2023, restrictions will apply to "existing passenger ships enroute directly to or from a port located outside the Special Area and to or from a port located east of longitude 28°10' E within the Special Area that do not make any other port calls within the Special Area".

RWO, a supplier of 'intelligent water management solutions', suggests that it is fair to assume that more areas will come under the regulations as pressure to protect the world's oceans from pollutants continues to grow.

### Next Generation AWTS

In today's environment, cruise lines have two main options when it comes to sewage treatment – to install an advanced wastewater treatment system (AWTS) or hold treated sewage onboard.

RWO recently launched its new generation AWTS, with first installations taking place onboard two of the Solstice-class vessels – the *Celebrity Silhouette* and *Celebrity Reflection*. The installations will upgrade the vessels existing RWO MEMROD sewage treatment plants in preparation for the regulation changes in 2023. Type approved in accordance with IMO MEPC.227(64) including chapter 4.2 for nitrogen and phosphorus removal within special areas, RWO's CleanSewage Membrane Bioreactor (CS-MBR) is a sustainable biological treatment technology that has been designed to minimise a vessels impact on the environment, exceeding regulatory requirements by providing the highest effluent standards.

Customisable to individual requirements, the CS-MBR treatment process can be broken down into three stages: solids are removed from the wastewater during the mechanical pre-treatment process; a high-performance activated sludge process commences where pollutants are degraded and removed; and clean water is separated from the activated sludge using a submerged membrane resulting in water that is completely free of solids and pure enough to be re-used in other functions such as laundry, or as technical water.

Membrane technology will be game-changing for the cruise sector. Membranes remove over 99% of solids, including microplastics and viruses, which enhances water purity and prevents diseases. While membranes are sometimes used as an additional stage after the biological treatment process, what makes the CS-MBR unique is its submerged membrane design used in the bioreactor during the final treatment stage. This enables a compact design and increases energy efficiency.

The system also features an automated cleaning-in-place (CIP) function to clean the membranes. This is a

LARS NUPNAU,  
RWO BUSINESS  
DEVELOPMENT  
MANAGER



crucial design point as it makes it easier for the crew to operate the system and minimises downtime and maintenance requirements.

Furthermore, a sustainable membrane technology uses fewer chemicals during the treatment process. Chlorination is not needed to remove bacteria and viruses, and the CS-MBR also does not require the use of flocculants or other chemicals for disinfection.

### Cross-industry Collaboration

As the recent COP26 gathering showed, expectations for sustainability will only continue to rise. In an increasingly digital and connected maritime industry, RWO is also working alongside industry partners including TUI Cruises and Hanover University in support of the cross-industry 'OSCAR' research project. Funded by the German government, OSCAR is researching online modelling, simulation, and remote-control systems for onboard environmental technologies on cruise ships.

Scientists from the Institute of Sanitary Engineering and Waste Management (ISAH) are developing and testing digital twins for AWTS. The aim of the project is to design a digital twin that enables ship management companies to simulate the AWTS of a cruise ship onshore using data from the vessel, to support crew and provide advice or guidance where required.

In October last year, the ship sewage treatment plant in the ISAH technical centre located at the Hanover-Herrenhausen sewage treatment plant went live. It was fitted with a smaller version of RWO's CS-MBR system. ■

\*Source: [https://www.virtuoso.com/getmedia/2a8b057b-8b0b-4bcf-bf1d-834d8227acfe/2021-VIR-Sustainability-Release\\_FINAL.aspx](https://www.virtuoso.com/getmedia/2a8b057b-8b0b-4bcf-bf1d-834d8227acfe/2021-VIR-Sustainability-Release_FINAL.aspx)



# BETTER UNDERSTANDING YOUR BALLAST WATER MANAGEMENT SYSTEM

By **Mark Riggio**, head of marine, Filtersafe

When it comes to ballast water management, the priority has firmly shifted to operational compliance. As a result, enforcement of regulations, for example by the United States Coast Guard, has become increasingly stringent. The penalties for regulatory non-compliance include costly fines and reputational damage. And operational issues increase operators' vulnerability to these risks.

It is critical that ship operators better understand their vessel's ballast water management system (BWMS) and what operating conditions it is suitable for, as well as how it has been installed and should be maintained. Operators who understand their BWMS and its capabilities can efficiently achieve regulatory compliance and minimise disruption. However, those that have an inappropriate system installed, or lack the expertise to effectively use it, will ultimately pay a higher price.

## Operational issues

Currently, in line with the IMO's latest MEPC 77 discussions, there are no blanket exceptions or bypassing of systems for ships operating in challenging waters. This means operators must treat the water in sediment-rich areas to the best of their BWMS and/or filter's ability and operational challenges must be overcome.

A common operational issue experienced is system clogging, which usually takes place in waters with high levels of total suspended solids (TSS). These sediment-rich waters can be found all around the world, for example in the ports of Shanghai and Hamburg. Clogged BWMS and filters can cause operational delays during ballasting, leading to inefficiency and loss of earnings and can damage components.

For example, Filtersafe has seen cases where filters have retrospectively been added to a filterless systems to ensure regulatory compliance and avoid disruption when operating in challenging water conditions. A leading containership operator also asked Filtersafe to retrofit one of its filters as a pre-filter to a BWMS that was being damaged by clogging due to its inferior existing filter. While this solution was effective, it is no substitute for fitting an appropriate BWMS with a high-performance filter from the outset, which remains the most cost and time efficient option.

## Appropriate filters

The filter is central to ensuring that your BWMS is compliant for the lifecycle of the vessel and that operational issues are avoided. While there are dozens of BWMS to choose from, there are only a handful of filters available to the market. Therefore, focusing on the filter is one obvious way for owners to distinguish between a high performing BWMS and a lower quality one.

The unique operating profile and route of the vessel should also be taken into account. If vessels are regularly



MARK RIGGIO

visiting sediment-rich waters then it becomes increasingly important that the filter's operational performance in heavy sediment loads is considered. Looking at a filters Shanghai Test score will help you understand if it is suitable.

The Shanghai Test was developed to promote an advanced understanding of how a BWMS and filter perform in real waters. It simulates the conditions in the Port of Shanghai, well known for its high TSS levels. While current IMO testing standards require a BWMS and filter to function at 50mg/L TSS, ports such as Shanghai have TSS levels of up to 1,000mg/L.

## Leveraging data

Vessel data can also play a key role in BWMS commissioning and operations, for example helping crew overcome operational issues such as filter clogging. A modern BWMS and filter outputs valuable data on everything from filter pressures and energy usage to ballast flow and backflushing levels. This data can be used to report any issues or required maintenance which can either lead the crew to a solution or be remotely addressed by a provider.

However this can be overwhelming if crews do not understand how to leverage it. Effective training at installation and throughout the lifecycle of the system will always be key. Therefore, choosing a supplier who takes a collaborative approach and treats their BWMS or filter as a service is important. An investment in a specific filter or system is also an investment in that supplier's experience and expertise.

Ballast water treatment is one of the toughest and most complicated water treatment challenges in the world. A BWMS must be compact enough to fit on a ship, yet capable of handling city-sized water flow rates – all while being operated by a ship's crew who have many, higher-priority tasks to complete during ballasting operations. Considering the steps outlined above will help to safeguard operational compliance, avoid fines and reputational damage, and minimise any impact on the crew. ■

# LNG BOOSTS CII COMPLIANCE TO 2030 AND BEYOND

By **Steve Esau**, COO, SEA-LNG

The benefits of LNG as a marine fuel have been discussed and analysed for decades but how does it stand up to the latest maritime environmental regulation? The IMO's Carbon Intensity Indicator is set to shake up the vessel efficiency and emissions clauses in the charter party agreements from 2022 onwards, so is a logical place to start. Meanwhile, the European Commission is in the process of introducing legislation aimed at accelerating the decarbonisation of shipping as part of its Fit for 55 package.

## Carbon Intensity Indicator

Analysis from multi-sector marine fuel coalition SEA-LNG has found that LNG-fuelled vessels will be able to continue operating as normal under the IMO's Carbon Intensity Indicator (CII) system until after 2030. Fossil LNG blended with bioLNG and renewable synthetic LNG will further extend compliance to 2050 and beyond.

CII is a gauge of how efficiently all ships transport cargo measured in grams of CO<sub>2</sub> emitted per deadweight ton capacity and nautical mile. Coming into effect in 2023, vessel operators will be required to provide a baseline performance and receive initial ratings in 2024.

CII thresholds will tighten annually, requiring operators to document vessel performance and demonstrate it has achieved the required threshold for the year. A ship's carbon intensity rating on an A-E scale will be officially recorded in the vessel's Ship Energy Efficiency Management Plan (SEEMP).

The SEA-LNG analysis compared emissions for two identical 180,000dwt Capesize vessels, one using conventional oil-based marine fuels, the other using LNG as a marine fuel. The results showed that the LNG-fuelled vessel immediately rated two grades higher than the conventionally fuelled vessel. LNG can be the difference between having a 'moderate' C-rated ship and having a 'major superior' A-rated ship on the IMO's CII scale.

LNG-fuelled vessels can also gain improved carbon intensity ratings by adopting drop-in carbon-neutral bioLNG now, or renewable synthetic LNG in the longer term. For example, the analysis showed that for every 10% increase in the content of these fuels in a blend with traditional LNG, the vessel gains two years of additional compliance. Adding bioLNG or renewable synthetic LNG, both fully interchangeable with traditional LNG in LNG-fuelled vessels and bunkering infrastructure, will enable maintenance of an advantageous CII rating over the life of the vessel and ensure that owners are not left with stranded assets.

In calculating the impact on CII grades of a change of fuel from HFO to LNG, SEA-LNG used a figure of 20%, on a Tank-to-Wake basis, to represent likely emissions

STEVE ESAU, SEA-LNG



reductions across the broad range of vessel performance. This saving figure is derived from the 2nd Lifecycle GHG Emissions study by Sphera, which indicates that LNG-fuelled vessels are capable of achieving a reduction in their carbon footprint of as much as 30% on a Tank-to-Wake basis, and 23% on a well-to-wake basis, when compared to the use of traditional oil-based fuels.

## Fit for 55

Fit for 55 contains a basket of policy measures aimed at putting the European and, to an extent, the international shipping industry on a pathway to full decarbonisation by 2050 in line with the European Green Deal objectives. The policy files include FuelEU Maritime, revisions to European Emissions Trading System (ETS), the Energy Taxation Directive (ETD) and the Alternative Fuels Infrastructure Directive (AFIR) and amendments to the Renewable Energy Directive (RED III).

The proposed policy measures are broadly goal-based and technology neutral. FuelEU Maritime is the centre piece of this package, proposing greenhouse gas intensity reduction targets for the energy used on-board by a ship which become increasingly more stringent over time. It recognises the need for the GHG emissions intensity of marine fuels to be calculated on a Well-to-Wake basis and to include all major GHGs (carbon dioxide, methane and nitrous oxides).

LNG and its bio and synthetic cousins provide a way of complying with these pending European regulations.

## Technology innovations

Methane slip is a hot topic – often characterised as an irredeemable flaw of LNG marine engines, disqualifying them from playing a role in maritime energy transition. The 2nd Lifecycle GHG Emissions Study forecast that, by 2030, methane slip from marine engines will have been virtually eliminated as technological improvements under development by engine manufacturers, such as introduction of oxidation catalysts and high-pressure gas injection, continue.



The report used the latest available engine and supply chain data including data provided by OEMs including Caterpillar MaK, Caterpillar Solar Turbines, GE, MAN Energy Solutions, Rolls Royce (MTU), Wärtsilä, and Winterthur Gas & Diesel (WinGD), as well as fuel suppliers ExxonMobil, Shell, and Total. Methane emissions from the supply chains as well as methane released during the onboard combustion process were included in the analysis.

New developments in LNG dual-fuel engines continue apace. For example, engine designer WinGD recently announced test results that exceeded their expectations when their X-DF2.0 second-generation dual-fuel engine platform achieved fuel savings of up to 8% in gas mode and up to 6% in diesel mode. The platform is retrofittable for future fuels, providing reassuring flexibility for the future.

### Supply and bunkering

The bunker vessel fleet continues to grow in line with the increasing number of LNG new build vessels. In March 2022, for example, Mitsubishi Shipbuilding received an order from KEYS Bunkering West Japan for a 3,500m<sup>3</sup> capacity LNG bunkering vessel that will be equipped with a dual-fuel engine. In addition to being Japan's first dual-fuel LNG bunkering vessel, it will also be the first bunker vessel to offer LNG bunkering in western Japan.

Shell published its Energy Transition Progress Report 2021 in April and noted plans to double the size of its global LNG bunkering network to around 15 major ports on key international trading routes by the mid-2020s. Shell has now completed more than 400 ship-to-ship LNG bunkering operations in seven countries and eight ports, and last year carried out its first bioLNG bunkering trial in Rotterdam.

Increased availability is making LNG a viable option for more owners. LNG bunkering is now offered at 141 ports worldwide, and Clarkson forecasts that this will grow to 170 ports in 2022. By end of 2022, LNG bunker vessels will be operating in northern Europe, the Mediterranean, US, Canada, South Korea, Japan, Malaysia, China, Singapore, Brazil and South Africa. Other regions such as Australia are also investing in LNG bunkering.

### A fuel in transition

LNG is often referred to as a transitional fuel when perhaps it is more accurate to say that it is a fuel in transition. There has been significant progress on increasing production of bioLNG and development of renewable synthetic LNG. LNG-fuelled vessels and infrastructure invested in today will be part of a net zero future as they can use and deliver bio and synthetic LNG as these fuels become more broadly available.

BioLNG is now available commercially in Europe and North America. Suppliers are quoting prices for delivery of bioLNG bunkers in Rotterdam, the biggest marine fuel bunkering hub in Europe, and in a number of North Sea and Baltic Sea ports. The world's largest LNG-fuelled vessel, the CMA CGM *Jacques Saade* used a 13% bioLNG mix when refuelling in Rotterdam as early as 2020. In June 2021 *Baleària* completed a 133mile fast ferry trip



CONTAINER SHIP *ELBLUE* RECENTLY REPLACED AROUND 50% OF ITS FUEL WITH SYNTHETIC LNG

fuelled by 100% bioLNG between the ports of Barcelona and Ciutadella (Menorca). And in September 2021 JAXLNG together with Element Markets supplied a bioLNG blend to Tote's *Isla Bella* in Jacksonville.

BioLNG produced from sustainable biomass has massive potential, as shown by an analysis by the International Energy Agency. Supplies are forecast to rise dramatically as businesses like Wärtsilä, Biokraft, Gasum, Titan LNG and CMA CGM step in to increase production capacity. Gasum is confident it has enough capacity to meet market demand for carbon neutral fuels with its bioLNG production and at a lower cost than other future alternative fuels.

The way forward for renewable synthetic LNG is also clear. Like other synthetic fuels, such as green ammonia and green methanol, it is made from hydrogen produced from electrolysis using renewable electricity. Between 70% and 80% of the cost of all of these synthetic fuels is related to the cost of producing the hydrogen feedstock. However, the fact that renewable synthetic LNG can be used in existing vessels and transported, stored and bunkered using existing infrastructure means the total cost of the pathway is likely to be significantly lower for renewable synthetic LNG than it is for other synthetic fuels.

MAN Energy Solutions recently reported operating tests that confirmed that the 1,036TEU container ship *ElbBLUE* reduced its greenhouse gas (GHG) emissions by 27% by operating on a blend of renewable synthetic LNG and conventional LNG, compared to LNG alone. Emissions were reduced by up to 34% compared to heavy fuel oil operation. The measurements were carried out onboard the ship in September 2021 when the *ElbBLUE* became the first container ship worldwide to replace a portion of its bunkered gas fuel (around 50%) with renewable synthetic LNG.

To summarise, research suggests that LNG and its bio and synthetic derivatives provide a way of complying with the latest environmental regulations. The rapidly growing order book for LNG-fuelled vessels illustrates that increasing numbers of shipowners and operators understand the compliance and environmental benefits of LNG. ■



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Please fill the boxes with the quantity wanted

PRINT	DIGITAL	PRINT + DIGITAL
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AS22	<input type="checkbox"/>
WP21	<input type="checkbox"/>
WS21	<input type="checkbox"/>
SLC21	<input type="checkbox"/>
MIET21	<input type="checkbox"/>
WS21	<input type="checkbox"/>
FSSP21	<input type="checkbox"/>
SCRM21	<input type="checkbox"/>
SURV10	<input type="checkbox"/>
HIST20	<input type="checkbox"/>
ICE20	<input type="checkbox"/>
SST20	<input type="checkbox"/>
HSMV20	<input type="checkbox"/>
EEDI20	<input type="checkbox"/>
AS20	<input type="checkbox"/>
DS20	<input type="checkbox"/>
HF20	<input type="checkbox"/>
MD20	<input type="checkbox"/>
LNG/LPG20	<input type="checkbox"/>
MI19	<input type="checkbox"/>
ICCAS19	<input type="checkbox"/>
WIN19	<input type="checkbox"/>
PPA19	<input type="checkbox"/>
WFV19	<input type="checkbox"/>
PRO19	<input type="checkbox"/>

Please check the relevant boxes

- I'm a member
- USB format is required
- I enclose a cheque for \_\_\_\_\_ payable to RINA.
- Credit Card No: \_\_\_\_\_  
Expiry date: \_\_\_\_/\_\_\_\_/\_\_\_\_ Security code: \_\_\_\_\_  
Signature: \_\_\_\_\_  
Print name: \_\_\_\_\_
- I wish to receive information on technical developments in or related to the maritime industry and on future RINA events.
- I understand that I may stop receiving such information at any time.

# CALENDAR

What's happening next?

**MAY 20, 2022**  
**CYBER SECURITY & RINA**  
**FUTURE DIRECTION EVENT**

RINA conference  
London, UK

**JUNE 8-9, 2022**  
**WARSHIP 2022**

RINA conference  
Bristol, UK

**JUNE 30-JULY 01, 2022**  
**WATER-JET PROPULSION 2022**

RINA conference  
Online

**SEPTEMBER 13-15, 2022**  
**ICCAS 2022**

RINA conference  
Yokohama, Japan

**NOVEMBER 16, 2022**  
**PRESIDENT'S INVITATION**  
**LECTURE**

RINA event  
London, UK

**NOVEMBER 29 - DECEMBER 1, 2022**  
**SCALING DECARBONISATION**  
**SOLUTIONS - REDUCING**  
**EMISSIONS BY 2030**

RINA conference  
Rotterdam, Netherlands

For more information please visit:  
[www.rina.org.uk/RINA\\_Events](http://www.rina.org.uk/RINA_Events)



**JUNE 6-10, 2022**  
**MARINE ENVIRONMENT**  
**PROTECTION COMMITTEE**  
**(MEPC)**

IMO meeting  
London/Online  
[www.imo.org](http://www.imo.org)

**JUNE 6-10, 2022**  
**POSIDONIA**

International exhibition  
Athens, Greece  
[www.posidonia-events.com](http://www.posidonia-events.com)

**JULY 4-5, 2022**  
**DISTORTION CONTROL IN SHIP**  
**BUILDING**

Course  
Online  
<https://asranet.co.uk/>

**JULY 11-15, 2022**  
**IMO COUNCIL**

International forum  
London/Online TBC  
[www.imo.org](http://www.imo.org)

**JUNE 15-17, 2022**  
**INTERNATIONAL CONFERENCE**  
**ON SHIPS AND MARINE**  
**RESEARCH (NAR)**

International conference  
Genova, Italy  
[www.atenanazionale.org/nav/nav2022](http://www.atenanazionale.org/nav/nav2022)

**JUNE 26-30, 2022**  
**INTERNATIONAL MARINE**  
**DESIGN CONFERENCE (IMDC)**

International conference  
Vancouver, Canada  
[imdc2022.org](http://imdc2022.org)

**SEPTEMBER 6-9, 2022**  
**SMM**

International exhibition  
Hamburg, Germany  
[www.smm-hamburg.com](http://www.smm-hamburg.com)

**SEPTEMBER 15-16, 2022**  
**FOUNDATION DESIGN OF**  
**OFFSHORE WIND TURBINE**  
**STRUCTURES**

Course  
Online  
<https://asranet.co.uk/>

**OCTOBER 11-12, 2022**  
**BASIC NAVAL ARCHITECTURE**

Course  
Online  
<https://asranet.co.uk/>

**OCTOBER 17-21, 2022**  
**7TH SYMPOSIUM ON MARINE**  
**PROPULSORS (SMP)**

International symposium  
Wuxi, China  
[www.smp2021.com](http://www.smp2021.com)

**OCTOBER 17-21, 2022**  
**TECHNICAL COOPERATION**  
**COMMITTEE**

IMO meeting  
London/Online TBC  
[www.imo.org](http://www.imo.org)

**OCTOBER 20-21, 2022**  
**DESIGN & ANALYSIS OF**  
**FLOATING WIND TURBINE**  
**STRUCTURES**

Course  
Online  
<https://asranet.co.uk/>

**NOVEMBER 2-11, 2022**  
**MARITIME SAFETY COMMITTEE**  
**(MSC)**

IMO meeting  
London/Online TBC  
[www.imo.org](http://www.imo.org)

**NOVEMBER 28 - DECEMBER 2, 2022**  
**IMO COUNCIL**

International forum  
London/Online TBC  
[www.imo.org](http://www.imo.org)

**DECEMBER 12-16, 2022**  
**MARINE ENVIRONMENT**  
**PROTECTION COMMITTEE**  
**(MEPC)**

IMO meeting  
London/Online TBC  
[www.imo.org](http://www.imo.org)

IF YOU HAVE A CONFERENCE OR  
EVENT YOU WOULD LIKE TO BE  
CONSIDERED FOR THIS PAGE PLEASE  
CONTACT: [TNA@RINA.ORG.UK](mailto:TNA@RINA.ORG.UK)

**Bo Cerup-Simonsen,**  
Chief Executive Officer at  
Mærsk Mc-Kinney Møller  
Center for Zero Carbon  
Shipping (Class of 2009)

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## Support Transition to Zero-Emission

The shift toward a zero-emission society has accelerated in various fields, with governments making their GHG targets more ambitious and sustainable finance gaining more attention. Likewise, the time has come for the maritime industry to systematically manage the GHG emissions from shipping, as represented by the introduction of a GHG emissions evaluation framework into international shipping.

ClassNK provides Zero-Emission Transition Support Services, a comprehensive menu of services to support customers in dealing with the various challenges they may encounter when managing GHG emissions in pursuit of zero-emission shipping.

[https://www.classnk.com/hp/en/info\\_service/ghg/](https://www.classnk.com/hp/en/info_service/ghg/)

