THE
NAVAL ARCHITECT

A publication of **THE ROYAL INSTITUTION OF NAVAL ARCHITECTS**
For more related news please visit: **www.rina.org.uk**

MAY 2023

NORWAY'S ROAD TO NET ZERO

PLUS: JAPAN PUSHES FORWARD WITH LNG FERRIES

JOTUN

Committed to the green shipping movement

The need to improve sustainability in the shipping industry is accelerating. The global industry must cut carbon emissions, protect marine biodiversity and leverage the use of data for smarter decision-making.

With nearly 100 years of experience of charting through unknown waters, Jotun is committed to continuously innovate and develop advanced products and solutions designed to protect biodiversity and cut carbon emissions to support global sustainability ambitions and achieve cleaner operations for all industry players. A clean hull ensures cleaner operations.

Clean shipping commitment

VISIT US AT
NOR-SHIPPING
STAND D03–04

jotun.com

CONTENTS

May 2023

FEATURES

THE NAVAL ARCHITECT

Editor: Daniel Johnson
Editorial Assistant: Tom Barlow-Brown
Production Manager: Nicola Stuart
Publications Sales Coordinator: Henry Owen
Publisher: Dmitriy Ponkratov

Advertising Sales: J P Media Services
Email advertising: jpayten@jpmediaservices.com
Telephone: +44 (0)1737 852135

Published by:
The Royal Institution of Naval Architects
Editorial Office:
8-9 Northumberland Street
London, WC2N 5DA, UK
Telephone: +44 (0) 20 7235 4622
Telefax: +44 (0) 20 7245 6959
E-mail editorial: editorial@rina.org.uk
E-mail production: marketing@rina.org.uk
E-mail subscriptions: subscriptions@rina.org.uk

Printed in Wales by Stephens & George Magazines.

A 2023 subscription to The Naval Architect costs:

THE NAVAL ARCHITECT SUBSCRIPTION (10 issues per year)			
LOCATION	PRINT ONLY	DIGITAL ONLY	PRINT + DIGITAL
UK	£232	£232	£296
Rest of Europe	£245	£232	£308
Rest of World	£261	£232	£325
	Includes P+P	Inclusive of VAT	

The Naval Architect Group (English Edition)
Average Net Circulation 8,195 (total)
1 January to 31 December 2022
ISSN 03060209

RISE AND RISK OF THE EV

By **Daniel Johnson**

Nor-Shipping, one of the industry's most pivotal and well-attended events, returns to its regular biennial summer schedule next month following the upheaval of the Covid-19 pandemic. Bringing the global maritime community together at venues across Oslo and Lillestrøm from 6 June, organisers of the four-day exhibition and conference say this year will be its "biggest ever" event week. With shipowners, shipyards, technology innovators and investors gearing up for the show, much of the news coming out of the industry in recent weeks has taken on a particularly Norwegian flavour which is reflected in the pages of this issue of *The Naval Architect*.

When putting the issue together, one statistic that really caught my eye shows that in 2020 80% of all cars sold in Norway were electric (page 22). Along with demand for lithium-ion (Li-ion) batteries, the adoption of electric vehicles (EVs) is rising sharply as the global push for net-zero carbon emissions accelerates. There has been a significant uptake of EVs across Europe, North America and China and, according to DNV's Energy Transition Outlook 2023, released in early May, that 80% figure will be mirrored in the global vehicle fleet by 2050. Some analysts predict that EV manufacturers will be the dominant users of Li-ion batteries transported via ships by the end of this decade.

So how does the shipping industry react to this rapidly changing landscape? Insurers have long warned about the potential dangers that lithium-ion batteries can pose for the shipping and wider logistics industries, whether they are being transported inside electric vehicles or as standalone cargo. The risks of carrying them on ships was highlighted last year by Allianz Global Corporate & Speciality (AGCS) in a report that ranked fire and explosion as the number one cause of marine insurance losses by value from 2017 to 2021. Four main hazards were cited, including fire, explosion, toxic gases and the potential for thermal runaway, which is considered a likely element in the loss of the ro-ro car carrier *Felicity Ace* in March 2022.

AGCS also identified four common causes of Li-ion battery fires, listing substandard manufacture, over-charging, over-temperature by short-circuiting and damaged battery cells, which, among other causes, can result from cargo shift in rough seas if not adequately secured. It also pointed out that ro-ro and car carrier vessels can be more exposed to fire and stability issues.

Just a few weeks ago, delegates at a Lithium-ion Batteries in the Logistics Supply Chain conference held in London were warned that regulation is moving far too slowly to keep pace with the batteries and EVs, with Heike Deggim, IMO's director of Maritime Safety Division, asserting that "urgent action needed to arrive at measures to keep vessels and crews safe".

The conference was jointly organised by shipping line initiative Cargo Incident Notification System (CINS) which

CAR CARRIER *FELICITY ACE*. SOURCE: PORTUGUESE NAVY

followed it up with the launch of the first in a series of in-depth advisory publications aimed at minimising the risks of transporting Li-ion batteries and cells by sea. The guidelines, published in partnership with the International Group of P&I Clubs, the TT Club and the International Cargo Handling Coordination Association (ICHCA), provide a general overview and will be followed by three further documents: Regulatory Compliance Checklists; Risk Assessment and Emergency Response; and Training and Educational Awareness.

"We strongly urge all stakeholders in the production, supply, transport, handling and sale of lithium-ion batteries whether as individual components or integrated into an electronic device, vehicle or other product to recognise their responsibilities in maximising safety when in transit," commented Dirk Van de Velde, deputy chair of CINS. "Our guidelines will create greater awareness of the possibilities of the damaging and life-threatening incidents, which have already occurred, and instil more urgent motivation to act before more catastrophic disasters result."

CINS is also seeking further engagement with relevant regulatory bodies in search of practical changes that will help alleviate the dangers of Li-ion batteries.

The lack of regulation surrounding Li-ion batteries has seen some carriers simply ban their carriage. Norway's Havila Kystruten announced recently that it will no longer carry electric or hybrid cars on its ferries because of fire risk. The company stressed that its vessels met all current safety requirements, but that it believed the danger these types of vehicles posed to passengers and crew is too great.

Draft amendments to SOLAS for fire protection of ro-ro passenger ships constructed from 2026 will be submitted to MSC 107 at the end of May, however currently most ships lack the suitable fire protection, firefighting capabilities, and detection systems to tackle Li-ion battery fires at sea. With the incessant increase in global demand for the batteries and EVs, it would appear time for the adoption of a much more robust approach to risk management. ■

NEWS

AUTONOMOUS SHIPS

ONE SEA AND ESA JOIN FORCES ON AUTONOMOUS SHIPPING

Autonomous vessel alliance One Sea and the European Space Agency (ESA) have established a strategic collaboration to promote the development of new space-enabled services which will support the maritime sector's transition towards autonomous shipping.

The new partnership will combine One Sea's expertise in the maritime sector and in autonomous shipping with ESA's technical competence and mandate through the Business Applications and Space Solutions programme to support the development and demonstration of space solutions in addressing user needs.

Satellite communications and satellite navigation play a key role in the adoption of autonomous shipping technologies and operations. During offshore passages, ships are often further from land than satellites which can offer invaluable secure and resilient communication channels for monitoring, command, and control of autonomous ships. Furthermore, in ports and congested areas, high precision Position Navigation and Timing (PNT) provided by satellites is also critical for the safe operation of autonomous shipping.

Sinikka Hartonen, secretary general of One Sea Association, says: "We are thrilled about the possibility to collaborate with ESA. We are looking forward to finding ways to jointly support the development of safe and sustainable maritime transport."

ONE SEA SECRETARY GENERAL SINIKKA HARTONEN

"ESA is keen to kick-off the work with One Sea Association and its members to strengthen the development and adoption of space solutions as enablers of digital and autonomous shipping, accelerating the sustainable transformation of the maritime sector," adds Rita Rinaldo, head of ESA's Business Applications Projects and Studies Implementation Division.

WIND POWER

NORSEPOWER SECURES FUNDING TO BRING SAILS BACK TO SHIPPING

Finnish wind power company Norsepower has raised €28 million (US$30 million) in its latest Series C funding round to boost the production and reach of its rotor sail technology.

The round was led by French investment manager Mirova through its impact private equity fund Mirova Environment Acceleration Capital and also saw the participation of the Finnish Climate Fund (Ilmastorahasto), OGCI Climate Investments, Nefco – The Nordic Green Bank, Tesi, and Power Fund II.

According to Norsepower, the funding will help the company bolster its product research and development efforts, as well as support its marketing, recruitment and intellectual property portfolio.

CEO Tuomas Riski says: "Our goal is simple – to cut the emissions of large ships by saving fuel with our proven Norsepower rotor sails. We are going to bring a modern spin to wind propulsion technology. We empower the industry to use our product alongside other technologies to achieve zero-carbon, cost-effective sailing. With over 30,000 vessels globally that can benefit from our product, our scale-up ambitions are bold but realistic. It's a win-win for everyone, including the planet."

The Norsepower rotor sail, a modernised version of the Flettner rotor, uses a minimal amount of the ship's electric power to rotate cylinder-shaped rotors on its deck.

The product has been used by customers for more than eight years and has 250,000 operating hours of verified performance data gathered from several shipping companies and charterers, including Bore, Sea-Cargo, Scandlines, Vale, CLdN, Socatra and Nippon Marine.

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

"THE BLUE MBA PROVIDES GREAT INSIGHT INTO ESSENTIAL ASPECTS OF THE SHIPPING AND LOGISTICS INDUSTRY. WITH WORLD-CLASS TEACHING STAFF AND SENIOR PARTICIPANTS FROM MANY PARTS OF THE INDUSTRY, IT IS A DYNAMIC LEARNING EXPERIENCE COUPLING THEORY AND PRACTICE IN INTERACTION."

EXECUTIVE MBA IN SHIPPING AND LOGISTICS (THE BLUE MBA)

A unique industry needs a unique MBA. Take your career to the very top international level by joining the world's premier Executive MBA designed specifically for shipping and logistics professionals.

Find out more details from Programme Director, Irene Rosberg
Visit bluemba.cbs.dk or email ir.mba@cbs.dk

CBS EXECUTIVE MBA IN SHIPPING & LOGISTICS
COPENHAGEN BUSINESS SCHOOL

EQUIS ACCREDITED · AACSB ACCREDITED · ASSOCIATION OF MBAS ACCREDITED

ALTERNATIVE FUELS

PROVARIS LAUNCHES COMPRESSED HYDROGEN FLOATING STORAGE SOLUTION

Australian energy company Provaris has unveiled plans for a new hydrogen floating storage vessel for various applications, including bunkering for the maritime sector, intermittent/buffer storage for green hydrogen production, and long-duration storage for excess renewable energy.

The concept, named H2Leo, has been designed with a capacity range of 300 to 600tonnes of compressed hydrogen gas, expandable up to 2,000tonnes.

"This solution provides the global hydrogen industry with an energy efficient and cost-effective storage solution," according to the company.

Leveraging the FEED-level engineering, safety studies, and design approval for Provaris's H2Neo hydrogen carrier received in December 2022, the American Bureau of Shipping (ABS) has also provided approval in principle (AiP) for H2Leo.

The floating storage unit will have two cargo tanks with independent isolation, safety valves and manifolds for compressed hydrogen transfer. ABS has carried out risk and safety workshops to assess and mitigate hydrogen handling risks and Provaris will work with ABS for design approval, cargo tank testing and construction.

The H2Leo class will have a fixed beam and depth of 31m and 17m respectively, with length and draught varying according to the specified cargo capacity.

Per Roed, Provaris chief technical officer, says: "The H2Leo is a flexible hydrogen floating storage unit that can be optimised in size, capacity and operations for different applications. Its SIMOPS (simultaneous operations) capability allows for continuous operations, and it has a large working deck and hull for installing auxiliary systems such as compression and hydrogen bunkering."

The development of H2Leo will run parallel to the remaining engineering and approvals for H2Neo, targeting prototype testing and final class approval later this year, with H2Leo set to become available in 2025.

OFFSHORE

OFFSHORE WIND INSTALLATION FIRM DOUBLES UP ON MEGA JACK-UP ORDER

Norway's Havfram Wind has ordered a second wind turbine installation vessel from CIMC-Raffles in China.

The order represents the first optional vessel in an existing shipbuilding contract with CIMC-Raffles, and the vessel design will be similar to the first GustoMSC NG20000X jack-up vessel currently under construction.

The latest battery hybrid drive train technology is incorporated in the design to reduce carbon emission per installed megawatts of offshore wind capacity.

The NG20000X self-propelled jack-up has a hull length of 151m and the capability of installing offshore wind turbines with a rotor diameter of more than 300m, as well as XXL monopiles weighing up to 3,000tonnes at water depths of up to 70m.

Capacities have been optimised for high variable deck load and extreme lift heights expected over the next decade, according to Havfram. The crane has a lifting capacity of 3,250tonnes.

The vessel is expected to be delivered in the late fourth quarter of 2025.

"Globally, we experience a steadily growing demand for offshore wind capacity. At the same time, developments within wind turbine technology cause larger wind turbine components and require therefore larger wind turbine installation vessels," says Martin Degen, Havfram Wind commercial director and vice president.

"The decision to order a second NG20000X jack-up vessel with CIMC Raffles is based on the good established co-operation with the shipyard and several commitments with major offshore wind developers. As previously announced, we have signed a contract with Ørsted to install wind turbines at their Hornsea 3 project, starting in autumn of 2026," adds Even Larsen, CEO of Havfram Wind.

THE SECOND VESSEL WILL BE REPLICA OF THE GUSTOMSC NG20000X JACK-UP. SOURCE: HAVFRAM WIND

IN BRIEF

DECARBONISATION

G7 PUSHES FOR ZERO EMISSIONS BY 2050

A meeting of G7 climate, energy and environment ministers held under the Japanese G7 presidency in Sapporo, Japan, has reiterated its commitment to achieving zero greenhouse gas emissions from shipping by 2050, putting pressure on the International Maritime Organization to follow suit at July's Marine Environment Protection Committee (MEPC) meeting. The G7 ministers also agreed to introduce intermediate targets for 2030 and 2040 in line with efforts to limit the temperature increase to 1.5°C above pre-industrial levels.

SHIPBUILDING

ICONIC YARD DELIVERS AGAIN

The iconic Belfast shipyard Harland & Wolff, once the builder of some of the world's most famous ships, including the ill-fated *Titanic*, has delivered its first complete vessel in more than 20 years. The barge, which has been transported to London by sea, is the first of an order of 23 to be delivered to a waste management firm Cory Group. The shipyard is due to begin work on a much bigger construction contract for the Royal Navy in 2025.

CLASSIFICATION SOCIETIES

CLASSNK RELEASES SHIPBOARD CCSS GUIDELINES

ClassNK has announced the publication of new guidelines for shipboard carbon capture and storage systems (CCSS). Available to download via the classification society's website, 'Guidelines for Shipboard CO_2 Capture and Storage Systems' cover an overview of shipboard CCSS, including safety requirements related to the systems and their installation on the ships, and provisions for the notation indicating the vessels are equipped with such systems or designed as "ready" for their installation.

TANKERS

VITOL'S V-BUNKERS UNVEILS SINGAPORE'S FIRST ELECTRIC-HYBRID BUNKER TANKER

Vitol's Singaporean bunker operations company, V-Bunkers, has taken delivery of its first electric-hybrid bunker tanker. Classed by Bureau Veritas (BV), *Marine Charge* features advanced energy storage and charging technologies that will help curb greenhouse gas emissions (GHG) from port operations in Singapore.

V-Bunkers placed an order with Chinese yard Zhejiang Shenzhou Sunshine Heavy Industry for two of these 103m vessels in 2021, with the second tanker, *Marine Dynamo*, scheduled for delivery in Q2 2023. The bunker tankers are designed to significantly reduce carbon emissions in port locations and will be deployed for harbour operations within Singapore.

"We are delighted to be the first to bring ESS technology to the local bunker craft sector and thus contribute to the reduction of emissions in the port of Singapore, the world's largest bunkering port," says Mike Muller, head of Vitol Asia. "We consider deployment of these two electric-hybrid bunker tankers to be an important step forward in Singapore's decarbonisation journey."

Both tankers are built with BV's Electric-Hybrid notation and feature state-of-the-art energy storage systems (ESS) technology, comprising lithium-ion batteries and a highly automated power management system (PMS), to achieve an estimated 10% reduction in GHG emissions.

BV's notation addresses the complexity of electric hybrid system implementation, defining requirements for storage, power distribution, control, and instrumentation, as well as tests that must be carried out to validate power management and critical safety considerations, such as thermal runaway.

"It is heartening to see the industry embrace sustainable solutions to reduce carbon emissions and improve energy efficiency. V-Bunkers' electric-hybrid bunker tankers are a positive step towards building a greener and more sustainable future for Singapore's port operations," says David Barrow, BV vice-president for South Asia and Pacific.

V-BUNKERS' FIRST ELECTRIC-HYBRID BUNKER TANKER, *MARINE CHARGE*

SIGN UP TODAY

The 24th edition of Europe's largest commercial marine and workboat exhibition, is a proven platform to build business networks.

Seawork delivers an international audience of visitors supported by our trusted partners.

Seawork is the meeting place for the commercial marine and workboat sector.

- 12,000m² of undercover halls feature 500 exhibitors with over 70 vessels, floating plant and equipment on the quayside and pontoons.
- Speed@Seawork on Monday 12 June at the Royal Yacht Squadron in Cowes offers a sector specific event for fast vessels operating at high speed for security interventions and Search & Rescue.

  Speed@Seawork Sea Trials & Conference
- The European Commercial Marine Awards (ECMAs) and Innovations Showcase.

  ecm awards european commercial marine in partnership with SIEMENS
- The Conference programme, chaired by industry experts, helps visitors to keep up to date with the latest challenges and emerging opportunities.
- The Careers & Training Day on Thursday 15 June 2023 delivers a programme focused on careers in the commercial marine industry.

sea WORK MARINE CIVILS

IN PERSON ONLINE

13 TO 15 JUNE 2023 | Southampton United Kingdom

For more information visit: seawork.com
contact: +44 1329 825 335
or email: info@seawork.com

#Seawork mercatormedia magazines|events|online

Media partners

MARITIMEJOURNAL COMMERCIAL MARINE BUSINESS

BOATINGBUSINESS THE UK LEISURE MARINE BUSINESS

NEWS ANALYSIS

SLUMPS, SURGES, SAFETY AND SURVEYS

By **Malcolm Latarche**, Correspondent

Following a string of record breaking boxships over the last few months, the sad state of the sector has been revealed in recent reports on container freights. In mid-April, *MSC Loreto*, the first of *MSC Irina*'s 23,346TEU five sisters, was delivered to Seaspan Corporation by Yangzi Xinfu Shipbuilding, a subsidiary of Yangzijiang Shipbuilding Group. With more ULCSs due in the coming months, the pressure on rates is not likely to lift soon.

Norway-based container market analyst Xeneta in its monthly report described April as being a 'torrid time' for the container shipping industry with global long-term ocean freight rates diving 10.6%. All regional trade lanes registered month-on-month declines. Xeneta's Shipping Index, which crowd-sources container rates data to track real-time developments, shows prices have now slumped 13.6% in 2023 alone and that rates have declined for eight months in a row.

Xenata CEO Patrik Berglund said that while April's rates are still 5% up on 2022, "it looks unlikely that year-on-year growth will be maintained much longer and we can very likely expect further falls ahead."

In the liquid trades, things look very different. LNG carrier orders are at a record and tankers meanwhile are showing a resurgence of interest. Clarkson Research reports a record 325 LNG carriers are now on order, equivalent to about half of the existing fleet and around 80% of these – 268 ships – are destined to serve new liquefaction capacity now under construction. The general feeling is that last year's record annual orders of 184 ships will not be matched but predictions of over 100 new ships this year demonstrates confidence in the need for new vessels.

April saw a surge in new tanker orders which some analysts put down to a low orderbook and a likely need for over 100 new ships this year just to maintain fleet size. New Times shipyard picked up an order for 8 + 8 Suezmaxes from Greek interests, Shanghai Waigaoqiao and order for a pair of scrubber-fitted Suezmaxes from Seatankers Management and South Korean builder DH Shipbuilding secured another order for a pair of Suezmaxes from Euronav. There were also some orders for smaller vessels and chemical tankers for a variety of yards.

Away from the world of newbuildings, safety was very much on the minds of the authors of a new report by Singapore-based Maritime Technologies Forum (MTF). The report covers what the MTF sees as gaps in operational management practices and crew training requirements in connection with decarbonising the shipping industry and in particular within the International Safety Management (ISM) Code, International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) and The Maritime Labour Convention (MLC).

CREW TRAINING WILL BE CRITICAL IN SAFELY ADOPTING ALTERNATIVE FUELS AT SCALE. SOURCE: SHUTTERSTOCK

Nick Brown, CEO of Lloyd's Register which led the study, said: "Understanding the challenges in safely adopting alternative fuels at scale is a critical step to accelerating maritime decarbonisation. This research, led by LR lead marine consultant Yildiz Williams, provides much needed clarity on the hurdles we face as an industry in the safe operation of alternative fuels and the recommendations to overcome those challenges."

Publication of the MTF report coincided with the results of a survey by a consortium comprising the Global Maritime Forum, the Global Centre for Maritime Decarbonisation and the Mærsk McKinney Møller Center for Zero Carbon Shipping. The survey of almost 30 of the leading shipping companies revealed that over 80% expected that in future their fleets would be operating on at least three different fuel or power 'families' with 45% contemplating four or more fuel types. The families suggested by the survey linked interchangeable fuels together, with heavy fuel oil, marine gas oil, marine diesel oil, and biodiesel making up one category and LNG, biomethane/bio-LNG, and synthetic/e-methane/e-LNG making up another. Methanol and ammonia also featured as options and were seen as areas of growth. The survey revealed that in 2030 operators anticipated two thirds of their ships still running on fuel oils but that falling to 17% by 2050.

The least-popular family of measures was alternative power, which includes solar panels and wind assistance; 38% of respondents had no adoption of alternate power, 50% had plans but no pilots of the measures, 8% had piloted the measures and not yet adopted, and 4% had pilots with rollouts on the way. No respondents had alternative power deployed at scale. ■

WWW.MARINTECCHINA.COM

MARINTEC CHINA 2023

中国国际海事技术学术会议和展览会

REBUILD TOGETHER 构建未来

Scan to Marintec China website

5 - 8 DEC 2023

SHANGHAI NEW INTERNATIONAL EXPO CENTRE
上海新国际博览中心

marintec china

Organised and Managed by 承办单位

Informa Markets

SSNAME
上海市船舶与海洋工程学会

Co-sponsored by 协办单位

China State Shipbuilding Corporation Limited
中国船舶集团有限公司

China Association of the National Shipbuilding Industry
中国船舶工业行业协会

Chinese Society of Naval Architects & Marine Engineers
中国造船工程学会

NEWS EQUIPMENT

ENGINES

WÄRTSILÄ 25 ENGINES PICKED FOR THUN TANKERS

Wärtsilä has been selected to supply the engines for four new resource efficiency 'R-class' chemical tankers being built for Swedish fleet owner Erik Thun.

The 115m, 7,999dwt ships will be constructed by Ferus Smit shipyard in the Netherlands with delivery from 2024 and onwards.

The vessels will operate with the Wärtsilä medium-speed four-stroke 25 engine, the latest addition to the company's engine portfolio, which features "outstanding fuel economy, low emissions, and smoke-free operation at all loads". The engine is also future-fuels ready.

VISUALISATION OF AN R-CLASS VESSEL IN THE KIEL CANAL. SOURCE: ERIK THUN

"Decarbonisation is a key driver for our operations. It makes total sense, therefore, for us to select the Wärtsilä 25 engine," says Henrik Källsson, deputy managing director at Erik Thun. "We recognise the reliability, fuel efficiency, and compact design of the engine, and the option to operate with clean future fuels is very important to us. We are impressed with the investments Wärtsilä is making by developing these very modern and future-proof engines. We believe the Wärtsilä 25 is the world's most advanced engine in the 2,000kW range."

"We have had a long-term partnership with Wärtsilä and have developed a mutual trust over the years. We appreciate their brave approach in enabling the marine industry to achieve decarbonisation via these new engines that are capable of being converted to run on alternative fuels," says Patrick Kuiper, mechanical designer at Ferus Smit.

PROPULSION

STADT RECOGNISED FOR INNOVATION IN PROPULSION

Norwegian electric propulsion specialist STADT has been presented with the RINA-QinetiQ Maritime Innovation Award 2023.

The award, which is presented by RINA in conjunction with QinetiQ, recognises outstanding scientific and technology research and development in maritime technology areas like propulsion and hydrodynamics.

CEO and owner Hallvard Slettevoll received the award on behalf of STADT during the RINA Annual Dinner from RINA's president, Catriona Savage, on Thursday, 27 April in London. More than 300 RINA delegates and members took part of the event.

The award was made in recognition of the development of STADT Lean Propulsion – a patented electric propulsion technology with a range of attributes never previously achieved in a propulsion solution.

HALLVARD SLETTEVOLL RECEIVES THE AWARD FROM RINA PRESIDENT CATRIONA SAVAGE

According to the RINA awarding committee: "It is an innovative, unique and patented stealth electric propulsion technology. Supporting the goals and requirements of the next generation of naval surface ships – as well as very obvious, commercial vessels and applications.

"The STADT Lean Propulsion system has features that has not been achieved in previous propulsion solutions. Its most impression feature being is its completely silent, stealth operation, which is already been adopted in a series of naval ships and commercial vessels.

"The systems impressive efficiency comes from its very low power loss. At time contributing to lower emissions and a reduced carbon footprint."

Hallvard Slettevoll comments: "STADT is honoured to receive the 2023 RINA Maritime Innovation Award in a competition with other international and world leading design and technology companies. As a world leading institution and society for the maritime industry and universities all around the world, RINA's award and approval is a recognition of our efforts, our technology and achieved results for propulsion excellence."

COATINGS

STOLT TANKERS OPTS FOR GRAPHENE-BASED PROPELLER COATINGS

Norway's Stolt Tankers, a subsidiary of Stolt-Nielsen, has become the first chemical tanker company to apply Canada-headquartered Graphite Innovations & Technology's (GIT) graphene-based propeller coatings to its fleet.

Stolt Tankers will apply GIT's XGIT-PROP coating to the propellers of 25 ships during 2023.

XGIT-PROP is said to be "eco-friendly" and is designed to release the growth of fouling on ship propellers and reduce the frequency of propeller 'polishings' or cleanings after two to three coats. It also maintains the propulsive efficiency of the propeller and reduces damage due to cavitation, thereby lowering noise emissions.

According to Jose Gonzalez Celis, energy and conservation manager at Stolt Tankers, the propeller coatings were a simple way to maximise fuel savings and minimise emissions. "The shipping industry needs innovators like GIT to help drive change and make a significant positive impact on our oceans. Our agreement with GIT will mean we can protect our oceans without compromising operational efficiency," he says.

"I can't say enough about the Stolt Tankers team and their desire to achieve their ambitious sustainability goals. Our XGIT-PROP puts this desire into action. They were able to measure significant improvement in fuel efficiency while ensuring they help maintain healthy and vibrant oceans," adds Mo AlGermozi, co-founder and CEO at GIT.

In April 2022, Stolt Tankers completed a trial of the GIT graphene propeller coating on the 29,709dwt *Stolt Acer*. The company noted a significant reduction in fuel consumption and subsequently applied the coating to five additional ships.

XGIT-PROP IS DESIGNED TO BRING DOWN MARINE GROWTH AND ENHANCE PROPULSION EFFICIENCY. SOURCE: STOLT TANKERS

ALTERNATIVE FUELS

GOAL-BASED APPROACH TO NEW FUEL TECHNOLOGIES CALLS FOR COLLABORATION

By **John Bergman**, CEO, Auramarine

Looking at ship orders this year, we see that methanol is strongly gaining popularity as an alternative fuel. Based on today's orderbook according to DNV's Alternative Fuels Insight platform data, by 2028 we expect to see 25 methanol-fuelled vessels in operation and a further 81 on order.

It is not a race or a contest between fuels. Rather it is growing recognition of the fact that there will be no 'silver bullet' new fuel. The industry as a whole will need to take a fuel-agnostic and collaborative approach to decarbonisation, because each vessel and fleet will have different requirements and limitations.

One of the first considerations for any shipowner – whose decisions will impact the work of naval architects working with them – is where regulations are pushing them and how the scale-up of new fuel production and infrastructure is being supported.

On 23 March 2023, European Union (EU) co-legislators agreed on FuelEU Maritime – the new EU regulation ensuring that the greenhouse gas (GHG) intensity of fuels used by the shipping sector will gradually decrease over time, by 2% in 2025 to as much as 80% by 2050. The European Commission specifically stated that FuelEU Maritime takes a goal-based and technology-neutral approach, allowing for innovation and the development of new fuel technologies to meet future needs and offering operators the freedom to decide which to use based on.

There is recognition within the industry of the role that LNG will play as a transitional fuel, and dual-fuel LNG ship orders remain strong. Despite the growing interest in methanol, LNG is still the most widely used alternative fuel – 81% of all vessels ordered with alternative fuels last year will run on LNG.

Biofuel is another viable fuel that is gaining traction. It is worth noting that although biofuels can be used as marine fuels in the same way as conventional fuel oils, they have some properties that need to be considered. Biofuels can be corrosive and every element of material used in a fuel supply system must be examined to ensure a safe environment for the fuel. We expect to see a greater volume of global biofuel bunkering this year and continued development work to upscale its infrastructure. As a sustainable fuel, biofuels are one of the most feasible future fuels. A thorough and consultative approach is required to find the best solution for each ship and to avoid any negative impact to the ship's fuel systems.

AURAMARINE CEO JOHN BERGMAN

From regulatory point of view, there are still some calculation challenges; as DNV reports, EU Directive 2018/2001 (EU RED II), Annex V, Part C provides a methodology for calculating greenhouse gas emissions from the production and use of transport fuels where the CO_2 emissions of biofuels shall be taken to be zero. However, the IMO's EEXI and EEDI only consider emissions on a tank-to-wake basis, so the use of biofuels has no impact. The effect of biofuels on the IMO's CII could be significant, but the associated calculations may be subject to approval by the vessel's flag administration.

Regional developments

The new fuels market is projected to grow in 2023, and it will not be purely driven by regulations. Growing global awareness of the acute climate challenge is resulting in increased pressure being placed on shipowners by cargo owners, charterers and the financial community.

A regional transition is also underway in the shipping industry, which is likely to accelerate in 2023. The Asia marine fuels market is projected to grow this year, and it can be expected that biofuels will reach five million mt/year in Singapore by 2030 on the back of the development of the Maritime and Port Authority of Singapore's (MPA) quality standard for biofuel blends.

China's general marine fuels market is expected to grow to around 4.5% next year due to high trade activities with major global economies. Specifically, its biofuels market is likely to see strong growth between now and 2031; the key driver being the growing need for cleaner fuels in cities and ports to reduce GHG emissions.

The scaling up of low and zero-carbon fuels is moving in many positive directions, but the production and bunkering infrastructure will take time to develop to ensure availability and supply at the right price. Not all new fuels will be

available simultaneously; methanol is currently available in over 100 major ports, and LNG is offered in around 150 ports. Large scale introduction of biofuels (and ammonia in the future) still requires efforts and collaboration between engine and fuel system manufacturers, biofuel suppliers, shipowners and infrastructure. Many shipowners are therefore hedging their options.

To support the varied needs of shipowners globally, Auramarine takes a holistic, fuel agnostic approach to our fuel supply systems. We want to ensure there will be technology available to reliably support all the fuel choices emerging. We believe that it is important that the maritime industry has the tools and partners it needs to safely manage their fleets as the marine fuel supply chain transforms and becomes more complex.

At Auramarine, we have already developed a fuel supply unit to support the uptake of methanol which has received significant interest among shipowners, operators, OEMs and shipyards. Projects are expected this year, and to support the demand we anticipate, our new factory in Shanghai has a dedicated production line for methanol fuel supply systems. The total capacity of our new factory is up to 500 fuel supply units for various fuel types per year.

The new factory will also act as a base for our research and development programme because we recognise the industry's need for more than one new fuel to satisfy its diverse demands. Ammonia is starting to gain traction, as it is inherently zero-carbon. According to Clarksons, more than 130 orders have been placed for ammonia-ready vessels globally. New ship designs are emerging, and technology development is proceeding at pace.

Infrastructure is not yet available for large-scale uptake, and further research is required, but throughout 2023, we expect to see more developments in ammonia as a marine fuel as the technical challenges are resolved. At Auramarine, we are participating in that process, developing an ammonia fuel supply system to ensure ship owners can have confidence in this fuel choice.

Regulation continues to evolve

The decarbonisation of international shipping is a priority for the IMO and by mid-2023, it is expected to agree on a revised and strengthened Strategy on Reduction of GHG Emissions from Ships. To support the need for more information on new fuel availability, the IMO's Marine Environment Division has launched a project to evaluate the state of readiness and availability of low- and zero-carbon ship technology and marine fuels.

While it is uncertain how much the results of the study will influence the IMO's targets, shipowners can expect further pressure to adopt new fuels, and Auramarine continues to support them with a fuel-agnostic and collaborative approach to its technology developments. ■

ENGINE HEALTH AND LUBRICANTS MUST NOT BE OVERLOOKED AS ALTERNATIVE FUELS EMERGE

By **Gianluca Marucci**, technical services director, Castrol Global Marine and Energy

While alternative fuels may be shipping's current area of focus, it must not be forgotten that fuels and lubricants are intrinsically linked. Any change to either – be it in terms of supply, specification or type – could have a knock-on effect on the other – potentially impacting engine health, crew safety and vessel emissions.

Alternative fuels are understandably a focus of the industry as they can offer large emissions reductions required to meet regulatory targets. At the time of writing, the EU's 'Fit for 55' goal is to have reduced greenhouse gas (GHG) emissions by at least 55% by 2030 compared to 1990 levels. The IMO is targeting a 40% reduction in the carbon intensity of all ships by 2030 and aims to cut the annual greenhouse gas emissions from international shipping by at least half by 2050, both compared with 2008 levels.

While alternative fuels are considered to meet these targets, at the same time incremental vessel and engine efficiency gains achieved through proper maintenance and lubrication should not be overlooked. These are critical to alternative fuels safely achieving their full decarbonisation potential. So, how can the industry ensure lubricants are given due attention?

Collaboration in practice

If shipowners and operators are to be supported in whichever fuel or technology they choose to navigate the marine decarbonisation transition, lubricant providers must continue to collaborate closely with original equipment manufacturers and industry coalitions, as well as shipowners and operators themselves, to prepare for new and emerging technologies.

Castrol recently collaborated closely with MAN Energy Solutions (ES) on its Cyltech 40 XDC cylinder oil, which can be used for ships operating on LNG and methanol, as well as conventional fuels. The cylinder oil achieved Category II Status from MAN ES in July 2022 after extensive field testing. MAN ES introduced the new performance category for Mark 9 and above two-stroke engines after these engines were recognised to require cylinder oils with excellent overall performance and a special focus on cleanliness.

This is an example of practical collaboration required to ensure suitable lubricants are developed alongside alternative fuels and green engines. Close collaboration also helps to maintain and even improve crew safety measures, reliability standards, and best practises as the marine industry goes through unprecedented changes. Best practises around condition monitoring and oil analysis, for example, are ever-important as alternative fuels are increasingly used.

The monitoring and testing evolution

Marine engines are critical to shipping's decarbonisation journey, but they are also vulnerable, as the optimal pairing of fuel and lubricant is a complex decision in today's landscape. The careful monitoring of lubricant performance and engine conditions, as well as in-depth oil analysis, can help reduce the risk of engine issues that may impact the safety of crew, especially those in the engine room, by highlighting any minor issues before they become major and ensuring equipment is in good condition. This also protects expensive engine assets, minimises loss of earnings and financial inconveniences for operators, and ensure engines are running at optimal efficiency, reducing a ship's fuel use and emissions.

The need for these advanced condition monitoring and oil analysis services is only set to increase as the use of off-specification fuels, often unbeknownst to the shipowner and operator, adds to an already complex landscape. A 2022 research paper entitled 'Testing Times' by Lloyd's Register and Thetius estimates that more than one million metric tonnes of off-specification or non-compliant fuels are detected each year, costing ship operators between US$27,000-US$50,000 per incident.

As previously established, lubricants and fuels are interconnected, so any change in fuel specification, contamination or unknown fuel blends may impact lubricant choice and performance. Fuel testing is being cited as one means of protection against bad bunkers. But at the same time, the careful monitoring

GIANLUCA MARUCCI, CASTROL GLOBAL MARINE AND ENERGY TECHNICAL DERVICES DIRECTOR

of lubricants also holds the potential to reduce damage to assets that could result in downtime, loss of earnings, and operators being stuck with the costs of repair.

If the fuel is considered a ship's energy source, the lubricant should be considered its blood, providing essential evidence as to the current health and condition of the engine and critical machinery. Digitalisation is also enhancing condition monitoring and testing capabilities and is challenging conventional ways of thinking and working in the marine industry more broadly. Digital monitoring, predictive maintenance and remote data analysis using the latest technology such as artificial intelligence are increasingly important.

At Castrol, we have embraced digital technologies, but we do recognise that these solutions are most effective when they are used in tandem with human intelligence and expertise. Digital technology alone cannot always be relied upon to effectively interpret data and provide shipowners and operators with actionable insights. Often the most efficient and effective solution to an engine issue is to quickly get an expert's advice wherever you are in the world.

The bottom line is that lubricants should remain on the engine and not be overlooked as alternative fuels continue to come on the market in the coming years. The increased complexity that these new fuels will herald amplifies the role that lubricant suppliers must take, as consultants and service providers. Using both artificial and human intelligence, lubricant providers are well placed to step up to the industry challenges and provide services, such as advanced condition monitoring and oil testing, that will ensure smooth sailing and, ultimately, contribute to the industry's decarbonisation journey. ■

IMO

PANAMANIAN NAVAL ARCHITECT TARGETS IMO'S TOP JOB

By **Richard Halfhide**

In July, the IMO Council will convene for the election of a new Secretary General. Needless to say the pending appointment will come at a critical time for the organisation, particularly with regard to the growing outside pressure to adopt binding and robust instruments to tackle shipping's carbon emissions. As befits one of maritime's most prominent roles the position has attracted candidates with a wealth of experience, many of them well known within the industry.

Among these one name is notable for his long association with the organisation, both as a representative of the Panama Maritime Authority (AMP) and later as an integral member of IMO staff. Originally a naval architect by training Arsenio Antonio Dominguez Velasco has played a pivotal part in such matters as the development of anti-piracy measures, the Ballast Water Management Convention and addressing the plight of seafarers during the Covid-19 pandemic.

Speaking at London's Panamanian Embassy, Dominguez tells *The Naval Architect* that 25 years of navigating IMO politics, during often challenging circumstances, make him ideally positioned to lead the organisation towards a less bureaucratic, more transparent way of conducting its business.

He explains: "To appreciate what is needed for IMO you have to know what it has been, where it needs to go, be knowledgeable enough about the organisation's internal aspects to understand what can be done to improve the processes and how we support the member states. I have the energy, the willingness, experience and expertise to take it to the next level."

Environmental focus

Since the start of 2022, Dominguez has served as director of the Marine Environment Division, where much of the daily operations revolve around supporting the work of the Marine Environment Protection Committee (MEPC), which he had previously chaired while serving as Panama's ambassador to IMO between 2014 and 2017.

Unsurprisingly the environmental agenda is foremost among his strategic priorities but he's keen not to downplay the considerable progress already made, citing the air pollution provisions of MARPOL Annex VI (adopted 1997) and Energy Efficiency Design Index (EEDI, adopted 2011), which marked the first time a UN-affiliated organisation had agreed to mandatory measures.

Dominguez acknowledges that five years on from the initial GHG strategy in 2018 maritime is now lagging behind other sectors, but is confident that MEPC 80 can deliver the necessary short- and mid-term measures on the roadmap towards decarbonisation by the middle of the century. He describes the recently implemented Carbon Intensity Indicator (CII), a tool which raises supply chain questions that hitherto fell outside IMO's remit, as a "great achievement", albeit one which must continue to evolve and incumbent upon the flag states to effectively police shipowners making no obvious effort to comply.

"When the 2020 sulphur cap came into force developed a form for ships to demonstrate they tried to get compliant fuel but for whatever reason couldn't. Then at least a ship could demonstrate it at least tried its best to meet the requirement. Obviously if it's a recurrent situation then the port state control would need to take the necessary measures."

Dominguez also advocates the adoption of some form of economic measure to support the funding of decarbonisation. "We currently have five proposals on the table, including levy and fee-based proposals. What's important is that we gather the necessary agreement to move forward with an economic measure that is going to support this transition. We need to support the most vulnerable members, which are small and developing states. I would favour bringing these parties with different proposals together because they have commonalities."

Data-driven

IMO's funding depends upon the contributions of member states based on the tonnage of their fleets. But Dominguez is conscious of how much of this funding depends on continued goodwill and confidence in the organisation, making effective technical support for those that might be

ARSENIO DOMINGUEZ

IMO CANDIDATES

Seven nominations have been received for the Secretary General elections, which are scheduled to take place on 18 July:

- Mr Moin Uddin Ahmed (Bangladesh)
- Mr Suat Hayri Aka (Türkiye)
- Mr Arsenio Antonio Dominguez Velasco (Panama)
- Dr Cleopatra Doumbia-Henry (Dominica)
- Mrs Nancy Karigithu (Kenya)
- Ms Minna Kivimäki (Finland)
- Mr Zhang Xiaojie (China)

The Council's decision will be submitted to the 33rd session of the IMO Assembly for approval in late 2023. The successful candidate will formally take office on 1 January 2024.

struggling to meet their obligations with instruments such as the Hong Kong Convention for ship recycling.

He explains: "Technical cooperation starts with an assessment of the needs of the member states. We have the Member States Audit Scheme as well as the needs that are expressed during discussion, which allows us enough information to do an assessment, then tailor the activity and carry it out.

"The important part is how we're going to measure over a period of time, say two to three years, to review the success of that activity then go back and measure it again. Then we look into where that success has been replicated in others, as well as where success wasn't achieved and the member state still needs additional support.

"That gives us the opportunity to better use the resources, both human and financial, and thereby become more attractive to donors outside, and we can provide tangible results into the implementation of the 2030 Agenda for Sustainable Development. Of course, these sustainable cooperation activities are focused on developing countries, particularly the LDCs [Least Developed Countries]."

Proud Panamanian

Maritime wasn't an obvious career choice for Dominguez, whose father worked for the country's electricity company. Nevertheless, his interest in shipping led him to study ship design, construction at the University of Veracruz, Mexico. He returned home six years later and found employment as an assistant manager in the steel department of a repair yard. Then, in 1998, the formation of the AMP, which consolidated the country's previously disparate maritime interests into a single entity, offered Dominguez the opportunity to join its new office in London.

Although based in the UK ever since he's proudly Panamanian. "That's why I feel sometimes I have the right to criticise my country when there's a need to push for things to get better. When I joined we were on the grey list and black list of several MoUs and one of my focuses was to make it known that Panama is not just ship registration per se but much more than that."

Shortly after coming to the UK, Dominguez found himself immersed in the implementation of the STCW Convention for seafarers, representing Panama at meetings of IMO and ILO which led to the development of the Maritime Labour Convention. Coming from a technical background he had little experience of the way such organisations operated but quickly grew to appreciate the impact their decisions have upon society as a whole.

The human element has remained a strong area of focus and, while engaged as director of IMO's Administrative Division, Dominguez led the organisation's response to the Covid pandemic, encompassing not only the logistics of ensuring the organisation could continue to operate but also the humanitarian crisis of hundreds of thousands of seafarers unable to return to their homes for months on end.

"One area that was an awakening for me was how difficult it was making other entities aware how important shipping is. This is where the organisation needs to change and start looking outside and learning from other sectors. We share the same challenges when it comes to decarbonisation and diversity so let's get onboard with them."

"The pandemic was exceptional circumstances and it took a lot of discussion with the member states. But one positive was how the industry got together very quickly and involved other UN agencies. The WHO were very supportive towards us in delivering vaccines and getting their member states to start recognising seafarers as key workers. There is still work to be done in facilitation and with shore leave limitation, but let's see how technology will start providing a better image of what seafaring is in order for us to be more attractive."

Communicating better

The mantra of shipping's need to communicate better with the wider world is one that resonates through much of Dominguez's rhetoric. In 2021, IMO's current Secretary General, Kitack Lim, found himself on the receiving end of harsh rebukes when investigative journalists 'doorstepped' him outside his London home after he allegedly avoided their requests for an interview. By contrast his would-be successor is keen to emphasise his belief in candour.

"The more that we talk the better IMO is understood. Yes, decisions are ultimately made by the member states but we play a role in that process. It's not about passing the blame because it's beyond my mandate.

"I don't believe in negative press because when there's news out there it gives us the opportunity to look at whether we're communicating our successes the right way, or if the message is not getting across the way it should. At the same time are we knowledgeable enough of how people are seeing us? We are so global but we only seem to be on the news when something bad happens."

"I believe in an IMO that is open and transparent, inclusive and diverse. The moment that you face all this you can take action. What is important for me is that we can stimulate the exchanges and discussions. The more we do that the better we collaborate," he concludes. ■

NORWAY

NORWAY'S ROAD TO NET ZERO FINDS LEADERS IN THE SHIPPING INDUSTRY, BUT WILL IT BE ENOUGH?

By **Tom Barlow-Brown**

A DOMESTIC CRUISE SHIP IN HJORUNDFJORD, NORWAY. SOURCE: HURTIGRUTEN CRUISES

Norway has long been a key producer in the energy sector. The country's oil and gas industry has been the lynchpin of its economy for many years and the Norwegian shipping industry retains close ties with it. This may be why, despite the best endeavours of politicians and in the private sector efforts to seriously decarbonise key heavy industries in Norway have made slow progress in recent years. This raises questions of whether the country's goal of fully decarbonising by 2050 are seriously achievable.

According to the International Energy Agency's (IEA) Energy Policy Review for 2022, to meet the goal of being a low emission society by 2050 Norway has "considerable work ahead." Many key parts of the economy are already electrified. For example, in 2020 80% of all cars sold in Norway were electric as are large parts of the public transport network. "The remaining reductions will be more complex, challenging and costly" as the areas where significant work needs to be done are also the largest emitters of emissions: heavy industry, transport and energy production. Incentivising this may prove difficult as the oil and gas industry make ups 65% of the share of Norwegian exports. Since the war in Ukraine led to a drop in Russian gas exports Norway is now the EU's largest supplier of oil and gas by a significant margin. The country must come to terms with this duopoly of still being committed to extracting wealth from its oil and gas fields, while at the same time aiming to be a leader on carbon reduction. Revenue from the fossil fuels industry is ultimately finite, so the country will need to invest even more in plans to decarbonise over the next 30 years.

In a joint statement in 2022 the Norwegian and United States governments announced the "Green Shipping Challenge" to catalyse the transition towards decarbonising the shipping industry. Organisations taking part include Maritime CleanTech, Norsk Industri (The Federation of Norwegian Industries), the Norwegian Shipowners' Association (NSA) and DNV. Those signing up to the pledge declare that they will strive to reduce emissions from shipping by at least 50% by 2030. This is on top of the existing IMO target of reducing emissions by 40% and 50% by 2030 and 2050 respectively. This is no small feat as the Confederation of Norwegian Enterprise estimates that this will require 700 vessels to be low-emission producers and 400 to produce zero emissions.

The Norwegian Shipowners' Association, one of the largest bodies representing Norwegian maritime industry, has stated that its climate strategy is for the entire Norwegian fleet to be carbon neutral by 2050. This is an ambitious goal, but the association has stated that its members are behind it with 77% agreeing that they can meet the 2050 goal.

Speaking at a Nor-Shipping press event in Oslo in March, the association's director of politics and analysis, Gabrielle Legrand Gjerdset, stated: "This won't happen by itself. You must have policies that promote this and the technology and development in the shipping companies. The companies know that this comes with a price and they're willing to pay more for green fuels, especially the deep-sea companies. Very high numbers, over 80%, say that they are willing to pay more for green fuels."

While it is positive that shipowners want to take a proactive stance on decarbonising, NSA believes that government policy needs to expand to support private companies. "We are concerned that Norwegian policies and the instruments that we must use are not really prepared for the green transition," Legrand Gjerdset added, "so, we're working very closely with the government to try to turn the investments and to promote the green shift."

In a 2019 Norwegian government report the Norway emissions inventory estimates that emissions from domestic shipping and fishing vessels were 2.95 million tonnes CO_2 in 2017. However, based on AIS data DNV estimates this may be higher at a total of 4.8 million tonnes CO_2, 1.8 million tonnes higher than the estimate. Ferry operators have been quick to decarbonise, likely spurred by NOK665 million (US$62 million) in grants from Enova, a subsidiary of the Norwegian Ministry for Climate and the Environment. At the time of the report 33 ferry routes in the country were fully or partly electrified. This investment in decarbonising domestic ferries also makes sense as they form a cornerstone of the national infrastructure. However, domestic short-sea cargo vessels have seen much less investment, and it is largely down to individual private sector companies to take the lead. Despite emitting 594,000tonnes of CO_2 per year the Norwegian government has stated that the "creditworthiness" of short-sea cargo shipping is a barrier to investment.

Groups like the Maritime CleanTech cluster are currently working to bring together large companies like Yara and Norwegian Energy and smaller startups to focus their efforts on decarbonisation. Yara is a particularly big player and its involvement in efforts towards a goal of zero-emission shipping is crucial. For example, the HEGRA (HErøya GReen Ammonia) initiative, launched as part of a joint venture with energy company Statkraft and Aker Clean Hydrogen in 2021, aims to decarbonise the ammonia plant in Herøya. Equinor, by far one of the largest energy producers in Norway, has also recently agreed to invest heavily in renewable production. The company plans to build several hydrogen plants in a partnership with German energy company RWE. No doubt spurred by the drive toward carbon neutrality companies such as state-owned Equinor, which made a record US$65 billion profit from oil and gas revenue in 2022, is now investing in hydrogen production. A move that is likely to be welcomed.

The use of existing oil and gas infrastructure to support the transition to renewables is something that is also being investigated by the Wilhelmsen group. The organisation is another key actor in the Norwegian maritime industry, and it has recently established a subsidiary group, Wilhelmsen New Energy, to support its shift towards renewable energy. For the company, establishing a network of onshore bases, many of them converted from existing oil and gas installations, is central to preparing a starting point for zero-emission shipping. As part of the HyShip project the company aims to establish a connection between Stavanger and Mongstad to deliver hydrogen between these coastal fuel points. "These are the bases that are serving the oil and gas industry today and, in the future, of course, also the offshore wind industry. They provide all the logistics in and out of the north," says Tomas Tronstad, head of shipping and technology for Wilhelmsen New Energy.

"Wilhelmsen and Topeka are working alongside the Norwegian government to increase the construction of new hydrogen fuel hubs and logistics centres along Norway's west coast and in the far north. This will provide a key basis for the green transition in the shipping industry in years to come," adds Tronstad. While Wilhelmsen appears to be making a concerted effort to provide a preemptive support network for the transition to renewables, Tronstad also feels other companies could do more. "We need public companies to take their purchasing power and use that. I think that's also a universal thing that would really spur this green shift," he says.

One such company that aims to do this is Höegh Autoliners. The company is one of the largest leading

NORWIND BREEZE, A CSOV VESSEL BUILT BY VARD TO SERVE THE OFFSHORE WIND SECTOR

global providers of ro-ro services and the operator of one of the 8,500CEU New Horizon class PCTCs, the world's largest. The company has made it clear that it is serious about decarbonising deep-sea shipments of vehicles and equipment. They have eight ammonia-ready newbuild orders on the table, with another four currently in design stages. CEO of Höegh Autoliners Andreas Enger says that he believes that within the renewables sector there is "a real lack of leadership." The company has ambitions to cut their emissions to zero by 2040. This is a bold target to aim for, but Enger is optimistic. "We have reduced our unit CO_2 emission by 37% since 2008 and we committed to reduce it by another 30% by 2030. I'm going to say I'm a bit fed up with people talking about modifications, fuel efficiency and existing fleets, and AI voyage planning; because in our world, that's an absolute no-brainer."

Höegh is also investing heavily in LNG technology and the company's subsidiary, Höegh LNG, recently received a grant of €5.9 million along with Wärtsilä for a new green energy initiative. The project aims to develop a system to convert ammonia back to hydrogen, which will then be installed onboard a Höegh LNG vessel.

For a country whose economic destiny has been intrinsically linked to the oil and gas industry Norway is making big moves in tackling the road to zero emissions. Many challenges remain and co-operation between the private sector and the state is key, particularly when it comes to the maritime industry. However, industry leaders are stepping up and new projects have shown that the will is there to change. The question is, can it happen soon enough? ■

OFFSHORE WIND COULD PROVIDE LUCRATIVE CONTRACTS FOR SHIPPING

Norway is a country with vast potential for being a major player in offshore wind production. Several Norwegian offshore shipping companies have developed a strong strategy for offshore wind and some of them are already the world's largest in the field.

However, progress in the sector has, until recently, been slow and the drive to innovate and invest does not always translate into the installation of wind farms in Norwegian territorial waters. The country presently has 65 offshore wind projects in progress but only two of these are operating and a third has reached a stage where it can be connected to turbines. None of the remaining projects are in the build phase.

The slow growth of the offshore wind sector presents problems for the country's strategy of reaching net zero and has a knock-on effect on the adjacent shipping industry, which relies on offshore contracts to fill its coffers. According to the Norwegian Shipowners' Association, shipping companies feel that the most important factor for further growth in the offshore wind market is increased access to projects. This in turn creates increased profitability. The association is therefore pushing for greater public and private sector investment in offshore wind in the belief that more ambitious goals will feed competition.

Despite the slowness to act on offshore wind production, the shipping industry sees great value for further investment. A recent report by engineering company MultiConsult shows there is the potential for 338GW of energy production from offshore wind in Norway. This is 10 times the government target of 30GW by 2040 announced in May 2022.

Groups like Norwegian Energy Partners (NORWEP), an independent non-profit organisation established by the government, aim to bridge the gap with the offshore wind sector and by representing Norwegian industry and promoting growth. It is comprised of roughly 330 partner companies from the Norwegian energy and ocean industries, including trade unions. Hydro and Statkraft, the two largest energy companies in Norway, are also closely involved. As the country transitions away from a reliance on oil and gas it is likely that those who are active in the offshore shipping sector will convert vessels to meet the specifications for offshore wind. NORWEP also collaborates closely with Clarksons Platou and Maritime Cleantech, as well as with Ocean Technologies Group.

According to Jon Dugstad, director of wind and solar at NORWEB: "As offshore wind production ramps up so will the demand for vessels."

He adds: "Currently there is a huge vessel demand. For example, the Beatrice offshore wind farm, which was installed in 2022 required 50-plus vessels involved just in the construction of the wind farm and there are a number of these projects."

The transfer of capability in the offshore industry from oil and gas towards wind and other renewable energy presents great potential for not only Norway but the whole of the North Sea, and it's possible that this could redefine the area as Europe's next economic powerhouse.

NORWEGIAN AQUACULTURE INDUSTRY FACES CHALLENGES AS IT BEGINS TO MODERNISE

By **Tom Barlow-Brown**

Ask anyone involved in the Norwegian maritime industry and they will tell you that aquaculture is big business. The country is the largest producer of salmon in the world. According to the OECD, in 2018 the Norwegian salmon production totaled 4 million tonnes of fish of which 70% came from offshore aquaculture.

Since then, the amount that Norwegian salmon farms has produced has grown exponentially and the aquaculture industry is the country's largest domestic source of income after fossil fuel production. However, recently the industry has been plagued with issues such as high rates of salmon deaths and recently large government tax levies aiming to reap further rewards for the country.

Initially proposed in March 2023 as a 40% levy on profits from salmon producers, the new resource tax bill is to ensure that local communities receive a greater share of the profits from aquaculture. Nevertheless, the move has worried companies and shares in the seafood index on the Norwegian stock exchange took a sharp dive as a result but have since bounced back. The Norwegian government has since lowered the proposed levy to 35%, but the move still has companies worried. Norwegian owned farms, both at home and abroad have also recently reported high numbers of excess deaths amongst salmon populations. Norway reported the deaths of 58 million salmon in 2022, an increase of 1 million on the previous year.

However, the outlook isn't entirely gloomy and there are hopes that new innovative projects will provide the answers to some of the industry's woes. While the sheer size of the Norwegian salmon industry has allowed for a period of complacency, since 2020 the government has given financial incentives to modernise.

According to Stål Heggelund, director of maritime and aquaculture sector at Norsk Industri, the push to change started when the government established new development licenses. "The Norwegian aquaculture industry did not really do a lot of research and development to really to push the technology forward," he says. "The government came around and said, 'we'll give you some incentives to make new aqua agriculture technologies to reduce sea lice and fish escapes.' That pushed a huge number of new technologies and ideas."

It is hoped by some those newer technologies, like the new 385m Jostein Albert salmon 'Havfarm' owned by Nordlaks, will lead the way to a greener, more sustainable aquaculture industry. Officially designated Havfarm 1, the vessel which was built by CMC Raffles in China is the world's biggest. Nordlaks hopes to put more into production. A second Havfarm, Havfarm 2, is currently in the design phase and will feature more advanced technology such as a dynamic positioning system.

THE JOSTEIN ALBERT HAVFARM

The Jostein Albert static platform, which is shaped like a large bulk carrier, can hold 10,000 tonnes of fish in six 47m x 47m mesh pens suspended underneath superstructure, which extends 30m below sea level. The platform is moored 5km southwest of Hadseløya, in Norway's Vesterålen region. A turret mooring system consisting of 11 mooring lines provides a stable anchor in rough seas. Each mooring line is connect to the ship's turret meaning the entire ship can move in response to the environment.

The Jostein Albert is also fitted with an innovative lighting system, provided by Glamox, "that is tailor-made to the aquaculture operations on board," according to Salve Epletveit, technical superintendent Nordlaks. "Most importantly we have a lighting solution that helps us take excellent care of the fish, who are sensitive to strong lights," he says. Sensors turn the lights on, and off which slowly transition between darkness and light in order to not startle the fish with sudden changes. The platform is also fitted with six Rolls-Royce Marine tunnel thrusters to pump fresh seawater into the pens and automated feeding systems supplied by local aquaculture company Akva.

Despite its innovative nature deployment of the Havfarm has not been without issues. A 2021 report by the Norwegian Directorate of Fisheries declared that the health of fish in the farm's pens was poor. However, Nordlaks since appealed this decision and the farm is now in full production mode.

Norway aims to double aquaculture production by 2030. Unfortunately, in a further blow to industry progress the Norwegian government has recently decided not to issue further development licenses for aquaculture projects. As a result, and in response to proposed tax increases, Nordlaks announced in 2022 that it would also be putting US$460 million of investments on hold. It therefore remains to be seen whether the Norwegian aquaculture industry can bounce back from its recent setbacks and stay at the top of its game. ■

NOR-SHIPPING PLACES DIVERSITY FRONT AND CENTRE IN 2023

By **Tom Barlow-Brown**

The shipping industry has often been accused of being old fashioned and inaccessible. This is something that naturally puts off younger generations from gaining the access that they might need to progress. Diversity is also a problem and in a predominantly male dominated industry it is important that spaces exist to promote a range of voices.

Step forward two organisations that are working hard to change that. Youngship, founded in Bergen in 2004, and the Women in International Shipping and Trading Association (WISTA), which celebrates its 35th anniversary this year. Both groups will be holding special events at Nor-Shipping in Oslo this June to provide an inclusive space for discussion about the future of shipping.

Youngship is a non-profit organisation run by, and for, its members, who work in their main jobs. The organisation has 700 members in Norway and 5,000 globally. Membership of the organisation comes from diverse background in the shipping industry. Out of the members in Norway approximately a quarter come from the naval architecture field.

The organisation has seen an increasing interest from all fields in becoming a members and sponsors. New members are usually recruited by older colleagues or are encouraged by other members of their team. Youngship has also begun to reach different companies in new fields of work, such as the consulting sector, which traditionally has not been too engaged.

"We do not have any political agenda, what we want is to be a front runner. We want to be a chosen platform for young professionals that are entering this amazing industry," says Natalie Kim Le Nguyen, chair of Youngship. "So, our vision and mission are simply to facilitate networking and knowledge sharing opportunities and bridge the gap between the elder generation and the young generation. This is key in enhancing knowledge and it's also a way to remove the barriers to move this industry forward."

THE BOARD MEMBERS OF YOUNGSHIP OSLO

Following its founding in 2004 Youngship has expanded globally and now has branches in the Middle East, Americas and Asia. Major companies have also signed up as partners providing a diverse range of sponsorships, including Kongsberg, Yara and DNV, to name a few. At Nor-Shipping 2023 the group will be holding a range of events throughout the week focusing on different topics. Of note to many will be a seminar covering the impact of sanctions and the changing face of globalisation in the shipping world today, an event that will be sponsored by DNB.

Featuring alongside Youngship at this year's event will also be WISTA, whose goal is to promote the role of women in the shipping industry. The organisation, which was founded in 1988, aims to be a major player in attracting more women to the maritime industry and to retain and elevate women in our industry. Operating on a voluntary basis in 56 different countries around the world with more than 3,500 members they are a membership organisation for thought leaders in the shipping industry.

Open for both women and men

Despite representing women in the shipping industry, the organisation is also open to men, and in Norway 10% of its members are male. WISTA has recently launched a campaign to increase the numbers of women in the shipping industry, where equality between the sexes has historically been low. In March 2022 it launched the '40 by 30' campaign aimed at increasing the percentage of women in the industry to 40% by 2030; the percentage of women in leading positions in the maritime industry in Norway is approximately only 15%.

The group held its first '40 by 30' workshop in 2022 at the Norwegian Shipowners' Association in which 17 companies participated. Further workshops will be held throughout Nor-Shipping featuring a range of different talks and seminars. WISTA will also be holding its 35th anniversary party on the 6 June to coincide with the event.

Both WISTA and Youngship are leading the way in encouraging new talent into the maritime industry and Nor-Shipping has shown that they have its full backing. Perhaps this will signal a change as more companies put diversity front and centre too as the industry moves fully into the 21st century. "If you don't do anything to change your culture, or create the belonging, you don't harvest the potential of recruiting those diverse persons. This doesn't go only for women, it goes for all kinds of diverse talents," says Stine Mundal, president WISTA Norway. ■

Nor-Shipping takes place in Oslo, Norway, on 6-9 June.

JAPAN

FERRY SUNFLOWER GOES LNG

European ferry operators have been early adopters of LNG as alternative fuel. Back in January 2013, Finland's Viking Line introduced *Viking Grace*, the world's first large ro-pax ferry powered by LNG. Japanese ferry operators arrived late to the party with Ferry Sunflower being the very first Japanese ferry operator switching to LNG. The Mitsubishi Shipbuilding-built *Sunflower Kurenai* was introduced on the Beppu-Osaka overnight service exactly 10 years after the maiden voyage of *Viking Grace*

By **Philippe Holthof**, Correspondent

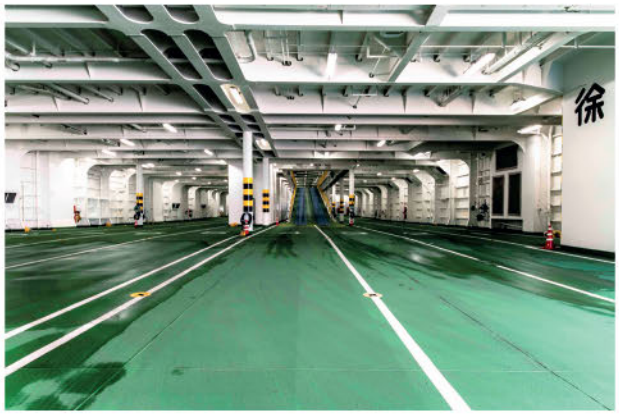
The pathway towards net-zero greenhouse gas (GHG) emissions is a long one and whilst LNG was initially meant as an answer to the 0.1% sulphur cap in Sulphur Emission Control Areas (SECAs), its GHG emissions benefits are highly dependent on the well-to-wake methane slip. Japan is not a 0.1% SECA yet which may partially explain why domestic ferry operators have been hesitant to burn LNG as an alternative, cleaner fuel. Mitsui O.S.K. Lines (MOL) subsidiary Ferry Sunflower is now bucking the trend with *Sunflower Kurenai*. Introduced on the 12-hour Beppu (Oita)-Osaka route on 13 January, *Sunflower Kurenai* was followed by sister ship *Sunflower Murasaki* in mid-April.

Ferry Sunflower has two more LNG-powered ro-pax ferries on order at Naikai Zosen. Due for delivery in 2025, the yet unnamed ships will be introduced on the freight-oriented Oarai-Tomakomai Motorway of the Sea route. The single screw vessels will boast an ISHIN streamlined bow shape, first adopted on MOL's PCTCs. ISHIN stands for complete revitalisation or reformation in Japanese language. The design of the aerodynamically rounded bow reduces wind pressure, using the lift force from diagonal headwinds to help propel the vessel. It has been jointly developed by MOL, MOL Techno-Trade and Akishima Laboratories (Mitsui Zosen).

LNG pack

LNG supply, or better still, the lack of it has been another stumble block for Japanese ferry operators to walk down the LNG path. But Japan is now adapting LNG supply to expected demand with new LNG infrastructure being rolled out. In typical Japanese fashion, *Sunflower Kurenai* has its quarter access ramps on the starboard side, so truck-to-ship bunkering is via the starboard bunker station. LNG bunkering takes place in the port of Beppu with four LNG tanker trucks simultaneously connected via a dedicated skid. In a later stage, the LNG logistics system will rely on dedicated LNG bunker barges with a bunker station duplicated on the port side. The twin Type C tanks are located on deck, aft of the accommodation on Deck 6. Well protected by steel plating on either side, the Wärtsilä tanks are offset to the portside on account of the starboard stern quarter ramp. Wärtsilä also designed and supplied the complete

JAPAN'S FIRST LNG-FUELLED FERRY, *SUNFLOWER KURENAI*. SOURCE: ©MITSUBISHI SHIPBUILDING



TRUCK SPACE. SOURCE: ©MITSUI O.S.K LINES

fuel gas supply system (FGSS) as well as two of its extremely fuel efficient medium-speed type 16V31DF dual fuel main engines with an output of 8,800kW at 750rpm each. Flender supplied the single input, single output hybrid gearboxes with a PTO/PTI shaft. The three dual fuel Yanmar 8EY26LDF auxiliary engines each have an output of 1,730kW at 720rpm.

A Mitsubishi Shipbuilding in-house design, the 199.9m-long and 28.00m-wide *Sunflower Kurenai* was built by Mitsubishi's Shimonoseki yard, a prolific builder of ro-pax tonnage. Due to the 200m length restriction of the yard's slipways, large ro-pax ferries are now built by Mitsubishi's Nagasaki yard with no ro-pax ferry orders present in Mitsubishi Shimonoseki's orderbook following the delivery of *Sunflower Murasaki*. The optimised hullform represents a new platform with propulsion tank tests performed at Mitsubishi Heavy Industries' Research & Innovation Centre in Nagasaki district. To improve the propulsion efficiency on the one hand and reduce the hull resistance on the other, the twin shaft lines are spaced close together, being supported by brackets. Kawasaki Heavy Industries' twin controllable pitch propellers are integrated with the Becker twist rudders, further guaranteeing fuel optimisation. A pair of Kawasaki Heavy Industries bow and stern tunnel thrusters enhance the manoeuvrability, avoiding the use of tug assistance.

Vehicle decks

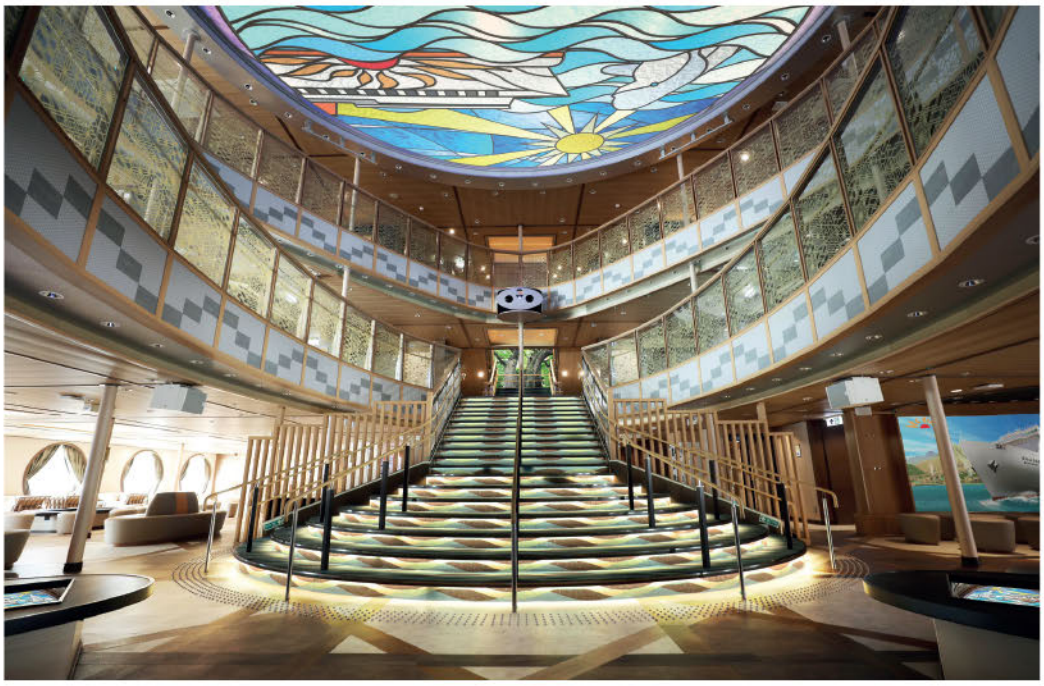
Built for domestic service, *Sunflower Kurenai* didn't have to comply with IMO's Safe Return to Port (SRtP) requirements. For this reason, the two main engines are located in a single compartment with the three auxiliaries located in a separate compartment abaft of the main engine room.

Forward of the engine compartments are two dedicated car decks inboard of B/5 longitudinal bulkheads. Located beneath the main deck, Decks 2 and 3 have a free height of 2.2m each, being accessed via fixed ramps fore and aft on the 44CEU Deck 3 level with a single ramp leading to the lowermost deck which has a capacity of 56CEUs. The two ramps that connect Deck 4 with Deck 3 have side-hinged covers but there is no cover for the ramp leading to Deck 2. It is a steep climb from the lower decks to the accommodation decks, but two elevators connect directly with the upper decks. This is part of the barrier-free access policy in the wake of Japan's fast ageing population. Even a few of the cabins are barrier free.

As befits Japanese long-distance ro-pax ferries, the 4.4m-high main deck, Deck 4, is accessed via bow and stern quarter ramps. Made by MacGregor in Japan, the starboard ramps have a length of 23.0m and clear width of 6m. MacGregor also supplied the two 44m-long by 4.0m-wide hoistable internal ramps that connect Deck 4 with the 4.2m-high Deck 5.

The main deck has an intake of 78 x 13m trucks with four lanes on the starboard side and three lanes on the portside of the offset casing. With the casing stretching only about one-fourth of the ship's length, freight vehicles can be stowed fore and aft of the casing, bringing the total number of freight lanes to eight. The upper freight deck follows the same layout, yet at 59 x 13m trucks, its capacity is remarkably lower than that of the main deck. The official nominal capacity communicated by both the shipyard and Ferry Sunflower stands at 137 x 13m trucks. This would equal to about 1,850 freight lanemetres which seems an underestimation for a two-deck freight deck ro-pax ferry the size of *Sunflower Kurenai*.

TECHNICAL PARTICULARS *SUNFLOWER KURENAI*	
Length oa	199.99m
Length,bp	187.00m
Breadth, moulded	28.00m
Depth to main deck	9.75m
Draught, full load	6.80m
Gross tonnage	35,471
Gross tonnage, Japanese	17,114
Deadweight	6,918t
Trucks (13m)	137 (+ 100 CEUs)
Passengers	716
Passenger cabins/berths	244/716
Main engines	2 x Wärtsilä 16V31DF
Output	2 x 8,800kW at 750rpm
Service speed	22.5knots
LSAs	1 Mansei fast rescue boat (6 persons), 4 Fujikura Composites MES (350 persons each) connected to 20 inflatable liferafts (42 persons each)
Class	Japanese Government
Class notation	N/A
Flag	Japan



THE ATRIUM OF THE SHIP IS SPREAD OVER THREE LEVELS. SOURCE: ©MITSUI O.S.K LINES

Accommodation with wow factor

Just like in Europe and other parts of the world, Japanese ferry operators suffer competition from cheap airlines. But Japan's coastal ferries also compete with fixed links and long-distance high-speed trains which further explains the relatively low passenger capacities of Japanese long-distance ferries. *Sunflower Kurenai* and *Sunflower Murasaki* are an exception as Beppu is a popular tourist destination, being synonymous with hot springs, boasting the country's largest health resort.

Replacing the smaller 153.0m-long and 25.0m-wide *Sunflower Ivory* and *Sunflower Cobalt*, the 716-passenger capacity *Sunflower Kurenai* and *Sunflower Murasaki* have a passenger surface area of 8,300m², close to 70% above that of their predecessors which had a capacity of 1,050 passengers.

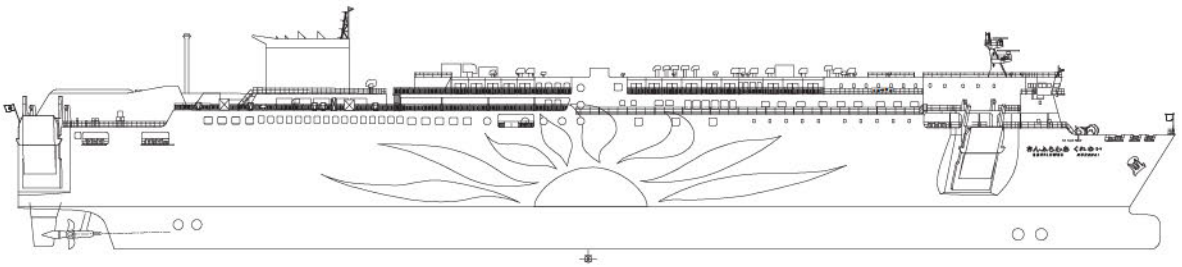
The general arrangement of the three passenger decks follows the cabins forward, public spaces aft principle. As for the passenger amenities, it is quality rather than quantity that prevails with the interior design the work of Japan's Flux Design. The lavish interior design centres around 'kizuna' with kumiko patterns abound on flooring, wall panels, glass dividers and all kinds of decorations. Kizuna stands for the enduring bonds between people or close relationships forged through mutual trust and support. The Beppu-Osaka route has existed for 110 years and the bottom line is to re-discover ferry travel through the Seto Inland Sea, bringing people and families closer together again.

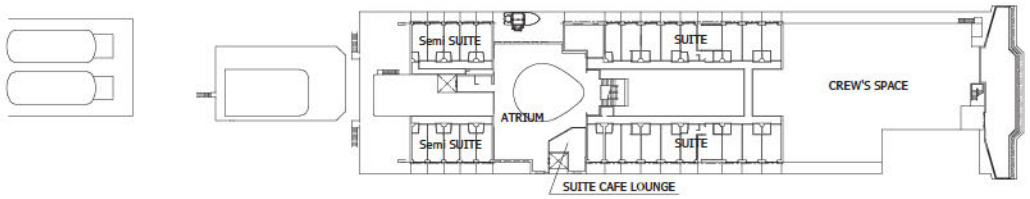
SUNFLOWER KURENAI'S SELF-SERVICE RESTAURANT BRINGS DINING ON A JAPANESE FERRY TO A NEW LEVEL. SOURCE: ©MITSUI O.S.K LINES

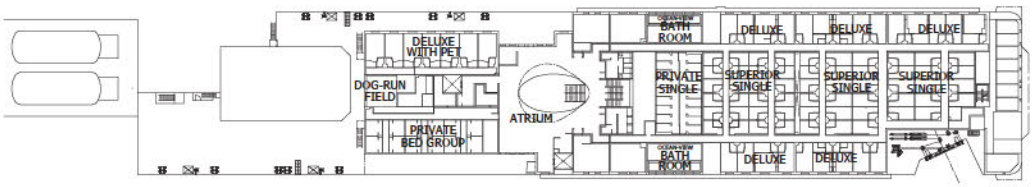
The *pièce de résistance* is the soaring three-deck central atrium with its grand staircase, an architectural trademark of modern-day Japanese long-distance ferries. On Deck 6, the main passenger deck, the atrium is integrated into an open plan lounge with the main entrance hall to the starboard side, a shop and seating lounge to port and a soft play children's playroom forward of the grand staircase. Atop of the atrium is an eye-catching projection screen with Epson's compact 30,000lumen 3LCD projector which has been specifically developed for vivid theatrical and film projections or areas with high ambient light such as shopping centres and galleries.

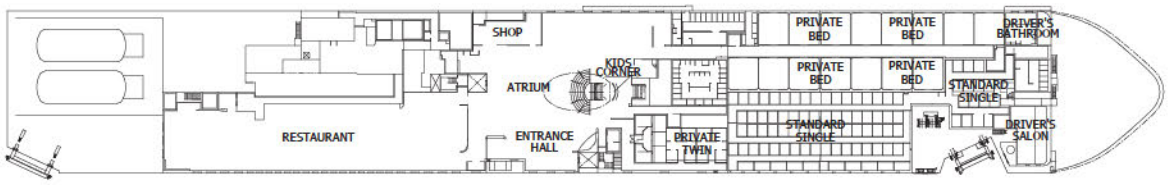
The ship's 252-seat main buffet-style self-service restaurant is located starboard aft on Deck 6, accessed from the atrium square. Due to a shortage of staff, dining options on Japanese ferries are often restricted with the ubiquitous vending machines selling beverages and food, including microwave meals. Albeit *Sunflower Kurenai* lacks an à la carte restaurant, the self-service restaurant somehow brings dining on a Japanese ferry to a new level. Sailings alternate between *Sunflower Kurenai* and *Sunflower Murasaki*. Sunday to Thursday, departures from Beppu are at 18:45 and from Osaka at 19:05 with arrivals the next morning at 06:35 and 06:55, respectively. On Fridays and Saturdays, a later departure with a more civilised arrival times should attract cruise passengers. Even so, onboard facilities remain rather limited as nightlife on Japanese ferries is a far cry from

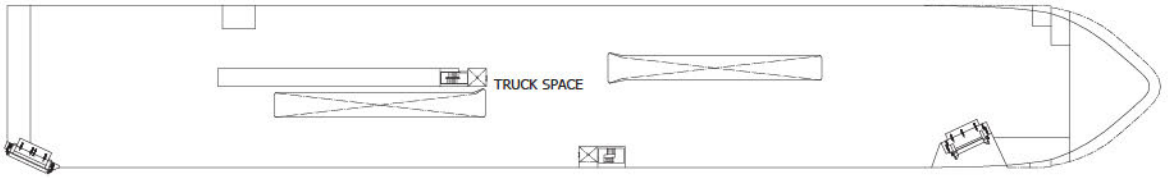
SUNFLOWER KURENAI GENERAL ARRANGEMENT

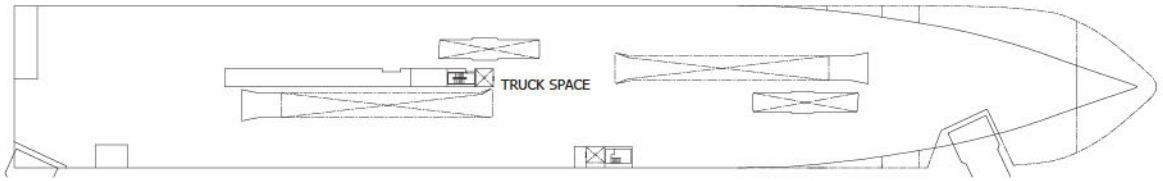


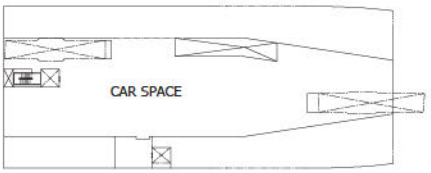


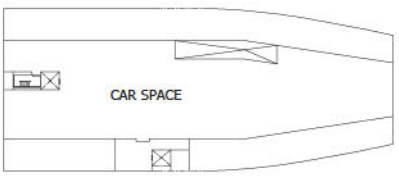












JAPANESE-STYLE SUITE. SOURCE: ©MITSUI O.S.K LINES

that on cruise ferries in Europe. Besides a good meal, passengers will enjoy the shared ocean view grand baths, located midships on Deck 7. Men and women are strictly separated with commercial drivers having their own grand bathroom forward on Deck 6, mirroring the starboard driver's lounge.

European-style cabins

Until not too long ago, the number of European-style cabins with private facilities on Japanese overnight ferries was typically very limited. Instead, passengers slept in dormitories with tatami mats or foldaway futons. Another option were individual capsule berths. *Sunflower Kurenai* still has shared dormitories with real beds rather than mattresses. The no-frills cabins are located in the forward section of Deck 6; 15 European-style dormitories with 16 private pod-type berths each and 89 single-bed cabins. Adjacent to the atrium are a 19-person Japanese-style barrier-free dormitory as well as eight barrier-free two-berth cabins. All cabins on Deck 6 have shared toilet facilities. In contrast, the 30 deluxe outside cabins, seven of which are pet-friendly, and the 30 superior single inside cabins as well as the 26 superior twin inside cabins on Deck 7 have their own wet unit while the 30 suites on Deck 8 come with their own balcony. Suite guests also have their own suite café lounge in the atrium's upper level. Most of the suites are European-style, but two are Japanese-style. In total there are 19 different cabin categories for a total of 716 passengers, the ship's maximum passenger capacity.

Japanese ferry operators struggle to attract young workers with more than half of the crew members working on ferries being over 50 years old. Consequently, the number of crew – including onboard services crew – is limited to a maximum of 43 who are accommodated in a cabin section just abaft and below the fully enclosed Deck 8 bridge.

Japanese domestic ro-pax ferries are exempted from lifeboats with *Sunflower Kurenai* boasting a Mansei fast rescue boat as well as four marine evacuation systems (MES) connected to 20 inflatable liferafts, both supplied by Fujikura Composites. ■

OCEAN-VIEW BATH ROOM. SOURCE: ©MITSUI O.S.K LINES

OPTIMISING OPERATION SCHEDULES USING METEOROLOGICAL AND OCEANOGRAPHIC DATA AND OPTIMAL ROUTE PLANNING SIMULATION

By **Yoshiko Sato**, **Minayo Hata** and **Catharina Trones**, Japan Weather Association

In Japan's coastal shipping industry, the potential needs for opening new service routes and construction of new ships for ferries and ro-ro ships have increased in recent years. There are mainly two reasons for this. The first is that the Japanese government has announced its aim to become carbon neutral by 2050, and the movement to reduce greenhouse gas (GHG) emissions is accelerating. Secondly, the logistics industry is facing a shortage of truck drivers, the '2024 problem', and the reduction regulations of GHG emissions.

On the other hand, there are few examples of ship operation schedules that consider the effects of weather and sea conditions when opening new service routes. Therefore, we planned an operational schedule for the new service route, using optimal route planning simulation which takes into account the weather and sea conditions and the propulsion performance of the ship. We also verified the reduction effect of fuel oil consumption.

In this article, we present an example of a coastal ro-ro shipping company's new service route between Kyushu and Tokai. This newly planned route is a liner service with the aim of reducing logistics costs by shortening transportation time. In order to aim for arrival at the market in the early morning the day after shipment, we assumed the scheduled departure at 23:00 and arrival in less than 20 hours. However, this schedule is likely to be tight for ships that will serve this route. Therefore, the feasibility of the operation was preliminarily verified through a route planning simulation to evaluate its validity.

Elemental techniques of the optimal route planning simulation

This optimal route planning simulation uses three elemental technologies: meteorological and oceanographic information, ship propulsion performance estimation, and route planning calculation.

For the meteorological and oceanographic information, we used high-precision and high-resolution forecast data for the area around Japan provided by the Japan Weather Association (Table 1). The spatial resolution is two minutes latitude and longitude (approximately 3.7km), the temporal resolution is one hour, and the forecast period is up to 96 hours ahead. Forecasts are updated eight times a day for winds and waves, and once a day for ocean and tidal currents. Moreover, each element improves the prediction accuracy by data assimilation, as shown in the example of waves off the coast of Kochi, Figure 1. In the case of route planning for Japanese coastal vessels, whether to use this high-resolution and high-precision meteorological and oceanographic information has a great impact on the results.

Ship propulsion performance differs from ship to ship. We estimated the propulsion performance of this individual ship rather than the standard hull form.

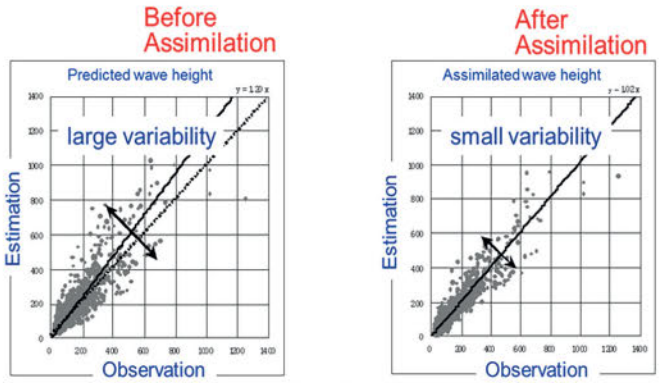
For the estimation, we received information from the shipping company on the main features of the individual ship and the results of sea trials, which we used as the basis for estimating resistance loss. Furthermore, we performed regression analysis using ablog (abstract log) data for a certain period and tuned the performance data so that the resistance loss multiplied by the obtained regression coefficient and the propulsion output were in balance.

The route plan calculation uses a dynamic programming. Originally, in order to formulate an optimal route plan, a combination of meshes that minimises fuel oil consumption (FOC) is obtained by optimisation calculation. This simulation finds the optimal route with the minimum FOC by optimisation calculation. However, in this case, the purpose is to plan the operation schedule for the new service route. Therefore, we

Elements	Model	Resolution	Frequency
Coastal ocean winds	MSM, GSM (Japan Meteorological Agency)	Spatial resolution: 3.7km (1/30deg) Time resolution: 1 hour	8 times a day
Coastal ocean waves	JWave (Japan Weather Association)		
Ocean and tidal coastal currents	JCOPE2 (JAMSTEC)		Once a day
*Accuracy of all forecasted data is highly improved by assimilation by observed data			

TABLE 1. OUTLINE OF WEATHER AND OCEANOGRAPHIC INFORMATION

FIGURE 1. EXAMPLES OF DATA ASSIMILATION EFFECT AT KOCHI (IN 2009)



at KOCHI	1 day	2 days	3 dais
correlation coef.	0.815	0.754	0.683
regrresion coef.	0.994	1.052	1.134
average error ratio	15.5	17.3	28.6
RMSE	38.1	45.4	56.3

at KOCHI	1 day	2 days	3 dais
correlation coef.	0.906	0.841	0.779
regrresion coef.	1.004	0.997	1.025
average error ratio	5.7	7.9	14.9
RMSE	22.0	32.3	38.3

TABLE 2. SIMULATION RESULTS OF THE NEW SERVICE ROUTE'S VOYAGE TIME

Route		The mean annual voyage time	The annual maximum voyage time
Outbound route	Kyushu to Tokai	19.4 hours	20.6 hours
Inbound route	Tokai to Kyushu	20.6 hours	23.7 hours

calculated the expected required voyage time by fixing the route and output.

Simulation of route planning for new service routes

We performed year-round simulations to confirm seasonality. The engine output during the voyage was set to a constant value, and simulations were conducted to calculate the required voyage time on the same route, and to obtain the expected voyage time and fuel consumption over a whole year.

The simulation results for the planned route of the new service route are shown in Table 2. The average annual voyage time for the planned route was 19.4 hours for the outbound route and 20.6 hours for the inbound route, with the longest voyage time exceeding 20 hours for both routes. Although the Kuroshio Current, a strong ocean current, flows through this route, the voyage time is shorter for the outward route than for the inward route because the ships can take advantage of the Kuroshio Current.

To clarify, Figure 2 shows a map of the Kuroshio Current and the planned route of the new service route for the year in which this simulation was conducted. In February, the Kuroshio flows offshore, but in June and December, the Kuroshio overlaps the route for about a half of the distance. Since the outbound route is in the same direction as the Kuroshio Current, it is possible to navigate with the help of the current. On the other hand, the inbound route is against the Kuroshio Current, so the resistance of the current reduces the speed.

Source: Japan Meteorological Agency website

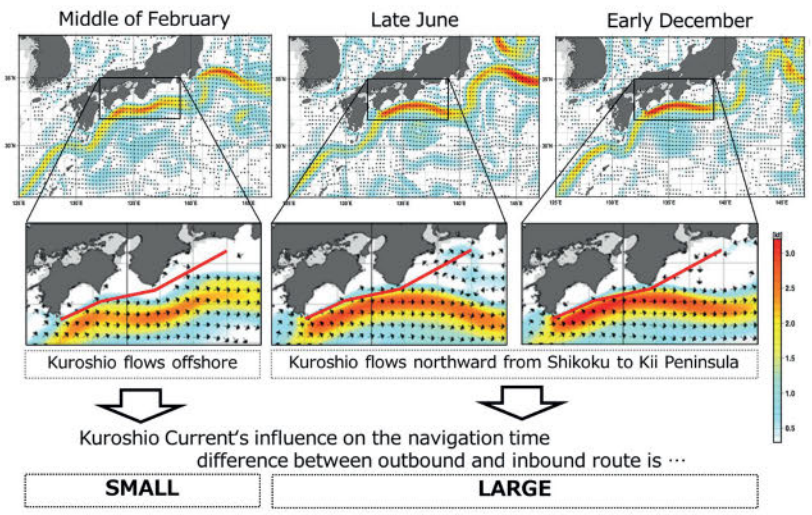


FIGURE 2. MEAN OCEAN CURRENT MAP OF THE KUROSHIO IN THE YEAR OF SIMULATION

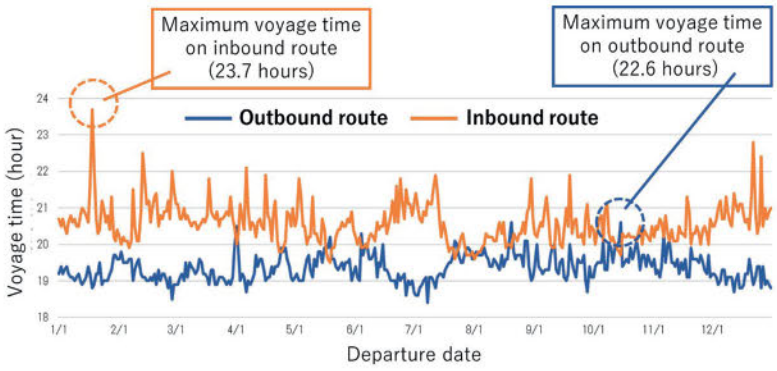


FIGURE 3. A TIME-SERIES CHART OF VOYAGE TIMES IN A YEAR-ROUND SIMULATION

Route		The mean annual voyage time	The annual maximum voyage time
Outbound route	Kyushu to Tokai	18.8 hours	20.1 hours
Inbound route	Tokai to Kyushu	20.1 hours	22.9 hours

TABLE 3. SIMULATION RESULTS OF THE OPTIMAL ROUTE'S VOYAGE TIME

Figure 3 shows a time-series chart of voyage times for each departure date in a year-round simulation. As a feature throughout the year, weather and ocean conditions other than ocean currents have little influence on the voyage time for the outbound route. For the return trip, voyage time tends to be longer from winter to spring, when the voyage is more susceptible to low-pressure systems.

The results indicate that many voyages exceed the arrival time with the originally planned schedule of 20 hours per voyage.

What happens if the optimal route is used?

We found that a voyage on the planned route does not allow the ship to operate on the planned 20-hour schedule. So, what if the optimal route is planned by using the weather and sea conditions?

Table 3 shows the voyage times when the optimal route is used. Compared to the results for the planned route (Table 2), the average outbound time was 18.8 hours and the average return time was 20.1 hours, a reduction of about 30 minutes. Even voyages that took more than 20 hours on the planned route can be shortened to less than 20 hours by using the optimal route.

The optimal route also optimises the FOC, but what about the results? The average FOC reduction over the year for each case was 2.7%. As shown in Table 4, the average and maximum FOC reductions were 2.9% and 5.5%, respectively, for the outbound route, and 2.5% and 4.5% for the inbound route. The reduction was greater on the outbound route than on the inbound route because the use of the Kuroshio Current would have reduced fuel consumption.

As an example of an individual voyage simulation, the results with the longest voyage time are shown in Figure 4.

The voyage time from the simulation in this case is 20.6 hours for the planned route and 20.1 hours for the optimal route. In other words, using the recommended route reduces the time by 30 minutes. Furthermore, a 3.1% FOC reduction was obtained.

Conclusion

In conclusion, it is reasonable to plan the operational schedule for new service routes at 20 hours or more. In addition, there is a high possibility that optimisation can be achieved by utilising an optimal route plan that takes into account weather and sea conditions.

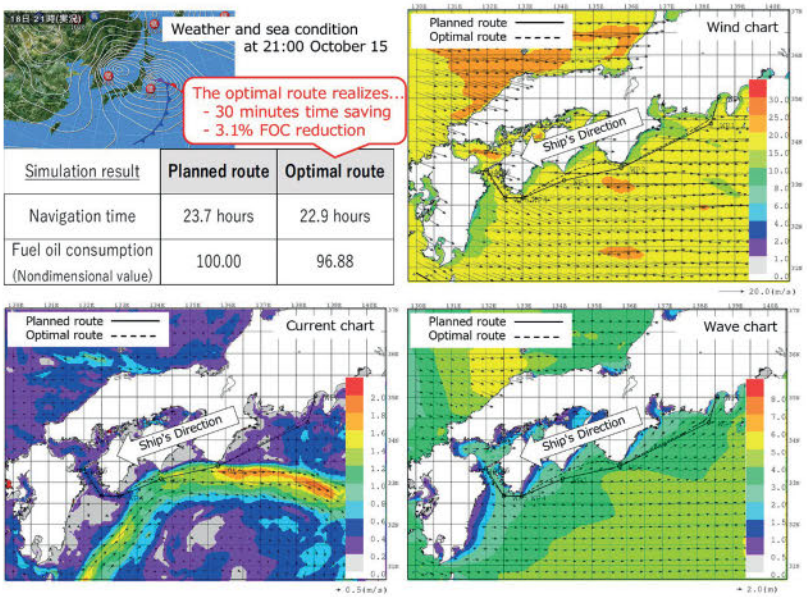
The simulations conducted in this case were based on the assumption that the ship would navigate at a speed of approximately 20knots, but in reality, there is room for increasing the ship's speed. Therefore, based on the results of the study, the new service route was in fact opened with a navigation schedule of 20 hours per voyage by adjusting the ship's speed and using an optimal route plan that takes weather and sea conditions into consideration.

When we interviewed the shipping company about the situation after the start of the new service route operation, they evaluated that the vessels were operating optimally according to the plan. Furthermore, the use of optimal route planning appears to have enabled the vessel to operate not only with an optimised navigation schedule, but also with reduced GHG emissions.

This simulation can be further applied. For example, conditions can be added such as suspending operations

Route		The mean annual FOC reduction effect	The annual maximum FOC reduction effect
Outbound route	Kyushu to Tokai	2.9%	5.5%
Inbound route	Tokai to Kyushu	2.5%	4.5%

TABLE 4. SIMULATION RESULTS OF THE FOC REDUCTION EFFECT ON THE OPTIMAL ROUTE



Simulation result	Planned route	Optimal route
Navigation time	23.7 hours	22.9 hours
Fuel oil consumption (Nondimensional value)	100.00	96.88

FIGURE 4. AN EXAMPLE OF AN INDIVIDUAL VOYAGE SIMULATION

during stormy weather such as typhoons. This would enable advance study of highly accurate operation schedules that more accurately reproduce reality.

The modal shift in shipping is expected to accelerate in the future, and the opening of new service routes, and an increase in the size of ships in service on existing routes will likely be promoted. In such cases, preliminary studies using this route planning simulation will contribute not only to optimise the operation schedule but also to reduce GHG emissions. ■

SOURCE: SHUTTERSTOCK

SMART SHIPS

SMARTER SHIPPING: RIDING THE WIND OF INNOVATION

By **Marco Bibuli**, Ph.D., robotics, automation and control engineer, CNR - INM

In the last century, the movement of humans and goods by means of ships and vessels has surely become one of the most time- and cost-efficient transportation methods. In order to improve the effectiveness of ship transportation a constant increasing effort has been put towards technical and technological advancements.

The field of automatic systems and robots has brought disruptive enhancement in the shipbuilding and maintenance processes. The employment of robotic tools for automatic construction and assembly of parts and subsystems is currently a standard operating procedure within the industrial production lines. On the other hand, as soon as ships leave their home harbours, their command, management, and maintenance are completely left in the hands of well-trained human personnel.

During navigation, it is a real challenge for human operators to guarantee the perfect efficiency and reliability of the entire ship system; to achieve this goal, a constant inspection and maintenance routine must be carefully carried out. It should also be noted that a number of specific operations require additional logistics and ship idleness in order to be executed – e.g. hull cleaning or cargo hold structure inspections; the former requiring the ship to be standing still since it would be unconformable and rather dangerous for a human operator to perform the activity during navigation and with a moving propeller, the latter demanding scaffoldings or similar support structures to perform the inspection. The execution of such actions requires the ship to be stopped, thus losing money for their inactivity while standing in harbours for which additional money has to be expended.

With these issues in mind, stakeholders and industrial operators have tried to figure out how a number of these activities could be performed during navigation or in a faster time span, aiming in particular at three main objectives: 1) reducing the required operational time (and related costs); 2) enhancing the quality of the operations (in terms of performance, precision, etc.); and 3) improving the safety level for human operators.

The solution to pursue such objectives is robotics. In the last decade, we have witnessed a revolutionary process where intelligent and autonomous agents have gained a space within operating ships. Robotic systems can provide 24/7 service capabilities, increasing operation speed and performance, in turn reducing costs and,

in a great number of cases, maintaining the human personnel far from the operative environment and thus preserving their safety.

Of course, robots cannot do everything, so specific robotic systems have to be designed and developed for the specific required operation. Moreover, a certain degree of interoperability between the robotic tool and the human personnel has to be properly foreseen, since particular operational occurrences may not be completely managed by the robotic agent in an autonomous way.

In recent years, a number of international projects and development actions have taken place towards the problem of efficient inspection and monitoring; the issue is related to the problem of reporting the status of welfare of the ship in terms of integrity of the structures, presence of rust and cracks, identification of parts to be substituted/repaired. European projects like MINOAS, INCASS, SMARTBOT and CROCELLS propose the re-engineering of the overall vessel inspection methodology, by introducing an innovative system concept that integrates human personnel with high locomotion-enabled robots, effectively "teleporting" the human inspector from the vessel's hold to a control room with virtual reality properties.

These technological frameworks include a variety of heterogeneous robotic platforms like flying drones, mobile ground and crawling vehicles and underwater agents capable of collecting data characterising the operational environment of interest.

Flying robots can provide a rapid remote visual assessment of the state of the area under inspection; by means of image processing techniques it is also possible to autonomously or semi-autonomously detect relevant hull defects and assist the surveyor with quantitative data. Mobile ground and crawling systems can be exploited for selective and high-precision inspection of particular spots, also providing contact-based data gathering as in the case of ultra-sonic measurements needed for structure integrity evaluation. The same concept is realised in underwater environments, as in ballast tanks, whereby means of underwater vehicles it is possible to collect imagery evidence as well as thickness data without emptying the environment from the water to let the human operator access.

The described operations, carried out in a supervised or totally autonomous way, dramatically improves the level of the work, allowing an enhanced data quality in terms of precision and repeatability, reducing the operational time of the activity and raising the safety level for the human personnel who can operate in a remote access fashion. Furthermore, the implicit digitalisation of all the collected information can be instantly made available over the network and integrated with the already existing data.

Following this trend, many development actions have been made towards the problem of hull cleaning. The condition of the hull heavily affects the performance of vessels in terms of fuel use, which directly turns into a cost effort. In particular, the fouling phenomenon is the main cause of ship efficiency loss; the increase in frictional drag caused by the development of fouling on ship hulls can reduce speed in excess of 10%, with an equivalent fuel burn increase of about 40%.

As for the inspection task, automatised hull cleaning devices are gaining their space as effective tools onboard ships; depending on the specific area of application (dry hull or submerged part), they are characterised by different specifics, starting with the locomotion method that can be based on magnetic wheels or legs for dry platforms, while underwater hybrid solutions mix propeller-based motion with magnetic devices for contact maintenance with the hull.

Although the technology related to materials, actuation systems and sensors is consolidated and reliable for all the mentioned applications, communication still represents a challenging issue. In confined and in-underwater environments, the lacking penetration of electromagnetic waves forbids a wireless connection, thus making the employment of umbilical cables the only possible solution. On the other side, a great effort is provided by researchers and industrial stakeholders in trying to render these robotic platforms intelligent as possible in order to cope by themselves with a complex and harsh environment.

Following this development philosophy, brand new concepts of ship design are coming up; new ships are intended to support the interoperability between human personnel and autonomous agents, sharing information in order to improve the overall ship system knowledge and speed up the management and maintenance actions in a collaborative paradigm. The new concept is known as Extended Ship meaning that the ship extends its capabilities in terms of self-knowledge and self-maintenance and not as a mere transportation medium anymore. The ship also appears extended from a landside standpoint, since the reliable remote connections available nowadays (Wi-Fi, 5G, satellite) allow a constant dialogue with the ship worldwide, thus providing second-by-second management and support.

These are only the first steps towards the very disruptive leap of the upcoming Autonomous Ship, the waterborne counterpart of autonomous cars. It is not possible to say yet if there will ever be a ship navigating without a single human operator onboard, but there will surely be different ships with respect to the one we are used to seeing. New ship design will accommodate for suitable infrastructure for an optimised employment of intelligent robots and will guarantee an integrated data aggregation, revolutionising the way we conceive transportation at sea. We already can imagine production lines onboard ships to directly construct spare parts for repairs and maintenance. In a future vision, robots will not only be employed for in-ship operations (such as inspection or repair), but also as outboard perception systems, in such a way to gather in advance an additional assessment of the environment: for instance observing the surrounding area from atop with flying drones to verify the presence of traffic and exploring the underwater segment to gather a detailed bathymetric profile of the sea-bottom.

Robotics is revolutionising the way we navigate the sea and make use of its resources; we cannot wait to set sails to see where this wind of innovation will bring us. ■

DIGITAL SOLUTIONS FOR A SUSTAINABLE FUTURE

By **Despina Panayiotou-Theodosiou,** co-CEO, Tototheo Maritime

The International Maritime Organization's target of halving total greenhouse gas (GHG) emissions from shipping by 2050 compared with 2008 levels will ultimately require the use of alternative, emissions-free power sources. Yet digital solutions based on the Internet of Things, artificial intelligence and machine learning, for example, will also play a significant role in the industry's decarbonisation efforts.

By providing easy access to transparent, reliable data, digital solutions support accurate decision-making to help shipping companies improve vessel and fleet performance and minimise fuel consumption and GHG emissions. Recent developments in satellite connectivity have also brought faster processing speeds, making data analysis more efficient and thereby ensuring actionable insights are more accessible than ever before.

While vessel and fleet optimisation tools can make a substantial contribution towards sustainability goals, to fully leverage their potential, the industry must adopt them on a broader scale. Due to the cost of digital solutions and the bandwidth needed to support them, smaller companies are generally more hesitant to embrace digitalisation. Yet environmental regulations apply regardless of a company's size or finances, and a time will come when all shipowners need to deploy efficiency-driving software.

Digital due diligence

Fortunately, with more technology providers now entering the maritime market, digital tools are becoming more affordable. To maximise their chances of success in a fast-changing industry, owners of all sizes should perform their 'digital due diligence'. This involves gaining a clear understanding of requirements and objectives and identifying the solutions most likely to yield the desired outcome.

If cost is the most immediate obstacle to maritime digitalisation, culture and attitudes present a more complex barrier. As an industry that dates back thousands of years, shipping is rooted in tradition and is generally more resistant to change than younger sectors. For many vessel owners, the fleet-wide roll-out of novel technology is a daunting prospect.

Nevertheless, the industry is coming to acknowledge that while the initial outlay and learning curve may be steep, digital tools will improve the efficiency of onboard processes and vessel operations to save money and time in the long term. Any early concerns that advanced technology would make ship operations needlessly complicated and eventually replace seafarers are easing.

Digitalisation is effecting change across the industry but, amid the constant reminders of its efficiency benefits for shipowners, we must not lose sight of the ultimate goal of decarbonisation: the protection of our planet and its inhabitants.

DESPINA PANAYIOTOU-THEODOSIOU, TOTOTHEO MARITIME CO-CEO

In fact, with a unique connection to the world's largest ecosystem – the ocean – ships are also telling us more than ever about the health of our planet. Research vessels are designed for this purpose, but even commercial vessels – if equipped with the right monitoring tools – can serve as floating reporting platforms, offering unparalleled insight into the effects of climate change on marine ecosystems and the impact of sustainability measures.

And it is clear that we must do more than simply improve efficiency to protect our planet. While efficiency-enhancing software can significantly reduce fuel consumption, unless and until that fuel is from a clean, renewable source, emissions from ships will remain a pressing concern.

Power to change

Once more, the initial hurdle to implementing new fuels is cost, meaning that a shift in mindset is required here too. This applies not only to shipping companies, which must be willing to embrace change, but also to energy majors, which need to place their faith in the energy transition and increase their investment in alternatives to fossil fuels.

The good news is that digital technologies also offer a key to ensuring effective deployment of the alternative power sources shipping needs to unlock its low carbon future. While the journey to maritime decarbonisation will be long and filled with obstacles, optimising fleet performance can help us navigate the voyage. In doing so, digital solutions and the performance enhancements they enable will ensure that our destination – a sustainable future for shipping as well as the planet and its population – remains in clear view. ■

ENVIRONMENTAL LEGISLATION

DISMANTLING THE INVISIBLE BOUNDARY BETWEEN COASTAL WATERS AND THE HIGH SEAS

By **Sahan Abeysekara**, principal specialist, Lloyd's Register

Nearly two-thirds of the world's oceans are beyond national jurisdiction. It is home to a number of unique species and ecosystems that are key to marine biodiversity and vital to Earth's climate.

Significantly, no single state has authority on the high seas, which means international agreements are crucial. They provide a global framework for protecting marine areas and species, assessing impacts of human activities, capacity building and transfer of marine technologies along with the equitable sharing of benefits from marine genetic resources.

A busy period for policy makers has seen a number of accords, acting as instruments to protect at least 30% of world biodiversity by 2030.

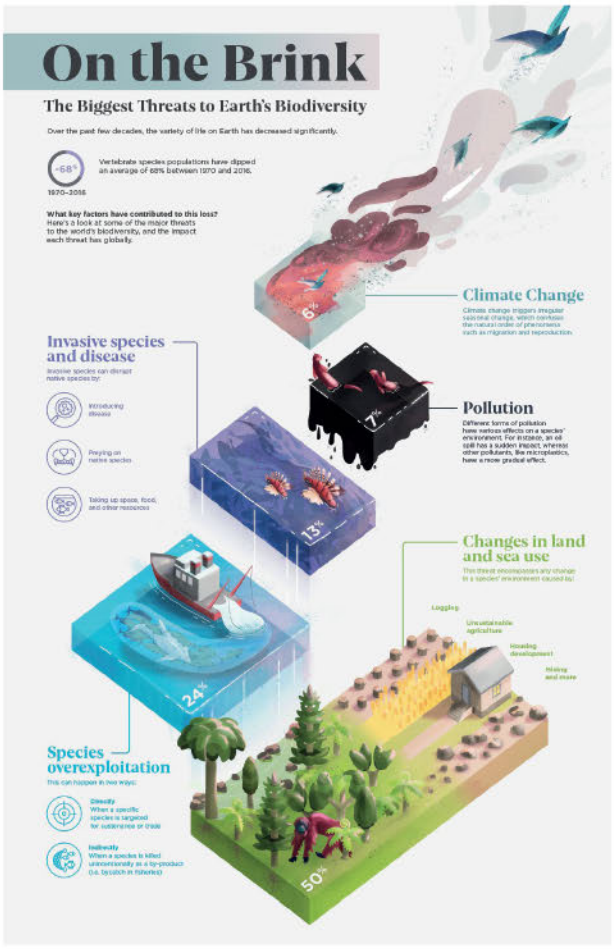
Informally known as the High Seas Treaty, the conservation and sustainable use of marine 'Biological Diversity of Areas Beyond National Jurisdiction (BBNJ)' was reached as a result of negotiations lasting just shy of 20 years and it came at an important time.

The draft agreement for the High Seas Treaty falls under the UN Convention on the Law of the Sea (UNCLOS). UNCLOS provides the overarching international legal framework for the ocean. It creates obligations to protect and preserve the marine environment and to conserve marine resources, but it does not specify mechanisms or processes for conserving marine biodiversity in BBNJ. A sectoral approach cannot address multiple pressures on the ocean and the different ways they interact. Regional approaches will also be insufficient given the connectivity of marine ecosystems and extension of ocean currents.

Prior to the signing of the High Seas Treaty, the Kunming-Montreal Global Biodiversity Framework (GBF) was agreed under the Convention on Biological Diversity (CBD), which covers both land and sea and was adopted by COP15 in December 2022.

The framework's aim, to reverse biodiversity loss by working with the parties to the convention in their national jurisdiction, outlines the need to prevent invasive alien species (IAS) from threatening Earth's biodiversity.

Invasive species and diseases are the third biggest threat to Earth's biodiversity and all the top six most threats to biodiversity include the sea in one way or another and target 6 of the GBF directly addresses this and aims to:

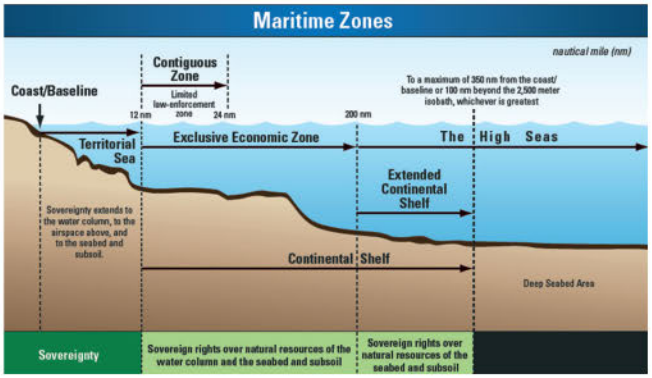


SOURCE: VISUALCAPITALIST

"Eliminate, minimise, reduce and or mitigate the impacts of invasive alien species on biodiversity and ecosystem services by identifying and managing pathways of the introduction of alien species, preventing the introduction and establishment of priority invasive alien species, reducing the rates of introduction and establishment of other known or potential invasive alien species by at least 50%, by 2030, eradicating or controlling invasive alien species especially in priority sites, such as islands."

Could the protection of world biodiversity have direct impact of world shipping?

One of the most important principals of UNCLOS is the 'right of innocent passage'. The principle enshrines the right to passage, as long as it is not prejudicial to



MARITIME ZONES DEFINED BY THE UN CONVENTION ON THE LAW OF THE SEA. SOURCE: NOAA

the peace, good order or security of the coastal state whose territory covers the coastal waters in question. A vessel in innocent passage may traverse a coastal state's territorial sea continuously and expeditiously, without stopping or anchoring except in certain unavoidable and unforeseen situations.

The world fleet has continued to enjoy this freedom of navigation whilst complying with the relevant environmental regulations. The legal aspects of enforcement within these territorial waters are established, but not when it is beyond an Exclusive Economic Zone (EEZ) – and in some cases Contiguous Zone. UNCLOS clarifies the jurisdiction of ships on high seas.

The UN High Seas Treaty proposes the creation of a global network of Marine Protected Areas (MPAs), set aside for long-term conservation along with other types of Area Based Management Tools (ABMT) that support ecological connectivity, climate change resilience and preserve species and ecosystems.

It also proposes developing minimum global standards for screening, scoping, conducting and monitoring Environmental Impact Assessments (EIAs) and Strategic Environment Assessments; developing best practice guidelines for assessments and how to prohibit or manage activities that risk harm to BBNJ.

The implementation of the agreement will require appropriate institutional arrangements together with the establishment of a scientific and technical body to independently advise and evaluate EIA and MPA processes. It is also crucial that funding mechanisms to support the implementation of the agreement, including capacity building programmes, are put into place.

Back in March, the Biden administration unveiled a new plan to work with the ocean to mitigate and adapt to the climate crisis. The plan discussed similar approaches for creating Climate-Adaptive Marine Protected Areas with the following commitment:

"To create, connect, strengthen, and expand Marine Protected Areas (MPAs) and MPA networks while enhancing the connectivity of MPAs with one another, as well as onshore and inland conservation and use adaptive management. Designing networks of MPAs that protect core habitats for species at various life stages or provide areas for breeding, resting, feeding, and migrating to promote biodiversity, population persistence and resilience, and an increased capacity to adapt to environmental change."

These MPAs can significantly improve carbon storage, coastal protection along with the reproductive ability of marine life and biodiversity.

Although the protected areas will not fully reverse the impact of climate change, they remain an extremely useful tool for combating the effects of biofouling and damage to marine ecosystems. Now that we have concrete evidence that MPA networks are beneficial for biodiversity, from sources such as the Pew Charitable Trusts, maritime stakeholders must back these initiatives in order to stem the negative effects of climate change. It is therefore a great positive to see the US government's commitment to establishing these networks.

Will this be a game changer for environmental regulations in marine industry?

Marine environmental regulations applicable to world shipping are monitored and compliance checked at the territorial waters. The majority of these regulations are designed to be more stringent within territorial waters or up to EEZs but lack any real control over the high seas.

Marpol Annex I: Allows the discharge of oil (with certain exceptions) generated in machinery spaces and oil or 'oily mixture' from the cargo area of an oil tanker under certain conditions to sea when the ship is '*En Route*'. This can cause any discharge to be spread over a greater area of the sea than is reasonable and practicable, with conditions including the distance from nearest land, rate of discharge and total quantity.

Marpol Annex II: Allows the discharge of residues of noxious liquid substances (in certain categories) to sea under certain conditions. Once more, the important factor is here distance from the nearest land.

Sewage discharge, as per Marpol Annex IV and garbage discharge, as per Marpol Annex V, follows the same principal. This is prohibited near land, but discharge standards remain relaxed away from these coastal areas.

Until the ships have to comply with the Regulation D-2 performance standards, ballast water exchange (BWE) at high seas is considered a method for complying with the BWM Convention. Furthermore BWE+BWT as an accepted method of BW management is being proposed. Ships can uptake BW from a port, discharge in high seas (untreated) and ballast from high seas, and discharge at next port (treated). Since the numerical organism count (D-2) standards have to be met at the discharge,

it could be argued that it follows the BWMS Convention requirements. But the question remains, who will be enforcing this on the high seas?

Scrubber effluent discharge has been a debated topic since its inception. Some administrations have prohibited open-loop and hybrid scrubber effluent discharge in their territorial waters. The concerns lie not only with the heavy metal, cancer-causing polycyclic aromatic hydrocarbons (PAHs) but also the acidity of effluent discharge. Similar concerns may persist with open-loop carbon capture and storage (CCS) designs. You could ask, how have these regulations been developed? Were any EIAs conducted? If so, why have those assessments not identified discharges in the high seas as potential risk to the ocean?

The answer lies with the perception.

Perception that an invisible boundary is separating coastal waters from high seas, perception that high seas have an unlimited pH buffer, making them the greatest carbon sink without any ramifications. Perception that the fundamentals of precautionary principals shouldn't apply to shipping.

BBNJ may challenge those perceptions. MPAs may prohibit ship discharges by limiting navigation into MPAs, thereby preventing pollution and ocean acidification. It also may give flag states greater obligations on environmental protections on the high seas. The treaty could potentially open up new ways of thinking, allowing us to consider the risks to the high seas and not just the risks to coastal waters – preventing the transformation of one type of pollution into another. BBNJ could very well be the catalyst to raising awareness of the potential risks of other ship discharges, such as microplastic pollution, underwater noise and food waste.

Can we accept the new reality?

The world is changing, and attitudes have changed. Ship operators want to do their best and charterers are continuing to seek green credentials. Ship crew, in particular the millennial generation, are more aware than ever of the climate emergency we face. The key positive is that the technology is already there and will keep emerging, helping us face up to the climate crisis.

Solutions such as scrubbers are always going to be a temporary fix until the industry has the readiness to adopt cleaner fuels, but until then closed-loop scrubbers with treatment are an option and can be seen as a short- to mid-term step.

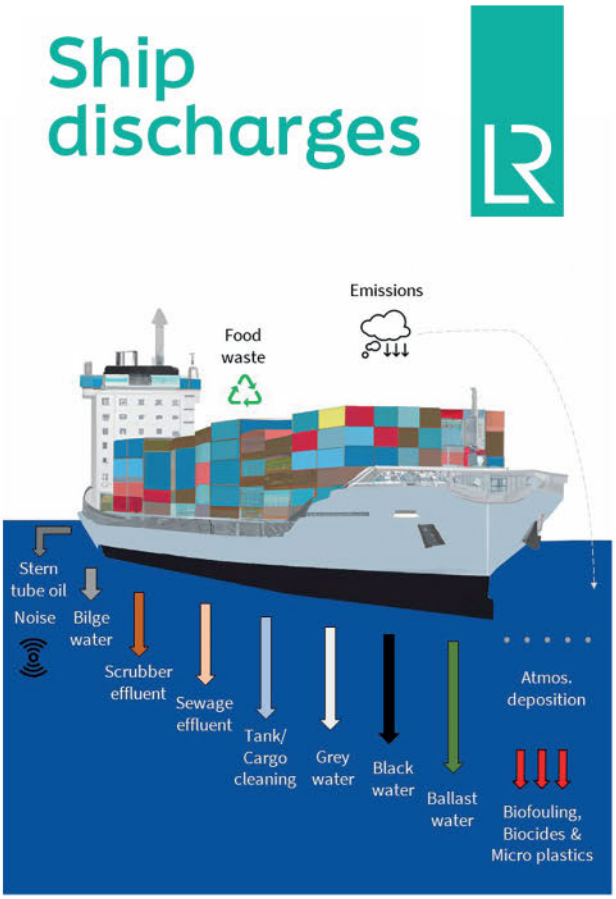
Advanced OWS (oil water separator) technology now exists, which limits discharges to five parts per million – with some technology claiming to contain less than one part per million in real-world cases. More advanced 'next generation' ballast water management system (BWMS) solutions are now coming to the market and data driven biofouling solutions offer prevention of IAS and fuel consumption.

Other examples of the industry acting include the coating sector, which is researching biocides and microplastic free solutions. New propeller designs and sound absorbing solutions are also emerging to reduce underwater radiated noise and digital solutions are becoming available for predictive maintenance, with real-time data and options for remote monitoring of equipment from shore side.

The instruments that the High Seas Treaty will be using for oversight on high seas activities, or the aspects of the treaty's effects on shipping, are still unknown. However, considering associated activities and different nations' plans to meet UN Sustainable Development Goals, the shipping industry can expect changes to its way of operating.

Clever ship designs, quality equipment, data driven solutions, trained crew and smarter systems will allow the shipping industry to face these new challenges.

After all, we as an industry are acting upon mandated GHG emission targets. We are an industry which has the lowest CO_2 per ton-mile. Maritime is an industry that can take the initiative and protect planet Earth's precious biodiversity. ■



A VARIETY OF DISCHARGES BY SHIPS CAN HAVE A NEGATIVE IMPACT ON THE MARINE ENVIRONMENT. SOURCE: LLOYD'S REGISTER

FUEL CELL PIONEERS ARE MAKING POSITIVE STRIDES TOWARDS DECARBONISATION: REGULATORS SHOULD TAKE NOTE

By **Johan Burgren**, marine business manager, PowerCell

TORGHATTEN NORD'S HYDROGEN FERRIES WILL OPERATE ON NORWAY'S MOST EXTENDED AND WEATHER-EXPOSED FERRY CONNECTION. SOURCE: TORGHATTEN NORD

Maritime fuel cells are evolving, and fast; new projects will deliver power for larger vessels, for longer distances, and in tougher conditions than ever before. As the technology progresses, the case for fuel cells as a major component of decarbonisation strategies across the global fleet is becoming harder to ignore.

A new ferry project in Norway, which will be the largest maritime hydrogen fuel cell project delivered, outlines the scale of fuel cells projects we can expect in coming years. Torghatten Nord will develop and operate two approximately 120m-long hydrogen ferries on Norway's most extended and weather-exposed ferry connection between Lofoten and Bodø, with a long and demanding sailing time of more than four hours.

Scalable, multi-megawatt solution

The ferries are powered by PowerCell's Marine System 200, providing the two ferries with 6MW power each, for a lifespan of more than 15 years, with a capacity of 599 passengers, 120 cars and 12 trucks each. Systems integrator SEAM will be responsible for the delivery of propulsion, control, and safety systems. The PS200 is the building block for multi-megawatt fuel cell systems, and PowerCell will be providing 32 PS200s to each ferry. The ferries will be fuelled by green hydrogen and reduce CO_2 emissions by 26,500tonnes per year. This corresponds to the CO_2 emissions from 13,000 diesel cars per year, according to the route operator. Final delivery is to take place in the fourth quarter of 2024.

The deployment of fuel cells on such a challenging route is the culmination of more than 30 years of development, learning from fuel cell projects on land, and even in the aerospace sector. PowerCell's systems have been specifically designed for use in the maritime industry as a scalable, durable, and flexible emissions-free solution. The marinisation process of the technology was conducted in close collaboration with class societies. With the approval in principal and rigorous work on the safety aspects of our technology, we have a robust system that is easy to service, in which refurbishment or replacement of critical parts can be completed without the need for a drydock.

In Norway alone, there are roughly 800 ferry lines, and with hydrogen power a significant element in Norway's decarbonisation plans, this segment is one where we can expect to see growing interest in hydrogen-electric solutions.

In Europe, several countries have rolled out preferential policy to support hydrogen fuel cell for marine applications, which meets the International Maritime Organization's (IMO) regulation to reduce greenhouse gas (GHG) emissions from the global shipping industry. In China, last September saw the Ministry of Industry and Information Technology release the Suggestions on Accelerating Inland Vessels with Green Technologies, which highlighted the promotion of hydrogen-powered vessels. All these factors pave the way for hydrogen fuel cell technology in marine applications.

Larger fuel cell stacks and module power ratings of more than 20MW are expected to be on the water in two to five years due to increased power density and expanded economies of scale. This will also drive down costs per MW by developing smarter technology, production methods and larger standardised sizes.

Regulations pushing towards a true-zero solution

The development of this technology comes as new regulations such as the EU's Green Deal are pushing fleets towards electrification, hydrogen and other emission-free

energy. Starting next year, the maritime sector will be included in the EU Emissions Trading System (ETS), which will further increase the demand for net-zero, hydrogen-powered solutions. As we are already seeing in the EU, the financial rewards for installing equipment such as fuel cells are set to be substantial.

Meanwhile, outcomes from the latest IMO MEPC intersessional working group focused on further discussion of mid-term measures, ahead of the next intersessional working group meeting (ISWG-GHG 15) where the IMO will likely update its wider greenhouse gas strategy. Mid-term measures might include technical components, such as an GHG intensity standard, as well as an economic component, all aimed at incentivising the global availability and uptake of low- and zero-carbon fuels. The basket of measures discussed also included lifecycle carbon analysis (LCA) and collection of live fuel data consumption to better inform outcomes.

As regulators and industry build on the outcomes of this session, it is essential that further steps move the industry away from 'business as usual'. Shipowners need to see zero-emissions solutions as the 'next-build' solution for their fleets – we cannot afford to wait until the next generation of ships to adopt the zero-carbon technologies of the future.

The progress of emissions trading legislation in the EU and US show that, regardless of what the IMO decides, the future is low carbon for any vessels trading in either of these regions. In the EU ETS, carbon emitted will have to be paid for or traded – 40% of carbon emitted to begin with in 2024, rising to 100% in 2026. Carbon is now trading as close to €100 per tonne, up from around €7 per tonne a few years ago. For companies with carbon allowances to trade, this is a huge opportunity – and a major cost for those that don't. At the same time, the EU fuels directive stipulates a steadily increasing reduction in carbon intensity between now and 2050. The final version of the EU fuels directive will see ships required to gradually reduce greenhouse gas emissions by curbing GHG intensity by 2% as of 2025, 6% by 2030, 14.5% by 2035, 31% by 2040, 62% by 2045 and 80% by 2050. Shipowners who use renewable liquid and gaseous fuels of non-biological origin between 2025 and 2034 will receive more emissions offset credits than those who do not.

If shipping is to keep pace with the speed of decarbonisation the world needs, it requires global regulation that will support technology developers and owners in delivering and adopting low carbon technology

POWERCELL'S JOHAN BURGREN. SOURCE: POWERCELL

rapidly. This will require a percentage of 'true-zero' options – such as hydrogen fuel cells - with zero tailpipe GHG emissions, and a mix of low carbon options such as green methanol or ammonia. Moving away from 'business as usual' is essential – it will not be enough to simply switch fuels and continue as usual. As we can see in the EU, those installing equipment such as fuel cells to reduce carbon emissions from any fuel – even a low carbon one – will be set to reap commercial rewards. This is a dynamic that should be replicated globally. Trustworthy carbon accounting, on a well-to-wake basis, will be essential in creating the necessary incentives to make this a reality.

Fuel cell advances

It is not only ferries that are making use of fuel cells today. PowerCell Group projects involving other vessel types include providing fuel cells to the Hydrogen One, the world's first methanol-fuelled towboat, being developed by Maritime Partners using e1 Marine's methanol-to-hydrogen generator technology. This first-of-its-kind towboat is set to hit the water in 2023.

In September 2022, PowerCell Group received an order for fuel cell systems and related services to US-based Amogy to be installed in a workboat. The fuel cell system that PowerCell will deliver will be integrated in Amogy's solution, where ammonia is reformed into hydrogen. In this way, it is possible to provide continuous power to a workboat over extended periods. The workboat will be used to demonstrate how to build a complete power system targeted to the marine industry.

Embracing fuel cells technology today sets shipowners and operators on the right course for zero-emissions shipping to meet stringent industry regulation. With our advancements in developing a system specifically for maritime players, we are leading the way towards fully decarbonising the industry. ■

POWERCELL'S SYSTEMS HAVE BEEN DESIGNED AS A SCALABLE, MULTI-MEGAWATT SOLUTION. SOURCE: POWERCELL

DATA ANALYTICS DELIVERS DIRECT ANSWERS ON CII

A new study developed by METIS Cybertechnology with Andriaki Shipping offers detailed analysis of the true gains to expect of the options offered to reduce ship greenhouse gas emissions

By **METIS Cybertechnology** and **Andriaki Shipping Co. Ltd**

Big Data and artificial intelligence are often said to be reshaping the future of the maritime industry, although skeptics sometimes resist the attractions of the algorithm because they suspect a disconnect between the basis of analytics and the business of shipping.

Now, METIS and Andriaki Shipping have applied the power of analytics to uncover the buried relationships between ship operating parameters and the International Maritime Organization's Carbon Intensity Indicator (CII) that will help owners evaluate the options to enhance CII performance.

The IMO CII measures carbon intensity over time, given in grams of carbon dioxide (CO_2) emitted per cargo-carrying capacity and nautical miles travelled. The regulation rates ships on a scale of 'A' to 'E' and requires continuous improvement. Today, high frequency data capture is invaluable for CII reporting, where traditional logs (e.g. noon reports) provide neither the quality nor volume of data to deliver comprehensive benchmarking.

Taking into account fast-growing data capture, higher speed connectivity and advances in cloud computing, METIS and Andriaki Shipping use a combination of established methodology, new algorithms and mathematical modelling to measure the impact of alternatives to improve CII performance. Doing so gets to the heart of the practical gains AI makes possible by interpreting hidden patterns and structures in data, and the response to those patterns available to machine learning (ML).

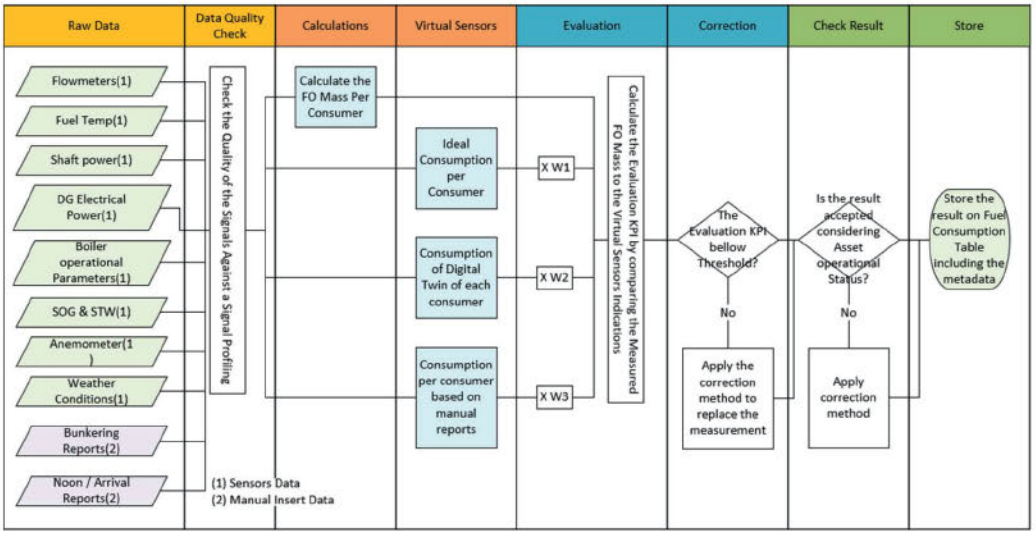
CII variables

Voyage performance requirements will be established by the owner, or by agreement with the charterer, but from the CII perspective the optimum will be achieved when CO_2 emitted per cargo-carrying capacity and nautical mile is minimised. While optimised speed for minimum fuel consumption will be a central consideration, other variables include: the ship's trading pattern (time in ballast and laden); the time spent waiting in port; and energy used in-port.

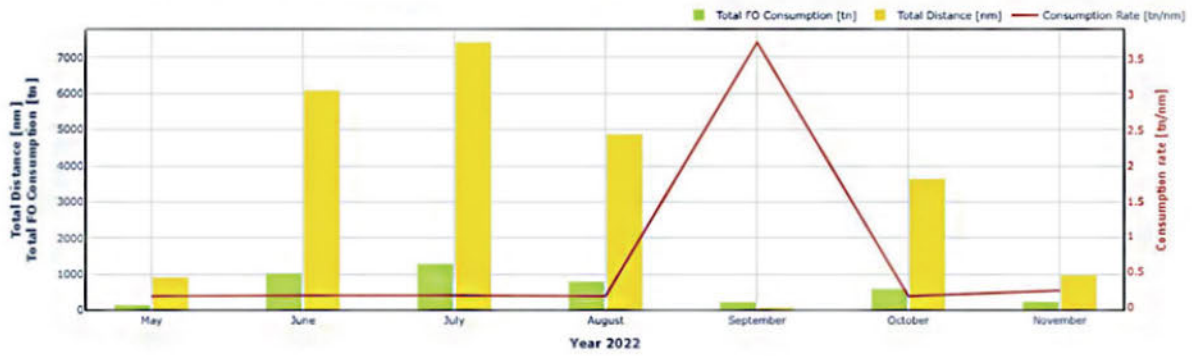
Within this framework, performance optimised for CII will nonetheless in part rely on the ship's ability to convert energy use into distance travelled.

In addition to being able to analyse a ship's bunker fuel consumption by energy produced, AI-based modelling can establish the value of different energy-saving strategies. As a first step, the METIS/Andriaki methodology evaluates the high frequency raw data itself, based on a specific signal profiling, calculations from flowmeter readings and three "virtual sensors" which ensure the reliability of results by learning to interpret the relationships between variables.

In a case study involving a 91,373gt bulk carrier (16m-17m mean draft), the analysis suggests 7% could be cut from fuel consumption simply by reducing speed from 12.5knots to 12.0knots. The same modelling also better establishes the impact for CII of hull fouling, where drag has consequences for speed and fuel consumption, but may also require a ship to reduce payload to meet its charter commitments. Again, the model would be invaluable for evaluating



FUEL OIL CONSUMPTION CALCULATION FLOW



VESSEL'S CONSUMPTION (TN/NAUTICAL MILE) RATE PER MONTH

weather routing optimisation claims or the impact of port turnaround efficiencies on CII.

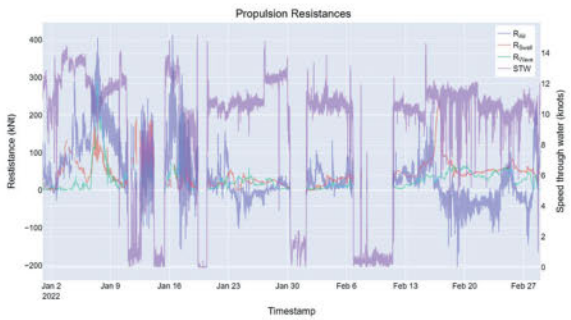
Going further, METIS and Andriaki Shipping offer specific evaluations of several new energy efficiency solutions developed to save fuel, weighing up the options based on life cycle cost.

Evaluating alternatives

An ideal candidate for analysis using high frequency data are waste heat recovery (WHR) systems – a key technique identified by IMO for GHG emission cutting potential.

Taking a Zeolite adsorption chiller as the candidate technology, the METIS-Andriaki analysis uses a specialised software library to model an operational simulation of adsorption chillers on a Very Large Crude Carrier with a main engine of 31,640kW MCR. Based on experimental data sampled every 15 seconds and mathematical modelling, total cooling energy for an entire year is given as 160,407kWh. With the respective electric power requirement being 45,831kWh, the adsorption chiller require only 6,959kWh to operate: the net saved electric power is 38,872kWh, equivalent to an 8.94tons annual fuel saving from a single unit. With the vessel having capacity for eight modules, the CII impact could be substantial.

A second study focuses on four sister vehicle carriers of 36,902gt delivered in the same year, three of which underwent full hull-blasting followed by application of silicone-based antifouling paints whilst the fourth was spot blasted with conventional paint



MAJOR ADDED PROPULSION RESISTANCES AND SHIP SPEED THROUGH WATER

applied. Over a two-year evaluation measurements were taken every 15 seconds, and resampled at 30-minute intervals.

Over a range of operating profiles and weather conditions, the "conventional" paint demanded approximately 12% more power (on average). After the analysis, the shipping company undertook hull cleaning and propeller polishing to correct the performance shortfall.

Another case study relates to the installation of an ESD in the area of the propeller of an 84,850gt oil tanker during drydock. The vessel undertook sea trials in both laden and ballast conditions, under good weather conditions before and after the dock.

Using AI-based analytics approach, and taking into account different main engine loads in relation to the actual speed profile, the vessel's performance after the drydocking in terms of shaft power to speed was given as between 4% and 14% ahead of its pre-docking data.

Keeping in trim

Trim optimisation minimises ship hull resistance, but is a field of limited research, although most estimates energy savings as falling in the range of 0.5% to 5%. However, the optimal trim tables employed by shipping today are usually based on calm sea states, whereas a dynamic system which considers sailing speed, displacement and actual weather state is essential for optimisation.

In the case at hand, data from continuous monitoring system of a 333m length oil tanker featuring a 31,640kW (MCR) main engine was acquired over 24 months, with weather data collected from four providers and filtered, and measurements recorded with a sampling rate of one minute.

The ship's power needs could potentially be reduced by ~3% and up to ~16% by selecting the optimal trim for certain speed and draft configurations. Further investigation into this subject is needed to obtain greater accuracy and proceed to their verification, although stakeholders might also note that this is an easily implemented solution which can bring significant reductions in CO_2 emissions.

SCRUBBERS' LONG-TERM VIABILITY REMAINS POSITIVE

By **Kashif Javaid**, director of sales, Wärtsilä Exhaust Treatment

Many vessels built 10 years ago will have to last through considerable regulatory change leading up to 2035 and beyond. The shipping industry cannot afford to scrap and replace its entire global fleet, and instead should turn to solutions that create a platform for further development.

Instead of replacing existing vessels, adopting proven technology makes it possible for the existing fleet to be part of the decarbonisation transition and avoid an early grave – with all the associated life cycle carbon costs of scrapping and building a renewed global fleet. By shifting mindsets and viewing scrubbers as a technology platform with the ability to tackle multiple pollutants, including SOx, NOx, particulate matter (PM) and CO_2, they will play a long-term role in decarbonisation.

CO_2 capture can be used with any carbon-containing fossil fuel and even biofuels. While the infrastructure for producing and distributing non-carbon fuels – such as ammonia and hydrogen – is under development, these fuels will not be 'silver bullet' solutions. A range of fuels will be required to meet the needs of different vessels and different operating strategies and routes. This is because not all vessels can be easily retrofitted for future fuels, and these fuels may only be speculatively available on the routes they operate anyway.

Beyond tackling SOx, scrubbers are a catalyst for multiple abatement technologies to be added the exhaust chain. This includes tackling NOx emissions by adding selective catalytic reduction systems (SCR) or exhaust gas recirculation systems (EGR) to ensure compliance with MARPOL Tier III requirements. In addition, scrubbers can reduce PM levels below standard land-based requirements, and a filter can be applied to capture ocean microplastics. The addition of a carbon capture and storage (CCS) unit to the platform can enable owners to future-proof their existing assets even further while achieving favourable payback terms.

Short-term market prospects are positive

The economics of this approach make sense both today and into the future. Shipowners who invested in scrubbers prior to the 2020 global sulphur cap are enjoying a competitive advantage. There are few signs that this will abate, with payback models demonstrating currently that returns can be made in a considerably short timeframe. This creates a huge driver for the continual uptake of exhaust gas abatement solutions.

Indeed, the scrubber installation market is in much better shape than it was last year. And even last year, there was quite a strong business case given the fuel spread between high and sulphur fuel. There are still quite a significant number of vessels sailing on low-sulphur fuel which, if they had a scrubber installed, could have saved more on their bunker fuel bills last year.

Additionally, high earnings in the container segment last year, historically the major segment for scrubbers, has seen shipowners quite reluctant to take vessels out of service to install scrubbers. There was little newbuild activity in this segment too, and a major factor for this is the Covid-related challenges in China. Most of the retrofits are installed in the Shanghai area, and due to the restrictions, it was not always possible for installations to proceed.

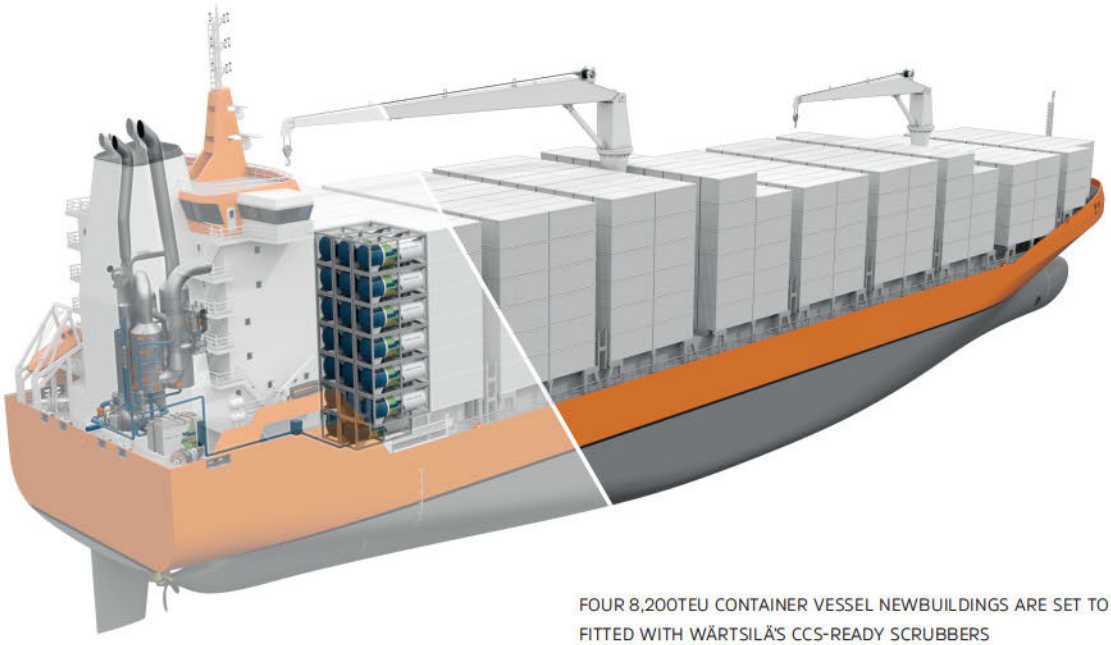
Container rates have been falling this year, which makes the installation of scrubbers more attractive, and tanker market should also see an increase in scrubber retrofits as scrubber-equipped ships are earning almost twice as much as non-scrubber ones in some segments. The Mediterranean Emission Control Area (ECA) could also be a driver for more scrubber orders.

A new wave of scrubber retrofits is expected this year. We remain optimistic that there will be more contracting of scrubber installations in the coming months. Mature scrubber technology now exists to ensure a smooth integration for a full CCS unit with the opportunity for ship owners to be CCS-ready.

A springboard into CCS

In preparation for the expected rollout of CCS in 2025, owners now have the option to install a CCS-ready scrubber for both retrofit and newbuild vessels. Here is where our team of experts perform additional design and engineering work to ensure that future retrofits for a full CCS system on the vessels have already been

KASHIF JAVAID



FOUR 8,200TEU CONTAINER VESSEL NEWBUILDINGS ARE SET TO BE FITTED WITH WÄRTSILÄ'S CCS-READY SCRUBBERS

accounted for either during the newbuilding or scrubber retrofitting stage. Additional measures are taken to ensure adequate space for the future installation of CCS system, such as minimising idle load, optimising utilities, and preparing the control and automation system accordingly. Retrofitting a CCS-ready scrubber requires space to be reserved above it and the funnel to be raised a few metres, and in most cases, it is better to do this as early as possible.

A scrubber serves as excellent preconditioning of the exhaust gas, optimising CCS performance in addition to its inherent environmental benefits. By adopting a CCS-ready module, shipowners can be assured that they will have continued regulatory compliance for SOx emissions and enable smooth CCS system adoption in the future.

Our CCS technology is now being readied for market. Our CCS pilot unit on Solvang's 21,000m³ ethylene carrier *Clipper Eos* aims to deliver a CO_2 capture rate of up to 70% of CO_2 emissions, which will ensure compliance with the International Maritime Organization's (IMO) decarbonisation targets as well as Solvang's ambition to decarbonise their deep-sea fleet.

This test will prove the technical viability of the system and provide vital lessons about crew training and handling in-operation. The trial will also enable us to test how the technology can integrate with land-based CO_2 reception and storage infrastructure.

With a successful CCS pilot, further commercialisation and scaling will follow. We have already received the first order for CCS-ready scrubbers for four 8,200TEU container ship newbuildings, with delivery expected later this year.

Leading classification societies are working to provide regulations and guidelines for owners and operators. ABS released its first set of regulations for installation of onboard CCS in December 2022, and others are expected to follow this year.

Shipowners can be future-ready

Shipowners who invest in a scrubber today are laying the foundations to easily upgrade their systems with additional technologies to improve maritime sustainability, future-proof their assets and ensure compliance. As a mature technology with a strong return on investment, scrubbers – with the possibility to be CCS-ready today – will enable shipowners to future-proof their assets and meet compliance.

In 2018, the IMO adopted its initial GHG strategy to reduce CO_2 emissions per transport work, targeting a reduction in vessel carbon intensity by 40% by 2030, and a reduction in total annual GHG emissions from international shipping by at least 50% by 2050, compared to 2008. Revisions are already underway, and a new strategy is expected to be agreed at MEPC 80 in July 2023 that will require more rapid emission reductions.

The IMO has also started discussing how onboard CCS solutions and their related carbon accounting principles can be implemented in the Energy Efficiency Existing Ship Index (EEXI) and Carbon Intensity Indicator (CII) regulations. Several flag states – such as Korea, Japan, Liberia and Norway – have submitted papers to MEPC with proposed approaches and solutions. The main discussion has been deferred to MEPC 80 to ensure the outcome is properly aligned with the overall strategy.

Despite the current regulatory uncertainty, the industry should be optimistic that scrubber platform solutions can help support the latest regulations, including CII and EEXI, and prepare for carbon pricing further down the road towards 2030 and 2050. ■

ALTERNATIVE MARITIME POWER ENABLES EMISSIONS-FREE PORT STAYS

With the regulatory landscape increasingly favouring shore power capabilities, ERMA FIRST's new high-voltage AMP solution provides owners flexibility in accessing the electrical grid while berthed

By **Dimitris Tsoulos**, BLUE CONNECT director, ERMA FIRST

As gateways to global trade, ports are critical economic and commercial hubs. However, they are also a major source of air pollution. While vessels are berthed in port and running their diesel-fuelled auxiliary engines to power the auxiliary equipment and accommodation load, they emit a harmful combination of pollutants including carbon dioxide, nitrogen oxides, sulphur oxides and particulate matter. Given the proximity of ports to densely populated urban areas, this has serious consequences for human health. The impact on marine life and the environment in general is also significant and wide ranging.

Such is the contribution of berthed vessels to air, water and noise pollution that regulators in Europe, North America and China have proposed or introduced measures directly targeting cleaner ship operations in ports. A common theme throughout the provisions is the requirement for vessels and ports to have the capacity for shore connection – otherwise known as 'alternative maritime power' (AMP) or 'cold ironing'.

The benefits of alternative maritime power solutions

By drawing all the energy it needs to meet hotel load requirements from an onshore power supply (OPS), a vessel can shut down its onboard generators at berth to eliminate emissions. For shipping companies, this allows adherence to port regulations in emissions control areas while contributing to overall emissions-reduction targets. It also reduces the burden on the auxiliary engines, extending their lifecycle and minimising the frequency and cost of maintenance.

As further incentive for shipowners and managers to implement an AMP system, charterers are increasingly demanding the use of the technology and, in some cases, may even be willing to cover or share installation costs.

Yet the benefits of AMP extend far beyond those available to the vessel operator. The elimination of

emissions and engine noise has a positive impact on local marine life as well as on the well-being of vessel crew, port staff and residents of port-adjacent communities, while the reduction of engine vibrations has a similarly positive effect for marine life and crew. The technology will therefore allow ports to continue operating as regulations become increasingly stringent and widespread.

For ERMA FIRST, shipping's need for shore power that is practical, adaptable and high in efficiency offered an opportunity too good to miss.

If ports are to continue operating in accordance with regulations, they will have to eliminate air and noise pollution sooner rather than later. There are a number of different challenges that need to be addressed when it comes to AMP, such as different regulations, vessel types, voltage requirements and port infrastructure, for example. BLUE CONNECT provides shipowners and operators with a single solution that will provide a safe OPS and help ports worldwide achieve environmentally friendly operations by offering vessels of all types, power demands and operational requirements flexible access to the electrical grid while berthed.

Flexibility to cover shore connection

ERMA FIRST's BLUE CONNECT system is a revolutionary high-voltage AMP solution suitable for both retrofit and newbuild installations and is available in containerised and stand-alone versions. While standard models currently cater to ro-ro, ro-pax and pure passenger ferries as well as container ships, cruise ships and tankers, the system can be tailored to the needs of other vessel types upon request. Users benefit from world-class reliability, the highest-quality system components from leading manufacturers and access to ERMA FIRST's global service network.

BLUE CONNECT includes a cable management system (CMS) for connecting the vessel to shore, a power transformer to convert high voltage to low voltage and the necessary switchgear to protect crew and equipment. Operation is controlled and monitored by the shore-connection main control panel, while power changeover supports shore-to-vessel synchronisation to help prevent a blackout upon connection. The solution can also be integrated into a vessel's alarm-monitoring and/or power-management system.

Based on vessel requirements, BLUE CONNECT can be supplied in four configurations: low-voltage fixed connection, low-voltage portable connection, high-voltage fixed connection and high-voltage portable connection. The low-voltage options are designed for ships with an onboard power distribution of 440V/60Hz, while the high-voltage versions serve vessels with a power distribution of 6.6kV/60Hz. The fixed systems, suitable for ships requiring connection from one side only, requires a permanent connection to the main switchboard, with the portable systems enabling plug-in connection at either side of the vessel.

DIMITRIS TSOULOS, BLUE CONNECT DIRECTOR, ERMA FIRST. SOURCE: ERMA FIRST

Shore power safety

Alongside flexibility, another key aspect of BLUE CONNECT's design is safety. With a growing number of ports promoting and stipulating the use of AMP, standardisation is paramount to ensuring the safe and efficient deployment of AMP technologies worldwide. The IEC/IEEE 80005 Utility connections in port series provides general requirements for high- and low-voltage shore connection systems, including detailed guidance on shoreside and onboard infrastructure – as well as the shore-to-vessel interface – and the corresponding safety measures.

Required safety measures and components as described by IEC/IEEE 80005-1:2019 include the implementation of adequate protection for the medium-voltage switchboard, earth fault protection, earth switches, the mechanical interlocking of connectors and safety loops. Continuous monitoring of the system's operations is also essential, while various conditions must be met to ensure safe connection and disconnection.

Typically, AMP solutions incorporate safety measures exclusively for high-voltage installations since the risks at the low-voltage level are deemed less severe. However, while less dangerous, low-voltage installations are not immune to faults. To ensure the protection of the onboard electrical grid and the system itself, ERMA FIRST conducted a risk assessment of its low-voltage solution during the BLUE CONNECT development process, and based on the results, implemented measures including self-diagnostics that make it easy for the operator to identify the cause of any communication or power loss.

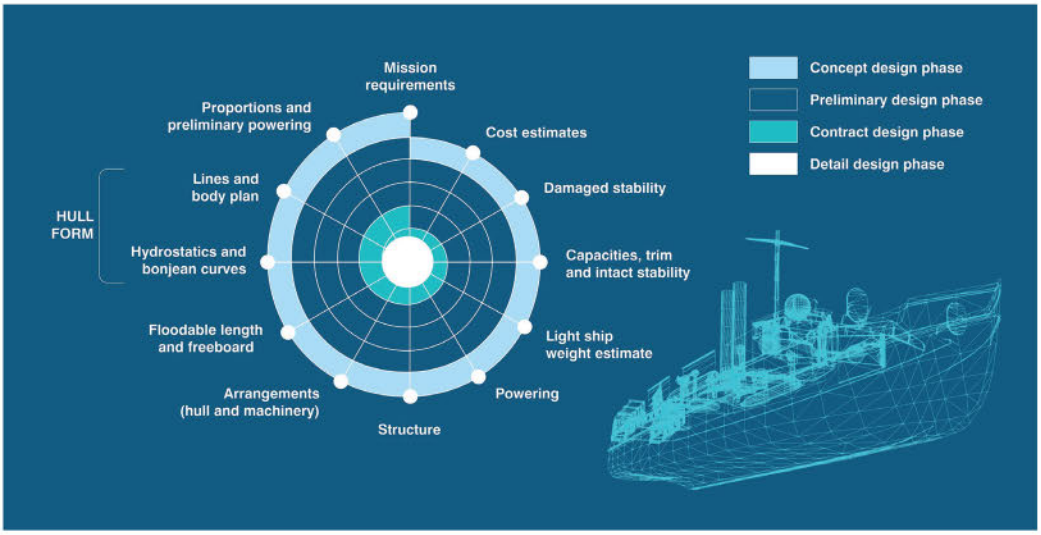
With the global regulatory landscape surrounding AMP use finally taking shape, shipowners are increasingly acknowledging shore connection as a crucial capability.

BLUE CONNECT is the most advanced and comprehensive example of AMP technology on the market and will make a significant contribution to the reduction of emissions at ports worldwide while maximising flexibility and safety for the user. ■

CFD & HYDRODYNAMICS

DESIGN OPTIMISATION USING COMPUTATIONAL FLUID DYNAMICS

By **Johnathan Green**, BMT, email: johnathan.green@bmtglobal.com



SHIP DESIGN SPIRAL

Maximising propulsion efficiency, reducing hull resistance and ensuring seakeeping ability – before a ship first touches the water its design has met a matrix of design parameters. Owing to the increased adoption of numerical methods of analysis across industry, ship designers have access to more tools and techniques than before to aid in ship design. Rising fuel costs, carbon emissions targets and more challenging operational requirements are pressing ship designers to make efficient use of these tools to deliver optimal ship designs.

Designing a ship is a challenging engineering undertaking and requires a substantial level of technical expertise across multiple disciplines. The ship design spiral is a representation of the multiple stages of ship design – concept, preliminary, contract and detailed design.

Whilst the ship design spiral appears suitable it can prove challenging to implement. Due to the expanding number of ship systems a growing number of analyses are needed. Following the ship design spiral can mean a detailed analysis is not performed for all systems on all designs.

Landing craft design

Recent ship design programmes illustrate fundamental changes in mission and performance requirements, necessitating ship designs which may be radically different from current ships in operation. One difficulty in designing such new concepts is the lack of experience from which to draw when performing design studies, landing craft are an example of this shift. Landing craft are increasingly required to be launched further offshore, making the hull form challenging to design as they need to:

- operate in shallow water as well as the open ocean;
- operate in following seas when approaching the shore;
- remain stable once on the beach; and
- ensure sufficient indicated horsepower as draught constraints lead to smaller than optimal propellers.

Through simulation-based numerical methods ship designers can perform complex analyses more rapidly and at a reduced cost – enabling more efficient designs and facilitating progress through the ship design spiral. Numerical methods such as computational fluid dynamics (CFD) can establish many design parameters including main hull resistance, appendage drag, ship powering coefficients, air resistance, airflow and superstructure interaction, and gas emissions.

The CAIMEN landing craft – designed to support expeditionary operations worldwide, ranging from amphibious assault to disaster relief and humanitarian aid – is an example of the successful application of numerical methods of analysis. Using a CFD-based approach, BMT was able to de-risk and expedite the delivery of new landing craft designs to meet the operational requirements of modern-day navies.

CFD verification and validation

Verification and validation are the principal means for assessing the accuracy and reliability of CFD

CAIMEN LANDING CRAFT © BMT

simulations. The objective of these tasks is to demonstrate the accuracy of the CFD code so it may be used with confidence and the results considered credible for design.

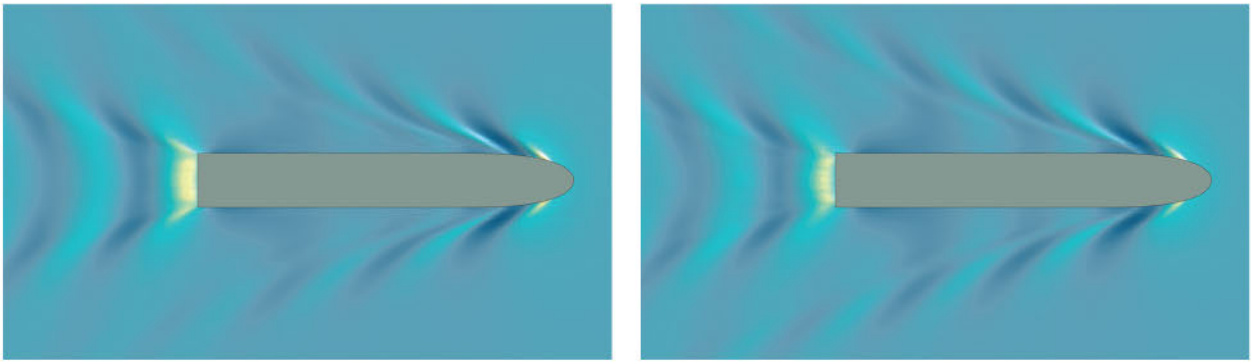
Verification is the assessment of the accuracy of the solution to a computational model by comparison with exact analytical results. When using a commercially available CFD software package – as is the case here – this validation is often performed by the software developer and documents made available for review and distribution.

Validation assessment determines if the CFD simulation agrees with physical reality through comparison to experimental results. To achieve this for the present case, CFD results were compared to results from towing tank experiments for the hull form design prior to the optimisation exercise. An extensive set of CFD simulations considered a range of loading conditions and operational conditions for which experimental results were available. Several computational meshes were considered to ensure the solutions converged towards the exact solution as the mesh spacing was reduced. All resistance values obtained from the CFD simulations were within 1.4% of the experimental values – inside the total uncertainty of the experimental values. Providing confidence the CFD approach was able to capture the flow features affecting the landing craft.

Hull form optimisation

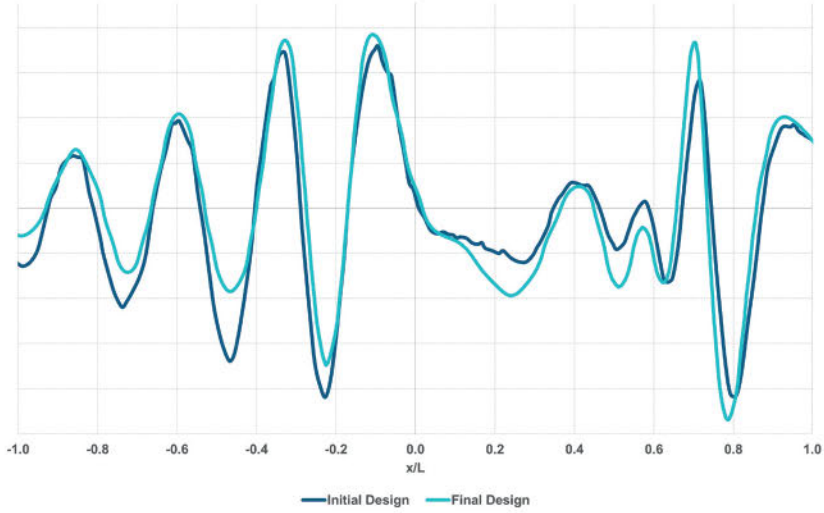
Confident the CFD approach was able to capture the flow features around the hull – the calm water resistance of the initial design of the hull was determined. This enabled a qualitative assessment of the key flow features negatively affecting the ship performance. Several iterations on the initial design were performed and a final design selected balancing the operational requirements of the landing craft and the hydrodynamic efficiency of the design. Results are presented for the initial design and the final design.

The Kelvin wake for the initial hull form design shows to wave patterns, generated from the bow



INITIAL DESIGN FINAL DESIGN

SHIP KELVIN WAKE



TRANSVERSE PROFILE OF FREE SURFACE HEIGHT

and the stern. The bow wave is pronounced and the wavelength shorter than expected for the design conditions. Due to flow separation at the bow, the bow wave does not interact strongly with the stern wave.

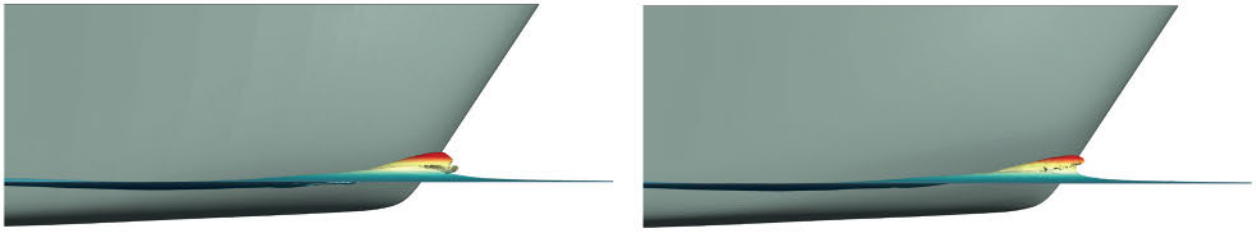
To assess the Kelvin wake further, a transverse profile of the free surface height was extracted a nominal distance away from the ship centreline.

At the bow, x/L = 1.0, the wavelength is significantly less than the theoretical wavelength, $\lambda/L \approx 0.16$, associated with the Froude number. This indicates a secondary wave pattern, a likely result of the sharp gradient in the hull close to the bow and the inflection behind the forward shoulder.

At the stern, x/L = 0.0, due to the far aft location of the centre of buoyancy for a ship operating at this Froude number a large wave pattern is generated. In addition, the waterline is not tapered in towards the stern creating a discontinuity. Both factors contribute to strong flow separation at the stern resulting in the formation of a significant wave pattern.

In the final design improvements were made to the fairing of the sectional area curves and the bow waterlines to reduce the secondary wave pattern which forms due to flow separation at the bow. This can be observed in the Kelvin wake and in the bow wave between the initial design and final design.

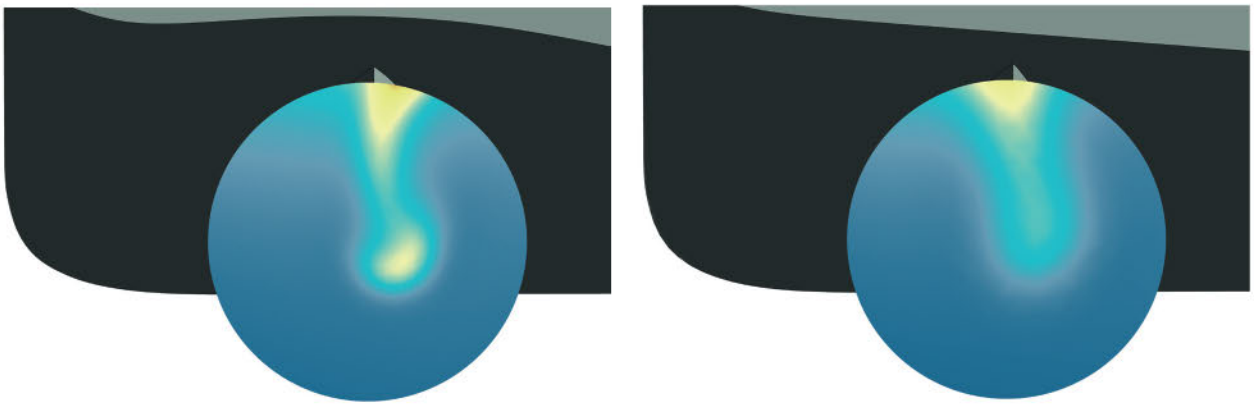
In addition to implementing design changes to



INITIAL DESIGN

FINAL DESIGN

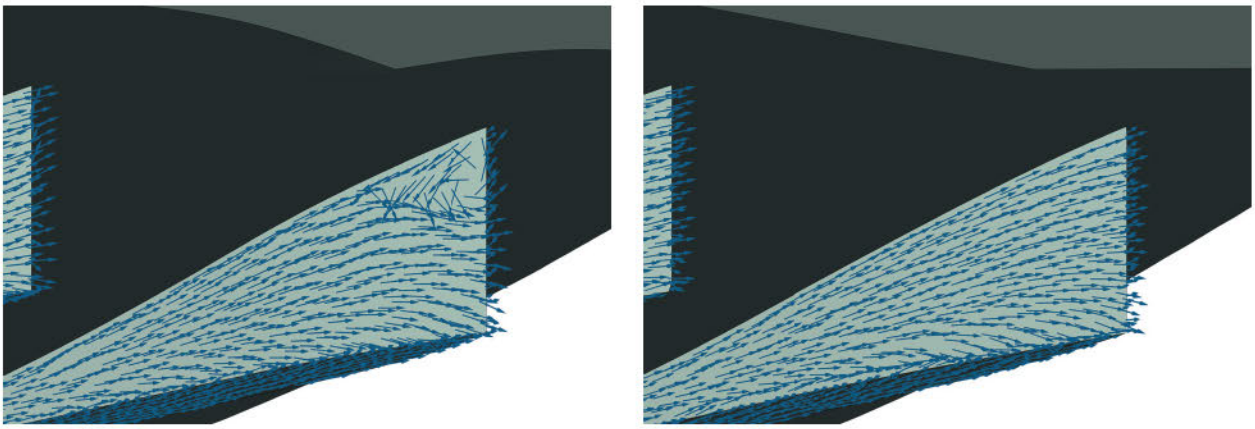
BOW WAVE



INITIAL DESIGN

FINAL DESIGN

PROPELLER WAKE FRACTION



INITIAL DESIGN FINAL DESIGN

FLOW VECTORS

minimise the wave resistance, the stern of the ship was a key focus area for optimisation. The design of the stern needs to balance the conflicting requirements of acceptable wake flow quality and speed performance. The propeller wake fraction for the initial design shows the propeller will operate in a spatially varying wake field, with changes in the axial velocity ranging from 45% to 95% of the freestream velocity.

This wake fraction range is indicative of a vortex region at the aft end of the skeg – which can be seen in the flow vectors at the aft end of the skeg.

The large wake fraction range coupled with oblique flow into the propeller will adversely impact the propeller efficiency – increasing noise, vibration and cavitation levels. The vortex region at the aft end of the skeg can also be observed in the dynamic pressure field at the propeller, aiding in identifying the cause. Flow acceleration between the two skegs in the initial design causes a pressure differential on the two sides of the skeg, inducing flow over the trailing edge.

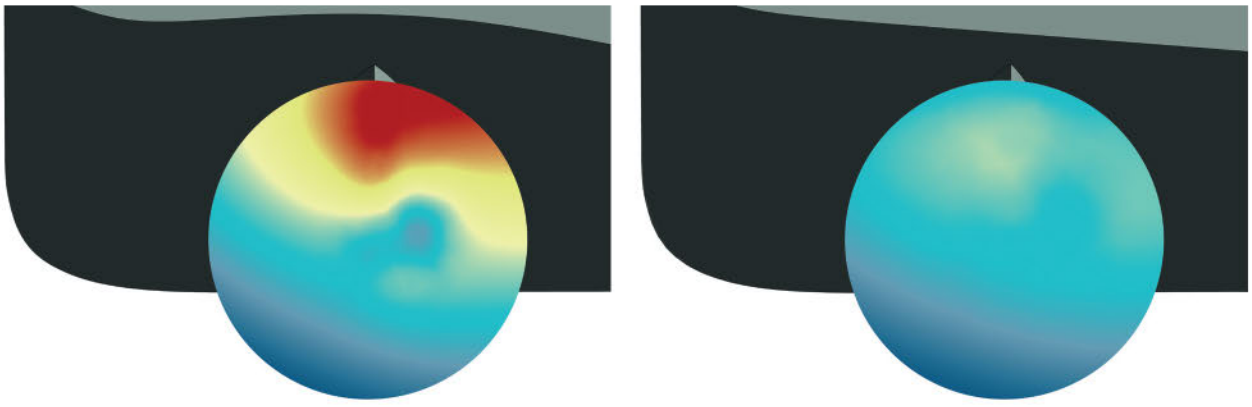
In the final design, an asymmetric design of the skeg reduced the size of the trailing vortex. Coupled with changes to the design of the propeller tunnels these changes removed the recirculation region at the aft end of the skeg – improving the propeller wake fraction and increasing the uniformity of the dynamic pressure at the propeller location.

Conclusion

In this study, a simulation based numerical approach was applied to the design and optimisation of a landing craft hull form. The initial design geometry was assessed through a CFD-based approach to identify areas where improvements may be made whilst retaining the operational requirements of the landing craft. Several design iterations were performed and a final design selected which achieved a balance between the operational requirements and hydrodynamic efficiency.

An assessment of the final design demonstrated a reduction in the wave height and reduced resistance – a reduction in the total hull resistance by 5%. In addition, significant improvements to the quality of the flow into the propeller results in notable improvements to the propulsive efficiency.

The study shows the capability for CFD-based optimisation approaches to form a fundamental part of ship design. Through employing panel codes based on strip theory, Navier-Stokes-based CFD approaches and towing tank testing, ship designers have access to a range of analysis approaches to achieve the right balance between time, cost, and fidelity of assessments throughout a ships design lifecycle. ■



INITIAL DESIGN FINAL DESIGN

DYNAMIC PRESSURE FIELD

CAREERS

AUKUS OPPORTUNITIES

By **Dr MJ Cianni** CEng, FRINA, FIEAust, email: cianni@raptohna.com

The AUKUS alliance comprising of the UK, USA, and Australia currently, with the possibility of New Zealand joining in the near future, is estimated to create 20,000 jobs over the next 30 years, and represents a great opportunity for RINA naval architects and UK chartered engineers registered through RINA as members or fellows.

The new SSN-AUKUS submarines will be based on a British design, with some made in the UK by BAE Systems and Rolls-Royce. This design will also replace the current seven nuclear-powered submarines used in the UK with the potential size of the UK Submersible Ship Nuclear Replacement (SSN(R)) fleet increased to 19, creating and securing many thousands of jobs in the UK.

Australia and New Zealand in particular will need to build a workforce of naval architects and chartered engineers, who will work on the SSN-AUKUS project in the UK for the initial builds and then to support future submarine builds in Australia and New Zealand. Australia has currently committed to a fleet of eight nuclear-powered submarines. It will become only the seventh country in the world to gain nuclear-powered submarines and expects to receive delivery of its own submarines in the early 2040s. In the meantime, British submarines will start to be rotated to Australia from early 2027 to help build the country's knowledge, workforce and infrastructure in preparation.

Investing in military infrastructure can have significant economic benefits in the wider economy. As the Lowy Institute notes in its report from 2019 on the Australian defence industry, defence spending can create jobs and support the growth of local businesses, as well as promote economic growth and stability. It concludes the investment in Australian manufactured submarines is set to have a positive growth and stability outcome.

According to a report by the Australian Industry Group also from 2019, manufacturing is the most important source of innovation in the economy, using more technology, robotics and advanced knowledge than any other sector. Therefore the UK's 50-plus years of experience in nuclear submarine manufacture is highly probable to be a critical driver of economic growth and job creation for the foreseeable future.

RINA has a mutual recognition agreement with the Institution of Engineers Australia and a framework for naval architects' professional review, sits on UKNEST supporting the Second Sea Lord regarding Naval Engineering Enterprise, and supports the national shipbuilding skills task force.

UK naval architects, chartered engineers and those working towards RINA membership or fellowship, and UK

DR MARCO CIANNI

Engineering Council registration as chartered engineers can position themselves to take advantage of this opportunity, by firstly becoming recognised in the UK as a naval architect through RINA, and then register as a chartered engineer via RINA with the UK Engineering Council, which will enable them to work on this project in the UK. For access to the Australia and New Zealand SSN-AUKUS opportunities, UK naval architects, chartered engineers and those working towards this professional recognition can contact an authorised Institution of Engineers Australia mentor and sponsor to assist them through the registration process. Currently more than half of the engineering workforce in Australia was born overseas.

The Institution of Engineers Australia is currently exploring the possible development of a nuclear engineering Area of Practice to support the nuclear aspect of engineering through new competency frameworks and training to build and maintain capability.

Another pillar of the three-part SSN-AUKUS deal covers Defence Digital (part of MoD Strategic Command) and the sharing of advanced military technologies, including defensive cyber strategy, capability, development and policy, quantum computing and artificial intelligence. Integrated logistics support (ILS) for the predicted 50-year lifespan of the project, reliability and redundancy analysis, domain/situational awareness, surveillance and radio technology, and nuclear waste reprocessing and disposal are all fundamental to the project and require specialist engineers in these fields.

Working on a strategically important global project such as SSN-AUKUS also offers the possible opportunity for current RINA members to demonstrate exceptional contributions to the profession and a record of superior achievements to apply for fellowship of RINA with the support of two current fellows, increasing their seniority and earning potential both in the UK and Australasia. With typical salaries in Australia being approximately three times that available in the UK. ■

ADVERTISERS INDEX

If you would like to receive further information on the advertisers featured within The Naval Architect please contact:
JP Media Services at **jpayten@jpmediaservices.com**

CONFERENCES

ANNOUNCING IMDC 2024

Following the successful conference in June 2022 produced by the University of British Columbia at Vancouver, BC, and reported upon in *The Naval Architect* in September 2022, the retiring chair of the IMDC International Committee, Professor David Andrews, announced that the next IMDC would take place in just two years' time in June 2024. IMDC 2024 would be organised by the Technical University of Delft and the outgoing head of the M3 (Marine) Department at TUD, Professor Hans Hopman, announced that the conference would take place at the Netherlands Naval Establishment, just beyond the National Maritime Museum, Amsterdam.

NATIONAL MARITIME MUSEUM, AMSTERDAM

Observers of the series of IMDC conferences, which started in 1982 in London and was sponsored by RINA, will note that the usual triennial sequence was, like so much, disrupted by the Covid-19 pandemic such that the 2021 IMDC was postponed to 2022. That delayed Vancouver conference was successful but with a reduced number of attendees, some of whom were belatedly unable to attend or had to do so virtually over several time zones. By getting back to the three-year pattern meaning just two years between Vancouver and Amsterdam conferences, it is hoped the typical number of papers presented can be restored. This will also restore the intent of having mainly three parallel sessions over the three and a half days of conference plus some plenary sessions each morning – and hence this article is the announcement that abstracts will be asked for shortly, with full papers to be submitted in January 2024.

By holding the conference in the heart of Amsterdam, the welcome reception on Sunday evening and the conference banquet on Wednesday evening will take place at the National Maritime Museum, close to the conference venue. Part of the museum will be open, as will the replica three masted vessel moored alongside. The grand Open Courtyard within the museum will be the venue for the banquet. It is planned that there will be the usual shipyard visit on the Thursday afternoon following the formal end to the conference.

The IMDC series of conferences have been motivated by a clear focus on design in the broad range of maritime sectors. Thus, papers are welcome from practitioners and researchers in the theory and application of engineering design to marine vehicles and structures. There are some long standing topics, but also the organising body for each IMDC encourages papers on topics that it sees as appropriate to the host nation's maritime activities. It is therefore expected that there will be paper presentation sessions on the following topics, but other "marine design" issues are not excluded:

- Ship design methodology issues such as: design spiral, systems engineering, set-based design, design optimisation, concurrent design, modular design, configuration-based design, "fuzzy" design aspects.
- Novel marine design concepts, such as: hull form design, transport ships, service vessels, naval vessels, yachts and cruise ships, specialised and complex vessels.
- Offshore structure design approaches, such as applications to: offshore wind turbines, floating fish farms, floating cities.
- Influence of energy transition on maritime design.
- Influence of unmanned and autonomous transition of maritime design.
- Influence of digital transition on maritime design, such as: digital shadows and twins, model-based systems engineering, AI, ML and big data.
- Influence of regulations on maritime design.
- Fleet and transportation systems design.
- Maritime design education.

The schedule for the paper submission process is as follows:

- 1 June 2023: Abstract submission window opens with a rolling review and abstract acceptance.
- 1 October 2023: Deadline for abstract submission.
- 31 October 2023: All notifications for abstract acceptance sent out.
- 31 January 2024: Deadline for paper submission.
- 29 February 2024: All notifications of paper review (with comments for revision where appropriate).
- 15 April 2024: Deadline for final/amended paper submission, giving authors six weeks for revision.
- 15 May 2024: Conference programme on web site; papers will be uploaded after acceptance and payment made by authors.
- 2-6 June 2024: Conference.

It is hoped this short article has provided sufficient insight to encourage all those with an involvement in marine design to consider submitting papers and attending the latest in this prestigious series of conferences and we look forward to yet another opportunity for the maritime design community to share in the latest design concepts and experiences. ■

For further information visit www.imdc-info.com or contact the local organising chair, Assistant Professor Austin Kana, contact@IMDC-info.com.

The Royal Institution of Naval Architects Presents:

SURV 11: Creating the Future of Sustainable Fast Boats

21-22 June 2023, Rotterdam, Netherlands

REGISTER NOW

In June, maritime professionals will gather for the Royal Institution of Naval Architects (RINA) 11th instalment of the Surveillance, Search and Rescue Craft (SURV) Conference. The event will take place on 21-22 June 2023 at the Wereldmuseum, Rotterdam, the Netherlands.

In partnership with the Royal National Lifeboat Institution (RNLI) and Dutch shipyard DAMEN, the conference will provide a forum for discussion about the available resources and requirements to enable a sustainable future in the design, construction, and operation of fast boats (pilot; search and rescue; police; coastguard boats etc.).

In partnership with:

DAMEN

RNLI Lifeboats

www.rina.org.uk/SURV11_2023

CALENDAR

What's happening next?

MAY 31 - JUNE 1, 2023
WARSHIP 2023
RINA conference
Bath, UK

JUNE 6-9, 2023
DRY DOCK TRAINING 2023
RINA training course
London, UK

JUNE 13-16, 2023
DRY DOCK TRAINING 2023
RINA training course
London, UK

JUNE 21-22, 2023
SURV 11 - CREATING THE FUTURE OF SUSTAINABLE FAST BOATS
RINA conference
Rotterdam, Netherlands

OCTOBER 3, 2023
OFFSHORE WIND SUMMIT 2023
RINA conference
Aberdeen, UK

NOVEMBER 28-29, 2023
HISTORIC SHIPS 2023
RINA conference
London, UK

For more information please visit:
www.rina.org.uk/RINA_Events

MAY 23-25, 2023
COMPIT 2023
International conference
Drübeck, Germany
www.compit.info

MAY 24-26, 2023
62ND INTERNATIONAL CONGRESS OF NAVAL ENGINEERING AND MARITIME INDUSTRY
International symposium
Bilbao, Spain
https://62congreso.ingenierosnavales.com

MAY 24-26, 2023
HYDRONAV 2023
International symposium
Sopot, Poland
www.prs.pl/hydronav2023

MAY 31 – JUNE 9, 2023
MARITIME SAFETY COMMITTEE
IMO meeting
London/Online
www.imo.org

JUNE 1-2, 2023
WIND FOR GOODS 2023
International summit
Sant-Nazaire, France
www.windforgoods.fr/en

JUNE 6-9, 2023
NOR-SHIPPING
International exhibition
Oslo, Norway
www.nor-shipping.com

JUNE 12-16, 2023
27TH INTERNATIONAL CONFERENCE ON PORT AND OCEAN ENGINEERING UNDER ARCTIC CONDITIONS (POAC 2023)
International Conference
Glasgow, UK
www.peridynamics.org/poac2023

JUNE 18-20, 2023
WORLD MARITIME RESCUE CONGRESS
Rotterdam, Netherlands
https://wmrc2023.com/

JUNE 22, 2023
MANAGING AGEING OFFSHORE ASSETS
International seminar
Aberdeen, UK
https://events.imeche.org/ViewEvent?e=7604

JULY 3-7, 2023
MARINE ENVIRONMENT PROTECTION COMMITTEE (MEPC)
IMO meeting
London/Online
www.imo.org
JULY 12-14, 2023

OSES 2023
International symposium
St. Julian's, Malta
www.osessociety.com/oses2023

JULY 17-21, 2023
IMO COUNCIL
International forum
London/Online
www.imo.org

AUGUST 23-25, 2023
INAMARINE 2023
International exhibition
Jakarta, Indonesia
https://inamarine-exhibition.net

AUGUST 28-30, 2023
8TH HULL PERFORMANCE & INSIGHT CONFERENCE
International conference
Pontignano, Italy
email: volker@vb-conferences.com

AUGUST 28 – SEPTEMBER 1, 2023
IWSH 2023
International symposium
Aalto University, Espoo, Finland
https://iwsh2023.com

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

35th Anniversary

METS TRADE

MARINE EQUIPMENT TRADE SHOW

SAVE THE DATE

WE'RE SWITCHING IT UP FOR 2023. WE'LL SEE YOU FROM WEDNESDAY - FRIDAY!

WED - 15-11-23
THU - 16-11-23
FRI - 17-11-23

The METSTRADE Show is the world's largest marine equipment trade show and the only truly international B2B exhibition. With excellent networking opportunities, a broad range of showcased innovations and located in one of the most beautiful cities in the world, the METSTRADE Show is an unmissable event for every professional in the marine industry.

METSTRADE FEATURES

SYP SUPER YACHT PAVILION
MYP MARINA YARD PAVILION
CMP CONSTRUCTION MATERIAL PAVILION
FTP FOILING TECHNOLOGY PAVILION

ORGANISED BY rai AMSTERDAM
POWERED BY ICOMIA
MEMBER OF IHSA
OFFICIAL CATALOGUE PARTNER IBI

ClassNK is a major supporter of the Digital Era

While the maritime industry is reshaping its structure due to digitalization, ClassNK's role of ensuring the safety of ships and environmental protection as a third party organization remains the same. ClassNK is proactively applying digital technology to strengthen its services based on outcomes from a variety of research in areas including robots and analytic technology.

Further, ClassNK contributes to the digital transformation of the entire maritime industry by providing a platform for the collection and distribution of data. Together with industry players, ClassNK is promoting IoS-OP(www.shipdatacenter.com) consisting of clear rules for fair data use between data owners and users, along with a highly secured data center.

ClassNK CHARTING THE FUTURE

www.classnk.com