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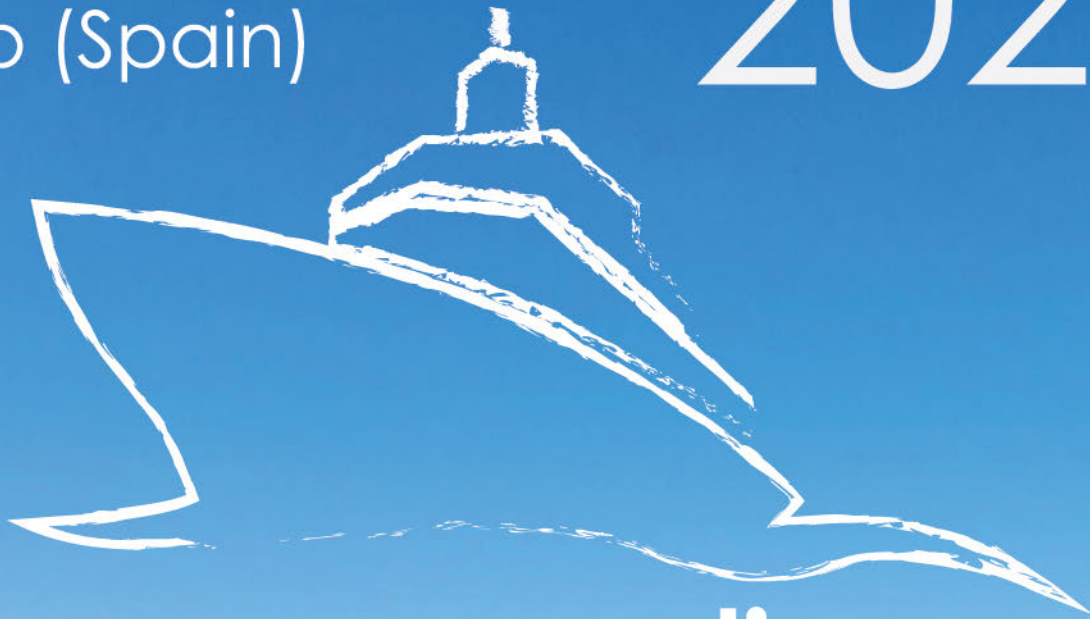
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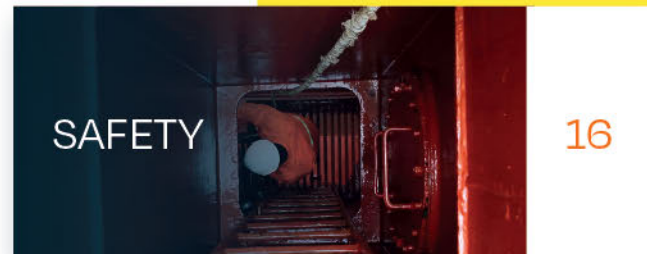


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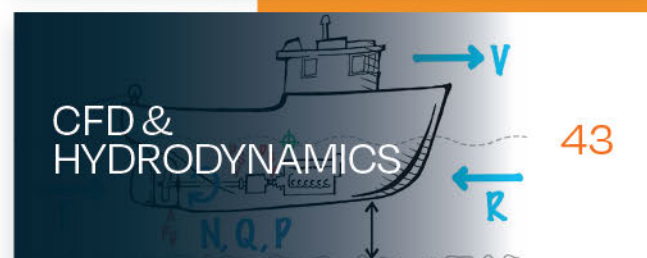
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A FLYING START TO THE YEAR FOR AUXILIARY WIND PROPULSION

By **Daniel Johnson**

In my conversation with Kongsberg Maritime chief designer Per Egil Vedlog about the company's latest low-emissions, methanol-ready tanker design for Sirius Shipping (see p.26), he also touched on a similar design ordered last year by Swedish operator Terntank that has been optimised to feature wind-assisted propulsion (WAP). The suction sails on Terntank's vessels are expected to reduce emissions by around 8% and contribute to an impressive Energy Efficiency Design Index of more than 40% below the 2025 Phase 3 requirements.

Terntank joins a growing number of shipping companies looking to the wind to reduce the fuel consumption on their ships and, consequently, lower their greenhouse gas (GHG) and other emissions. At present, more than 30 large vessels are equipped with WAP systems, and the number of installations is set to surpass 50 in 2024, according to the International Windship Association (IWSA). Around 3,000 merchant ships are projected to use wind propulsion by 2030 and 30,000 by 2050.

The new year has blown in with a flurry of interest in the fuel-saving technology, with February seeing several technology companies announce WAP system developments and installation plans. In addition to news from Econowind and Anemol (see p.13), Finnish rotor sail manufacturer Norsepower reported agreements to use its technology on a number of vessels, including a significant order to put 16 sails onto three large ro-ro cargo ships being built in China for Louis Dreyfus Armateurs. According to Tuomas Riski, CEO of Norsepower, this fleet-wide contract is a "game changer for the whole auxiliary wind propulsion industry" and the biggest deal ever made in the mechanical sails market.

In the UK, GT Green Technologies, in collaboration with Carisbrooke Shipping and the University of Bristol, has received a substantial £3.7 million grant from the UK government to install a 20m AirWing system on the 11,200dwt ship *Vectis Progress*. The grant comes from the Clean Maritime Demonstration Competition Round 4, funded by the UK Department for Transport, and testing of the system is scheduled for late 2024/early 2025.

Also close to home, RINA headquarters was pleased to play host to the unveiling of Project Aquilo, the latest design collaboration between naval architects Deltamarin and rigid wind sail designer BAR Technologies. The companies have jointly developed an Aframax/LR11 design concept optimised for wind-assisted propulsion that promises to be a significant leap forward in overall performance by integrating a brand-new hull form with BAR Technologies' WindWings technology. This development is expected to contribute to daily savings in fuel efficiency calculated at around 26.8tonnes at 14knots and around 12.6tonnes at 12knots in an average global route.



DELTAMARIN AND BAR TECHNOLOGIES' AQUILO CONCEPT. SOURCE: DELTAMARIN

Projects such as the Aquilo and Kongsberg's Terntank tankers are perfect examples of how, if a newbuilding is going to have a wind propulsion system installed, the ship design can be optimised. Not only the hull form, but also the locations for the sails and the design of the conventional propulsion system so that it can be adapted to variable load from the sails in an optimal way.

Per Egil Vedlog was also keen to point out to me that making WAP projects a reality is far more complex than simply adding new equipment. It inevitably impacts a wide range of design and operational aspects, from a ship's weight and structural strength to stability and manoeuvrability.

Of course, optimism about the technology does need to be tempered with a dose of practicality. Not every ship type can be fitted with a WAP system and not all operational routes have suitable wind patterns for their deployment. It might also be worth noting that we are now in an era of extreme weather thanks to global warming. It has been well-documented that increased clear-air turbulence is ushering in a new reality for air travel. At sea level, one could ask if the rapid intensification of large storms, hurricanes and tropical cyclones is likely to throw up unforeseen load case and deployment issues for wind-assisted sailing.

Despite these concerns, among the broad spectrum of technologies and fuel solutions being considered to keep vessel emissions low, WAP systems are gaining momentum as we approach the midway point of what the IWSA has dubbed 'The Decade of Wind Propulsion'.

With more and more shipowners raising their sails to put demonstrator ships into operation, it is an exciting and challenging developing field for the naval architect and engineer. One that RINA will shine a spotlight on later this year with its Wind Propulsion 2024 conference. The agenda will bring attendees fully up to speed with recent technological, design and policy developments, and cast their minds into a future landscape of wind propulsion technology. ■



NEWS

ALTERNATIVE FUELS

KOREA ACHIEVES MILESTONE IN STS METHANOL BUNKERING



ANE MAERSK RECEIVING GREEN METHANOL FROM BUNKER TANKER GOLDEN SUNNY HANA. SOURCE: ULSAN PORT AUTHORITY

South Korea has successfully conducted the world's first ship-to-ship (STS) green methanol supply to a very large container ship.

The operation saw the 16,000TEU *Ane Maersk* receive green methanol from bunker tanker *Golden Sunny Hana*, owned by Hana Marine, at the Ulsan Port anchorage.

South Korea's Ministry of Oceans and Fisheries established the relevant institutional foundation, including the 'Guidelines for Approval of Self-Safety Management Plan for Methanol Supply', and accumulated important know-how through two methanol supply demonstrations with Ulsan Port Authority in July and November last year.

As competition among global ports for the methanol fuel market is intensifying, the success of this latest demonstration is significant. It is expected that it will not only enable Korean ports to further consolidate their position in the world as a sustainable marine fuelling location but will also promote the growth of the country's sustainable marine fuelling industry in the future.

Kang Do-Hyung, the Minister of Oceans and Fisheries, says: "Competition among international ports to pre-empt the market by building ports that supply sustainable marine fuel is accelerating. Under the goal of achieving net zero by 2050 in the global shipping sector, we will make all-out efforts to strengthen competitiveness so that Korea can lead the global trend of switching to sustainable fuels."

INLAND & COASTAL VESSELS

HYDROGEN-POWERED BARGE READY FOR EMISSION-FREE SHIPPING ON THE RHINE

Dutch shipowner Future Proof Shipping (FPS), the EU-funded Flagships project and the Interreg-funded ZEM Ports NS project have launched the *H2 Barge 2*, a hydrogen-powered vessel that will ship goods emission-free on the Rhine between Rotterdam in the Netherlands and Duisburg in Germany.

The *H2 Barge 2* is the first of two demonstrators in the EU-funded Flagships project, and the second demonstrator of the ZEM Ports NS project. The vessel, formerly *Fenny 1* and *FPS Waal*, was built as a conventionally powered container ship. It is 110m in length with a capacity of 190TEU.

During 2023, *H2 Barge 2* was stripped of all combustion engines and fossil fuel tanks by Holland Shipyards Group. It now has a completely new 100% emission-free propulsion system including PEM fuel cells, hydrogen storage, battery packs and an electric drivetrain installed below deck. Six fuel cells from Ballard Power Systems raise the total power installed to 1.2MW.

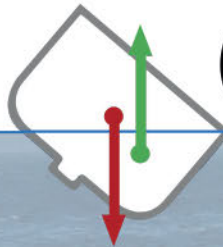
H2 BARGE 2 BOASTS SIX FUEL CELL MODULES, PROVIDING A TOTAL FUEL CELL CAPACITY OF 1.2MW. SOURCE: FPS

H2 Barge 2 is expected to reduce 3,000tonnes of CO₂ annually when sailing the Rhine.

Jyrki Mikkola, the Flagships project coordinator, says: "We've been working hard for several years to get to this point. Having the first demonstrator on the Rhine is truly a great achievement by Future Proof Shipping and the rest of the partners."

The second demonstrator vessel in the Flagships project, *Zulu 06*, will be deployed in Paris in 2024.





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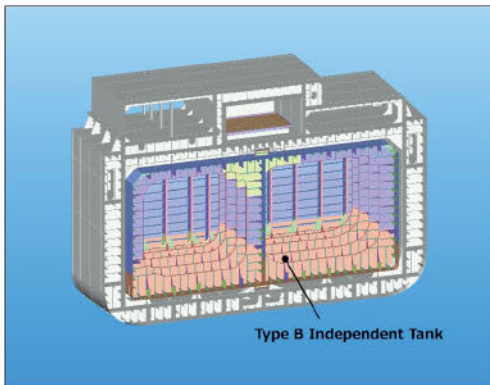
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ALTERNATIVE FUELS

CLASSNK OKAYS AMMONIA FUEL TANK DESIGN FOR CONTAINER SHIPS

Classification society ClassNK has awarded an approval in principle (AiP) for the design of a prismatic ammonia fuel tank (IMO Type B independent tank) for container ships developed by the Planning and Design Centre for Greener Ships (GSC) in Tokyo, Japan.

Ammonia has been tagged as a primary marine fuel for shipping decarbonisation since it does not emit CO₂ when combusted. However, its utilisation presents challenges, such as the risk of leakage and relatively low volumetric efficiency.



SOURCE: GSC

While Type B tanks require a refined fatigue analysis, it is possible to use ordinary steel as the material for the structure of fuel storage holds space, except for the bottom part which is intended to be a partial secondary barrier, resulting in a reduction in the amount of steel for low-temperature service. Additionally, prismatic tanks offer superior volume efficiency compared to cylindrical tanks as they can be designed to fit the ship's hold.

The Type B tank developed by GSC has been designed to ensure the safe storage of ammonia and to minimise the reduction in the number of cargo containers due to the placement of fuel tanks in consideration of operational needs.

Furthermore, the shape of the storage space for the tank has been simplified from the typical bench corners for container carriers, improving constructability and increasing the fuel volume.

ClassNK says it carried out the design review of the tank based on Part GF of its 'Rules and Guidance for the Survey and Construction of Steel Ships' incorporating the IGF Code and 'Guidelines for Ships Using Alternative Fuels (Edition 2.1)'.

RO-ROS

CONTRACT SIGNED FOR ENVIRONMENTALLY FRIENDLY NORTH ATLANTIC RO-ROS

CIMC Raffles shipyard in China has won a contract from Smyril Line of the Faroe Islands for the construction of two identical ro-ro cargo ships.

Measuring 190m in length and having 3,300 lane-metres for trailers, the vessels will join Smyril Line's current network when they start sailing between Europe, the Faroe Islands and Iceland in 2026.

According to the company, the ships have been designed in close cooperation with naval architects Knud E. Hansen to ensure optimal year-round seaworthiness in the North Atlantic with great emphasis on crew comforts and wellbeing on board.

Smyril Line says that compared to its existing fleet the vessels will emit significantly less CO₂ per transported tonne. At the same time, the ships will be equipped with a battery system and the possibility for shore power, allowing for emissions-free port operations. The ships will also be prepared to sail on e-methanol.

"Now is the time to set ourselves new and bigger goals towards reducing emissions in the North Atlantic,"

says Jens Meinhard Rasmussen, CEO of Smyril Line. "The company's main goal is to ensure safe and reliable transportation of both passengers and cargo, and to connect the periphery of the North Atlantic with the rest of the world. With the new ships, we emphasise futureproofing and leading the company towards a greener energy solution and the goals for decarbonisation in our fleet renewal."



SOURCE: SMYRIL LINE

OFFSHORE

EIDESVIK OFFSHORE AND AGALAS TEAM UP FOR METHANOL-POWERED CSVS



EIDESVIK OFFSHORE'S CEO, GITTE GARD TALMO, AND AGALAS CEO MATS NYGAARD JOHNSEN. SOURCE: EIDESVIK

Options for four additional vessels have been granted.

Incorporating cutting-edge technology, the vessel will feature a battery hybrid system alongside dual-fuel gensets capable of operating on either methanol or MGO. The vessel is set to be built at the Sefine Shipyard in Turkey with delivery in early 2026.

The newbuild will be equipped to perform inspection, maintenance and repair (IMR) work. Upon delivery, it will enter a time charter with Reach Subsea. Full management of the vessel, including crewing, will be provided by Eidesvik Agalas.

"The versatile vessel is designed to meet the demands of both the oil and gas sector and the offshore wind industry. This flexibility increases our capabilities and competitiveness in the future energy mix," says Gitte Gard Talmo, CEO at Eidesvik Offshore.

Designed by NSK Ship Design, the CSV is 100m in overall length with a breadth of 21m and can accommodate 100 people. It is equipped with a 150tonne heave-compensated crane and a deck area of approximately 900m².

Norwegian shipowners Eidesvik Offshore and Agalas have partnered to build a construction support vessel (CSV) for subsea and offshore wind operations that will be equipped with methanol engines and a battery hybrid system.

The vessel will be the world's most environmentally friendly vessel within its operating segments, according to the companies.

The ship will be owned by an entity named Eidesvik Agalas, with Eidesvik Offshore retaining a majority stake of 50.1%. The remaining shares will be owned by Agalas.

SHIPYARDS

SUMITOMO HEAVY INDUSTRIES EXITS SHIPBUILDING

Japan's Sumitomo Heavy Industries is to end its shipbuilding business this year, citing a deteriorating environment for the business that includes rising material costs, a rapid decline in ship prices and intense overseas competition.

Its subsidiary Sumitomo Heavy Industries Marine & Engineering will cease taking new orders for commercial vessels from FY2024 and will exit the shipbuilding business after completing its current newbuild backlog.

Sumitomo's shipbuilding legacy can be traced back more than a century, with the establishment of the Uruga Senkyo Corporation in 1897. Sumitomo Heavy Industries Marine & Engineering was spun off from Sumitomo Heavy Industries in 2003. Its motto was to become "a top player in the middle-size tanker market," with a specific focus on Aframax tankers as a differentiation strategy.

Sumitomo Heavy Industries made the decision to "withdraw from the business of building new general commercial vessels" at a meeting of the board of directors in February.



SUMITOMO HEAVY INDUSTRIES MARINE & ENGINEERING'S MAIN SHIPYARD IS IN YOKOSUKA, JAPAN. SOURCE: SUMITOMO CORP

In a statement, the company said it has found it challenging to sustain the shipbuilding business despite having implemented various measures, including limiting the number of vessel orders it accepted and overhauling its shipbuilding system.



NEWS ANALYSIS

WILL GEOPOLITICS SCUPPER MEPC AMBITIONS?

By Malcolm Latache, Correspondent



TRANSITS PASSING THE SUEZ CANAL HAVE DROPPED 42%. SOURCE: SUEZ CANAL AUTHORITY

February marked the start of a third year of hostilities by Russia in Ukraine, the fourth month of attacks on commercial shipping in the Red Sea by Houthi rebels in Yemen, three months of captivity for the crew of the car carrier *Galaxy Leader* and the abandoning of the general cargo vessel *Rubymar* after being hit by two Houthi missiles.

Other ships in the Red Sea have suffered less serious missile strikes and there have also been incidents involving commercial vessels in the Black Sea with both Russia and Ukraine being blamed for attacks. Safety is of course the prime concern for operators but the impact on operations cannot be ignored.

The shipping industry is well aware of these issues and the continuing problems with the Panama Canal drought affecting transits through that vital artery. Now it seems that the UN has also woken up to the fact and in February UNCTAD published a 'rapid assessment report' on the impacts of the three unrelated factors.

UNCTAD estimates that transits passing the Suez Canal decreased by 42% compared to its peak, with weekly container ship transits falling by 67%, and other ship types all showing significant declines. Meanwhile, total transits through the Panama Canal plummeted by 49% compared to its peak.

The main thrust of the report looks at the impact on freight rates among other things saying that some rates have tripled because of events in the Red Sea. It also brings in the effect on the environment caused by ship emissions and says, "the disruption in the Red Sea and Suez Canal, combined with factors linked to the Panama Canal and the Black Sea, could erode the environmental gains achieved through 'slow steaming', as rerouted vessels increase speeds to cover longer distances".

The distances involved are not insignificant. For example, an oil tanker going from the port of Ras Tanura to Rotterdam will travel 11,169 nautical miles via Cape of Good Hope against just 6,436 using Suez, an increase of 42%. A container ship between Singapore and Rotterdam travels and extra 29% or 3,467 nautical miles.

In some cases, two of the factors can combine. For example, Europe used to import Russian oil for refining but that has stopped due to sanctions. Instead, the oil is now shipped to India and products brought back to Europe. Greatly increasing the time and distance for voyages.

The report shows how container ships have sped up from just over 14knots in October to over 16knots in January before falling back to around 15.5knots in mid-February. The fall in February could be attributed to Chinese New Year and may take off again as things get back to normal after the annual hiatus. UNCTAD says accelerating from 14 to 16knots increases fuel use per mile by 31%. The longer distances caused by rerouting from the Suez Canal to the Cape of Good Hope imply a 70% increase in greenhouse gas emissions for a round trip from Singapore to Northern Europe.

One wonders how the decreased efficiency of the world fleet will affect decision making at MEPC 81. Some of the papers submitted for discussion are critical of the CII with one by Intercargo examining the impact of port stays on different sized bulk carriers and highlighting that voyage length in relation to port stay is not adequately considered. Another paper submitted jointly by ICS, IMPA and IHMA suggests that shaft power limitation employed by several vessels to meet EEXI rules is affecting safety when manoeuvring in port.

A large number of submissions to MEPC will likely not take into account a potentially long period of altered trade patterns such as the one experienced over the last months. The majority are concerned with technicalities and interpretation of existing rules and measuring the success or otherwise of earlier regulations and initiatives.

A criticism often levelled at the IMO is that it invariably puts ambition above technical possibilities with operational worries and objections even further down the list. Usually, the industry just has to put up with that. But, as shipping costs start to soar the impact on economies and electorates is beginning to bite and with 2024 being a super election year, national delegates at MEPC might just be more concerned about keeping costs of goods and raw materials down rather than emissions. ■



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NEWS EQUIPMENT

SAFETY

NAPA SYSTEMS BOOST SAFETY ON ISLE OF MAN FERRY

The Isle of Man Steam Packet Company has installed NAPA's full suite of stability management, emergency decision support, electronic logbooks, data reporting and integration systems on its flagship ferry *Manxman*.

The digital platforms will provide both crew and ashore teams with critical safety and situational information for the 133m vessel's operations between the Isle of Man and Heysham, according to NAPA.

Under the agreement, the maritime software and data services provider installed its Loading Computer to guarantee the ship's stability in all sea conditions, while also providing analytics that help optimise

cargo and deadweight management. This will play an integral role in ensuring the safety of the ferry, which has a capacity of 948 passengers and 237 vehicles, in a passage that often sees adverse weather and rough seas.

In addition, NAPA's advanced Emergency Computer enables the continuous monitoring of vulnerability and risk levels and delivers survivability assessments in case of damage. This will provide the crew on board and their colleagues ashore with critical real-time insights to support decision making on regular operations. It will also ensure a coordinated response, with direct cloud-based information sharing with Emergency Response Services, in case of an emergency.

The *Manxman* is also fitted with NAPA Logbook, which streamlines onboard data collection and reporting. "Automated entries and calculations remove duplication, thereby reducing administrative workloads for crews while limiting the risk of errors," says a spokesperson from NAPA.

The data collected will facilitate reporting in an increasingly complex regulatory landscape, with the system allowing for reports required under the European Union's Monitoring, Reporting and Verification (EU-MRV), and the IMO's Carbon Intensity Indicator (CII) and Data Collection System (IMO-DCS), to be generated automatically.

SOURCE: MILES COWSIL



ALTERNATIVE FUELS

BABCOCK WINS LPG AND AMMONIA CONTRACTS IN CHINA

Babcock's LGE business, a specialist in marine liquefied gas solutions, has won contracts to provide its LPG and ammonia cargo handling and fuel gas supply systems to Chinese shipyards.

The contracts are for two mid-size LPG carriers for a Chinese shipyard customer and European owner plus six very large ammonia carriers (VLACs) for a Chinese shipyard and an Asia-based shipowner.

The new vessels will be delivered during 2026 and 2027 and will service the increasing requirement for international long-haul LPG and ammonia transportation with Babcock's ecoVGC and ecoVLAC technology.

The business reports it secured a record number of

new contracts in 2023 for the design and supply of cargo handling and fuel gas supply systems for marine transportation of LNG, LPG, ethane, ammonia and CO₂, all using in-house developed and patented or patent-pending technology.

Neale Campbell, managing director, says: "We're committed to providing environmental and economic solutions for our customers' assets and investing in pioneering technology for the future.

"These latest contract wins further build on the existing developments, especially in ammonia shipping, for Babcock's LGE business and mark an important milestone in our technological approach to fully support the industry's transition to net zero."



WIND PROPULSION

WORLD'S FIRST WIND-ASSISTED CHEMICAL TANKER SETS SAIL

Netherlands-based shipping company Chemship has launched its first ship with wind-assisted propulsion. This makes the MT *Chemical Challenger* the first chemical tanker in the world to be equipped with the technology.

The ship will serve on Chemship's trans-Atlantic route between the East Coast of the United States and the Mediterranean.

The 134m-long vessel has been fitted with four 16m-high VentoFoilS from Econowind. The aluminium wind sails create a direct wind surface of 180m². Smart vacuum technology quintuples the force of the wind, creating a gross wind surface of 900m² – equivalent to a 30m x 30m sail.

Chemship expects the sails to achieve an average CO₂ reduction of 10%.

Chemship CEO Niels Grotz sees shipping returning to its roots. "As an avid sailor, I know the power of the wind," he says. "We will now harness this sustainable and free energy source on MT *Chemical Challenger*. Despite the fact that shipping already has the lowest carbon



INSTALLATION OF THE VENTOFOILS. SOURCE: CHEMSHIP

footprint of all transport modes, we can use wind to make our existing fleet even more sustainable.

"With the VentoFoilS, we will use less fuel and thus reduce CO₂ emissions. For this vessel, we anticipate an annual CO₂ reduction of 850tonnes. This is equivalent to the yearly CO₂ emissions of over 500 passenger cars."

WIND PROPULSION

MARSHALL ISLANDS AWARDS AIP FOR SAIL SYSTEMS

The Republic of the Marshall Islands (RMI) Maritime Administrator has awarded an approval in principle (AiP) to Anemoi Marine Technologies for its rotor sail systems following a review of two bespoke configurations of the wind-propulsion technology.

The AiP was issued after undertaking a comprehensive review of a 210,000dwt Newcastlemax bulk carrier designed by Shanghai Merchant Ship Design & Research Institute (SDARI), thereby validating Anemoi's four rotor sails with a folding deployment system and six rotor sails with a bespoke rail deployment system.

The review included a technical assessment of how the installation of rotor sails in both configurations will impact the vessel's Energy Efficiency Design Index (EEDI) calculations, with an estimated improvement of 20%

for the rail system and 17% for the folding deployment system for the vessel's EEDI.

Anemoi's technology has already been installed on board several RMI-flagged vessels. Installation of Anemoi's rail deployment system was completed in June 2023 on the 82,000dwt Kamsarmax bulk carrier *TR Lady*. The 400,000dwt very large ore carrier *Sohar* is scheduled for completion in mid-2024 with Anemoi's folding deployment system.

Anemoi chief executive Kim Diederichsen says: "We are delighted to have received the support of the RMI for Anemoi's award-winning rotor sail technology. Wind propulsion has found its place in modern commercial shipping and this partnership is the latest step in demonstrating the positive impact of rotor sails."

RENDER OF SIX ANEMOI ROTOR SAILS
DEPLOYED ON NEWCASTLEMAX BULK CARRIER
WITH A RAIL DEPLOYMENT SYSTEM. SOURCE:
ANEMOI MARINE TECHNOLOGIES



CLARKSON RESEARCH SERVICES: HISTORIC AND SCHEDULED DELIVERY

Data extract from World Fleet Register available at www.clarksons.net/wfr

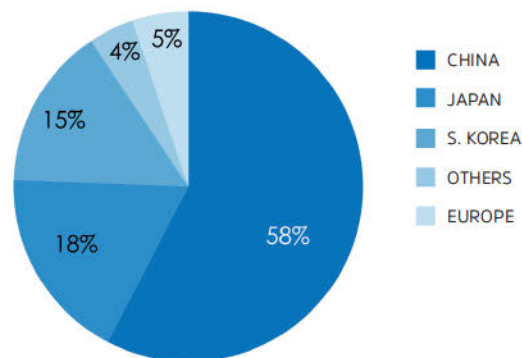
VESSEL TYPE	2012		2013		2014		2015		2016		2017		2018
	2 nd Half	1 st Half	2 nd Half	1 st Half	2 nd Half	1 st Half	2 nd Half	1 st Half	2 nd Half	1 st Half	2 nd Half	1 st Half	
VLCC >= 200,000	22	21	9	14	10	9	11	23	24	29	21	21	
Suezmax 125-200,000	15	23	4	4	4	7	3	8	19	35	22	25	
Aframax 85-125,000	15	14	6	4	13	22	10	31	22	36	28	26	
P'max Tankers 55-85,000	6	7	5	3	1	2	1	7	11	10	11	7	
Products 25-55,000	30	50	29	49	49	60	57	60	42	39	23	27	
Products 10-25,000	5	10	4	1	8	4	0	3	2	7	6	10	
Chem & Spec. 10-55,000	9	6	13	12	11	36	29	43	38	38	33	45	
Tankers < 10,000	40	34	36	27	23	14	17	21	14	23	37	44	
Capesize > 100,000	65	63	40	56	38	46	42	65	39	55	20	30	
Panamax 80-100,000	94	101	68	62	35	57	41	71	40	75	27	39	
Panamax 65-80,000	39	34	42	42	20	19	4	1	2	6	1	2	
Handymax 40-65,000	146	147	119	95	97	136	118	123	90	121	51	57	
Handysize 10-40,000	118	116	83	99	71	112	87	87	52	73	35	52	
Combos > 10,000	0	0	0	0	0	0	0	0	0	0	0	0	
LNG Carriers	2	4	13	14	19	16	16	15	18	20	12	32	
LPG Carriers	8	22	16	14	14	25	40	49	33	45	17	26	
Containers > 8,000 teu	28	51	33	59	42	58	62	37	26	34	36	47	
Containers 3-8,000 teu	19	46	29	26	25	18	6	2	0	2	5	7	
Containers < 3,000 teu	41	31	21	22	30	28	36	44	28	36	42	54	
Offshore	10	12	19	32	32	25	13	26	20	17	24	24	
Cruise Vessels	1	6	0	3	2	5	1	8	2	7	3	8	
Passenger Ferries	8	5	6	12	8	13	8	6	16	20	11	11	
Others	100	98	84	74	58	68	49	50	55	49	56	50	
TOTAL	821	901	679	724	610	780	651	780	593	777	521	644	

DATA INCLUDES ALL VESSELS WITH LOA ESTIMATED AT >100M

THE ORDERBOOK BY YEAR OF DELIVERY ON THIS PAGE IS BASED ON REPORTED ORDERS AND SCHEDULED DELIVERY DATES AND DO NOT NECESSARILY REPRESENT THE EXPECTED PATTERN OF FUTURE DELIVERIES

ALL DATA TAKEN AS OF 1ST JANUARY 2024

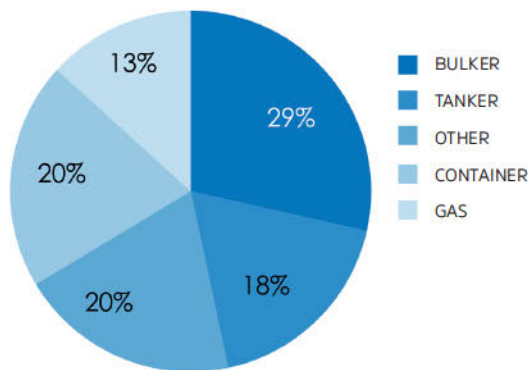
ORDERBOOK BY BUILDER REGION (NUMBER OF VESSELS)



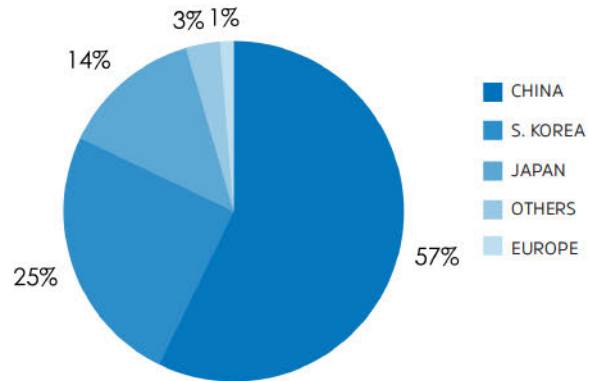


2018	2019		2020		2021		2022		2023		Scheduled Orderbook		
2 nd Half	1 st Half	2 nd Half	1 st Half	2 nd Half	1 st Half	2 nd Half	1 st Half	2 nd Half	1 st Half	2 nd Half	2024	2025	2026
18	39	29	22	15	23	12	24	18	17	5	2	5	11
7	23	3	11	19	20	3	28	14	5	3	8	27	27
24	41	12	12	6	28	25	21	18	24	14	33	57	41
6	6	7	6	4	1	1	4	5	1	0	2	11	15
22	50	46	43	29	39	37	35	23	22	11	39	68	63
8	5	10	4	7	7	13	8	7	4	3	5	4	3
41	34	28	32	25	25	24	24	26	17	15	52	69	25
43	26	23	21	18	23	32	30	33	28	25	71	36	16
21	31	49	65	48	52	36	28	22	34	22	38	35	28
25	69	64	95	47	65	37	52	46	63	49	107	101	112
2	1	4	3	0	0	1	8	13	11	8	19	17	2
33	55	77	92	56	60	56	53	70	72	80	169	136	58
47	53	45	47	47	85	58	68	92	85	65	165	128	30
0	1	2	0	2	3	0	0	0	0	0	0	0	0
23	22	20	16	21	35	30	17	16	14	25	82	89	83
9	16	13	19	12	19	14	20	22	40	29	49	40	61
23	27	23	13	22	28	26	22	27	40	47	132	119	71
3	6	1	1	5	5	1	0	13	27	43	126	39	10
40	48	56	42	57	54	49	52	75	80	112	201	64	24
14	10	11	5	5	14	16	31	48	27	23	55	24	11
4	12	10	6	8	8	14	8	13	8	10	20	16	9
18	16	15	11	11	15	14	12	10	8	9	30	12	7
48	57	56	39	70	82	92	87	93	59	66	225	205	125
479	648	604	605	534	691	591	632	704	686	664	1,630	1,302	832

ORDERBOOK BY SECTOR (NUMBER OF VESSELS)



ORDERBOOK (DWT) BY BUILDER REGION



SAFETY

RENEWED CALL FOR UNIFIED ACTION TO PREVENT FATALITIES IN ENCLOSED SPACES

By Tom Barlow-Brown

A hidden danger that has plagued the maritime industry has once again come into the spotlight. Seemingly innocuous compartments, cargo holds and fuel tanks, vital for storage and operation on board any vessel, have become graveyards for far too many seafarers due to a lack of attention, regulation and understanding.

A recent surge of enclosed space related deaths on ships has led InterManager to call on the shipping industry to work together to improve safety in these challenging onboard areas. The global shipmanager association's intervention follows the death of three seafarers and five shore workers in accidents in enclosed spaces over seven days in December 2023. This brought the total known deaths last year to 31.

InterManager records these incidents on behalf of the wider shipping community, sharing them with regulators in its role as a member of the International Maritime Organization (IMO). Statistics shared by the organisation reveal that since 1996 310 people lost their lives in enclosed spaces on ships – 224 seafarers and 86 shore personnel in 197 accidents.



SOURCE: INTERMANAGER

CAPTAIN KUBA SZYMANSKI. SOURCE: INTERMANAGER



Captain Kuba Szymanski, the secretary general of InterManager, who has previously highlighted the stark realities of enclosed space accidents, has redoubled his call for change.

Focus on blame overshadows need for reform

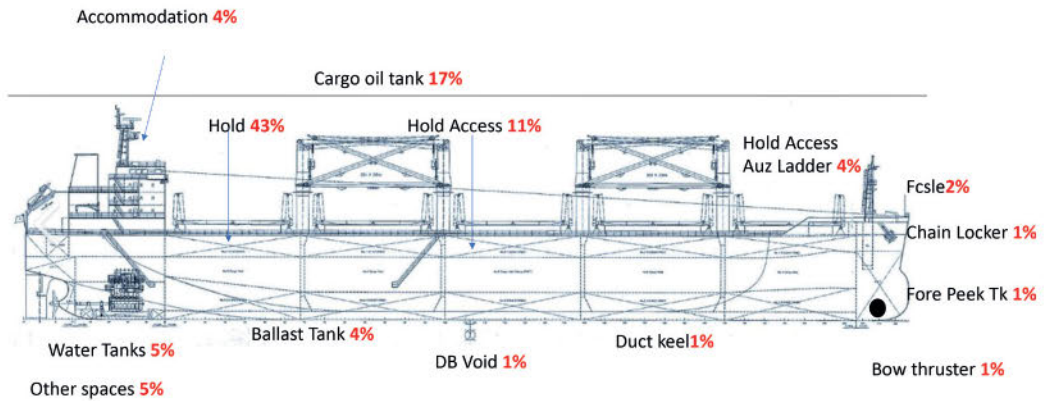
"It is a minefield. We've created an unsafe environment, and then we blame people for not navigating it properly. It's absurd," he reflects, highlighting the paradox at the heart of maritime safety. His words echo the frustration felt by many within the industry, where the emphasis on blame often overshadows the need for systemic reform.

Moreover, Szymanski sheds light on the ineffectiveness of regulations introduced in 2011, which were intended to curb enclosed space fatalities. "Since 2011, an increase in fatalities in our data is related to the introduction of new IMO introduced regulation. This regulation hoped to eradicate all enclosed space accidents. But it was evident that it didn't because the shipping industry was barking up the wrong tree," Szymanski laments. The failure of these regulations to address underlying issues underscores the urgent need for a comprehensive overhaul of safety protocols.

"One of the biggest issues is the flawed design of enclosed spaces. Take the Australian ladders, for instance. They're like mousetraps, deadly and unnecessary," Szymanski asserts passionately, underscoring the urgent need for redesign and improved ventilation systems. These ladders are the result of regulations that state a vertical ladder inside a cargo hold be equipped with intermediate horizontal platforms, thus allowing stevedores better access holds to carry out loading or discharging operations.

However, Szymanski argues that the enclosed nature

WHERE ENCLOSED SPACE ACCIDENTS HAPPEN – ALL SHIP TYPES, 1996 TO 1 DECEMBER 2023. SOURCE: INTERMANAGER



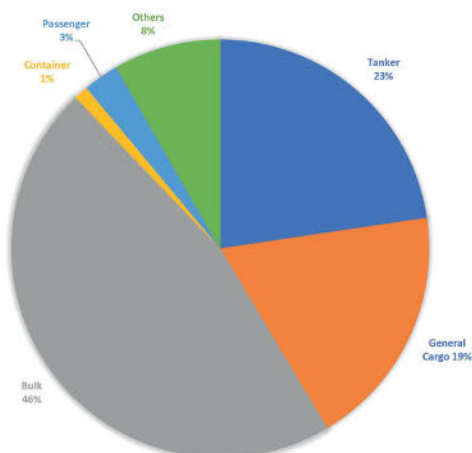
of Australian ladders makes them more difficult for personnel to escape from in the event of an accident. The absence of proper access points and ventilation further exacerbates the risks associated with entering enclosed spaces, turning routine tasks into potential death traps for unsuspecting seafarers.

"In the international regulations, it's very clear – human beings should not be entering enclosed spaces regularly. Yet, we're seeing instances where they're forced to do so due to operational pressures," Szymanski explains, highlighting the systemic failures that endanger seafarers' lives. The pressure to meet deadlines and maintain operational efficiency often takes precedence over safety, creating a perilous environment where lives are needlessly put at risk.

"As an industry, we need to have one voice, one approach to safety. Fragmented standards and practices only put lives at risk," Szymanski emphasises, calling for unity and collaboration across the maritime industry. The lack of consistency in safety protocols and procedures leaves room for confusion and oversight, further compromising the well-being of seafarers.

A joined-up approach

The multifaceted challenges surrounding enclosed space safety in the maritime industry, from regulatory shortcomings to design flaws, show that the issues are complex and often interconnected, requiring a unified and collaborative approach to address effectively.



ENCLOSED SPACE ACCIDENTS BY SHIP TYPE, 1999 TO 1 DECEMBER 2023. SOURCE: INTERMANAGER

By prioritising safety, fostering collaboration among stakeholders, and reimagining design standards, the maritime industry can mitigate the risks associated with enclosed spaces and ensure the well-being of seafarers worldwide.

The IMO sub-committee relating to the Carriage of Cargoes and Containers is in the process of revising Resolution A.1050(27) to ensure the safety of personnel entering enclosed spaces on ships, with a target to complete this in 2024. Resolution A.1050 (27) concerns the "recommendations for entering enclosed spaces aboard ships".

Elsewhere, organisations such as logistics insurer TT Club Mutual Insurance have published their own risk mitigation strategies. These include the need within the maritime industry to "embody a culture where time and resources are fully aligned with safety", ensuring that "people inside the space can communicate with those on the outside", and ventilating an enclosed area before entry and during work activities.

It is evident that a concerted effort is needed to drive meaningful change and enhance safety standards. RINA is therefore calling on its expert members to volunteer to take part in the further development of work on design for enclosed space safety.

The initiative to engage the expertise of the Royal Institution of Naval Architects underscores the importance of collaboration and interdisciplinary cooperation in tackling complex maritime challenges. By harnessing the collective knowledge and experience of industry professionals, this endeavor seeks to examine technical proposals, identify key areas for improvement, and formulate actionable recommendations to enhance safety standards.

This call for expert volunteers signifies a commitment to a diversity of perspectives, recognising that addressing enclosed space fatalities requires input from a broad spectrum of industry voices. Evidently it is only through the collective efforts of naval architects, engineers and other industry professionals that effective measures to mitigate risks and safeguard the lives of seafarers can finally be implemented.

Experts interested in aiding RINA's research can contact *The Naval Architect* via editorial@rina.org.uk. ■



CREW WELL-BEING BEHIND DEVELOPMENT OF NAVIGATION SAFETY SOLUTIONS

By **Tom Barlow-Brown**

Navigating safely at sea is one of the most crucial parts of the safe operation of maritime vessels. Too often accidents have occurred due to negligence, fatigue or poor visibility, sometimes with big consequences for a vessel's crew, and the environment. Recently, several solutions aided by new advancements in digital technology and AI have come on the market, but one company in particular is leading the way.

Headquartered in Turku, Finland, Groke Technologies is a pioneering software company helping to spearhead this revolution in maritime navigation. At the helm of this venture is co-founder and CEO Juha Rokka, a seasoned maritime engineer with a passion for leveraging cutting-edge technology to transform the maritime industry.

Established in 2019, the company boasts a team of about 20 tech-savvy professionals dedicated to developing advanced software for situational awareness and collision avoidance in maritime operations. Speaking to The Naval Architect, Rokka sheds light on the company's core capabilities of combining machine learning, artificial intelligence, and sensor fusion technology to provide a comprehensive view of a vessel's surroundings. This technology, he explains, enables real-time monitoring of vessels' environments, augmenting the capabilities of onboard crew members.

"Our mission is to remove human error from watchkeeping duties on board," Rokka states. He underscores the monotony and challenges of traditional watchkeeping, highlighting the potential of Groke Technologies' solutions to alleviate cognitive stress for crew members while enhancing safety standards.

Day and night tracking

Groke Technologies' flagship product, Groke Pro, embodies the company's commitment to innovation and excellence. With two camera sensors capable of tracking vessels in day, low-light and night-time conditions, Groke Pro offers versatility for crew members on the bridge which can also be linked to devices to enable monitoring of the system from other areas of the ship. The blending function of the system seamlessly integrates the colours of the day camera and the night vision of the thermal camera, allowing users to adjust the two camera views according to their preferences.

Rokka emphasises the ease of installation: "It's a simple and easy installation and is usually ready within one day, typically its placed on the compass deck on its own pole. We also have connectivity in the system so we can do all the software updates."

This efficiency is paramount in an industry where every moment counts, particularly amidst growing demands for autonomous ships and a dwindling supply of crew members. One of the key selling points of Groke Technologies' software is its user-friendly interface, likened to the simplicity and intuitiveness of a smart phone or tablet.

These USPs were key deal makers with early adopters across Japan's domestic fleet and Groke is now leveraging on that success, making headway with more globally focussed shipowners and managers. Indeed, there are 80,000 IMO registered vessels that would benefit from the technology. The rationale here is that the global fleet is faced with a number of challenges.



GROKE'S 'DIGITAL WATCHKEEPER', GROKE PRO. SOURCE: GROKE



Trends in autonomous shipping accelerated perhaps by the worrying shortage of skilled seafarers, is resulting in a number of companies developing technologies that not only lessen the navigational burden, but substantially improve maritime safety.

What sets Groke Technologies apart from other contenders, however, are Groke Pro's thermal and visual data detection capabilities, as well as the user interface. Moreover, the system's seamless integration with existing navigation systems and commitment to continuous improvement underscore its competitive edge.

Feedback from shipowners that use the technology provides valuable insights into the tangible benefits of Groke Technologies' solutions. While specific statistics on accident prevention remain elusive, testimonials from early adopters attest to the efficacy of the technology in enhancing safety and operational efficiency. Rokka cites instances where Groke Technologies' risk analysis features have empowered captains to navigate congested waters with heightened awareness, potentially averting hazardous situations.

Growth opportunities propelled by wind

Looking ahead, Rokka envisions broader applications for Groke software, particularly in emerging sectors like wind-powered vessels. As the maritime industry embraces the idea of using wind-assisted ships, new

watchkeeping methods will need to be explored to counterbalance the loss in visibility caused by the sails. The company stands poised to support this transition, offering tailored solutions for operators of these vessels.

Groke Pro's Sensor Fusion capability represents another cornerstone of its system, combining data from the two cameras, radar and AIS. After processing the data, Groke Pro integrates all information into a single view, providing superior situational awareness for users. This machine vision-based object detection relies on the latest machine learning technology and is one of the largest databases in the industry. The system can detect and classify vessels that don't have AIS in both day and night-time conditions, further enhancing situational awareness.

"Every month we are releasing new machine learning models and new software. This improves all the time because it's mathematically really complex and we are using all the data we can collect in the training to produce better models," says Rokka.

The emergence of new navigation technology companies leveraging AI and digital enhancements marks a transformative shift in ship safety. The novel solutions offered by Groke Technologies and fellow companies not only enhance efficiency but also mitigate risks, ushering in a new era of maritime safety and operational excellence. ■



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FORESHIP'S SAFETY CONCEPTS LAY FOUNDATION FOR PATHWAY TO AMMONIA-FUELLED CONTAINER VESSELS

By **Daniel Johnson**

Ammonia offers considerable promise as an alternative fuel for shipping. However, at present no in-service ships are capable of sailing on ammonia, with the substance's toxicity just one of the safety challenges standing in the way of its use. While there are several ammonia-fuelled design projects underway, most are centred on small or gas carrier vessels and as a result their findings may not directly translate to large deep-sea oceangoing vessels such as container ships.

Canadian ship lessor Seaspac and the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping (MMMCZCS), in close collaboration with naval architects Foreship and the classification society American Bureau of Shipping (ABS), have sought to address this gap by jointly developing a concept design for an ammonia-fuelled 15,000TEU boxship. The concept was awarded approval in principle (AiP) by ABS last summer and at November's Europort 2023 Foreship's extensive work on the design was recognised with the presentation of a ship design of the year award reserved for organisations demonstrating a significant contribution to environmentally friendly ship design.

"We believe the project is a fantastic example of leading maritime organisations working together and taking tangible steps to decarbonise the maritime industry," says Foreship's chief technical officer, Jan-Erik Räsänen.

Räsänen tells *TNA* that the concept design was developed based on partner collaboration and a qualitative hazard identification (HAZID) risk assessment workshop facilitated by ABS that helped to identify potential major safety threats and hazards and guided Foreship's design of arrangements able to sustain safe ammonia supply, storage, bunkering and venting. "Over the course of the project, safety was very much one of the primary goals," he stresses. "How do we make the vessel safe?"

Räsänen notes that compared to traditional or other alternative fuels, ammonia fuel storage presents unique challenges, such as the need for larger tank sizes and the risk of tank rupture due to collision or impact. The ammonia storage tank solution selected for the concept design is a 11,500m² sized insulated IMO Type B tank, which was chosen to satisfy the owner's requirements for an endurance of 12,000nm, including unumpables, fill-limits and a safety margin.

Practical storage tank location

"The tank location was subject to multiple iterations," Räsänen says, "with the final location chosen to be underneath the accommodation. Of course, cargo

space is everything for a container ship and this yielded the optimal loading capacity. It also provided better protection from the potential risks of dropped containers onto the top of the ammonia tank." The accommodation length was adjusted to ensure sufficient volume was available for the tank.

Tank geometries and configurations were also analysed in some detail. "Whilst we initially used the probabilistic approach based on maximising the tank's width, the design was subjected to further verification during the HAZID workshop. One of the key outputs from the workshop was to switch to using the more proscriptive B/5 requirement in line with current rules and regulations and IGF Code," explains Räsänen.

Foreship's design also includes tank connection space (TCS) which is located directly above the ammonia storage tank. The TCS holds all bunker lines, fuel supply lines and tank ventilation lines. It also contains electric motors for the deep-well fuel pumps along with a dedicated area to facilitate extraction of the deep-well pump head for maintenance and repair.

The vessel's ammonia bunker stations are located two bays aft of the accommodation, arranged at port and starboard sides and ensuring that the parallel body line is sufficient to ensure proper contact with the bunker vessel. This arrangement provides the shortage possible bunker line whilst still maintaining the required hazardous zone separation from the accommodation entrances and air inlets, notes Räsänen.

The bunker station is designed as a semi-enclosed type with an open side towards the bunker vessel. Its location results in the loss of one container row in the hold due to the width of the station. The bunker station deckhead is envisioned to be reinforced to provide protection from dropped objects, which in the worst-case scenario could be fully laden containers.

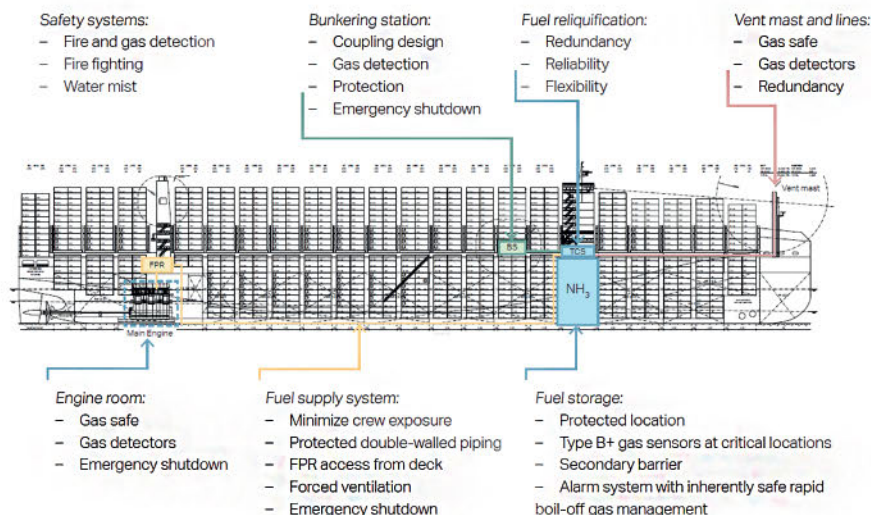
The full bunkering and transferring system design includes three 8inch supply connections, one 8inch vapour return and an expected bunker capacity, subject to further design and safety review, of around 2,000m³/hr.

"Of course, the bunker station will be provided with the full range of required safety features to deal with ammonia spillage and leakage and protection of personnel and equipment," Räsänen points out.

Aft towards the vessel's main engine is the fuel preparation room (FPR). This contains all equipment for fuel preparation and supply purposes including fuel



FOCUS AREAS FOR SAFE AMMONIA SUPPLY, STORAGE, BUNKERING AND VENTING. SOURCE: FORESHIP



pumps, fuel valve trains, heat exchangers, filters, knock out drums and ammonia release mitigation systems. The FPR has been located as close as possible to the main and auxiliary engines to reduce the route length of the ammonia piping, explains Räsänen. All pipework not contained in secondary enclosures designed to safely manage ammonia leaks will be of double-walled type, with leak detection provided for the inner pipe.

The longest route of double-walled piping on the vessel is from the forward ammonia tank and TCS all the way aft to the FPR. "Again, the routing of this pipe was subject to a lot of debate and discussion during the HAZARD workshop, the final solution being that this would be routed through the existing duct in the double bottom of the vessel," Räsänen notes.

The FPR is split into two separate spaces: main engine FPR and auxiliary engine and boiler FPR. This builds on further risk mitigation solutions recommended by the MMMCZCS from other ammonia projects. Each FPR is accessible via controlled air locks from the open deck.

Venting considerations

The vent systems for the design concept have been designed to minimise the gas released to open space and also facilitate effective and safe dispersion should a release occur. Primary concerns when venting ammonia including toxicity levels, flammability levels and ensuring an acceptable distance from the vent mast riser and riser location from the accommodation and ship personnel. The concept design proposes that the vent mast is located at the fore of the ship and at least 25m from the nearest air intake, outlet or opening to accommodation spaces.

Räsänen explains that it was important to keep the vent mast away from the cargo hold to avoid damage during operations. As there is a cargo hold at the very aft of the ship, the engine funnel was ruled out as a possible location for the mast, as was the accommodation block for obvious safety reasons.

It is envisioned that as on ammonia carriers, all accommodation windows facing the vent mast will

be non-opening and there will be strict controls around entering and exiting the accommodation block to ensure that no ammonia release can enter the space.

Additionally, two independent vent lines are provided on the vessel, one port side and one starboard side, under the hatch covers to route the vent to the vent riser. The vent mast is also provided with fixed gas detection.

Opportunities and challenges

"Further CFD analysis on gas dispersion is foreseen in further stages of the project to prove the risk rating of having the vent mast at the fore of the ship," Räsänen says. He adds that the project has also identified a number of opportunities and challenges to take forward.

Opportunities include: further reduction of the risks associated with leakages or releases when storing ammonia; further optimisation of the ammonia storage tank location, volumes and the vessel's endurance to minimise container slot loss and the risk of penetrations; and further definition of hazardous zones, adequate separation of spaces for ammonia-related equipment and ensuring the vessel has the correct access and egress points to accommodation and crew spaces.

The challenges identified comprise, amongst others: leakage and release scenarios to reduce risks to crew on board; quantifying ammonia emission profiles, particularly around pilot fuel usage and safety implications; and ammonia onboard systems development and safe design integration with OEM suppliers as they mature with technology, particularly around main engines.

Räsänen concludes that the project so far demonstrates that large ammonia-fuelled container vessels are technically feasible and can achieve an acceptable preliminary safety concept, however careful consideration of the multiple known challenges, and unknowns, will be required as the design is developed through to its next stage. ■



ÖRESUNDSLINJEN FERRY NOTCHES UP 'WORLD'S FIRST' PFAS/PFOS CONVERSION

By Daniel Johnson

Foam firefighting systems on ships typically make use of a family of synthetic chemical compounds known as perfluoroalkyl and polyfluoroalkyl substances (PFAS), however their use is now being questioned as they have been shown to be toxic, bio-accumulative and very persistent substances in the environment. A common PFAS-compound in foam systems is perfluoro-octane sulfonic acid (PFOS) which has been restricted in most Western countries since 2009 under the Stockholm Convention because of its impact on human health. These restrictions have led to an industrial transition and replacement of PFOS.

Following work by the Ship Systems and Equipment (SSE) Sub-Committee at the IMO, the Maritime Safety Committee (MSC) in June 2023 adopted resolutions MSC.530(107) amending SOLAS Chapter II-2 and resolutions MSC.534(107) and MSC.535(107) amending the HSC Codes (1994 and 2000) to prohibit the use of firefighting foams containing PFOS. The ban applies to both fixed and portable systems and comes into effect for new ships on 1 January 2026. The PFOS in systems on existing ships will need to be removed and disposed of safely ashore no later than the first survey date on or after 1 January 2026.

Last month, Swedish marine engineering company Scanunit carried out what it believes to be the world's first replacement and decontamination of a PFAS/PFOS foam firefighting system on a commercial vessel. The work was carried out on the *Aurora*, a 1992-built ferry operated by EQT-owned Öresundslinjen, over one weekend.

Work on the 238m, battery-powered vessel involved the removal of some 200litres of AFFF foam containing PFAS/PFOS followed by decontamination of the tanks, 200m of pipelines and 52 spray nozzles of the ship's firefighting system.

The decontamination was performed by Scanunit using a Sani A PFAS removal system supplied by LifeClean, a specialist chemical provider based in Sweden. Decontamination and cleaning of the system produced 2,200litres of wastewater which was removed by waste disposal contractor Fortum Waste Solutions.

According to Marcin Mikolajczak, Scanunit's managing director, emptying the system of the PFAS foam began at 22:30 on Saturday and the system was able to be refilled with a fresh supply of fluorine-free foam concentrate by 06:00 on Sunday.

Testing of the system after the changeover showed it was far below the European Chemicals Agency (ECHA) and US Environmental Protection Agency (EPA) restriction of 1ppm. The test carried out by Eurofins Scientific laboratory analysts on the *Aurora* sample returned a result of just



TANK INSPECTION AFTER DECONTAMINATION. SOURCE: SCANUNIT

4,400ng/l or 0.0044ppm.

Collective approach

Mikolajczak notes that the collaboration between Scanunit, LifeClean, fire suppression systems provider Johnson Control and Fortum Waste Solutions underscores a collective commitment to environmental responsibility and innovation in the maritime industry. The successful project not only meets the impending regulatory requirements but also sets a new standard for the industry's approach to environmental safety and sustainability, he says.

Mikolajczak continues: "We are proud to support Öresundslinjen in reaching their environmental goals. Our innovative decontamination process reflects our commitment to delivering environmentally conscious and effective marine engineering solutions."

Öresundslinjen spent close to 12 months evaluating different options to get the *Aurora*'s engine room fire suppression system PFOS/PFAS free before deciding to team up with Scanunit and LifeClean to decontaminate the system.

According to Christian Andersson, senior chief engineer at Öresundslinjen: "Their strong cooperation together with Johnson Control, Fortum Waste Solutions and Eurofins gave us a cost-efficient option which met our expectations. Excellent project planning together with the ship's crew meant the job was completed during the ship's regular weekend night layup avoiding unnecessary down time."

"The ship is now ready for the 2026 PFOS ban with a fluorine-free system and once again our efforts leading the industry in sustainability and environmental responsibility by taking early action has paid back," he concludes. ■



FINLAND

PEOPLE ARE KEY TO KEEPING FINLAND'S MARITIME CLUSTER AHEAD OF CURVE

By Kari Reinikainen, Correspondent



THE FINNISH SHIPBUILDING INDUSTRY HAS A STRONG TRACK RECORD FOR INNOVATION, INCLUDING THE REVOLUTIONARY *ROYAL PRINCESS*. SOURCE: TRAVELINGOTTER/ CREATIVE COMMONS

The Finnish shipbuilding industry and its wider maritime cluster have a strong track record for innovation and in order to remain in business, they need to remain ahead of the curve in the face of competition from the Far East. Access to people with the right skills is crucial for the sector to retain its position and this it cannot do by domestic means alone.

The first diesel-electric icebreaker, *Sisu* (not the present vessel of the same name), was built in Finland in 1939, following two naval vessels completed earlier in the same decade with the same type of power plant.

In 1967, the overnight ferry *Finlandia* entered service. It was powered by four medium-speed diesels and this soon became a favoured option on many passenger ships for decades to come. *Royal Princess* of 1984 revolutionised the layout of cruise ships, again setting a trend. Azipod, the first podded electric propulsor, emerged from Finland early in the following decade.

Impressive as the past is, the outlook for the Finnish shipbuilding industry and the wider maritime cluster remains surprisingly good, although some challenges remain on the horizon, says Pentti Kujala, Professor Emeritus of Marine Technology at the Aalto University

in Helsinki and Full Tenured Professor in Taltech, Estonian Maritime Academy in Tallinn.

"[Meyer] Turku has work for two years ahead and it is possible that there will be further orders for Icon class cruise ships," he tells *The Naval Architect*. Royal Caribbean Group that has two further 248,600gt units of the Icon class on order and which in January took delivery of *Icon of the Seas*, the first ship of the type, is gathering experience from the new ship, Kujala notes.

The new ship has been a success, according to Michael Bayley, president and chief executive officer of Royal Caribbean International, the group's contemporary market unit. "We've never seen such incredible demand reaction and pricing power that we've seen with a new product that we've introduced. It's really been phenomenally successful," he remarked in the Final Quarter 2023 conference call in early February.

The Helsinki Shipyard now has a new owner, Davie Shipbuilding Group of Canada, which has stated that the acquisition of the Finnish yard creates a leading builder of ice-breaking tonnage. Kujala says that the shipyard is negotiating at the moment with a number of customers for new ship projects consisting of e.g. icebreakers and cruise ships.





KUJALA PENTTI

The third shipyard in the country, Rauma Marine Constructions (RMC), has a large ro-pax ferry for TT Line in Australia nearing completion and a second one under construction. It also has an order for four 4,000tonne displacement corvettes for the Finnish Navy. "The market for ferries is a tough one, because of competition from shipyards from Far East," Kujala notes.

RMC has operated as an "assembly yard", with a light organisation of its own and significant reliance on contractors and suppliers. Several of its ferry projects have been delivered late and over budget, which Kujala says was due to Covid-related challenges and insufficient project management resources at RMC. Ironing out these problems could help the yard to defend its position as a builder of ferries.

Workforce needs to update skills

In addition to its own shipbuilding, the Finnish maritime cluster includes a range of businesses that range from ship design to the supply of various other services and many kinds of equipment. As these are mainly well established and have links with customers all around the world, they are not entirely dependent on the domestic yards. They are, all in all, enjoying a strong business environment.

However, keeping all three yards in business is very important for the maritime cluster of the country because it provides a critical mass of demand that can sustain the cluster. Like many industrialised countries, Finland's population is ageing and recruitment is a challenge that the cluster is aware of and which needs attention, Kujala states, adding: "We need people with the right skills and there are challenges in attracting them to shipbuilding."

The industry has launched a campaign at schools, targeting 16- to 18-year-olds, with a message that the maritime sector offers exciting career prospects in an international environment, Kujala points out. However, it is obvious that the cluster will need a workforce from abroad as well.

In his Pro gradu -work (master's thesis), which was approved at the Turku University of Applied Sciences in 2022, Lassi Kokkala noted that due to the continued advances in technology and automation it would become increasingly important to focus vocational training in narrowly targeted specialist areas, both in shipbuilding and the wider maritime cluster. "The results of training, however, are transferred to productive work after a time lag and the training itself only lays the foundation for skills that should continuously be refined and developed further at work," he wrote.

Referring to other studies made in the sector, Kokkala said that abilities to innovate and to solve problems are essential in the maritime sector, but that in reality some universities of applied sciences place far more weight on these matters than others. He added that digitalisation would also play a growing role in the maritime cluster and therefore open platforms for innovation should be set up to accelerate its use in the cluster.

Rapid development of technology has led to a situation in which many people of working age fall behind these advances and the need to address this through training has been recognised by the government.

Competition for people

Meanwhile, the Finnish Economic Policy Council said in a report published in January 2024 that since 2015 Finland's population has grown only thanks to net immigration.

"With an ageing population and a lower birth rate, Finland will continue to need immigrants in the coming years. However, given the global competition for international labour and talent, it is not self-evident that they will end up in Finland. Some of the changes [in legislation] envisaged by the government, such as stricter requirements for citizenship, may make Finland less attractive in the international labour market," the council concluded.

The country in general and the maritime cluster in particular have a few strong cards up their sleeve, however. Work-life balance is generally deemed to be good in Finland and the key four regions where the maritime cluster has its strongest footprint – the capital



THE MEIN SCHIFF 7 WAS LAUNCHED IN DECEMBER 2023 AT MEYER WERFT IN TURKU. SOURCE: TUI CRUISES

Helsinki and the cities of Turku, Rauma and Vaasa, all on the west coast, all have lots of green spaces and easy access to nature, including the archipelagoes outside them.

In its strategy for the years 2017-25, the Finnish marine cluster, which employs some 40,000 people and has an annual turnover in the region of €6.0 billion, set a vision that by the end of next year Finland "would have the most creative, agile and adaptive maritime network known from innovation of customised solutions, services and forms of operation delivered in flexible schedule and with competitive price."

It highlights the need for multidisciplinary research with both domestic and foreign organisations and the integration of the latest technology into maritime applications. Energy, environmental and sustainability technologies, smart ships and systems plus competence services are in the spotlight of the work.

The Finnish maritime cluster has been ahead of the curve in environmental matters. In early 2013, Meyer Turku delivered the 57,655gt cruise ferry *Viking Grace* to the Finnish cruise ferry owner Viking Line: it was one of the first large LNG-powered passenger vessels built anywhere.

In December 2023, *Mein Schiff 7*, a methanol-ready cruise ship for TUI Cruises in Hamburg, was launched

and two months later, the ferry company Viking Line together with the ports of Turku in Finland and Stockholm in Sweden signed a memorandum of understanding to create a green corridor that would make the 10-hour crossing carbon free by 2035.

Ageing population challenge

This builds partly on experience gained at a Decatrip project, which included Viking Line together with industrial and university partners. This again has a business model that brings the ferry company, freight customers and green energy suppliers together on a long-term commitment basis as its foundation, which also means that the template can be used elsewhere, too.

At the time of writing, several trade unions staged strikes against planned labour market and social security reforms of the right of the centre government of Prime Minister Peter Orpo. These, the government says, are necessary as the population is getting older and the share of the working age population of the total is decreasing.

The future outlook for the Finnish maritime cluster will, at least to a certain degree depend on how the country can address the challenges it is facing on the macroeconomic level. While the country is by no means alone with the problems of an ageing population, a lot will depend on its ability to address them. ■



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SOURCE: KONGSBERG MARITIME

CHEMICAL & PRODUCT TANKERS

SIRIUS STRIDES FORWARD ON PATH TO ZERO EMISSIONS WITH KONGSBERG'S METHANOL-READY CHEMICAL TANKERS

By **Daniel Johnson**

In 2010, Sirius Shipping's chemical tanker *Olympus* became the first in the world to reduce its NOx emissions by 90% through retrofitting. Today, the vessel sails with pioneering equipment that controls emissions on all engines and saves fuel by recycling exhaust heat.

The *Olympus* is an indicator of Sirius's long-term efforts to achieve greener shipping, with the Swedish tanker operator noting that an awareness of threats to the global environment like acid rain, eutrophication and climate change forms a natural part of its daily operations in Northern Europe. "We transport oil and chemicals in a sensitive environment. Our vision is for our ships to emit no harmful substances at all," says managing director Jonas Backman.

As part of this vision, Sirius is developing a portfolio of newbuilds that is says will be among the market leaders in its segments and recently awarded Kongsberg Maritime a contract to provide the design, engineering and equipment for two cutting-edge MGO/ biofuel and methanol-ready chemical tankers.

"The partnership with Kongsberg started several years ago when we were working closely to find the best future vessels for our customers," says Backman. "They listen to our requirements and goals for low-emission vessels and at the same time make a workplace for our

crew to feel safe and at home. This has resulted in a contract for the two newbuildings, with the ambition for many more. With these vessels we are well on our 'Pathway to ZERO'."

An evolution in tanker design

The new vessels will be highly advanced, low-emission 15,000dwt tankers with a range of Kongsberg Maritime equipment that can operate on battery-powered hybrid propulsion. Options for two further vessels are included. For Kongsberg Maritime, the collaboration with Sirius builds on a current nine-ship programme with fellow Swedish owner Terntank, with a similar design and equipment package.

Per Egil Vedlog, chief designer, Kongsberg Maritime Ship Design Solutions, tells *TNA*: "We are embracing the fuel transition and a big desire to adopt sustainable technologies. Our new chemical tanker design has now received combined orders for 11 ships, and these really are the next generation of cargo ship, with a combination of energy saving technologies."

Vedlog continues: "The first nine ships, ordered in three batches by Terntank, are based on our super-efficient hull form, and feature progressive steps to improve efficiency through the use of methanol fuel, batteries, onshore power and even wind-assisted propulsion on the final three. These will be highly efficient ships and

will have an Energy Efficiency Design Index above 40% below the 2025 Phase 3 requirements.

"This series continues with Sirius's order for two more vessel of a very similar design, without suction sails."

All 11 vessels will be built by China Merchants Jinling Shipyard. The first ship for Sirius will be delivered in July 2026.

Kongsberg Maritime's contract with Sirius is valued at around NOK100 million (approximately €8.3 million). As part of the contract the company will also supply steering gear, Promas with flap rudder and CPP, tunnel thruster with Mcon thruster control system, K-Chief integrated automation systems including Vessel Insight, AutoChief propulsion control system and deck machinery. This is in addition to design and engineering services.

The company's NVC 614 CT design, part of what has been dubbed the Evolution 15K series, features a hull form of Ice Class 1A, with a wave-piercing bow and distinct styling of the forecastle deck and forward and aft signal masts to match the design of rest of the Sirius fleet. "Our patented wave-piercing bow shape helps the vessel cut through waves, reducing slamming and fuel consumption," explains Vedlog. "It is well suited to cargo and passenger operations and in rough

weather can help the vessel maintain speeds by cutting through waves, rather than riding over them.

"The hull is Ice Class 1A efficiency, and there is a more streamlined design for the whale deck, to suit the styling of the Sirius fleet. In addition to significantly less resistance in rough sea conditions, reduced acceleration gives less sloshing in cargo tanks and better comfort."

Vedlog adds that the cargo operation working area is under shelter by an enclosed deck trunk for safe operation in harsh winter conditions. All main cargo equipment is arranged in the deck trunk for easy and safe maintenance and operation. The cargo system features 14 epoxy coated cargo tanks and 14 submerged electric or hydraulic operated cargo pumps. Cargo capacity is approximately 16,780m³.

Main propulsion and manoeuvring for the 147.9m vessel are provided by Kongsberg Maritime's Promas propulsion system. "With over 400 references across a range of ship types, Promas combines rudder and controllable pitch propeller into one propulsion system which optimises the hydrodynamic properties of the ship and delivers increased efficiency and thrust while using less energy. It has proved a popular solution with a fuel saving of around 6%," notes Vedlog.

He adds: "Compared to conventional propellers, the rudder forces with Promas are also much higher, meaning drag is reduced and this improves slow speed and harbour manoeuvring. The rudder will also have a flap to increase manoeuvring performance in narrow harbours."

TECHNICAL PARTICULARS NVC 614 CT	
Length overall	147.90m
Moulded breadth	22.00m
Depth moulded to main deck	11.70m
Design draught	8.70m
Number of tanks	14
Cargo capacity	approx. 16,780m ³
Methanol fuel storage tank	approx. 700m ³
Marine gas oil	approx. 610m ³
Main engine	2-stroke slow-speed, low-pressure dual-fuel engine from WinGD, type 5X52-2.0 with HPSCR, developing 5,850kW at 102rpm
Aux. engines	4 x Volvo D16 with built-on SCR, developing 550kW each
Economiser	Geasab Economiser, energy contribution => 500kW/85%M-CR & 300kW/50% MCR
Energy Storage Unit	Corvus ESU, 420kWh capacity. Spinning reserve / Peak shaving / Blackout recovery
PM Tunnel Shaft Generator	Generator mode 1,000kW / Motor mode 1,000kW

Transformative collaborations

Vedlog concludes that Kongsberg Maritime is delighted to be working with Sirius and China Merchants Jinling Shipyard on the project. It is a feeling echoed by both the Chinese yard, which has gained valuable experience in constructing chemical tankers for European owners, and Sirius.

According to a China Merchants Jinling Shipyard spokesperson: "Since the yard signed the first 15,000ton LNG dual-fuel chemical tanker contract with Kongsberg Maritime's design team in 2014, we have opened the door to the chemical tanker market in Northern Europe with cutting-edge energy-saving and low-carbon designs such as dual-fuel propulsion, in-line shaft generator and DC-link.

"This was already an advanced design over eight years ago, it was a challenge for China Merchants Jinling Shipyard and Kongsberg Maritime, but we succeeded with our joint efforts. We hope to continue to work with Kongsberg Maritime in the future to design and build future ships that are more popular with the market and shipowners."

Sirius MD Backman observes: "With Evolution 15K we're taking another step forward – for our customers, colleagues and the environment. Our new tanker has been designed to provide the highest levels of sustainability, efficiency and safety as well as excellent working conditions." ■



FIRST OF A NEW BREED OF LNG-POWERED TANKERS ENTERS SERVICE

By Daniel Johnson



NEWBUILD LISELOTTE ESSBERGER. SOURCE: ESSBERGER TANKERS

One advantage of LNG as an alternative marine propulsion technology is feasibility; the technology is already mature enough for uptake and the fuel can be provided at harbour. To mobilise the country's shipping industry towards this low-carbon option, Germany's Federal Ministry of Transport and Digital Infrastructure (BMVI) has been providing funding for the construction of new LNG-powered ships, a beneficiary of which has been E&S Tankers, a joint venture between Essberger Tankers and Stolt Tankers.

The company recently put into service the first of four newbuild dual-fuel Type 2 tankers to have received more than €6.3 million in subsidies from BMVI for the installation of LNG equipment. Built by China Merchants Jinling Shipyard, the *Liselotte Essberger* is said to be 30% more energy efficient than typical

vessels of its size and type and at the leading-edge of a new breed of tankers designed to meet the dual challenges of being environmentally friendly and ensuring exceptional safety for both crew and cargo.

The vessel was officially greeted at E&S Tankers' Port of Hamburg headquarters at the end of 2023 having completed a maiden voyage from the port of loading in northern China via Singapore, the Suez Canal, through the Mediterranean, and northwards to Germany. Most of the journey was completed in LNG mode. The LNG fuel for the ship's propulsion is stored in a deck-mounted tank with a capacity of 350m³, enough for a distance of around 4,200nm.

Liselotte Essberger is an ice-going (1A) chemical tanker with eight pairs of stainless steel cargo tanks suited to a wide variety of cargoes, an overall length of 119.9m and beam of 18m. The cargo hold adopts a special double deck design to effectively protect cargo safety and prevent marine pollution.

The vessel features a MAN HyProp ECO propulsion system built around a MAN 6L35-44DF medium-speed engine producing 3,180kW at 750rpm. The power system features a shaft generator/motor with PTO/PTI capabilities. A 4.5m diameter controllable pitch propeller runs at 110rpm connected through a Renk gearbox and confers a service speed of 12.9knots.

As well as the dual-fuel main engine there is a MAN 6L23/30DF auxiliary with a power output of 850kW complemented by a pair of Lindenberg Scania gensets running on MGO. The ship's two Heatermaster boilers are also capable of running on LNG. Running on LNG allows the ship to be NO_x Tier III compliant and when running on oil fuels an SCR system is employed. The vessel has an assigned EEDI of 9.64, which is well below the maximum 15.46.

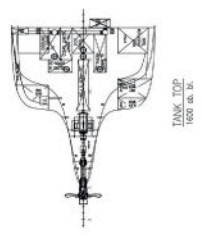
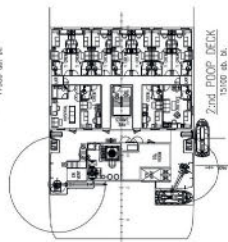
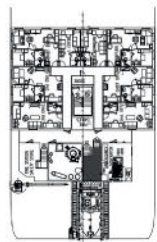
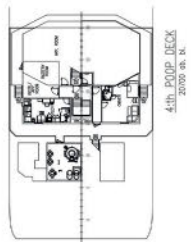
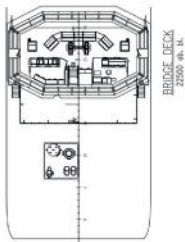
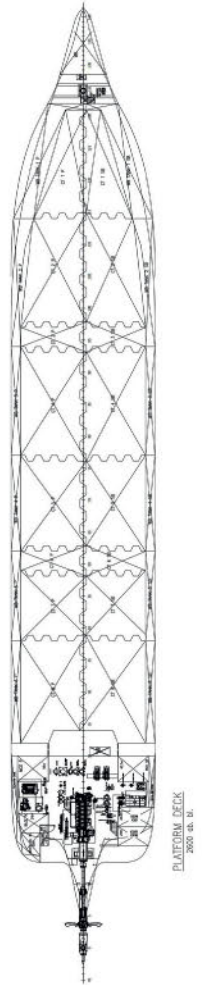
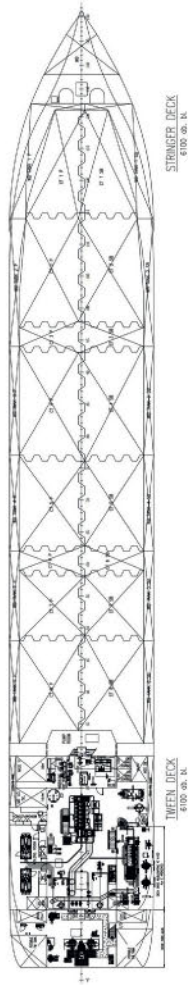
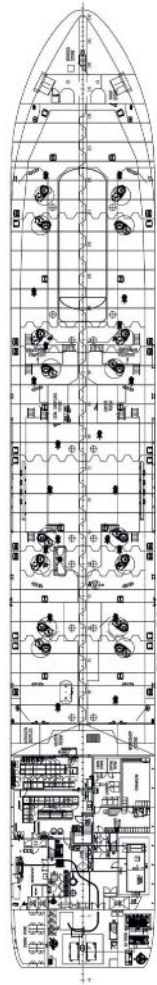
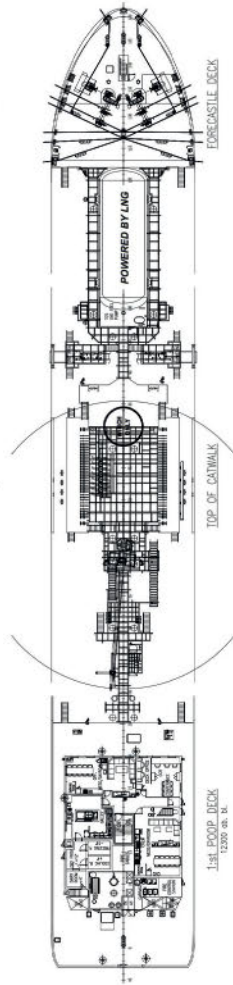
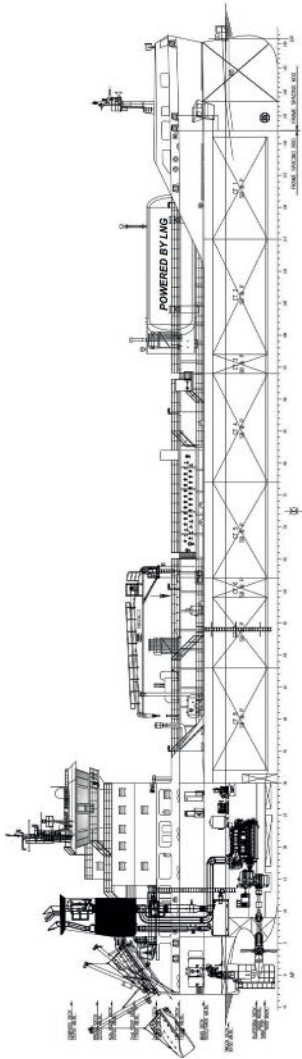
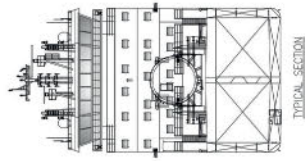
Crewed by 15 people, *Liselotte Essberger* has been designed by Sweden's FKAB Marine Design, with input from seafarers, to ensure safe transportation of cargoes in harsh environments such as the winter season in the northern Baltic Sea. At the time of writing, the vessel's sister ship, *John T Essberger*, was en route to Hamburg from China and it is anticipated that China Merchants Jinling Shipyard will deliver the third and fourth ships in the series by the end of the first quarter of 2024.

Liselotte Essberger is further profiled in RINA's *Significant Ships of 2023*, to be published this month. ■

TECHNICAL PARTICULARS LISELOTTE ESSBERGER	
Length, oa	119.90m
Length, bp	117.11m
Breadth, moulded	18.00m
Depth, moulded	9.20m
Draught, design	6.50m
Gross tonnage	6,377t
Number of tanks	16
Cargo capacity	7,682.60m ³
Cargo pumps	16 deep-well
Main engine	MAN 6L35-44DF
Service speed	12.9knots
Classification society	DNV
Flag registry	Portugal



GENERAL ARRANGEMENT OF LISELOTTE ESSBERGER. SOURCE: CHINA MERCHANTS JINLING SHIPYARD





HAPAG-LLOYD'S GIANT 23,660TEU CONTAINER VESSEL *BERLIN EXPRESS* FEATURES A MACGREGOR DESIGNED HIGH-PERFORMING CARGO-HANDLING SYSTEM. SOURCE: MACGREGOR

DECK & CARGO EQUIPMENT

CARGO-STOWAGE OPTIMISATION ENHANCES CARGO-CARRYING EFFICIENCY

A holistic and tailored approach to designing stowage solutions is helping owners increase their earning potential and minimise the environmental footprint of their ships, according to MacGregor

While optimising efficiency in the transport of goods is fundamental to a ship's earning capability, owners sometimes pay insufficient attention to the vessel's cargo-handling system during the early design stage. In a typical design process, parts of the cargo-handling system are treated as separate entities, with lower priority than other critical components of the ship. By the time the stowage infrastructure is in place, a unique opportunity to maximise cargo-carrying efficiency has been missed, and any major changes to the vessel in the future will involve significant downtime and loss of revenue.

According to maritime load handling specialist MacGregor, planning a newbuild around its stowage requirements is the key to optimising cargo capacity and earnings from the vessel's maiden voyage.

"Often, during the initial stages of ship design, stowage arrangements don't receive the consideration they deserve, and the vessel ends up with a sub-optimal loading capacity and flexibility, which limits its profitability," comments Esa Lukkala, MacGregor sales

manager for Multi-purpose Vessels (MPV) and General Cargo Vessels. "If the owner wants to rectify this at a later stage, it will cost them a lot of time and money. Taking a holistic view of the cargo-handling system and its desired capabilities in the early design process pays off in the future."

By addressing stowage arrangements from the beginning, an owner can ensure that the system's constituent parts – such as weather and tween-deck hatch covers, movable bulkheads, cranes, lashing bridges, container stanchion and fittings, and the cell-guide system – function optimally as a combined unit, adds Lukkala.

As the only supplier able to design and deliver all of these products, MacGregor takes a holistic approach to cargo handling. Its cargo-stowage solution serves MPV, general cargo, and container vessels of all sizes. For example, MPV can offer flexibility by accommodating different cargo configurations, making them adaptable to various trade routes and cargo demands.

More cargo; fewer emissions per carried container

Considering stowage arrangements at the earliest opportunity is necessary for reasons other than profit. Modern shipowners have growing environmental, social, and corporate governance (ESG) responsibilities, not to mention regulatory obligations. Compliance with the International Maritime Organization's (IMO) Carbon Intensity Indicator (CII), for example, is a planning priority for shipping companies worldwide.

"Shipowners and yards are doing a lot of good things to reduce their vessels' environmental footprint, such as adopting digital tools for more efficient route planning and optimising hull forms for reduced friction," says Arto Toivonen, MacGregor sales manager for Lashings and Cargo Boost. "However, what tends to be overlooked is the extent to which a carefully conceived stowage system can contribute to ESG agendas."

By allowing owners to safely transport more cargo per voyage, the MacGregor cargo-stowage solution minimises emissions per carried 20ft-equivalent unit (TEU). In fact, Toivonen reports that a highly efficient cargo-handling system, when compared with the average stowage arrangements, can cut emissions per TEU by up to 15%, depending on the ship.

Ultimately, decreasing emissions in line with IMO targets will rely on the widespread adoption of cleaner energy sources, but alternative fuels are also considerably more expensive and have greater storage demands than conventional heavy fuel oil. Thus, as shipping's green transition advances, the importance of an efficient cargo-handling system will only become more evident, Toivonen explains.

"Eventually, we will reach the point where incremental performance enhancements are no longer enough to maintain regulatory compliance, and shipowners will simply have to make the switch to greener fuels," he says. "Optimised cargo handling will help them to offset the significant costs involved while compensating somewhat for the reduced hold space resulting from more complex fuel-storage requirements."

Enabling a significant capacity increase with Cargo Boost

Optimising stowage on board existing ships presents a different set of issues, but this does not mean that owners of ships in service have no options for improving their cargo-carrying efficiency. MacGregor has developed its 'Cargo Boost' solution specifically to help owners of existing vessels overcome the challenges of sub-optimal loading capacity.

"It's common for shipowners who have followed a design process that doesn't account for stowage requirements from the outset to approach us later on requesting our expertise in increasing their vessels' cargo capacity," notes Toivonen. "The solution we provide in such cases, Cargo Boost, has proved popular with customers as it offers a second chance to optimise cargo-carrying efficiency while enabling a quick return on investment."



LASHING BRIDGE. SOURCE: MACGREGOR

While the average cargo-handling system has a utilisation rate of approximately 80%, MacGregor's target is at least 90%, Toivonen continues. "For a 10,000TEU vessel, this equates to an extra 1,000 TEUs transported per voyage. Yet in certain cases, we can increase a ship's cargo capacity beyond its expected maximum, allowing a 10,000TEU vessel to carry, say, 11,000TEUs."

Implemented across a 10-vessel fleet, Cargo Boost can increase fleet-wide capacity by the equivalent of an additional ship, resulting in the earning potential of 11 vessels with the costs and emissions of 10. "This makes it an easier, cheaper alternative to the early adoption of alternative fuels," says Toivonen. "Of course, all shipowners will have to make the changeover eventually, but Cargo Boost can buy them time until alternative energy sources are more mature and their price point has come down."

With its cargo-stowage solutions and Cargo Boost, MacGregor has developed a service offering that covers the full scope of shipowners' cargo carrying optimisation needs, says Toivonen. "Most companies that supply stowage systems work solely with shipyards, but we work with owners as well. We have an in-depth understanding of how our clients operate their vessels, and we use this knowledge to design tailored systems whose constituent parts work in harmony to deliver the highest levels of cargo-carrying efficiency." ■



ESA LUKKALA (LEFT) AND ARTO TOIVONEN. SOURCE: MACGREGOR



AIR LUBRICATION SYSTEMS

DACS OFFERS STRAIGHTFORWARD SOLUTION TO REDUCE HULL RESISTANCE

Damen Shipyard Group's air lubrication system boosts fuel efficiency of Amisco cargo vessel



DAMEN HAS RETROFITTED THE DACS SYSTEM TO AMISCO'S CARGO VESSEL DANITA

Damen Shipyards Group has declared its mission to become the most sustainable maritime solutions provider. For the shipbuilder pursuing this goal means working on multiple fronts as it seeks to develop a portfolio of sustainable services covering the lifecycle of a vessel.

A small selection of examples includes the embracing and development of alternative fuel technologies, and the construction of full electric vessels.

A further example of Damen's work towards increased maritime sustainability, is the Damen Air Cavity System (DACS). This innovative approach, the result of collaboration with the Technical University of Delft (TU Delft), helps to reduce a vessel's resistance in the water.

While much work has been done in optimising hull forms to increase efficiency, this work tends to focus on wave reduction and pressure resistance. However, this does not represent the whole picture. For vessels sailing at low Froude numbers, the most significant contributor to resistance is friction drag.

Damen R&D engineer Sasha Zverkhovskiy says: "The potential of air lubrication to reduce this resistance of a vessel in the water is well known. As a result, the vessel requires less power and, therefore, consumes less fuel. Ultimately, this can lower both opex costs and emissions."

Zverkhovskiy explains that there are two main approaches to air lubrication. One is based on local density reduction. Here, air is injected along the flat bottom of the hull in a dispersed form, thus creating a large amount of bubbles,

thereby reducing the density. This method requires quite a large volume of air but provides relatively little efficiency.

The second method, on the other hand, while requiring some slight modification of the vessel, does offer a stable air flow. This method is based on creating stable air layers, that reduce the wetted area by separating the hull from the water.

It is this method which that DACS system applies. DACS features air cavities formed by injecting air behind a vertical obstruction with a sharp edge – the so-called cavitator. A series of such cavities is created along the flat bottom of the vessel. Two skegs running along the bottom of the vessel, either side of the cavities, stabilise the air flow. This method, as well as requiring less air – and, therefore, less power – represents a more effective method of reducing resistance, according to Damen.

Furthermore, the system can be easily and rapidly installed during a period of scheduled drydocking with minimum disruption to the vessel's operational uptime.

Complying with the latest regulations

The installation of DACS is combined with Triton, Damen's award-winning trend monitoring solution. Triton collects data from thousands of sensors located around the vessel to inform appropriate decision making and provide valuable information about an operation.

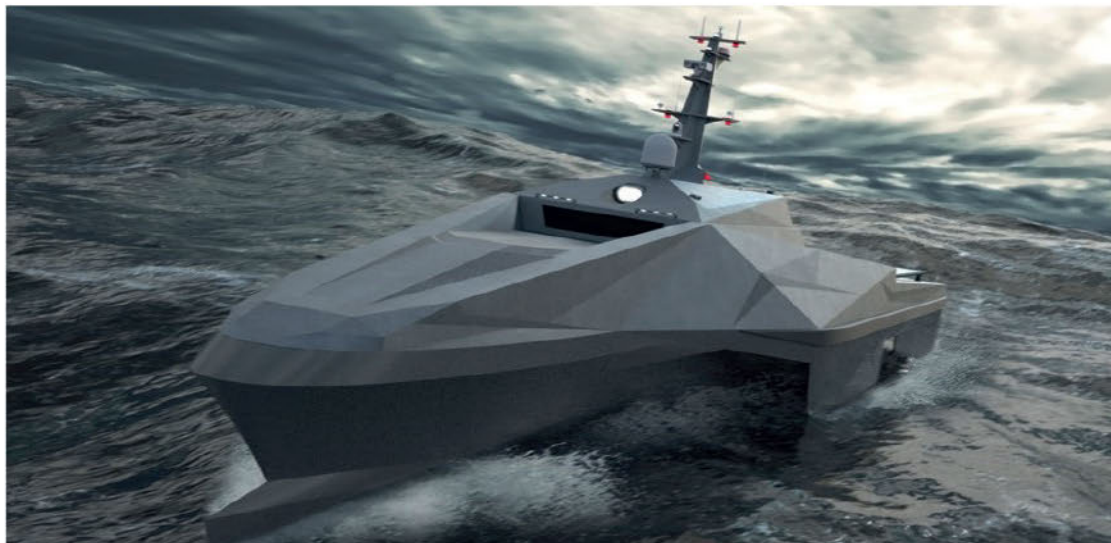
Armed with the data from Triton, the operator can, for example, adjust the sailing profile and route to maximise efficiency and reduce fuel consumption.



The Royal Institution of Naval Architects Presents:
Warship 2024: Future Surface Combatants

18-19 June 2024, Adelaide, Australia

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Sponsored by BMT, Babcock, Defence SA, and ANSYS and Supported by the RINA Australian Division, the Royal Institution of Naval Architects is once again hosting the highly popular Warship International Conference in June 2024.

The increasing complex warship design requires an effective engineering assistance, design configuration control, supply chain and inventory management to meet operational requirements. With the introduction of autonomy and disruptive developments such as quantum technologies, could future operating concepts evolve leading to a step change in design requirements. With vessel design lives between 25 and 50 years naval architects need to consider the effects of current and future technological and operational developments now.

For the first time, RINA Warship Conference will be a 2-stream event with more talks available to hear from than ever before! The event will be a fantastic learning and networking opportunity, filled with many presentations, interactive Q&A panel discussions, and chances to catch up with old friends as well as make new connections from the Warship industry

Keynote Speakers



Rear Admiral Rachel Durbin CSC, RAN

A distinguished leader in the Royal Australian Navy, RADM Durbin's career encompasses pivotal roles in marine engineering and strategic naval operations. With her extensive experience in naval capability development and engineering workforce management, her insights will be a cornerstone of the conference.

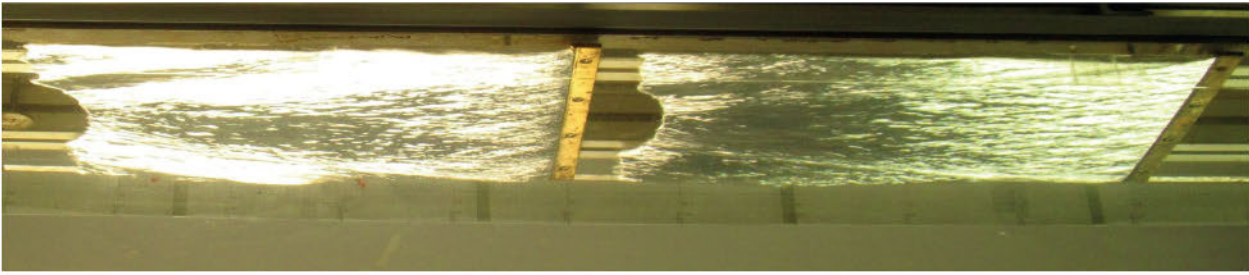


Glenn Callow, Chief Technology Officer, Austal Limited

An expert in autonomous systems and naval technology, Glenn brings a unique perspective from his time at BAE Systems and Rio Tinto, where he led innovative projects in autonomous and digital technologies. His expertise is vital in understanding the future of warship design and construction.

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RIGOROUS TESTING TO THE SYSTEM BY DAMEN AND TU DELFT INCLUDED WATER TUNNEL AND TANK TESTS

Additionally, Triton provides clear information on the volume of fuel consumed. This not only demonstrates the benefits that DACS has brought to the operation, it also makes reporting of CII, EEXI ratings and EU-MRV very straightforward.

Putting the theory to the test

A further benefit of the air cavity system is that it can be tested using scale models in a tank. Damen and TU Delft have applied rigorous testing to the system, including water tunnel and tank tests at leading research institutes such as the Marine Research Institute Netherlands (MARIN) and at DST in Germany.

A test conducted in towing tanks serves to demonstrate the potential of DACS to cut fuel consumption and emissions. Here, scale tests were conducted for both an inland waterway passenger vessel and a seagoing passenger vessel.

In both tests, resistance and propulsion were measured at a range of speeds and water depths, corresponding to the operational conditions of a full-size vessel. In addition to taking the regular measurements, the bottom of the vessel was filmed to visualise the impact of the cavities on air flow.

For the inland vessel, the DACS system was able to reduce the wetted part of the hull by a significant 30%. The impact this had on the vessel's performance was clear to see; the net power reduction, including with the addition of a compressor to inject the air (up to 20kW dependent on speed) was considerable at up to 18%.

Going to sea

Incorporating DACS to a seagoing vessel is somewhat more challenging. For a start, the vessel is exposed to waves, which equals increased motions, particularly roll motions. This has implications for the stability of the air flow. Additionally, on a typical slender seagoing vessel, the flat bottom area relative to the total wetted area is smaller than on an inland vessel. In the MARIN test, for example, the DACS system was able to reduce the wetted area by 15% – half of the reduction of the inland vessel.

The increased size of the vessel also demands a larger compressor for the air injection. With DACS installed and

allowing up to 100kW for the blowers, the test results revealed a net power reduction of around 5%. For full block ships the savings will rise to 8-12%.

Size counts

At first glance, this appears less impressive than the results on an inland vessel. However, as Zverkhovskiy explains, all is not necessarily what it seems.

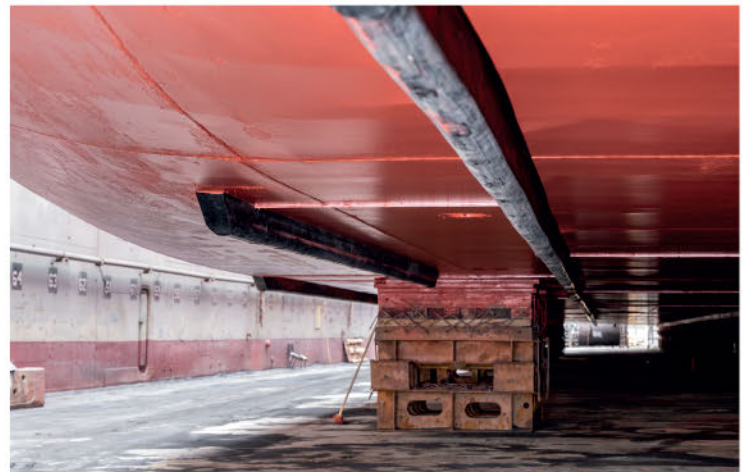
“The first impression is that the effect of DACS on a seagoing ship are less. While the relative efficiency is indeed lower, we should consider the size of the vessel. A seagoing ship will be larger than its inland counterpart and will sail at higher speeds. As such, they require more installed power and consume more fuel. Therefore, the effects of DACS on absolute savings and emissions reduction may in fact be more significant,” he notes.

Cutting carbon in cargo

The benefits of DACS demonstrated in a test environment, it was time to assess the system's performance in the real world. Damen didn't have long to wait. At the end of 2022, the company received a call from Andrei Gussarov at Estonia-based vessel operator Amisco.

The company operates a fleet of nine vessels – mini bulkers, general cargo vessels and container vessels. Amisco was looking to reduce its fuel consumption, as Gussarov explains.

“We had multiple reasons for this. New regulations such as CII and EEXI make it clear that the time to act is now. We also see that more and more clients expect increased sustainability, and we wanted to demonstrate our commitment to them. Besides this, we wanted to help



WITH DACS INSTALLED TO *DANITA*, AMISCO WILL ACHIEVE THE CII RATING NECESSARY TO CONTINUE OPERATING IN THE BALTIC SEA IN THE FACE OF NEW, STRICTER EMISSIONS REGULATIONS, WHILE REDUCING THE COSTS OF OPERATION

make a difference in the world. Sustainability is the future and we want to be a part of that."

Reduced emissions at the push of a button

Gussarov admits that he faced some initial scepticism about selecting DACS – after all, despite impressive test results, the system had yet to be installed on a working vessel. DACS did, however seem to match the company's requirements.

"DACS is a really straightforward installation. We didn't want a complex system on board that would make more work for the crew. We needed something that would be easy to operate, low on maintenance and which would generate real results. With DACS, all we need to do is push the button," he says.

Amisco's requirement was to install DACS to its general cargo vessel MV *Danita*. The 5,232gt super ice class vessel is 115.5m long with a beam of 16.5m. The vessel enjoys a high cargo intake, though, as an older ship, her fuel consumption is relatively high. She was the perfect candidate for the DACS system.

Damen calculated that the system would save up to 7% on fuel consumption for the vessel.

"And we did it. The system is working perfectly, as confirmed by RINA. I would highly recommend DACS.

It's the simplest solution available at the moment and it works exactly as it should do, reliably reducing the costs of operation and reducing our emissions in line with regulations," says Gussarov.

Planning ahead

The first commercial use case has proven successful for the DACS air lubrication system, lowering opex and emissions as predicted by the test cases. This paves the way for wider adoption in the future. As Zverkhovskiy explains, though, the potential benefits of DACS extend beyond retrofitting existing tonnage.

"The results of the tests and the first use case on an actual vessel, confirm the potential for DACS to reduce opex," he says. "Beyond this, however, it's clear that the system also has implications for capex. A newbuild vessel that features the DACS system would require less installed power from the outset, thereby significantly reducing the cost of newbuilding.

"Perhaps the most significant benefit, however, is the reduction in emissions that DACS provides. Whether on an existing or a newbuild vessel, we are very confident that DACS will be playing an important role in supporting the maritime energy transition in the coming years. We're looking forward to more successful projects in the future." ■



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 International Conference on Computer Applications in Shipbuilding
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As environmental demands and increasing regulatory compliance requirements place additional pressures on ship owners and operators, advancements in digital technologies are being exploited by ship designers, builders, and operators to develop and evolve effective and sustainable green ship solutions. Increasing amounts of data are collected, managed, and used across all stages of a ship lifecycle, to continuously improve quality, performance, efficiency, and compliance environment requirements.

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- Transitioning current computing systems with future developments, to maximize the use of captured data
- Collaborative working and data sharing across all platforms and regulatory bodies
- Enhanced methodologies for accuracy, quality, and productivity.
- Advancements and Innovative applications of visual technologies.
- Use of digital data to optimize ship operational performance and cost effectiveness.

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ENGINES

METHANOL POWERING THE ENERGY TRANSITION

By **David Tinsley**, Correspondent



METHANOL HAS EMERGED AS A MAINSTREAM CHOICE FOR NEWBUILD PROJECTS INCORPORATING ALTERNATIVE FUEL PROPULSION. SOURCE: WÄRTSILÄ

the 35 booked in 2022. By contrast, the number of orders placed for LNG-fuelled newbuilds fell in 2023 to 130 from 222 the year before.

The rapid pace of technical development through 2023 has continued into 2024, such that prospective buyers now have an unprecedented choice of main and auxiliary plant that can be run on methanol, involving an increased number of vendors. New models are, to the greatest extent, derived from proven, conventionally-fuelled or dual-fuel designs, a factor which affords buyers greater confidence when striking out on the energy transition pathway via 'greener' fuels.

Accelerating uptake of methanol-capable marine power plant has been underpinned by an intensification of developmental work by engine designers and manufacturers, spanning both two- and four-stroke machinery and the range of ship propulsion and auxiliary applications.

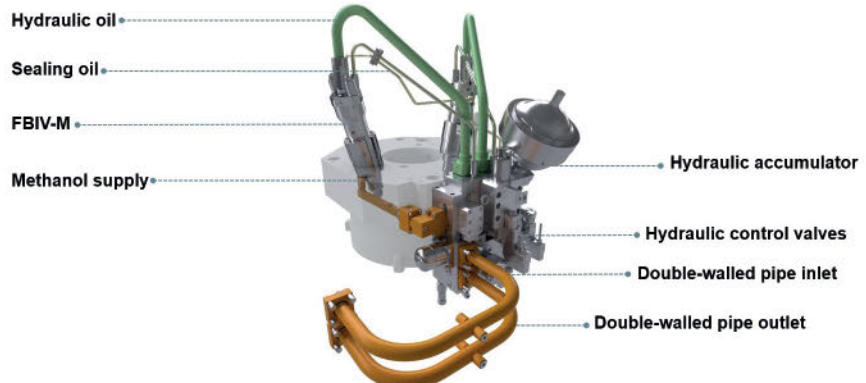
Methanol is one of the primary alternative fuel choices for the shipping industry to achieve net-zero carbon emissions by 2050. A widening appreciation of the fuel's lean-burning properties, practicalities, and logistic benefits, in conjunction with the expanding engine offering, have seen methanol emerge in 2023 as a mainstream choice for newbuild projects incorporating alternative fuel propulsion.

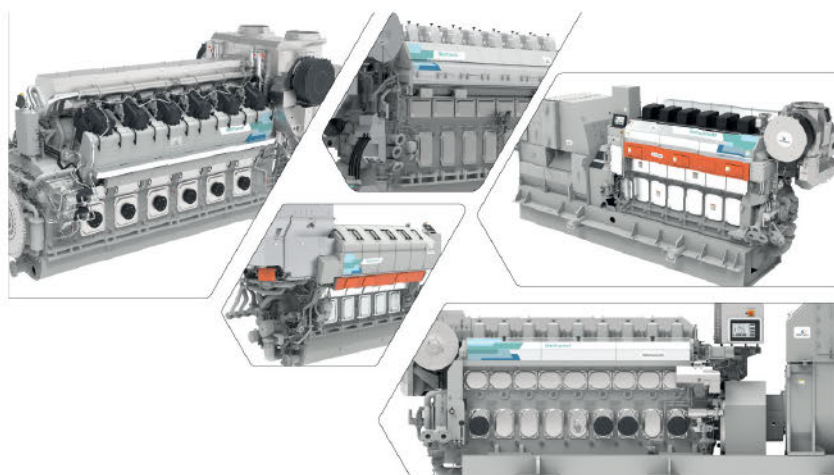
According to DNV, methanol was specified in contracts signed last year for 138 newbuild vessels, excluding methanol tankers, denoting a steep increase compared to

MAN Energy Solutions has very high expectations with regard to methanol as a marine fuel, and stated last year that it could foresee around one-fifth of all large merchant vessels, by measure of engine output, being powered by 'green' methanol by 2050. 'Grey' methanol, produced from LNG, may not significantly reduce well-to-wake CO₂ emissions, but carbon-neutral 'green' methanol, made using renewable electricity or from biomass gasification, will be of fundamental environmental value in the context of the shipping industry's route to decarbonisation.

To that end, the programme of ME-LGIM methanol dual-fuel, two-stroke propulsion engines has been expanded rapidly over the past two years, such that it now spans bore sizes from 450mm to the most potent 950mm size, applicable to the broadest range of mercantile shipping. The latest addition is the G70ME-C10.7-LGIM

BUILDING ON THE STANDARD TWO-STROKE, THE ME-LGIM ENGINE HAS ADDED METHANOL COMPONENTS ON THE CYLINDER TOPS. SOURCE: MAN ES





WÄRTSILÄ HAS RECENTLY MUCH EXPANDED ITS METHANOL-CAPABLE FOUR-STROKE PORTFOLIO. SOURCE: WÄRTSILÄ

design, initially for release in five- and six-cylinder formats, targeting bulk carriers in the 180,000-210,000dwt category, Suezmax tankers, and container vessels of around 3,000-4,500TEU capacity.

By the end of last year, the company had surpassed 150 sales of ME-LGIM engines, of which more than 70 involved the largest bore, G95ME-LGIM series in its Mk 10.5 variant. One of the latest additions to the tally signified a breakthrough in the VLCC market. The 7G80ME-LGIM unit ordered by China Merchants Energy Shipping for a 306,000dwt newbuild at Dalian Shipbuilding Industry is the world's first methanol dual-fuel engine to have been booked for a VLCC.

As a sulphur-free fuel, methanol enables full compliance with the 2020 IMO low-sulphur regulation and is also beneficial for engendering lower CO₂ than heavy fuel oil during the combustion process. While all ME-LGIM engines have exhaust gas recirculation (EGR) systems to drive down NO_x to Tier III criteria, towards the end of last year a further option for achieving Tier III compliance was introduced in the shape of selective catalytic reduction (SCR) technology.

In addition, a version of the ME-LGIM design capable of running on a mixture of methanol and water meets performance requirements while ensuring Tier III certification. The ME-LGIM-W variant, wherein the emulsified fuel reduces combustion temperature, has the merit of obviating the need and expense of EGR or SCR.

Swiss technology makes its mark

Within a short space of time, two-stroke specialist Winterthur Gas & Diesel (WinGD) has drawn up a comprehensive portfolio of methanol-fuelled propulsion engines, spanning the 520mm- to 920mm-bore range, and is committed to delivering the first example of the new X-DF-M generation in early 2025.

In advocating methanol as a practical proposition, Chinese-owned, Swiss-based WinGD cites ease of handling on board as a key advantage, stemming from the fact that it does not require compression or refrigeration and is liquid under ambient conditions. From logistical and availability standpoints, methanol is already a widely traded chemical with established port infrastructure.

Offering dual-fuel flexibility and operating according to the diesel principle in both diesel and methanol mode, the X-DF-M engine is derived from the X diesel series with the addition of a methanol injection system and associated servo oil drive. Pilot diesel fuel injection ensures accurate ignition throughout the load range when running on methanol. While Tier II NO_x levels can be met irrespective of whichever fuel is used, exhaust gas aftertreatment is required for Tier III certification, and WinGD's first-line recourse is to SCR.

Subject to confirmation by the licensee engine builders concerned, WinGD has issued a schedule for prospective release of product documentation and initial engine deliveries under the methanol engine development programme. This encompasses the X52DF-M-1.0, X62DF-M-1.0, X62DF-M-1.0, X72DF-M-1.0, X82DF-M-1.0 and X92DF-M-1.0 series.

The first projected shipments involve 10X92DF-M-1.0 and 6X82D-M-1.0 models, expected in the second and third quarters of 2025. For the other bore sizes, opening deliveries are anticipated between the first quarter of 2026 and final quarter of 2027.

Wärtsilä expands offering

In the four-stroke, medium-speed domain, Wärtsilä has recently added four further engine series to its catalogue of machinery capable of primary operation on methanol, making for one of the industry's broadest such portfolios. Methanol-ingesting versions of the W20, W31, W46, and W46TS designs are expected to be available from 2025 onwards, adding to the existing W32 methanol engine launched in 2022.

Together with the methanol retrofit possibilities that Wärtsilä intends to realise for installations in existing vessels, the development means a major expansion in the market reach of methanol-fuelled engines as regards vessel type and size, encompassing unit powers from 1,000kW to nearly 21,000kW. Methanol upgrades are either currently available or to be rolled out for the W31, W32, W46F, W46TS and also the Sulzer-originated ZA40S engine.

Wärtsilä has a track record in methanol going back to the 2015 when it converted the first of the four ZA40S main engines in the Swedish ro-pax ferry *Stena Germanica*.





TYPE APPROVAL TESTS WITH THE HiMSen H32DF-LM. SOURCE: HD HHI

Low-speed four-stroke challenger

Favoured by many Japanese and east Asian coastal and intra-regional operators over the medium-speed four-stroke and low-speed two-stroke options, the low-speed four-stroke engine concept continues to be refined by Japanese manufacturers. A new design from Hanshin Diesel which melds the low-speed four-stroke principal with a methanol-firing capability has thereby extended the reach of the fuel to a substantial and traditionally conservative fleet operating community.

Confidence in the LA28M will be drawn from the fact that the engine is derived from a diesel engine, the LA28 type, which enshrines all the characteristics of reliability and efficiency that have been proven throughout the low-speed, trunk piston engine portfolio. The moderate crankshaft speed enables direct drive to the propeller, obviating the need for a gearbox.

Essentially a dual-fuel engine, the LA28M encapsulates Hanshin's view that methanol offers environmental and practical benefits at a lower capital cost than that entailed with other alternative fuels such as ammonia or hydrogen.

To be released in six-cylinder in-line format, the configuration most popular with the target market, the LA28M has a nominal output of 1,103kW at 330rpm. Starting is effected with MDO or MGO, also used through the low-load range until crankshaft speed reaches the high-load point whereupon methanol is injected as the main fuel, supplemented by MDO or MGO as pilot fuel so as to ensure stable combustion. Should there be any failure in the methanol fuel supply system or double-wall piping, switchover can be made to MDO or MGO. Mechanical (camshaft) drive is retained for methanol fuel and pilot fuel injection and valves.

The LA28M has been specified for Japan's first methanol-fuelled coastal tanker, which is under construction by

Kanashashi Heavy Industries and due to enter service in December 2024. Ordered from Kanashashi's parent company Murakami Hide Shipbuilding by a partnership comprising MOL Coastal Shipping, Tabuchi Kaiun and Niihama Kaiun, the 65.5m-long vessel will be employed in domestic methanol transportation under a timecharter contract with Mitsubishi Corporation.

The development of the tanker involves a broader project alliance, including Hanshin Diesel, and the scheme has qualified for Japanese Government funding in accordance with an R&D-based strategy for raising the technological and efficiency standard of the coastwise shipping sector.

MAN opens four-stroke methanol portfolio

After nearly a decade of working on the development of methanol-fuelled, two-stroke propulsion engines, and with the first LGIM methanol dual-fuel plant at sea in 2016, engineers and technicians at MAN Energy Solutions in Denmark have more recently turned their experience to the task of creating gensets capable of running on either methanol or conventional fuel. This has placed the company in a position to supply comprehensive installations that reduce a ship's carbon emissions.

As the issue of the latest endeavour, the L21/31DF-M is the first small-bore, four-stroke methanol engine in the MAN ES catalogue and in the vanguard of the industry's roll-out of such machinery in the 1,000-1,980kW power segment.

While the L21/31 genset from which the M model has been derived has proven performance and reliability from a sea-going population of thousands of units and an accumulated 110 million-plus operating hours in all iterations, the conversion to methanol posed significant challenges, including the adaptation of the control system.

The L21/31DF-M offers on-line monitoring via an advanced, proprietary SaCoS electronic control system.

Another feature of the new genset is a low-pressure port fuel injection (PFI) concept, which feeds fuel safely at low pressures and lessens a customer's capital expenditure.

Encompassing five in-line engine models and choice of 60Hz and 50Hz generator frequencies at 900 and 1,000rpm respectively, the power band embraced by the L21/31DF-M opens the design to a very wide range of merchant vessels. The debut contract ensues from China Merchants Heavy Industry and calls for a total of six seven-cylinder sets to be fitted in two newbuild PCTCs, each of which has also been specified with an ME-LGIM methanol dual-fuel two-stroke main engine. Delivery of the first of the auxiliaries is due in 2025.

As well as production of a dedicated design, MAN ES intends to introduce retrofitting gensets for methanol effective from 2025 onwards. To that end, it was announced in December that an agreement had been forged with Alfa Laval to devise a methanol fuel supply solution for MAN four-stroke engine conversions.

Ever-rising star: the Korean brand

Giving new dimension to HD Hyundai Heavy Industries' standing in the dual-fuel medium-speed engine market, the methanol-capable H32DF-LM design addition to the HiMSEN portfolio achieved a landmark order from a Japanese-owned shipbuilder last year.

The deal with Tsuneishi Shipbuilding involves calls for a total of 16 units, as four shipsets for auxiliary power applications in newbuild tonnage to be constructed at the Japanese group's Chinese yard, Tsuneishi Zhoushan. Tsuneishi's orderbook features methanol-fuelled bulk carriers and boxships.

The H32DF-LM covers a maximum output band of around 3,000–4,500kW in six- to nine-cylinder formats at the 320mm-bore size, one of the most populous and fiercely contested segments of the four-stroke business. The production batch of 16 entails the eight-cylinder version throughout.

The award is considered commercially highly significant, given the longstanding dominance of the Japanese market by competitors with much longer histories than the HiMSEN family. The nomination of the dual-fuel design followed a 75-engine contract from Imabari Shipbuilding for 15 shipsets of the H32C diesel-engine in genset aggregates.

While what may be termed conventional methanol is already widely available, investment in sustainable methanol production is growing year-on-year, meaning that shipowners adopting methanol fuel now will benefit from a clear decarbonisation pathway as increasing quantities of low-carbon 'blue' and carbon-neutral 'green' methanol become accessible. ■



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16 May 2024, London, United Kingdom

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Join 300+ industry professionals for a fantastic evening out in Central London and catch up with your old friends, colleagues and clients as well as make new connections at the RINA Annual Dinner 2024!

Principal Guest & Speaker



Mr Arsenio Dominguez, Secretary General, International Maritime Organization (IMO)

Mr. Arsenio Antonio Dominguez Velasco (Republic of Panama) has been elected by the IMO Council as the Secretary-General of the International Maritime Organization (IMO). After approval by the Assembly at the end of November, he has started his duties from 1 January 2024, for an initial term of four years.

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INVESTMENT IN AGENTS OF CHANGE: OXICATS

By **David Tinsley**, Correspondent



TOWARDS AN OXICAT-EQUIPPED FOUR-STROKE: TEST ENGINE RUNNING UNDER THE IMOKAT II PROJECT. SOURCE: MAN ES

Despite making up less than 2ppm of the atmosphere, methane is responsible for at least one-sixth of the total radiative forcing, a measure of the greenhouse gas (GHG) effect causing global warming. Methane slip from natural gas-fuelled engines thus has a high environmental cost.

With a growing merchant fleet equipped to use LNG for shipboard power, the maritime sector has intensified efforts to reduce methane slip and fugitive methane emissions. The impulse for fresh initiatives reflects new imperatives created by increased research data as to the extent and climatic implications of methane release into the atmosphere, and most notably the regulatory groundswell.

In the latter respect, with shipping's incorporation this year into the EU's Emissions Trading System (ETS), the reach of the edict will come to encompass methane emissions (as well as nitrous oxide) from 2026 onwards. Moreover, FuelEU Maritime requirements for the GHG intensity of energy utilised on board will take effect in 2025, necessitating closer attention by ship operators to methane slip.

Enhancements to marine engine design since the first LNG dual-fuel models were introduced 20 years ago have progressively reined-in incompletely burned methane, reducing or minimising slip rates, and markedly so in high-pressure two-stroke types. In the four-stroke category, emissions aftertreatment also affords a means of tackling methane slip and its

deleterious atmospheric impact, although this presents tough technical challenges.

In the case of exhaust abatement solutions, the most promising method to treat and control enduring methane emissions is to pass the exhaust gas over a catalyst and convert the remaining CH_4 into CO_2 by complete oxidation. Although CO_2 is a greenhouse gas, it is far less potent than methane. In fact, methane's 100-year global warming potential (GWP) is around 28 times higher than CO_2 , and even greater on a 20-year term.

MAN ES targets 70% methane emissions reduction

Marine engine market leader MAN Energy Solutions has refined engine-internal measures throughout its two-stroke ME-GI range, minimising unburnt residues to the extent where it quantifies and guarantees methane slip levels at 0.2-0.3g/kWh over the load range. In its portfolio of four-stroke, LNG dual-fuel models, the slip factor has been halved over the past 10 years through internal engine architecture changes, but the company is pursuing different routes to achieve yet lower levels.

While an oxidation catalyst (oxicat) is not an option for two-strokes because of unsuitably low exhaust gas temperatures, it is a viable technology for removing unburnt hydrocarbons and carbon monoxide from four-stroke engine exhaust gases. The exhaust gas temperatures from MAN's four-stroke dual-fuel (DF), and also spark-ignited (SI), engines are sufficient to support the oxidation of methane slip.

Among the latest R&D initiatives in the four-stroke domain, MAN ES has taken forward a project to develop and prove an oxidation catalyst with the ultimate goal of cutting methane emissions by 70% at 100% engine load. Under the IMOKAT II endeavour, the recipient of funding from the German Federal Ministry for Economics and Climate Action, the study team at the company's Frederikshavn premises in Denmark is to investigate the operational behaviour of a pre-turbo catalyst conceived at group headquarters in Augsburg.

Whereas the predecessor IMOKAT I project, conducted in partnership with German academia, reviewed and evaluated different catalytic materials, coming up with a sulphur-resistant material containing no precious metals that facilitated high methane conversion, IMOKAT II signifies the prototype and technology demonstration stage. The current work at Frederikshavn centres on investigating the material's potential on a test engine, with the goal of designing a catalyst solution that can be applied to a full-scale engine. Field testing aboard a vessel was expected to get under way within the first quarter of 2024.

Hyundai HiMSEN initiatives

The ever-more prominent dual-fuel, four-stroke medium-speed engine range produced under South Korea's home-grown HiMSEN brand is also to be embellished with methane oxidation catalyst

technology. South Korean reports indicate that HD Hyundai Heavy Industries Engine & Machinery Division is planning to complete a prototype oxidat by the third quarter of 2024, and then put the unit through a pre-release test campaign to ensure that the system functions and performs as expected.

It is anticipated that oxidat aftertreatment will cut methane release by up to 80%. The Group has previously implemented engine-internal abatement measures for the LNG dual-fuel engines, encompassing refinements to combustion chamber design and the use of control logic in the shape of the software-based Methane Slip Solution (MSS). Integrated into the proprietary HiMECS engine control system, MSS employs multi pilot fuel injection (MPI) and cylinder cut-off strategies and is focused on 0-50% engine load conditions. With MPI, additional pre-injection of pilot diesel fuel promotes flame propagation in gas mode.

The design change entails the minimisation of crevice volumes in combustion chamber parts, i.e. cylinder head, cylinder liner, flame ring and metal gasket, showing efficacy across the load range. The combination of MSS and crevice reduction has the most beneficial outcome when dual-fuel engines are running at lower loads, purportedly cutting methane slip by some 80% at 25% load. ■



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Wind Propulsion 2024

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The current use of alternative fuels and renewable energy sources within the shipping industry is still relatively scarce. Growing environmental legislation and concerns are driving the need to develop and apply innovative alternative power and propulsion technology for ships. Now, industry players are increasingly putting a modern spin on one of the oldest concepts in shipping: harnessing the power of wind for ship propulsion.

Since the inaugural conference in 2019, the annual event has attracted a high level of interest in the maritime community. Attending speakers and delegates span the technology companies, academia, ship owners and industry associations. Over 100 delegates gathered at the IMO HQ for the Wind Propulsion 2023 Conference to hear presentations from companies including MOL; bound4blue; Anemoi Marine Technologies; Norsepower; Wärtsilä; RISE; Bureau Veritas Solutions M&O; MARIN and many more.

The 2024 conference agenda promises to bring those attending fully up to speed with recent technological, design and policy developments, and cast the minds of attendees into the future landscape for wind propulsion technology.

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ABC BUILDS MEDIUM-SPEED FLEXIBILITY

By **David Tinsley**, Correspondent

Acknowledging the challenges and uncertainties faced by shipowners and operators navigating the energy transition, Anglo Belgian Corporation (ABC) has augmented its medium-speed offering with a multi-fuel engine in widely favoured, six-cylinder in-line configuration.

Suited to short-sea/coastal, inland waterway and special-purpose vessel applications in the 1,230-2,160kW power band, the 6EL23 is the third addition to the groundbreaking Evolve engine platform.

A defining feature of the Evolve concept, the adaptable cylinder head design, facilitates a move from liquid, conventional fuel to dual-fuel firing and to 100% gaseous fuels, eliminating the need for a specific fuel commitment from the outset.

The 6EL23 is fully optimised for efficient operation on diesel, incorporating proprietary Exhaust After-Treatment System (EATS) technology for IMO Tier III (NOx) and EU Stage V (NOx and soot) emission criteria, while providing a pathway to ultra-low- and zero-emission alternative fuels such as methanol and hydrogen. This obviates the requirement for complete engine re-build or replacement.

Given the cost sensitivities of the primary target markets, ABC's characteristic emphasis on product affordability, reliability and design simplicity has held good in conjunction with the technological advance signalled by the Evolve generation and its latest member.

The six-cylinder, 230mm-bore engine joins the inaugural Evolve 4EL23 unveiled towards the end of 2021, followed little over a year later by the 20-cylinder vee-form 20EV23, representing the pinnacle of power within the Evolve line-up at a maximum output of 7,200kW. The new model can be supplied in either single-stage or two-stage turbocharged versions, affording a broad choice of power/speed settings within a compact structural envelope.

The engine platform features a common-rail system, variable valve timing (VVT) and Miller cycle, with micro pilot fuel injection for future dual-fuel functionality, or a mechanical pump-line-nozzle (PLN) fuel injection system for liquid fuels, and pre-design for 100% gas firing using a spark plug.

By virtue of an exchangeable power unit, comprising the cylinder head, valve train, water jacket, cylinder liner, conrod, piston, intake and exhaust elbows, the Evolve engines champion ease of maintenance and reduced overhaul time in conjunction with multi-fuel adaptability. Component commonality within the Evolve range offers particular benefits for customers operating multiple in-line, or both in-line and vee-type engines, simplifying technical management and stock extent.

Resilient ABC spans distinct markets, notably the marine industry, locomotive builders and power generation, and



ABC'S 6EL23 UNVEILED. SOURCE: ABC

product development accords with the strategy of ensuring suitability to the different fields and income streams.

Exports account for about 85% of the Ghent factory's output. Part of the family-owned Ogepar Group, whose various engineering subsidiaries include German turbocharger manufacturer Kompressorenbau Bannewitz (KBB), ABC's approach replicates its parent's long-term thinking and philosophy of continually ploughing profits back into the undertaking, reflected in sustained allocations to R&D.

This has led to a raft of new developments in recent years, not least the Evolve generation, but also last year's DZD methanol dual-fuel engine series, plus extensive work on hydrogen-capable internal combustion engines, including the nascent family emerging from the BeHydro joint venture with CMB. ■

TECHNICAL PARTICULARS ABC ENGINE 6EL23	
Bore	230mm
Stroke	310mm
Cylinders	6 in-line
Nominal power range, single-stage turbo	1,230-1,980kW
Corresp. speed range	750-1,200rpm
Nominal power range, 2-stage turbo	1,800-2,160kW
Corresp. speed range	1,000-1,200rpm
Idling speed	400rpm
Length	3,780mm
Height	2,584mm
Width	1,587mm





CFD & HYDRODYNAMICS

PAIRING OF MULTI-ORDER TOOLS FOR PRACTICAL AND EFFECTIVE SYSTEM SIMULATION

By **Donald MacPherson**, technical director, HydroComp, Inc

Naval architects require capabilities for effective and credible hydrodynamic and propulsion system simulation. As we look to high-order tools such as CFD for solutions, we frequently encounter settings where CFD a) is too costly in time, resources, or expense for the available schedule or the nature of the problem being investigated, or more significantly, b) is not able to fully simulate the “Vessel-Propulsor-Drive” system (for prediction of fuel consumption or emissions, for example).

It is precisely these scenarios where a system simulation executive (such as HydroComp NavCad) can be paired with CFD calculations and employ multi-order modelling to improve workflow efficiency, reduce expense, and provide answers in a whole-system perspective. Let’s first consider the possible computational solutions that we have in our hydrodynamics and propulsion system analysis toolbox: high-order models, simplified physics models, and statistical models.

You’ll note that we are calling these “models”. It is important to appreciate that none of these are reality, they are different models of a particular reality. Each has its place in ship design depending on the kind of problem that needs to be solved, the resource-to-value budget, and competency in the use of the model.

High-order CFD models determine pressures and velocities for a body moving through a fluid in a defined space. Bodies can be hulls, appendages, propellers, and other components of the system – and meaningful design metrics, such as drag, lift, thrust, torque, are found by integration of the various pressures. Special characteristics,

such as vorticity or cavitation (either its incidence or its fully formed volumes), can also be derived and observed. A multi-component analysis in the CFD space is limited to its “wetted” components – such as the self-propulsion analysis with hull, stern gear, and propeller.

Everything is a system problem first and a component problem second

Step back for a moment and consider “what is a shipowner buying?” You might say engineering services. Well sure, but at the end of the day, what is a shipowner buying?

Speed and thrust. They are buying speed and thrust. Speed is the difference between a ship and a buoy. It is what fulfills a business plan for a merchant shipping company. It lets a motor yacht to visit different locales. It lets a race team take the checkered flag. Thrust is the critical “product” delivered by tugs. Thrust pulls fishing nets, or the anchors for oil rigs. It allows a ship to make speed.

But there is more. Every business is run on the ratio of benefit-to-cost. High-order CFD analysis can indeed give us figures that reflect the benefits of speed and thrust and to a certain extent the cost of propulsion torque (with a self-propulsion analysis). However, unless all components of the “Vessel-Propulsor-Drive” system are evaluated, we are missing several critical pieces of the cost equation. Fuel consumption is perhaps the most obvious and significant operational cost, but there are ancillary costs also to be considered – the environmental cost of emissions or the social cost of radiated noise. Then we need to look at capital costs. Is the engine power – and its power curve across the anticipated rpm range – sufficient to handle

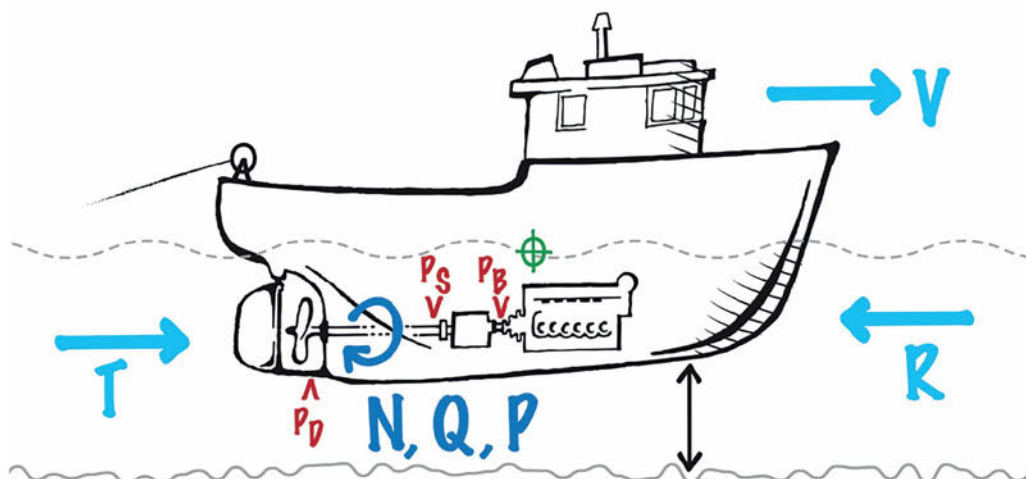


FIGURE 1.
APPLICATION OF
REDUCED-ORDER
TOOLS FOR SYSTEM
ANALYSIS



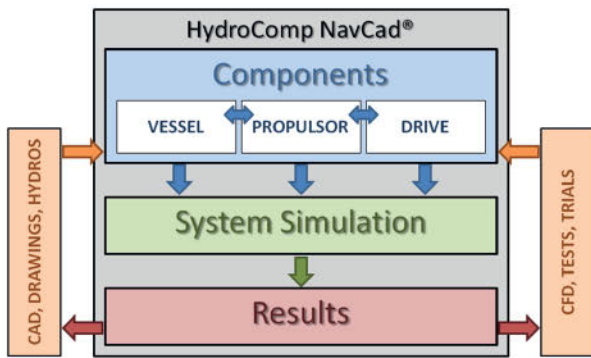


FIGURE 2. SYSTEM SIMULATION FRAMEWORK OF NAVCAD

the expected thrust margins that might be encountered? There is also the cost of getting a component wrong. Is the shaft rpm giving us the best propeller efficiency, or will performance be compromised because we made a poor early decision?

Figure 1 describes the principal components of the system, and the interconnected equilibrium shared by the Vessel, Propulsor, and Drive.

As noted, one of the challenges of CFD for ship design is that it cannot easily provide a simulation framework for the system. It is an indispensable contributor for analysis and design of the Vessel and Propulsor components of the system, and for their interaction, but the connection to the Drive and its corresponding “cost” metrics of fuel consumption, emissions, and noise are not easily modelled.

This is where a system-focused tool, such as HydroComp NavCad, can be coupled with CFD to provide an optimised workflow for complete system analysis. NavCad’s simplified physics and statistical models are the backbone of a reduced-order system simulation framework that can be enhanced with coupling to higher-order CFD computations when circumstances justify an increased fidelity.

NavCad provides several coupling strategies with CFD. Figure 2 describes the system simulation framework of NavCad, its library of reduced-order models for component analysis, and its potential connection to higher-order CFD – both as a receiver of CFD prediction results and as a source for information back to the CFD

computational space. Interaction with CFD can be loosely or tightly coupled, depending on the communication approach and the requirements of the calculations.

So how can we make the best use of our higher-order tools? A variety of strategies are available for naval architectural offices to significantly improve CFD outcomes and workflow effectiveness, including the use of “frugal CFD” and modified actuator disk modelling.

Frugal CFD

One popular feature of NavCad is its “Aligned Prediction” capability, whereby one of the available resistance prediction models can be “aligned” to a specific reference ship. Many designs are related to earlier work, so it can be valuable to leverage the knowledge invested in prior model testing and/or sea trials to help achieve the highest fidelity prediction for the new design. The Aligned Prediction feature deconstructs existing performance as defined by these tests or trials, then rebuilds, scales, and correlates the resistance prediction of the design under investigation to the reference ship. In other words, the alignment learns how a method deals with a known reference, and correlates the new prediction based on what it has learned.

This process can also be used with CFD results instead of empirical test/trial data, so that the performance of the reference ship is the CFD prediction of the subject design itself. In this case, we can obtain high fidelity outcomes with a limited number of reference ship CFD runs. For example, we may be investigating 10 or more speeds in a NavCad design session, but we generally need far fewer speeds to be run in CFD to obtain suitable figures for alignment. There is no need to spend the resources on additional intermediate runs – NavCad can handle that.

A distribution of four speeds is generally sufficient, and they are best placed at Froude numbers reflecting the nature of the ship and the operating objectives. Of course, including a run at the project’s design speed makes sense. Then add FNs that match hydrodynamically significant speeds in the wave-making curve, such as the typical 0.30 FN hump for displacement hulls or the 0.45-0.50 FN peak of a semi-displacement fast craft. NavCad’s higher-order ADVN resistance prediction method – a feature of the Premium Edition – can provide additional guidance for the FN positions of wave-making humps and hollows.

A similar strategy can be applied to propeller alignment using NavCad’s “Aligned Series” option. This utilises the KTKQ curve of a “reference propeller” for alignment, and open-water CFD calculations at a few J values will provide sufficient distribution.

Modified actuator disk modelling

Full rotating-frame 3D CFD computation of propeller performance can be very costly in time and resources, so it is quite common to replace the propeller with a “proxy” virtual propeller – the actuator disk (AD). In many CFD tools, the AD is seeded with a KTKQ curve that is used to estimate body force sources for the disk.

The AD is a simplified physics model of the propeller. For the benefits of greatly reduced computation time and



DONALD
MACPHERSON



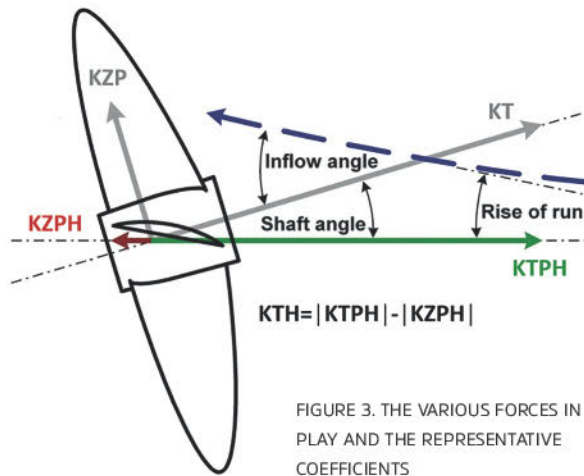


FIGURE 3. THE VARIOUS FORCES IN PLAY AND THE REPRESENTATIVE COEFFICIENTS

oblique (non-axial) flow will introduce forces perpendicular to the propeller shaft, as well as an effective reduction in the axial thrust. These missing forces and corrections can be very influential for the determination of high-speed planing craft performance. In other words, when using an AD for the propeller component, the omission of the lift-generating normal force and axial thrust correction can result in a system analysis that is fictitious.

A recent addition to NavCad is its calculation of normal force for a propeller in oblique flow, and export of this data in a special propeller KTKQ data file. This can be used within the programming or scripting feature of CFD codes to provide the missing lift force vector. Figure 3 illustrates the various forces in play and the representative coefficients. This data can be prepared in advance with a specified propeller or delivered in real-time for case-by-case propeller matching via dynamic server mode coupling with NavCad Premium.

development complexity, we accept that there are going to be differences between the AD prediction and a higher-order 3D CFD prediction of the propeller component. For many purposes, the simplifications are acceptable. However, there are cases where the traditional AD omits important force vectors.

The actuator disk body forces extracted from the KTKQ data are “in-plane”, where thrust forces are axial in direction and torque moments are tangential (or circumferential in the plane of the AD). Any propeller in

Finding efficiency

Whether we are referring to propulsion system efficiency or design workflow efficiency, the pairing of multi-order tools can provide substantial benefits to the engineers and naval architects responsible for delivering a successful ship to an owner. Get the system simulation functioning first. Then use the tremendous benefit available to you in your high-order CFD assets as effectively as possible to improve the components of the system. ■



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In December 2024, the International Maritime Organization (IMO) will host 109th session of the Maritime Safety Committee (MSC) where the Maritime Autonomous Surface Ships (MASS) group will meet again. The Royal Institution of Naval Architects and the Danish Society of Engineers (IDA Maritim) are organising the 3rd Autonomous ship conference on 20-21 November 2024 ahead of the IMO meeting.



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LETTERS TO THE EDITOR

UNMANNED, UNSUPPORTED AND NEGLECTED: AN URGENT APPEAL TO SAVE TALL SHIP SV *TENACIOUS*



TENACIOUS AND FRIENDS AT THE HAMLET OF GRYTVIKKENA ON SOUTH GEORGIA IN THE SOUTH ATLANTIC. SOURCE: ANDY PAK POY

Dear Sir,

After a five-year project costing £14.3 million to design and construct the tall ship *SV Tenacious*, a unique three-masted barque and the largest wooden ship to be built in Britain for more than a century, she sailed on her maiden voyage on 1 September 2000.

The construction project involved resurrecting the derelict Vosper Hovermarine site in Southampton to create a shipyard specifically to build this ground-breaking wooden ship to further the aim of the Jubilee Sailing Trust (JST). This is to integrate disabled and non-disabled men and women working together to crew square rigged sailing ships. The construction project took over four years, involving more than 1,250 workers, volunteers and employees, skilled and unskilled, disabled and non-disabled and consumed over 409,000-man-hours.

JST's mission brought to every continent

Since that maiden voyage *Tenacious* has:

- completed more than 600 voyages;
- sailed over 350,000 nautical miles;
- visited all five continents, including Antarctica where the crew, wheelchair users among them, disembarked onto the ice;
- completed many trans-Atlantic voyages and one circumnavigation, spending two years in the Pacific;
- formally signed on over 25,000 voyage crew (of whom over 10,000 were disabled, including more

than 3,500 wheelchair users);

- and become the first square rigger to provide sail training for Royal Navy personnel since the Inshore Training Squadron was closed down by Admiral Jacky Fisher in 1903.

Sadly, largely because reasonable expectations of a major boost in funding were confounded by the executors' extraordinary decision to award the JST less than one-third of one percent of the £78 million inheritance that named it as one of the three charities wholly to benefit, the ship's owner has had to go into liquidation and appoint a receiver. *Tenacious* is now sitting unmanned, unsupported and neglected in Sharpness Dock.

Ideally the ship could be acquired for sail training activities. She is configured and equipped for manning by a permanent crew of nine – who could sail the ship themselves, at a pinch – with a voyage crew of 40, normally comprising 20 disabled and 20 non-disabled men and women.

Old-school wind power for cargo shipping?

Alternatively, *Tenacious* could easily be converted to load high value cargoes, such as those regularly carried across the Atlantic by the square rigger *Trios Hombres*. Her operating costs for the JST were approximately £150,000 per month but these would be slashed were she to be operated as a cargo ship with a smaller crew that might also comprise fee-paying members of the public keen to experience sail training before the mast. There is increasing justification and interest to develop such wind-powered cargo vessels.

It would be a tragedy were the receiver to scrap this fine, revered vessel, much loved by the thousands who helped build her and who have sailed on her since. Surely there are some among *The Naval Architect's* worldwide readership that might be able to find a way to put her back into useful service. There is a voluntary group of like-minded enthusiasts that is trying to find her just such a role and I would encourage readers to visit www.tenacious.org.uk for more information. ■

Howard MacKenzie-Wilson

EX-SHIPBUILDING DIRECTOR OF THE JUBILEE SAILING TRUST



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Life in the shipping industry today can be pressured and stressful. The Mission to Seafarers is there to give help and support to seafarers around the world.

Our centres offer an opportunity to relax and to use the telephone and email facilities to keep in touch with family and friends. We also assist with more serious problems such as being stranded far from home when a shipowner runs into financial difficulties, or being left unpaid for months.

We depend entirely on donations to continue our caring work for the people like you who play such a vital role in all our lives.

To donate online or for more information visit:

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Support Transition to Zero-Emission

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

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