

MAY 2022

THE MOTORSHIP

Vol. 103 Issue 1203

MARINE TECHNOLOGY

ABB Turbocharging:
Christoph Rofka

EEXI in mind:
BV's Vassilios Dimoulas

Wärtsilä interview:
Stefan Nysjö strategy

Poseidon Principles:
Marine Insurance impact

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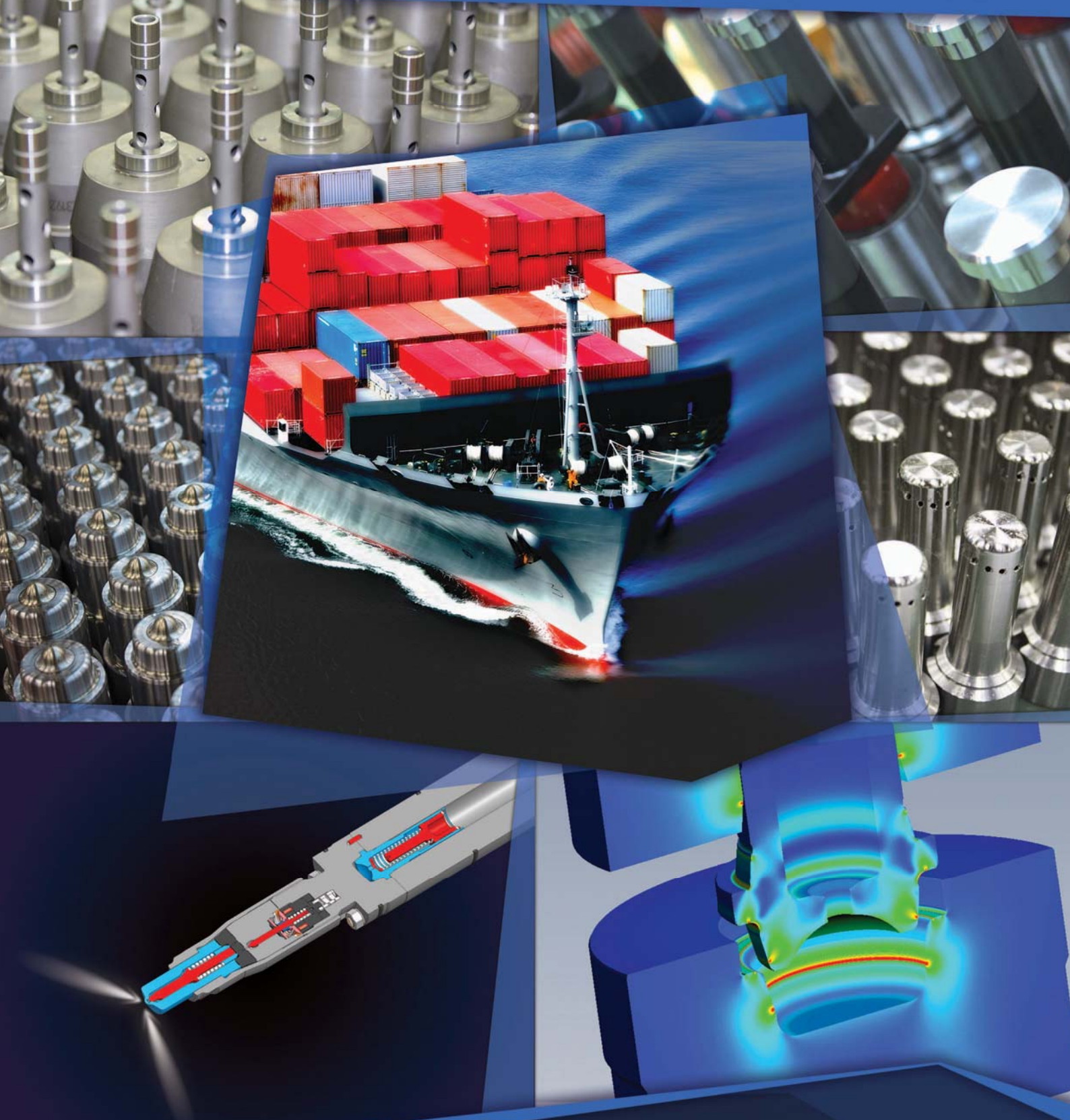
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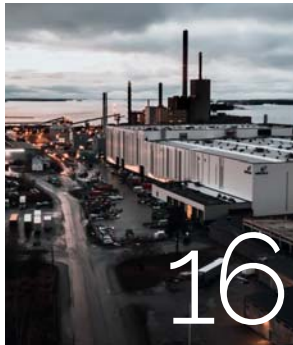
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DUTCH YARDS STUDY SHARED AUTOMATED PANEL PRODUCTION



Groningen Maritime Board (GMB) has initiated a study into the possibility of establishing a centre for robotised shipbuilding production in the northern Netherlands.

A grant of EUR250,000 (US\$263,000) has been provided by Groningen Province to GMB for a feasibility study into a facility that would be used on a shared basis by the industry in the region. The Shared Facility project will focus on the technical, operational and economic viability of establishing a dedicated plant for robotic production of micro panels to be supplied to participant shipyards.

The overarching aim is to better safeguard the industry's future in the face of intensified global competition by raising the technological level, improving efficiency and optimising cooperation throughout the shipbuilding chain.

Although the region's maritime cluster remains one of the most dynamic and extensive in Europe, orders are being lost to low-wage economies such as China for whom shipbuilding is of industrial strategic importance.

Automation and robotisation are viewed by the Shared Facility advocates as a potentially decisive means of raising efficiency, boosting output with the same number of employees, increasing quality and shortening contract to delivery times. An additional prospective benefit of such investments is fostering greater attractiveness to the younger generation, against a

■ The project coordinator believes the project could deliver significant efficiency improvements, which would increase the production capacity of yards associated with the project

backcloth of the increasing average age of workers in Dutch shipyards and allied sectors, and persisting difficulties in recruiting personnel.

However, as the business of many of the northern Dutch firms often entails customer-specific solutions and small series per product, there are challenges attached to the introduction of robotised section building, as this requires an integrated, comprehensive approach.

Conoship said "This demands a cultural shift across the entire design phase. Rather than thinking in terms of processes specific to one company, we should approach the design from the perspective of the entire shipbuilding chain. This will help the full shipbuilding chain to achieve significant savings throughout the process. A degree of standardisation is paramount."

Also central to the robotisation theme is the better use of data. Application of the digital twin concept would provide a model from which production data can be generated to control cutting machines and automated systems such as welding robots and collaborative robots (cobots), for the manufacture of micro panels. A subsequent step would be to build a self-learning production process through the application of artificial intelligence (AI) techniques.



VIEWPOINT

NICK EDSTROM | Editor
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The Heart of the Matter

Following hard on the heels of Russia's invasion of Ukraine and the formal application by Sweden and Finland to join NATO, it would be easy to overlook the implications of the European Union's €210bn energy transformation package for our customers.

Beneath the headline, which is that Russia will cease to be a major energy supplier to the EU within the next five years or so, the energy transformation plan has major implications for our readers.

As is traditional in horsetrading within Brussels' Ring, the deal will distribute taxpayer largesse widely and assiette au beurre (pork barrels) for the EU's various interest groups. LNG producers and importers will naturally focus significant attention on the development of LNG transportation infrastructure within the EU.

Much of the gas demand that is currently satisfied by Russian supplies will be substituted with LNG import terminals. We have reported extensively on the development of LNG import terminals around the EU, and the increasing adoption of LNG-fuelled propulsion within the EU.

However, the broader implications of the plan extend beyond LNG.

The decision to lift the target for the EU's proportion of clean energy from 40% by 2030 to 45% is less significant than some might think: it merely reflects the likely pace of the roll out of offshore and onshore renewables in the trading bloc's largest economies. Similarly, coal power generation will decline rapidly across many parts of the trading bloc over the second half of the current decade.

But importantly from our perspective, the continuing decline in seaborne thermal coal consumption will be offset by the emergence of a number of new trades, including the carriage of seaborne ammonia and potentially hydrogen. Rotterdam will remain a major energy distribution hub, even if the commodities themselves change. Patrizia Kern of Swiss Re, who discusses the impact of the Poseidon Principles for Marine Insurance, noted in passing that ship insurance has been around over 700 years. Changes in cargoes and ship types have occurred before and will occur again.

The likely impact of the introduction of hydrogen vectors into the maritime sector at scale is perhaps the single most interesting question confronting the sector at the moment. OEMs and operators and owners find themselves (sometimes uncomfortably) at the centre of global energy politics to a greater extent than at any point since the energy crises of the 1970s.

We cover the launch of Belgium-based BE2HYDRO's new 100% hydrogen-fuelled medium-speed engine in a feature in this issue. However, the order of a Jones Act-compliant hybrid SOV for operation off New York State is equally noteworthy – as it indicates that recent orders are not merely being driven by European regulatory regimes.

Elsewhere, we feature interviews with Stefan Nysjö of Wartsila Power and Christophe Rofka of ABB Turbocharging in this issue.

Finally, we feature a Design for Performance article about OSK-Shiptech's perspective on circularity approaches in shipping. The implications for shipping remain unpalatable – Chinese steelmakers are unlikely to produce green ship plate in the near term – while there is little interest in raising additional obstacles for certifying shipbreaking in the Indian sub-continent until recycling capacity in the west revives.



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The International Association of Classification Societies (IACS) has released a Unified Requirement (UR) relating to fire issues for ballast water management systems (BWMS) on ships, UR F45.

The UR sets out measures that should be taken to mitigate fire risks associated with each of eight different types of systems and will be implemented by IACS members to new ships and to new installations of BWMS on existing ships from 1 July 2022.

SOLAS fire space requirements impose limits on the location of the ballast water treatment room which affect system types differently, and the UR provides requirements for fire prevention, detection and extinction along with specific ventilation arrangements. These requirements are in addition to those required by SOLAS Chapter II-2.

"The UR has been developed on the assumption that only one person is present in a ballast water treatment room while the ballast water treatment system is running," states the IACS Annual Review 2021. "It recognises that when the system is being maintained and not running there may be additional people present."

This issue has been on the table for very long within IACS, and now finally they have all agreed to have it as a minimum requirement, says Jad Mouawad, CEO of Mouawad Consulting. "This is positive and gives unified requirements for those systems across class societies. But I don't expect any major hurdles for most systems here, only that both

NEW IACS REQUIREMENTS FOR BWMS TAKE EFFECT FROM JULY

engineering firms and makers must go through them and ensure that whatever affects their systems or installations is already taken care of. We have already started working with some makers to ensure compliance with those requirements."

Continuing work on SOLAS Chapter II-2

IACS continues to work on unified

interpretations of SOLAS Chapter II-2 – which contains ship construction requirements for fire protection, detection and extinction. Regulation 9 of the chapter contains the requirements for containing a fire in its place of origin, and IACS notes that there have been many interpretations made.

In 2021, IACS identified areas where a change to the regulation

is needed and proposed a review to IMO. IACS has since established a project team to review the regulation and ensure that the requirements are consistent and references are correct before preparing a submission to the IMO with a new text.

The IACS Annual Review 2021 is available here: <https://iacs.org.uk/media/8962/iacs-ar-2021-low-res.pdf>

Hav Design to develop methanol-fuelled SOV

ESVAGT has chosen HAV Design to develop a methanol-fuelled offshore wind service operation vessel (SOV) that will service renewable giant Ørsted's UK East Regional program which includes the Horn Sea Two Offshore Wind Farm offshore UK.

HAV Design will deliver both the ship design and an integrated equipment package including propulsion system, engines, propellers and positioning system. The total contract value is approximately NOK 200 million.

The main purpose of the SOV is to safely transfer technicians and spare parts to and from wind turbines and offshore substations.

The newbuild hybrid vessel is of HAV 833 SOV design. The vessel will be equipped with methanol-electric propulsion system, including a battery pack that allows very low to zero-emissions operations.

The SOV will be 93 metres long and 19.6 metres wide and will



accommodate up to 124 persons.

ESVAGT has a fleet of more than 40 vessels. "This is the 10th SOV that ESVAGT is developing together with HAV Design. The long-term close cooperation with HAV Design will ensure the highest performance and efficiency, and always based on Safety First," says Kristian Ole Jakobsen, DCEO in ESVAGT.

Hydrogen approval

Earlier in May 2022, HAV Group was been granted preliminary approval for the hydrogen-based energy system involving fuel cells

developed in the FreeCO2ast project. The project is currently developing a high-capacity hydrogen energy system that can be retrofitted onboard one of Havila Kystruten's coastal cruise ships.

The Norwegian Maritime Authority issued a statement of preliminary assessment which confirms that the alternative design is considered feasible and sound in accordance with IMO guidelines on alternative design (MSC.1/Circ.1455) and that the project is ready to advance into the final design phase.

BRIEFS

EPS Carbon capture Eastern Pacific Shipping (EPS) is to install carbon capture and filtering systems on two MR tankers, with an option to equip three more vessels. The first installation will be completed by the end of 2022. The modern MR tankers will be fitted with Value Maritime's Filtree System, a prefabricated gas cleaning system that filters sulphur and 99% of PM. The system will include a carbon capture module charging a CO₂ battery onboard.

Gulf Oil Cat II NOL

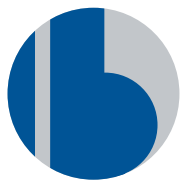
Gulf Oil Marine has announced that its initial No Objection Letter (NOL) from MAN Energy Solutions for its CAT II 40BN cylinder oil, GulfSea Cylcare XP 5040X, has been extended by another three years. The extension follows from the successful completion of more than 2,000 hours of confirmation tests. The performance of the oil has been affirmed on two different engine models – MAN Mark 9.2 and Mark 9.5 – both running on low-sulphur fuels.

Real time CO₂ tool

Korean Register (KR) has awarded Singapore-based Marine Technology Solution a type approval certificate for its direct and continuous CO₂ emission measurement system called CARBON LENS. CARBON LENS continuously analyses and records the flow of emitted CO₂ from each stack of a vessel, taking into account its temperature and exhaust pressure. This data is then live-streamed from the vessel to designated recipients ashore.

Gases to Newcastle

The Port of Newcastle Green Hydrogen Hub Project is to receive A\$41 million in funding. The green hydrogen project is a joint venture with Macquarie Capital and Macquarie's Green Investment Group and is currently progressing an ARENA funded feasibility study. Newcastle's Green Hydrogen Hub Project is being developed with a phase one minimum 40MW electrolyser that over time could increase to a capacity of over 1 GW.



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EEDI AND EEXI REQUIREMENTS CONTINUE TO EVOLVE

The Motorship discussed the future of EEDI and EEXI requirements with **Vassilios Dimoulas**, Technology & Innovation Manager, Greece Cyprus & Malta, Bureau Veritas Hellas

Q The IMO's EEXI requirements are anticipated to be changed to include alternative fuels and emission reduction technologies. What are the current limitations of the requirements?

A The IMO is constantly updating its guidance on how to consider innovative energy efficiency technologies in the EEXI and the EEDI. The latest update is MEPC.1/Circ.896, which was approved during MEPC77 and includes very useful amendments to previous guidance on wind assisted propulsion systems. IMO understands that this guidance is to be kept under review as technology evolves and experience is gained from its application.

In my view, the most important limitations currently on the EEXI/EEDI but also on the CII regulation is the lack of emission factors for carbon neutral fuels (e.g. biofuels, biogas, synthetic gas etc.) and the lack of credit given for the use of carbon capture technology.

The first obstacle is linked to the lifecycle assessment of fuels (the "well to wake" approach), which is currently under development at IMO. Already, Intersessional working groups 9 and 11 have produced very promising draft documents on methodologies for such an approach, however, as other industries on land are also involved in defining the full accounting principles, their development may take more time.

There is, however, a pressing need for the maritime industry as carbon neutral fuels are already available today and able to be used in existing ships without modifications. At the same time, fuel producers need to be provided with confirmed volume orders in order to secure supplies of the necessary feedstocks for production.

The question of carbon capture must also be addressed, as we see this technology evolving quickly and potentially becoming a good option in the short term, while technology for carbon-free fuels is still under development. In regulatory terms, the experience already exists from SOx scrubbers and NOx abatement systems that are already in service, so we believe that a framework for CO2 abatement systems can be put in place relatively quickly.

As a class society, our role is to support industry pioneers with our experience and expertise. Our main focus is safety, so we are working hard on joint development products that are producing rules and guidelines for the safe application of all these technologies on board.

Q What you envisage will happen to the regulations going forward?

A In the very short term, we are looking forward to what MEPC 78 in June will endorse, especially regarding correction factors and exemptions to the CII calculation. Much is expected by operators who wish to benchmark their ship's performance and decide on short term operational policies as the regulations will enter into force.

In addition, the International Association of Classification Societies (IACS) has worked hard to provide the industry with much-needed clarifications and common interpretations for

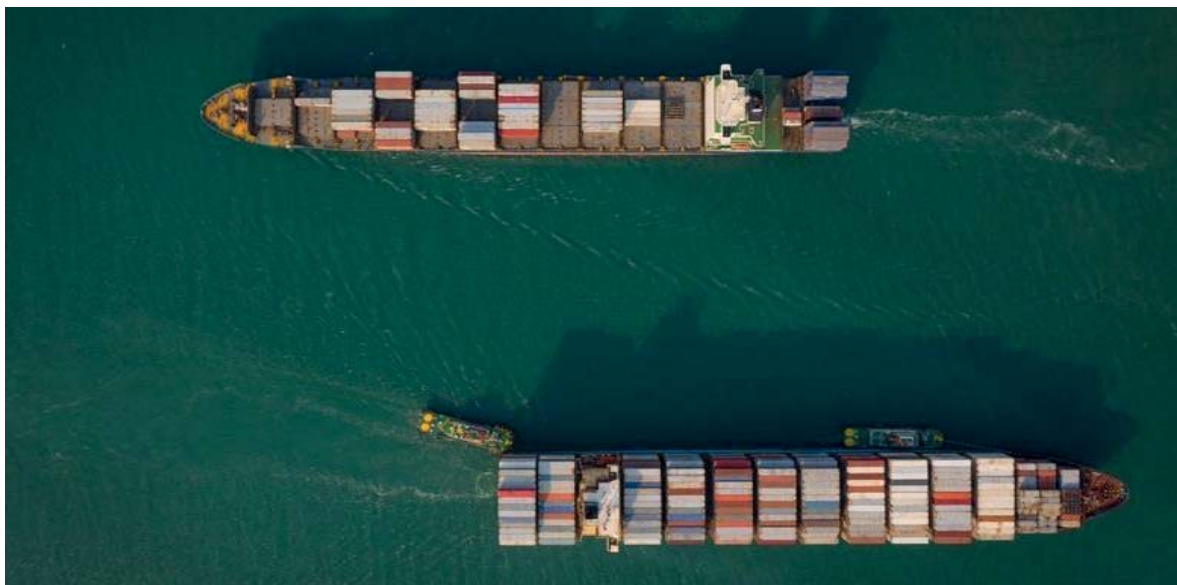


Vassilios Dimoulas, Technology & Innovation Manager, Greece Cyprus & Malta, Bureau Veritas Hellas

the many vague points in the calculation of the attained EEXI for existing vessels, which in many cases is lacking information on speed-power curves and SFOC. Finalizing these guidelines, including also acceptable methods for EPL and ShaPoLi (shaft power limitation), is a step that is eagerly awaited by the industry in order to streamline the application of both these regulations in 2023.

The next step would be for IMO to finally address the application of carbon neutral fuels and carbon capture in terms of emission factors, but also to establish the safety frameworks through the Maritime Safety Committee that will cover the application of alternative fuels and technologies, many of which present major safety challenges for the crews on board. Class societies, including BV, are already working hard on this question, and we hope that our work in rulemaking will help IMO and the MSC in updating codes like the IGF Code to include alternative fuels like Ammonia and Hydrogen and safety codes for devices like high temperature fuel cells.

The final challenge for IMO is whether a zero or net-zero emission target will be set for 2050 for shipping. This subject was briefly touched upon during MEPC77, under the pressure exerted also by COP26, however the members chose to focus on development of the short-term measures as a priority.



■ BV offers a digital platform, VeriSTAR Green, to help shipowners to assess their compliance with EEXI and CII regulations

Q What are the most challenging aspects from the point of view of developing the technical details?

A In my humble opinion, the safety issues related to the application of alternative fuel technology on board is the biggest challenge for technology developers, regulators and ourselves, as class societies. New safety concepts need to be developed and included in regulations. A prime example is the major hazard of toxicity for fuels like methanol and ammonia. Regulations have so far considered safety zones based on flammability. How could such zones be developed to address toxicity and what mitigation measures are needed to avoid, detect and minimize leaks?

The good news is that simulation technology for gas dispersion has evolved and is available. Moreover, the industry has gained experience in performing risk assessment through HAZIDs and HAZOPs. All these techniques and experience can be used to develop new safety regulations. At BV, we have made a good start on this and have developed tentative rules based on such studies.

However, rules are also developed by seeing how they work in practice, so we are actively following joint development projects with early adopters where we apply these rules, learn from their practical application and refine them further. We all strive to provide the best solutions to effect decarbonisation of the shipping industry, but the safety of crew and passengers is paramount and cannot be overlooked.

Q What momentum is there for EEDI phase 4?

A Indeed, some discussions are taking place. However, we believe that other measures may have priority, such as the inclusion of new technologies in the existing frameworks. EEDI Phase 4 could be one potential measure to ensure the development of new designs that will be able to use alternative fuels, as energy efficiency technologies have more or less reached their limits with Phase 3 of the EEDI. Its application could be envisaged within IMO's mid-term measures development roadmap.

Q EEXI/EEDI requirements are anticipated to be updated to include other emissions, such as methane and N₂O. How important will this be for the industry as it moves to choose a future fuels pathway?

A Methane and N₂O are much more potent greenhouse gases than CO₂ and their emissions need also to be

reduced and taken into account. Their consideration is linked with the discussions about the potential application of an EEDI Phase 4. The subject was included in the MEPC77 agenda, but due to time constraints it was one of the many topics that were deferred.

However, it is not just the EEDI that is linked to the consideration of methane and N₂O emissions. These GHGs are considered in the work by IMO's intersessional working groups 9 and 11 on the development of lifecycle (LCA) GHG/carbon intensity guidelines. If we take LNG for example, methane is not only emitted during combustion but also during production, and the LCA approach should take this into account. N₂O is a possible by-product of the combustion of ammonia and certainly needs to be considered together with the benefit offered by this nominally carbon-free fuel.

In terms of combustion and slippage of such gases, the news is in general good as engine makers are constantly refining their equipment to minimize this effect, partly driven by the potential application of relevant regulations. I would however avoid making an estimate on the timeline of the application of such regulations, as the last two MEPCs and the related working groups' works, which were conducted remotely due to the pandemic, have offered very limited time to regulators, who had to defer many important subjects for later sessions. Let's hope that IMO will soon resume work in person so that such important subjects can be addressed efficiently.

Q What are your thoughts on the future of new fuels?

A One can argue forever about the decarbonisation of the shipping industry, the possible pathways and predictions about what will be the "fuel of the future". The fact remains that climate change is here and it already impacts our lives. Even though ocean-going ships are by far the most efficient way of transporting goods around the globe and their share in GHG emissions is also by far the smallest in the transportation sector, the industry must do its part in reducing its carbon footprint, and why not with the ambition of reaching net-zero by 2050.

Technology is evolving, and so are the rules and regulations to go with it. However, substantial investment by governments is needed to scale up supplies of alternative fuels, as well as incentives to encourage early adopters to apply and test the technology, in addition to rules and regulations.

MARINE INSURERS TO PROMOTE GHG TRANSPARENCY VIA PPMI

The introduction of Poseidon Principles into the marine insurance market will have wider reaching effects than simply promoting greenhouse gas emissions transparency, as **Patrizia Kern**, Chair, Poseidon Principles for Marine Insurance (PPMI) explained in London

Unlike the Poseidon Principles' namesake for the financial sector, vessels that are responsible for fewer emissions will not be incentivised. Conversely, ship owners will not face the prospect of having coverage withdrawn for vessels that are more polluting in the short term, Patrizia Kern, Chair of PPMI reassured journalists at a press event in London in early May. "We are not going to walk away at the first step."

Rather than resorting to withdrawing cover, Kern anticipated a situation where PPMI signatories might engage more actively with ship owners to understand their plans to improve the emissions profile of their vessels, or trajectory, as she termed it.

The entry into force of the Poseidon Principles for Marine Insurance (PPMI) in May 2022 does represent a potentially highly significant development in establishing climate related financial disclosures within their portfolios as a risk that requires management for the insurance sector.

The PPMI will initially be used solely for the purposes of direct insurance, where insurers have a direct relationship with the ship owner. There was no intention of applying the PPMI more widely in the insurance industry, such as in the reinsurance market. "The PPMI will just be used in the direct insurance market," Kern told *The Motorship*.

However, Kern noted that vessels with a more polluting operational profile might eventually face higher hull and machinery (H&M) insurance costs, if more polluting vessels had the effect of lowering the overall emissions profile of an insurer's portfolio.

"When we assess whether a vessel is a good risk or not when assessing the [insurance cost], we look at a number of factors, among which emissions will be one," Kern said. "And you could have a situation where the risk is not financially sustainable."

Drivers for the Establishment of PPMI

Kern began by recognising insurers' unique role in promoting responsible environmental stewardship throughout the maritime value chain.

Insurers are involved in providing services at every step in the value chain, ranging from fuel production and bunkering, through to the insurance for the vessels themselves and even the cargoes themselves.

Meanwhile, insurers are coming under pressure from civil society and NGOs to exit the coal, and to a lesser extent oil and gas sectors, Kern said. The PPMI offered a means of heading off accusations of greenwashing, while gaining insight to enhance strategic decision-making, and address the impacts of climate change.

Benchmarking

The Poseidon Principles for Marine Insurance are built on four principles – Assessment of climate alignment, Accountability, Enforcement, and Transparency – which they share with the Poseidon Principles for Financial Institutions and the Sea Cargo Charter.



This will require signatories to measure the carbon intensity of their hull and machinery portfolios on an annual basis, using the Annual Efficiency Ratio (AER).

The data will be based on the ship owner's annual submission provided to the IMO's DCS scheme, which will limit the additional bureaucratic burden of complying with the scheme and ensures that the data will be supplied according to a common reporting framework.

The Motorship notes that the metric has been selected as the IMO DCS does not capture data on the mass of cargo carried on individual voyages, which means it is impractical to attempt to calculate the Energy Efficiency Operational Indicator (EEOI) (see box)

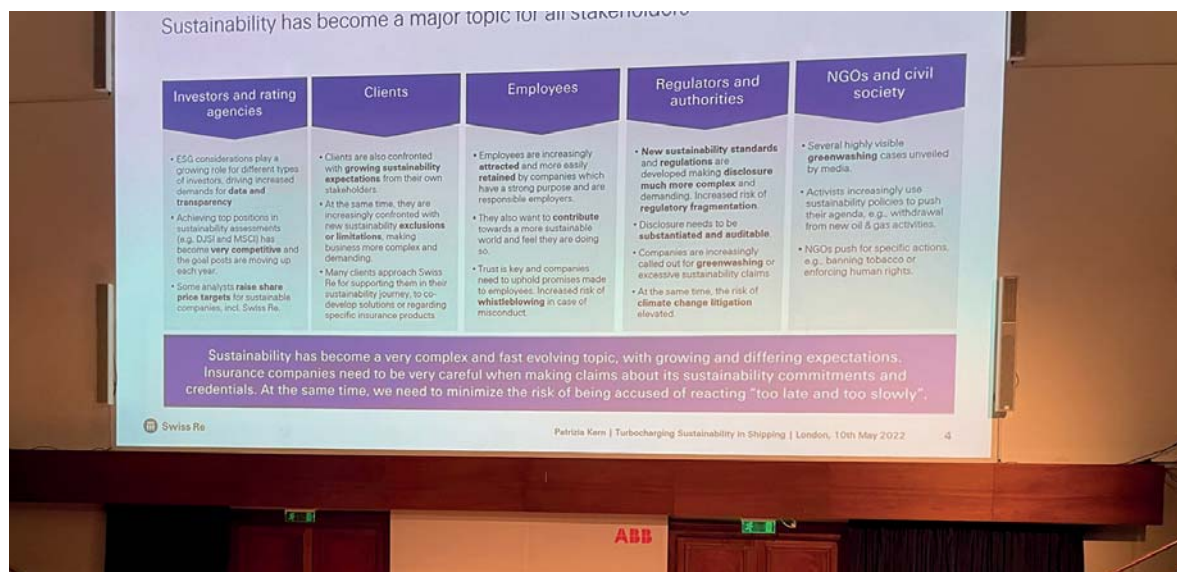
The requirement for the provision of data was likely to be introduced through a standardised covenant clause in insurance contracts, Kern noted. It remains unclear how customers will respond to marine insurance companies attempts to amend existing contracts by introducing reporting requirements.

"This means we will establish a non-physical reporting framework that will enable us to give full transparency on hull and machinery exposure."

The portfolios will then be assessed for climate alignment (carbon intensity relative to established decarbonisation trajectories). The PPMI is currently basing its climate alignment upon the IMO's agreed 50% reduction in net emissions by 2050 target. A second trajectory (based on a 100% reduction) against which a fleet's emissions could be benchmarked would also be provided.

Kern added that Swiss Re, along with AXA XL, was a signatory to the Net Zero Insurance Alliance, which was targeting a 100% reduction in net emissions by 2050.

■ Marine insurers are facing increasing scrutiny from regulators, civil society and NGOs, Kern said



■ Patrizia Kern, Head of Marine, Corporate Solutions, Swiss Re and Chair, Poseidon Principles for Insurance (PPMI) Marine insurers are facing increasing scrutiny from regulators, civil society and NGOs, Kern said.

“This means we will establish a non-physical reporting framework that will enable us to give full transparency on hull and machinery exposure

The first reporting period will take effect by the end of 2022. Each Signatory is expected to will report the overall climate alignment of its shipping portfolio to the Secretariat by the end of November every year.

Future Scope

Some aspects of the PPMI are still under discussion, Kern said. “One outstanding question is what are the incentives that the insurance company and the banks will have to create to de risk this transition, because very clearly the transition is going to come with risk... But I promise you we are working very hard to find it.”

Kern also identified that customers were becoming increasingly interested in other aspects of insurers' portfolios. “We are coming under a lot of pressure from activists, especially in the coal, oil and gas sectors to really exit these sectors.” Kern also added that potential new entrants into the industry frequently identify sustainability as an important criterion when selecting a career.

Meanwhile, EU regulatory pressures also needed to be taken into account. The European Commission is currently finalising plans to introduce an EU Taxonomy for Sustainable

Insurance, having held a consultation in 2021 on a proposal to add a social element to the taxonomy on sustainable insurance.

One of the features of the PPMI framework was that it was a flexible framework. “The intention is to add other ESG metrics to the Poseidon Principles for Marine Insurance in future,” Kern added, which would offer insurers the flexibility to respond to upcoming EU regulations.

A significant proportion of the market

However, Kern was at pains to stress that the PPMI was not just a European forum. Ms Kern assessed that the nine signatories represented “around 30% of the market”, although accurate marine insurance market coverage data is not publicly available. Meanwhile discussions are ongoing with nearly two dozen other insurers, which were expected to increase the number of signatories. “A number of interested parties were waiting for the scheme to be set up, and we are receiving interest from parts of the world.”

Signatories to PPMI

The PPMI entered into force once eight or more insurance companies had agreed to sign up to the framework. The Association's founder members include Swiss Re Corporate Solutions, Gard, Hellenic Hull Management, SCOR, Victor Insurance, Norwegian Hull Club, Fidelis Insurance, Wills Towers Watson, Cefor, EF Marine, Cambiasso Riso, Lockton and the International Union of Marine Insurance.

AER versus EEOI

The selection of AER as the metric against which greenhouse gas emissions can be identified offers several advantages compared with the EEOI metric.

Put simply, the IMO Data Collection System (DCS) does not capture data on cargo mass carried. As the EEOI metric (which is $\text{gCO}_2/\text{cargo ton}\cdot\text{mile}$) is based on tonne/mile calculations, it would require the collection of the data before individual

vessel baselines can be calculated. This would have the practical effect of delaying the introduction of the PPMI until the data collection exercise was completed.

The AER ($\text{gCO}_2/\text{dwt}\cdot\text{nm}$) is calculated using an approximation of the total annual transport work performed by a ship, obtained from its total distance travelled and dwt (in tonne units). The AER suffers by comparison with the EEOI as vessels

frequently carry less cargo than their maximum capacity, while the metric does not capture the impact of ballast legs where vessels have no cargo on board.

The weakness of AER from a shipowners' perspective is that fuel consumption is the only variable that can affect the metric's result. Slower steaming or cargo capacity reduction are the most readily available options for owners.

TOUGHER MEASURES NEEDED TO MEET IMO TARGETS

Will the IMO's efficiency measures be enough to reach current emission targets? "No," says **Iain Mowat**, Principal Analyst, EMEARC Refining and Oil Product Markets at Wood Mackenzie

With events like COP26 focusing global attentions on the urgency of net zero targets, the IMO has increasingly come under pressure to go beyond its initial target of halving emissions by 2050, towards a commitment to zero emission shipping. But, says Mowat, achieving the current target of cutting emissions by 50% is already a major challenge.

Maritime transport is responsible for roughly 940 MT of CO₂ annually and approximately 2.5% of global greenhouse gas (GHG) emissions. Without mitigation measures, there are concerns that shipping's share of carbon could increase. International shipping is also on the rise: global maritime trade is expected to expand by nearly 50% by 2030 in comparison to 2015 levels.

The adoption of EEDI and EEXI measures at MEPC 76 ensures that international shipping is well placed to meet carbon intensity targets, he says, but those measures will not be enough to fully decarbonise the sector.

Fuels of the future

Wood Mackenzie predicts that marine oil bunker fuel will peak in 2025 and that LNG will be the main source of market growth in the longer term, displacing nearly 0.6 million b/d of oil bunkers by 2030. In the early 2030s, the global marine fuel market should start to decline, and synthetic e-fuels should become more widespread after 2040 when green hydrogen capacity will be more readily available.

Mowat says that while some biofuels could directly replace distillates and provide a new source of supply in the longer term, this is not a perfect solution. Trials are taking place and biofuel technology is developing, but supply availability is a key constraint because shipping will have to compete with aviation, which is likely to be a bigger source of future demand growth.

"In order to support a much faster decline in carbon emissions, the relative costs of low and zero carbon fuels needs to fall substantially over the next two decades," says Mowat. "While we do not expect this to occur in relation to biofuels, the cost of synthesised e-fuels derived from green hydrogen is expected to fall considerably as the costs of production decline."

These e-fuels could be the ultimate renewable shipping fuel. Versions of diesel, methanol and ammonia are all possibilities. However, production costs are currently high.

"The cost of carbon in conventional fuels could be made more expensive through a GHG levy, or other mechanisms could be introduced such as a GHG fuel standard and/or GHG cap and trade system. All of these measures are likely to be considered by the IMO as part of the development of mid and long-term GHG reduction measures for international shipping."

Boosting efficiency

Initiatives such as using smaller engines, deploying wind and solar power and waste heat recovery could be helpful in the sector's efforts to cut emissions, says Mowat. However, many



■ Iain Mowat, Principal Analyst at Wood Mackenzie expects the cost of e-fuels to decline as technologies scale up

of these technologies have high marginal abatement costs. For example, the marginal abatement cost for solar panels is substantially higher than for wind power, as wind energy is being used for direct propulsion on the vessel. "Solar PV would be used to convert sunlight to electricity, which would then be used to charge a battery, which would then be used to power an electric motor, as an additional source of propulsion on the vessel. This would require substantially more investment for a similar contribution to the vessel's propulsion when compared to wind power."

The most attractive energy efficiency measures are hull shape optimisation and engine derating, as they are both highly cost effective.

More is needed

Mowat says that the adoption of EEDI and EEXI requirements will likely result in the IMO achieving its target of reducing carbon intensity by at least 40% by 2030. However, a major shift towards low- and zero-carbon fuels by 2050 is absolutely required to reach IMO's target to halve overall greenhouse gas emissions from international shipping by 2050, and to meet the 2050 carbon intensity target, the IMO needs to extend EEDI regulations beyond Phase three with ambitious new targets.

"Emissions will need to decline at a much faster rate after 2030 if the sector is to meet its target, and if the IMO commits to net zero, even more will need to be done," says Mowat.



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WÄRTSILÄ'S 46TS-DF SETS FUEL ECONOMY RECORD

A new version of Wärtsilä's 460-bore engine claims 52% efficiency, Paul Gunton reports

A new version of the Wärtsilä 46 diesel engine has set "a new fuel economy record in the market for medium-speed engines", according to Lars Anderson, the OEM's Director, Product Management & Sales Support.

He was speaking during a webinar in April to launch its 46TS-DF engine, which is fitted with a new design of two-stage turbocharger that helps the engine deliver 52% efficiency in either gas or diesel modes. More important than that, he said, is that "this engine is substantially better over its whole operating range than any other benchmark [engine] in the market".

In addition, it offers "the lowest CO₂ emissions in the segment and a methane slip that is 20% below the market benchmark", he added. Its efficiency minimises its fuel consumption – "one thing we are certain of is that future fuels will be expensive", he said – which will improve its OPEX and total cost of ownership, he predicted.

Which fuel emerges as the preferred low-carbon fuel is irrelevant, suggested Stefan Nysjö, Wärtsilä's Vice President, Power Supply. "We are fuel agnostic and ... we will offer the technology owners need whichever fuel they choose", he said.

The engine platform utilised a modular construction approach, which would simplify production and maintenance, and ease future conversion to alternative fuel types, he said.

It is an approach that Wärtsilä is adopting across its portfolio, he said, initiated by the launch a few weeks earlier of the Wärtsilä 32 methanol engine. He drew attention to the marketing slogan for the new engine, 'the power to change', "and with that comes the power to choose".

Wärtsilä's Director of R&D and engineering, Juha Kytölä, also stressed the importance of its modular strategy. It provides "consistent quality through less component variance and high commonality between engine versions".

Valve timing

Stepless valve timing is another development introduced on this engine, on both inlet and exhaust valves. "This system is novel and has not been used in any marine engine in the



past", Mr Kytölä told *The Motorship*. In the past, valves have been controlled in steps "and for inlet valves only", he added.

This innovation makes it possible to "adjust the timing of the inlet valve and exhaust valve whilst operating the engine, within a range, in a stepless manner, for each cylinder", he explained. This optimises air supply and combustion which, together with its two-stage turbocharging (see box) "results in the engine's superior efficiency".

Cylinder-level control requires a huge amount of data to be collected and processed in real time, Mr Kytölä told the webinar, which is achieved through a complex automation system, which he described as "the brain of the engine".

It provides "infinite possibilities to tune the engine", he said, which not only yield higher efficiency but also optimise the engine's operation to suit each fuel's methane number "to optimise operations with variable gas qualities".

This system is also modular, with each electronic module "software adaptive, which means that when an operator changes a module, it will automatically load software from the other modules". This, he said, provides protection against cybersecurity threats to the engine.

■ Wärtsilä 46TS-DF is the latest addition to Wärtsilä's portfolio of future proof engines and has been designed to set a new benchmark in efficiency and emissions performance

New turbo boosts power density

For the 46TS-DF engine, Wärtsilä has developed "a completely new turbo charging system that is totally focused on large bore medium speed engines", according to Wärtsilä's Director of R&D and engineering, Juha Kytölä.

It is a two-stage arrangement – reflected in the engine's 'TS' suffix – consisting of one low pressure and one high pressure turbocharger arranged in series, combined with two charge air coolers per cylinder bank. "This arrangement allows us to reach extremely high compression ratios and very

high turbocharging efficiencies in a very compact design", he said, which leads to a high power density for the engine.

Yet each turbocharger – made by Napier to a Wärtsilä design – has a relatively small compression ratio, which allows a very robust design and high efficiency across a wide operating field along with very stable performance, he went on. In addition, their rotational parts are relatively small, resulting in low rotor inertia, "which enables very fast load taking", he said.

It would be technically possible to apply

the same turbocharger technology to other engines, according to Federic Bottos, product manager for the 46TS engine family, who said that two stage turbocharging system also helps pure diesel engines reach extreme efficiency and power density.

But the market at the moment is "focused strongly on dual fuel gas engines that guarantee the best fuel flexibility and the lowest CO₂ footprint", he said. "But we are also evaluating development of a pure diesel version of our 46TS as next engine type", he said.

PROVARIS ADVANCES GREEN HYDROGEN CARRIER DESIGN

Provaris Energy (previously GEV) has prepared a preliminary engineering design for a GH₂ carrier designed for the export and import of compressed hydrogen



■ A rendering of Provaris' 26,000m³ GH₂ Carrier concept design

Provaris' design team and consultants continue to advance the detailed Contract Design Package (CDP) phase, which is now 70% complete and on track for final delivery in June 2022. The team has compiled several work packages to provide an updated outline specification, general arrangement drawing, and other key design and engineering plans. These are now being shared with shipyards for construction schedule and capital cost estimates, along with class societies as part of the Approval for Construction milestone targeted for mid-2023.

The packages include hull design optimization (speed-power, structural steel assessments, and intact and damage stability), finite element modelling, shipboard safety systems, general arrangement drawings and a ship outline specification.

Two vessel sizes are being designed, one with 26,000m³ capacity and one with 200,000m³ capacity. Both have been granted Approval in Principle from ABS. The onboard storage tanks will have an operating pressure of 250 bar. Technical partners include Wärtsilä, Ballard Power systems and APL/NOV.

Provaris has engaged ABS Consulting for the gas dispersion, fire, and explosion safety studies necessary to allow class to verify the safety issues of the vessel surrounding its operation, especially in regard to the hydrogen storage tanks and cargo management.

Per Roed, Chief Technology Officer, said: "The H₂Neo engineering and design is now progressed sufficiently to commence discussions with class for the design of testing and approval for construction. We are also now integrating port infrastructure designs for our supply chain discussions with ports in Asia and more recently in Europe."

Discussions with class societies, including ABS, are underway, and Provaris is now progressing concept designs for the export and import of hydrogen in locations that include Asia and Europe. It is expected that a base design will be adaptable to multiple locations, with site specific access and regulatory requirements a key requirement for customisation.

Provaris has engaged Paaras Marine Solutions, a marine

structural engineering company based in Singapore, to develop and assess port solutions for both the loading and unloading of compressed hydrogen using the Provaris GH₂ Carriers, with the scope of the appointment to include:

- Singapore: concept development of an unloading marine jetty facility in Singapore to receive the GH₂ Carriers for unloading and decompression of compressed hydrogen for local distribution. Concept solutions will include jetty solutions abutting onshore and a facility located offshore with subsea pipeline connecting on onshore distribution network
- Port Melville, Tiwi Islands, Northern Territory, Australia: evaluating existing marine facilities at Port Melville to accommodate GH₂ Carriers including the loading facilities for compressed hydrogen.
- Barge Storage of Compressed Hydrogen: concept development of a storage barge will be considered for storing compressed hydrogen based on the requirements for intermittent or redundancy in the supply chain.

Concept designs will be included in the feasibility studies in progress for Tiwi H₂ and HyEnergy (Western Australia), along with analysis of compressed hydrogen with port operators now underway in Europe.

Provaris says the advantages of compressed hydrogen include that it is commercially viable at low volumes, has a small footprint compared to liquefaction, is the most energy efficient way of transporting green hydrogen and can be loaded via onshore berth facilities or offshore buoy systems.

Martin Carolan, Managing Director & CEO, said: "Management has recently completed a visit to Europe and the UK to market Provaris' compressed hydrogen solution, receiving an encouraging response given our target delivery for 2026. With the demand in Europe for import solutions starting from 2024-2026 the interest in transport solutions has increased given the focus on energy security and new gas infrastructure seeking approvals for gas imports required to demonstrate a hydrogen capability."

FLEXIBILITY AND MODULARITY UNDERPIN ENGINE STRATEGY

Stefan Nysjö, Vice President Power Supply – Marine Power at Wärtsilä discusses the importance that fuel flexibility is likely to play in the new multi-fuel operating environment, and locates the new 46TS-DF engine in a broader context



■ Stefan Nysjö

In his previous interview with *The Motorship* in March 2020, Mr Nysjö discussed the role that combustion technology could play in the decarbonisation of the maritime sector.

In the intervening period, the focus of discussions has moved on from the technological aspects of decarbonisation and increasingly begun to centre on questions around potential future fuel choices. "The discussions I've been having with customers and other stakeholders in the industry [over the last 18 months] ... are now about what will be the right fuel."

It is a measure of how the conversation has progressed since 2020, when "you were writing about whether the technology would be available". Practical issues relating to the cost of the fuel, and availability issues are becoming increasingly discussed.

Mr. Nysjö reiterated that Wärtsilä does not expect the market to consolidate around a single fuel or solution but will rather enter a multi-fuel period.

A flexible engine platform

This strategic positioning has underpinned a number of technology choices. "We are focusing on the development of fuel agnostic, and fuel flexible [engine technologies]. So, this is where we are driving things."

This strategic thinking has informed the development of the 31, Wärtsilä's first engine, and more recently in the 46. Both the engines have been developed with a two-stage turbocharged engine that has been designed to be both fuel-agnostic and flexible.

Mr. Nysjö notes that Wärtsilä had not neglected the small-bore market during its recent development of products for the medium-bore and large-bore markets. "We plan to launch a new product for the small-bore market later this year," Mr. Nysjö said, adding that it would also be developed with a high focus on efficiency and the same modular design platform used by the recent 31 and 46 engine launches.

Mr. Nysjö noted that the modular aspect of the new engine development programme meant that refinements in certain components could be readily integrated into existing engine platforms.

Looking forward, this was likely to mean that the engine portfolio was likely to be streamlined in future to enable the adoption of future fuel variants. The conversion of existing engines to operate on alternative fuels is likely to become an increasingly important solution in the future to meet decarbonisation goals. "The benefit of working with modularised products, is that it enables flexibility [by swapping modules], which should ease conversions and upgrades at a later stage."



■ Stefan Nysjö noted that the new Smart Technology Campus at Vaasa, which will open in May 2022, would make an important contribution to the collaborative working required for the modular development of its engine platforms

Modular approaches

The new alternative fuels are expected to be more expensive than existing fuels, at least during the initial period, which is expected to drive an increased focus on fuel efficiency.

Wärtsilä engineers were continuing to conduct research into optimising the operation of some of the new fuels. "Hydrogen is a completely different kind of animal," Mr. Nysjö comments. Over time, it was likely that further refinements will be developed. Because of the pace of the technological development, both in terms of engine control systems, as well as in other units, it was also possible that technological developments in certain areas, such as turbochargers, could have knock on effects on other parts of the engine platform.

In fact, Mr. Nysjö noted that greater technological advances were likely to come from increasing focus on maximising the overall performance of the vessel as an integrated system, rather than improvements in engine efficiency alone. "Our engines are increasingly approaching the technological limit of efficiency," Mr. Nysjö said simply.

Such holistic approaches towards efficiency would focus on maximising the efficiency of the vessel over the operating range of the vessel. "Then you come to very much into various types of hybrid setups, where the engine itself becomes the control system. This is where I think there is a probably a lot more to be gained, particularly from a decarbonisation perspective, by elevating the efficiency across the operational band of the vessel."

Retrofit packages for older engines

However, the rapid rollout of new product developments, and the concurrent development of improvements for the new 32 and 46 engines, was not likely to lead to the neglect of previous engines. "We are continuing to develop [alternative fuel] retrofit packages for older product types, which is a separate line of development... It is an important area for us as reducing emissions from older vessels is critical for the maritime transition, which is why we are investing heavily in technology development."

The challenge of converting an older engine type to dual-fuel operation is that the vessel itself was not necessarily planned for an alternative fuel. Wärtsilä was able to offer shipowners direct consultation around potential solutions, and discussions with interested parties were ongoing. But it is quite a different business line, Mr. Nysjö concluded.

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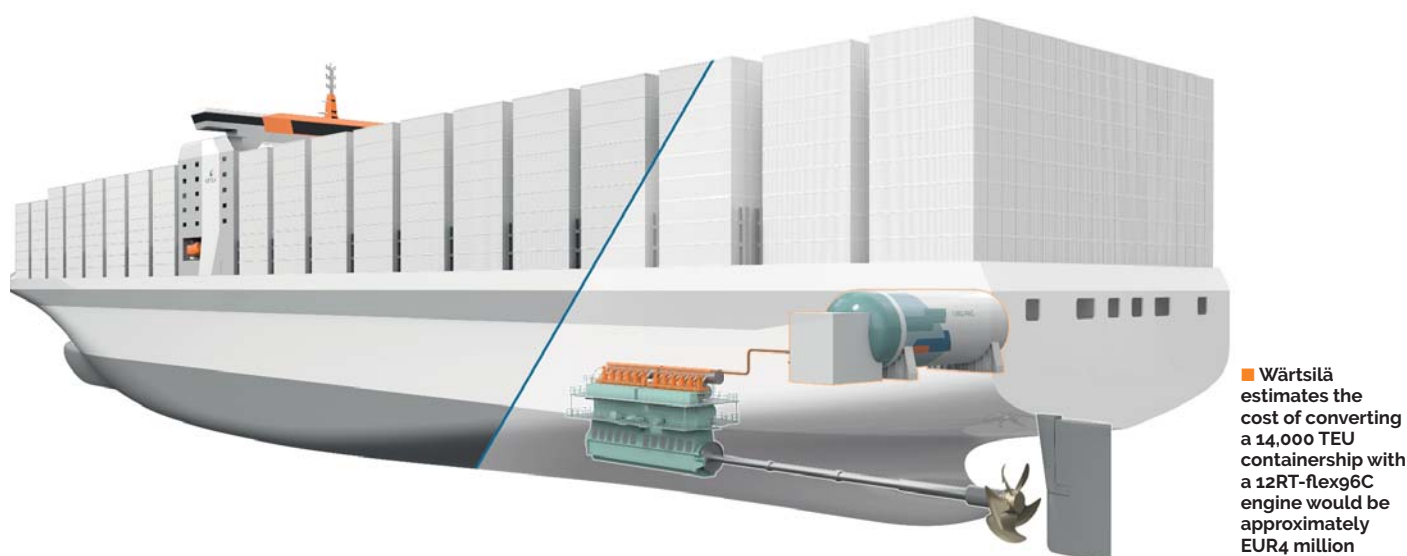
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WÄRTSILÄ TARGETS Q3 2023 FOR FIRST 2-STROKE RETROFIT PILOT

Wärtsilä's newly launched multi-fuel retrofit platform enables the conversion of 2-stroke electronically-controlled marine propulsion engines, currently running on diesel, to operate on either LNG, methanol or ammonia with minimal off-hire time for the vessel



The development of the concept was recently concluded after successful tests at Wärtsilä's two-stroke engine laboratory in Trieste. MSC Shipmanagement has collaborated with Wärtsilä throughout the development, and the pilot installation on a 13,000 TEU MSC containership powered by a Wärtsilä 12RT-flex96C is currently in project execution and expected to be ready for LNG by the third quarter of 2023. A subsequent ammonia retrofit on the same technology demonstration vessel, is planned for 2024.

The platform's medium-pressure combustion technology has the high compression ratio of Diesel cycle without the bulky, expensive fuel supply components, and the simplicity and low energy demand of Otto cycle, without the methane slip (≤ 0.3 g/kWh).

A world-first feature of the concept is the cryogenic fuel supply system. Cryogenic LNG is supplied directly to the engine at around -150°C and at low pressure, rather than heating it to around 40°C as is done for other engine technologies. This eliminates the need for expensive, energy-demanding and high-maintenance compressors, pumps and heat exchangers and means the footprint of the fuel supply system is minimal, maximising installation flexibility for retrofitting vessels in service. As a further energy efficiency measure, the fuel pressure is amplified to more than 100 bar before injection into the cylinder using servo oil power already available from the engine and jacket cooling water is used to raise the temperature of LNG to expand it to gas.

Up to 800 m³ in onboard space can be saved on fuel gas supply systems on the most power-hungry vessels, with capital investment in them reduced by up to 20% and operating costs also lowered. The multifuel supply

system also offers redundancy and operational flexibility and reliability, with the capability of switching to use conventional liquid fuels such as HFO, MDO or VLSFO.

"The hybrid combustion principle applies to all fuels on the platform, but they will demonstrate different thermodynamic behaviours and will require different tuning strategies," said Sangram Nanda, General Manager 2-Stroke Product Management & Engineering. "We are preparing to run full-scale engine testing on LNG in our 2-stroke laboratory in Trieste in June 2022 thus finalising engine performance development activities for this fuel. We will then shift our focus to methanol with the first tests planned before the end of 2022. Ammonia testing will commence before the end of 2023, with the aim to carry out the adaptation of MSC's technology demonstration vessel and a first vessel conversion within 2024."

Retrofit package

The new equipment required for retrofit is skid mounted where possible to expedite installation. To ensure fuel flexibility, storage tanks and piping can be specified to be future-fuel compatible in advance, and a new innovative flexible steel pipe has been incorporated to ensure retrofit is possible even where space is limited.

The modular add-ons include an additional control system for the new cryogenic fuel added adjacent to the engine's original one, which will continue to control diesel combustion. Cylinder covers have been redesigned and two new injectors added to ensure flame propagation and complete burn of the injected fuel.

"To take full advantage of the inherent modularity of our platform, which allows us to convert the engine from one

fuel to the other with minimal effort and investment, we are defining the fuel containment and supply system to be compatible with both LNG and ammonia for the MSC technology demonstration vessel. For commercial conversion projects, it is advisable to consider the requirements for such system compatibility during the project specification phase," said Nanda.

Operational flexibility

Key benefits of the retrofit include reduced emissions and GHG footprint with negligible fuel slip and overall low energy consumption, long-term CII compliance and extended operational lifetime for the vessel.

For a 15,000 TEU containership, conversion to enable the use of LNG can offer around a 20% improvement in Annual Efficiency Ratio (AER). This can be improved further at a later date by adding synthetic or bio-LNG as a drop-in fuel. Wärtsilä's financial modelling indicates that a vessel that would fall into CII's D rating in 2023 can keep within the C rating until at least 2030 by using LNG. Adding a blend of 20% bio-LNG would keep the vessel within category A until around 2030.

The improvement in AER could enable a ship operator to keep in the highest available CII rating to, for example, work with charterers demanding high levels of environmental protection. Alternatively, the vessel operator could choose to make use of the gap between maximum compliance and required compliance to operate with greater flexibility – increasing vessel speed for some voyages while remaining within the limits of the CII rating. This could lead to greater utilisation of the vessel and access to charters that require a higher speed. Or the operator could choose to take advantage of differences in fuel prices, for example by adjusting the proportion of bio-LNG used, or running on conventional fuel for some voyages while still staying compliant.

A methanol pathway

As well as the conversion to LNG, the platform enables the switch from diesel directly to methanol or ammonia. "We see a growing interest in methanol conversions, for which we are close to securing the first orders," says Stam Achillas, Head of Business Development & Sales, 2-Stroke Fuel Conversions. "We anticipate the first methanol conversion project in the second half of 2023. When it comes to ammonia, owners gravitate more towards fuel-readiness options, both as the next step after an LNG or methanol conversion and for newbuilds. Furthermore, stakeholders such as financiers, charterers and fuel suppliers are eager to join the discussion, and it won't be long before we see innovative financing and business models related to fuel conversions emerging."

Some bulk carriers could find achieving CII compliance difficult, and the methanol conversion pathway, with lower fuel tank costs, could enable a capsize bulk carrier that would otherwise drop to a D rating by mid-2023 to stay within a C rating until almost 2030 by converting to use first fossil methanol and then adding bio-methanol as a drop-in fuel.

Project management

The multi-fuel retrofit platform is aimed at vessels operating with two-stroke, electronically controlled engines, including both large and smaller bore engine types. Initially Wärtsilä/WinGD branded engines will be targeted, but the technology can be applied, in principle, to any electronically-controlled 2-stroke engine.

A typical project can take up to a year and a half from initial planning to completion, but off-hire time is minimised with the engine conversion taking approximately three weeks,

and a target to complete the vessel fuel conversion within five weeks at a repair yard. The scope of the conversion includes per cylinder: cylinder cover with fuel/gas injectors, high-pressure accumulator, gas evaporator (LNG only) and fuel pressure amplifier. Per engine, it includes: rail box enclosure with ventilation system, engine control system upgrade, instrumentation, sensors, cabinets and cables, safety and monitoring system extension, turbocharger rematching, on-engine piping, on-engine platform conversions and safety spare parts.

Wärtsilä is able to specify and deliver the full spectrum of fuel conversion solutions for merchant ships including fuel gas supply system including LNG tank, 2-stroke main engine conversion, 4-stroke DF or multi-fuel auxiliary engines as a conversion or replacement, boil-off-gas management system and safety systems. The company also offers extended support to customers with its digitally-enabled lifecycle solutions.

For vessels opting for an LNG retrofit, onward conversions to future fuels can be made simpler and more cost effective with planning ahead at the initial LNG retrofit stage. Storage tanks and piping can be specified in advance to ensure compatibility with future fuels, for example. The conversion can also be combined with energy-saving technologies like air lubrication systems, gate rudders or rotor sails to maximise efficiency gains.

Wärtsilä estimates that the engine specific conversion cost for a 14,000 TEU containership with a 12RT-flex96C engine would be approximately EUR4 million. For a 310,000dwt VLCC with a W7X82 engine, the engine conversion cost would be EUR2.9 million, and for a 210,000dwt Newcastlemax bulk carrier with a W6X72 engine it would be EUR2.7 million.

A broader market

Achillas anticipates interest in the platform from newbuilding projects. "Despite the technology options available, owners still struggle with deciding which fuel pathway to choose for their newbuilds, mainly due to the ever-present uncertainties surrounding the availability and pricing of future fuels. A solution to this conundrum may be a generation of truly fuel-ready vessels, designed and built purposely for later fuel conversion. In such a concept, our fuel conversions platform can ensure the two-stroke propulsion engine will be ready for any marine fuel."



■ Stam Achillas,
Head of Business
Development &
Sales, 2-Stroke Fuel
Conversions
at Wärtsilä

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DAY ONE – TUESDAY 22 NOVEMBER 2022

08:00 **Coffee & Registration**

09:00 **Chairmen's welcome**

Lars Robert Pedersen, Deputy Secretary General, BIMCO

Martin Kröger, Chief Executive Officer, German Shipowners' Association (VDR)

Reinhard Lüken, Managing Director, German Shipbuilding And Ocean Industries Association (VSM)

09:15 **Gold Sponsor Welcome – DNV**

09:25 **KEYNOTE PANEL: THE JOURNEY TO 2030 WITH SHOREPOWER**

Moderator: **Lars Robert Pedersen, Deputy Secretary General, BIMCO**

Ricardo Batista, Policy Officer, Directorate-General for Mobility and Transport European Commission

Isabelle Ryckbost, Secretary General, ESPO

Martin Kröger, Managing Director, German Shipowners' Association (VDR)

Dr. Kai-Dieter Classen, Deputy Director External Affairs, Hamburg Port Authority

10:30-10:50 **Coffee break**

SESSION 1 **ELECTRIFICATION FOR BIG SHIPS**

10:50 **The rise of hybrid propulsion systems**

Dr. Torsten Büssow, Managing Director, Electrical & Power Systems Business, Wärtsilä

The presentation explains several hybrid systems we are building at the moment and summarizes our experience of 70 hybrid vessels from Wartsila.

11:05 *Stefan Goranov, General Manager, Sustainability Solutions, WinGD*

11:50-12:10 **Q&A**

12:10-13:40 **Lunch & Networking**

SESSION 2: **DIGITALIZATION, DIGITAL EFFICIENCY AND THE FUTURE TECHNOLOGY OF THE MARITIME SECTOR**

13:40 **Shipping decarbonization and digital thread**

Mia Elg, R&D Manager, Deltamarin

This presentation focuses on showcasing a realistic pathway to decarbonized shipping with practical examples from our ongoing projects. We discuss about the related digital modelling and optimization methods and about their application and validation.

13:55 **The Digital Wave**

Gregory Puckett, Head of Group Digital, MAN Energy Solutions

In his presentation, Mr. Puckett describes the "digital wave" within MAN-ES. From connectivity, to cloud, from data to artificial intelligence. The digital wave is continuous, it is variable, it can be calm one moment, and stormy the next. Most interesting it will never not turn back.

14:10 **Digitalization – Digital Tool to Ensure Engine Efficiency**

Matthias Winkler, Managing Director, CM Technologies GmbH

Digitalisation for engine performance measurement including automated data transfer between ships and ashore. Important is the possibility to have all data at one place allowing access from everywhere at any time for anyone. Useful assistance for ship and shore personnel.

14:40-15:00 **Q&A**

15:00-15:30 **Coffee break**

SESSION 3: THE MOTORSHIP AWARD

- 15:30-17:00** Nominations will be announced shortly
- 17:00** Conference close
- 17:00** Pre Dinner Drinks Reception
- 18:30** Dinner Venue to be announced
*Announcement of the Motorship Award winner,
Presented by Nick Edström, Editor, The Motorship*



DAY TWO – WEDNESDAY 23 NOVEMBER 2022

- 08:30** Coffee & Registration
- 09:15-09:30** Recap of day 1 by Chairmen
*Lars Robert Pedersen, Deputy Secretary General, BIMCO
Martin Kröger, Chief Executive Officer, German Shipowners' Association (VDR)
Reinhard Lüken, Managing Director, German Shipbuilding And Ocean Industries Association (VSM)*

SESSION 4 CARBON LEVY SOLUTION

- 09:30** The Future of Bunker Fuels for world's Shipping Fleet
Jon Buckingham, Chief Mechanical Engineer, BMT

- 10:15-10:35** Q&A
- 10:35-10:55** Coffee Break

SESSION 5 FUTURE APPROACHES

SESSION 5.1 EFUELS & BIO FUELS		SESSION 5.2 SUSTAINABLE APPROACHES FOR THE FUTURE	
10.55	On the Way to Zero Emissions: Considerations for the Design and Operation of Fuel Treatment Systems <i>Franciska Kjellström, Global Application Manager, Marine Fuels, Alfa Laval</i>	10.55	Carbon Levy – Why Advanced Coatings Will be Essential to Success in the Age of the Carbon Levy <i>Philip Chaabane, CEO of I-Tech</i>
11.10	Power-to-X - Decarbonisation With Future Maritime Fuels <i>Daniel Chatterjee, Director Technology Management & Regulatory Affairs Head of the Green-and High-Tech and NetZero @PowerSystems Program, Rolls-Royce</i>	11.10	Who can improve energy efficiency in ship operations and bring down emissions? <i>Rene Taudal Poulsen, PhD, programme director for BSc Program in international shipping and trade, Copenhagen Business School, Denmark</i>
11:55-12.15	Q&A	11:55-12:15	Q&A

- 12:15-13:45** Lunch & Networking

SESSION 6 ALTERNATIVE FUELS

SESSION 6.1 AMMONIA	SESSION 6.2 METHANOL
13.45 <i>Peter Morsbach, Vice President Sales Operations, Høglund Marine Solutions</i> 14.00 Transitioning towards the use of carbon-free ammonia as a marine fuel <i>René Sejer Laursen, Director – Fuels & Technology, Global Sustainability Copenhagen, ABS*</i> 14:45-15.05 Q&A	Methanol: A Future Proof Marine Fuel <i>Gregory Dolan, CEO, Methanol Institute</i> Development of worlds 1st methanol engine for very large container ships <i>Dr Gwang-Hyeon Yu, Senior Researcher Green Oiler & engine Systems research, Hyundai Heavy Industries</i> 14:45-15.05 Q&A

15:05-15:35 Coffee Break

SESSION 7.1 MULTIFUEL ENGINES	SESSION 7.2 RETROFIT SOLUTIONS
15.35 Will "multi-fuel" propulsion engines be the solution to solve the "future fuel" uncertainty? <i>Rolf Stiefel, Regional Chief Executive, Bureau Veritas Marine & Offshore</i> 15:50 <i>Maikel Arts, General Manager, Market Innovation, Wärtsilä Marine Power</i> 16.05 Lubrizol <i>Title and Speaker tbc</i> 16:35-16:55 Q&A	15.35 Combining efficiency technologies with wind to deliver results beyond compliance <i>Tuomas Riski, CEO, Norsepower</i> 15.50 The role of retrofitting in the Clean Fuel Transition <i>Jan P. Brugger - Co-Founder & COO, FuelSave</i> <i>The use of hydrogen & methanol retrofit technology can help shipowners to meet IMO Tier III standards. An alternative to urea or ammonia, these solutions achieve substantial emission reductions and cost savings, whilst curbing OPEX.</i> 16.05 Retrofitting to Methanol DF operation – an Owners experience <i>Per Westling, Managing Director, Stena RoRo AB</i> 16:35-16:55 Q&A

16:55-17:10 Conference Wrap up with Moderators and Chairmen

Lars Robert Pedersen, Deputy Secretary General, BIMCO
Reinhard Lüken, Managing Director, German Shipbuilding And Ocean Industries Association
Martin Kröger, Chief Executive Officer, German Shipowners' Association (VDR)

17:10 Conference Close

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ABC ENGINES INTRODUCES 100% HYDROGEN COMBUSTION

Belgium-based ABC Engines' joint venture company BEH2YDRO launched a 100% hydrogen combustion engine at the World Hydrogen Summit held in Rotterdam in May, and the news was followed by the delivery of a crew transfer vessel powered by a dual-fuel hydrogen engine



■ A rendering of the 65-tonne bollard pull Hydrocat, which will be powered by 2.6MW, V12 BEH2YDRO engines burning up to 85% hydrogen in combination with 15% diesel.

The launch of the 100% hydrogen engine comes after BEH2YDRO, a joint venture between ABC and CMB, launch its dual-fuel engines in September 2020. Operating on 85% hydrogen gas and 15% conventional fuel, these engines can be used flexibly when hydrogen is unavailable.

The 100% hydrogen engines have a power range from 1MW to 2.6MW and are available in 6- and 8-cylinder in-line engines and 12- and 16-cylinder V-engines.

A 1MW BeHydro hydrogen-powered engine reduces CO2 emissions by 3,500 tonnes per year (or the equivalent of 300 hectares of forest) and produces as much energy as one 3MW wind turbine or 36,000 solar panels.

BEH2YDRO says these engines emit no harmful emissions such as carbon (CO2), nitrogen (NOx), sulphur oxides (SOx) or soot particles. In addition, they are non-toxic, don't use scarce raw materials such as lithium, zinc, cobalt, platinum, rare earths, avoid environmental damage caused by the extraction of scarce raw materials and the by-products are completely safe (the emissions consist of water vapour and aspirated air).

They are easy to maintain and have a long service life thanks to an optimised air/gas mixture that reduces component heat-up. In addition, the BEH2YDRO hydrogen engines are extremely versatile because they don't experience problems if slight impurities are present in the hydrogen.

The engines feature a double-walled hydrogen connector and a cylinder design where the piston head lacks the typical hole used to raise it. Instead, a different raising mechanism is employed and the piston head is uniquely shaped to avoid overheating.

"With the launch of this monofuel hydrogen engine we are taking an important next step in the development of our BEH2YDRO engines. BEH2YDRO can now supply both dual fuel and mono-fuel hydrogen applications for a wide range of heavy industrial applications such as shipping, gensets, locomotives, etc. Thanks to BEH2YDRO we can already green a large part of the off-grid industry today," said Alexander Saverys, CEO of CMB.

A new breed of cat

In May, CMB.TECH and Windcat Workboats announced that the world's first hydrogen-powered crew transfer vessel (CTV) Hydrocat 48 had completed sea and bunkering trials. The vessel uses clean fuels to reduce up to 80% of its traditional fuel usage and associated emissions.

The Hydrocat 48 is based on the Windcat MK 3.5 design. These vessels can also be used for a range of activities, supporting both construction and the operation and management of an offshore wind farm, such as emergency response, standby, survey and dive support vessels.

Dual fuel technology has been integrated into the MK3.5 series without compromising on performance and retaining the reliability of a traditionally fuelled vessel, says CMB.TECH.

CTO of CMB.TECH Roy Campe said: "The suitability of this technology for a CTV is mainly because existing diesel engines can be used. No fundamental changes to the main engine are required, which not only means that maintenance and repair remain simple but also that the engine can easily be switched back to diesel fuel without any modifications. Even if hydrogen is not available, the vessel can continue to run on traditional fuel, making it a very robust and reliable solution for the offshore wind industry."

The base dual-fuel 749kW engine installed on the vessel was manufactured by MAN Energy Solutions and retrofitted by CMB.TECH with a hydrogen injection system which injects hydrogen in front of the intercooler. The operating behaviour, fuel consumption and all other characteristics of the engine correspond exactly to the MAN D2862 LE428, a V12 diesel engine with a displacement of 24 litres.

A precisely measured quantity of hydrogen is added to the charge air. This mixture of hydrogen and air is then ignited with the injected diesel fuel in the combustion chamber of the cylinders. Depending on the engine's operating point, only a very small amount of diesel fuel is needed. The diesel injection parameters are optimised in dual fuel mode to achieve the lowest emissions and the best consumption values.

Therefore, in dual fuel mode, considerably less CO₂ is released in the exhaust gases in circumstances where operating behaviour and full load characteristics remain unchanged. In the event of problems in the hydrogen circuit or a depleted hydrogen supply, a switch back to diesel can be made at any time. This guarantees uninterrupted operation with normal reliability.

CO₂ emissions are reduced by up to 85%. The remaining soot particles and nitrogen gases (NO_x) are removed by a particulate filter and SCR system so that the latest and strictest emissions standards worldwide are easily achieved. Irrespective of the operating mode, the limit values according to IMO Tier III are complied with.

MAN notes that all hydrogen carrying components are double walled, and a hydrogen monitoring system will detect leaks immediately. The venting system will evacuate the leaked hydrogen, supply to the engine will be cut and the engine will return to diesel mode without interrupting power supply.

CMB.TECH and Windcat Workboats are working on the further optimisation of engine capacities and the increased use of the hydrogen percentage. The two companies have also developed solutions for the supply of hydrogen to the vessel taking into account the early phase of hydrogen bunker fuel development. CMB.TECH has designed a 40ft 500bar trailer for refuelling multiple applications, so all customers can be served by the one system, which can also support the Hydrocat.

Windcat, together with its joint venture partners TSM and FRS, has three more vessels under construction that can be delivered with the hydrogen technology on board. More CTV designs are being developed.

Safety learning curve

CMB.TECH was the first to build a hydrogen-powered passenger shuttle, the Hydroville, in 2017. The 14 metres long vessel has a displacement of 14 tonnes, a top speed of 27 knots and can run on diesel if necessary.

"The Hydroville was an important first step," says Campe. "It took a lot of pioneering work to get the ship up and running. For example, in close cooperation with a team of engineers



from Air Liquide, we developed a system to refuel with hydrogen. There was nothing like it in the port of Antwerp. The hydrogen was initially stored in a tube trailer parked on the quayside, but we've since then installed a fully-fledged hydrogen refuelling station on the premises. We use it not only to bunker the Hydroville, but also to refuel our own staff's hydrogen-powered Toyota and Hyundai cars."

Next will be the first tugboat in the world with 2.6MW, V12 BEHYDRO engines burning 85% hydrogen in combination with 15% diesel. The 65-tonne bollard pull Hydrotug has been ordered by the Port of Antwerp.

Both the Hydroville and the Hydrocat were built to Lloyd's Register class, and the Hydrotug will be also. Decarbonisation Business Development Manager, Peter Van de Graaf, has been involved in all three projects and is positive about the development process, even though "the industry is on a steep learning curve with more knowledge gained from each project." The knowledge is spread around, and it is always important to listen to everyone when considering safe designs.

Hydrocat has its compressed hydrogen fuel stored in tanks on deck. Van de Graaf believes that compressed hydrogen can be cost competitive on certain vessels, compared to liquified hydrogen as it is simpler and cheaper to store, without the need for vacuum insulated tanks and liquification of hydrogen, which is energy intensive. Hydrogen can be used safely onboard, it is very volatile as a gas compared to LNG, therefore new interpretations of ventilation for safety are required. Hydrogen has about a third of the energy density of diesel oil, so if an onboard fuel pipe were to break due to fire, any explosion would be short-lived and not release a lot of energy. A limited amount of hydrogen would remain in the pipe after a shutdown of the hydrogen system.

Van de Graaf is keen for the industry to keep moving forward. "We need significant research to find more specific engineered solutions to ensure safe deployment. Hydroville was delivered in 2017, so it's taken five years for the delivery of the next vessel, Hydrocat. We are already in 2022, and 2050 is not that far away." Key to more rapid development, he says, is hydrogen-specific updates to the IGF Code, the use of alternative fuels is regulated but the regulations are not prescriptive. Moreover, we need collaboration at all levels to advance the industry towards defined requirements, standards, and more commercially viable solutions.

■ Belgium-based ABC Engines' joint venture company BEH2YDRO launched a 100% hydrogen combustion engine at the World Hydrogen Summit held in Rotterdam in May

'STEP CHANGE' IN SLOW SPEED TURBOCHARGING IN 2023

Christoph Rofka, Senior Vice President, Medium & Low Speed and Rail, ABB Turbocharging, hinted at a step change in low-speed turbocharging in a recent interview with *The Motorship*

Speaking on the sidelines of a press conference in central London in May, Christoph Rofka, Senior Vice President, Medium & Low Speed and Rail, ABB Turbocharging outlined a number of exciting initiatives for the turbocharger and technology supplier.

The most 'eye catching' initiative was a new approach towards low speed turbocharging, which ABB Turbo plans to unveil at the next CIMAC conference.

The solution relates to a change in how the turbocharger is applied on an engine. "By challenging conventional ways in which turbochargers are installed, we have seen a lot of potential."

Rofka noted that the individual turbocharger itself would look quite conventional. "We have made progress improving the efficiency to weight ratio to make the turbocharger more compact, but that was something that we had already done with the previous generation."

The solution was expected to lead to significant improvements in efficiency, but Rofka noted that he was unable to elaborate further at this stage.

Rofka noted that he expected that the development of the solution would be well advanced by the middle of 2023. Rofka added that ABB was planning to bring the new turbocharging concept to market by the end of 2024.

Modular design concepts

The new design extends ABB Turbocharging's modular approach towards turbocharger design.

Currently, individual components within the turbocharger, such as the turbine stages or compressor stages, are being designed toward generic values – such as higher efficiency, lighter weight, and greater compactness – and can be introduced into the turbocharger design platform to improve performance as component level advances occur.

Redesigning the turbocharger to permit easier service access appears to have coincided with advances in the reliability of the unit itself. "The substantial improvement in the reliability of turbochargers over the last 10 to 15 years."

However, the turbocharger itself was likely to have been redesigned to reduce the amount of time required to exchange the central cartridge in the unit.

Rather than requiring an overhaul during every dry dock, or extended port stay, the new solution could see more flexibility in when an overhaul needs to be done and the time required to carry out the overhaul shortened.

"I would expect the next generation [of turbochargers] to be able to exchange the core of the unit during every regular port stay. This naturally leads on to quite new ways of service and maintenance models."

Rofka agrees readily that the new service models that ABB Turbocharging has begun to offer are being made possible by improvements in the data that it gains into the performance of its turbochargers.

"We have recently launched a product where we connect our turbochargers from running hour zero... we have also



■ Christoph Rofka, Senior Vice President, Medium & Low Speed and Rail, ABB Turbocharging

recently launched Turbo MarineCare, which offers customers a warranty from drydock to drydock based on the evaluation of operational data".

The first solution offers basic connectivity from day one, providing very basic engine performance data and turbocharger performance data. In return, ABB will have access from day one. This will allow us to develop more attractive offerings for the life cycle, as we will know the operation history of all of our turbochargers in the future, which will allow us to assess the health condition of the equipment. Our service agreement Turbo MarineCare seamlessly connects to this from running hour zero providing a life-long equipment warranty.

"At the end of the day, it will be a little like turbocharging as a service," Rofka says. "We know the data, we know how the turbocharger has been operated, we know best when to make the best service."

This links up with the possibility of servicing the turbocharger during each port stay. "This will be offer enormous flexibility for our customers. And we have a huge service network to facilitate."

The development was one of the first products of a new product development approach that had been adopted by the company's engineers, which has seen the company move away from highly descriptive product requirements towards a directional set of requirements.

"Instead of several pages of requirements, we gave our engineers four or five bullet points... The result has not been the result of a strategic decision, but rather the result of challenging designers to take really big steps and assume more risk, rather than focusing on iterative improvements."

METHANOL REFORMATION TO EASE HYDROGEN ECONOMY

Proponents of onboard methanol-to-hydrogen reformation see a big future for a fuel mix that they say offers greater flexibility than pure hydrogen

US-based company Element 1 has developed a range of methanol-to-hydrogen generators that it says takes advantage of the relatively low cost of methanol. Mixed with water, it is rich in hydrogen, making it more cost effective than many other feedstocks, with much lower levels of harmful emissions.

The cost of reforming methanol is about one third the cost of reforming natural gas, says the company. It occurs at half the temperature of natural gas reforming, and this lower temperature translates to lower cost materials, less insulation and fewer parts. The cost of methanol is often lower than the cost of compressed hydrogen and in many cases provides the lowest cost of hydrogen at the point of use.

Additionally, a mix of methanol and water has a freezing point of -71°C , so it can be used as a feedstock in cold climates. Its hydrogen generation capacity is not affected by low temperatures and it can be stored indefinitely without degradation in fuel quality. This means storage tanks can be larger, making refuelling costs lower.

Element 1 has joined into a partnership with Maritime Partners and Ardmore Shipping to create a joint venture called e1 Marine, and the company's M-series methanol to hydrogen generator received Approval in Principle (AiP) for marine applications from Lloyd's Register in May. Lloyd's Register has also confirmed that final approval for the technology is possible, including for inland waterways.

Element 1 has also partnered with US-based RIX Industries which has licensed the proprietary M-Series hydrogen generator technology from Element 1. Under the terms of the license agreement, RIX Industries has been granted rights to manufacture and deploy Element 1's M-Series onboard hydrogen generators for use in fuel cell mobility applications, including marine vessels and off-road vehicles such as mining trucks, tractors, and heavy-lift trucks in both North America and Europe.

RIX Industries highlights that rather than storing hydrogen, the company's reforming process allows for a methanol-to-hydrogen propulsion strategy that can be distributed across a vessel's infrastructure. The M2H2 Series is specifically designed to displace stored compressed hydrogen to support primary propulsion, auxiliary power systems, cold ironing and bunkering.

Bryan Reid, Chief Sales Officer at RIX Industries, said: "While hydrogen is an appealing answer industry-wide, its deployment is deeply complicated by cryogenic temperature requirements and/or high-volume, high-pressure storage. However, the ability to generate hydrogen on-demand is breaking through these barriers, tapping into safe, convenient methanol to eliminate complexity and achieve decarbonisation."

Methanol is available globally, price competitive to MGO, only requires minor modifications to current bunkering infrastructure and does not have the complexity, expense, or safety concerns of ammonia. Additionally, Reid says a pure hydrogen solution would be challenging for ports to offer as tank filling is expensive and requires caution. This could



increase expenses from US\$1 to US\$16 per kg by the time hydrogen gets to the pump.

For existing vessels, no major retrofit of ship infrastructure is necessary to deploy hydrogen-on-demand. With proper cleaning, tanks currently used for diesel storage can instead store liquid methanol at ambient temperatures.

With high-pressure capabilities no longer necessary, tank size and shape can be more flexible in nature. For new vessels, this characteristic enables naval architects to design creatively shaped tanks for best fit. By redefining the footprint required for propulsion systems, premium deck space or cargo volume that might have previously been unavailable is freed up.

Methanol tanks can be incorporated within any unique void in a ship's structure – custom-fit to make use of otherwise unusable space. Instead of a traditional engine room, new ship designs may include a reformer area featuring a primary methanol-to-hydrogen system. Capacity can then be extended by capitalising on small spaces across the ship for additional reformers and methanol tanks.

The systems are modular, scalable, and when combined with PEM fuel cells can support power needs ranging from 10kW to MW applications. They provide high energy efficiency (>80%) with minimal noise and vibration and produce high-purity (99.97%) hydrogen with no NOx, SOx, or particulate matter (PM). When renewable methanol becomes available, they can achieve net zero CO2 emissions.

While green methanol will be a great boon to decarbonisation, grey methanol is bridging the gap in the interim, giving shipbuilders a means to meet mandates along the way and prepare for the future, says RIX Industries. "With methanol-to-hydrogen capabilities, ship propulsion is no longer restricted to diesel engines and the cylindrical tanks of yesteryear."

■ US-based RIX Industries has the license to manufacture and deploy Element 1's proprietary M-Series hydrogen generator technology for use in fuel cell mobility applications, including marine vessels in North America and Europe

HOW IS SHIPPING MEASURING UP TO CII

As next year's deadline for the introduction of the Carbon Intensity Indicator (CII) looms, the industry is preparing for a changing environment, writes **Samantha Fisk**

While the shipping industry needs little reminding that it needs to cut its carbon emissions, shipowners will need to find solutions for their existing fleet that meet CII targets both next year and over the operational life of their assets.

The CII is a CO₂ emission measurement for a ship while transporting goods or passengers. Unlike the EEDI or EEXI measurements, the measurement and reporting of a vessel's CII rating will be an annual requirement. In addition, the yardsticks against which the ship will be rated (from A to E) will steadily rise over time. Ships that achieve a D rating for three consecutive years or an E rating in a single year, a corrective action plan needs to be developed as part of the SEEMP and approved.

For Newport Shipping, it is clear that shipowners cannot postpone decisions while waiting for the introduction of a potential future fuel. Simply put, the owners of ships sailing today need to act if they want their existing fleets to receive a high rating after 2023.

Turgay Colak, head of R&D, Newport Shipping comments about why CII is so critical for existing vessel in that: "For existing vessels, CII enables authorities to monitor ships' efficiency by means of CO₂ emissions. Vessels that cannot demonstrate compliance with the CII regulations by the vessel specific deadline may be unable to trade internationally. Owners need to take action to reduce CO₂ emission such as reducing speed, engine load limitation, operational optimisation or by operating on alternative fuels."

Shipowners are expected to respond by looking at costs and benefits of emissions reduction solutions, ranging from emission linked KPIs for ship management and crew, new shipping contracts involving emission targets as well as examining the impact of carbon credits on charter rates.

Ingmar Loges, Managing Director, Newport Shipping comments about the pressures on the market that: "Shipowners will have to invest in their fleets, through newbuilds and retrofits, in order to comply with emissions regulations and to retain their license to operate. Moreover, they are facing pressure from their clients and consumers to provide clean transport."

Shipowners are reluctant to invest in comparatively unproven solutions to improve the CII rating. "Owners can manage by reducing the speed for a while but the CII rating is not a one-off certification and the rating thresholds will become increasingly stringent towards 2030. So at some point reduced speed will be not enough," Colak adds.

So what are the other options in place for shipowners today? LNG is starting to take off in the newbuild sector with more orders now going through for LNG vessels. LNG is also a good solution for the existing market due to the fact that it is readily available to the market today.

Lianghui Xia, Managing Director, Newport Shipping comments that: "Among the choices available in the market, LNG is competitive on both environmental performance and energy content. From an operational perspective, it is highly practical as the supply infrastructure is already well



developed and compatible with the ship trading routes. Bio LNG and Synthetic LNG will further add to the mix."

Also, financial LNG offers benefits for owners that are looking to make the fuel switch. Loges comments about the financial conundrum that: "What financial burden might arise from not doing anything to reduce CO₂. Higher capital costs with the risk of not getting any money due to a bad environmental score. Less earning potential due to slow steaming in order to reduce CO₂. There are already dedicated funds available for green projects. Most European states have subsidy schemes for Green Projects including LNG. Shipowners will have to invest in their fleets, through new builds and retrofits, in order to comply with emissions regulations and to retain their license to operate. Moreover, they are facing pressure from their clients and consumers to provide clean transport."

However, the effects of the CII look like they may also be felt even further. Loges notes that: "The impact of the CII Rating is just the beginning. It will accelerate the implementation of UN Sustainable Development Goals." Shipping needs to start acting if it is going to meet to tackle the carbon challenge.

■ Lianghui Xia,
Managing Director,
Newport Shipping

MODULAR FUEL SUPPLY SYSTEM OFFERS FUTURE FLEXIBILITY

Auramarine's holistic approach to the future fuels market has seen its latest development, a modular fuel supply system for engines and other methanol consumers, ready to support future flexibility and enhanced digital functionality

The unit supplies methanol from the service tank to the master fuel valve, filtering it, and regulating the flow, pressure and temperature of the methanol to suit the requirements of engine designers.

The system includes automatic draining and nitrogen inerting, and double block and bleed configurations to any serviceable methanol line segments. Safety features address the toxicity of methanol, with the system's piping designed to minimise the risk of leakage. All ignition points have been eliminated, and leak detection systems are employed.

All components and electric equipment are specially selected, as the system is designed to fit in closed and Ex rated hazardous areas. The electrical cabinets, control panels and variable frequency drives are designed to be fitted separately to a safe area.

Methanol can be stored in ambient temperature and pressure ranges. The high-pressure injection of methanol is achieved with supply pressure at approximately 13 bar and temperature in the range of 20-40 degrees Celsius.

For dual fuel engines operating on methanol, Auramarine's HFO and MGO units are suitable for pilot and backup fuel supply and have already seen extensive service on current LNG-operated vessels.

A growing market

Auramarine is working with multiple engine designers but is initially focused on the low pressure supply units. The result, though, is a flexible and adaptable fuel supply system that is also suitable for engines with high injection pressure, and Product manager Valtteri Vainio says the system can be adapted to suit the conversion of existing LNG or conventional fuel engines to dual-fuel methanol operation if, for example, sustainable LNG is not readily available. "The biggest advantage of methanol is that it can be stored at ambient pressure and temperature. So, the storage tank itself does not require that much design sophistication," says Vainio.

Ventilation is an important issue in the retrofit market particularly, as the system needs to be located in an Ex area with separate ventilation. If this cannot be provided, it can be installed on deck. "We do our system installation design on a case-by-case basis, and we can check what space is available on board and adjust our units accordingly. We can also deliver the unit in smaller modules if required so they can be easily fitted to the engine room."

Auramarine is in advanced talks with shipyards, shipowners and class for the supply and installation of the system, with full 3D designs already completed. In addition to the new system, the company delivers a range of fuel supply and auxiliary systems along with a full lifecycle service.

Digital developments

The methanol fuel supply system includes digital functionality including a PLC control system, which provides connectivity and communication between its control systems and the



vessel to enable automatic data collection. This includes the provision of fuel consumption data to the propulsion system's main automation system. Owners and operators can also benefit from predictive maintenance strategies and improved reliability as a result of advanced data logging.

This functionality will expand as part of developments underway on Auramarine's biofuel supply system. The properties of some biofuels differ significantly from those of traditional marine fuels, and they can be corrosive and wearing on metals. Additionally, the acidity, reactivity, filtration properties and coagulation of biofuels require careful consideration and monitoring.

“We can also deliver the unit in smaller modules if required so they can be easily fitted to the engine room”

Auramarine delivered its first biofuel-ready fuel supply units early in the 2010's and continues to develop products to support the growing uptake of biofuels from diverse feedstocks. The company is currently participating in the BioFlex project, which aims to develop a least-cost solution for the production of sustainable and storable liquid fuels that meet the specifications for both flexible power generation and marine transport with large internal combustion engines. As part of the project, Auramarine is expanding the digital functionality of its fuel supply system to record and report on a range of fuel quality parameters.

Current development work also includes an ammonia fuel supply system. "There has been a lot of discussion on ammonia as a new fuel, and we expect it will become a viable alternative within the next three years," says CEO John Bergman. "We are always working on our R&D pipeline, where we have several focused projects in relation to new and future fuels, new changeover systems, and new product and service lines."

■ Auramarine's system can be adapted to suit the conversion of existing LNG or conventional fuel engines to dual-fuel methanol operation

POWER DISTRIBUTION BOOSTED BY PROTECTION SOLUTIONS

Yaskawa Environmental Energy/The Switch is adding an Electronic DC Breaker (EDCB) and Electronic Bus Link (EBL) to its DC-Hub solutions



■ The new single drive and DC-Hub package was successfully piloted during the conversion of Hagland Shipping's general cargo ship *Hagland Captain*

The EDCB technology guarantee selectivity and safety through ultra-rapid fault detection and disconnection, ensuring complete redundancy in DC power distribution for fully electric and hybrid vessels. They can also be utilised in other applications, such as in protection of large battery systems, and are likely to feature in the company's upcoming latest-generation single drive and DC-Hub package (see box).

The EDCB and EBL are now standard building blocks in the company's marine drive offering, enabling our DC-Hubs to perform at the highest standards of efficiency and reliability. "With microsecond range response, both devices provide maximum system protection and ride-through capability," says Head of Product Line High Power Converters, Teemu Heikkilä.

Protection on the inside

The EDCB is integrated within inverter modules inside the DC-Hub, increasing redundancy within the hub by detecting, cutting and disconnecting any critical fault in 10 microseconds. That is much faster than the millisecond range response of a conventional fuse. Selectivity reduces fault duration and isolates any damaging effect to just the affected module, ensuring the least possible energy disruption.

"As well as protecting against inverter module failure towards DC links, the EDCB also dampens oscillations towards DC links by dedicated inductance in series of active components. The EDCB allows each module to work

independently and also facilitates charging, as you can charge the inverter module capacitor through it with no need for any other device. It makes the system solution much simpler with fewer components and connections," says Heikkilä.

The EDCB provides complete protection with ride-through capability. The risk with using conventional fuses in DC set-ups, which is mostly still the case, is that the entire DC link and associated functions will trip if the fuse goes. "With EDCB, the DC link will not drop in voltage, and the power will stay on, keeping the ship running," says Heikkilä.

Unique in the market

To Heikkilä's knowledge, there is no competing solution in the market. Fuses are the competition. "Fuses are fine for AC systems, but with the move to DC distribution, things are very different. Unlike in AC systems, the fault current in DC distribution does not have zero crossing, so protection devices need to perform at a whole new level. Our concept is based on semiconductors and fast current measurement. In other words, it is a measured data-based fast and predictable protection," he says.

EDCB technology can be utilized in other applications, such as in protection of large battery systems. As batteries get larger, the energy content increases, and so does the short-circuit current rating. The challenge is that existing marine DC systems are not designed to handle this high short-circuit current. "To limit the amount of battery short-

circuit current, you can use the EDCB to effectively block the current, providing both protection and safety by not releasing short-circuit current to the system. We are working on a new electronic protection device to limit DC short-circuit currents to enable implementation of large batteries, but also optimise system cost," says Heikkilä.

Protection on the outside

Whereas the EDCB is integrated within the DC-Hub, the EBL connects multiple DC-Hubs in a vessel's DC distribution system to isolate faults and ensure redundancy. Ultra-rapid splitting of on-board grids in microseconds, regardless of the type of fault, ensures the other DC-Hubs are not affected. The EBL also allows vessel systems to share energy between DC-Hubs in normal operations. "With EBL ultrafast performance, it is possible to operate breakers closed in normal operation, which optimizes energy flow and, therefore, fuel consumption," says Heikkilä.

EBLs also guarantee selectivity between DC-Hubs if a major fault occurs, rapidly disconnecting them to isolate the fault. Allowing each DC-Hub to work independently creates complete redundancy, securing power availability for safe and seamless operations. "The EBL also allows a ring network topology to be set up, which ensures redundancy no matter how large a system is," says Heikkilä.

Although perfectly suited to the stringent demands of dynamic positioning (DP) vessels, any ship type from ferries to tankers can benefit from this technology to unlock efficiencies, savings and increased reliability. "At a time when the industry is focusing on using and producing environmental energy in the most sustainable manner, it's the perfect solution for shipowners looking to optimize operational uptime, cost control and sustainability," says Heikkilä.

Providing flexibility

Heikkilä adds that future flexibility in terms of energy sources is a key investment consideration for owners right now. "You can combine an additional DC-Hub with an EBL to allow existing systems to handle all kinds of loads and potential new power sources such as fuel cells, solar panels and wind generators. It's an important ingredient to make ships ready for the future energy mix," says Heikkilä.

The EBL was first piloted on North Sea Shipping's 12,705-dwt advanced offshore construction vessel *North Sea Giant* (built 2011), which was converted to hybrid propulsion in 2019. The energy storage system (ESS) supplied by Corvus Energy forms part of the ship's DP3 power management system, providing spinning reserve power to all parts of the ship instead of having to keep fuel-hungry gensets running. The battery set-up features three separate power units, each with a The Switch DC-Hub, and six generators in total.



■ Teemu Heikkilä

“At a time when the industry is focusing on using and producing environmental energy in the most sustainable manner, it's the perfect solution for shipowners looking to optimize operational uptime, cost control and sustainability

To fulfill DP3 power demands, the EBL features two insulated-gate bipolar transistors (IGBTs) effectively connected in series – one in the positive and one in the negative line – with completely independent drive and control. In case of a hidden failure, the EBL guarantees that a short-circuit current is interrupted before any damage occurs. "Pairing the vessel's DC-Hubs with our EBL allows each unit to work independently. Isolating faults protects the entire operational system, providing redundancy if one unit fails or even in case of hidden failure," says Heikkilä. "By rapidly connecting and disconnecting energy sources from one another, including batteries and engines, they can be optimized for efficiency. This eliminates the need to run the ship's three power units during all operations, saving on long-term fuel costs and reducing emissions."

More recently, the EBL has also been ordered as part of the company's comprehensive delivery – including DC-Hubs and permanent magnet shaft generators – being integrated into Berg Propulsion's diesel-electric direct-drive solution for a bulk carrier under construction in China for a Canadian owner.

New-generation drive in the pipeline

Heikkilä reveals that Yaskawa Environmental Energy/The Switch is also close to finalising its latest-generation single drive and DC-Hub package. The solution was successfully piloted on Hagland Shipping's 4,699-dwt general cargo ship *Hagland Captain* (built 2012), which was converted to battery hybrid propulsion last year.

A second pilot involves a series of 5,000-dwt eco-friendly bulk carriers under

construction for Norwegian owner Misje Eco Bulk at Colombo Dockyard in Sri Lanka. The first is set for delivery early this year.

The ships feature Wärtsilä's fully integrated hybrid solution, enabling the vessels to enter and leave harbour, and perform cargo operations, with zero emissions. "These projects are hybrid DC-Hubs with multiple energy sources, which enable energy-efficient operation with fully electrical mode.

Our new-generation product is optimised for DC distribution with multiple sources and consumers," says Heikkilä.

Larger vessels with two shaft lines require two DC-Hubs to ensure redundancy if one line or drive goes down. Heikkilä says the company is ready to deliver the full offering from next year. "The market is much more active now than last year, so we look forward to expanding the business," he concludes.

MEETING THE NEEDS OF TOMORROW

Although it may be seen as a minor part of a ship, deck equipment is stepping up to the challenge of making systems that will meet with the demands of the market in the future, writes **Samantha Fisk**



■ Vestdavit's PLR-type davits are widely used, including the PLR-5002 with the Norwegian Coast Guard (pictured)

The holistic ship is how a ship is to be viewed in the future with all systems that 'plug' into it being able to be viewed and monitored. Also, with the electronification of more systems come a greater power demand onboard. So making systems that not only are green but also are efficient is important when taking in the whole operation of the vessel. Each part has its part to play in making a vessel as efficient as possible.

For Vestdavit they are seeing this as a key area of development with their own MissionEase system. William Goodall, Project Management and Business Development, Vestdavit comments about the developments that: "We are continuing to develop our patented MissionEase system which is a combined launch and recovery and multi-handling system."

MissionEase is a 'tailored' system that can fulfil the requirements of vessel operators for the Military and Defence – Mine hunting Vessels, Multi-Role Vessels and Mission Bay Equipped Vessels, Offshore – Personnel Transfer Vessels, Cable Laying Vessels, Seismic Survey Vessels, Cruise & Pleasure – Expeditionary Cruise Vessels, Large Yachts. Vestdavit works with integrators and hangar specialists to provide total multi-role capability.

The digitalisation of systems is also playing an important role in the developments, as Goodall explains that: "We are seeing the increasing need for Programmable Logic Controls in order to support L&R of ever larger and more sophisticated payloads in a wider and wider operational window."

Goodall notes that the trends that the company is now seeing emerge in the market is towards great automation and larger payloads on systems.

Palfinger is also setting new heights with its latest development of its offshore cranes. The company recently announced that it is to equip Aker BP's new installations, through a new framework, with state-of-the art offshore cranes based on a new technology and standardization to increase the safety level and reduce operating costs.

In 2017 PALFINGER started working on the concept for Remote Operated Offshore Cranes (ROOC) together with Aker BP and Optilift. The technology of the ROOC for the new platforms will be based on the work done in the past years as well as the recent deliveries to the Valhall IP platform.

Andreas Hille, Senior Vice President Product Line Management and Engineering at Palfinger: "We are excited to continue our cooperation with Aker BP on this project which combines innovation, research and development based on our many years of experience. Together we are setting new standards providing modular and scalable offshore cranes with integrated remote and autonomous control technologies."

Aker BP is planning a final investment decision in 2022 for the NOA Fulla field development in the NOAKA area and a new central platform on Valhall (NCP) with tie-in of King Lear. Both developments are planned with advanced technology standards in terms of equipment.

"NOA Fulla og NCP/King Lear are major field developments on the Norwegian Continental Shelf. The cranes Palfinger will



■ Palfinger's OPTS system is a multifunctional hydraulic aerial lift for transporting both people and materials in a safe, quick, and efficient way

deliver through the frame agreement represent a very important delivery in our operations strategy where remote work and automation are key drivers. By standardising cranes across these development projects, we can also improve quality and reduce costs," comments Ine Dove, SVP Operations & Asset Development, Aker BP.

One of the key elements in the contract has been the importance of remote working as part of BP's strategy to reduce risk and exposure of personnel working their assets as well as optimize operating costs.

Palfinger highlights that the ability to provide safe and secure working conditions is one of the main drivers for remote and autonomous control. Additionally, the technology is also expected to yield huge cost savings, particularly for operations that traditionally require either calm weather conditions, large crews and facilities, or highly repetitive tasks that can be performed remotely with new digital tools.

The framework agreement between Aker BP and Palfinger is valid for ten years with the option to extend. It covers the development and implementation of remote-controlled cranes as well as the delivery of a total of six electric cranes for four platforms.

SEAONICS has also launched a new all-electric gangway for the offshore wind market. Once again meeting the needs of its customers towards electrification and autonomous operations in the renewable offshore wind energy market. The all-electric and autonomous gangway is aimed at making all cargo and personnel handling greener and safer.

With an increased focus on renewability and sustainability, the SEAONICS ECMC Gangway, will cover the growing demand for smart solutions within the SOV market, the company says.

The latest addition to the SOV concept is the all-electric gangway, which includes:

- The all-electric drive system minimizes risk for oil spill
- The autonomous landing mode system ensures safer and faster operations
- Accurate motion control with responsive electric actuators

- Low power consumption in idling mode

The new gangway design is based on SEAONICS' philosophy of electrifying all handling operations at sea.

Fendercare Marine has also recently announced that it has successfully completed another STS transfer of liquefied natural gas (LNG) using its new LNG transfer system, off the coast of Gibraltar.

The LNG STS operation between two large LNG carriers was conducted in February 2022 inside the Bay of Gibraltar under the approval of the local port authorities.

Fendercare oversaw the entire operation and utilised its manifold-to-manifold LNG transfer system, along with composite hoses and fenders. Fendercare conducted all pre-operational studies, including a compatibility assessment, detailed risk assessments and dynamic mooring analysis.

An offshore team comprising of a Mooring Master/Person in Overall Advisory Control (POAC) and LNG Superintendents was deployed, and all were on board throughout to ensure the operation was conducted safely and in line with local and international standards and guidelines.

Fendercare worked with its local partner Smith Imossi Shipping Agency, who assisted with handling both vessel calls and any requirements from the ships. Tom Fitchew, business development manager, Fendercare Marine comments that: "We are delighted with another very successful LNG STS, which again shows again our ability to deliver highly professional, efficient and safe transfers to our customers. We see Gibraltar as a hub for LNG STS and would like to say a big thank you to everyone involved."

The company highlights about the transfer that it follows the successful completion of an LNG STS transfer for another customer off the coast of Malaysia in November 2021, as well as the first LNG STS off the coast of the Skagen Odde peninsula in Denmark the following month. As part of its strategy Fendercare says that it has recognised the demand for cleaner solutions, in particular LNG, which has prompted its own developments.

EU MEGA STIMULUS TO CREATE EUROPEAN HYDROGEN MARKET

The European Union's USD221 billion (EUR210bn) REPowerEU scheme will accelerate the emergence of a hydrogen economy in the EU, while ending the trading bloc's reliance upon imported Russian hydrocarbons by 2027

The announcement by the European Commission's DG Energy on 18 May that it was accelerating the pace of decarbonisation across its member states in response to Russia's war in Ukraine was widely expected.

The scheme will seek to bring forward the end of the EU's energy dependence upon imported Russian oil and gas supplies from 2030 to 2027.

The scheme takes the energy savings that the Fit for 55 package is expected to deliver (equivalent to 116 billion m³, bcm, or 30% of the EU's current natural gas consumption), and extends the energy efficiency savings and consumption substitution schemes from previous EU packages. Fully EUR97bn investment in the scheme are intended to promote energy efficiency measures among energy-intensive industries, as well as among other commercial consumers.

From a shipping perspective, the scheme includes short-term measures to expand the EU's LNG imports and to expand gas pipeline capacity. However, the scale of the increase is quite moderate. The announcement only envisages a 40% increase in imported seaborne LNG volumes, with the scheme anticipating a rise in LNG imports of 50bcm. Pipeline supplies of natural gas will only increase by 10bcm.

In all, the EU only directly earmarked EUR10bn towards investments to import sufficient LNG and pipeline gas by 2030.

The biomethane sector has been treated separately, both because of its lower environmental footprint, and potentially because it would substitute imported LNG with local energy. The production of renewable methane has been allocated EUR37bn. The investment represents a significant change in ambition, dwarfing the EU's previous support towards the biomethane sector. In July 2021 the European Commission announced investments of some EUR118 million in 32 bioLNG projects. However, even allowing for rapid growth in production, the investment will 'only' increase production to 17bcm by 2030.

The scheme represents a limited short-term increase in natural gas and LNG imports, and domestic biomethane production. Cumulatively, the scheme will only increase supply of natural gas, LNG and biomethane by 77bcm.

For the purposes of comparison, Russia typically supplied between 170bcm and 200 bcm via gas pipeline to EU customers before 2020. Russia has also supplied around 20% (close to 24 bcm) of Europe's LNG imports in recent years from the Yamal project.

Renewables and hydrogen

The REPowerEU announcement reinstated the higher target for the proportion of clean energy in the bloc's energy mix from 40% by 2030 to 45%. In part, this merely reflects the likely pace of the roll out of offshore and onshore renewables in the trading bloc's largest economies, which have significantly exceeded the expectations of wind-sceptics since 2020. Achieving the targets will be easier to achieve as the proportion of coal fired power generation will decline



rapidly across many parts of the trading bloc over the second half of the current decade.

The REPowerEU announcement also confirmed that the largest investments in the European Union's scheme have been allocated to the expansion of the renewables sector and the stimulation of Europe's emerging hydrogen economy.

The scheme included EUR113 billion, which included EUR86bn for the expansion of renewable production capacity and EUR27bn for the expansion of hydrogen electrolyser capacity.

The scheme envisages the production of 14 million tonnes of hydrogen or ammonia, around 8mt of which is intended to substitute existing natural gas consumption. This will lower natural gas consumption by around 27bcm, according to DG Energy.

In terms of the split between domestic production and imports of hydrogen or ammonia, 4mt will be produced within the EU, supported by the expansion in the EU's green hydrogen production capacity (as well as the expansion in underlying renewable energy generation).

The scheme directly anticipates the import of up to 10 million tonnes per year of hydrogen or ammonia. This is likely to directly promote the development of green hydrogen supply in neighbouring Norway, and creates an opportunity for the UK, which will remain the largest producer of renewable electricity in Europe into the 2030s.

Assessment

The European Commission has not let the Ukraine crisis go to waste, and renewable energy advocates have increased renewable energy targets to 45%. Although the European Commission is supporting the expansion of biomethane production, and supporting the expansion of natural gas imports, the scale of the increase is lower than expected, and suggests that natural gas is being promoted as a near-term source of supply to meet European Union demand over the coming five- to ten-year period.

The significant expansion in funding for hydrogen production is likely to accelerate the introduction of green hydrogen into the EU's energy mix, and also create the conditions for the first commercial markets for imported seaborne hydrogen, and large scale ammonia imports by 2027.

■ The EU plans to offer EUR86bn to increase the proportion of energy produced from renewable sources by 2030

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THE ROLE OF 5G IN SHIPPING: QIAN MA, ABS

ABS has released a whitepaper titled *Insights into Vessel Connectivity*, and following on from that, Qian Ma, Engineer II, discusses the potential role of 5G technology in an exclusive interview with *The Motorship*

Q Can you explain LEO and 5G from a satellite perspective?

A LEO is a satellite orbit with an altitude of lower than 2,000 kilometres. Depending on their purpose, satellites on LEO may choose different kinds of electromagnetic waves as a way of communication. 5G waves are one form of the waves used by satellites.

Currently most of the commercial satellites use lower frequencies, from L-band (1 – 2 GHz) to X-band (8 – 12 GHz), and are picking up the Ku (12 – 18 GHz) and Ka (26 – 40 GHz) bands. These lower frequencies (L-band to X-band), even though having low data capacity and higher latency, are sufficient for their current applications in GPS, communications, weather radar, etc.

The waves in higher frequencies (Ku and Ka bands) used by satellites are similar to the frequency range of 5G waves, but they don't necessarily have the same specifications with 5G on other aspects such as latency, which means that some satellites may not be using 5G technology. However, recently there are some satellite companies that have launched satellites broadcasting 5G waves.

Q The whitepaper says this: "fast and reliable connectivity between the vessel and the remote station is considered essential even if the crews are onboard for monitoring and vessel operational functions." Is 5G the most likely/realistic/only option for this with respect to low latency and data?

A For monitoring vehicles in motion, the lower the latency, the better, due to the high risk involved with the high speed and large weight of the vessel, and 5G technology is the most likely option because of its low latency. The waves other than 5G used by LEO satellites might not have latency low enough.

Q Is there any value in smart (but not autonomous) ships having 5G connectivity?

A Yes. Smart, as defined by ABS Guide for Smart Functions for Marine Vessels and Offshore Units (2021), is the capability to continuously collect, transmit, manage, analyze and report data. 5G connectivity, though not mandatory for smart functions, is recommended.

Q Is 5G safe for humans?

A Yes, 5G is safe for humans. All electromagnetic waves carry radiation, in the form of either non-ionizing radiation or ionizing radiation. Electromagnetic waves that have lower frequencies carry non-ionizing radiation, which does not have enough energy to remove electrons from atoms and molecules, and hence have no significant risk to humans. Direct exposure to non-ionizing radiation may damage tissue due to heat, but this is very uncommon and is mainly a concern for people who



work on large source non-ionization radiation devices.

As the frequencies of the waves increase, passing that of the ultraviolet (UV) (7.5×10⁵ GHz to 3×10⁷ GHz) into the realm of X-rays (3×10⁷ GHz to 3×10¹⁰ GHz) and gamma-rays (above 3×10⁹ GHz), the waves carry enough energy to remove electrons from atoms and molecules. This will cause damage to tissues if exposure is high enough.

5G technology uses electromagnetic waves in frequencies up to 52.6 GHz, which are much lower than those of X-rays and gamma-rays and carry non-ionizing radiation. Therefore, 5G is safe to humans.

The Centers for Disease Control and Prevention (CDC) provides information on ionizing and non-ionizing radiation.

The whitepaper

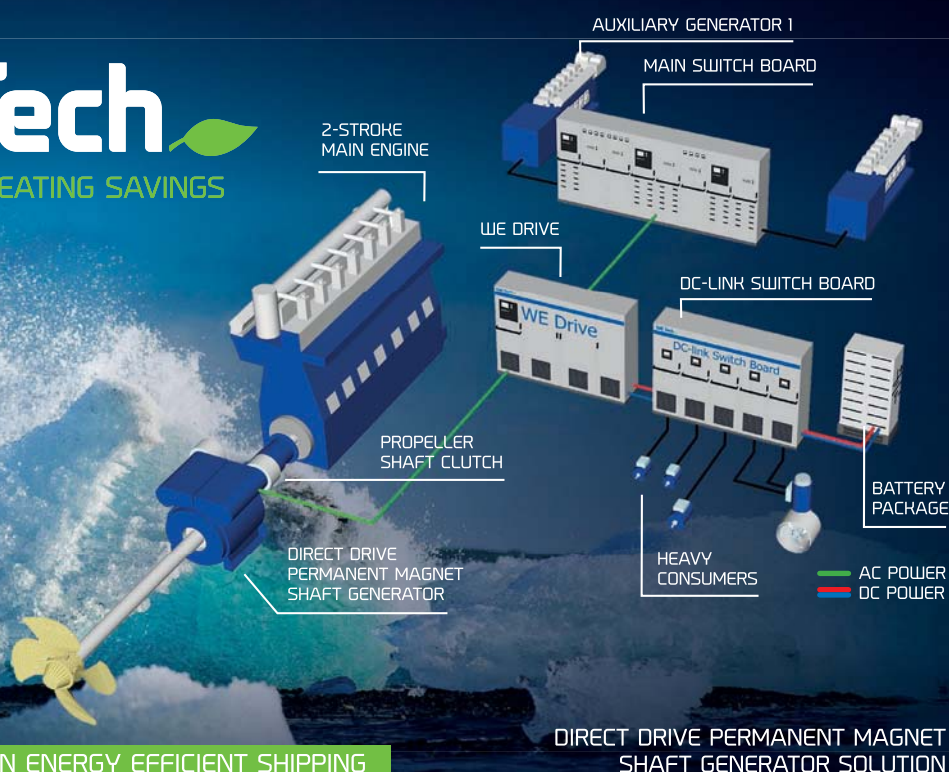
Insights into Vessel Connectivity discusses communication technologies available and provides guidance to vessel owners, operators and system vendors in ensuring they are equipped to meet current and future demand. The publication reviews the relevant regulations and industrial standards on vessel connectivity, as well as future technology development and challenges.

"The ship-to-shore interface is the location of some of maritime's most dynamic change and as the demands on the technology grow ever greater, so is its importance to vessel operations and safety. As a leader in supporting the adoption of smart technologies at sea and with experience in pioneering autonomous and remote-control projects around the world, ABS is well placed to assist the industry with this vital technology," says Patrick Ryan, ABS Senior Vice President, Global Engineering and Technology.

■ 5G technology offers particular advantages for the monitoring of vessels, owing to its low latency

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WIDER CIRCULAR ECONOMY VIEW INCLUDES EMBEDDED EMISSIONS

OSK-ShipTech, the Denmark based naval architects, are calling for the industry to widen their perspective to take into account the CO₂ emissions generated during construction and demolition



■ Should a full life-cycle analysis take into account CO₂ emissions produced during the construction of vessels?

As the industry increasing focuses on moving towards meeting net-zero emission targets in 2050, it is high time that the shipping industry widened its focus, moving from a narrow focus on the CO₂ emissions produced from fuel consumption. "We must focus on the broader picture in the CO₂ emissions debate," OSK-ShipTech, the Danish naval architecture consultancy announces.

OSK-ShipTech has a strong track record in contributing to the designs of many recent high-profile ro-pax ferries. The ferry industry has been an early adopter of alternative fuels and introducing battery-hybrid propulsion solutions. One consequence of the decline in 'direct' emissions from ship propulsion and hotel loads is that 'indirect' emissions (or emissions associated with the construction of the ship) have risen as a proportion of total emissions during a vessel's operational life.

According to Anders Ørgård, Chief Commercial Officer of OSK-ShipTech, reducing the direct CO₂ emissions should remain a priority, but shipowners cannot turn a blind eye on the indirect contributors of CO₂ emissions: notably the manufacturing process of a ship and all the components it is made of.

Full-electric study

A recent study conducted by the consultancy revealed that for a full-electric ferry, powered by climate-friendly electricity, non-operation-related CO₂ emissions could reach well in the excess of 55 per cent of the total CO₂ emissions produced during the ship's 20-year life cycle.

This illustrates that a holistic life cycle approach is paramount when considering a newbuild. "Rather than exclusively focusing on the emissions from operations, shipowners should make a cradle-to-grave life cycle

analysis," says Ørgård. "A life cycle analysis offers the opportunity to develop a build strategy, reducing the emissions during both construction and operation, thus further optimising the ship's operational life."

The study comes on the back of a controversy surrounding the idea of sustainability and the new guidelines from the Danish consumer ombudsman, which were released in December 2021.

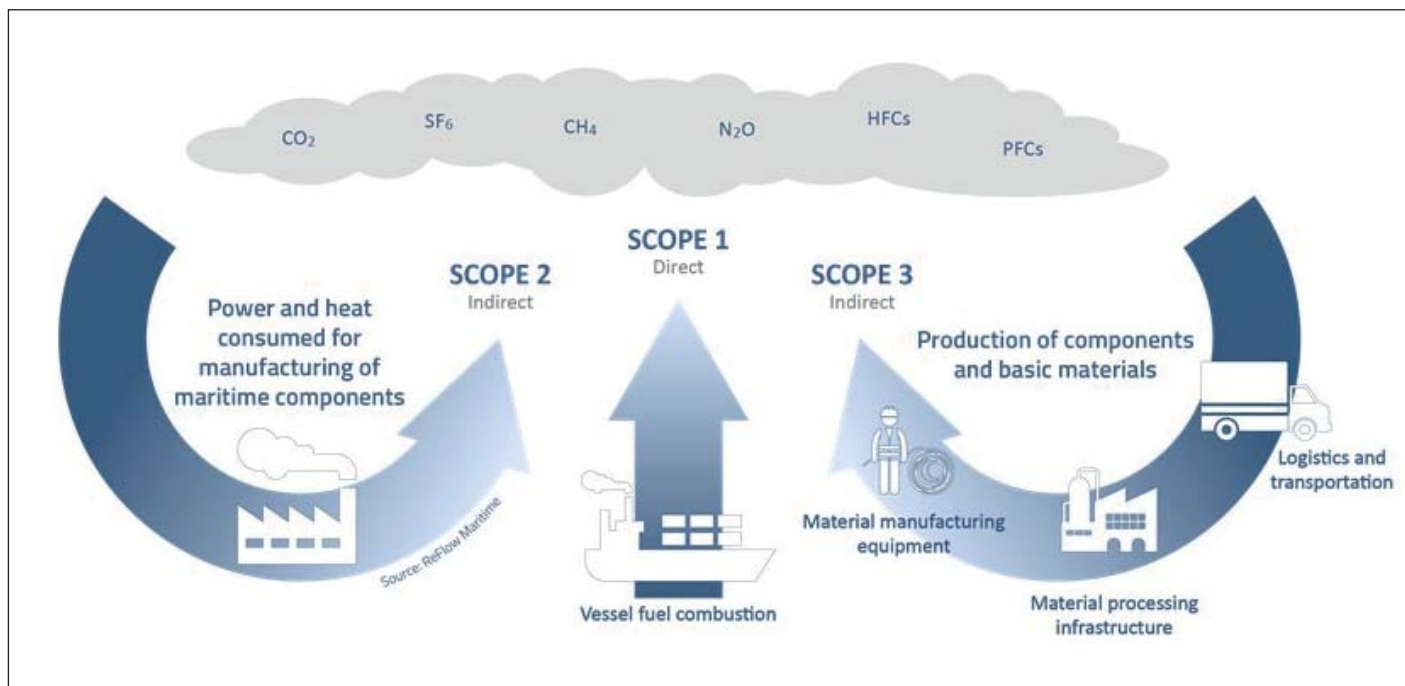
According to the new guidelines, it is emphasised that statements like 'emission-free' and 'climate-neutral' for example are to be fully documented through the product's entire life cycle by use of life cycle analyses, which to be verified by experts. The guidelines pose commercial and reputational risks as claims of sustainability that cannot be substantiated with a life cycle analysis could be punished by substantial fines of up to six-digits in US dollars.

In the case of ships, such a life cycle analysis includes a cradle-to-grave evaluation. In addition to the ship's operation, the CO₂ footprint from construction and recycling of the ship should equally be considered.

Life cycle assessment of a full-electric ferry

OSK-ShipTech's study included a life cycle assessment of Fanølinjen's 2021-built, full-electric ferry GROTTÉ; a 50-metre-long double-ended ro-pax vessel operating the 12-minute Esbjerg-Nordby shuttle service. Notwithstanding the short distance it covers, GROTTÉ effectively sails 12 hours per day. The study is therefore representative of a large ro-pax ferry with an equivalent daily operating time of at least 12 hours.

The assessment, which covered the six stages in a ship's life, all the way from mining of the resources and processing of the steel to the recycling of the ship, was executed in line with ISO 14040 and ISO 14044 standards.



For redundancy's sake, and to make long positioning trips possible, most electric ferries are still equipped with diesel engines. Experience from operating full-electric ferries has taught that they operate for approximately 90-95 per cent of the time on electricity. For this reason, they also need backup power from other energy sources.

Drawing on publicly available data, the climate-friendly electricity used to power GROTTÉ has an emissions intensity of 0.0187kg CO₂/kWh, compared to the 0.297kg CO₂/kWh of the electricity generated from a typical mix of renewable and conventional energy sources (such as coal, wood chips, and natural gas) available on the grid.

OSK-ShipTech has calculated that during its entire lifespan, from cradle to grave, GROTTÉ will produce 2,508 tonnes CO₂-eq from the ship's operation with 1,833 tonnes CO₂-eq attributable to the manufacturing of the vessel. As the ship and its materials will be recycled upon demolition, scrapping of the vessel will have a positive CO₂-eq footprint of 1,124.54 tonnes.

The Motorship notes that circular economy paradigms, based on the concepts of recycling, reusing and upcycling material, are likely to receive increasing attention in the future.

There is no such thing as a zero-emission ferry

The tonne CO₂-eq from GROTTÉ's operation still surpasses the tonne CO₂-eq from the ship's construction by a good margin, according to Ørgård. "Our analysis clearly illustrates that a zero-emission ship doesn't exist at all," he says. "To put

it simply, one can no longer ignore the CO₂ emissions generated from manufacturing, which can be more than 50% of the cradle-to-grave CO₂ footprint in some cases."

Following this in-depth life cycle assessment, OSK-ShipTech is ready to apply the knowledge gained in future newbuilding projects, helping shipowners to develop a build strategy to drastically reduce CO₂ emissions during the construction processes. "A life cycle analysis already starts in the ship's concept stage," says Ørgård, "thus allowing us to develop a build strategy, which we can take into account, when we calculate the total cost of ownership and the total cradle-to-grave CO₂ burden."

As the steel structure accounts for nearly 40 per cent of the CO₂ footprint in a ship's construction, a strategy should be developed to focus on the hull and steel structure already in the design stage.

"One should also consider the country of build," clarifies Ørgård. "In many countries, steel plate production is produced from (coal-fired) blast furnaces. As part of their build strategy, shipowners should equally consider where to build their ships and where to purchase the steel." Besides the steel structure, erection of a ferry's accommodation configuration is another significant polluter, accounting for about 10 per cent of the total building process. "Our interior design branch, Steen Friis Design, has developed a tool to calculate the CO₂ emissions from the accommodation. This is yet another example demonstrating that we are with the shipowner all the way," adds Ørgård.



CCO Anders Ørgård

Aura Seaways

OSK-ShipTech was responsible for the conceptual design of the *Aura Seaways*, which was DFDS's first newbuilding since the 1980s. Serving the southern Baltic route between Karlshamn in Sweden and Klaipėda in Lithuania, the 4,500 lane-metres Ro-Pax will lower CO₂

emissions per trailer by 20% compared with existing DFDS vessels.

The reduction reflects the specification of highly efficient engine technology as well as hydrodynamic form refinements, as well as the scale effect of increased capacity on the vessel.

The vessel and a sister vessel, *Luna Seaways*, are powered by four Wärtsilä 46-series diesels producing a total 33,600kW. Each vessel has been prepared for future adaptation to LNG fuel, while the vessels are equipped with exhaust gas aftertreatment systems.

LOW EEDI FOR DUAL-FUEL COASTER

Accumulated Dutch experience in the business of designing, operating and trading ships in the European short-sea arena has found new expression in a dual-fuel, multi-purpose carrier accredited with an especially high efficiency rating, writes **David Tinsley**



Credit: Conoship International

■ *Lady Marie Christine* has been assigned to the Baltic forestry goods trade

First of four sisters ordered in China by Wijnne Barends, the 5,875dwt *Lady Marie Christine* was formally christened in the owner's home port of Delfzijl on April 9. She incorporates a range of features that chime with long-run decarbonisation objectives. The technical strategy adopted better ensures the company's wellbeing in a consistently tough market by facilitating compliance with future environmental legislation without requiring substantial modifications.

The combination of solutions applied in the design, including LNG-capable main engine with suitability for bio-LNG, optimised hull lines and propulsion train, frequency-controlled shaft generator, waste heat recovery, and auxiliary use for port stays only, has achieved an energy efficiency design index (EEDI) value of 9.33gCO₂/tnm (tonnes per nautical mile). This is some 57% of the mandatory Phase 2 requirement of 15.9gCO₂/tnm.

Wijnne Barends contracted the four 115m newbuilds from Wuhu Shipyard after entering into a long-term charter agreement with the Finnish forestry products group UPM. The design developed by Conoship International accordingly makes particular provision for UPM exports and raw material needs, but with added scope for project cargoes, and incorporates ice strengthening and other measures to meet the exigencies of Baltic navigation through the winter months.

Initially, the new vessels are expected to spend 80-90% of their time trading between the Gulf of Bothnia and north continental ports, running south one week and making the northbound sailing the following week. The LNG fuel tank capacity is sufficient for a two-week round trip, with bunkering taking place primarily in Finland.

Besides the primary requirement for efficiency, volume and productivity in conducting southbound shipments of paper, pulp, timber, plywood and other goods, the design caters to the client's inward (northbound) flows of china clay, woodchips and pulp wood.

The compactness of the machinery room in the *Lady Marie Christine* series contributes to the maximisation of the hull envelope for revenue earning. The forward positioning of the bridge and accommodation, plus the underdeck placement of the LNG fuel storage, have fundamentally influenced cargo carrying potential and load flexibility, by creating an extensive, flush deck area for oversized cargo and weatherdeck stows. The low-profile funnel casing is offset on the starboard quarter. The ship has DNV's Hatchcoverless notation, and is certified for open-top operation at a 5.5m draught to transport voluminous or heavy items of freight. The design accordingly enhances the ship's long-term trading flexibility.

The single, box-like hold is 9.5m deep and accounts for 71.4m of the ship's 108m length between perpendiculars, and for 13.8m of the 16.5m breadth, conferring an underdeck volume of 316,400ft³. Since forestry products are of relatively high density, and given the point loads imposed by project freight, the tank top is reinforced for 15t/m². The on-deck cargo carrying capacity is substantial, spanning the vessel's full width of 16.5m and 80.5m of the hull's length.

The primary power source is a six-cylinder model of the well-proven Wartsila 34DF dual-fuel, medium-speed engine, which acts on the shaftline through a reduction gearbox. Wartsila's Opti Design has tailored the proprietary,

controllable pitch propeller and HP nozzle to align with the hull hydrodynamically, and remote oversight of the whole is afforded by way of a data collection unit.

Main engine power output of 2,550kW provides for open-water transits at up to 13.7 knots and ensures independent navigation through normal winter ice conditions. Driven off the gearbox, the specific nature of the shaft generator is such that the requisite electrical energy can be delivered continuously, at all times, in all power/speed modes, promoting optimum engine running.

A comprehensive waste heat recovery system, working off the two 200kW Scania auxiliaries as well as the main engine, uses cooling water for the hot water system and to warm the accommodation in colder environs. Quality insulation was necessitated to meet the challenge presented by the transfer distance between the engine room aft and the deckhouse, cabins and crew facilities forward.

While allowing alternative use or immediate switchover to marine diesel oil, the propulsion engine's operation on LNG secures a considerable emissions benefit, relative to an HFO installation, equating to a reduction of as much as 85% in NO_x, virtual elimination of SO_x and particulates, plus 25% less CO₂. The machinery and LNGPac fuel storage are conducive to adoption of carbon-neutral bio-LNG in the future, and the arrangements also facilitate other possibilities such as bio-methanol or ammonia.

Wijnne Barends' technical manager Ad Toonen said that discussions with DNV helped convince the company as to the potential of the LNG concept in application to the new ships. "When we want to address other fuels, such as ammonia and methanol, we still see a bright future for this vessel and its fuel options. Bio-LNG will be the most plausible next step. As for other fuels, we will have to see what future rules will be implemented, then we will know what better can be done. But with the configuration of this ship, we are two steps ahead in terms of being ready to meet future rules."

Although initial thought had been given to placing two 100m³ tanks on the weatherdeck, the final design decision was made to provide LNG fuel containment in a single 200m³ tank below deck on the vessel's port side, close to the main

PRINCIPAL PARTICULARS - *Lady Marie Christine*

Length overall	115.24m
Length bp	108.44m
Breadth, moulded	16.51m
Depth, moulded	8.50m
Draught, summer	6.20m
Draught, open top mode	5.50m
Gross tonnage	4,966t
Deadweight	5,875t
Hold capacity(grain/bale)	316,400ft ³
Timber capacity, overall	8,186m ³
Containers, on hatches	155TEU
Dual-fuel main engine, power	2,550kW
Speed	13.7kts
Auxiliaries	2 x 200kW
Bow thruster	350kW
Ice class	1A Finnish/Swedish
Class	DNV
Flag	Dutch

engine. This called for special insulation and fire protection arrangements and a strengthened support structure to ensure integrity and safety. The solution has obviated the loss of up to 25% of available cargo space on deck, giving a competitive advantage over other LNG-fuelled vessels and allowing conveyance of long-length project shipments, such as wind turbine blades of 80m or more.

As endorsed by specific DNV class notations, the reinforced double bottom, main deck and hatch covers allow the transport of heavy goods such as paper rolls, and the use of 20-ton grabs to effect hold discharge of bulk commodities. Hold monitoring, including acceleration sensors, minimises the risk of cargo damage.

Lady Marie Christine is set to be followed out of Wuhu Shipyard on the Yangtze by *Lady Mathilde*, *Lady Menna*, and *Lady Monique*. Charterer UPM has committed to reduce the greenhouse gas emissions of its supply chain by 30% come 2030. Use of environmentally-considerate tonnage will also help deliver a lower carbon footprint to customers' value chains.



■ The hull shape of the new LNG-fuelled Lady M series was optimised by Conoship using CFD calculations

HYDROGEN-READY WINDFARM SERVICE VESSEL

Against expectations of soaring demand for renewable energy over the coming decade, a Norwegian company is investing in the creation of an entire fleet of ships dedicated to providing technical support on offshore wind farms, writes **David Tinsley**



Credit: Astilleros Gondan

■ **Edda Breeze**
nearing completion
in northern Spain

The first of the new breed of commissioning service operation vessels(CSOVs) ordered by Haugesund-based Edda Wind is now being readied at her Spanish yard of build for a long-term assignment in the German Bight.

The 88m *Edda Breeze* leads a Norwegian-designed series of five from Astilleros Gondan, located at Figueras(Castropol) in the northern Spanish province of Asturias. Conceived to function as a host vessel for technicians undertaking commissioning and maintenance work on wind turbines, the diesel-electric class is distinguished by a 'walk-to-work' capability and by preparation for future zero-emission performance using hydrogen fuel.

Two similar, 89m newbuilds, also emanating from the drawing board of Norwegian consultancy Salt Ship Design, have been booked by Edda Wind at Colombo Dockyard in Sri Lanka.

Advanced CSOVs that offer a high standard of accommodation and transfer safety for personnel engaged in wind farm development and upkeep, and which incorporate ready means of technological upgrade, will form an important part of the value chain in the booming offshore wind energy segment.

Key features of Edda Wind's new generation include anti-heeling and roll reduction systems to provide good working and living conditions onboard and a motion-compensated gangway with an adjustable pedestal for safe and efficient connections to the turbines, even in harsh weather conditions.

The design is suited to operations involving both fixed-foundation and floating turbines regardless of size.

Edda Breeze has the security of long-term employment with German company Ocean Breeze Energy, for duty on the latter's BARD Offshore 1 wind farm 100km off Germany's North Sea coast. Edda Wind's 11-year contract started during the second quarter of 2021, and is currently served by the 98m *Edda Fjord*, with the *Edda Breeze* due to be assigned at the outset of July this year.

The new ship embodies the Salt 0217 design and has a diesel-electric installation backed up by two independent battery banks. Caterpillar high-speed engines deliver power to a pair of cycloidal-type propulsion units incorporating permanent magnet electric motors.

With battery-diesel hybrid propulsion, IMO Tier III-certified main generators, and other energy saving equipment, the newbuild will, on service entry, produce significantly less greenhouse gas emissions than more conventional tonnage. However, so as to realise a future zero-emission objective without compromising operational capabilities, the vessel has been readied for adoption of a novel, hydrogen propulsion system, based on liquid organic hydrogen carrier(LHOC) technology.

The patented system that would be employed is the brainchild of German-headquartered Hydrogenious LOHC Technology. The unique feature is that hydrogen is brought aboard chemically bonded in a thermal fluid from which it is

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SHIP DESCRIPTION

released as and when needed. The carrier oil, benzyltoluene, can be loaded and unloaded with hydrogen many hundreds of times, and enables large quantities of hydrogen to be stored and transported under ambient conditions, using the existing fossil fuel infrastructure. It is advocated as a safe and logistically advantageous alternative to compressed and fluid hydrogen, and offers a favourable energy density factor. The LOHC release unit draws hydrogen from the benzyltoluene medium on demand aboard the ship.

Last year, Johannes Ostensjo entered into a joint venture with Hydrogenious to formulate and market emission-free propulsion systems for the global shipping market based on the LOHC concept. The new company, Hydrogenious LOHC Maritime, aims to have a megawatt-scale commercial product ready by 2025. Norwegian government agency ENOVA has agreed NOK26m(US\$3m) in funding for the development by the partners of a 200kW pilot plant under the HyNjord R&D project. This will integrate three core components, comprising the LOHC release unit, a fuel cell, and an interface to the vessel's power management system.

Power delivery aboard *Edda Breeze* in the immediate term will be primarily reliant on the three main gensets, each employing a Caterpillar four-stroke engine, running on marine gas oil. The chosen 3512E design of machinery is a 170mm-bore, V12 diesel rated at 1,770kW. The aggregates are configured for variable-speed operation, integrated into the vessel's electric hybrid system using a special CAT control cabinet. The installation incorporates proprietary selective catalytic reduction(SCR) technology, ensuring Tier III compliance.

The electric cycloidal propulsion units are of the Voith eVSP type, and promise full-cycle efficiency gains while meeting exacting manoeuvring criteria. Accurate dynamic positioning, even under harsh conditions, together with optimum responsiveness, and safe and quick transfer of personnel at offshore installations, are absolutely critical to CSOV operations.

The eVSP design features an integral, permanent magnet synchronous electric motor claimed to offer a 15% power saving in transit relative to a vessel equipped with a nozzled propeller, plus efficiency gains in DP mode arising from the ability to rapidly react to the influences of wind, wave and currents. It delivers high torque and a mechanical efficiency advantage deriving from the elimination of gears and shaft lines. The proprietary VRS roll stabilisation module counteracts rolling motions by up to 70% both under way and when stationary. A troika of powerful(1,300kW) Brunvoll thrusters is tunnelled into the foreship section.

The MacGregor equipment package features an Horizon all-electric walk-to-work gangway. The solution delivered includes the largest integrated passenger lift ever fitted to a wind farm service vessel, interconnected to a 5t Colibri 3D motion-compensated crane. This enhances logistic support by allowing seamless switching between crane and gangway control from a centralised station on the vessel's bridge.

The Horizon gangway and Colibri crane were introduced to the MacGregor portfolio through the 2019 acquisition of Norwegian counterpart TTS.

 **The Horizon gangway and Colibri crane were introduced to the MacGregor portfolio through the 2019 acquisition of Norwegian counterpart TTS**

PRINCIPAL PARTICULARS - *CSOV Edda Breeze*

Design	Salt 0217
Length overall	88.3m
Length bp	77.1m
Breadth, moulded	19.7m
Depth, moulded	7.0m
Draught	5.4m
Deadweight	2,500t
Cargo deck(external)	450m ²
Propulsion system	Diesel-electric
Fuel	MGO/hydrogen-ready
Main genset engines	3 x 1,770kW
Main propulsors	2 x 1,900kW
Speed, maximum	10.5kts
Bow thrusters	3 x 1,300kW
Class	DNV
Class notations	*1A Offshore service vessel, NAUT, (A)HCS, Eo, Clean Design, COMF(V3, C3), DYNPOS AUTR, SF, DK(+), SPS-2008, BWM-T, BIS, Battery Power, HELDSK-SH, Walk2Work
Accommodation	120(97 technicians/23 crew)
Flag	Norway

Edda Wind's second CSOV from Gondan was launched on March 19 this year. She will be deployed under contract to SSE Renewables for the construction and commissioning of the initial two phases of the Dogger Bank wind farm in the North Sea, off the Yorkshire coast of England. The scheme will realise an output capacity of 3,600MW, among the largest developments of its kind worldwide.

The two 89m CSOVs booked at Colombo Dockyard will be of the Salt 0425 design, a further development of the 0217 type. The Sri Lankan builder, in which Japan's Onomichi Dockyard has 51% ownership, has augmented its workload over recent years with higher added value tonnage such as cables, anchor-handlers and hybrid-powered minibulkers. The latest contract testifies to the yard's growing capabilities.

Edda Wind has retained Ostensjo Rederi as project manager for the newbuilds in Colombo, and Norwegian suppliers will account for about 40% of the ships' main systems. As with the tonnage ordered in Spain, the pair from Sri Lanka will be prepared for hydrogen fuelling under the collaboration with Hydrogenious LOHC Maritime.

Besides the CSOVs, *Edda Wind* has two service operation vessels(SOVs) under construction elsewhere in Spain, at the Zumaia premises of Astilleros Balenciaga, in the Basque Country. Although smaller than the CSOVs, the SOVs will provide a maximum access height of 34m above the sea surface by way of an Horizon walk-to-work system tailored to the shipowner's requirements. The Balenciaga newbuilds will also benefit from the additional efficiency rendered by the centralised control station being located near the DP operator's position on the bridge.

The first of the Balenciaga pair, the 83m *Edda Brint*, has been fixed for 15 years to MHI Vestas, with the charter agreement taking effect during the second quarter of 2022. As with the CSOVs, the class has also been specified as hydrogen-ready, potentially putting the ships in the vanguard of carbon emission-free SOVs worldwide. The design type is the Salt 0358, in which the maximum number of people aboard is 60, half that of the *Edda Breeze* CSOV generation.

Edda Wind was formed in 2015 by the Ostensjo Group, and the Wilh.Wilhelmsen organisation became a partner five years later. Today, the publicly-quoted company also includes interests associated with John Fredriksen and Idan Ofer.

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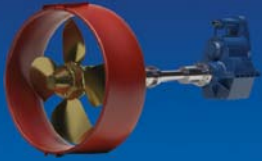
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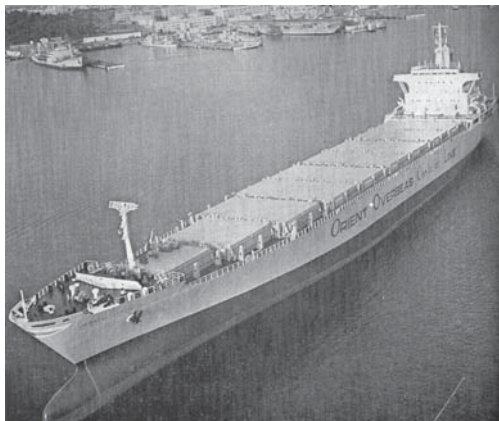
CYLINDERS AND CONTAINERS

The May 1972 issue of *The Motor Ship* kicked off with the suggestion that planned maintenance might be a good idea.

Recognising that it had been discussed with some frequency in the past, the lead article examined the perennial hot topic of cylinder liner wear rates, suggesting that initial investment in chrome plating of cylinder liners and piston grooves meant that engines could operate for as long as 20,000-plus hours between overhauls rather than the much shorter intervals then common. Indeed, the effect on reliability of frequent stripping-down and inspection was queried. It was suggested that dismantling and reassembly often left machinery in a worse state. Maybe marine engineers should learn from the aircraft industry, which put reliance on borescopes inspections or oil analysis to predict when overhaul might be required.

The ship descriptions in this issue majored on the rapidly expanding container vessel fleet. The main description concerned *Oriental Chevalier*, a reversal of current trends, being built in France for Chinese owner C Y Tung subsidiary OOCL. This was the second of a series of four 205m long 21,756 dwt vessels, carrying 477 standard 40ft containers plus a further 31 20ft boxes – equivalent to 985 TEU in current measurements – which was regarded as 'medium sized' by early 1970s standards. A single CCM-built Sulzer 10RND90 engine, rated 29,000 bhp at 122 rpm was directly coupled to a 6.4m diameter 4-bladed SMM propeller, remarkably similar to current container ship practice. One novel fuel-saving feature was a 775kW turbo-alternator, using steam from an exhaust-gas fired boiler, supplementing two 675kW diesel alternators. Trials suggested that at a 21.7knot service speed, fuel consumption was about 96t/day, equivalent to 184g/container mile, in comparison to the 240g/container mile recorded by larger (1842 TEU capacity) faster (26 knot) vessels. This was summarised as "a refreshing change from the current vogue of ever larger and faster vessels, an interesting approach to attaining economic viability in these days of financial depression." 'Plus ça change', as the ship's French builder might say if still operating today.

An example of the larger faster vessels currently in vogue was the Elbe Maru, a 53,000gt ship built for Mitsui-OSK Lines at Mitsui's Tamano yard. One of five similar, but not identical, vessels of around 1842 TEU

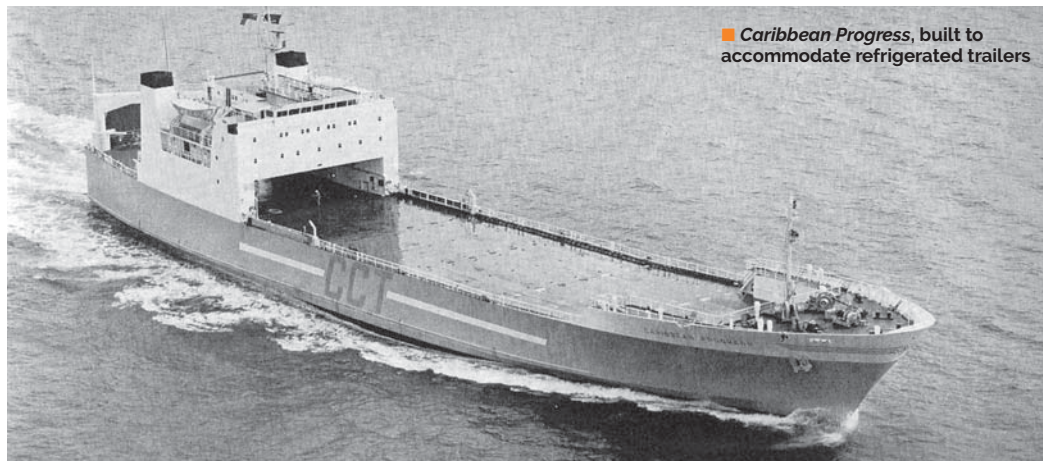


■ Chinese-owned, French-built container ship
Oriental Chevalier

capacity, Elbe Maru was powered by no fewer than three Mitsui-B&W K84EF main engines, a 12-cylinder centre engine and two 9-cylinder wing engines, each driving a six-bladed fixed pitch propeller. With total installed power of 84,600 bhp, the triple-screw boxship recorded an average 31 knots on sea trials.

The all-container vessel had not taken over completely, a third ship described was the *Caribbean Progress*, a 117m 4,084 dwt combined ro-ro/container carrier for Caribbean service. Most of the traffic was expected to be trailers with diesel-powered refrigerators so the trailer holds included flexible fuel pipes and valves so avoid mechanics carrying cans of fuel around the ship, as well as exhaust gas collection pipes and powerful ventilation fans. Twin Crossley-Pielstick 10PC2V 4,240 bhp engines were good for a service speed of 17.3 knots.

Finally, an editorial comment noted a rationalisation by the P&O group, under which five operating divisions and six corporate entities were replacing 120 previous group companies, resulting in a number of redundancies, including shore-based superintendents. Although recognising the possible short-term gains, our predecessors wrote: "It must be wondered if such drastic rationalisation will not strain the loyalties of valuable senior personnel". We wonder what they would have made of the controversial 'rationalisation' by P&O Ferries, involving some 800 staff sackings, exactly 50 years later?



■ Caribbean Progress, built to accommodate refrigerated trailers

THE MOTORSHIP

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TMS magazine is published monthly
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Digital Edition: £GBP177.00

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Registered in England Company Number 2427909.
Registered office: Spinnaker House,
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