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Ship&Offshore

THE INTERNATIONAL PUBLICATION FOR OFFSHORE & MARINE TECHNOLOGY

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Second term ahead

Journalists and editors are rarely speechless. Nor should they be, as communication is their profession, the principal tool of their trade. And yet, I don't really know where to start at the moment.

Almost every conversation – professional or private, at home or abroad – turns at some point to Trump, to the start of his second term, to the executive orders he has just signed, to questionable statements about the forest fires in California compared with Austria and Finland, to disrespectful remarks towards sovereign states like Canada and Denmark.

Will the atlases be rewritten because it is no longer called the Gulf of Mexico, but now the Gulf of America? And what will happen to the Panama Canal? Will the United States actually reclaim influence as Trump wants to reduce the excessive fees for US vessels?

And above all: the withdrawal of the United States of America from the World Health Organization, the Paris Climate Agreement and the broad freeze on foreign aid.

However, even President Trump is not above the Constitution, and legal constraints apply to everyone. Initial lawsuits have already been filed, challenging his actions and ensuring adherence to constitutional principles. So are we paying too much attention to his current statements and should we only judge him – like every politician in fact – by his actions?

The re-election of Donald Trump as President of the United States also introduces a complex set of dynamics for the global maritime industry. His approach to international trade, environmental regulations, and geopolitical tensions is expected to have significant implications for maritime stakeholders worldwide.

US-flagged vessels might face less stringent emissions standards, creating a competitive disparity. Additionally, Trump's support for the fossil fuel industry could slow the transition to alternative fuels like hydrogen, ammonia, or biofuels, potentially delaying global progress toward decarbonisation – not only in the maritime industry but regarding international climate protection progress.

By the way, why do conservative and – you have to call them that – fascistic politicians work themselves up over wind turbines? How can dangerous half-knowledge about risks – which must of course be sensibly considered and addressed, such as potential dangers to birds and other wildlife or the use of certain materials – combined with loud blustering make certain groups in society completely forget all the advantages of on- and offshore wind farms and the far more serious dangers of fossil or nuclear power generation? Not surprisingly, Trump has signed an executive order to halt approvals temporarily for new wind energy projects in federal lands and waters, threatening thousands of jobs and renewable energy and climate targets in several US states. It is really hard to comprehend.

And to stay briefly on the subject of labour, which of course influences not only, but also the maritime industry: new immigration policies could affect the availability of skilled labour for the maritime and logistics sectors, particularly in regions reliant on foreign workers.

Another issue is Trump's approach to foreign policy, which is set to heighten geopolitical tensions, particularly with China and Iran. This will have direct implications for maritime security and the stability of key shipping routes. For example, conflicts in the South China Sea or the Strait of Hormuz could disrupt global trade and increase shipping insurance costs.

To summarise: the global maritime industry faces a period of uncertainty as it navigates the implications of Donald Trump's second term. His policies will create trade tensions and challenges to environmental regulations and geopolitical stability.

Industry stakeholders will need to remain adaptable and proactive in addressing these shifting dynamics, ensuring resilience in an ever-changing global landscape.

Shipbuilding & Equipment

Offshore & Marine Technology

Ship Operation

GreenTech & SORJ

With GreenTech and the latest edition of the Ship and Offshore Repair Journal (SORJ), the current issue of Ship&Offshore again contains two highly relevant thematically focussed supplements.

In addition to further detailed reporting on the repair and maintenance business, this issue offers an extensive feature on sustainable technology in the maritime industry.

The GreenTech Special Edition starts on page 15; the Ship and Offshore Repair Journal starts on page 25

Regulars

The offshore installation vessel measures 175m in length and has a 155-m high boom, which can lift more than 3,000 tonnes

Source: Van Oord

Offshore installation vessel delivered

Boreas | Rotterdam-based offshore construction company, Van Oord, has taken delivery of the offshore installation vessel, *Boreas*, at Yantai CIMC Raffles Offshore in China. Named after the Greek God of the northern winds, the vessel has been designed to transport and install the latest foundation modules and turbines at offshore wind farms.

Following a voyage to the Netherlands and final outfitting work including installation of equipment for storing and handling wind turbine foundations, the vessel will be officially named. It is likely to become commercially available during the third quarter of the year.

The 175m-long unit has a 155m-high boom capable of lifting 3,000 tonnes. Four large legs, each measuring 126m, will enable the vessel to work in water depths of up to 70m. It will be capable of installing wind turbines of up to 20MW, making it the largest such vessel so far. Van Oord has opted to have the vessel ready to use methanol as fuel, reducing its carbon footprint by close to 80%, the company claims.

Biofuel supply a potential constraint

DNV | Although biofuels such as fatty acid methyl ester (FAME) and hydrogenated vegetable oil (HVO) have significant potential for supporting ship's decarbonisation drive, classification society, DNV, warns that their uptake in the future could be hampered by supply constraints. In its latest white paper, 'Biofuels in Shipping', DNV also stresses that their safe introduction, and critical operational and technical features should be clearly understood.

According to DNV, shipping consumed about 0.7 million tonnes of oil equivalent (mtoe) of biofuels, 0.6% of global biofuel supply and just 0.3% of shipping's total energy consumption. It is essential that the biofuels used are properly monitored and meet strict sustainability and greenhouse gas saving targets, verified by a Proof of Sustainability or similar document.

Source: Med Marine

The tug was recently launched in Turkey

New tug launched at Ereğl

Med Marine | Turkish shipbuilder and tugboat operator, Med Marine, will expand its fleet following the recent launch of a MED-A2360 tug of Robert Allan RAmparts 2300-W design. The 23.4m-long tug, constructed at the Ereğli Shipyard that was itself built by Med Marine 20 years ago, will have a bollard pull of 65 tonnes and forward and aft winches, enabling the vessel to assist in the manoeuvring of large vessels, and undertake towing, pushing, mooring and firefighting operations. The vessel will have a crew of seven and a service speed of almost 12 knots.

James Fisher orders four more tankers

Fleet of the future | London-listed James Fisher and Sons plc has ordered four new 6,106dwt chemical tankers at China Merchants Jinling Shipyard (Yangzhou) Dingheng Co Ltd.

The new vessels will have LNG dual-fuel propulsion systems and will incorporate a range of sustainable features that have proved successful on the company's two ships of a similar size, *Sir John Fisher* and *Lady Maria Fisher*. These include optimised hull forms, waste heat recovery systems, LED lighting systems, and environmentally controlled engine room fans.

Source: James Fisher

The new vessels will incorporate a range of sustainable features that have proved successful on the company's *Lady Maria Fisher*

Keel laid for Arctic cruise vessel

Captain Arctic | Goltens Dubai has hosted the keel-laying ceremony for the Polar expedition vessel *Captain Arctic* for French owner Selar. The 70m-long vessel will rely primarily on renewable energy sources for propulsion, resulting in a 90% reduction in CO_2 emissions compared with conventional ships, Goltens said in a statement. It will harness 90% of its power from wind sails mounted with solar panels.

Goltens' shipbuilding client is Chantier Naval de l'Ocean Indien (CNOI) in Mauritius.

The construction of *Captain Arctic* signals a pivotal step in advancing green technologies, and Goltens said it is dedicated to ensuring every aspect of the project embodies the company's vision for sustainable development, minimising ecological footprint while maximising efficiency.

Goltens' CEO Sandeep Seth commented: "The ceremony was a testament to the spirit of innovation and collaboration that drives Goltens. Selar and CNOI have entrusted us to build a vessel that not only meets, but exceeds the expectations of the modern maritime industry. The project reflects our shared dedication to sustainability, innovation and a greener future for the seas."

He added that the *Captain Arctic* represented the first of its kind in the luxury cruise expedition vessel.

Rendering of the *Captain Arctic* Source: Selar

New division

Gibdock Yachting | Ship repair yard Gibdock has launched Gibdock Yachting, a new division dedicated to superyacht maintenance and refit services, as part of its efforts to expand in a growing market.

The new division will leverage Gibdock's experience in servicing superyachts while collaborating with BWA Yachting, a global leader in yachting services.

Gibdock Yachting will offer services ranging from hull and propulsion system repairs to interior refurbishments, supported by an extensive network of specialised subcontractors. Through its partnership with BWA Yachting, the division plans to deliver comprehensive solutions to meet the evolving demands of superyacht owners, managers, and crews.

Publication on stowaway management

Growing risk | A new publication from the International Chamber of Shipping (ICS) and Witherby Publishing Group provides guidance to shipowners and seagoing personnel on managing the risks associated with stowaways in a variety of circumstances. 'Shipboard Response to Stowaways and Distressed People in Small Boats – 2025-26 Edition' sets out the various circumstances and the growing risks associated with stowaways and migrants risking their lives in overcrowded and often unseaworthy boats in busy waterways.

Stowaways are a growing concern for the security of ships, the safety of crew members, and the related costs of interrupted schedules and delayed vessels for owners and operators. There are wide-ranging insurance implications too. Information on the subject is limited and many incidents remain unreported, but the cost per incident is definitely rising and costs the industry millions of dollars every year.

Examples of the 'irregular' movement of people at sea include scenarios ranging from a single stowaway hidden on a cargo ship to hundreds of people representing mixed groups, crammed into a large open boat. Stowaways and people rescued at sea, once on board a 'host' ship, are all essentially unauthorised people who present some common security risks, as well as specific challenges and responsibilities.

The migration of people by sea has taken place for centuries, but internet communications and global news are now available across most parts of the world, laying bare the vast contrasts in quality of like in different regions.

Assessing nuclear options

NuProShip | A Norwegian-led partnership, NuProShip, is examining the scope for nuclear propulsion in shipping. Funded by the Research Council of Norway, the project is being supported by the Norwegian subsidiary of Fincantieri, Vard, the Norwegian University of Science and Technology in Ålesund, DNV, the Norwegian Maritime Administration, Knutsen Tankers, and Spanish nuclear consultancy, Idom. The first stage of NuProShip, an abbreviation for 'Nuclear Propulsion in Shipping', assessed advanced nuclear reactor technologies developed by 99 different companies and selected three types for further research. Two companies are based in the United States – Kairos Power and Ultrasafe, and one in Sweden, Blykalla. The Kairos technology is based on a fluoride high-temperature molten salt reactor; the Ultrasafe system uses a helium-cooled gas reactor; and the Blykall setup is based on a lead-cooled reactor using uraniun oxide as fuel.

Source: Vard

The project assessed various advanced reactor technologies

Partners adopt sustainable port calls

With the EcoTow solution, the carbon emissions from towage jobs are mass balanced by carbon credits generated by Svitzer's use of biofuel across its international towage operations Source: Höegh Autoliners

Australia | Towage company, Svitzer, and vehicle transporter, Höegh Autoliners, have cooperated in the development of an emissions-reducing procedure in towage operations in Australia. At the end of the *Höegh Aurora's* maiden voyage to Australia, Svitzer implemented its first EcoTow operation, a proprietary carbon insetting system. Svitzer claims the arrangement has offset carbon dioxide emissions almost entirely.

The system works by balancing carbon emissions from towage operations with carbon credits generated by Svitzer's use of biofuels in its international towage operations. The offsetting process is assessed and assured by an external auditor.

The 9,100-CEU *Höegh Aurora*, capable of operating on a range of marine fuels, is the first in a series of twelve Aurora-class pure car truck carriers. Its sustainable features have reduced carbon emissions per vehicle transported by 58% compared with the current industry standard, the company says.

Navantia takeover agreed

H&W | After a long period of uncertainty over their future, the four shipyards operated by Harland & Wolff (H&W)– Belfast, Appledore, Methil and Arnish – are being placed into administration as part of the Navantia takeover deal, with the new owner not set to inherit the yard's various million pound debts.

The Spanish state-owned shipbuilder entered a long negotiation with the British Government to hash out an agreement which would allow the yards to stay open. Now, administrators will be appointed to the yards.

The four yards together employ around 1,000 workers, with these jobs set to be protected by the agreement with Navantia.

Methane reduction equipment ordered

EnviroPac | French container line, CMA CGM, is to install newly released EnviroPac methane reduction systems from Wärtsilä on eight 9,200-TEU LNG-fuelled container ships under construction at Shanghai Waigaogiao Shipbuilding (SWS) in China. The EnviroPac systems will be fitted to Wärtsilä 34DF constant speed engines. The order for the first two vessels was booked by Wärtsilä's joint venture company, CWEC (Shanghai) Co Ltd in the final quarter of 2024.

Although LNG offers a promising option to replace conventional carbon-heavy fuels, methane slip is a significant disadvantage. There are a number of initiatives in progress to tackle this issue. Cutting methane emissions from unburnt fuel in the combustion process will be one of the most effective ways of cutting greenhouse gas emissions over the next ten years, Wärtsilä said.

The company claims that EnviroPac, which is available for both new and recent versions of this engine type, will reduce methane emissions by about 50% without altering power output per cylinder of 520kW. Apart from the environmental benefit, ships operating on LNG with EnviroPac systems will incur fewer penalties in European waters arising from the bloc's Emissions Trading System and FuelEU Maritime.

CMA CGM placed an order for the new EnviroPac feature for the 34DF constant speed engine

NES to equip bulk carriers

Wilson | Norwegian Electric Systems (NES) has been contracted to deliver the power systems for eight newbuild bulk carriers that Udupi Cochin Shipyard is constructing for dry cargo shipping group Wilson.

NES' scope of supply includes energy design and a complete power system. This contains delivery of main generators, main propulsion motors, bow thruster motor, DC switchboard, main propulsion and thruster control, and transformers.

The equipment will be delivered between the second quarter of 2026 and the second quarter of 2028.

At Nor-Shipping 2023, NES and its sister companies in HAV Group announced a commercial initiative to provide solutions for emission reduction in short sea transport. For this project, NES will utilise its know-how from energy optimisation of ferries and offshore vessel and apply it to Wilson's dry cargo vessels.

Udupi Cochin Shipyard will construct the eight 6,300 dwt dry cargo vessels Source:Wilson

Source: Boskalis

The *Windpiper* is being developed by converting an existing vessel

Boskalis unveils largest rock installation vessel

Windpiper | Royal Boskalis BV has announced the conversion of an existing vessel into the world's largest subsea rock installation (SRI) vessel, with a capacity of 45,500dwt. The *Windpiper*, due for delivery in the first quarter of 2026, will double the capacity of the company's three-ship SRI fleet, propelling it to pole position in this specialised sector.

The 227m-long DP2 *Windpiper*, with a breadth of 40m, total installed power of 31MW and seven thrusters, will have a moonpool for the inclined fall-pipe installation. This component is essential to protect offshore structures such as the foundations of wind turbines, for example. The vessel will have more than a hundred single-occupancy cabins capable of accommodating client representatives alongside the ship's own crew.

The vessel's size and cargo capacity will make it well-suited to projects with long transit distances between rock-loading sites and offshore projects, Boskalis said. These are likely to lie in regions including the North American East Coast, the Baltic Sea, and the southern North Sea. The ship's size will also minimise the number of round trips required per project, saving time, fuel, and emissions.

The Dutch company has a strong track record in repurposing existing vessels enabling them to carry out new functions. The company points out that this sustainable approach not only extends the useful life of existing hulls, reduces the need for new steel, and saves time in bringing ships to market.

The *Windpiper* is expected to undertake its first projects in north-west Europe.

First delivery of renewable diesel

HVO100 | Marine fuels firm, KPI OceanConnect, and Neste, the Finnish oil company, have completed the first delivery of renewable diesel, HVO100, for the cruise industry in Singapore. MY Renewable Diesel™, sourced from the Vopak Penjuru Terminal, was supplied by the Global Energy-operated bunker barge, *Maple*, to a cruise vessel at the Singapore Cruise Terminal in November.

Jesper Sørensen, head of Alternative Fuels and Carbon Markets at KPI OceanConnect, commented: "This successful delivery is a testament to how partnerships can help advance the industry's green transition."

Svitzer orders battery-powered tug

The Svitzer ASD electric tug
Source: Svitzer

ElectRA 2500-SX | Copenhagen-based towage company, Svitzer, has ordered another battery-powered tug to be built by Sanmar Shipyard and deployed in the Øresund Strait between Denmark and Sweden. With a capacity of 1,818 MWh and a 70-tonne bollard pull, the 52m-long azimuthing stern drive tug will be built to a Robert Allan design and delivered in the second half of this year. Battery power will enable the 25m-long ElectRA 2500-SX tug to operate safely and effectively on electrical power alone. However, the vessel will also have two generators for back-up, extended endurance, and firefighting operations.

Svitzer's Scandinavian managing director, Mathias Jonasson, commented: "In recent years, we have experienced an increasing demand for green towage services in Scandinavia, including the Øresund Strait. At the same time, we have committed to doing our part to significantly reduce CO_2 emissions in the industry by 2030. Getting a new battery-powered tug solves both challenges as we can continue to provide reliable and safe services to our customers while reducing the carbon footprint."

Sanmar Shipyards' Tamer Geçkin, Electrical Systems director, said: "We are honoured to support Svitzer in decarbonising their fleet and building this new high-performing battery tug."

ClarkSea Index closes 2024 6% higher

Source: HansePhotoStralsund/Fraede

Product tankers are currently in high demand in the newbuild market. Pictured is the *Brahms* from shipping company GEFO, which was serviced at Strela Shiprepair Yard in June 2024.

ANNUAL PERFORMANCE | The research department of London-based shipbroker, Clarkson, tracks the performance of global shipping's many sectors on a daily basis. At the end of each year, it gauges the performance of freight markets, orderbook development, and new ship prices. 2024 was a broadly positive year but global shipping faces some new challenges.

Congestion, re-routing and supply chain disruption drove the cross-sector ClarkSea Index up by 6% last year, to USD 24,964 a day, 30% higher than the ten-year trend. Various sectors stood out: the container market notched up its strongest performance ever, with the exception of the pandemic period, with freight rates rising 149% and charter rates up by 48%.

Red Sea re-routing was the largest factor, Clarkson Research said, with about 700 ships taking the Cape of Good Hope route and increasing tonne-mile demand by 12%. However, higher volumes, up 5%, an earlier-than-usual peak season, and congestion were also contributory factors.

The dry bulk sector also performed well, with Capesize bulkers up by no less than 76% year-on-year, to USD 21,862 per day. Average earnings for bulk carriers were up by 21%. Iron ore and coal imports to China were key drivers.

Tankers did not fare as well. Typical earnings for a 2010-built VLCC, for example, fell by 22% from USD 43,206 to USD 33,502 while tankers across the board were down 13% from USD 40,775 to USD 35,441. The final quarter of the year was weaker than expected but, despite this, tanker earnings over the year were still 46% higher than the ten-year trend and tonne-miles were 11% higher than 2022 levels.

The LNG spot market fell sharply, with rates for a 160,000m^3 vessel down from an average of USD 97,077 in 2023 to USD 42,192. Very large gas carriers followed a similar trend: average day rates fell from USD 91,625 to USD 42,028.

New ship prices rose across the board with the exception of the standard 174,000-m^3 LNG carrier which eased by 2%. The ClarkSea newbuilding index rose 6%, with 15,500-TEU container ships clocking up the biggest increase, rising 21% from USD 168.5 million in 2023 to USD 204 million last year.

Contracting volumes increased in all sectors apart from bulk carriers. Last year was, in fact, the most active newbuilding market since 2007, Clarkson noted. Orders for tankers topped the table with an increase of 42% in volume – from 37.5 million dwt in 2023 to 53.4m dwt last year. In gross tonnage, nearly half of the ships ordered last year were ready for alternative fuels, with LNG the prevailing choice of many liner operators.

Global seaborne trade, at 6.2%, registered its strongest growth in 15 years. But this was caused largely by geopolitical factors including re-routing via the Cape and significant changes to Russian oil flows. Clarkson also noted underlying increases in Atlantic to Pacific commodity flows.

Clarkson noted that 2025 appears to have started on a more cautious note in some segments. Nevertheless, key themes of recent years, including managing disruption (with geopolitical uncertainties heightening) and going green (FuelEU Maritime, IMO) look set to continue.

Separately, analysis by Bimco has revealed that no less than 12 million dwt of new product tankers are set to be commissioned this year, a 16-year high and the second highest delivery volume on record. The total represents an increase of more than 250% on the 3.4 million dwt that was delivered in 2024.

Bimco's chief shipping analyst, Niels Rasmussen, revealed that 278 medium-range (MR) tankers were ordered in the two years from January 2023. On average, close to two MRs will be delivered each week. The long range 2 (LR2) segment will also see substantial growth, with one vessel delivering every week on average.

The surge in deliveries is set to coincide with the commissioning of major new oil refineries in Mexico and Nigeria. Analysts predict that these facilities will have a significant impact on products tanker trades, with a possible reduction in tonne-miles a likely outcome.

AiP for wing sail-equipped LNG carrier

BASIC DESIGN | The Liberian Registry and the Korean Register (KR) have granted Approval in Principle (AiP) to Samsung Heavy Industries (SHI) for the basic design of its wing sail-equipped LNG carrier. The wing sail, an eco-friendly auxiliary propulsion system, generates thrust through lift created by the pressure difference between the upper and lower sections of its wing structure, resembling the form of a sail.

The newly certified LNG carrier enhances propulsion efficiency with the installation of wing sails, the parties said in a statement. Additionally, it features a forward bridge placement that effectively resolves the major navigation visibility challenges commonly encountered with wind-assisted propulsion systems. SHI expects that by integrating the wing sail with its proprietary "SAVER Wind" air resistance reduction device, wind resistance will be further minimised, enabling the system to harness wind propulsion and lower carbon emissions.

According to the UK Department of Transport's Clean Marine Plan, the wind propulsion technology market is projected to grow to KRW 3.5 trillion (EUR 2.3 billion) by the 2050s. In line with this forecast, SHI plans to expand the application of this technology to other eco-friendly vessels, including ammonia and carbon dioxide carriers.

Jang Hae-gi, executive vice president and head of Technology Development at SHI, emphasised, "Wind power, being both infinite and emissions-free, is a crucial pillar for achieving carbon neutrality in the shipbuilding and shipping industry. Samsung Heavy Industries is committed to focusing its efforts on developing products and technologies that comply with environmental regulations."

KR's Chief Technical Officer, Kim Yeontae, commented, "This AiP certification reflects SHI's continued innovation in eco-friendly technologies. We believe it will make a significant contribution to helping the shipping industry reach carbon neutrality."

Thomas Klenum, executive vice president of the Liberian International Ship & Corporate Registry (LISCR), added, "The maritime industry is a hard-to-abate sector that needs innovation and new technologies to reduce GHG emissions. Although ships have been using the wind to sail the oceans for over 5,000 years, it is new and innovative to use wing sails on ocean-going cargo ships, especially LNG carriers. Therefore, the Liberian Registry is very proud to award Samsung Heavy Industries with an Approval in Principle for their Wing Sail System installed on their eco-friendly LNG carrier design that supplements the AiP issued by KR."

Illustration of the wing sail-equipped LNG carrier design

Source: Liberian Registry

Significant milestone in the advancement of hydrogen technology

AIP | Lloyd's Register (LR) has awarded Approval in Principle (AiP) to HD Korea Shipbuilding & Offshore Engineering Co, Ltd (HD KSOE) for its vacuum-insulated large-scale liquid hydrogen (LH_2) tank system.

The successful testing of a large-scale vacuum chamber for this AiP also marked the world's first technical validation of large-scale LH_2 tank insulation design, the partners said in a statement. The vacuum insulation system addresses some of the most pressing challenges of using hydrogen in the maritime industry: the scalability of liquefied hydrogen storage and transportation of the fuel, they added.

Storing liquid hydrogen at -253°C while minimising boil-off gas requires vacuum-insulated tanks similar to thermos flasks, but achieving this on a large scale in ships is technically unproven. For example, NASA's largest existing LH_2 tank holds 5,000m^3, yet ship-based applications may require tanks over four times larger.

HD KSOE's vacuum system is said to provide an innovative system that drastically reduces the time required to achieve a vacuum in large tanks.

Global hydrogen industry participants, including Woodside Energy, Mitsui OSK Lines (MOL), and Hyundai Glovis, contributed to the design development and validation. The system and test results were shared with these companies and international classification societies, including LR, which confirmed a significant reduction in vacuum time in shipyards.

The image shows a demonstration of the large-scale tank vacuum system with representatives from HD KSOE, Woodside Energy, M.O.L. and Hyundai Glovis Source: LR

In collaboration with HD KSOE, LR undertook rigorous design assessments and performance verifications of the soft vacuum insulation system, in line with its classification rules and international standards for gas ships.

Dr Byeongyong Yoo, vice president at HD KSOE, commented: "HD KSOE has been dedicated to providing technological solutions for large-scale energy shipping such as LNG, LPG, Ammonia, CO_2, and now hydrogen. This hydrogen vacuum system solution and large-scale validation test are part of these efforts. We will continue collaborating with leading global companies to drive the energy transition and achieve net-zero goals."

Jason Crusan, VP Energy Solutions at Woodside Energy, added: "This is a key achievement which builds confidence that liquid hydrogen ships can be efficiently designed and constructed in a shipyard environment".

Ammonia dual-fuel engines available from June

FINAL TESTS | Winterthur-based marine engine firm, WinGD, is close to completing final tests on its ammonia dual-fuel engines and the first units are scheduled to be delivered from June this year. The company has disclosed that latest tests of its X-DF-A technology have confirmed that key parameters have fallen entirely in line with its expectations.

A 52-bore single-cylinder unit is still undergoing tests at the company's Engine and Research Innovation Centre (ERIC) in Winterthur. This will allow rapid validation of the ammonia combustion system, the company said, and follows earlier combustion tests and validated systems on dedicated test rigs. A range of classification societies have already approved the company's safety setup.

Over the next few months, a multi-cylinder engine will undergo final tests at WinGD's Global Research Centre in Shanghai. However, the first X-DF-A engines are already being built.

Sebastian Hensel, WinGD vice president, Research & Development, said: "The single-cylinder X-DF-A concept is running well, with combustion efficiency, emissions, and pilot consumption within our range of expectations. This milestone is a testament to our uniquely rigorous approach to innovation and the fantastic work of our development team and partners."

The company has already notched up orders for close to 30 X-DF-A engines. They are to be installed on ships including bulk carriers, container vessels, LPG/ammonia carriers, and tankers. The first ten units have been ordered by Exmar LPG for four new gas carriers, and a further six engines will be installed on new CMB. Tech bulk carriers.

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Partnership in South Korea established

Representatives from Bureau Veritas Marine & Offshore and Samsung Heavy Industries Co, Ltd

Source: Bureau Veritas

CCS PROJECTS | Bureau Veritas Marine & Offshore (BV) and Samsung Heavy Industries (SHI) have established a partnership to develop floating carbon dioxide storage units (FCSU) and carbon capture and storage (CCS) projects in South Korea.

The collaboration, which aims to cut greenhouse gas emissions, will focus on validating and certifying effective and sustainable CCS technologies. The partners will also collaborate on pilot projects to test the commercial potential of CCS technologies. The classification society will manage technical review and independent technology risk assessments.

BV Marine & Offshore senior vice president, Asia Pacific, Alex Gregg-Smith, commented: "Our partnership with SHI is an important step in our efforts to support the deployment of innovative carbon capture and storage technologies. By combining our expertise, we aim to advance the commercialisation of FCSU and CCS solutions, which are critical for achieving global climate goals."

Speaking for SHI, Haeki Jang, CTO, said: "This collaboration marks a significant step towards realising our vision of a sustainable future. By leveraging the strengths of both SHI and BV, we are committed to accelerating the deployment of carbon capture and storage solutions that meet the evolving demands of the global maritime and offshore industries."

Guidance on methanol and ammonia issued

COMPETENCE STANDARD | Classification society DNV has issued a competence standard (ST) for methanol and a recommended practice (RP) for ammonia to equip ship operators and crews with more knowledge of the new safety risks posed by these fuels which are essential components in shipping's decarbonisation process. To ensure that ships using new fuels can do so safely, it is essential that ships' crews are aware of the risks and have the right knowledge and skills to adopt necessary processes and procedures, the classification society said.

According to DNV's Alternative Fuels Insights platform, the number of ships on order that will use these two fuels continues to rise. Up to last November, the classification society finds 27 ships with an ammonia fuel capability on order, and 322 with methanol.

DNV Maritime CEO, Knut Ørbeck-Nilssen, commented: "Embracing new fuels and technologies is essential to achieving our decarbonisation goals, but these advancements introduce new risks, adding complexity to an already challenging operating environment. To obtain a safe, timely, and impactful maritime transformation, we need to ensure safe operations by supporting both our seafarers and onshore personnel. Competence development is crucial for managing the transition safely and avoiding a safety gap that could put crew, assets, the environment, and our decarbonisation efforts at risk."

Kirsten Birgitte Strømsnes, business development leader in DNV Maritime Advisory said: "Introducing methanol or ammonia as fuel on board vessels will impact personnel ashore, the shipboard crew and the shipowner's organisation. It is critical that the crew can recognise risks and operate systems safely and the organisation needs to accommodate for this through safety management system and other organisational means."

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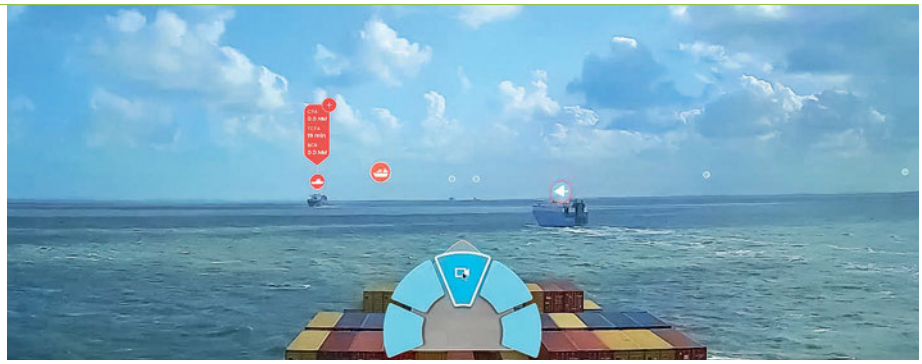
Connecting science and industry

The maritime industry in Germany and Europe stands at a crossroads. With deep-rooted expertise and world-class research institutions, it has the potential to lead in innovation and technological advancements in the sector. However, to remain competitive in a rapidly evolving global market, a stronger connection between science and industry is imperative. This connection is the foundation for developing sustainable and efficient initiatives that meet modern challenges, including those relating to decarbonisation and digitalisation. China's rise as a maritime superpower underscores the urgency of this endeavour. Through substantial state-led investments, strategic industry-science partnerships, and reduced bureaucratic hurdles, China has managed to dominate key aspects of shipbuilding, port infrastructure, and emerging technologies like autonomous vessels. If Europe fails to match this momentum, it risks falling further behind in technology development and the construction of assets in heavy engineering sectors, including shipping. Germany and Europe have an abundance of maritime know-how, with leading universities, research institutions, and innovative companies already paving the way for breakthroughs. However, significant barriers persist. Bureaucratic processes and high operational costs often slow down progress, limiting the region's ability to translate scientific advances into commercial success. Cutting-edge projects risk stagnation without targeted support and streamlined pathways for development.

To counter these challenges, a strategic approach to funding and fostering industry-science collaboration is crucial. Public investment in research and development, coupled with incentives for private sector participation, can catalyse progress. Streamlining regulatory frameworks and reducing administrative burdens are equally essential to unlock innovation and foster a climate conducive to growth.

Content



The Human Factor

Propulsion & Engine Technology

Operational Optimisation

Artificial Intelligence

The human element in maritime decarbonisation

CRITICAL ROLE When decarbonising the international shipping industry, focus should not only be on technologies and alternative fuels, but also on the impact on personnel, writes Dr Edmund Hughes, director of Green Marine Associates Ltd

The maritime industry is at a pivotal moment in its decarbonisation journey. Over the past decade, the sector has transitioned from focusing solely on air pollutants like sulphur oxides to adopting comprehensive strategies for reducing greenhouse gas (GHG) emissions. This evolution presents both significant challenges and transformative opportunities for stakeholders across the globe.

When the Energy Efficiency Design Index (EEDI) and Ship Energy Efficiency Management Plan (SEEMP) were introduced in 2013, they did more than establish new global benchmarks. They catalysed a shift in the industry's approach to energy efficiency, laying the groundwork for operational performance measures like the Carbon Intensity Indicator (CII) and an increased focus on GHG emissions reduction for the sector using alternative fuels and innovative technologies. The introduction of regional regulations including the EU's Emissions Trading System and FuelEU Maritime, which could affect up to 30% of the global fleet, have sharpened that focus.

Amid this, the critical role of the human element often remains underappreciated. Yet, it is clear that the success of maritime decarbonisation efforts depends not just on fuels, innovative energy systems and technological solutions, but also on the actions of shore staff and seafarers. These professionals are not merely operators of new systems – they are the key enablers of the industry's sustainable future. Their decisions, from route planning to fuel management, determine whether advanced technologies achieve their full potential or not.

This human-centric reality demands a fundamental shift in approach. Training must evolve from basic operational competencies to fostering a deep understanding of the systems that personnel have to manage and energy efficiency principles. Shore teams need advanced skills to analyse complex performance data and optimise vessel operations, while seafarers require knowledge to align everyday practices with emissions goals. Most importantly, the industry must cultivate a culture where environmental protection becomes as integral to operations as safety awareness.

Leadership plays a pivotal role in driving this transformation. Maritime executives must champion an organisational


Source: Shutterstock

ethos that integrates environmental considerations into decision-making. This includes incentivising energy-efficient practices, fostering collaboration between ship and shore teams, and embedding environmental performance as a core metric of operational excellence.

However, balancing regulatory compliance with operational realities remains a pressing challenge. For instance, fuel wasted by ships awaiting berth availability highlights inefficiencies that undermine sustainability efforts. The industry's response, such as the International Maritime Organization's (IMO) mandated Single Maritime Window for streamlined data exchange, exemplifies how digitalisation can address such issues. Similarly, Singapore's upcoming requirement for electronic Bunker Delivery Notes underscores the shift toward digital solutions in emissions monitoring and compliance.

Looking ahead, maritime GHG emissions pricing mechanisms will play a vital role in bridging the cost gap between traditional and green fuels. To be effective, these mechanisms must provide an enabling pathway, with funds allocated to incentivise green fuel adoption and mitigate investment risks for shipowners and fuel producers. The fundamental shift for shipping from tank-to-wake to well-to-wake compliance further underscores the need for advanced digital tools, including artificial intelligence, to navigate regulatory complexities.

The path to maritime decarbonisation hinges on unprecedented collaboration. Sharing information across industry actors will enhance risk management and inform investment decisions, especially as the finalisation of IMO's mid-term regulatory measures approaches. Resources like the International Chamber of Shipping's 'Reducing Greenhouse Gas Emissions: A Guide to International Regulatory Compliance, Second Edition' offer invaluable guidance for navigating these challenges, providing stakeholders with actionable insights and a clear roadmap.

The journey toward decarbonisation is not merely about compliance – it is about building a sustainable, efficient future for shipping. Success will depend on the sector's ability to adapt, innovate, and collaborate, transforming challenges into opportunities for growth and environmental stewardship.

Viability of nuclear power systems in design of future LNG carriers

REGULATIONS Nuclear power has the potential to make a transformational impact on carbon emissions reduction across the electricity, industrial and transportation sectors. Its ability to provide clean alternative power generation options in shipping has already attracted attention and the journey to cleaner maritime energy is gaining momentum. However, progress will not happen without regulations that provide a sound foundation for nuclear-powered systems in maritime, writes Jin Wang, Director of Technology at classification society ABS.

Aft detail of the design

Source for both images: ABS/Herbert Engineering

From the perspective of achieving IMO's 2050 net-zero ambition, it would be a mistake to ignore nuclear power as part of the maritime fuel mix. Nuclear power for ships holds out the prospect of using advanced small modular nuclear reactors (SMR) as propulsion, while nuclear for future fuels includes scenarios where small modular nuclear reactors are positioned near shore to produce power for ports and support the production of alternative fuels.

Developing the systems that could power merchant vessels, provide shore power and generate clean fuels, means bringing together players in marine and offshore design with builders of nuclear systems to fill knowledge gaps and exchange ideas.

ABS has set itself the goal of supporting government and industry initiatives focused on the adoption of advanced nuclear technology in commercial shipping, including key research with the U.S. Department of Energy and various New Technology Qualification and Approval-in-Principle projects with industry.

Both marine and offshore sectors could generate high potential demand, sharing as they do an increased focus on clean energy usage. The offshore market exhibits immediate demand due to the power requirement created by ports and other industrial users.

ABS unveiled the industry's first comprehensive rules for floating nuclear power plants at a forum for nuclear industry leaders held jointly with Idaho National Laboratory (INL). The event saw presentations on the latest reactor technologies from leading companies and publication of a detailed study from ABS and Herbert Engineering Corporation (HEC), modelling the design, operation and emissions of a floating nuclear power plant.

Additionally, the ABS Requirements for Nuclear Power Systems for Marine and Offshore Applications provides the first classification notation for nuclear power service assets such as floating nuclear power plants or nuclear-powered floating production, offloading and storage units. The requirements are agnostic to specific reactor technologies technology and propose a framework for nuclear regulators to collaborate with flag administrations and ABS for complete regulatory oversight and license.

Feasibility study for an LNG carrier

With advances in nuclear engineering and the development of many types of nuclear reactors, there are many opportunities to implement the technology for commercial ship propulsion. ABS and HEC often collaborate to investigate the application of new technologies for commercial vessels. The work leverages HEC's expertise in naval architecture to incorporate novel arrangements and equipment into conventional vessel types. With insights from ABS on classification and regulatory requirements, the concept vessel designs are first looking at novel arrangements.

In addition to previous studies researching a nuclear-powered container ship and a Suezmax tanker, there was interest in studying a nuclear-powered LNG carrier. These large vessels are increasing in demand as the international LNG trade remains important for global energy security.

LNG is stored on board in large cryogenic tanks that maintain natural gas (primarily methane) in a liquid state around -163°C. Benefits from nuclear propulsion include decarbonised high-power availability, reduced or eliminated bunker costs, and associated reduced bunker time in port. The typical energy demand for LNG carriers is between 30 and 75MW.

Technical specifications of advanced nuclear reactors under development today, often referred to as small modular reactors for their scaled-down designs, are not widely available, or are not specifically designed for ship propulsion applications. The intended scope of this study is to consider and discuss a standard LNG carrier

design using nuclear power for propulsion and other primary energy needs.

The high-level design of a standard LNG carrier is presented to illustrate how one type of advanced nuclear fission technology may be applied for shipboard power in the future, with an emphasis on what aspects of ship and reactor design may require further investigation to guide the development of the integrated technology and regulatory framework.

To conceptualise the possible design, the team invited a reputable small reactor designer to provide information regarding the use of its reactor design for ship propulsion. The design has been supported by the U.S. Department of Energy's Advanced Reactor Demonstration Program (DOE ARDP) to demonstrate the commercial viability of SMRs.

The main conclusions of this study of nuclear-powered commercial vessel designs are that nuclear power would be a supportive means of dramatically abating shipping emissions, but significant hurdles remain in public perception and international regulations before this can be achieved.

However, the maturity of advanced nuclear technologies that could be implemented for ship propulsion is low. Therefore, the level of detail provided in this study was limited to engineering information available from the design of terrestrial applications for engineering postulation and recommendations for future design optimisation.

The modular reactor philosophy imposes significant restrictions on ship design. The modularity concept imposes a fixed maximum SMR power output per reactor, corresponding to a set lifespan of its core.

It is advantageous if the nuclear power plant equipment and fueling lifecycles align with the vessel's life. Challenges with access to suitable shipyards or other support facilities and the physical removal of the reactors are significant and could be avoided by addressing the issues in the design stages.

Although it is possible to operate an SMR at a lower constant power level, its core will last longer. This may cause the reactor end-of-life not to line up with the ship's standard drydocking schedule, thus imposing significant additional operational costs.

This means that SMRs would be better suited for just a few sizes per ship type (mostly larger ships). In the design presented in the study, the SMR is considered to have an output capacity of 17.5 MWe associated with a core lifespan of five years.

This matches well the total power requirement of a 147,000m^3 LNG carrier, imposing the use of two reactors and a core switch at each special survey. However, if the same SMR were considered for a QMax LNG carrier (262,000m^3) with a total energy need of approximately 56MW, four SMRs would be needed, operating at around 80% of their maximum power.

This would imply a core switch approximately every six years and three months, which would represent the primary driver for service scheduling. This SMR feature may impose limits to ship capacity that can be offered to the market.

The ability of nuclear power plants to tolerate higher accelerations due to ship motions and vibrations can allow for flexibility in the overall design. While there are significant weight balance and arrangement benefits to keeping the plant at midships, for specific vessel types like oil tankers and LNG carriers, the midships location would not be feasible or would significantly penalise cargo capacity.

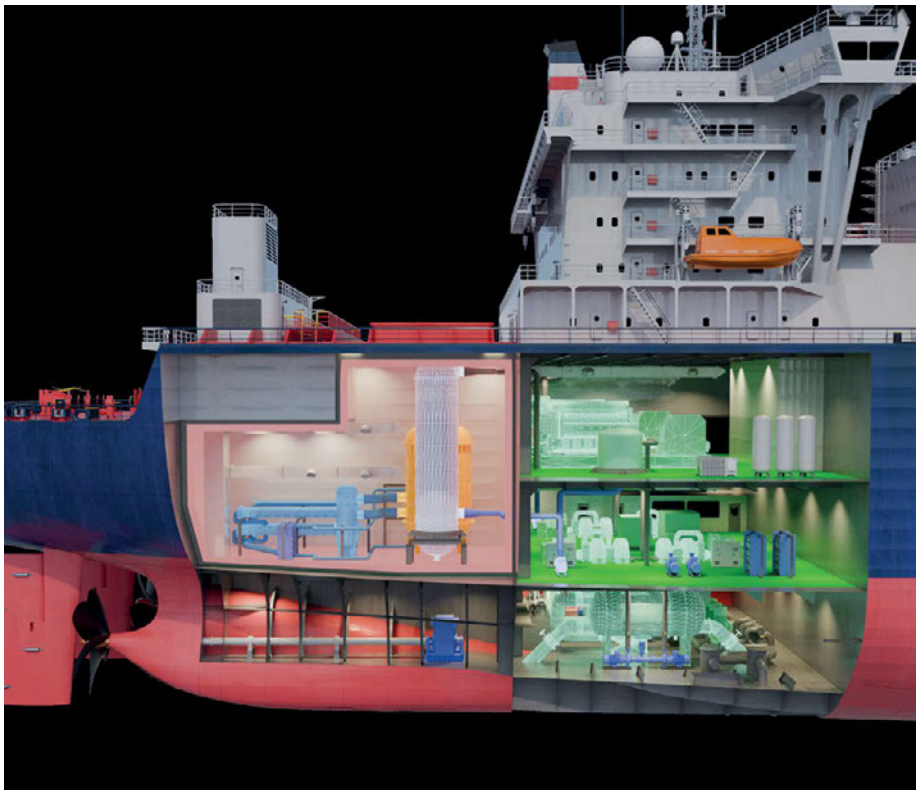
The degree of redundancy required by a nuclear-powered vessel may be higher than a more conventionally powered vessel for safety reasons, causing a decrease in productivity. The presented nuclear vessel design has two separate power, propulsion and steering plants, which provide a high level of redundancy compared to no redundancy typically accepted of single-screw vessels driven by marine diesel engines. Opportunities for optimisation exist on many levels for future design iterations.

Conclusion

The ABS focus is on bringing together major players in marine and offshore design with designers of nuclear systems. ABS can help to fill knowledge gaps that nuclear power companies may have around marine and offshore and vice versa.

With the feasibility demonstrated for small nuclear reactors on board large containerships and gas carriers and offshore platforms, it is likely that regulation and reactor licensing will prove the primary driving force in realising full scale projects. With renewed interest in building new technologies that are feasible for the marine sector, it will likely be up to lawmakers to support the ambition of reducing carbon emissions by enough to meet 2050 targets.

While the regulatory landscape continues to develop, ABS is encouraging both modular system providers and vessel designers to establish further joint industry projects that can explore challenges and opportunities.



Cutaway of the main components and the engine room

The *Olympic Boreas* achieved close to a 50% reduction in fuel consumption compared with other CSOVs Source: Ulstein

Setting new standards in marine power efficiency

LOAD REQUIREMENTS The Ulstein® Power Variable Speed Generator (VSG) is designed to optimise power generation on vessels by dynamically adjusting speed to match load requirements. Together with technical measures and overall ship design, the operational results on the CSOV *Olympic Boreas* showed a record-low fuel consumption of just 2.7 tonnes per 24 hours during a week of DP operations, Ulstein revealed recently.

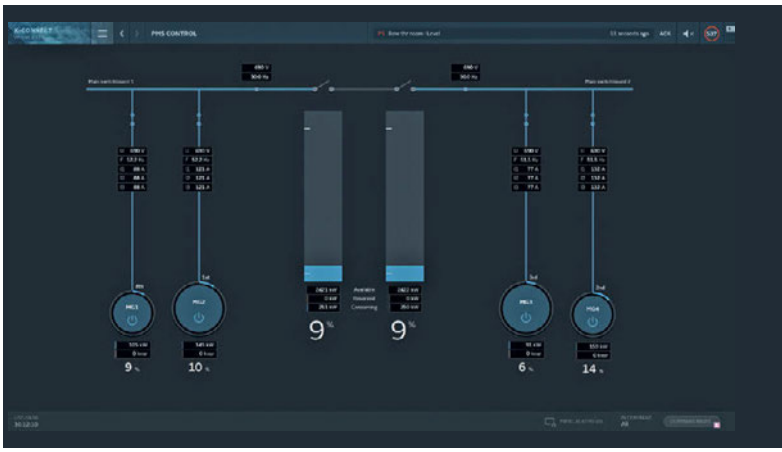
In November, the Norwegian offshore vessel operator Olympic took delivery of the second construction service operation vessel (CSOV) *Olympic Notos*, from compatriot shipbuilder Ulstein. Significant fuel savings had been achieved in dynamic positioning on board the previously delivered sister vessel *Olympic Boreas* during operations for BP off the UK, prior to starting work on an offshore wind project in the UK North Sea.

These are the first CSOVs to employ the Twin X-Stern system, with four main thrusters fore and aft in a symmetrical dual-stern hull, allowing flexible operation in dynamic positioning (DP2) mode. This is complemented by variable-speed diesel-electric propulsion, hybrid battery power, energy storage and smart energy management to maximise fuel efficiency.

Based on the Ulstein SX222 design by Ulstein Design & Solutions AS, the vessels are intended for work in the offshore energy segments, with a length of 89.6m and beam of 19.2m, and accommodation for 126 people in 91 cabins. They are also equipped with a heave motion-compensated gangway system for efficient transfer of personnel and cargo at variable landing heights.

The thruster configuration, combined with variable speed capability, is the key factor behind boosting energy efficiency by allowing precise multi-directional positioning control with optimal

The remote operation centre Source: Marius Beck Dahle



The VSG has been designed to optimise power generation Source: Ulstein

use of thruster power to cut fuel usage, explained Olympic's chief technical officer Runar Stave. "Furthermore, high manoeuvrability with the multi-thruster system enables enhanced seakeeping and stability in variable sea states, which contributes to greater operational efficiency and improved safety with gangway crew transfers. Less noise and vibration from reduced thruster usage also gives a more comfortable onboard experience for the crew in accommodation of hotel standard," he said.

"The ability to run the engines at variable speed means that power production can be optimised based on the vessel's energy demand. The implementation of several technical measures on board the vessel has resulted in a power demand of only 250-300 kW under certain conditions.

At such low power levels, operating at variable speed facilitates optimal operation of the engine – as opposed to operating at constant speed – and results in significantly lower energy consumption per kWh. Consequently, the ability to operate the engine at variable speed, combined with the technical measures and the overall ship design, has enabled the *Olympic Boreas* to consume only 2.7 tonnes of fuel per 24 hours during a week of DP operations, which is approximately 50% less than other sailing CSOVs," according to Stave.

"As well as cutting fuel consumption, reducing engine speed leads to significant reductions in maintenance costs by extending service intervals, contributing to lower operational expenses over the vessel's lifetime," he added.

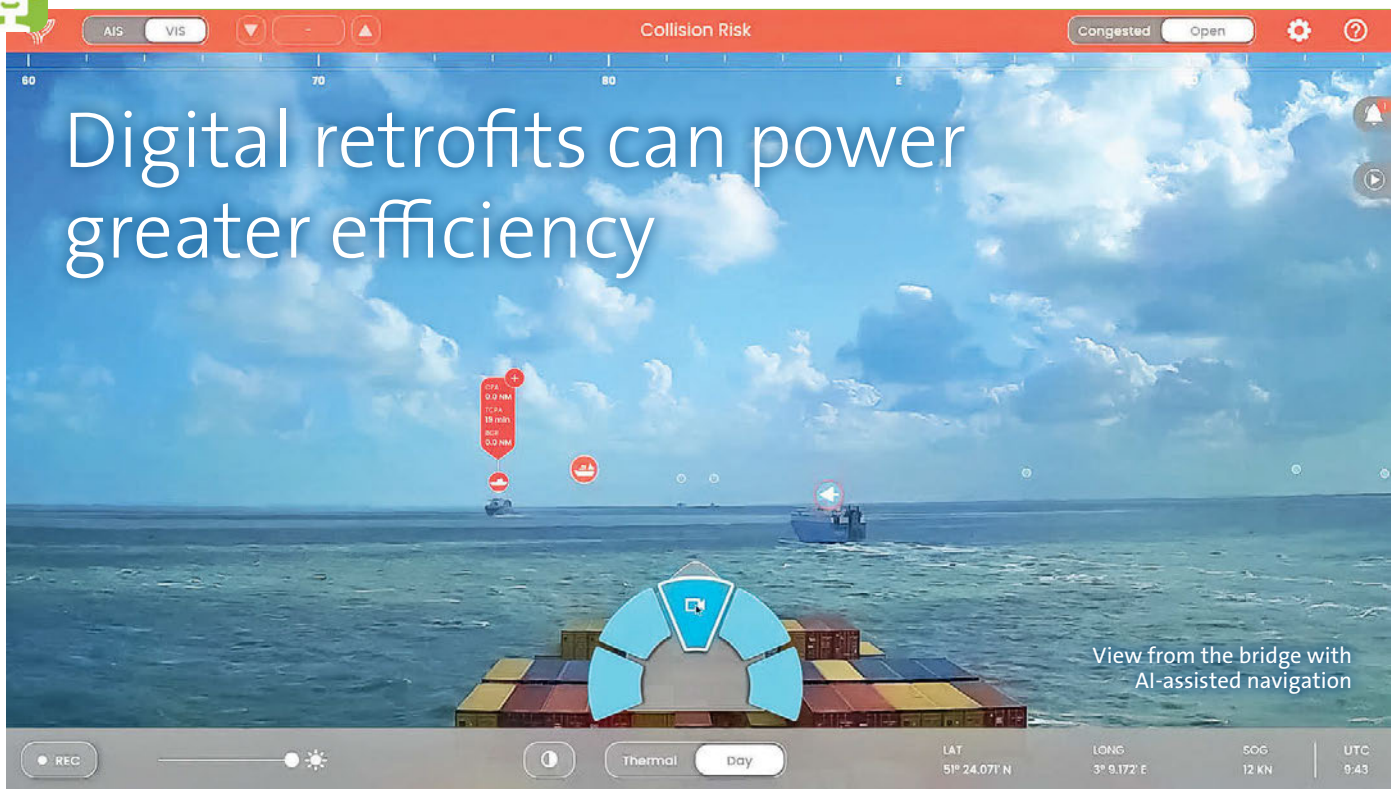
These vessels have a hybrid battery system that can operate as a spinning reserve, reducing the need for auxiliary generators and further improving fuel efficiency. Additionally, a smart energy management system uses automated digital algorithms to manage power production and consumption in real-time, providing instant power when needed, while reducing overall energy usage.

The CSOVs are also equipped with a shore power connection for emission-free port operations and battery recharging. They also have space for extra battery capacity, enabling full-electric operation in the future once the necessary infrastructure becomes available at sea. GHG emissions from the vessels have fallen in proportion to the cut in fuel consumption, and they are also ready to use methanol as fuel, which will further reduce their carbon footprint.

Olympic's chief commercial officer Glenn Erik Valø pointed out this is important from both a sustainability and commercial perspective, given the scheduled implementation of the EU Emissions Trading System (EU ETS) for offshore vessels from 2027. This will lead to higher fuel-related costs for vessels running on conventional fuels due to the need to compensate for emissions.

"Optimisation of energy efficiency and reduced emissions with these vessels will therefore represent a cost advantage that will be an important competitive differentiator in contract tenders for the vessels," he concluded.

Digital retrofits can power greater efficiency



Source: Orca AI

WATCHKEEPING | Human error is a principal cause of maritime accidents. Minimising the occurrence of such incidents can save lives, safeguard the environment, and save money by de-stressing the watchkeeping function. Nick Savvides reports.

Container ships are particularly vulnerable with small vessels sometimes hard to see in the busy approaches to terminals. Tight schedules and port calls in sometimes difficult conditions are a frequent concern.

Artificial intelligence (AI) can also upgrade vessel efficiency and offer owners and operators a guiding hand in the day-to-day running of ships, while the system 'learns' and improves as it functions.

Yarden Gross, CEO and founder of Orca AI, makes the distinction between an autonomous shipping system, and an automated system: "Automation reduces the workload of the crew and improves the performance [of the vessel] and allows the crew to supervise the operation, when you're in autonomous mode," he explained. Building efficiency into the maritime industry is becoming increasingly important as emissions regulations increase in intensity. Orca AI believes that the use of AI for navigational purposes can be a major player in these developments.

One company that is convinced that the system will improve their vessels' efficiency and their safety is Vancouver-based Seaspan Corporation. Torsten Holst Pedersen, COO, said the initial move to adopt AI came with the introduction of affordable satellite communications.

"A lot of things in shipping today wouldn't have worked ten years ago, including Orca. It would be prohibitively expensive and the AI would not work because we wouldn't be able to collect the data," explained Pedersen.

Now with affordable satellite systems such as Starlink, for example, the connectivity is far better and the necessary data can be downloaded to the cloud, and that allows the Orca AI algorithm to be constantly updated.

"Orca AI is integrating over 50 new systems each month," said Gross. "So far, 1,000 units have been installed globally. We have a large network of installers, in more than 20 shipping hubs worldwide. The installations are designed to be as straightforward as possible without interrupting the ships' operations."

The system utilises all-round vision through its SeaPod camera system comprising five high-resolution day cameras and three thermal cameras. The SeaPod is installed on the compass deck or the foremast and uses a range of sources to track weather conditions, potential obstacles, and traffic in the vicinity.

It can also locate small boats and fishing vessels, for example, that may have switched off their AIS transponders. The system can instantaneously calculate their movement, direction of travel, and potential navigational risk.

Gross explained that the vessels with Orca AI installations navigate to many different ports around the world, amassing and sending data to the cloud. The company's models can then be "trained" for any eventualities.

"You [then] have the capability to deploy updates to the entire fleet. Without connectivity it would take years to do that," Gross declared.

He stressed that the system is quick and easy to install. "The average installation time is six hours. The system is easy to use, and our Customer Success team offers a personalised training session lasting 15-20 minutes, followed by a five-minute computer-based training (CBT)."

He added: "Although the system is specifically designed for use in challenging navigation conditions, such as low visibility and crowded waters, the crew is encouraged to utilise it consistently for better situational awareness around the vessel."

According to Seaspan's Pedersen, the Orca AI system uses thermal imaging too, so it can see in dense fog, in regions such as the East China Sea, "where you'll have vessels that are not necessarily on AIS or forgot to switch on any lights because they're illegally fishing."

In fog, said Pedersen, you often see fishing boat lights and they look like they are on the horizon. "But when you see it with the thermal imaging, then you notice that there are loads of ships before you get to the light and you don't really notice them and you can't see which way they're going, but with Orca AI it gives you that information," said Pedersen.

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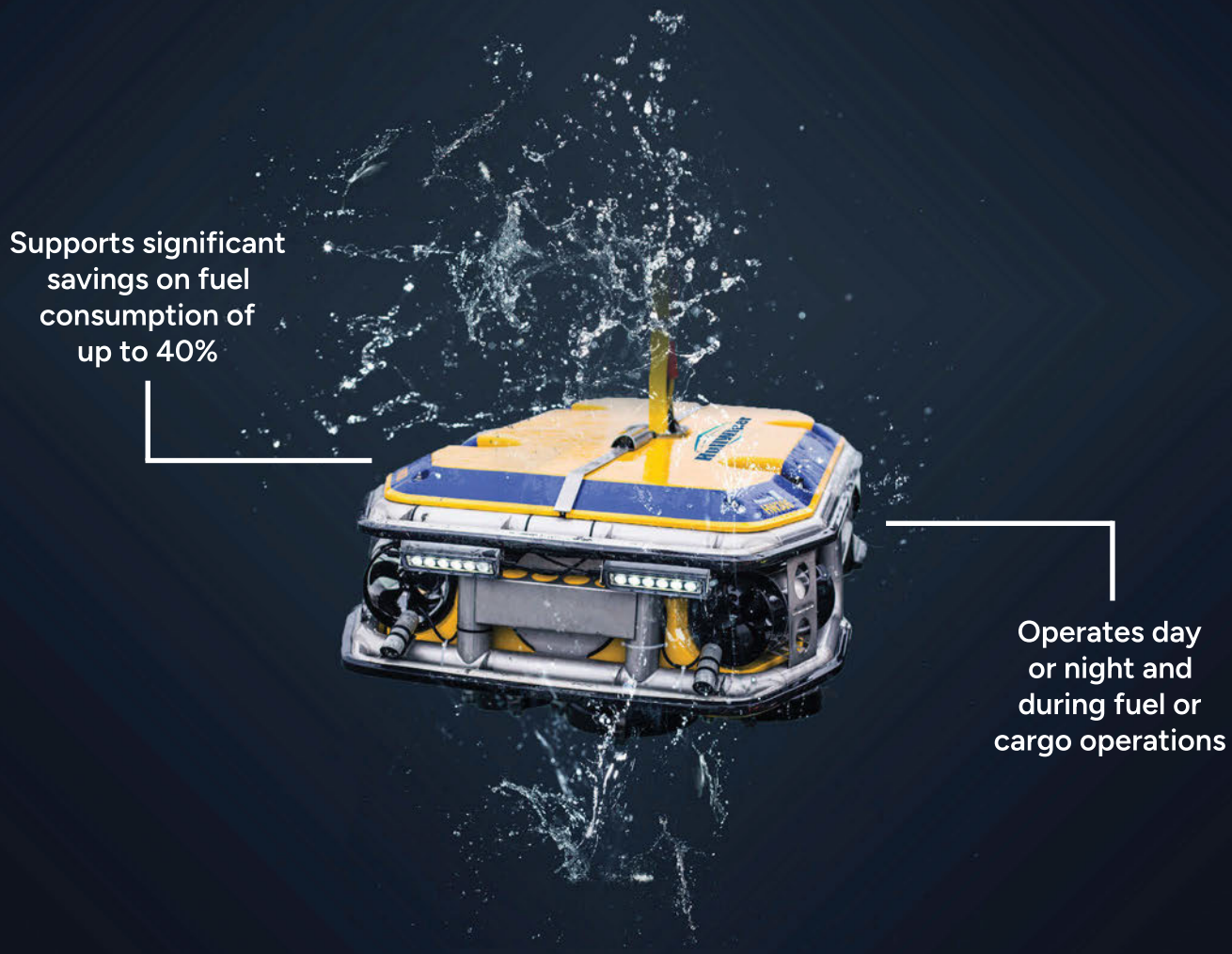

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HullWiper

WELCOME to the latest edition of Ship and Offshore Repair Journal and the first issue of 2025. As shipping's decarbonisation drive gathers pace, the repair sector is likely to see an upturn in demand for its services. There are many thousands of ships that will require modifications over the next decade and beyond. Proactive owners already have strategies in place to raise their sustainability rating. Many repair yards in Asia, conveniently located at the end of a long-haul voyage either from Europe or across the Pacific from the Americas, are well-placed but many are full and likely to favour existing clients. We take a look, therefore, at repair facilities in the Middle East which may offer interesting options. Meanwhile container ship retrofits are climbing the agenda as global liner companies feel the heat from their shipper customers seeking to establish more sustainable supply chains. And we also examine the thorny issue of the sector's new fuels that are under development in new types of engines and the challenges they pose for luboil developers and manufacturers.


Paul Bartlett
Managing Editor

CONTENT

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Mid East yards set to provide compelling repair options

The Middle East is a ship repair hotspot with a wide range of facilities capable of docking and repairing the largest tankers and ore carriers right down to small, specialised offshore support vessels (OSVs), service vessels, and everything in between. Demand for Arabian repair capacity is expected to climb steadily as Far East yards run at full capacity and owners seek new options.

Source: DDW

Drydocks World has recently announced major expansion of its South Yard

While there are several leading facilities in Gulf waters, there are also important repair yards lying elsewhere in the Middle East. Within the Gulf, large yards include ASRY, Drydocks World, International Maritime Industries and Qatar Shipyard, a joint venture between Nakilat and Keppel Offshore and Marine.

A range of smaller facilities service vessels trading regionally for local owners. And there is one hybrid yard, just eleven years old, Albwardy Damen, that combines ship repair and newbuilding. Built from scratch on the desert in Sharjah, it specialises in ship repair and the construction of tugs, offshore support vessels and a range of other service craft.

While the Red Sea conflict is currently a significant constraint on Red Sea business and operations at Zamil's repair yard in Jeddah, the Saudi group has two other repair yards on the country's Gulf coast. Outside of the Red Sea, the repair sector is running full ahead, say contacts in the Gulf, with healthy occupancy at most facilities.

For owners with repair requirements based outside the region, Asyad Drydock in the Omani Port of Duqm offers an interesting option. It is close to major shipping lanes traversing the Gulf of Oman, yet is outside the Gulf, saving extra deviation. The large yard has 2.8 km of quay, alongside water depths of up to ten metres, and two docks of up to 600,000dwt capacity. Duqm is a little over one-hour's flight from Muscat, or six hours by road.

Further up the coast but still outside the Gulf itself lies the world's second largest anchorage and one of the world's top-three bunkering ports. With 133 anchor positions in the Fujairah Anchorage Area, the Emirate is a popular location for owners to make crew changes, and for their ships to refuel, take on stores and spares and, if necessary, carry out underwater repairs and maintenance.

Not surprisingly, the port is stacked full of ships' agents, diving firms, and all types of marine engineering service companies. Most of the region's builders have a presence there. Having a good agent is essential: the port itself, its oil storage facilities, a cross-UAE oil pipeline from Abu Dhabi, and various underwater pipelines to offshore loading terminals mean that security is extremely tight.

Sailing through the Strait of Hormuz into Arabian Gulf waters opens up another range of region-focused yards. Servicing offshore craft and smaller vessels is the RAK Ports repair yard in Raz al Khaimah, and Arab Heavy Industries in Ajman. There are a significant

number of marine engineering firms dotted along the UAE coast and Abu Dhabi Shipbuilding further down the coast is a specialised builder that has, in the past, focused on naval vessels but in recent years has built a number of offshore support vessels.

Dubai, however, is one of the world's best known repair centres. Drydocks World (DDW), which opened for business in 1983, is a ship repair and conversion magnet. And nearby Dubai Maritime City hosts a large number of marine engineering firms all booking good business at present.

A continuous programme of expansion and facility upgrades positions DDW as one of the world's top repair yards. In December, it announced the completion of its expansion project in the South Yard where the yard will engage in the construction of some of the most complex offshore assets, and the conversion of others, including FSRUs and FPSOs.

Linked to Saudi Arabia by the King Fahd Causeway lies the island nation of Bahrain, home to the region's oldest major shipyard, ASRY, which opened for business in 1977. Well-known as a tanker repair yard, ASRY has strong ties with international clients as well as regional companies. It also has a thriving business in offshore vessel upgrades and repairs.

Qatar's Nakilat may be best known as owner of the world's largest LNG fleet. But it also has a sizeable repair and offshore construction yard, owned in a joint venture with Keppel Offshore Marine and managed by Qatar Shipyard Technology Solutions. The yard has one ULCC-sized dock, two VLCC-sized docks, a floating dock suitable for Q-Max LNG carriers or VLCCs, three kilometres of repair quays, a range of workshops, and cryogenic clean rooms.

There are several yards on Saudi's east coast in and around Dammam but further up the Saudi coast in Ras Al-Khair is the region's youngest and largest facility, International Maritime Industries, a joint venture between Saudi Aramco, Bahri, Lamprell, and Hyundai Heavy Industries. The Saudi shipyard provides both new construction and repair services (see box on the right).

ASRY capitalises on firm client base

Bahrain's Arab Ship Repair Yard has completed more projects on ships than rigs over the last twelve months but both sectors are fundamental to the yard's repair activities. The total number of projects has risen and the yield per contract has also increased, the yard revealed recently.

The Middle East's oldest major repair facility, established nearly 50 years ago in 1977, continues to break new ground with a diverse range of projects in addition to standard repair business. The Bahrain-based yard recently announced a fleet-wide deal with the Kuwait-based Arab Maritime Petroleum Transport Company (AMPTC) to dock, repair and maintain the company's 14-ship fleet including two LPG carriers and 12 products tankers.

Repeat business

Speaking to SORJ recently, the shipyard's Sauvir Sarkar, General Manager, Ship Repair and Engineering, revealed that the company has a steady stream of repeat customers from the region itself, as well as Greek tanker owners and an increasing number of Indian clients including the Shipping Corporation of India. This ensures good occupancy at its facilities which include a 500,000dwt dock, two floating docks, 15 repair berths, a wide range of workshops and service centres, and more than 250,000m^2 of fabrication space.

One-off projects are important too, Sarkar said, with high-end offshore support vessel hybrid conversions and battery installations now in demand. Routine repairs to offshore vessels and rig upgrades provide steady revenue streams too and, of course, the nearby Saudi market is an important source of business.

Operating flexibility is important in the repair business, some of which can be short-term and urgent. Sarkar stressed the importance of a flexible workforce and the ability to ›

IMI breaks the mould

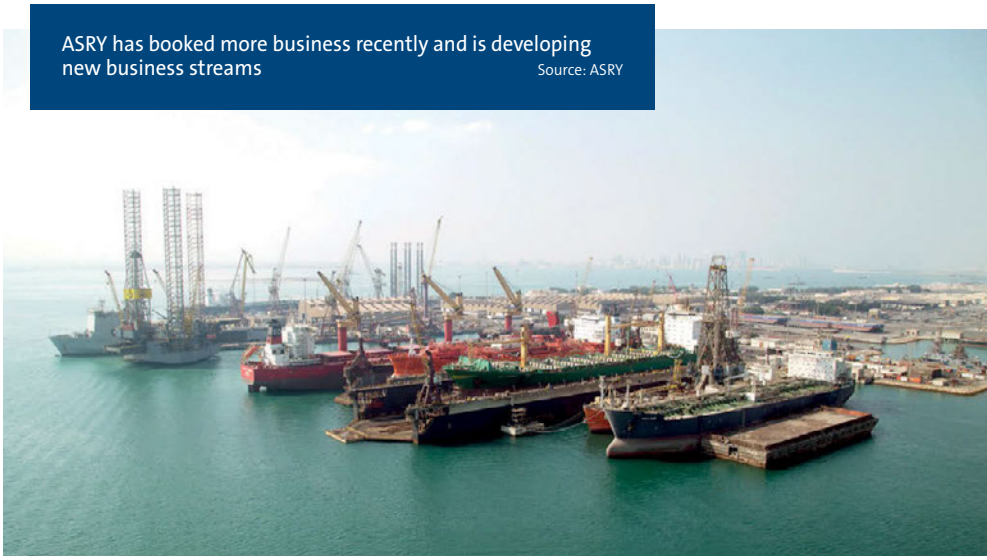
The youngest and largest shipyard complex in the whole region, Saudi Arabia's International Maritime Industries (IMI), is a trail-blazer for a number of reasons. One, its shareholders include the world's largest hydrocarbon energy company, Saudi Aramco, and one of the world's largest tanker companies, Bahri. And two, between them, these two shareholders have committed to ordering 20 offshore rigs and 52 vessels over the next decade, worth USD 10 billion.

The shipyard, in Ras Al Khair on Saudi's Gulf coast, also has a vast repair yard, with space for large ships, offshore support vessels, and rigs. Although leading charterers, including Saudi Aramco, have expressed an intention not to charter OSVs more than 15 years old, but about a quarter of the existing regional fleet of such vessels is already older.

Demand for OSVs is buoyant and such older vessels will certainly be required in the next few years. Demand is likely to outpace supply. IMI, together with other regional yards, could be set for a substantial OSV upgrade programme.

The shipyard's management is also taking an unusually forward approach to the engagement and training of young people. It is offering them a clear career path in the engineering or management skills that they choose and claims to have already helped more than a thousand young people to choose a variety of development programmes to develop their skills in an international and multicultural environment.

ASRY has booked more business recently and is developing new business streams Source: ASRY



ASRY has completed ship repairs for Maersk and the two parties have signed an MoU in ship recycling Source: ASRY

Expansion at Drydocks Word's South Yard will increase construction capacity by 40% Source: DDW

scale up and down at speed. ASRY's labour force has three components, he explained: a permanent multi-skilled contingent; a ready supply of subcontractors; and access to third-party platers, welders, and pipe fitters, for example, who are available at short notice.

Having been certified under the Hong Kong Recycling Convention in 2023 and approved in principle under the European Union Ship Recycling Regulation, ASRY recently recycled the *Wan Hai 185*, a small container ship. The project was overseen by Grieg Green, a 15-year-old environmental recycling consultancy and part of Norway's Grieg Group.

"Great experience!"

"It was our first experience but, even so, we had zero non-conformities in terms of safety and the environment which is remarkable," Sarkar said. "We undertook the project in full compliance with the approved Ship Recycling Plan for the yard as well as specifically for the ship. Grieg Green monitored every stage of the project. It was a great experience!"

Following the pilot project, ASRY signed a Memorandum of Understanding with the A.P. Møller-Maersk group to cooperate on future ship recycling in Bahrain in the middle of last year. The signing ceremony was attended by other interesting parties including local steel group, SULB Company, and APM Terminals Bahrain, operator of the island's container terminal. Sarkar revealed that ASRY could well scale up its recycling capabilities in the months ahead.

ASRY is also building two new self-propelled bunker barges for the Bahrain Petroleum Company.

DDW expands capacity and books more major deals

Drydocks World (DDW) has recently boosted capacity with the December opening of its South Yard expansion project in Dubai, increasing construction capacity by 40% and yard capacity by 25%. The 75,000-m^2 facility has what is claimed to be the largest load-out quay in the Middle East and Africa, capable of handling structures weighing up to 37,000 tonnes.

The South Yard will now have a workforce of up to 3,000 and is likely to focus on energy-related projects, the yard said. These will include the conversion of existing tankers into floating production storage and offloading (FPSO) units and regasification (FSRU) units, and infrastructure for building offshore platform topsides and platforms for the offshore wind sector. A 5,000-tonne sheerleg floating crane is likely to be commissioned next year.

Sustainability of future operations at the South Yard has been a priority. The facility is now operating entirely on clean energy provided by the Sheikh Mohammed bin Rashid Al Maktoum Solar Park. This, the company says, significantly reduces the facility's carbon footprint and ensures adherence to international environmental standards.

Commenting on the project, CEO Captain Rado Antolovic, said: "The South Yard represents a transformative step for Drydocks World. It enhances our ability to execute multiple complex global projects, while prioritising smarter logistics, efficient execution, and high HSSE standards. The facility is integral to supporting the energy transition and meeting the demands of a rapidly evolving market."

Projects completed recently at DDW include the conversion of the Voyageur Spirit into the FPSO Petrojarl Kong and the shuttle tanker Nordic Atlanta into the FSO Yamoussoukro, now both on station and working at ENI's Baleine field offshore in Côte d'Ivoire. Operations are understood to have started in December. The FPSO Firenze was also converted by DDW for the Baleine field.

Other conversions completed recently include the FPSO Atlanta, a tanker conversion and upgrade for an extended deployment on the Atlanta field off Brazil. Company representatives report that this was the most complex conversion undertaken so far.

The shipyard has about 150 repair projects in progress or on order including two FPSO conversions. In a December announcement, the company revealed a new project to build and install Ostwind 4, a German offshore wind development. In partnership with GE Vernova, the Ostwind 4 will be sited 30 km north east of Rügen Island connecting wind farms in the Baltic Sea to the German grid providing power for close to 2,000 households.

Albwardy Damen expands UAE network

Albwardy Damen's shipyard in Sharjah, built on desert land on the edge of the Gulf, is now eleven years old and combines new construction with ship repair in an unusual but highly successful business model. The yard's management, headed by Lars Seistrup, has overseen steady expansion recently at other sites including Fujairah and Dubai Maritime City (DMC).

Demand for servicing and repairs in Fujairah is steadily increasing, both in its workshop facilities on shore and also afloat repairs on the Anchorage. The company now how 200 full-time personnel permanently stationed in Fujairah, Willem Moelker, sales and marketing director, tells SORJ, with additional personnel seconded from Sharjah or Dubai when necessary.

The Red Sea crisis does not appear to have affected the number of calls at the Anchorage, locals say. Ships call there for part of their routine business: they carry out crew changes, pick up stores, spares, and complete afloat repairs.

Albwardy Damen's diving teams are in constant demand on the Anchorage in response to requests from owners to reduce fuel consumption and optimise ship performance by cleaning hulls and polishing propellers. Meanwhile class-approved underwater repairs are also a steady business stream, with windlass repairs a frequent requirement, Moelker said, owing to the deep water at the Anchorage which ranges from 80m to 120m.

The company can dock vessels of up to 35m in length at its Fujairah facility within the port area and there has been a large increase in crew boat dockings recently, as well as security-related vessels, and other service craft.

Other repair facilities in Fujairah include a laser alignment and in-situ boring team, constantly in high demand, and a dedicated glass reinforced plastic and glass reinforced epoxy piping and installation team.

Meanwhile, in DMC, the company has opened a dedicated mechanical workshop for servicing engines, thrusters and hydraulics. This facility helps to support an ›

Albwardy Damen's diving team is kept busy at the Fujairah Anchorage with a range of underwater repairs
Source: Albwardy Damen

Larger Middle East yards can benefit from regular large tanker business such as the 319,106dwt *Olympic Luck*, seen here at ASRY
Source: ASRY

increasing volume of two-stroke and four-stroke engine overhauls and reconditioning of parts for the Fujairah facility. The company's fuel pump, fuel valve, and governor teams are also based at the DMC facility.

Back at the Sharjah shipyard, there is plenty going on. As well as routine repairs, three search and rescue vessels were completed for Jawar Al Khaleej LLC, and the company has signed a letter of intent for a Damen Multipurpose Vessel 4916. Meanwhile, in anticipation of an upturn in dredging and offshore activity across the region, the company is building vessels for stock, one of Damen's long-held strategies.

Initially, three vessels will be built under the stock arrangement in which vessels can be mostly completed and therefore available on relatively short delivery times thereafter. The vessels in the programme will be a 27-m Multi Cat 2712 for delivery in November 2025, a 33-m Multi Cat 3313 SD (shallow draught) for delivery in the following month, and a 27m-long Shoalbuster 2711 for delivery in February 2026. All three vessel types are versatile workboats capable of fulfilling a range of functions including dredging and offshore installation and maintenance, two areas in which the yard's management anticipate significant growth.

Bustling business at DMC

Smaller engineering, repair, and upgrade firms in the UAE report strong demand for services and Dubai Maritime City (DMC), in particular, is on a roll. There is often a waiting time of a month or more for a docking or alongside slot which, seasoned veterans say, is unusual.

"There is definitely more demand for upgrades and retrofit projects," said long-time repair man, Paul Friedberg, owner of Nordmarin LLC, speaking to SORJ recently. "This is evident across all segments. Most companies in DMC are experiencing very high workloads and have substantial forward orderbooks. This is certainly the case at Nordmarin – we have never seen this level of activity or diversity of projects. We have an orderbook running into several months, higher than we've had for ten years."

A similar story is evident at Jome Engineering LLC which has facilities in Dubai Maritime City, Dubai Industrial City, Khalifa Port, and Fujairah. The 15,000-m^2 workshop in Dubai features cutting-edge repair machinery including laser cladding, computer-numerical-controlled lathe, and milling and balancing machines. The company's 400-strong workforce includes ex-seafaring chief engineers, diesel and automation engineers and experts in all relevant skills.

The company has a machinery service facility for two- and four-stroke units, a reconditioning capability, and scope to repair all rotating equipment including deep well LPG pumps, compressors, winches, and all types of valves. Jome's steel fabrication shop has dedicated bays for steel, tanks and pipe fabrication, blasting and painting shops, and a team of DNV class-approved welders.

The company also offers a retrofit and upgrade services both to structures and for environmental initiatives. The installation of scrubbers, ballast water treatment systems, wind sails and the preparation of machinery for alternative fuels are also available.

Meanwhile, 249-hectare Dubai Maritime City has recently doubled ship handling capacity, expanding to a thousand vessels annually. Measures taken to increase capacity have included major infrastructure upgrades including the retrofitting of ship lifts, the installation of substations and shore power supplies, and new ship cradles. The facility now has ship lifts with capacities of 3,000 tonnes and 6,000 tonnes. The extra plant is another move to attract business to the thriving ship service and repair hub.

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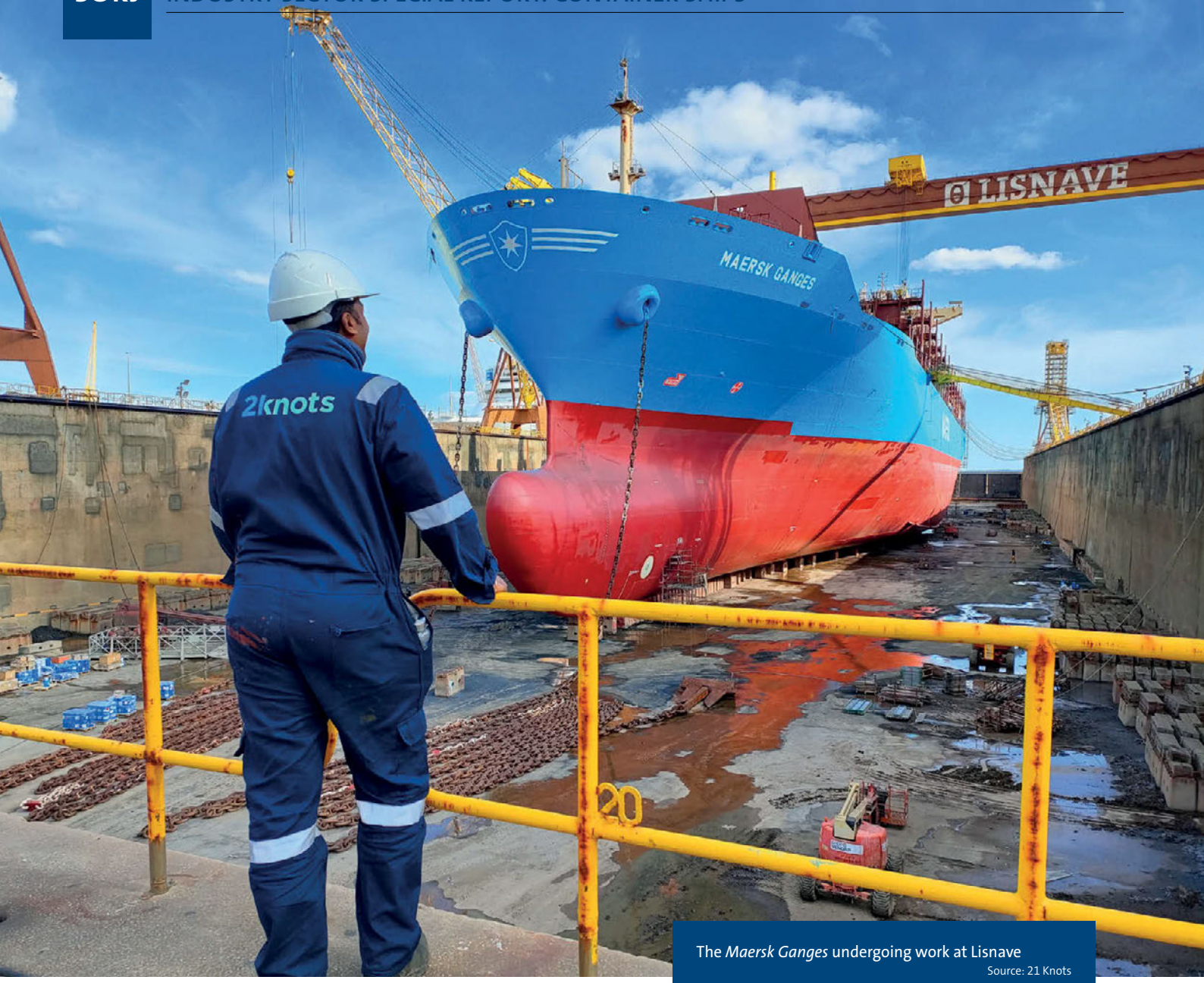


The *Maersk Ganges* undergoing work at Lisnave
Source: 21 Knots

‘Radical retrofits’ take centre stage

For container lines with ambitious environmental targets and customers with sharp eyes, decarbonising the fast vessels that carry much of the world’s trade is a top priority. Cutting a few percentage points here or there will not suffice. Nick Savvides examines the scope for ‘radical retrofits’ in this hard-to-abate shipping sector.

Following huge hikes in fuel prices around 2010, the battle for cargo between container lines saw container ships cut their speed to save fuel and offer more favourable rates. At that time German shipping company Peter Doehle’s CEO, Jochen Doehle said unequivocally “container ships will speed up again”.

A decade and a half or so later, container ships not only operate at significantly lower speeds, but many have made slow-steaming permanent. They have de-rated engines and retrofitted existing power plants so that they are effectively smaller units, and retrofitted single-fuel engines to make them into dual-fuel units.

Of course, when Doehle made his comments, ‘decarbonisation’ was low on the global agenda. But today, capping carbon emissions is a top priority, particularly in this transitionary period, where no zero-emission fuel exists. And ‘net-zero’ fuels, which emit the same amount of carbon as sequestrated, remain vastly more expensive than available fossil fuels.

Hard to abate

Container shipping is one of the ‘hard to abate’ sectors in maritime, with ships originally designed to burn up the miles at

high-speed delivering freight in just-in-time supply chains. Reconfiguring power plants, known as 'radical retrofits', is an option that is increasingly being considered by container lines, class and engine manufacturers.

The strategy is seen as a possible future abatement method for existing ships of a certain age that burn heavy fuel oil. Options include achieving emission reductions by using more sustainable fuels, dual-fuel engine conversions, or through the radical de-rating of engines.

A recent DNV and MAN Energy Solutions (ES) study set out the key retrofit requirements for ships with two-stroke engines that are electronically controlled, have a bore size of at least 50cm, and where sea trials were carried out after January 1st, 2015.

The cost of retrofitting, including modifying fuel storage and supply systems, ranges from USD 5 million to USD 15 million depending on the type of fuel. Some experts say that to be economically viable this should not exceed 25% of the original cost of a ship.

However, this depends on a range of variables, not least the cost of the ship in the first place, its age, and the projected future costs of the chosen fuel. A minimum newbuild cost of around USD 50 million is necessary for a ship to be suitable for retrofitting, said the report. According to the DNV/MAN study, tankers above 50,000dwt, bulkers above 160,000dwt and container ships of over 7,000 TEU, fit the retrofit criteria.

Costs for retrofitting to methanol power, however, can be lower. Vessels with large-bore four-stroke engines that conducted sea trials between eight and 15 years ago appear to be the most suitable candidates for dual-fuel retrofits.

Repair capacity a potential constraint

Klaus Rasmussen, head of retrofit projects at MAN ES, said that MAN already has dual-fuel retrofit options for LPG and methanol. "We're ready to take orders tomorrow – the engines are in place," he declared. However, repair yard capacity is a likely and significant constraint.

Market analysis has shown that some of the best retrofit candidates are large vessels in the container, pure car and truck carrier (PCTC) and tanker segments. Most of these ships are likely to have been built over the last ten years as single-fuel engines and a price tag of more than USD 50 million. With the likely cost of a retrofit at around USD 12 million, conversions should cost less than 25% of the newbuild value, according to the DNV/MAN study.

DNV's Business Development manager, Christos Chryssakis, said: "Less than 10% of the existing global merchant fleet [of around 85,000 ships] are regarded as theoretic candidates for retrofitting. We don't see this happening today due to costs and uncertainties but think that this could be achieved over the next five to ten years, particularly after 2030 when regulations really start biting."

Nitesh Ranvah, CEO and founder of 21 Knots, a naval architecture and engineering company based in India, estimates that various retrofit options can boost fuel efficiency. Additions such as bulbous bows, propeller boss caps, Mewis ducts, flap rudders, air lubrication, and advanced hull coatings can offer efficiency gains with a two-to-three-year return on investment (ROI), said Ranvah.

Radical de-rating

However, if radical engine de-rating is possible, it can raise the level of efficiency to around 25%, depending on the vessel. Even so, this will mean that existing vessels are only just in compliance with 2030 regulations by that time. They require a minimum of 20% emission reductions, while aiming for 30%, compared with 2008 levels, by 2030.

Radical de-rating of older ships can substantially decrease fuel consumption and prolong ships' operational lives. Ranvah's 21 Knots has acted as project manager for some six container retrofits on ships operated by top ten box lines. The projects have involved significant modifications to main engines, taking them from large 92-bore cylinders to smaller 82-bore or even 78-bore engines.

"Main engine retrofits of this type are led by the engine manufacturer, typically Wärtsilä and MAN," said Ranvah, "The engine is modified by fitting sleeves into the cylinder," he added. However, while he agreed that such 'sleeves' are normally made of steel, he said he could not go into the specific work carried out at shipyards. However, he did say that Chinese and Turkish yards, including Qingdao, Beihai and Besiktas, for example, have already performed these operations for all the top five container lines.

Extensive remedial work of this sort, however, can take up to six months including planning with two months in a yard. And with yard space currently at a premium for newbuildings, DNV points out that agreeing these contracts can be tough.

Nevertheless, Wärtsilä's Sangram Nanda Kishore, general manager Product Management and Engineering, said the Finnish company had pressed ahead with a programme of radical de-rating of 96-bore two-stroke engines. Its first conversion has now been in operation since October 2022.

According to Sangram Nanda, de-rating the company's 96C engine could cut fuel consumption by 2,000 tonnes per year, and around 6,200 tonnes of carbon emissions. Based on a fuel cost of USD 730/tonne, a carbon levy of USD 103/tonne, and savings in parts of USD 145,000, Wärtsilä estimates overall annual savings in excess of USD 2 million.

However, the introduction of FuelEU Maritime from January 1st will radically change the economics. Owners with ships operation in, to, or from Europe will have to re-examine their numbers in line with the steadily tightening regulation.

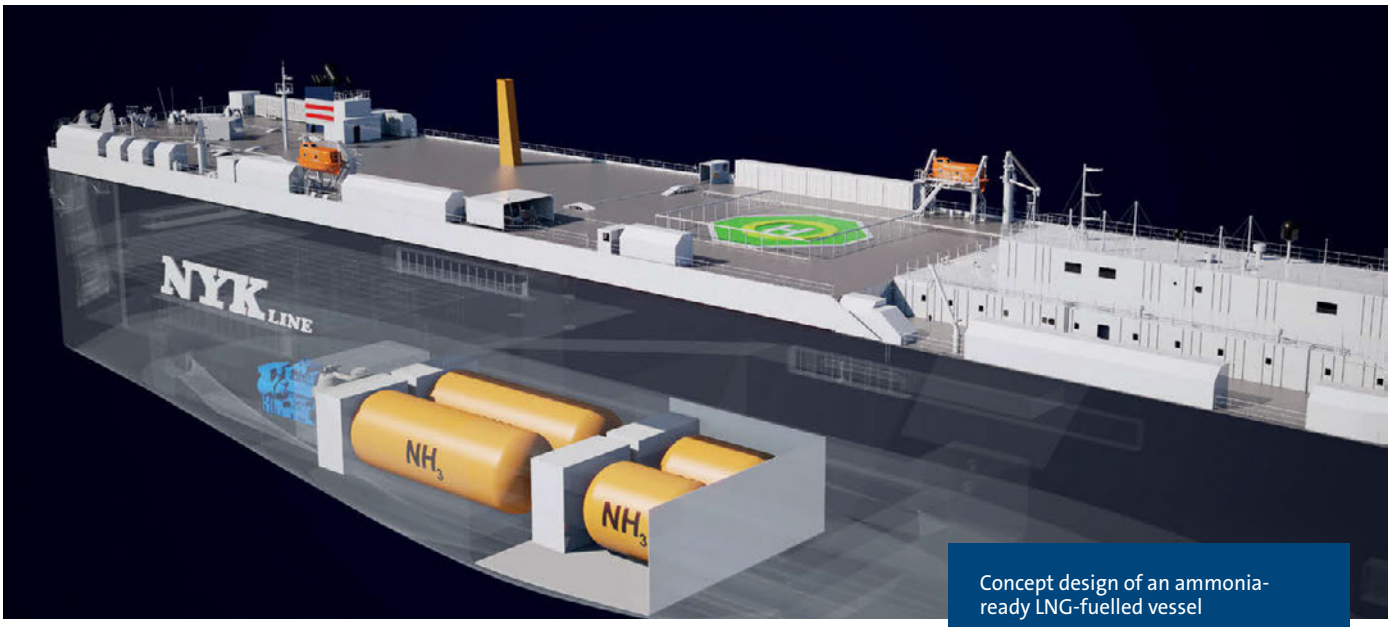
The process of engine de-rating is far from simple, Sangram Nanda points out. "What we do is to strip only a part of the engine, the cylinder head, the cylinder liner, the pistons, because it's a new combustion chamber design, the engine bore is reduced from 960mm to 720mm, so the volume effectively goes from 1,800 litres to 1,000 litres, per cylinder. And the 96C is about 5,720kW, which is reduced to around 3,086kW, a reduction of 1,920kW per cylinder."

Modifications for new fuels is possible. He added that the new cylinder head can have injectors added to and alternative fuel such as LNG, methanol or ammonia.

Wärtsilä's 96C engines were initially introduced in 2000 and produced until 2013. So the latest engines are now in the middle of their operational lives. Other engine types have now been identified for radical derating and, of course, the regulatory regime is likely to hasten the process.

In Wärtsilä's view, the Fit4Power programme and radical derating programme could prolong the operational life of vessels by up to five years, by which time new marine fuels could have become established. These could potentially further prolong a vessel's operating life.

New fuels: a very wearing concern



Source: NYK

Concept design of an ammonia-ready LNG-fuelled vessel

As shipping attempts to manage an uncertain future regarding the marine fuels of tomorrow, owners face a dilemma. There is no simple option. A retrofit is only the first challenge because corrosive fuels threaten to shorten the lifespan of engines and their components. Charlie Bartlett explores some of the issues.

At the time of writing, there are three fuels seen leading the drive to more sustainable energy sources across shipping's main market segments: methanol, biofuels and LNG. It is assumed that LNG, a fossil fuel, will eventually pave the way for bio-LNG, a chemical equivalent made from fossil-free, 'biogenic' sources – which would have emitted atmospheric methane in any case – without anyone having to drill for, or produce it.

These will soon be joined by ammonia. Ships are already being delivered as 'ammonia-ready,' although there is some debate as to what this, in fact, means.

"We see almost every day that a shipowner has ordered a newbuild with a methanol or ammonia-ready engine," Hrishikesh Chaterjee, Promotion manager, Two Stroke, at MAN Energy Solutions, and a marine engineer of eleven years, told Ship and Offshore Repair Journal recently.

"But from our point of view, this is still a research and development project. There is no commercially available product, he declared. "The question is, what is the industry preparing for? What is meant by 'ammonia-ready'? It could mean anything."

Meanwhile, the feedstocks of biofuel are limited, and once fully exploited, competition from other industries and inelasticity of supply could quickly see prices rise to the point where shipping is unable to afford them. The airline industry already poses massive price competition for biofuel, referred to as 'sustainable aviation fuel (SAF)'. Despite the name, it is anything but. A recent study by the UK's Royal Society found that to cover the 12.3 million tonnes of fuel required by airlines operating in the UK alone, about 68% of British crop land would have to be devoted to its production.

Green methanol is similarly constrained, combining a supply of biogenic carbon, which is finite, with a side-stream of electrolysed hydrogen, which need not be. Formed through bacterial degradation of organic matter which could include food, agricultural, and municipal waste, production of bio-LNG could be drastically less constrained in the long term.

But the fuel still has a limited supply/demand horizon. As the available production becomes fully utilised, demand will eventually outstrip supply and bunker fuel for ships is unlikely to rank high in the consumer portfolio.

Methanol: high octane sandpaper

Early on in the adoption of 0.1% and 0.5% low sulphur fuel (LSFO), there were concerns over the loss of lubricity in marine fuel. Sulphur is not by itself especially beneficial for an engine; but the hydro-processing refiners used to displace sulphur pared down the number of heteroatoms, reducing the aromatic hydrocarbon compounds and leaving behind a higher proportion of aliphatic compounds.

It was a good time to be a lube supplier. The lack of aromatic compounds brought down the lubricity of the fuel, meaning that wear, scuffing, and deposition rates in engines rose sharply. In response, the industry adjusted to higher consumption of lubricating oil, as well as the use of additives that would raise the fuel's lubricity before it entered the cylinder, in the hope of reducing engine wear.

Methanol (CH_3OH) is entirely aliphatic organic chemical compound. An alcohol rather than a hydrocarbon, it is extremely clean-burning and clean-running, and is likely to

clean the lubricant during operation, similar to other alcohol-based fuels like ethanol.

Traditionally, high-octane methanol has been used in spark engines, providing copious power for racing engines. During one famous incident in 1981, an Indycar pit crew appeared to have broken out in spontaneous dance, but were in fact engulfed in an invisible, smokeless methanol fire. In the engines of cars which have switched from petrol or diesel to methanol, problems have arisen in injectors and filters, where soot and deposits are dislodged from piping and internal engine surfaces cause blockages downstream.

Tests by Wärtsilä and experience from *Stena Germanica*, with engines that were retrofitted to burn methanol in 2016, suggest that methanol's fuel efficiency may be as much as 2% better than conventional diesel. But methanol's lubricity is negligible, and already, major challenges have been observed in its application, with engine wear occurring at a much faster rate. Fuel additives are necessary both to improve methanol's lubricity, and to reduce the accelerated rate of corrosion, which has been observed in fuel lines, tanks and valves.

In the study Renewable Methanol with Ignition Improver Additive for Diesel Engines, the authors found that the addition of about 3.5% rape seed oil, methyl ester, successfully improved its lubricity and allowed it to mitigate wear and achieve stable combustion in a high-pressure direct injection system. "Lubricants must be chosen and dosed carefully to avoid formation of acids during combustion," the study noted.

During last year's retrofit on the container ship *Maersk Halifax*, MAN Primeserv converted an existing MAN B&W 8G95ME-C9.5 engine into an 8G95ME-LGIM Mk10.5. Lengthening the vessel by 15m to accommodate the larger fuel tank, the engine retrofit itself would have involved drilling the cylinder cover to add fuel booster injection valves for methanol (FBIVM), as well as double-walled piping and control blocks mounted on the side of each cylinder.

The retrofit is to be regarded as a 'blueprint' for future installations, and similar operations in the future will form a major role in decarbonising the company's current fleet, "enabling shipowners to reduce drastically CO_2 emissions without having to commission newbuilds," Michael Petersen, senior vice president and head of PrimeServ Denmark, explained.

"Retrofitted engines are able to switch between fuels with minimal disruption, flexibility that is crucial for maintaining operational efficiency and reliability. At PrimeServ, we estimate that more than 4,000 existing marine engines have the potential to be converted to operation on green fuels like e-methanol and e-methane," he said.

Ammonia: toxic, corrosive, and carbon-free

Only two fuels seem to have virtually unlimited growth capacity: green hydrogen and green ammonia. The former, electrolysed from water using renewable energy limited only by our ability to construct it; the latter, combining this with nitrogen (N_2) cracked from the atmosphere, of which it makes ▸

up around 80%, via the Haber Bosch process – leaving minimal chance of running out any time soon.

Unfortunately, both are incredibly challenging to work with. Hydrogen is simply too voluminous to work as a sensible fuel for most ships, requiring around 2.5 times as much space as already-storage-hungry LNG fuel, and an extraordinary effort to refrigerate, to -253°C, the temperature of deep space, compared with LNG's -162°C. While there are a limited number of specialised vessels in operation using hydrogen – generally barges and ferries on very short routes with copious space below decks – and a number of proposals for vessels to transport it in large amounts, the concept is simply not scalable.

Ammonia (NH_3) is notable in that it uses nitrogen rather than carbon as a hydrogen carrier. This means that as well as emitting no carbon in its production, it could also be used as a zero-carbon fuel, emitting no CO_2 at the funnel, distinguishing it from methanol. But that does not render the fuel problem-free. It is highly toxic, with an extremely low limit of human exposure before certain death.

As one of the most widely produced and consumed chemicals, the handling of ammonia is mature at this stage; the need for nitrogen-flushing and double-walled piping is well understood. But far more complex is its use as fuel, a relatively new idea.

Burning ammonia fuel in a ship's engine is also expected to create a number of complex issues. In the ideal course of events, combustion of ammonia in a marine engine would yield nothing but water and nitrogen ($4NH_3+3O_2 \rightarrow 2N_2+6H_2O$).

But as shipping has long been aware, conditions at sea are seldom ideal. At high combustion temperatures, the creation of large amounts of NOx is a concern even with nitrogen levels at ambient atmospheric concentrations; but this effect is likely to increase dramatically while using a fuel of which nitrogen is a major component.

Compounding the problem, the lack of carbon in the fuel leads to a low 'radiation intensity' of combustion – in other words, the heat of combustion is slow to transmit. Inside of an engine, the laminar flame front speed, the method used to quantify this, is 0.015-0.07m/s for ammonia – a drastic shortfall compared with LNG (~0.36m/s) and methanol (~0.4m/s).

This generates concerns over delayed combustion leaving ammonia in the cylinder for too long. So an ammonia engine is therefore particularly sensitive to cylinder and injector layout, and vulnerable to partial combustion.

For this reason, beefed-up selective catalytic reduction (SCR) systems are a prerequisite of ammonia-fuelled ships. "In an ammonia engine, the SCR will have a double-layer of honeycombs," Chaterjee told SORJ. "A high temperature is needed inside the SCR so it can break down the NOx into nitrogen and oxygen. So these are decisions an owner needs to make today if they are building for the future."

A recent study, The Impact of Ammonia Fuel on Marine Engine Lubrication: An Artificial Lubricant Ageing Approach highlights it might be possible to mitigate some of the problem by heating prior to injection, similar to the way heavy fuel oil is handled today. "As an alternative to high-cost catalyst systems, scientific work is ongoing to reduce NOx emissions by preheating the ammonia for a partial decomposition before combustion," the study notes.

The lubrication needs of hydrocarbon fuels are well-understood, the study says, but the interaction of ammonia with lubes is "largely absent from the literature." Keen to address the knowledge gap, the study's authors bubbled various contaminant mixtures through a sample of heated conventional marine engine oil. These included a mix of ambient air and 1,000 parts per million of ammonia; air with trace ammonia (21.7% by volume); air with nitrogen dioxide (NO_2), a by-product of ammonia combustion; and ambient air. A copper plate was also installed in the tank to measure corrosion.

Applying the ammonia mixture, they discovered "a severe and rapid increase" in the corrosion taking place after 30 hours of testing. "It has to be stated that NH_3 represents a potential hazard for copper-containing engine parts and that engine performance as well as component lifetime might be negatively impacted by NH_3 fuelling," the study found.

Meanwhile, significant deposit formation was identified with both high and trace ammonia samples. "This shows that NH_3 impacted the oil condition in ways that were not immediately obvious through conventional oil condition analysis," said the study.

In all, the presence of ammonia was found to cause accelerated degradation of the lubrication oil according to most parameters. While oxidation and acidification was most pronounced with the NO2 sample, the other metrics – "deposit formation, corrosion properties and load-bearing capability" – were most seriously impacted in the high and trace ammonia samples.

But it is not all bad news. Another 2024 study, "Effects of ammonia energy fraction on combustion stability and emissions characteristics of naturally aspired industrial dual-fuel diesel engines", identifies good results with a 90:10 mixture of ammonia and diesel, injecting ammonia into the intake duct to mix it with air before entering the cylinder, where diesel pilot fuel is injected near top dead centre.

Dispersing ammonia in oxygen in this way improves combustion; even specific fuel consumption (SFOC) decreased. "The results obtained indicated that NH_3 does not cause a significant increase in cylinder pressure and improves combustion efficiency ... it has a favourable effect on specific energy consumption and engine efficiency. The inclusion of ammonia has a very beneficial effect on soot emissions."

The *Stena Germanica* is the first commercial ship in the world to run on methanol as its main fuel

Source: Stena Line

New engines, new fuels, and new challenges for luboil developers
Source: Shutterstock

Shipping's multi-fuel future drives luboil advances

The changing composition of shipping's bunker fuels is underpinning the development of a new generation of more versatile lubricating oils. Meanwhile, owners and operators are adopting more robust strategies to ensure that oils used to lubricate engine components are still providing sound protection.

The marine lubricants market is expanding steadily as research and development facilitates new products aligned to low-sulphur fuels and the low- or zero-carbon fuels of tomorrow. Estimated to be worth about USD 6.6 billion in 2024, the sector is likely to have a value of USD 7.8 billion by 2032, according to Indian research firm, SNS Insider.

A drive for greater sustainability in both marine fuels and the lubricants required to keep engines running efficiently is likely to underpin a cumulative annual growth rate of more than 2% over the eight years from 2024, the firm said. And research and development budgets are climbing fast as companies adjust the composition of their products.

As shipping's transition to a multi-fuel future accelerates, tracking the internal conditions of ships' engines is becoming more vital than ever. Traditional cylinder monitoring systems, many of which have not changed significantly in decades, are no longer fit-for-purpose, experts say.

Condition-based monitoring systems are now essential and can extend the operating lives of cylinders by 60-100%. The Shell LubeMonitor, for example, a digital setup, combines data from a range of sources including shipboard tests, coordinating the information and making it available on a single platform. This facilitates effective luboil management, saves money, and cuts maintenance requirements, Shell Marine says.

Meanwhile, Williams Shipping, one of Castrol's authorised distributors of marine luboils, points out that although synthetic lubricants are more expensive than mineral oils, their benefits far outweigh the extra upfront cost. Synthetic oil can provide superior fluid film protection against metal-to-metal contact, reducing maintenance requirements and extending time between oil changes. However, the company warns that synthetic oils may not be suitable for some older engines and suggests that its Used Oil Analysis can provide useful guidance.

Marine lubricant companies are all working hard on the development of new products for the marine engines of tomorrow whilst also raising performance for existing marine engines. Olivier Denizart, technical manager of Lubmarine, a division of TotalEnergies, has said that lubricants for the engines of tomorrow will need improved detergency characteristics, thermal stability, and oxidation resistance.

He highlights specific areas of the combustion chamber including the ring pack, exhaust valve and top ring area. The company has developed a 'fuel economy lubricant' that cuts friction and improves fuel consumption. It is suitable for cruise ships and ferries, offshore vessels, and power plants.

Engine builder WinGD recently approved Chevron Marine Lubricants' Taro Ultra Advanced 40 lubricant for use in all of its LNG engines. The product is designed to increase the protection of marine engine components and safeguard pistons at moderate base number and oil ash levels. The oil has been developed for large low-speed diesel engines with exhaust abatement systems operating on low-sulphur and zero-sulphur fuels, as well as LNG and methanol.

ExxonMobil chose Singapore as the site for its new Mobil ServTM Lubricant Analysis laboratory. The test facility is designed to support clients as they track the performance of new lubricants designed for new engines and new fuels. The company claims that its sophisticated interpretation algorithms and extensive used-oil database help to identify potential issues relating to lubricants before they become a problem. The opening of the new hub would augment its Mobil Serv Lubricant Analysis and save its customers time and money, the company said.

New maintenance setup uses CBM technology

Korean Register (KR), Sinokor Merchant Marine, and HD Hyundai Marine Solution (HDH) are pioneering a new approach to ship maintenance using condition-based maintenance (CBM) technology powered by artificial intelligence (AI). The partners are initially working on a system for ships' main engines and generators.

Advanced CBM systems will be installed on two Sinokor container ships – one 1,800-TEU vessel, and a larger 8,000-TEU ship. The CBM technology monitors equipment in real time, triggering maintenance only when necessary. This ensures continuous vessel reliability but is expected to yield substantial reductions in ship operating costs.

If, as expected, the project achieves positive results, it could open up an entirely new approach to routine and scheduled maintenance. Ultimately, it could also have an impact on commercial shipping's current class-based survey systems.

Signing ceremony for the joint development project on CBM technology

Source: Korean Register

The partners will have different responsibilities. Sinokor will provide maintenance history data. HDH will provide past operational data, and KR will develop big data analytics, AI algorithms, and software that can be used to apply the new systems to real ships. The executive vice president of the classification society's R&D Division, Kim Daeheon, commented: "By applying CBM technology to ship engine rooms, this joint development project will serve as a significant foundation for transforming vessel maintenance and collecting big data to advance smart shipping technology. Moving forward, KR plans to expand CBM applications to various ship equipment, including low-flashpoint fuel supply systems and batteries, creating comprehensive lifecycle technical services that will drive the future of maritime operations."

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GERMANIA SHIPYARD AGENCY GMBH

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• Navikon SRY Ltd (Poland)
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• BMT Repairs (Spain)
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• DSK Co., Ltd (Korea)
• HON Marine (Malaysia)
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• Oceantrans Marine Services Co. Ltd (China)
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• On Site Alignment (Netherlands, UK, USA, Singapore)
• MarineService Hirthals A.S. (Denmark)
• Metalock (Brasil)
• ROG Rotterdam Offshore Group (Netherlands)
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Gulf Marine Repair (Tampa, Florida, US Gulf)
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Caribbean Dockyard Engineering Services Ltd (CDESL) - Trinidad & Tobago
Chengxi Shipyard Co. Ltd - Shanghai, China
Colombo Dockyard Ltd – Colombo, Sri Lanka
Detyens Shipyards - Charleston, South Carolina, USA
Dormac Marine & Engineering - Capetown/Durban, South Africa
EDR Antwerp Shipyard - Antwerp, Belgium
Fayard A/S - Munkebo, Denmark
Gemak Shipyard – Tuzla, Turkey
Guangzhou Wenchong Shipyard – Guangzhou, South China
Harland and Wolff Heavy Industries – Belfast, N. Ireland
Hengli Heavy Industry - Dalian, North China
Huarun Dadong Dockyard (HRDD) - Shanghai, China
International Ship Repair - Tampa, Florida, USA
Lloyd Werft Bremerhaven AG - Bremerhaven, Germany
MTG Dolphin - Varna, Bulgaria
Netaman Repair Group - Tallinn, Estonia
Torlak Shipyard – Tuzla, Turkey
IMC Shipyard (Zhoushan) – Zhoushan, China
Nanyang Star Group – Zhoushan, China
Port Said Shipyard - Egypt
Shanhaiguan Shipbuilding Industry Co., Ltd – Hebei, North China

UNDERWATER AND AFLOAT

Argus Marine Services - Columbia
Avalontec Engineering - Singapore
ROG Ship Repair – Rotterdam
Atlantis Marine Services LLC - Fujairah, UAE
I-Dive Services, Singapore
Underwater Contractors -Spain
Resolve Marine Services – Gibraltar
Reprosub – Las Palmas
On Site Alignment – Rotterdam, Netherlands
LongKong Marine Engineering Co., LTD – China
Voyager Marine – India & Singapore
LDM Stations in Singapore and Europe

SEADOCK MARINE AGENCIES LTD

Akti Miaouli & Skouze 1,
Piraeus 185 35, Greece
Tel: +30 21 0429 2251
Mobile: +30 6947 56 46 36
Email: piraeus@seadockmarine.com
Web: www.seadockmarine.com
Contact: George Lyras

SHIPYARDS

EDR Antwerp (Belgium)
Bulyard, Varna (Bulgaria)
CMI Yiu Lian Weihai (China)
CUD Shipyard (China)
DSIC Changxingdao (China)
DSIC Shanhaiguan (China)
Fujian Huadong Shipyard (China)
Guangzhou Wenchong (China)
HRDD Shipyard (China)
IMC YY Shipyard (China)
Longshan Shipyard (China)
Paxoean Shipyard (China)
Qingdao Beihai Shipyard (China)
Ruitai Shipyard (China)
Stonestar Shipyard (China)
Weihai Huadong (China)
Xinya Shipyard (China)
Yiu Lian Dockyards (China)
Zhoushan Huafeng Shipyard (China)
Blohm + Voss (Germany)
Emden Dockyard (Germany)
Bredo (Germany)
Lloydwerft (Germany)
Onex Shipyards (Eleusis, Syros), (Grecee)
Chalkis Shipyards (Greece)
Skaramangas Shipyard (Greece)
Yiu Lian Dockyards (Hong Kong)
ASL Shipyard (Indonesia)
Paxocean Shipyard (Indonesia)
Hankook Made (Korea)
Qatar Shipyard Technology Solutions (Qatar)
Paxocean Shipyard (Singapore)
Astilleros Cernaval (Spain)
Astilleros Ria de Aviles, S.L. (Spain)
Metalships & Docks (Spain)
Untihai Shipyard (Thailand)
Desan Shipyard (Turkey)
Ozata Shipyard (Turkey)
Sefine (Turkey)
Seltas Shipyard (Turkey)
Tersan Shipyard (Turkey)
Gemak Shipyard (Turkey)
Harland & Wolff (UK)

MARINE & UNDERWATER SERVICES

TurboTechnik GmbH & Co. KG (Germany)
Dynamic Co. (Greece)
Subsea Services (Singapore)

Italy

BANCHERO COSTA & C.

Agenzia Marittima S.p.A.,
2 Via Pammatone,
16121 Genoa, Italy
Tel: +39 010 5631 626/629/634
Fax: +39 010 5631 602
Email: shipyard@bcagy.it
Web: www.bancosta.it
Contact: Fabio Bertolini
Mobile: +39 335 8078217
Contact: Daniele Perotti
Mobile: +39 335 7366801
Contact: Giovanna Ximone
Mobile: +39 335 7366802

COMPANIES REPRESENTED

Asaba shipyard (Equatorial Guinea)
Astilleros Cernaval, Algeciras (Spain)
Astilleros Mario Lopez, Malaga (Spain)
Chengxi Shipyard (China)
CM Korea Ltd
CMR Tunisie (Tunisia)
Colombo Dockyard (Sri Lanka)
Cromwell & C. (Argentina)
Crug-Versitec (marine sealing solutions - Cyprus)
Damen Shiprepair & Conversion
• Damen Shiprepair Amsterdam (The Netherlands)
• Damen Shiprepair Oranjewerf, Amsterdam (The Netherlands)
• Damen Shiprepair Brest (France)
• Damen Shipyards Den Helder (The Netherlands)
• Damen Shiprepair Dunkerque (France)
• Damen Shiprepair Harlingen (The Netherlands)
• Damen Oskarshamnsvarvet (Sweden)
• Damen Shiprepair Van Brink Rotterdam (The Netherlands)
• Damen Shiprepair Rotterdam (The Netherlands)
• Damen Shiprepair Vlissingen (The Netherlands)
• Damen Shipyards Sharjah-Albwardy Marine Engineering (UAE)
• Damen Curacao shipyard
• Damen Mangalia (former Daewoo Mangalia)
• Damen Verolme (former Keppel Verolme)
DIANCA Astilleros (Venezuela)
EST Engineering Ship Technology (Singapore)
Gemak Shipyard (Turkey)
General Naval Control (Italy)
General Shipping S.A (Greece)
Guangzhou Dengtai Shipyard (China)
Hyundai Mipo Dockyard (South Korea)
Hyundai Vinashin Shipyard (Vietnam)
Ibercisa (Spanish winches and deck machinery producer)
Komas-Korean Maritime Repairs Service (South Korea)
Malaysia Marine & Heavy Engineering (Malaysia)
MSR Gryfia Shiprepair Yard (Poland)
Paxocean Batam
Paxocean Singapore
Pregol Shiprepair Yard - Kaliningrad (Russian Federation)
Promar Uab (propulsion and sealing services – Lituania)
Qingdao Beihai Shipyard (China)
Riga Shipyard (Latvia)
Sasebo Heavy Industries (Japan)
Shanghai Shipyard (China)
Sociber (Chile)
SYM (Barcelona, Spain - Santo Domingo, Dominican Republic)
ST Marine
Underwater Shipcare, Singapore.
Zhoushan Xinya Shipyard (China)

Italy / Monaco / Switzerland

CAMBIASO RISSO SERVICES SAM

Gildo Pastor Center, 7 Rue du Gabian,
MC 98000, Monaco
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Fax: + 377 97987848
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Mobile: +33 640 623327
Private email: max@cariservice.com
Contact: Giovanni Palumbo
Direct Line: + 377 98801362
Mobile: +33 640616602
Contact: Mr Enrico Pittaluga
Direct Line: +37798801363
Mobile: +33640623184

COMPANIES REPRESENTED

Alabama Shipyard – Mobile (USA)
ASMAR, Chile
China Shipbuilding Corporation (Taiwan)
• Kaohsiung Shipyard
• Keelung Shipyard
Cosco Shipping Heavy Industry
• Cosco Dalian Shipyard

• Cosco Guangdong Shipyard
• Cosco Nantong Shipyard
• Cosco Shanghai Shipyard
• Cosco Zhoushan Shipyard
• Cosco Qidong Offshore
• Cosco Shipping Ppa, Greece
• Nacks
• Dacks
CUD Weihai (China)
Dakarnave (Senegal)
Drydock World Dubai
Elgin Brown & Hamer (South Africa)
Grand Bahama Shipyard (Bahamas)
Guangzhou Wenchong Dockyard (China)
Gulf Copper (Port Arthur / Galveston / Corpus Christi – USA)
IMC – Yy Zhoushan (Zhoushan, China),
Lisnave Estaleiros Navais SA (Portugal)
Namibia Drydock
Odessos Shiprepair Yard (Bulgaria)
ONEX Elefsis Shipyards SA, Greece
ONEX Neorion Shipyards SA, Greece
Orient Shipyard (South Korea)
PaxOcean Batam
PaxOcean Singapore
Qingdao Beihai Shipyard (China)
Remontowa Shiprepair Yard (Poland)
Renave (Brasil)
Santierul Naval Costanta (Romania)
Scamp Network Ltd (Gibraltar)
Smit International (Rotterdam)
Sefine Shipyard (Turkey)
Tersan Shipyard (Turkey)
Tsakos Indusrias Navales (Montevideo, Uruguay)
Tuzla Shipyard (Turkey)
Unithai Shipyard & Engineering (Thailand)
Western India Shipyard (India)

VICTORIA MARITIME SERVICES

MEMBER The International Association of Shiprepair Agents Ltd

7 Avenue des Papalins, MC 98000, Monaco
Tel: +377 99995160
Email: shiprepair@victoriamaritime.com
Web: www.victoriamaritime.com
Contact: Luca Spinelli-Donati,
Julia Sandmann, Carlo Spinelli-Donati,

SHIPYARDS REPRESENTED
Adria Docks of Trogir, Croatia
Asry of Bahrain
Alimia Group:
• Astander of Santander, Spain
• Astibal of Balboa, Panama
• Astican of Las Palmas de Gran Canaria, Spain
Besiktas Group:
• Art Shipyard of Tuzla, Turkey
• Besiktas Shipyard ofYalova, Turkey
• Park Shipyard of Yalova, Turkey
BLRT Group:
• Tallinn Shipyard of Tallinn, Estonia
• Turku Repair Yard of Naantali, Finland
• Western Shipyard of Klaipeda, Lithuania
Cammell Laird of Birkenhead, UK
Carell of Piraeus, Greece
Chantier Naval de Marseille, France
Dormac of Durban and Cape Town, South Africa
DS Ship / Yeosu Ocean of Ulsan, Korea
Fujian Huadong Shipyard of Fuzhou-Fujian, China
Huarun Dadong Dockyard (HRDD) of Shanghai, China
Oresund Drydocks of Landskrona, Sweden
PaxOcean Zhoushan, China
ROG of Rotterdam, Netherlands
San Giorgio del Porto of Genoa, Italy
Seatrium:
• Admiralty, Tuas, Tuas Boulevard, Benoi and Pioneer Yards of Singapore
• Tuas Boulevard Yard of Singapore
• Subic Bay of Philippines
• Estaleiro Jurong Aracruz of Aracruz, Brazil
Shanhaiguan Shipyard of Qinhuangdao, China
Talleres Navales Del Golfo of Veracruz, Mexico
Tampa Ship of Tampa, Florida
Tandanor of Buenos Aires, Argentina
Xinya Shipyard of Zhoushan, China
Yiu Lian Dockyards of Hong Kong

MARINE SERVICE COMPANIES REPRESENTED
Elettrotek Kabel of Bagnolo in Piano, Italy (special electrical cables producer)
Nextcorr of London, UK (marine growth prevention and corrosion protection systems)
PBM of Rijeka, Croatia (mechanical repairs)
Polyflake of Miami, USA (high-performance, long-term anti corrosion protection)
SES Marine Services of Singapore (voyage and afloat repairs)
Turbo-Technik Repair Yard of Wilhelmshaven, Germany (mechanical repairs)

Lithuania, Latvia, Estonia, Poland

ORCA MARINE UAB

MEMBER The International Association of Shiprepair Agents Ltd

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Mobile: +370 650 40900
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Web: www.orca-marine.eu
Contact: Viktoras Cernusevicius

SHIPYARDS
Asaba Shipyard (Malabo, Equatorial Guinea);
Asmar Shipyard (Chile);
Brodotrogir D.D. Shipyard Trogir (Croatia);
Carena (Abidjan, Ivory Coast);
Chantier Naval De Marseille (France);
Colombo Dockyards (Sri, Lanka);
Cosco Shipyards Group:
• Cosco Dalian (China);
• Cosco Nantong (China);
• Cosco Shanghai (China);
• Cosco Zhoushan (China);
• Cosco Guangdong (China);
• Cosco Lyanungang (China);
Davie (Quebec, Canada);
Detyens Shipyard (N. Charleston, Usa);
Dong Sung Engineering & Shiprepair (S.Korea);
Damen Shiprepair Group:
• Damen Shiprepair Dunkerque (France);
• Damen Shiprepair Oranjewerf Amsterdam (Netherlands);
• Damen Shiprepair Brest (France);
• Damen Shiprepair Den Helder (Netherlands);
• Damen Shiprepair & Conversion Rotterdam (Netherlands);
• Damen Shiprepair Vlissingen (Netherlands);
• Damen Shiprepair Amsterdam (Netherlands);
• Damen Shiprepair Harlingen (Netherlands);
• Damen Oskarshamnsvarvet (Sweden);
• Damen Shiprepair Van Brink Rotterdam (Netherlands);
• Damen Shiprepair Curacao (Curacao, Dutch Antilles).
Enavi Reparos Navais (Rio De Janeiro, Brazil);
Fama Group (Cyprus);
Gibdock (Gibraltar);
Harland & Wolff (Belfast, Uk);
Mmhe Shipyard (Malaysia);
Astibal (Panama);
Namdock (Walvis Bay, Namibia)
Narp Shiprepair:
• Kiran/Erkal Tuzla (Tuzla, Turkey);
• Hat-San Shipyard (Yalova, Turkey);
•Tersan Shipyard (Yalova, Turkey);
•Sefine Shipyard (Yalova, Turkey);
• Hicri Ercili Shipyard (Yalova, Turkey);
•Gisan Shipyard (Tuzla, Turkey);
Oman Drydock (Oman);
Sima (Peru);
San Giorgio Del Porto (Genova, Italy);
Tandanor (Buenos Aires, Argentina);
Tsakos Industrias Navales (Montevideo, Uruguay);
Zamakona Yards:
• Zamakona Pasaia (Spain);
• Zamakona Las Palmas (Canary Isl., Spain);

MARINE SERVICE COMPANIES
Argo Navis (Greece) - Marine Consulting & Engineering (Bwts, Soxnox);
Chinaport Cleanseas - De-Slopping, Cleaning (China);
Dgs Industrial & Naval (Brazil) - Afloat Repairs;
Mechadinamik - Mechanical Services, Turkey
One Net - Satelite Communications, Bridge Equipment Service;
One Tech - Technical Service;
Sym - Afloat Repairs & Marine Services

The Netherlands

AYS SHIPREPAIR

MEMBER The International Association of Shiprepair Agents Ltd

Oranjekanaal ZZ 14, 7853TC Wezuperbrug,
The Netherlands
Mobile: +31 6 47 952 452
Telephone: +31 85 0160 635
Email: hilka@aysshiprepair.nl
Web: www.aysshiprepair.nl

SHIPYARDS
EUROPE
Bulyard (Bulgaria)
Bredo Drydocks (Germany)
Gibdock (Gibraltar)
Platinum (Turkey)
NORTH AMERICA – CARIBIC
Canada East - Davie (Quebec)
Canada West - Seaspan (Vancouver)
Seaspan (Victoria)
US EAST COAST
Detyens
German Ship Repair Jamaica Ltd
PERSIAN GULF
Qatar Shipyard Technology Solutions
AFRICA
Namibia
NAMDOCK (Walvis bay)
SOUTH AFRICA
Dormac (Capetown)
Dormac (Durban)
Dormac(Saldanha)
ASIA
Korea:Orient Shipyard (Busan)
Indonesia: ASL Marine(Batam)
AUSTRALIA
Thales (NS Wales)
CHINA
DSIC Changxingdao Shipyard (Dalian)
Yiu Lian Dockyards (Hong Kong)
Yiu Lian Dockyards(Shekou)
Yiu Lian Dockyards(Zhoushan)
CUD (Weihai)
Zhoushan Changhong International Shipyard Co., Ltd
Zhoushan Putuo Changhong Shipyard Co., Ltd
Zhoushan CIMC Changhong Shipyard Co., Ltd

SHIP REPAIR SERVICES
BMT (Spain)
Greentec Marine
Haien Enc
Rotterdam Ship Repair (Netherlands)
German Ship Repair (Germany)
Offshore Inland (US /GoM)
Bludworth Marine (Houston)
SIRCO (Panama)
Mapamar (Brasil)
Brightsun(Singapore)
Trident divers (Worldwide)

AIMSS V.O.F

Snellenshof 51, 4811LN Breda, The Netherlands
Tel: +31 76 737 0002
Email: sales@aimss.nl
Web: aimss.nl
Contacts: Sami Golestanian
Email: sg@aimss.nl | Mobile: +31 6 28 96 38 48
Onno Kramer
Email: ok@aimss.nl | Mobile: +31 6 27 28 90 98

SHIPYARDS
• A&P Group (UK)
• ASL (Indonesia)
• ASMAR (Chile)
• ASYAD Drydock (Oman)
• CNDM (France)
• NASCO Group (China)
• NOSCO (Vietnam)
• SAS (South Africa)
• SGDP (Italy)
• TERSAN (Türkiye)
• TNG (Mexico)
• UNITHAI (Thailand)

MARINE SERVICES
• CROSSCOMAR (Spain), Afloat repair, Construction works, Underwater Services & Voyage Repairs
• DIAMOND SHIP (Taiwan), Store Supply
• GENERAL SHIPPING (Greece), Tank Coating Specialists, Docking Services & Turnkey Projects
• HAI HA M&S (Vietnam), Afloat repair, Construction works, Underwater Services & Voyage Repairs
• JASON MARINE ELECTRONICS (Singapore & Spain) Supply & Service of Navigation, Communication & Automation Equipment
• PBM (Croatia), Governors & ME Services, Woodward Parts & Services
• PMS (Panama), Afloat repair, Construction works, Underwater Services & Voyage Repairs
• RIDING TEAM, Supply of Qualified Welders, Fitters, Technicians, Electricians etc.
• SINGATAC (Singapore), Afloat repair, Construction, Underwater Services & Voyage Repairs
• WINKONG MARINE (China), Afloat, Underwater & Voyage Repairs
• YARA MARINE TECHNOLOGIES (Norway), Fuel optimisation, Scrubbers
• ZEBEC MARINE (India), Design, Engineering & Consulting Solution

Norway

BSA SHIPPING AGENCIES ANS

MEMBER The International Association of Shiprepair Agents Ltd

Akershusstranda 15, skur 35,
0150 Oslo, Norway
Contact:
Mr. Thord Peter Mossberg
Tel: +4723085000
Mobile: +4792012755
Email: peter@bsaship.com
Web: www.bsaship.com

SHIPYARDS
Brodograditeliste d.o.o Shipyard LP (Croatia)
Falkvarv (Sweden)
Cernaval Group Algeciras (Spain)
Hidramar S.L (Canary Islands)
General Shipping S. A (Greece)
TK Tuzla Shipyard (Turkey)
Sandock Austral Shipyards (South Africa)
Qatar Shipyard Technology Solutions (Qatar)
Seagull Group (Singapore & Malaysia)
Unithai Shipyard & Engineering Ltd (Thailand)
Fujian Huadong Shipyard Ltd (China)

HuaRunDadong Dockyard Ltd HRDD (China)
CUD (Wehai) Shipyard (China)
Pax Ocean Shipyard Zhoushan (China)
First Suez Ltd - Suez Canal Transit and Shiprepair (Egypt)
Caribbean Drydock Company S.A CDC (Cuba)

JML SHIPYARD AGENCY

Falkevägen 3, 457 40 Fjällbacka,
Sweden
Contact:
Markus Larsson, Managing Director
Mobile: +46 702 20 37 43
Email: markus@jmlshipyardagency.com
Web: www.jmlshipyardagency.com

SHIPYARDS REPRESENTED

EUROPE
Lloyd Werft, Bremerhaven, Germany
Sefine Shipyard, Tuzla, Turkey
San Giorgio del Porto, Genoa, Italy
Chantier Naval de Marseille, France
EDR Shipyard, Antwerp, Belgium
ASIA
Drydocks World, Dubai
Chengxi Shipyard, Jiangyin, China
Changhong International Shipyard, Zhoushan, China
PaxOcean , Zhoushan, China
Wenchong Shipyard Guangzhou, China
Shan Hai Guan Shipyard, China
Qingdao Beihai Shipyard, China
DSIC Marine Services, Dalian, China
PaxOcean, Singapore
PaxOcean Pertama, Indonesia
PaxOcean Nanindah, Indonesia
PaxOcean Graha, Indonesia
US, CANADA & CARIBBEAN
TNG, Veracruz, Mexico
Ciramar Shipyard, Dominican Republic
Chantier Davie, Quebec, Canada
German Ship Repair Jamaica

AFLOAT REPAIR

Global Offshore Service, Dubai UAE
Offshore Inland, US Gulf/Mexico
Crosscomar, Algeciras
UMA Marine, India
Link Marine / Automation, UAE
MCU Coatings
Carell, Greece

ULRIK QVALE & PARTNERS AS

MEMBER The International Association of Shiprepair Agents Ltd

Hoffsveien 13,
0275 Oslo
Tel: +47 22511616
Email: post@uqp.no
Web: www.uqp.no
Contact:
Oivind Qvale or Anders Lindheim

SHIPYARDS REPRESENTED

EUROPE:
Bredo Drydocks (Germany)
Nauta Shipyard (Poland)
Lisnave (Portugal)
Gemak (Turkey)
AFRICA:
Dakarnave (Senegal)
Dormac Marine & Engineering (South Africa)
AMERICAS:
Asmar (Chile)
Grand Bahama Shipyard (Bahamas)
Renave Industrial Group (Brazil)
Seaspan Vancouver Shipyard (Canada)
ASIA:
Arab Shipbuilding and Repair Yard (ASRY)
CHI Dalian Shipyard (China)
CHI Guangzhou Shipyard (China)
COSCO Shipping Shipyard (NANTONG) CO Ltd (China)
CHI Shanghai Shipyard (China)
CHI Xidong (China)
CHI Zhoushan Shipyard (China)
Japan Marine United Corp (Japan)

AFLOAT REPAIRS

Rotterdam Ship Repair (Netherlands)
Eerland Shiprepair (Netherlands)
HSD Marine (Singapore)
Marval (Chile)

Singapore

WSR SERVICES LTD

MEMBER The International Association of Shiprepair Agents Ltd

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Singapore Post Centre, S408600
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Email: mail.sg@umarwsr.com
Web: www.umarwsr.com

SHIPYARDS

ASL Marine Holdings Ltd-Batam, Indonesia
Caribbean Dockyard Engineering Services Ltd (CDESL) - Trinidad & Tobago
Chengxi Shipyard Co. Ltd - Shanghai, China
Ciramar Shipyards - Dominican Republic
Colombo Dockyard Ltd – Colombo, Sri Lanka
CUD (Weihai) Shipyard – Shandong, North China
Detyens Shipyards - Charleston, South Carolina, USA
Dormac Marine & Engineering - Capetown/Durban, South Africa
EDR Antwerp Shipyard - Antwerp, Belgium
Fayard A/S - Munkebo, Denmark
Guangzhou Wenchong Shipyard – Guangzhou, South China
Huarun Dadong Dockyard (HRDD) - Shanghai, China
Hutchison Ports TNG (Talleres Navales del Golfo S.A.) – Veracruz, Mexico
International Ship Repair - Tampa, Florida, USA
Netaman Repair Group - Tallinn, Estonia
Onex Neorion Shipyard S.A - Syros Island Greece
IMC Shipyard (Zhoushan) – Zhoushan, China
Nanyang Star Group – Zhoushan, China
Port Said Shipyard - Egypt
Shanhaiguan Shipbuilding Industry Co., Ltd – Hebei, North China

UNDERWATER AND AFLOAT

I-Dive Services, Singapore
LDM Stations in Singapore and Europe

Sweden

BSA SHIPPING AGENCIES ANS

MEMBER The International Association of Shiprepair Agents Ltd

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Web: www.bsaship.com

SHIPYARDS

Brodogradiliste d.o.o Shipyard LP (Croatia)
Cernaval Group Algeciras (Spain)
Hidramar S.L (Canary Islands)
General Shipping S. A (Greece)
TK Tuzla Shipyard (Turkey)
Sandock Austral Shipyards (South Africa)
Qatar Shipyard Technology Solutions (Qatar)
Seagull Group (Singapore & Malaysia)
Unithai Shipyard & Engineering Ltd (Thailand)
Fujian Huadong Shipyard Ltd (China)
HuaRunDadong Dockyard Ltd HRDD (China)
CUD (Wehai) Shipyard (China)
Pax Ocean Shipyard Zhoushan (China)
First Suez Ltd - Suez Canal Transit and Shiprepair (Egypt)
Caribbean Drydock Company S.A CDC (Cuba)

JML SHIPYARD AGENCY

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457 40 Fjällbacka, Sweden
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Email: markus@jmlshipyardagency.com
Web: www.jmlshipyardagency.com

SHIPYARDS REPRESENTED

EUROPE
Lloyd Werft, Bremerhaven, Germany
MSR Gryfia Shipyard, Szczecin, Polen
Sefine Shipyard, Tuzla, Turkey
San Giorgio del Porto, Genoa, Italy
Chantier Naval de Marseille, France
EDR Shipyard, Antwerp, Belgium
ASIA
Drydocks World, Dubai
Chengxi Shipyard, Jiangyin, China
Changhong International Shipyard, Zhoushan, China
PaxOcean , Zhoushan, China
Wenchong Shipyard Guangzhou, China
Shan Hai Guan Shipyard, China
Qingdao Beihai Shipyard, China
DSIC Marine Services, Dalian, China
PaxOcean, Singapore
PaxOcean Pertama, Indonesia
PaxOcean Nanindah, Indonesia
PaxOcean Graha, Indonesia
US, CANADA & CARIBBEAN
TNG, Veracruz, Mexico
Ciramar Shipyard, Dominican Republic
Chantier Davie, Quebec, Canada
German Ship Repair Jamaica

AFLOAT REPAIR/SERVICES

Global Offshore Service, Dubai UAE
Offshore Inland, US Gulf/Mexico
Crosscomar, Algeciras
UMA Marine, India
Link Marine / Automation, UAE
MCU Coatings
Carell, Greece

Switzerland

ENCOMPASS MARINE LIMITED

MEMBER The International Association of Shiprepair Agents Ltd

26 Flour Square, Grimsby
NE Lincs, DN31 3LP
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Tel: +44 (0) 1472 245500
Fax: +44 (0) 1472 245511
Email: services@encompassmarine.com
Web: www.encompassmarine.com
Contacts: David Maitland, Jon Thompson
Diving & Marine: Alan Jagger, Danielle Roberts

SHIPYARDS REPRESENTED

ART (Tuzla, Turkey)
Asyad (Duqm, Oman)
Asaba Shipyard (Malabo, Equitorial Guinea)
Cammell Laird Shiprepairers (Merseyside, UK)
Colombo Dockyard (Colombo, Sri Lanka)
COSCO Shipping Heavy Industry, China
• CHI Dalian
• CHI Nantong
• CHI Shanghai
• CHI Zhoushan
• CHI Guangdong
CUD (Weihai) Shipyard Co., Ltd.
Detyens Shipyard (Charleston, USA)
EDR Antwerp Shipyard (Belgium)
Grand Bahama Shipyard (Freeport, Bahamas)
Guangzhou Wenchong Dockyard (Guangzhou, China)
Hidramar Shipyards (Canary Isles, Spain)
Malaysia Marine and Heavy Engineering (Pasir Gudang, Malaysia)
Namibia Drydock and Ship Repair (Walvis Bay, Namibia)
Navantia (Spain)
• Cadiz Shipyard (Cadiz)
• Cartagena Shipyard (Cartagena)
• Ferrol-Fene Shipyard (Ferrol)
• San Fernando Shipyard (San Fernando)
Orient Shipyards (Busan/ Gwanyang, Korea)
Shanhaiguan Shipyard (Qinhuangdoo, China)
Zhoushan IMC-YongYue Shipyard (Zhoushan, China)
Zhoushan Xinya Shipyard (Zhoushan, China)

DIVING & MARINE SERVICE COMPANIES REPRESENTED

Atlantis Marine Services (Fujairah, UAE)
Blay Marine Tech (Spain)
Hellenika (Bulgaria)
Irwin Marine
Komas (Korea)
Lagersmit
Link Instrumentation (UAE & Singapore)
Marine Technical Services (Poland)
Maritime Shipcleaning Rotterdam
NARP Ship Repair (Turkey)
PmaxOne Services (Singapore)
Rentong Marine (China)
Rotterdam Ship Repair
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Offshore wind expansion to drive demand for support vessels

Source: AST Raygar

SOVs play a critical role in enabling wind farm operators to transport technicians and equipment to turbines

REMOTE MONITORING | As offshore wind farms proliferate in number and move into deeper waters further from shore, the role of service operation vessels (SOVs) is becoming more critical, both for the transport of components and personnel. It is estimated that up to 600 SOVs may be required by 2050 to meet industry demand.

UK-based AST Reygar is preparing for sector expansion by launching a remote monitoring system, BareFLEET, which has been designed to optimise SOV performance in real time while also providing long-term operational insights. These include tracking fuel consumption, emissions, vessel motions, gangway use, and navigation.

Daniel Clark, managing director of AST Reygar, commented: "BareFLEET provides an unparalleled level of detail in monitoring SOV performance, helping operators make informed decisions that improve efficiency and sustainability. By delivering real-time data and long-term trend analysis, BareFLEET enables operators to optimise vessel operations, ensure technician safety, and contribute to the offshore wind industry's green energy goals."

The system can be integrated across fleets of SOVs and crew transfer vessels. In such an arrangement, BareFLEET provides a unified view of wind farm operations, enabling the optimisation of daily plans and the streamlining of long-term optimisation strategies for fleet deployment.

Collaboration on green ammonia

FLOATING PRODUCTION | Lloyd's Register (LR) and Samsung Heavy Industries (SHI) have signed a Memorandum of Understanding (MoU) to undertake joint development of a floating production, storage and offloading (FPSO) system for green ammonia. The partners envisage that the FPSO will use renewable energy to provide power for the electrolysis of sea water to produce green hydrogen. This will be combined with nitrogen and synthesised to produce green ammonia which will then offloaded to ammonia carriers. It is envisaged that the FPSO will be linked to offshore wind farms in Europe.

Sean van der Post, LR's Offshore Business director, signed the MoU at Offshore Korea 2024 with SHI's chief Technology officer, Hae-Ki Jang. The two parties have agreed that SHI will undertake design of the FPSO and LR will then review it and provide technical advice for further design development.

"The green ammonia market is poised to grow rapidly in the coming decades," declared van der Post, "particularly as a clean fuel alternative for the global shipping industry. LR is looking forward to collaborating with SHI to help meet this demand."

Speaking for SHI, Hae-Ki Jang commented: "We are delighted to be working with Lloyd's Register on thie project as part of our development efforts towards achieving net-zero and pioneering advancements in green energy."

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New decarbonisation strategy

ADVANCED MODELLING | London-based energy and marine consultancy, ABL, a division of the Oslo-listed ABL Group ASA, is teaming up with the University of Stathclyde and the University of Plymouth to develop decision support software for maritime users seeking to keep abreast of evolving policy, the status of technological uncertainties, and in light of these, possible decarbonisation strategies.

The parties said that the software will be designed to support decision makers across the maritime community. They will include shipowners, charterers, cargo owners, ship and port managers, policy markers and advisors. Financial institutions and insurers will also benefit from the software, they said, because it will help them to navigate the complexities of decarbonisation policies and related decisions.

The software will be designed to enable advanced modelling and simulation techniques in the analysis of possible decarbonisation investments. The uncertainties which face shipping today will be considered, including the range of emerging technologies, supply chain development, greenhouse gas emission emission regulations, taxation, and energy and fuel prices.

ABL's Stefano Scarpa, association director – Maritime Decarbonisation & Global Emissions Consulting Lead, noted: "Such a tool does not exist in the wider maritime industry today. Maritime stakeholders therefore risk taking suboptimal decarbonisation decisions where they utilise information that can only look a year or two ahead as basis for investments that have a 20-30 year horizon.

"We will apply our expertise within maritime operations, vessels and ports design, energy and emission modelling to develop the new software. This will enable us to provide advanced predictive analysis and simulations, assisting our clients to navigate the complexities and uncertain conditions of their decarbonisation strategy," he added.

The two-year project, co-founded by Innovate UK, will engage software engineering capabilities that will be co-located with ABL's maritime decarbonisation team in London. That team will liaise closely with academic experts at the two universities.

ABL has a strong track record in the maritime decarbonisation field. It has completed projects in renewable energy production, energy storage and cold ironing, alternative fuels and electrification, climate change adaptation, emission audit, assessment and abatement consulting, and shipboard carbon capture and storage.

Assessing navigational risks in wind farms

Separately, ABL has won a contract to assess navigational risks associated with the *Korsnäs* offshore wind farm, Finland's first open-sea wind power project off the country's west coast in the Baltic Sea. The project between Vattenfall and Metsähallitus is to have maximum capacity of 2.5GW and annual production capacity of 7TWh.

ABL has been retained to provide a comprehensive navigational risk assessment, including quantitative risk modelling, stake holder engagement, and recommendations for risk mitigation procedures. The consultants will also assess the risks associated with sea ice in the vicinity of the project during winter months. The contract has been awarded to ABL's operations team based in Hamburg and will be carried out by the group's Ports and Harbours consultancy team, with specialist support from OWC, a renewable energy engineering specialist.

Tilo Klappenback, ABL's country manager in Germany, commented: "We are pleased to provide our expertise in navigational risk analysis to support this pivotal step in Finland's renewable energy development. This follows many years of successful collaboration by our team on similar work for Germany's Federal Maritime and Hydrographic Agency to assess shipping risks from offshore wind sites across the North Sea. This project win is therefore a testament to our established technical reputation in this field."

ABL's global ports and harbours consultancy includes a full-lifecycle service offering for maritime infrastructure projects, from supporting the financing of assets with engineering and technical due diligence, to safety, regulatory and environmental compliance support, operational asset integrity management, fixed object damage assessment, marine casualty management and expert witness support.

ABL is part of Oslo-listed consultancy group ABL Group ASA.

ABL has won a contract to assess navigational risks associated with the *Korsnäs* offshore wind farm, Finland's first open-sea wind power project off the country's west coast in the Baltic Sea

Source: Adobe Stock

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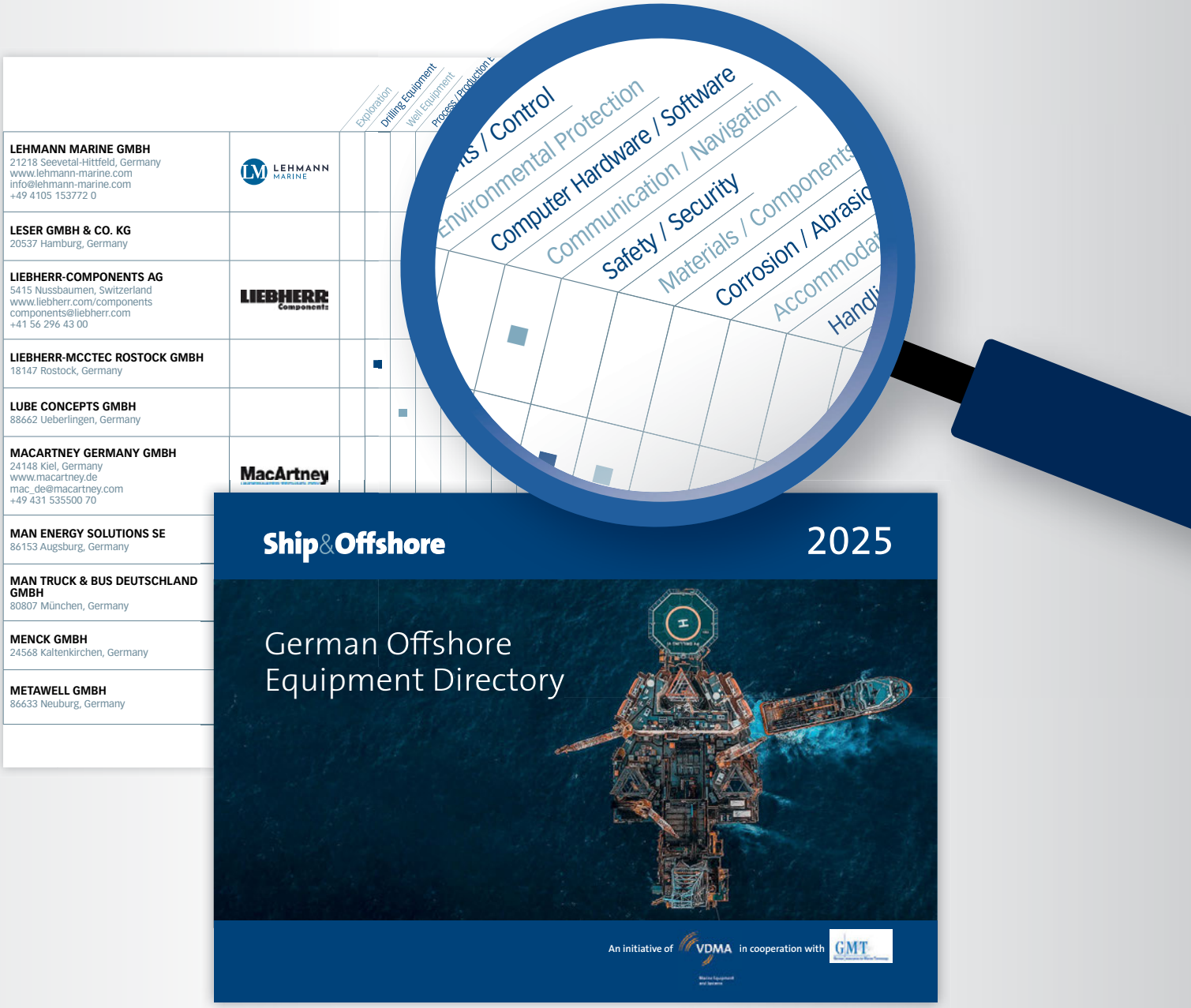


Contact: Jan-Michael Jasper, phone +49 40 23714-248, jan-michael.jasper@dvvmedia.com

Wisestella technology provides fleet-wide benchmarking capabilities, allowing managers to compare their vessels' performance against industry standards

Source: Wisestella

Artificial dissemination

COLLABORATION Artificial intelligence has the potential to improve maritime efficiency dramatically and mitigate risks, but only if the industry collaborates and shares data. Patrik Wheater reports.

There is no question that artificial intelligence (AI), advanced ship connectivity and autonomous system technology will have a profound impact on the way in which ships and crews operate in coming years. But as more companies invest in systems to reduce risk and improve efficiencies, the need to manage, qualify and understand an unprecedented amount of data has never been more pressing.

Peter Broadhurst, Inmarsat's SVP Safety and Regulatory, said the shift to the more open and expansive maritime communications landscape that multiple connectivity and AI brings presents its own unique set of challenges.

"The industry is already grappling with an influx of information, with ships receiving more than 30,000 messages each month from sensors, various data providers, and social media, alone. The data deluge already has the potential to overwhelm and confuse, rather than empower, if not managed effectively."

Speaking at the International Maritime Human Factors Symposium last November, Broadhurst said the problem is not with ship connectivity itself – which has advanced with new satellite technology and multi-orbit connectivity systems, such as NexusWave – rather the quality, management, and application of the data being transmitted.

"As the number of IoT devices connected to ships continues to skyrocket, the potential for a cacophony of alarms and conflicting information looms large," he said. Globally, there are about 19 billion connected IoT devices with another 41 billion due to be connected in the next few years.

"Everything is being monitored and connected. Data is being captured, stored, analysed, and used to make decisions. Integrated with data from external sources there is a rich data lake of information. However, we are working in an unregulated or loosely regulated space so are we defining the solution for the function we need or are we just collecting data and picking out what we need? Is it the right data for the right solution?".

To prevent these technological advancements opening a Pandora's box of problems, Broadhurst calls for a coordinated effort to develop a framework for industry-wide knowledge sharing to ensure the quality and appropriate use of data streams.

"By cooperating with all stakeholders – mariners, seafarers, owners, and charterers – the industry can create a shared understanding of the data landscape and its implications for safety and efficiency," he said, advocating a mindset shift from simply collecting data to actively using it to drive tangible outcomes.

"A collaborative approach is crucial, as the maritime industry is moving towards more autonomous systems, where reliable and consistent data will be the foundation for safe and efficient operations. The maritime industry is at a critical juncture with the proliferation of data and connectivity set to revolutionise the way ships are operated, maintained, and managed. But without a coordinated effort to harness this potential, the industry risks being overwhelmed by the very tools that could propel it forward."

While seafarers no doubt baulk at the prospect of sifting through even more data, AI could in fact help lessen the cognitive

load, with the technology's ability to learn from and predict specific outcomes, ultimately reducing human factor-related incidents.

Speaking at the same symposium, Andrew Moll, chief inspector at the UK's Marine Accident Investigations Board (MAIB), said investigators need to delve deeper into the underlying human factors that set the stage for accidents to occur in the first place. Moll said there is usually some pre-existing weakness that creates a safety vulnerability; a trigger event that tips things over the edge. How this is handled determines the severity of the outcome.

While not referring directly to AI, he said that by examining the lead-up to an incident, rather than just the headline-grabbing finale, investigators can uncover the systemic issues that may have been overlooked.

Understanding human factors and the gap between "work as imagined" and "work as done", he said, helps develop more realistic and effective safety procedures that better account for human limitations, workplace constraints, and the practical challenges encountered on the job. It would help organisations move beyond simplistic compliance-based models towards a more dynamic, adaptive safety management system grounded in the realities of the workplace.

Although human and organisational factor incidents are not widely analysed by investigators, Hollie Black, a Doctor of Philosophy at the University of Strathclyde's Maritime Human Factors Centre, believes AI has the potential to improve maritime safety dramatically. Referring to her research into the application of AI techniques to improve accident investigations, Black said AI and machine-learning algorithms leverage data to recognise patterns, trends, root causes and systemic issues, enhancing efficiency and reducing the expertise required for analysis.

"Through Natural Language Processing (NLP) and machine-learning, accident reports can be automatically classified, identifying the underlying human and organisational factors contributing to incidents," she said. "Currently, the industry faces challenges in conducting this analysis due to the burden of manual processing, but this approach significantly reduces the time and resources needed, making the process more efficient and accessible."

Central to this is the widespread use of SHIELD (Safety Human Incident & Error Learning Database), a comprehensive framework designed to categorise human and organisational factors systematically in safety-critical domains. Funded through the European Union's SAFEMODE project, SHIELD enables consistent analysis across incidents, facilitates the identification of patterns, and supports data-driven strategies to improve safety within the maritime industry.

"By integrating AI with SHIELD, we can accelerate safety learning and make maritime operations safer and more resilient," Black said.

Dr Rafet Emek Kurt, director of the Maritime Human Factors Centre at the University of Strathclyde stated that AI offers endless opportunities but warned careful consideration needs to be taken before changing the way human operators interact with ships and ship systems.

"Effective human-AI teaming on ships demands rigorous attention to safety, if AI systems are to be reliable and supportive, not disruptive. Maintaining crew engagement and situational awareness for critical decision-making in unforeseen scenarios is crucial," he said. "Despite common misconceptions, crew members are a source of resilience on board, not an error-making mechanism. Therefore, we cannot afford to lose this critical safety barrier."

The Maritime Human Factors Centre is currently involved in research to make sure this transition is effectively planned, designed and executed.

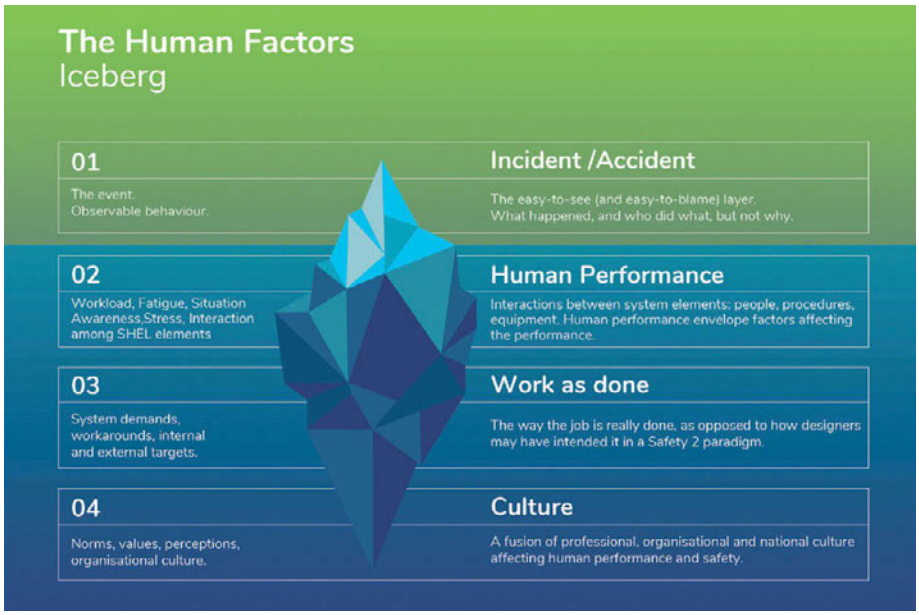
"Our 'human risk' informed design approach offers a framework to take human factor considerations into the design of new systems at an early stage, ensuring humans are kept in the loop," said Kurt.

Ali Demiral, chief technology officer, and AI lead at Wisestella, a Singapore-headquartered maritime systems provider, agrees that AI technology is unlikely to replace human operators any time soon, but will instead support and strengthen crew capabilities.

By using the power of large language models (LLM) to analyse vast troves of historical data, AI-based platforms can provide seafarers with tailored recommendations and insights. But the benefits extend beyond individual crews and vessels.

"Wisestella technology, for instance, provides fleet-wide benchmarking capabilities, allowing managers to compare their vessels' performance against industry standards," said Demiral. "Fleet managers now have the ability to identify areas where their vessels are operating optimally or falling behind, empowering them to make data-driven decisions and target their training and resources more effectively."

Through collaboration and with more companies inputting more data, the maritime sector can foster a much deeper understanding of maritime operations. By learning from these AI-generated insights, shipping companies and crew members can anticipate potential incidents and mitigate risks more effectively, ultimately improving maritime safety and operational efficiency.



The iceberg model emphasises that misunderstandings and conflicts often arise at the hidden level

Source: Maritime Human Factors Centre

Redefining performance accuracy metrics

MARITIME DATA Harnessing artificial intelligence to enhance performance analysis can unlock a new level of efficiency gains, writes Angus Whiston, Communications Director at DeepSea Technologies, a soft- and hardware solutions company

The maritime sector is at a critical crossroads, facing increasing pressures to decarbonise, meet regulatory standards, and improve operational efficiency across the board. With frameworks like the EU Emissions Trading System and the IMO's carbon intensity indicator (CII) now firmly in place, industry-leading companies are realising a growing need for more accurate, reliable vessel performance modelling. In this rapidly evolving environment, Eastern Pacific Shipping (EPS) is setting a new standard. Harnessing artificial intelligence to create a powerful new paradigm for performance analysis, the company's new models can predict vessel behaviour with over 99% accuracy, unlocking a new level of efficiency gains.

Navigating the challenges of uncertainty in maritime data

"Accuracy" and "savings" statistics are ten-a-penny in the maritime industry, and the foundations on which these numbers are built are almost always shaky at best. One of the biggest challenges in maritime performance modelling is the uncertainty inherent in the data collected from vessels. This uncertainty can significantly affect the accuracy of performance predictions and decision-making. It can be broken down into two primary categories, which will be familiar to those in the performance space:

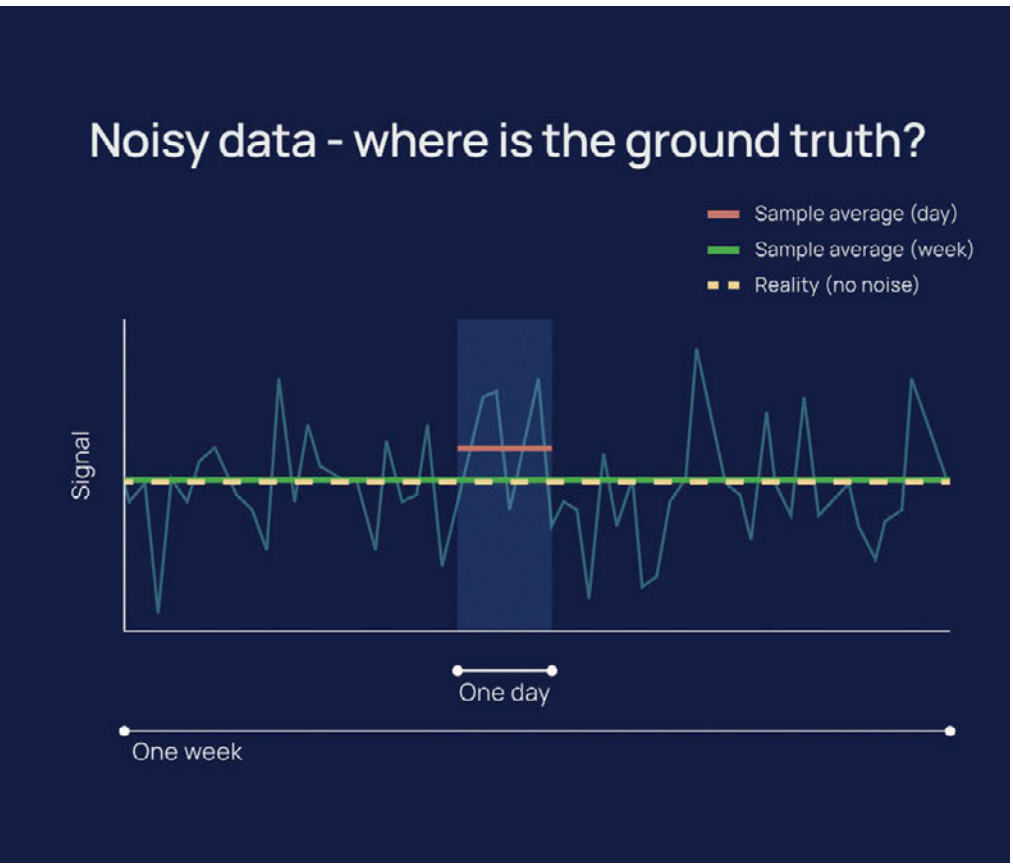
- Random uncertainty, which arises from the natural variability in data due to unpredictable factors like sensor fluctuations or environmental conditions (e.g., weather changes or ocean currents). In the world of modelling, this is technically known as aleatoric uncertainty;
- Knowledge gaps, which occur when the data used to build models is incomplete, outdated, or biased, leading to incorrect assumptions about the system. This is technically known as epistemic uncertainty.

Maritime datasets are almost always noisy and inconsistent, with discrepancies ranging from 3% (in very high-quality data) to over 10% in poorer datasets. The latter is typically the norm.

Traditional modelling approaches, such as static fuel consumption tables or basic algorithms, are simply unable to handle these variances effectively. This leads to significant errors in performance predictions, sometimes exceeding 15% on a spot measure.

Even more critically, these models are also limited in their ability to account for the complex relationships between key factors like weather, hull condition, engine performance, and sea state, which are crucial for understanding a vessel's true operational efficiency. And yet, the prize, which ultimately manifests in significant commercial advantages for those who can somehow overcome these obstacles, is vast.

To tackle these issues, DeepSea Technologies has spent the last eight years developing an advanced framework designed to generate models that are capable of withstanding these persistent data challenges. The aim has been to provide a meaningful way of ascertaining the true accuracy of a



An illustration of the challenge associated with ascertaining "model accuracy" in the midst of "inaccurate data"
Source for all images: DeepSea Technologies

given vessel performance model, addressing both types of uncertainty mentioned above.

This approach was rolled out across EPS' entire fleet during summer 2024. It integrates uncertainty into the modelling and validation process itself, ensuring that the models are reliable even when data is imperfect, or conditions change unexpectedly, as they often do).

Methodological innovations for predictive modelling: a rigorous, data-driven approach

One should always be sceptical of "savings" or "accuracy" figures that are stated as a single number, without any supplementary information about what that figure truly means. The uncertainty inherent in all maritime data leads to the question: if a model yields a particular output figure, what can it be tested against to gauge its veracity? Or put more simply, if the underlying data is itself "inaccurate", how can it be determined how well a particular performance model is capturing the real behaviour of a vessel?

In fact, a well-trained AI model will be able to disentangle the random uncertainty from the real phenomena present in the data – meaning that, when taking any 'spot' measure, the model can actually be more accurate than the underlying data that was used to train it. This phenomenon can be identified at play when observing that a model's accuracy appears to increase as the time period during which measurements are taken increases (ie. the aggregation error decreases).

Another challenge with ascertaining accuracy comes with understanding that a model might be very good at making predictions based on data it has seen a lot beforehand. However, it might fail when it comes to a new set of conditions which, of course, is an everyday occurrence in shipping.

One of DeepSea's key strategies to address this challenge involves dividing data into two distinct categories:

- Conditions the training data has seen before (i.e., in-domain data): This may be grouped around a particular set of operational scenarios, geographical areas, seasons, fouling states, or anything else;
- Conditions the training data hasn't seen before (i.e., out-of-domain data): this encompasses conditions which are not well represented in the training data. This will usually include such things as unusual sea states and non-standard operational profiles. However, given the almost infinite combinations of factors that influence a ship at any time (wind, swell, current, fouling, draft, etc.), they will also include a large proportion of what would be considered 'normal' sailing conditions. It is certain that, almost every day, a ship will encounter a 'new' (out-of-domain) reality which needs to be handled by its behaviour model.

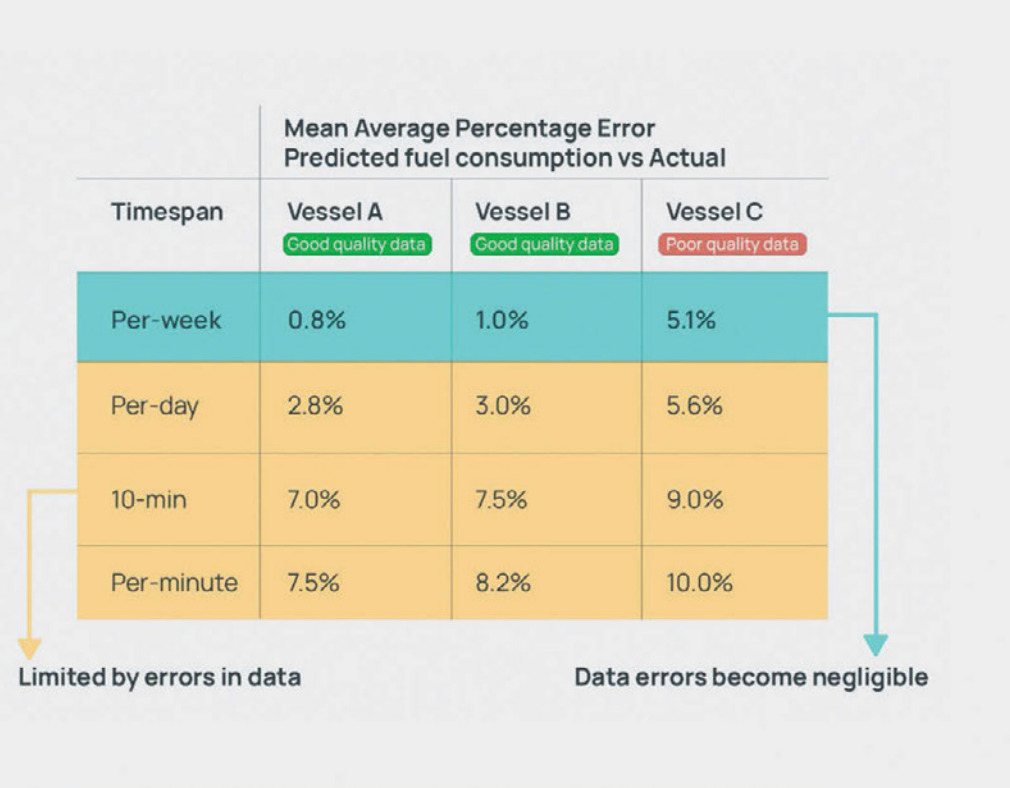
A model may test as 99% accurate against in-domain data but fail miserably when it comes to out-of-domain data. Given the certainty of encountering out-of-domain conditions on a regular basis during real-life sailing, this makes it a useless model.

EPS' models were tested with both types of data – a process which ensures that they can generalise well to new or unforeseen circumstances, improving their robustness and reliability. DeepSea Technologies uses synthetic datasets enriched with controlled noise to simulate a variety of real-world conditions, further enhancing a model's ability to deal with unpredictable variables like fluctuating wind speeds or changing hull conditions.

There are a series of systematic tests which EPS' models had to pass before they were deemed deployable:

- Residual plots: these visualisations compare predicted values against actual observations, helping to identify systematic biases in the model;
- Counterfactual simulations: this technique involves testing the model under hypothetical scenarios to assess whether it produces consistent and reliable predictions, even when faced with unexpected conditions;
- Uncertainty retention curves: these metrics track how well a model's predictions align with the actual level of uncertainty in the data. A smaller gap between uncertainty and actual error indicates that the model is more reliable and able to handle real-world conditions with greater precision.

AI-generated models must pass an extensive bank of tests like this before they are ready for real-world deployment, as those now powering EPS' vessels around the world have. Focusing on a single metric (e.g., a few spot-tests against in-domain data) might yield a fantastic ›



The accuracy results for DeepSea's AI models across three of EPS' ships – showing how, due to random data errors inherent in the data, the aggregation error decreases as the timespan increases. Unexpectedly, the model does not get better – it is the data that does.

statistic for the marketing team but might end up actually costing more money in fuel when deployed in a real-world environment.

EPS and AI: a next-generation approach

EPS' collaboration with DeepSea has yielded a new 'gold standard' of accuracy when it comes to performance modelling, demonstrating the potential of advanced AI to transform maritime operations. Over the course of six months, EPS integrated DeepSea's Cassandra platform across its fleet, successfully creating these highly accurate digital twins for hundreds of vessels.

Pavlos Karagiannidis, EPS' Fleet Optimisation Manager, summarised the significance of this milestone. "Inaccurate models lead to inaccurate insights," he said." The easiest way to cut the environmental impact of any ship – which is now of paramount importance – is to make it more efficient. Efficiency was never achieved through 'rough estimates'."

The tangible benefits of EPS' data-driven approach

The results of EPS' data-driven strategy over time are expected to be substantial, with significant improvements in several key areas:

- Fuel efficiency: by adopting DeepSea's AI-based performance models, EPS expects to achieve significant cost savings through making better decisions, faster;
- Regulatory compliance: the advanced models are giving EPS a new level of insight across the gamut of environmental regulations that we all now have to work towards, ensuring the company stays at the forefront of an increasingly eco-conscious market;
- Cross-functional collaboration: the integration of these digital twins provides, for the first time, a shared data framework that allows different departments – operations, technical, and commercial teams – to collaborate more effectively. This will lead to better decision-making across the organisation, driving profitability while also enhancing vessel performance.

Conclusion

EPS' experience underscores the importance of having access to high-quality, real-time data. Many shipping operators still rely on outdated, manually compiled reports which lack the accuracy and granularity needed for effective performance modelling. EPS' investment in high-frequency sensor data and a comprehensive validation process has proven to be a game-changer, setting a new standard for maritime operations.

DeepSea's methodology, which incorporates uncertainty quantification and robust validation techniques, provides a valuable system for other operators looking to improve their own modelling processes. By addressing both random and knowledge-based uncertainties, DeepSea's models remain reliable even under challenging conditions, making them a powerful tool for any modern maritime operation..

SeaCube's Green Reefer Leases offer up to 20% energy savings and emissions reductions, while the Net-Zero Reefer Leases allow customers to offset their remaining emissions through carbon credits

Source: SeaCube

Partners ramp up sustainability in reefer sector

AI REPORTING | US-based SeaCube, a leasing specialist in the refrigerated intermodal equipment sector, and emissions consultant, Greensee, have set up a new system designed to improve sustainability metrics in the cold chain logistics sector. The partners are now offering SeaCube's Green Reefer Leases and Net-Zero Reefer Leases monitored by Greensee's artificial intelligence-driven carbon emissions reporting technology. The system is based on patented distance calculation methodology and, it is claimed, can estimate any container shipment emissions profile in the world, on any transport with an accuracy of up to 99%.

SeaCube's Green Reefer Leases offer energy savings and emissions reductions of up to 20%. Its Net-Zero Reefer Leases, meanwhile, enable customers and shippers to offset emissions through carbon credits. Both initiatives are designed to drive cost efficiency whilst, at the same time, targeting more ambitious sustainability goals.

In a separate initiative, SeaCube is cooperating with Trane Technologies subsidiary, Minneapolis-based Thermo King, a specialist in transport refrigeration systems, and French container line, CMA CGM to test the Thermo King E-COOLPAC electric generating set, one of the first battery-powered reefer container gensets in the United States. This zero direct emission battery power technology allows the electrification of last-mile refrigerated transport (excluding truck power) and is another initiative in SeaCube's sustainability drive.

The E-COOLPAC is available with a range of battery modules, as well as extension packs, in a power range from 35kWh to 105kWh. It can be fitted, or retrofitted, to marine container chassis where a traditional diesel genset is currently positioned. Thermo King claims that the setup offers zero carbon dioxide and particulate emissions during operation, renewable energy charging compatibility thereby cutting the carbon footprint further, and compatibility with the company's marine refrigeration units as well as other brands of ISO1496-2 reefer units.

Reefer boxes typically account for about 10% of a ship's container capacity but can consume up to 20-30% of a vessel's total power output and therefore contribute significantly to carbon emissions. SeaCube's Green Reefer Leases address the issue by providing access to advanced energy analytics and optimised asset designs.

These include reefer boxes fitted with the latest controllers, enhance telematics, and efficient compressors. Meanwhile, real-time data analytics can optimise refrigeration systems, accounting for such variables as ambient temperature, cargo type, and trade lane. And the energy savings and emissions reductions can add up to as much as 20%.

Fabien Gresy-Aveline, CMA CGM vice president, Container Fleet, said: "The e-genset is a game-changer for our operations. By transitioning away from diesel, we are taking a significant step toward more sustainable refrigerated transport." Meanwhile, Singapore-based Pacific International Lines (PIL) is participating in a greenhouse gas reporting and reefer fleet optimisation programme sponsored by SeaCube and Greensee. This involved establishing baseline metrics for decarbonisation benchmarking and identifying opportunities for fuel savings and operational efficiency gains.

PIL's general manager, Logistics Division, Lim Cheek Wei, said: "Effective greenhouse gas reporting for refrigerated transportation contributes to providing PIL with good visibility on our emissions, helps us meet regulatory requirements, and support our long-term goal of achieving net-zero greenhouse gas emissions by 2050."

SeaCube Containers CCO, Gregory Tuthill, commented: "SeaCube and Greensee are setting the standard for sustainability in the cold chain industry. Through innovative solutions like energy analytics, the electric genset, and the Net-Zero Lease Programme, we are providing practical, impactful pathways to help customers reduce emissions and achieve carbon neutrality. These initiatives not only help customers meet their rigorous sustainability targets but also significantly reduce the carbon footprint of refrigerated transport."

Greensee founder and CEO, Luc Terrel, said: "Greensee's advanced analytics empower customers to accurately monitor and report emissions, ensuring compliance while enabling real-time optimisation of refrigerated transport. Our partnership with SeaCube is a pivotal step toward a more sustainable future in cold chain logistics."

New partnership to test AI systems

Source: Mythos AI

The unmanned survey vessel *Archie* uses sensors and real-time data acquisition in an advance pilot assist system (APAS) to operate in congested coastal waters and inland waterways

AUTONOMOUS NAVIGATION | Lomarlabs, a subsidiary of London-based Lomar Shipping and Mythos AI are to work together to develop autonomous navigation systems with the aims of improving safety, raising efficiency, and advancing sustainability. The systems developed by the partners will undergo pilot tests on Lomar vessels. The shipping company operates a 35-ship fleet, comprising 24 container ships, seven panamax bulkers, and four chemical tankers.

Mythos AI has developed the *Archie*, an unmanned survey vessel that uses sensors and real-time data acquisition in an advance pilot assist system (APAS) to operate in congested coastal waters and inland waterways. Autonomous systems used on board *Archie* comply with collision regulations.

The partners believe that autonomous technology can augment the capabilities of navigating officers by enhancing bridge resource management. Routes can be optimised to improve fuel efficiency while also improving safety through real-time situational awareness and constant attention. Furthermore, with appropriate cyber security systems in place, the cloud-based data interface can provide shore personnel with vessel contact and situational awareness.

Lomarlabs managing director, Stylianos Papageorgiou, said: "With rapid developments that will see the commercial use of autonomous ships and the International Maritime Organization aiming to finalise and adopt its non-mandatory Maritime Autonomous Surface Ships (MASS) Code to protect safety at sea by May 2025, this collaboration comes at a critical time. Working with Mythos AI underscores our commitment to harnessing the best in technology and innovation to create cleaner, safer and more efficient maritime futures, allowing us to push the boundaries of what's possible in sustainable shipping."

Geoff Douglass, CEO of Mythos AI, commented: "Our collaboration with Lomarlabs represents a major step forward in advancing sustainable shipping solutions. By combining our autonomous technology with their deep maritime expertise, we are charting a new course for the industry that prioritises both efficiency and environmental stewardship."

Lomar CEO, Nicholas Georgiou, added: "AI-driven technologies possess huge potential for our shipping and wider maritime industry. This collaboration puts us at the forefront of future innovations to drive the efficiency, effectiveness, safety and sustainability of operations at sea, not least in congested shipping lanes."

EU ETS: twelve months into the regulation

FIRST SETTLEMENT | Hamburg-based OceanScore has highlighted that the clock is ticking down towards the first deadline for submission by shipping companies of monitoring, reporting, verification (MRV) reports in March that will determine the scale of EU Allowances (EUAs) to be surrendered in September. A key component of the EU Emissions Trading System (ETS), which affects owners and operators with ships on trades within or to/from the trading bloc, the cost of the EUAs remains a major uncertainty.

There are nine more months before owners will know the financial cost of the ETS to shipping, first introduced in January 2024. OceanScore's managing director, Albrecht Grell said recently that many challenges remain and their true impact will only become clear when the first Allowances need to be surrendered in September.

"Fortunately,", he said, "the EU Emissions Trading System is now well understood by most players in the industry after a year of implementation, despite adding yet another layer of regulatory complexity to an already highly regulated business. But we see that significant obstacles still need to be overcome as we navigate the road ahead to efficient compliance."

OceanScore has identified a number of technical and commercial issues. Automation gaps, a lack of harmonised formats and standardised APIs, and errors in reporting systems have highlighted the need for a standardised approach. Some service providers, for example, have attempted to charge shipping companies twice for their data – once for providing the service, and once again for sharing the data via APIs.

Discrepancies between commercial voyage definitions and MRV reporting requirements, notably for voyage charter deals, have hindered compliance, OceanScore said. Meanwhile, technical off-hires need to be deducted when invoicing charterers for EUAs because responsibility for off-hires remains with the owner. "Improved reporting frameworks could help resolve these inefficiencies and support more seamless compliance," the consultancy said.

On the commercial side, transparency has proved an issue. Invoicing for EUA's is a labour-intensive exercise, with diverse format requirements, a range of request frequencies and interim statements making the process more complex. Tools are available to alleviate these issues; the company's own ETS Manager is now being used by about 50 companies representing 1,300 ships. From January next year, the company's OceanScore platform will be rebranded as Compliance Manager, covering both the ETS and FuelEU Maritime.

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