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THE NAVAL ARCHITECT

MARCH 2025

NUCLEAR OPTION

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VOLTRA

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ROBERT ALLAN

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MARCH 2025

THE NAVAL ARCHITECT

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A WORD FROM THE PRESIDENT

I am pleased to welcome readers to our refreshed *The Naval Architect*. The decision to combine our publications resulted from engagement with industry experts and members. We welcome your feedback on what you'd like us to keep, as well as any ideas for new content or areas for improvement – this is your magazine.

For RINA to continue serving our members and the wider maritime community, we need to adapt, collaborate and innovate. If you've attended events in the past year, you may have noticed some initial changes; this new publication is another example. There is much more planned for 2025.

There have been changes in the Secretariat over the last 12 months, and we are currently recruiting our new CEO. I would like to thank the Board of Trustees, Tom Boardley, and representatives from the Australia Division and Council who have been involved in the review process. We hope to announce the outcome in the coming months.

This year, I have had the pleasure of representing the Institution at the UK Chamber of Shipping Dinner and am looking forward to the Worshipful Company of Shipwrights' Livery Dinner and the IMarEST Annual Dinner this month. Among many valuable local events, we held a second successful CII conference in January and recently announced our speaker for our annual dinner. Commander Mike Forrester MBE will speak about HMS *Oardacious* and the 'World's toughest row' from his personal experience and that of this year's successful all-female crew. I hope you will join me on 22 May in London for what I know will be an excellent evening. ■

Professor Catriona Savage, RINA President & Chair of Trustees

NUCLEAR POWER: FROM BOGEYMAN TO LIFELINE?

The maritime sector's mindset on nuclear energy as a fuel is shifting

Over the course of just five years, nuclear fuel has flipped from an alt-fuel outsider bet to a potential favourite in the race to decarbonise the global shipping fleet.

This mindshift is largely part to nuclear fuel's impressive energy density. A single uranium fuel pellet – roughly the size of a fingertip and weighing 6-10g, for example – produces the energy equivalent to 564litres of oil, or 17,000m³ of natural gas, according to the Nuclear Energy Institute. For oceangoing commercial vessels including container ships or bulk carriers, which burn through thousands of litres of fuel daily, this means far less frequent refuelling and massive cost savings.

Hydrogen and ammonia require energy-intensive production processes, often still tied to fossil fuels, and the supply infrastructure for both fuels isn't all there yet. Battery power has certainly worked for smaller vessels on short routes, yet these vessels lack the capacity for extended range without a reliable offshore charging network.

Shipboard nuclear reactors, meanwhile, are proven technology, having been operated and demonstrated at sea for at least 70 years; we simply can't point to a similar track record for ammonia. It's maybe no surprise, then, that nuclear power advocates have become more optimistic, with Dr Jonathan Stephens of BWX Technologies sharing his vision for a phased small modular reactor roll-out across the commercial/civil shipping sector in the next five to six years (see pages 62-65).

This prediction may have been considered far-fetched just five years ago, but is this the case now? I remember attending an Interferry conference in London in late 2019, where Vince Jenkins, then of Lloyd's Register, argued the case for SMR adoption aboard ferries.

Back then, Jenkins' presentation raised eyebrows. Today, though, nuclear power is on very much on the IMO and MCA agendas; quite the turnaround in such a relatively short space of time. This doesn't solely apply to maritime; spiking prices and supply shocks, as witnessed in Europe since 2022, have made nuclear energy look less like a 'bogeyman' and more like a lifeline. Smaller and safer reactor technology is helping to obviate old fears. ■

Martin Conway, Managing Editor

RIBS

FUN-SIZED RIB FROM HIGHFIELD BOATS

UK builder Highfield Boats has launched its ADV 7 recreational RIB, a boat developed in collaboration with Slovenian design/engineering houses VOM Creations and Alpha Studio, and featuring naval architectural input from Andrej Justin, chief designer at Justin Yacht Design.

The boat was debuted at this year's boot Düsselfdorf expo, hosted in January. Measuring 6.98m x 2.68m overall (or with an internal length and beam of 5.19m x 2m), the ADV 7 is arranged to seat up to eight people, "making it perfect for both adventurous outings and family leisure time", Highfield Boats states. The boat has been built with a deep-V hullform with a very fine entry and 22° of transom deadrise, as well as stern platforms designed for ease of boarding and reboarding. The ADV 7 is also fitted with a heavy-duty T-top to shield guests from the sun. The overall boat weight comes to 1.3tonnes, excluding motors.

The arrangement includes two sundecks, a galley, a 270litre-capacity fuel tank and an option for a toilet. The RIB's 320mm-diameter tube is intended to act as a bumper during docking and as a means of deflecting water in rough seas, and the boat has a maximum output of 250hp (186kW). ■

Highfield Boats' ADV 7 features a deep-V hull with 22° of transom deadrise

TUGS

SVITZER ORDERS BATTERY-FUELLED ASD TUG

A rendering of Svitzer's forthcoming battery-powered tug, bound for operations in the Øresund Strait (image: Svitzer)

Turkey's Sanmar Shipyards aims to deliver a new battery-powered azimuth stern drive (ASD) tug to towage and marine services provider Svitzer in the second half of 2025. The newbuild, which will operate in the Øresund Strait between Denmark and Sweden, is being built to the specs of Robert Allan Ltd's (RAL's) ElectRA 2500-SX class, featuring an overall length of 25.4m, a draught of 5.6m and a bollard pull capacity of 70tonnes.

The tug will be equipped with a battery pack rated 1,818kWh, permitting zero-emission operations, plus a pair of generators for emergency back-up, extended endurance and firefighting operations. Mathias Jonasson, MD for Scandinavia at Svitzer, comments: "In recent years, we have experienced an increasing demand for green towage services in Scandinavia, including the Øresund Strait. At the same time, we have committed to doing our part to significantly reduce CO_2 emissions in the industry by 2030. Getting a new battery-powered tug solves both challenges."

Sanmar also recently delivered two new tugs to the Turkish Ministry of Transport and Infrastructure's Directorate General of Coastal Safety (DGCS), for tow-assist and emergency response work within national waters. The sisters, which went by the monikers *BOĞAÇAY LXIX* and *BOĞAÇAY LXX* while under construction at Sanmar's Altinova facility, have been modelled on RAL's RAmparts 2400SX-MKII design. Each tug measures 24.4m in length and a relatively wide 12m in breadth, the beam having been specified for enhanced stability in harsh weather or during challenging rescue operations.

Each sister features a moulded depth of 4.5m and a navigational draught of 5.45m, and draws on two CAT 3516E main engines, rated 2,200kW at 1,600rpm apiece, for a bollard pull of at least 77tonnes ahead. ■

OFFSHORE SUPPORT

W2W VESSEL ORDER FOR ST ENGINEERING

Singapore-based shipyard ST Engineering reports that it has been contracted to design and build a walk-to-work (W2W) offshore vessel for an unspecified oil and gas company. The W2W vessel will feature a length of 97m, a breadth of 19.6m and a draught of 6.1m, and will be able to accommodate up to 106 persons.

Scheduled for completion in the first half of 2027, the vessel will be equipped with a motion-compensated gangway for personnel transfers, plus a 10tonne-capacity crane with active heave compensation, for load handling in harsh seas. ■

NAVAL SUPPORT SHIPS

PORTUGUESE MULTIPURPOSE SUPPORT SHIP DUE IN 2026

Damen Shipyards Group has commenced construction work, at its Damen Shipyards Galati facility in Romania, on a multipurpose support ship for the Portuguese Navy. The contract for the ship was signed by the two parties in November 2023, and the project has been funded by the EU's Recovery and Resilience Facility, part of NextGenerationEU: the economic recovery package to support EU member states affected by the Covid-19 pandemic.

The multipurpose support ship is part of Damen's Support Ship range, spanning vessels of 7,000-9,000tonnes. The newbuild, to be christened NRP *Dom João II*, has a high level of flexibility and will be used for scientific and technological research, search and rescue, emergency relief and maritime safety and environmental and meteorological monitoring.

In acknowledgement of the growing importance of drones and autonomous technology, the multipurpose support ship will be capable of transporting and launching UUVS and USVs – as well as UAVs, for which it has a 94m x 11m flight deck.

The 107m vessel will have 650m² of deck space suitable for the transportation of up to 12 TEU containers. These will be used to house mission-specific modular systems such as mobile hospitals, hyperbaric chambers and ROV equipment, as required. To facilitate oceanic exploration and research, NRP *Dom João II* will also have state-of-the-art laboratory facilities and accommodation for scientific personnel. NRP *Dom João II* is scheduled for delivery in 2026.

YACHTS

57 FLY ON THE WATER

Luxury boatbuilder Cruisers Yachts has commercially launched its new 57 Fly flagship, a 17.4m x 5m model certified for up to 16 persons on board. Originally unveiled in October 2024, and designed in collaboration with Luiz De Basto of Miami-based DeBasto Designs, the 57 Fly's key features include three staterooms, a full-beam master suite and a sun lounge.

A spokesperson for Cruisers Yachts tells *The Naval Architect*: "The hull was designed in conjunction with Volvo Penta and Donald Blount and Associates. We worked diligently with them to maximise the efficiency of the hull bottom design with the Volvo Penta IPS 950 engine platform." The 57 Fly has also been equipped with Seafarer 9 stabilisers.

Devon Palmer, senior industrial engineer at Cruisers Yachts, comments: "With the 57 Fly, we aimed to explore new exterior experiences. Our goal was to enhance the connection customers feel with the water. Therefore, we concentrated on three main areas: exceptional water experiences, a top-tier flybridge and achieving all of this without compromising liveability." The flybridge offers seating for up to 12 guests on an aft U-shaped settee, and for three additional guests on forward U-shaped seating, as well as storage space.

The 57 Fly has been designed to draw 1.3m, and is powered by a joystick-controlled Volvo Penta D11 950 IPS engine, rated 540kW. This enables a cruising speed of 26knots, increasing to 30knots max. The vessel has an overall weight capacity of just 26.3tonnes, with onboard tank capacities arranged for 2,312litres of fuel oil, 568litres of fresh water and 360litres of waste water. The yacht also incorporates an energy-efficient lighting system.

The 57 Fly has a top speed of 30knots

ASIA-PACIFIC

JAPAN PUSHES ECO-FRIENDLY BUILD STRATEGY

The Japanese Ministry of the Environment and Ministry of Land Infrastructure has appointed domestic shipbuilder Japan Marine United (JMU) to assist its efforts in the 'Promotion of Zero-Emission Ship Construction' project – a drive to put in place a national infrastructure for increased production of zero- and low-emission ships, with an emphasis on identifying and avoiding bottlenecks.

According to reports, JMU aims to up its number of alt-fuel-powered newbuilds from 15% at present to 70% by 2030, and then to 85% by 2040, before producing purely green ships by 2050. In 2021, the Japanese Shipowners' Association forecast that some US$280 billion of investment would be required for the country's shipbuilding sector to meet IMO's 2050 net-zero target.

HEAVY LIFT

HEAVY-LIFT MUSCLE FOR JAPANESE WIND FARMS

Ulstein Design & Solutions has been contracted to provide the design for a heavy-lift ship for Japanese contractor Penta-Ocean Construction (POC). The vessel will specialise in offshore wind foundation installation work within the country's waters, and will comprise a customised version of Ulstein's HX118 design, which features a length of 215m, a 56m beam and a maximum draught of between 7.5-10m.

The customised design includes a tub-mounted, revolving, 5,000tonne-capacity Huisman main crane, permitting heavy-duty monopile installations. The crane comes with a main hoist and a universal quick connector, and has been designed with a compact tail swing, to optimise available deck space. Huisman will also supply the ship's monopile-handling system, which features a motion-compensated pile gripper.

Ulstein has also incorporated its U-STERN concept into the vessel's design. The U-STERN enables longitudinal storage of large components, such as monopiles, meaning these components can be stored along the length of the ship rather than across it, thereby maximising space and preventing overhanging.

When it's time to install these components, the U-STERN enables them to be upended (lifted vertically) directly along the ship's centreline. The U-STERN design also allows the ship to face directly into the waves during the installation process, reducing the impact of wave motion on the ship, to make the installation process smoother and safer – as well as to reduce fuel consumption by minimising the ship's need to compensate for wave-induced movements.

Ulstein comments: "Combining the U-STERN with transverse and longitudinal skidding systems, offshore lifts for monopiles are eliminated as the main crane is only used to support the upending and lowering of the foundation."

Both Ulstein and POC have been tweaking the ship's basic design since summer 2024, including a round of extensive model tests. The heavy-lifter will be built by Singapore's Seatrium Group, with completion scheduled for May 2028, and operations set to commence in the autumn of that year, Ulstein tells *The Naval Architect*. ■

The customised version of Ulstein's HX118 heavy-lifter includes a tub-mounted, 5,000tonne-capacity Huisman main crane

SHIP REPAIR

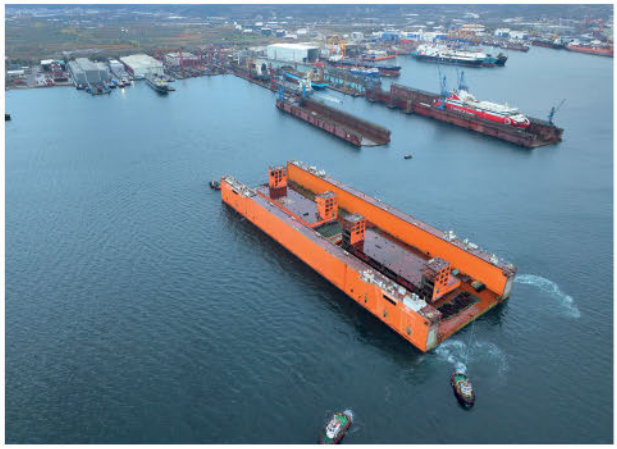
NEW FLOATING DOCK FOR BESIKTAS

One of Europe's busiest ship repair yards, Besiktas Shipyard in Yalova, Turkey, has taken delivery of an additional floating dock, boosting its annual capacity and enabling it to work on larger vessel types. The 85,000tonne-capacity dock, which measures 345m in length and has an inner width of 70m, was acquired from Singapore's Seatrium shipyard group, and arrived in Turkey towards the end of 2024, having made the lengthy journey via the Suez Canal.

The new floating dock is strengthened to accommodate very heavy ships and platforms, such as oil rigs, FPSOs and cruise ships, thereby allowing the yard to diversify its customer base. Once routine maintenance is completed, the dock will begin handling vessels in March 2025.

The Besiktas Shipyard now has two floating docks and a graving dock following the arrival of the new facility. ■

Besiktas Shipyard now has two floating docks and a graving dock at its disposal

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UNCREWED VESSELS

FUNDING BOOST FOR USV BUILDER SARONIC

Saronic says it has invested heavily in expanding its manufacturing capabilities for small USVs

Austin, Texas-based Saronic Technologies has raised US$600 million from a Series C round to advance its plan to build large numbers of uncrewed warships and "redefine maritime superiority for the US and its allies". The round values the company at US$4 billion, quadrupling Saronic's valuation.

Saronic plans to use the funds to build Port Alpha, which it describes as a "next-generation shipyard capable of delivering new classes of autonomous ships at the speed and scale needed to protect and defend the maritime domain". Saronic says Port Alpha "will enable the expansion of its surface vessel fleet into medium- and large-class autonomous ships for defence applications...[to] address gaps in US shipbuilding capacity".

"A core principle of Saronic is that we design our vessels for autonomy from the keel up," says Saronic CEO and co-founder Dino Mavrookas. "We will take the same approach with Port Alpha, designing a shipyard from the ground up to produce at a speed and scale not seen since WWII."

The company says: "Saronic has invested heavily in developing and expanding its manufacturing capabilities for small USVs over the past two years. Port Alpha will build on that foundation and deliver an advanced waterside facility designed from the ground up around a first-principles approach to shipbuilding. This approach will focus on eliminating inefficiencies, optimising workflows and creating a production system that maximises quality, scalability and speed. We will invest in US shipbuilding infrastructure and work with federal and state legislators to establish public-private partnerships." ■

RULES AND REGULATIONS

FIRST OPS COMPATIBILITY ASSESSMENT

Class society Lloyd's Register (LR) and vessel operator Capital Ship Management say that they have completed "the world's first" tanker onshore power supply (OPS) compatibility assessment. Consequently, Capital's forthcoming Suezmax oil tankers *Argeus*, *Aristoklis*, *Archelaos*, *Aristodimos*, *Ayrton* and *Amor* – all slated for delivery between 2025-2027 – will be fully compatible with the OPS infrastructure at the Port of Long Beach, California, ensuring a seamless connection to shore power at berth.

The assessment is reportedly the first completion of the tanker compatibility assessment after official publication of the IEC 80005-1 standard in 2012. LR says that the project resolved "the technical uncertainties relating to OPS compatibility, a challenge that had previously hindered shipowners and shipyards from specifying and installing the correct equipment". Clarification was necessary, LR adds, given the stringent emissions control requirements laid down by the California Air Resources Board (CARB) – and especially since 1 Jan 2025, when a new at-berth emissions regulation came into force. ■

NEW ORDERS

POLISH MOD ORDERS SUB RESCUE SHIP

The Polish Ministry of Defence has placed a contract for the construction of a submarine rescue vessel to support the new subs it is building under the Orka programme. The new vessel, *Ratownik* (*Rescuer*), will replace the rescue vessels ORP *Piast* and ORP *Lech*, which have been in service for 50 years.

The vessels will be built by a consortium comprising Polska Grupa Zbrojeniowa, PGZ Naval Shipyard and the Research and Development Centre of Maritime Technology. The new vessel will be larger than its predecessors, and fitted with the latest submarine rescue technology.

In a statement, the Ministry of Defence said the new unit "will not only provide greater submarine rescue capability... but will also allow for more effective protection of submarine infrastructure", an issue that has become particularly important considering recent incidents in the Baltic, such as the damage incurred by the Estlink 2 cable. The new vessel will also support NATO activity in the Baltic and undertake search and rescue and firefighting operations.

Ratownik will measure 96m x 19m and displace 6,500 tonnes max. With a range of 6,000nm and a speed of 16knots, it will host a crew of 100 plus nine additional specialist staff. It is due to be launched in 2027 and delivered to the Polish Navy in 2029. ■

The 96m *Ratownik* will be fitted with the latest submarine rescue technology

IT AND COMMUNICATIONS

PSC COMPLIANCE VIA APP

Kaiko Systems, which specialises in AI-powered data collection and analysis, has unveiled a mobile app intended to simplify port state control (PSC) preparations. The app will enable crew to access the RISK4SEA database of prioritised PSC risks ahead of port calls and create customised checklists based on the vessel's own port risk profile, based on the vessel type, its detention history, its owner's track record, and so on.

Fabian Fussek, co-founder and CEO of Kaiko Systems, says: "For the first time, crew and shore teams will be able to easily pre-plan in a collaborative fashion before the ship enters the port, to ensure the correct checks are made and to avoid lengthy inspections by port state control officers [PSCOs]." Fussek claims that the customised checklists will achieve "more than 90% accuracy" in predicting potential reasons for detention, while also "cutting out lengthy back-and-forth sending of Excel spreadsheets via email."

The process should work as follows: first, the vessel updates its next port of call via AIS, which automatically triggers RISK4SEA's system to capture the data, assess port state control inspection (PSCI) probability/severity and generate a tailored PSC checklist. Kaiko Systems then receives this checklist and instantly notifies the vessel via email. Crew members can open the mobile app to complete the checklist and submit their findings. Finally, the shore-based team reviews the incoming results on a centralised dashboard, proactively addressing any issues well before the vessel reaches port. The checklist presents high-risk items first, so that crew can focus on the most critical inspection areas right away. ■

Crew members can use the mobile app to complete customised checklists prior to port calls

GEARS, PROPELLERS AND THRUSTERS

SCHOTTEL SCOOPS CHINA PROPULSION ORDER

Schottel has been contracted to supply full propulsion packages for three new LNG bunkering vessels, currently under build at Nantong CIMC Sinopacific Offshore & Engineering, China.

Each package will include an SCP 119 4-X-type controllable-pitch propeller, featuring a 6m diameter and an input power of 5,800kW; a 360°-steerable SRP 380 R retractable rudder propeller, rated 1,300kW with a propeller diameter of 2.2m; and an STT 2 FP transverse thruster, rated 750kW.

The retractable rudder propeller has an 8°-tilted propeller shaft, which, Schottel says, "reduces the interaction between the propulsion unit and the hull, resulting in increased propulsion efficiency." The company adds: "In cases where not all thrusters are needed – for example, when changing location – the [SRP 380 R] can be retracted into the hull, reducing drag when travelling and vessel draught while berthing."

Each of the bunkering vessels will measure 159.9m x 25m and feature a loading capacity of 20,000m³, and will be capable of a free sailing speed of up to 15.5knots. Two of the vessels will be delivered to UK LNG bunkering provider Avenir LNG, and one to Singapore's Vitol International Shipping, between 2026 and 2027. ■

ENGINES

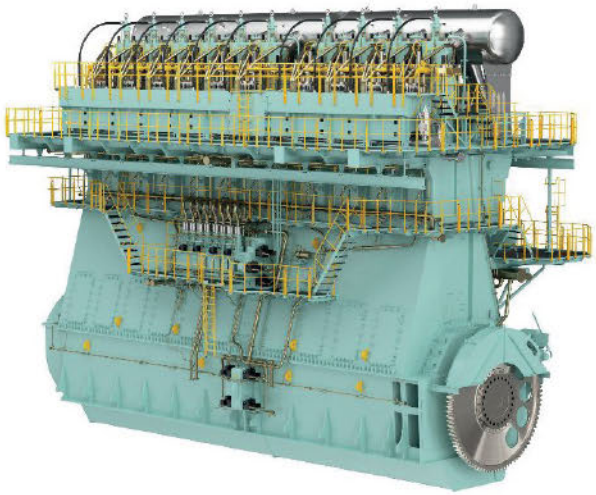
WINGD COMPLETES METHANOL ENGINE TRIALS

Swiss marine power specialist WinGD reports that it has concluded trials of the first commercial version of its 10X92DF-M engine – part of its new methanol-compatible X-DF-M engine series.

The 10X92DF-M was run at full load, on more than 95% methanol fuel, on a testbed at CSSC-MES Diesel (CMD) in Shanghai in mid-December.

Sebastian Hensel, WinGD VP for R&D, comments: "After validating the methanol technology on our 920mm-bore single-cylinder test engine, the 10X92DF-M is running smoothly at full load and according to our expectations."

The engine reportedly ran with less than 5% pilot fuel and minimal pilot fuel injector opening times. WinGD adds: "The trip function to diesel fuel and switching to methanol, at 45% and 75% engine load, were also tested."



The 10X92DF-M was run at full load, on more than 95% methanol fuel, on a testbed

The new 10-cylinder engine will be supplied to the fourth of a series of 16,000teu container vessels currently being built by China's COSCO Shipping Heavy Industry (Yangzhou) for affiliate operator COSCO Shipping Lines. These four vessels were originally ordered in 2021 as conventionally fuelled newbuilds, though COSCO has since declared an interest in incorporating methanol power into its fleet's operations. For example, in 2023, the company partnered with State Power Investment Corp and Shanghai International Port Group to invest in a facility to produce bio-methanol as a marine fuel. According to reports, this plant, located in Jilin province, is expected to produce 200,000tonnes of methanol annually from Q4 2026.

WinGD adds that the current single-fuel 10X92-B engine units installed on the earlier three container ships in the series will be converted to run on methanol after the fourth ship engine installation has been commissioned. ■

ELECTRIC PROPULSION

ELECTRIC POWER SURGE FOR AUS-PAC

Marine charger firm Seavolt and electric drive manufacturer RAD Propulsion are teaming up to provide "complete electric propulsion solutions" to boatbuilders, marinas and ports across Australia and the Pacific region, in a push for sustainable sailings within these territories.

Seavolt offers marinised chargers ranging from 7kW to 360kW, which are supported by on-site, micro-grid solar power systems, enabling vessels to top up on pure renewable electricity. Chris Cudlipp, Seavolt CEO, says: "We're getting constant enquiries from customers who want to electrify their fleets of outboard-powered boats. Seavolt can provide a complete charging solution, but no-one in the market was offering plug-and-play electric power replacement that supported ultra-fast charging. RAD Propulsion delivers that."

The RAD 40kW outboard is powered by long-range batteries and supported by multi-function displays, a drive-by-wire control system and connectivity via GPS, Wi-Fi, GSM and NMEA. Cudlipp adds: "With RAD Propulsion, Seavolt can now offer our customers a one-stop, hassle-free engine, battery and charging solution to repower their existing fleet or propel new hulls, free of air, noise and water pollution." ■

Seavolt and RAD Propulsion are offering a one-stop service for electric boat propulsion

WATER MONITORING

DETECTION KIT FOR HOT TUB HAZARDS

System monitoring company CM Technologies (CMT) has launched a new test kit for Legionnaire's disease, which, CMT warns, can easily breed in onboard hot tubs, spas and pools.

CMT's new test kit can detect Legionella bacteria within 25 minutes

"Hot tubs are a real problem," comments CMT managing director David Fuhlbruegge. "Most yachts have them these days, with operating water temperatures of between 37°-40°C, which is the ideal environment for both bathers and Legionella bacteria." While traditional water testing typically involves sending samples to a shore-based lab – a process that can take weeks – CMT claims that its new kit can detect Legionella bacteria "within 25 minutes", permitting fast and effective prevention. The test kit is designed for use with both hot- and cold-water systems.

"Water quality can change rapidly, especially on superyachts that are constantly moving between different locations and environments," Fuhlbruegge says. "Owners need the ability to monitor in real time and not just once or twice a year."

Such precautions could prevent not only outbreaks of illness but cancelled charters and potential lawsuits, adds Uwe Kreuger, CMT joint managing director. "Superyacht crews should be checking bacteria levels, disinfectant concentrations and heavy metals on a monthly if not weekly basis," Krueger says. "This allows crews to spot trends and take corrective action before problems spiral out of control." Water storage tank temperatures should also be monitored, Fuhlbruegge adds, to ensure that the water inside remains below 20°C, though many tanks exceed this temperature "due to the yacht's operational profile". ■

RESEARCH AND SURVEY

HOVERING AUV UNDER DEVELOPMENT

Tiburon Subsea has launched a programme to develop its own commercial undersea hovering AUV (HAUV), which will be used primarily to collect subsea data. The HAUV type will incorporate various systems and instruments supplied by Offshore Floor Geophysics (OFG), including a self-compensating magnetometer plus systems for non-contact cathodic protection inspection, depth-of-burial assessments and UXO surveys.

The HAUV will also feature Tiburon's patented, 2024-launched vectored thrust control system, JETTE, which utilises dual fore and aft thrusters, working independently and in tandem, for enhanced manoeuvrability (including hovering), speed and payload-carrying capacity compared to other marine drones, Tiburon claims.

The company adds that the HAUV would be best suited to missions such as oceanographic research, biodiversity management, cable inspection, hydrographic surveys, subsea security and methane leak detection. Its proposed dimensions include a a length of 1.85m and a 203mm diameter, and, weighing 54kg, it will be powered by two 1.5kWh lithium-ion batteries.

Tiburon Subsea was founded by ocean explorer Tim Taylor and ocean scientist Dr Sylvia Earle. Commenting on the arrangement between Tiburon Subsea and OFG, Taylor says: "Our respective companies share a goal and vision of creating new subsea survey and inspection capabilities for our clients. We believe that advancing dynamic underwater technologies will propel us into a new era in marine robotics." ■

The forthcoming HUAV will be powered by two 1.5kWh lithium-ion batteries

SENSORS AND INSTRUMENTS

KEEPING YOUR DISTANCE

Deep Trekker has launched a new ROV control accessory dubbed the Distance Lock, which has been designed to help operators to maintain a consistent distance between the ROV and its target. In this way, the item is intended to guarantee more accurate underwater inspections, including ship hull inspections and sea wall surveys, as well as tasks that require consistent distance over extended periods, Deep Trekker suggests.

The Distance Lock functions as a forward-facing proximity sensor. Mounted to the front of the ROV, it detects flat surfaces up to approximately 45° off-axis, then calculates the distance to these surfaces. "This provides operators with a reliable method for ensuring a fixed distance from the inspected target, enabling precise movement during long inspections," Deep Trekker says. The tool can maintain a fixed distance of between 0.5-10m and supports underwater inspections to a depth of 300m.

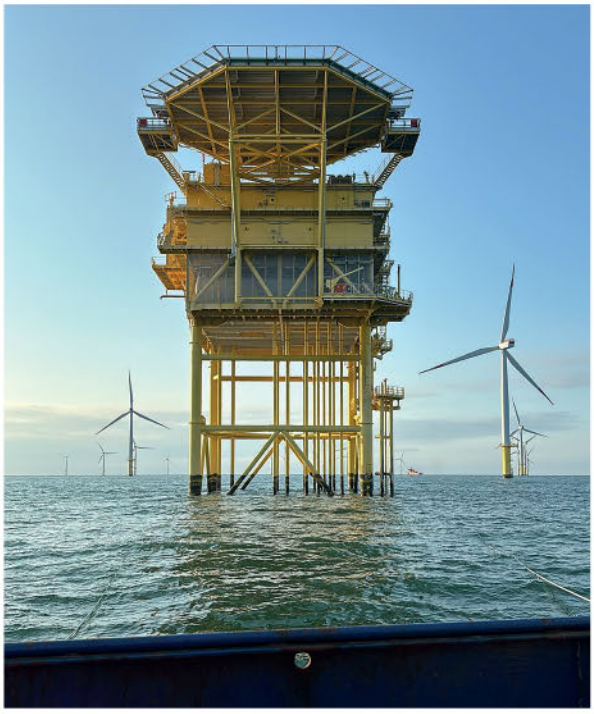
The data is displayed in real time on the user interface, enabling the operator to track any changes and make adjustments as necessary. Another claimed benefit of the Distance Lock is that it frees up the operator to concentrate on other tasks, such as monitoring the ROV's performance or capturing high-quality imagery. Deep Trekker adds: "The sensor provides operators with more stability, reducing the need for constant manual adjustments during lengthy operations." The Distance Lock is also designed to seamlessly integrate into the existing Deep Trekker Revolution and Pivot ROV platforms. ■

The Distance Lock can maintain a fixed distance of between 0.5-10m with targets

SUBSEA INSPECTIONS

ROV BOOSTS BUTENDIEK INSPECTIONS

Engineering services provider Acteon reports that an ROV helped the firm to complete the first year of a three-year plant inspection contract at the 288MW Butendiek offshore wind farm in the German North Sea. The contract was awarded to Acteon by Siemens Gamesa Renewable Energy (SGRE).



Acteon used a Seaeye Tiger ROV to conduct inspections at the Butendiek offshore wind farm

Acteon says that, during this first year, it used one Seaeye Tiger ROV to undertake subsea foundation inspections and to conduct "a multibeam echosounder seabed survey of the array cables and foundation scour", as well as inspections of the turbine's impressed current cathodic protection (ICCP) systems. The inspection results were uploaded to the iSite Subsea portal, maintained by Acteon subsidiary UTEC. Consequently, the project team could access and analyse these results as they came in.

The ROV was launched from *Arctic Hunter*, a 40.5m survey vessel provided by OS Energy. Acteon says: "A similar vessel will be available in 2025 and 2026 to perform survey and ROV inspection services for this site and others". The company tells *The Naval Architect* that the inspection scope is "equipment-agnostic" and that any inspection-class ROV would be suitable. ■

INSPECTION, REPAIR AND MAINTENANCE

CASI AIMS FOR STREAMLINED OPS

A UK joint project bringing together maritime autonomous systems developer Robosys Automation, USV manufacturer ACUA Ocean and Offshore Renewable Energy Catapult (OREC) will use Innovate UK funding to explore how ROVs and USVs can contribute to, and possibly streamline, operations and maintenance (O&M) tasks and inspections of offshore assets.

The Collaborative Automations for Subsea Intervention (CASI) project will see team leader Robosys deliver two work packages. The first is described as "multiple objective autonomous adaptive path optimisation", with an emphasis on weather-routing and optimisation of fuel consumption, including traditional marine fuels and hydrogen.

The second package will focus on the development of a software architecture to enable collaborative autonomy between ROVs and USVs, incorporating software algorithms for station-keeping and obstacle avoidance in unchartered offshore wind farms. The project will also see ACUA Ocean design a new ROV and accompanying launch and recovery system (LARS), tailored to ensure stability for the mothership in significant wave heights of up to 4m. The test and evaluation criteria for the LARS, which will include a life-cycle assessment, will be managed by OREC.

Robosys comments: "Maintenance, inspections and intervention cost approximately £18 million per year for a 1GW offshore wind farm, with £900 million@50GW anticipated by 2030 in UK. Current state-of-the-art subsea inspection requires ROVs deployed from larger heavy diesel-burning, crewed vessels, which are limited by safety, crewing, vessel availability and operational sea states.

"The project will help the maritime autonomy sector to further advance dual-use operations such as surveying, monitoring of critical offshore and underwater infrastructure, offshore energy and marine science, to increase productivity, profitability, safety and sustainability through these novel technologies." The partners expect to reveal the results of the project in spring 2025. ■

PERFORMANCE IS KEY

The Performance 90X aims to retain Performance Marine's high-end sports boat 'DNA' while adding cutting-edge tech and speeds up to 70knots

The deck of the Performance 90X comprises nearly 20 moulded parts

With more than 1,000 newbuilds and decades of high-speed action under its belt, sports boat brand Performance Marine is celebrating its 40th anniversary this year with the launch of the Performance 90X concept: a design intended to comprise a "perfect fusion of brute force and absolute control", the company says.

Getting to this stage has been quite the ride; the company and its various designs passed through several hands over the years before reaching its current German owners, Frauke and Stefan von Klebelsberg, who are now restructuring operations to future-proof Performance Marine's output.

The 90X is heavily influenced by the hull of the group's previous, 9m-long Performance 907 sports cruiser: a planing design, built in PVC. The revamped 90X was handled by German yacht design and engineering studio iYacht, which oversees offices in Hamburg and Kiel. Led by Udo A. Hafner, iYacht has completed more than 400 projects over the past 20 years and currently employs a 12-strong team of naval architects, designers and engineers. After a year in development, the 90X is now ready to enter production on a commercial scale.

Modular construction

Hafner comments: "iYacht [has] given the 90X a completely new look while honouring the DNA of the brand. The result is a new boat characterised by optimised ergonomics, enhanced functionality and a seamless blend of German high-quality craftsmanship and luxurious finishes."

While the hull structure did undergo some reengineering, this was far from an extensive overhaul; as iYacht puts it, "there was no need to replace what already works flawlessly". iYacht was responsible for both the design and the engineering of the new boat, which led to a few challenges – not least being the deck, an intricate structure comprising nearly 20 moulded parts.

Hafner tells *The Naval Architect*: "The deck itself is highly sophisticated, incorporating a wide range

of functional and comfort elements. To ensure both safety and stability, our team of designers and engineers worked in close collaboration throughout the entire process, synchronising all aspects of the design.

"Additionally, we were directly involved with the tooling company, ensuring that every detail was meticulously refined to meet the highest standards. This hands-on approach allowed us to optimise the modular construction, guaranteeing precision and structural integrity while maintaining the performance and aesthetic that define the 90X." The modular design may also speed up the fabrication of each boat when the series becomes commercially available.

Engine options

The 90X boat's propulsion system offers several options, including inboard Mercury MerCruiser engines with power outputs ranging from 430-1,130hp (approximately 320-843kW), coupled with a Bravo One XR drive. The variations include: two MerCruiser V6, 4.5litre-displacement models, with a total output of 500hp; two V8, 6.2litre-displacement models with a total output of 700hp; two V8, 8.2litre-displacement models with a total output of 860hp; or two V8, 8.7litre-displacement units with a total outputof 1,130hp.

The boat's top speed comes to an eye-watering 70knots. "The Mercury Zero Effort DTS system replaces traditional throttle and shift cables with cutting-edge digital precision, delivering instantaneous throttle response," iYacht adds. "This advanced technology ensures an unmatched driving experience with ultra-fast performance." Future customers can opt for a joystick piloting system, integrating engines, gearboxes, steering and thrusters into a single unit, for greater ease of handling and, especially, docking.

TECHNICAL PARTICULARS
PERFORMANCE 90X

Length	9.15m (oa)
Breadth	2.6m
Draught	0.43m
Max power	832kW
Max speed	70knots
Fuel capacity	600litres
Water capacity	117litres
Passengers	8
Design category	B

Boat app

The 90X cockpit was designed with a keyless ignition system that doubles as a wireless engine cut-off switch in an emergency. The onboard infotainment system includes multiple screens across the boat, enabling passengers, the driver and co-pilot to check the vessel's speed, while a dedicated boat app enables users to remotely monitor battery and fuel levels, or to even change the lighting and start cooling onboard drinks, using smart devices on shore.

As part of its design remit, iYacht also opitimised the available onboard space, allowing the designer to produce a cabin with a net headroom of 1.75m and a king-sized bed. iYacht designer Joachim Benders comments: "I spent a great deal of time focusing on ergonomics—exploring the relationship between function, space and people. I carefully analyse how guests move on board, and assess how the design translates into real-world experiences for users." ■

The iYacht-designed sports boat has a maximum speed of 70knots

ICE LOADS ANALYSIS

The loads exerted on the ship's hull and equipment during ice operations can have a major impact on performance, writes Ed Moakler, senior engineer, ABS Canada

Polar icebreakers are some of the toughest ships on the sea, given the job they are designed to do. But that doesn't mean they are unaffected by contact with the ice – especially the propulsion systems critical to their safe operation.

The ABS Harsh Environment Technology Center (HETC) was contracted to study the impact of ice loads – and in particular ice-milling by the propeller – aboard a high polar-class vessel. The operator wanted a means of estimating realistic vibration-inducing loads during ship-ice interactions.

The vessel's owner has experience with excessive vibration on an outgoing icebreaker and has sought to manage the problem with the replacement vessel. This analysis considered both icebreaking loads on hull plating as well as ice-milling loads.

There is very little literature on how to develop appropriate loads and frequencies for icebreaking and ice milling vibrations analysis. An initial attempt by the client to understand the ice loads was to use extreme loads measured from other icebreakers and then repeat them as a vibration-inducing excitation force. This resulted in the design failing most of the acceptance criteria.

A question of scale

To obtain a useable data set, HETC employed an approach that would seek to scale down the high loads to a more realistic loading scenario. From an engineering standpoint, scaling down a load is much harder than scaling it up, and this project required HETC to adapt some existing approaches.

Using the principles developed for fatigue assessments, the once-in-a-lifetime design loads were scaled down to levels more suitable for icebreaking and propeller milling-induced osculatory loads.

HETC established the load locations/directions based on physics and probable load paths as a result of ice-hull and ice-propeller impacts. The frequency for bow loading during icebreaking was estimated using the design ice conditions and ice mechanics coupled with the icebreaking performance of the vessel. The loading for the bow was determined using sophisticated ice mechanics and a dynamic crushing to flexure failure model.

The load rise time was determined using ice-crushing analysis up to the point of the onset of flexural failure while the vessel was operating at design speed. The unloading was taken as a mirror of the loading. Then, loads were repeated at a frequency corresponding to the calculated cusp length. Ridge-ramming loads are much higher, but do not continuously repeat, therefore were not considered in this assessment. Ramming loads are considered in the foundation acceleration requirements in the ABS Polar Class Rules.

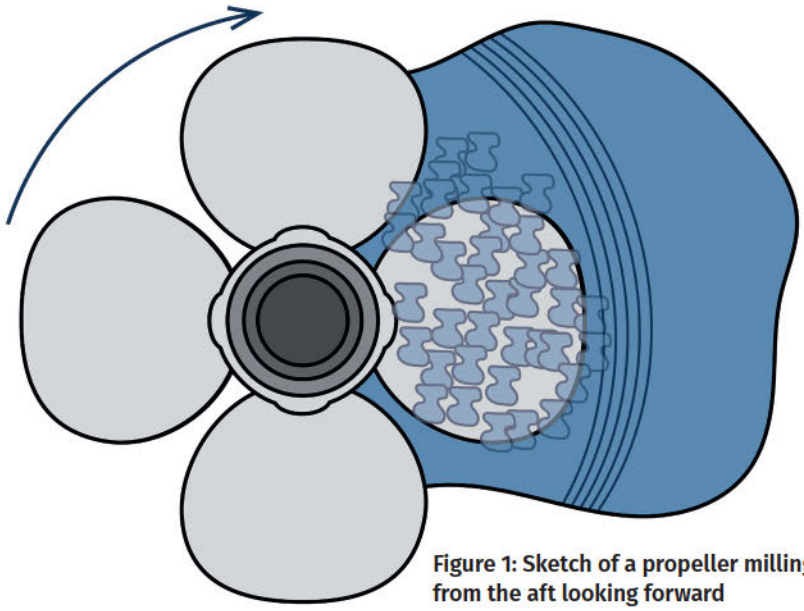


Figure 1: Sketch of a propeller milling ice, from the aft looking forward

The frequency for the propeller ice-milling loads was simply defined as the blade order frequency.

The loading for the propellers was estimated using a probabilistic ice interaction scenario. The peak (once in a lifetime) loading from the ABS Marine Vessel Rules was scaled down using a similar approach used in fatigue assessments and applied in both the time-domain and frequency-domain.

HETC scaled the ice load from the theoretical maximum to the specifics of the vessel under consideration to perform more realistic vibration analysis during icebreaking operations. The results demonstrated to the operator that it could use this approach to measure the impact of vibration on its

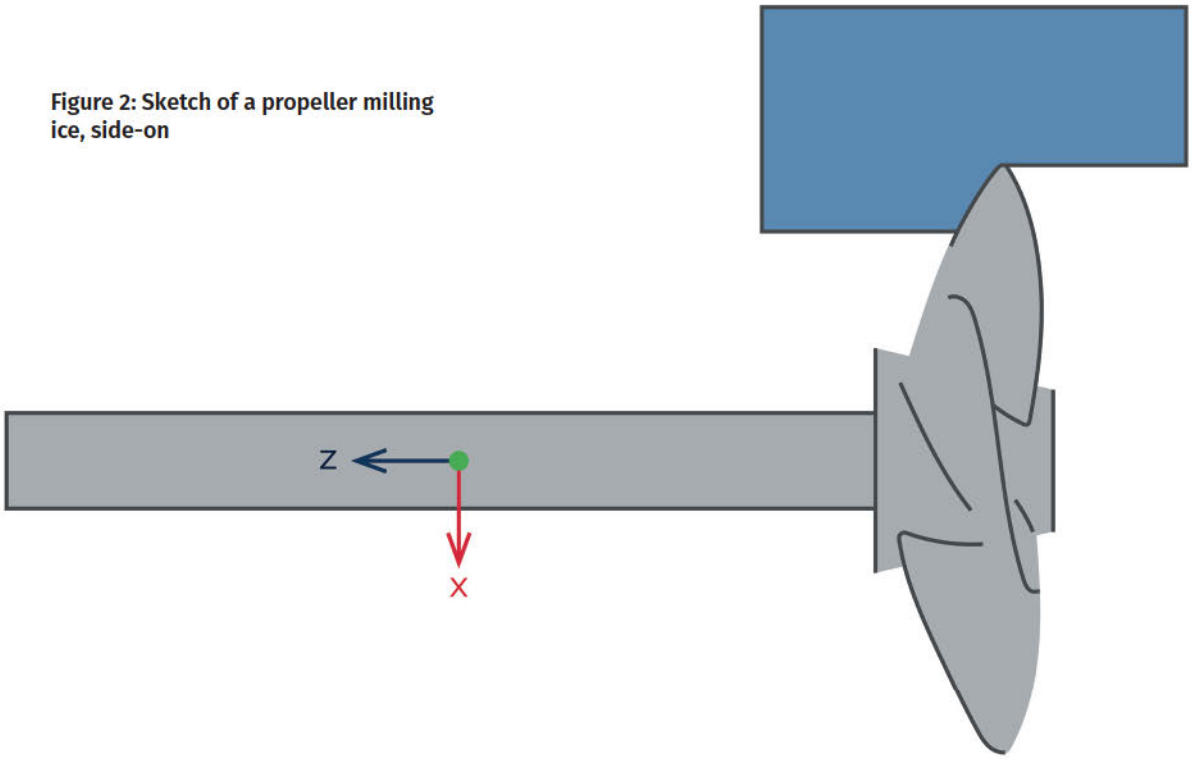


Figure 2: Sketch of a propeller milling ice, side-on

new vessels and make design adjustments that would enable the vessels to better undertake its missions.

The right tools

The icebreaking load time/frequency was determined using an in-house tool, Direct Design of Polar Ships (DDePS), which was developed by ABS HETC in partnership with several other ice experts.

DDePS allows the user to calculate ice loads using many different loading scenarios (including the design load scenario from the Polar Class Rules) for user-defined ice properties and vessel particulars for a ship-ice floe impact. DDePS uses the Popov collision model (which turns a 6D collision into a 1D collision) along with an ice model (called the pressure-area relationship) to determine the ice loads using an energy balance (external kinematic energy of the collision = internal crushing energy of the ice).

This enables the user to set the ship inputs for the collision (hull angle, principal particulars, speed) and ice (thickness, crushing strength, flexural strength, floe size) and output the ice loads. As this approach accounts for the velocity, HETC was able to use kinematic equations and the energy balance to determine the time it takes for the ice load to develop.

Using the vessel's particulars and design icebreaking capabilities, HETC was able to determine a realistic frequency of ice loads during icebreaking, which was used in conjunction with statistical ice loads from dedicated field trials to perform the vibration analysis. The analysis showed that vibrations due to icebreaking are within the acceptance limits.

The vessel design was also assessed for operational vibrations during propeller ice milling. While not explicitly stated in the ABS Polar Class rules, reasonable ice loads that can be used for milling analysis can be derived using various aspects of the ABS Polar Class rule requirements.

Data analysis

ABS has previously taken part in a joint industry project that measured ice impact loads on the hull and podded propulsors for an Arctic tanker, with ice load data collected over a period of several years.

Several different types of data were collected, ranging from compressive/tensile strains on plating and framing to linear variable differential transformer (LVDT) data within the pod struts. ABS has used this data across many different projects over the last decade, and was able to utilise aspects of the data for the ice-milling load time/impulse for the icebreaker in this project.

The magnitude of ice loads is dependent on many different factors, especially the speed and geometry of the impact. As such, it is difficult to transpose maximum/minimum ice load magnitude data from one vessel to another, especially when that magnitude is inferred from structural response. However, the response time/impulse of the impact is relatively constant when related to the vessel's speed – or in the case of propulsors, the blade frequency.

ABS was able to extract several clear milling events from the data set from the Arctic tanker and determine an impulse time/frequency that could be used for the time domain analysis. The magnitude of the load was calculated using the rule formulations.

From the ice-milling data, the peak loads were used to confirm the scaling methods proposed for

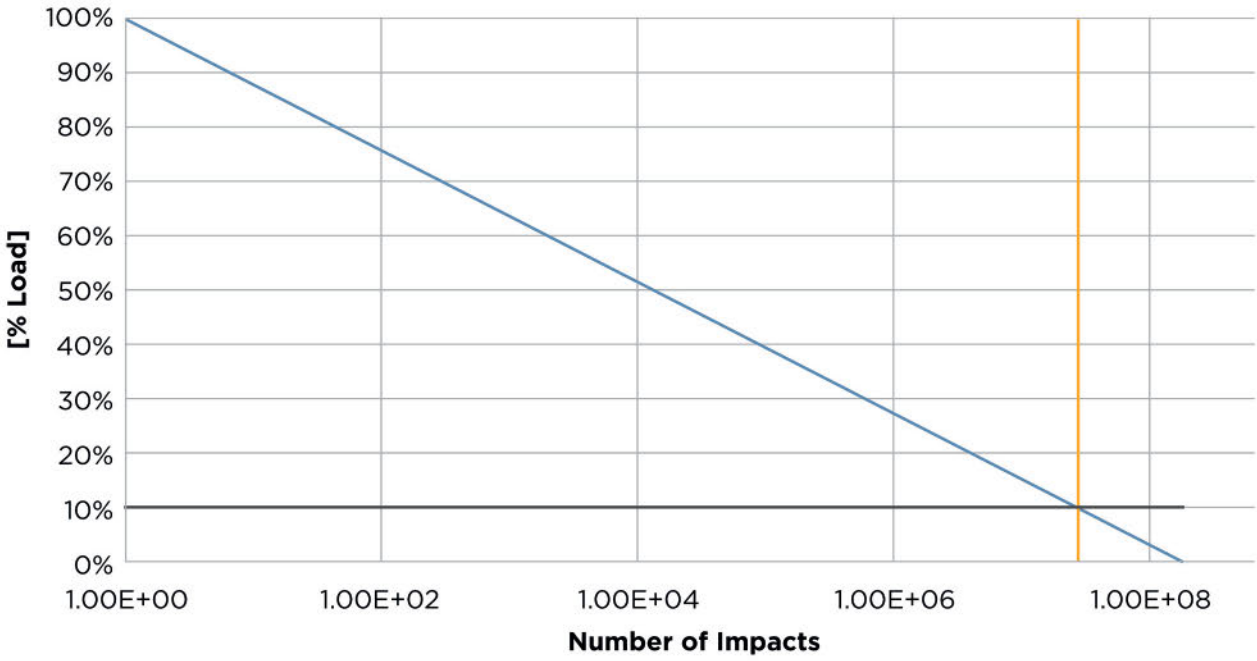


Figure 3: Percent load vs number of impacts

the new icebreaker design assessment. The time domain analysis used the scaled loads, starting with a blade order frequency loading.

Analysing the ice-milling data, it was quickly determined that most events are very short lived, lasting only a few seconds for a typical propulsor ice impact. In general, the maximum recorded peak values lasted only 1-4 blade impacts (~1 propeller revolution) before dramatically decreasing. To allow for a margin of comfort, the vibration analysis performed used several propeller blade rotations, for the input load. For the frequency domain analysis, the blade order frequency was used.

Ice crushing/milling

Ice crushing/milling is both chaotic and nonlinear. This nonlinear response makes it difficult to use typical load spectra in a frequency analysis as it becomes overly conservative due to the assumed harmonic nature of the load spectra.

To propose realistic loads that could be used within the frequency domain, HETC broke the rule loads into several components, and used a similar approach as is used in a fatigue analysis to scale the magnitude of these loads.

When a propeller interacts with ice the forces can be broken down into its components and applied to the ship model appropriately. The first component to consider is the tangential force which results in a torque because of the milling. As the blade cuts through the ice there is a force acting on the blade, approximately tangential to the propeller disk and resisting the rotation of the propeller.

This creates a lateral force on the stern tube bearing, as well as a torque on the shaft. The resistance to the torque comes from the prime mover on the other end of the shaft. Therefore, these forces act into the foundation of the motor for a shaftline arrangement. If the vessel were fitted with a podded propulsor, the lateral force and the torque would be taken in the body of the pod and then resisted by the pod's carrier bearing.

The other force acts axially through the shaft. As the blades strike the ice, a force bending the blade, either backwards or forwards is experienced, and this is absorbed by the thrust bearing.

Therefore, HETC proposed that the model be loaded with three separate loads acting simultaneously although possibly out of phase, depending on the propulsion arrangement.

HETC used the design equations for the forward and backward blade forces, the thrusts associated to the forward and backward loads, and the torque on the shafting. These loads are the once in a lifetime loads that the vessels propulsion components would experience, thus not appropriate for a vibration analysis.

The ABS Polar Class rules have requirements for a fatigue assessment of the propulsion components. For fatigue assessments loads of varying magnitude are applied at varying cycles. The higher the load the lower the number of cycles. In the case of the design loads the number of associated cycles would be one, whereas a very low load would be applied hundreds of thousands or millions of times.

The amount of time the propulsion system is expected to be encountering ice at various load levels was carefully examined and used to estimate a reasonable load cycle number for the vibration analysis. The data indicated approximately 107 cycles is considered and as appropriate for the vessel and the intended operation. This value also corresponds to the transition point in from low cycle fatigue and high cycle fatigue.

The total number of ice cycles was plotted against the load (as a percentage) to find the magnitude of the load at the transition point (multiplied by four as the propellers are four bladed).

For this vessel, the transition point corresponded to approximately 9.6% of the design load. The three load components were scaled down to 9.6% of the design load(s) and used in the vibration analysis. Using the scaled loads, the vibration analysis (both time and frequency domain) showed that for nearly all critical locations the vibrations were within the acceptable limits and highlighted some key areas where modifications may be required to reduce the vibrations to more acceptable levels.

Conclusions

HETC used its knowledge of ice mechanics and ship-ice interaction to develop realistic ice loads and load frequencies that can be used for conducting a vibration analysis for heavy icebreakers. The frequencies were derived using in house ship-ice interaction tools and measured data from an ice load monitoring system on an ABS classed Arctic tanker.

The loads for forward icebreaking were taken from measurements onboard another heavy icebreaker. The ice milling load magnitude was derived from the design load equations and scaled down to align with the transition point between low and high cycle fatigue.

The loads and associated frequencies were applied in both the time and frequency domain to perform the vibration analysis. The analysis showed that, for icebreaking, the vibrations were within acceptable limits. For ice milling, most of the locations were within acceptable limits, but some areas will require modification.

Importantly, this process can be used by others to develop realistic ice loads for vibration analysis, ensuring the vessel will not be over-designed for its expected operations, but also conservative enough that the equipment will not fatigue or fail, and personnel comfort will not be affected. ■

GREEN SEAS AHEAD

Eidesvik continues to factor in methanol as a fuel option across its expanding CSV fleet, with an order for another hybrid-powered newbuild placed with Sefine Shipyard. **Sam Fisk** reports

Norwegian offshore operator Eidesvik is expanding its construction support vessel (CSV) fleet with an order for a methanol-powered vessel designed for subsea and offshore renewables operations. This adds to the order placed last year for a methanol-powered CSV for the offshore wind market, with options for four additional vessels. The company has placed another order with a potential further three vessels to still be announced.

The latest CSV will have a similar specification to the first CSV currently under construction at Sefine Shipyard in Turkey, which is scheduled for delivery in 2026. The latest CSV is due to be delivered in early 2027.

Built in partnership with Agalas and Reach Subsea, the latest vessel is part of a collaboration to leverage combined expertise for enhanced operational efficiency, the company highlights. Upon its delivery, it will enter into a five-year time charter with Reach Subsea, with options for two extensions of one year each. Vessel and crew management will be provided by Eidesvik.

"We are pleased to announce yet another expansion to our fleet," says Helga Cotgrove, CEO, Eidesvik Offshore. "This vessel is designed to meet the demands of both the oil and gas sector and the offshore renewables industry, allowing us to capitalise on market opportunities in both these sectors."

Hybrid system

The new, 3,000dwt CSV is designed by NSK Ship Design and has a highly flexible structure, with an overall length of 99.9m, a breadth of 21m, a draught of 7.3m (or 6.1m in 'special purpose ship' mode) and accommodation for up to 100 personnel. Support operations will include: walk-to-work (W2W); power cable pull-in and commissioning; power cable protection; installation, maintenance and inspections; topside lifting for windmills and over-the-side services with a 3D-compensated crane; and ROV services, among others.

The company highlights that the CSV was designed to be one of the most environmentally friendly vessels in its segment. It will feature a battery hybrid system alongside dual-fuel gensets capable of operating on either methanol or marine gas oil (MGO). The 1,491kWh battery will be delivered by Corvus, while the engines, rated a combined 10,500kW, will be delivered by ABC.

When the vessel is working in flexible operational profile, a reduction of approximately 75% in CO_2 emissions is expected, NSK Ship Design claims. The vessel will have a service speed of 11knots, and will be able to store up to 1,000m³ of fuel oil, 900m³ of methanol and 300m³ of monoethylene glycol (MEG).

The CSV will be equipped with a 150tonne heave-compensated crane and a spacious deck of approximately 900m², which is beneficial for conducting inspection, maintenance and repair (IMR) and construction work. The vessel will also feature an ROV launch and recovery system (LARS) for 6,000m operational depth, and the ROV will be equipped for deep-water seabed operations.

"Green profile"

Financing for the latest CSV is a mix of shareholder equity and approximately 70% debt financing from Sparebank 1 Nord-Norge, Sparebank 1 SMN and Eksfin, with Eidesvik's equity portion funded from existing cash reserves.

Agalas looks to be strengthening its position in the offshore market across the different sectors such as wind, fishing and oil, and also with operating more environmentally friendly vessels in the future. "There has been a demand from the owners that the vessel must have a clear and distinct green profile", says Mats Nygaard Johnsen, Agalas CEO. ■

The forthcoming CSV, due in 2027, will run on batteries and a choice of methanol or MGO

ELECTRIC INCENTIVES

Electric launch and recovery systems for ROVs aren't just good for the environment; they could yield significant cost and energy savings, eLARS manufacturer MacArtney argues

Offshore pipelay and subsea construction contractor Allseas is replacing three of its traditional, hydraulic ROV launch and recovery systems (LARS) with all-electric equivalents, in a bid to boost efficiency.

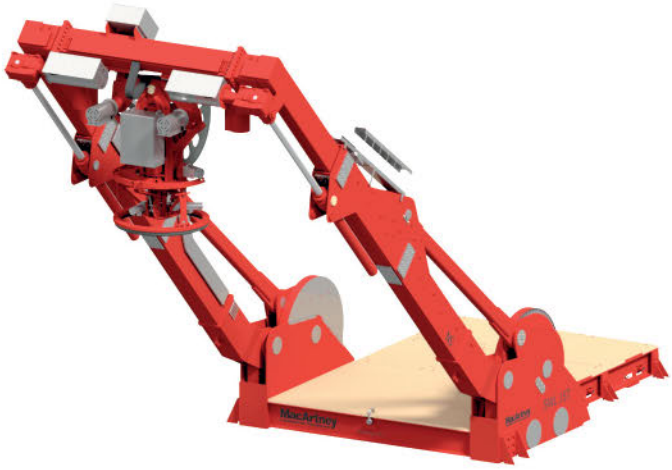
The scope of the contract includes three MacArtney eLARS units, comprising over-the-side, 150kN-SWL all-electric A-frames with docking heads and active heave-compensated (AHC) winches. These systems will deploy and retrieve electric ROVs aboard three of Allseas' DP-enhanced pipelay vessels, namely the 300m *Solitaire*, the 382m *Pioneering Spirit* and the 182m *Lorelay*. The electric ROVs will be used for survey and construction tasks, with the capability to descend to depths of between 4,000-6,000m.

Electric mindshift

The eLARS systems were picked as they fitted Allseas' design specifications, especially those related to high-deck deployment, enhanced safety for crew and equipment, plus recovery redundancy from maximum operating depths.

For Karsten Højbjerg, MacArtney product manager for launch and recovery, the Allseas order represents a small but growing industry trend for a switch from hydraulic to electric ROVs and, consequently, LARS.

"Many ROV manufacturers, including Saab and SMD, are producing fully electric ROV systems," Højbjerg tells *The Naval Architect*, "so some operators are thinking: 'why not also use a fully electric LARS'? The MacArtney eLARS eliminates the use of pressurised oil over water, significantly reducing the risk of oil spillage and potentially offering a competitive advantage.



MacArtney's eLARS clears the A-frame of multiple components and hoses

"This is especially the case for vessels entering American and Arctic waters, where an over-the-side hydraulic system could lead to higher insurance costs."

Reduced wear

Another advantage of switching from a hydraulic to electric LARS is the reduction in the number of components exposed to typical at-sea conditions, including cylinders, gaskets and filters.

Højbjerg continues: "On a typical traditional A-frame, you have about 120 hydraulic hoses. There are always hoses that are more exposed to sunlight, and these hoses will degrade faster. Every year, operators have to take the hoses off, put them in a test bench and test them for pressure and leakage, and then put them back onto the winch, which all takes up man-hours – and man-hours are money."

Electric LARS also make it easier to install preventative maintenance systems, which can alert the crew if any potential problems are detected, and which allows for online troubleshooting – especially if the crew are based on shore, an increasingly likely scenario in some vessel sectors. MacArtney has estimated that this switch to electric could reduce costs by up to 50% compared to hydraulic systems, considering reduced downtime, optimised scheduling and fewer crew being required on board – in both man-hours and crew travel costs.

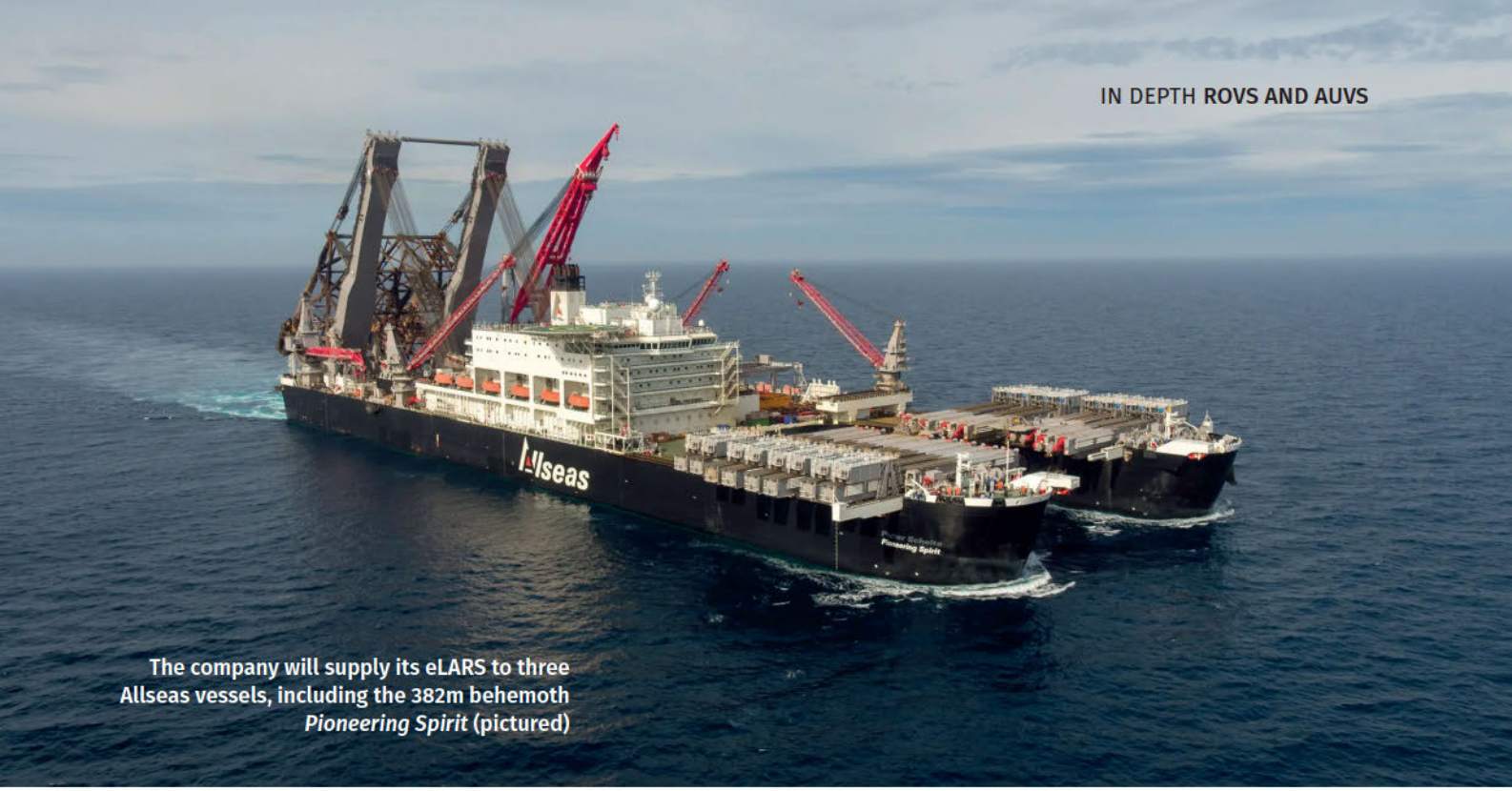
The eLARS can also recover some of the electrical energy it consumes through a process similar to regenerative braking. As the winch turns, it acts like a generator, its motor creating electricity. This electricity can then be fed back into the vessel grid. MacArtney has calculated that this process could make the eLARS up to 30% more energy-efficient than conventional LARS, depending on the application.

Power dynamics

In general, there may be a long-held perception that electric LARS may be somewhat 'weaker' than their traditional, hydraulic counterparts. It's a perception that Højbjerg is keen to disprove.

MacArtney's standard eLARS has a capacity between 3.5tonnes to 15tonnes, and each unit to be retrofitted on the three Allseas ships has a capacity of 15tonnes. However, the company can scale up this technology for heavier loads.

For example, in 2023, MacArtney delivered a 50tonne-capacity eLARS to Belgian operator Jan de Nul, for installation aboard its 130m multipurpose



The company will supply its eLARS to three Allseas vessels, including the 382m behemoth *Pioneering Spirit* (pictured)

vessel *Symphony*. This eLARS was capable of safely launching and retrieving Jan de Nul's in-house-built Swordfish subsea trencher, which has a weight of 45tonnes in the air when equipped for cutting operations. "After we built that one, we noticed a lot of the criticisms of electric LARS disappeared," Højbjerg says. In terms of footprint, the 50tonne-capacity version's 500kN A-frame features a leg height of 14m, with an 11m distance between the legs.

Achieving high-load capabilities with electric A-frames requires "a great effort from our skilled engineers, including precise calculations when assessing the steelwork and electrical parts", Højbjerg explains. He adds: "MacArtney has more than 25 years of experience in this field; we have built winches that can lift 100tonnes. We're using the same tech for the eLARS that we use to lift objects – the gearboxes, pinion wheels and so on. Where we had a rotating drum with wire, now we're just rotating an A-frame instead.

"We know the dynamics well from our experience of manufacturing winches. For instance, we know where the wear and tear is expected on the A-frame, and how to mitigate this."

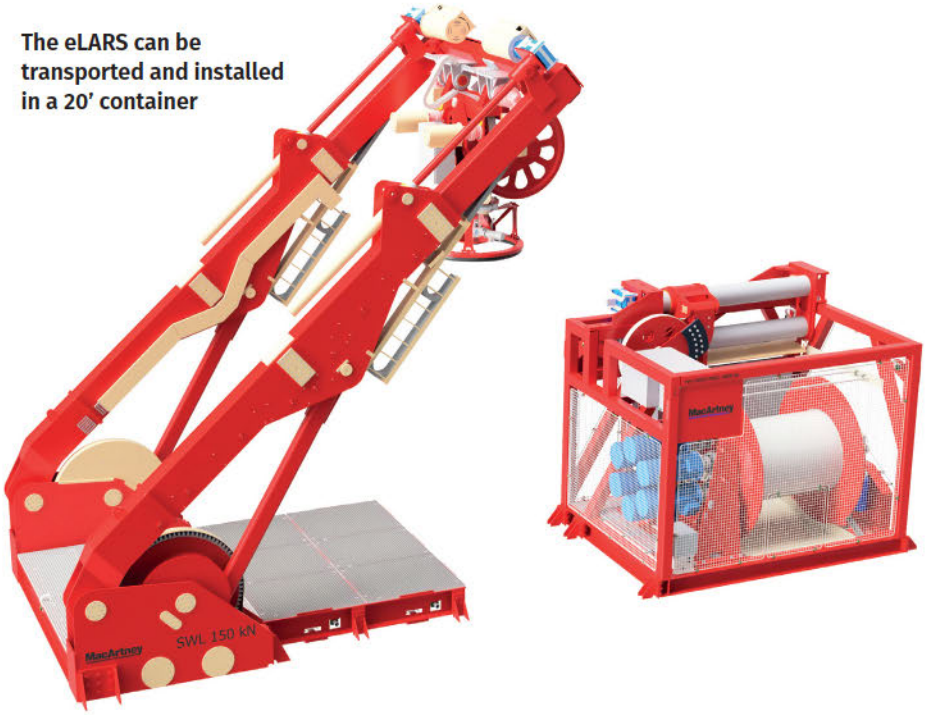
Install times

Installing or retrofitting an eLARS package from the quayside does require crane work, but the job can be completed "typically within a week", says Højbjerg, "though this depends on how the vessel is equipped or where the eLARS is installed on board".

He expands: "The 3.5tonne version was created for the spot market, which means it's very quick to swap in and out. It can be taken to the quayside in a 20' container with twistlocks; then lifted on board the vessel by crane, in one piece. The system's single connector is then connected to the ship's power and you're in operation."

MacArtney now has plans for a 7.5tonne-capable version of the eLARS, which would suit "research vessels, or ships carrying smaller, observation-class ROVs for pipe tracking and undersea investigations", says Højbjerg. ■

The eLARS can be transported and installed in a 20' container



A TOUCH OF CLASS

Classification societies have been helping navies across the globe to meet new challenges, as the threats they face evolve

Numerous countries are expanding and upgrading their naval forces, leading to more classification, advisory and technical work. As a result, navies are increasingly turning to classification societies to help them maintain older assets, which they now need to operate for longer than anticipated, and to ensure their assets are cyber-secure.

Speaking to *The Naval Architect* in late 2024, DNV business director for navy, Christian von Oldershausen (who is retiring after 47 years in the marine industry), said the market had developed at a brisk pace in 2024 because of global tensions. "Countries are rebuilding their own fleets and supporting others, such as Ukraine," he said. "All sorts of vessels are being constructed – frigates, support vessels, coast guard units, landing craft and others."

In 2024, DNV's activity in the surface vessel sector included support to the German Navy and Royal Netherlands Navy. Two options for the German Navy's F126 frigates were declared in late 2024, and DNV is also working on a classification contract, signed in 2023 with Damen Naval in the Netherlands, for the construction of four anti-submarine warfare frigates for the Royal Netherlands Navy. Two vessels of this design will be delivered to the Royal Netherlands Navy from 2029 onwards, and two more will be built for the Belgian Navy.

DNV is also providing full classification services for four 90m offshore patrol vessels (OPVs) for the Republic of Singapore Navy. While this contract was awarded by the OPVs' builder, Fassmer, DNV had already established a strong relationship with the Republic of Singapore Navy. "That relationship fostered trust between us and us as an assurance provider," said von Oldershausen. "We have built similar tripartite relationships with other navies and warship-builders, providing advice as and when required."

The Brazilian Navy recently celebrated the launch of the F200 frigate *Tamandaré*, the first of four vessels built by the Águas Azuis Consortium. The launch took place at the Thyssenkrupp Estaleiro Brasil Sul (tkEBS) shipyard in Itajaí, South Brazil, where the frigates are being constructed under DNV class. DNV is also responsible for plan approval for the *Escotillón IV* landing platform dock (LPD) for the Chilean Navy at Astilleros y Maestranzas de la Armada.

New naval rules

DNV first introduced RU NAV, its rules for naval vessels, in 2021. It completed the rule set in 2024, incorporating rules for hull structures, systems, ship types and additional notations, and RU NAV has been 'in force' since 1 January 2025. DNV also provides technical consultancy for newbuilds and operational vessels, a recent example being a ship structural digital twin for a frigate project for an undisclosed navy. DNV is similarly engaged in the development for several navies of acceptance procedures for unconventional materials, including material testing, welding, corrosion and fire safety.

In 2024, DNV was involved in two ongoing collaborative research projects sponsored by the European Defence Force (EDF). One, the €25 million CALIPSO programme, involved 30 different organisations and aims to provide a roadmap and guidelines enabling the defence sector to achieve EU sustainability goals though the introduction of emissions-reducing propulsion solutions.

The other EDF-sponsored project is MaJoR, a €47 million research effort that is developing a test environment for composites and other materials. The aim is to develop innovative maintenance, joining and repair technology.

Looking to the future, DNV is following developments in Norway, due to that country's long-term defence plan for 2025-2036. This plan recommends a total renewal for the Royal Norwegian Navy, including construction of at least five frigates and potential additions to Norway's submarine fleet. Ahead of his retirement, von Oldershausen said that one of the biggest changes he has seen in his time at DNV is the role of digitalisation, especially the growing use of digital twins and increased focus on cybersecurity.

Life extension

Bureau Veritas' (BV's) global market leader for naval vessels, Romain Cazal, described many similar trends in the market to those identified by von Oldershausen. "As governments modernise naval fleets to meet evolving challenges, so ensuring safety, efficiency and adherence to international and regional regulations is vital," he tells *The Naval Architect*, "but ensuring value for money is also a key consideration. New and innovative methods need to be adopted to maximise the value of naval assets as they age."

Cazal continues: "To help ensure that naval assets deliver the maximum return on investment, BV has developed a methodology to provide governments with a clear and accurate picture of the condition of vessels. One of BV's key offerings in this space is a life extension study [LES], a detailed inspection and analysis of a vessel's condition, and a structural analysis to determine its ability to continue to operate. By examining the vessel's

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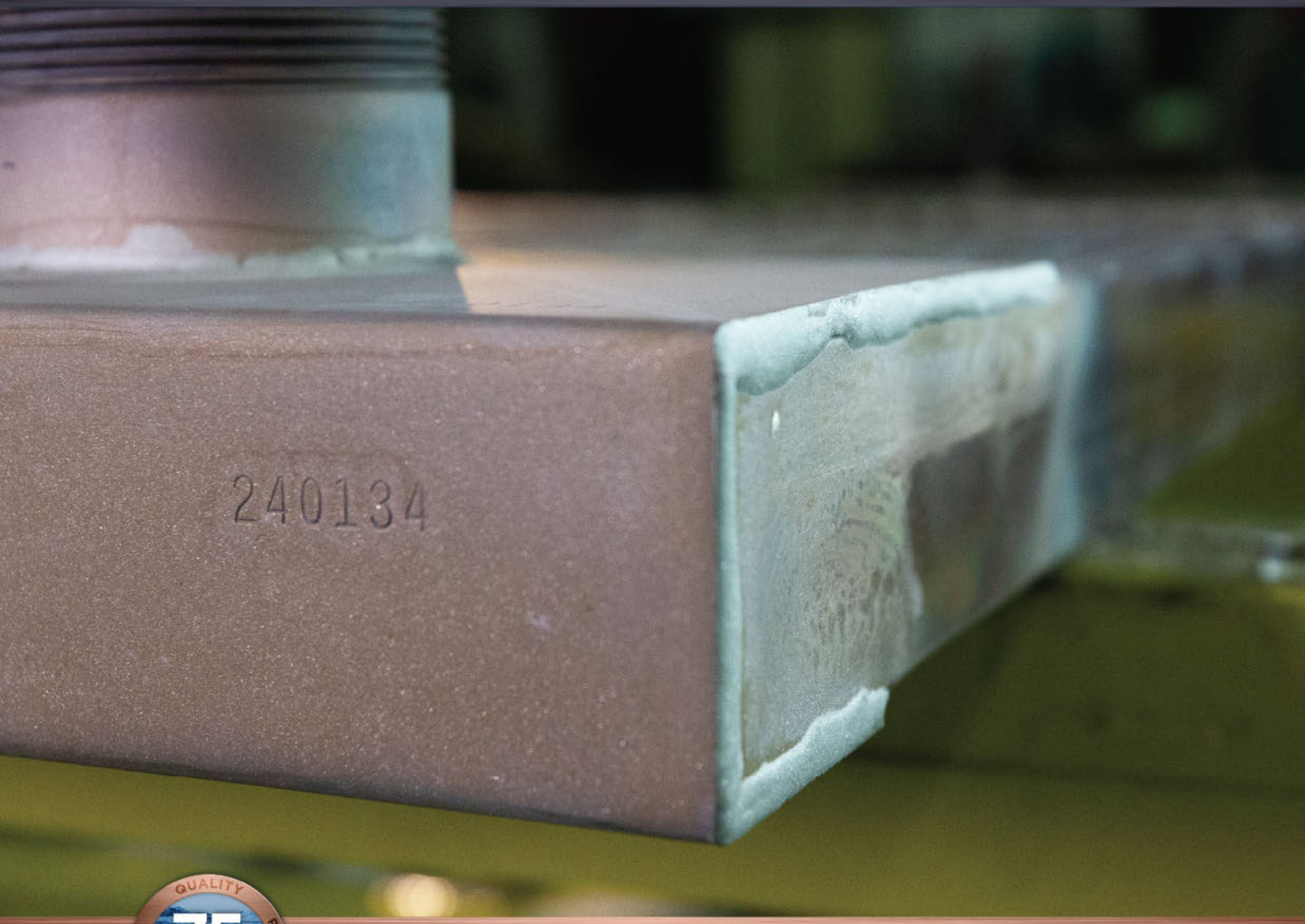

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Italian class society RINA provided a range of services for the Italian Navy's new landing helicopter dock, *Trieste*

history and current condition, and by combining this with performance predictions, we can provide actionable insights that inform decisions on refurbishment or continued deployment."

An LES assessment covers a vessel's hull structure, propulsion and auxiliary machinery, onboard equipment and navigation systems. Allied to LES is another BV service, Supply-R, which provides a customised risk assessment of potential supply chain issues, establishing a risk index whilst highlighting areas of concern that require strengthening or mitigation.

Like von Oldershausen, Cazal sees cybersecurity as a major growth area. "Modern naval vessels are much more sophisticated than their decade-old counterparts," he says, "but are much more at risk from cyber-attack. In response, BV has leveraged its extensive expertise in smart ship design, networks and telecommunications to provide cyber-health checks that help to identify potential vulnerabilities."

LHD contract

Recent projects for Italian class society RINA included the classification of the new landing helicopter dock (LHD) *Trieste*, the largest and one of the most advanced vessels in the Italian fleet. With an overall length of 245m and a full-load displacement of 38,000tonnes, *Trieste* features a through deck for helicopter and aircraft operations and a floodable dock for rapid deployment of amphibious assets, armoured vehicles and unmanned systems.

The vessel's modular interior spaces can support 1,064 personnel, including crew, embarked troops and mission specialists, serving as a command-and-control centre or a launchpad for conducting amphibious operations. In due course, ITS *Trieste* will also be capable of operating F-35B Lightning II short takeoff and vertical landing (STOVL) aircraft, and has a deck designed to withstand the extreme thermal loads generated by the aircraft engine exhaust, which can reach temperatures exceeding 1,500°C. This required a 'thermomechanical' calculation of the structure by RINA to verify the ability of the deck to maintain the mechanical proprieties required when the F35 takes off.

The LHD has a combined diesel-electric or gas (CODLOG) propulsion system, combining two MAN 20V32/44R diesel engines, two Rolls-Royce MT30 gas turbines and two electric motors. The redundant layout of the machinery systems has been verified for compliance with the class notation AVM-DPS-NS. With a range of 7,000nm, the propulsion system provides fuel efficiency and reduced emissions, and has been assigned RINA GREENPLUS MIL notation for environmental sustainability.

RINA has also conducted a gap analysis to assess compliance with the Naval Ship Code chapters II to VII, focusing on structure, buoyancy and stability, engineering systems, fire safety and escape, evacuation and rescue. The analysis demonstrated the compliance with the Naval Ship Code through the application of RINAMIL Rules for the classification of naval vessels, for which RINA recently completed a major update, due to enter into force in January 2025.

In the underwater domain, RINA is providing support for the Italian Navy's new submarine rescue ship ITS *Olterra*, under construction at Mariotti. The vessel will function as a mothership for the deployable submarine rescue system known as SAVER. Elsewhere, RINA is participating in the European Patrol Corvette (EPC) programme, also known as the 'Modular and Multirole Patrol Corvette (MMPC),' which aims to develop a new class of surface combatants with a modular design that can be adapted to the needs of the navies involved in the project. Rules specific to the design are being developed for this unique programme. ■

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FRIGATE TRIALS MARK NAVAL MILESTONE

The latest units in the FDI series, designed to operate alone or as part of a naval force, have been launched for sea trials, writes **David Foxwell**

The first in a series of frigates being built for the French and Hellenic navies has reached an important milestone, having commenced sea trials.

The first Frégate de Défense et d'Intervention (defence and intervention frigate, or FDI), *Amiral Ronarc'h*, was launched in late 2022 and undertook sea trials in November 2024 from Naval Group's shipbuilding facility at Lorient. A total of five FDIs are being built for the French Navy, with three FDI Hellenic Navy (FDHI HN) units being built for the Hellenic Navy.

The first FDI HN, HS *Kimon*, was launched in October 2023 and HS *Nearchos* in September 2024. The third unit has also been contracted and is under construction, and a fourth is planned. The new frigates have a displacement of 4,500tonnes, a length of 122m, a breadth of 18m, a speed of 27knots and accommodation for 125, plus 28 other personnel.

'Cyber-protected'

As the first unit in the FDI programme, feedback from *Amiral Ronarc'h*'s sea trials will feed into the programme for the FDIs for the French and Hellenic Navies. In addition to testing the vessel's machinery and related systems, the trials will include tests carried out on the ship's combat system while at sea.

Naval Group describes the FDI as "a multipurpose, resilient vessel capable of operating alone or as part of a naval force, and undertaking anti-ship, anti-air and anti-submarine operations". The vessels will also be capable of hosting operations by special forces, and are the first French frigates designed from the outset to be 'cyber-protected,' with a redundant IT architecture based around two data centres that host the ship's IT applications.

Armed with Exocet MM40 anti-ship missiles, Aster anti-aircraft missiles, MU90 anti-submarine torpedoes and naval guns, the FDIs for the French Navy will carry a heavy helicopter in the 10tonne class and an uncrewed aerial vehicle (UAV). They will deploy special forces using two commando boats and will be equipped with the new-generation Sea Fire radar developed by Thales, which, combined with the missile systems, will provide them with extended area defence capability.

Strongly armed

HS *Kimon* is currently undergoing harbour trials before beginning sea trials. HS *Nearchos* was due to be fitted with its sensors and intelligence module a few weeks after launching. A keel-laying for the third unit, HS *Formion*, took place in April 2024 and hull assembly was completed in August. One of the blocks for the vessel was fabricated by Salamis Shipyard in Greece.

The three frigates for the Hellenic Navy will be delivered in 2025 and 2026. These are also strongly armed, with Exocet MM40 B3C anti-surface and Aster anti-air missiles, a Rolling Airframe Missile launcher, MU90 anti-submarine torpedoes and naval artillery. Like the French frigates, they will be able to embark a helicopter and UAV.

Construction of the FDIs for the Hellenic Navy follows a 24 March 2022 contract between Greece and Naval Group for the initial trio of vessels, plus one optional unit, along with an in-service support package and the supply of MU90 torpedoes and 'Canto' countermeasures systems.

The Hellenic frigates will be equipped with a package of primary sensors developed by Thales and integrated with the ship's combat system. This package includes the Sea Fire radar, this being the first export success for the new digital radar system, which is a fully solid-state multifunction radar with a fixed, four-panel antenna that simultaneously performs long-range air and surface surveillance and provides guidance for anti-air missiles.

The underwater sensors for the new frigates are also being supplied by Thales and include a Kingklip Mk2 hull-mounted sonar and Captas-4 Compact towed-array sonar. ■

***Amiral Ronarc'h* pictured: five FDI frigates are being built for the French Navy and three for the Hellenic Navy**

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SAILING INTO SUSTAINABILITY

Joseph Hodgson, naval architect at OS Energy, one of RINA's corporate partners, explains the company's plans to integrate alt-fuels, optimise hydrodynamics and improve vessel efficiency

For more than two decades, OS Energy has provided specialised offshore services, focusing on the offshore wind industry, research and survey operations. Established as an environmental survey company, it has grown into a multi-service provider, operating a fleet of multipurpose vessels across North Sea and Baltic Sea projects. With headquarters in Glückstadt, Germany and offices in Flensburg, Newcastle and Esbjerg, the company takes a flexible, solutions-based approach to offshore operations.

As the offshore sector faces increasing regulatory pressure to improve efficiency and reduce environmental impact, vessel design is evolving to meet new sustainability and performance standards. In response, OS Energy has been developing projects that align with these industry shifts, integrating alternative fuels, optimising hydrodynamics and improving vessel efficiency.

A render of the OSSV concept developed by OS Energy, OSK Design and MPC Capital

This article examines three recent and ongoing projects that reflect these trends: the development of a new offshore supply vessel; a hydrogen retrofit initiative; and advancements in propeller design.

Next-gen OSSV

OS Energy, in collaboration with MPC Capital, is developing a new fleet of offshore survey and service vessels (OSSVs) designed to support offshore operations in Northern Europe. The first vessel, under construction at Finomar, Poland, with outfitting to be conducted at Esbjerg Shipyard, Denmark, will meet the increasing demand for specialised, environmentally sustainable service vessels as offshore wind capacity expands across Europe.

The OSSV is engineered to provide a wide range of services, including subsea inspections, environmental and seabed surveys and equipment supply. With a low air draught, it can operate beneath active wind turbine generators, increasing its operational flexibility. The vessel is also equipped with a moonpool featuring launch and recovery systems (LARS) for ROVs and AUVs, making it well-suited to offshore research and survey missions.

A modular engine and power grid set-up allow for seamless integration of alternative fuels and innovative ways of operating the vessel with reduced fuel consumption. At the design stage, the integration of methanol (as well as the future use of hydrogen) on board the vessel was included to provide insights to regulatory compliance, assess the requirements of safe zones for the storage and handling of low-flashpoint fuels and optimise the arrangement for delivering key services.

Efficiency boost

Efficiency of the hull design was tested in collaboration with Newcastle University academics and Strathclyde University's towing tank, as were extensive numerical simulations in-house and in partnership with OSK Design, who helped bring the design to reality.

To further enhance efficiency, the vessel is equipped with a dynamic positioning system (DP2) and is designed for up to 800kWh of battery power, for reduced fuel consumption and noise emissions.

For offshore operations, versatility is key, so the vessel includes an active heave-compensated (AHC) crane and a dedicated wet lab/workshop with direct access to the moonpool, making survey and research tasks more efficient. Designed with low-emission technology at its core, the vessel meets strict Environmental, Social and Governance (ESG) standards, positioning it as a forward-thinking solution in an industry increasingly focused on sustainability.

The vessel has been developed for regulatory compliance for the integration of alternative fuels.

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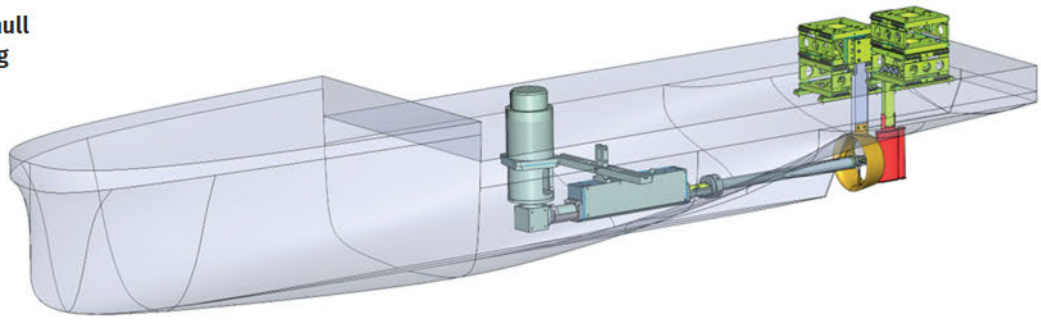


The design of the scaled hull model for the OSSV towing tank tests

Stricter environmental requirements, including the transition to alternative fuels and operational efficiency mandates, have influenced key design decisions. Meeting the technical demands of DP2 certification while integrating hybrid and future hydrogen-powered systems has also posed engineering challenges, requiring a flexible and modular approach to power management.

By addressing these challenges and integrating forward-thinking design solutions, OS Energy's newbuild OSSV represents a step toward more efficient, sustainable offshore operations.

TransShip II

OS Energy is also contributing to the advancement of low-emission vessel technology through its involvement in the TransShip II project, a £5.5 million initiative funded by InnovateUK. The project focuses on retrofitting the research vessel *Prince Madog* with a hydrogen-electric hybrid propulsion system, aiming to reduce emissions by up to 60%. This marks a significant step towards decarbonising the maritime sector and aligns with OS Energy's commitment to sustainable offshore operations.

As part of the collaboration, OS Energy is working alongside a consortium of partners to integrate hydrogen fuel technology while ensuring the vessel meets operational, statutory and class society approval. The retrofit will provide valuable insights into the feasibility of hydrogen-powered vessels in commercial and research applications, paving the way for future innovations in offshore energy and vessel design.

Technical challenges

Retrofitting an existing vessel with a hydrogen-electric propulsion system presents significant engineering and operational challenges, especially compared to designing a newbuild with integrated hydrogen capabilities from the outset. One of the primary difficulties lies in accommodating the additional space, system and structural requirements for hydrogen storage and fuel cell systems within the existing hull structure. For *Prince Madog*, this has required installation of a new 'fuel cell compartment' on the forecastle deck. This space, although small, is tightly packed with bespoke, cutting-edge technology.

The fuel cells themselves present a great interfacing challenge as each 100kW fuel cell requires cathode air in and out, hydrogen supply, ventilation in and out, anode purge and cooling! In most cases, the products needed for these systems must be class-approved; however, as the technology is so new, there is a distinct lack of commercially available off-the-shelves parts. It is therefore unsurprising that sourcing parts and equipment has caused delays and driven design changes.

The limited availability of hydrogen bunkering infrastructure and the public perception of hydrogen further complicate retrofitting. Hydrogen as a fuel source is not widely understood yet, and there is a fear of the unknown. However, while

The leading-edge tubercle-design propeller achieved greater efficiency than a conventional propeller at the design pitch condition

it is far less energy-dense than marine HFO – containing one-third of the energy per unit mass – hydrogen poses no greater danger and can be safely integrated in marine fuel cell solutions with the correct infrastructure.

Despite these challenges, we believe retrofitting remains a crucial pathway for reducing emissions in the short term, particularly for vessels with long service lives that would otherwise continue to rely on conventional fuels.

Propeller performance

The innovative leading-edge tubercle design draws inspiration from the unique hydrodynamic properties of humpback whale fins, which enable smooth manoeuvrability despite their considerable size. This biomimetic concept has been applied across various domains to improve fluid dynamic performance. Researchers at Newcastle University have extended this principle to marine propulsion, developing a novel propeller featuring tubercles along its leading edge, akin to those found on whale fins.

To evaluate the performance of this design, an open-water test was conducted at Newcastle University's Emerson Cavitation Tunnel, comparing a tubercle leading-edge propeller with a conventional counterpart. The tubercle propeller achieved approximately 3% greater efficiency at the design pitch condition, primarily due to reduced torque, and exhibited increased thrust under bollard pull conditions, making it particularly suitable for vessels requiring high thrust.

One of the most striking benefits observed was the substantial reduction in cavitation at high load conditions, a common issue in marine propulsion. CFD simulations further confirmed that the tubercle leading-edge design significantly reduces acoustic noise, making it an attractive option for noise-sensitive applications.

This promising technology has been implemented aboard two vessels operated by OS Energy through separate projects. *Prince Madog* was retrofitted with a four-bladed ducted propeller incorporating the tubercle design on both the propeller and the duct, as part of the UK government-funded clean maritime demonstration competition TransShip-II. Similarly, *Fortuna Crane* underwent retrofitting with a tubercle-enhanced propeller under the Horizon-funded RESHIP project. Both vessels are scheduled for sea trials with the newly designed propellers in the coming year. ■

CONFIDENT IN CÁDIZ

The Spanish Tax Administration Agency is taking delivery of a trio of long-range offshore patrol boats to help combat smuggling and crime in its national waters

The Spanish Tax Administration Agency (Agencia Tributaria) doesn't solely function as a revenue service: the organisation plays a key role in countering organised crime, money laundering and drug trafficking, both on land and in Spanish waters.

Most recently, the agency took delivery of the first of three new patrol vessels ordered for a mix of challenging surveillance and offshore intervention work. Christened *Peregrino I*, the first of the trio has also been described as the debut model in Rodman Polyships' new 111 Offshore Patrol class. The boat made its way from Rodman Polyships' construction facility in Meira-Moaña to its operational zone of Cádiz in late December 2024, and its primary tasks here will include confronting smugglers, conducting search and rescue missions and undertaking general sea patrols.

The second sister in the series, *Peregrino II*, is scheduled for delivery in March 2025, while the third, *Peregrino III*, is set to hit the water in November. Previously, Rodman Polyships supplied the agency's 43m-long offshore patrol vessel *Condor* in 2021; a vessel built to the specs of Rodman's 138 class, and hailed as the longest glass fibre-reinforced polyester (GRP) patrol boat to have been constructed in Europe (if not the world) to date.

Composite builds

The Rodman 111 is also a composite material-build, incorporating various types of GRP – selected for its resistance to corrosion and UV, its mouldability and its high strength-to-weight ratio. GRP-built units are also relatively easy to repair as they cure at room temperatures, and are simple to maintain, often requiring nothing more taxing than a cleaning and waxing of the surface.

***Peregrino I* has a range of more than 1,400 miles at 19knots**

Like its forthcoming siblings, *Peregrino I* features an overall length of 35.3m, a 6.2m beam and a depth of 3.4m to the main deck. The boat has been arranged for a 10-strong crew. Rodman Polyships tells *The Naval Architect*: "There is no specific area for casualties but nevertheless, in an emergency situation, the vessel can accommodate up to 10 persons. As for persons under arrest, one of the cabins is prepared to accommodate four persons."

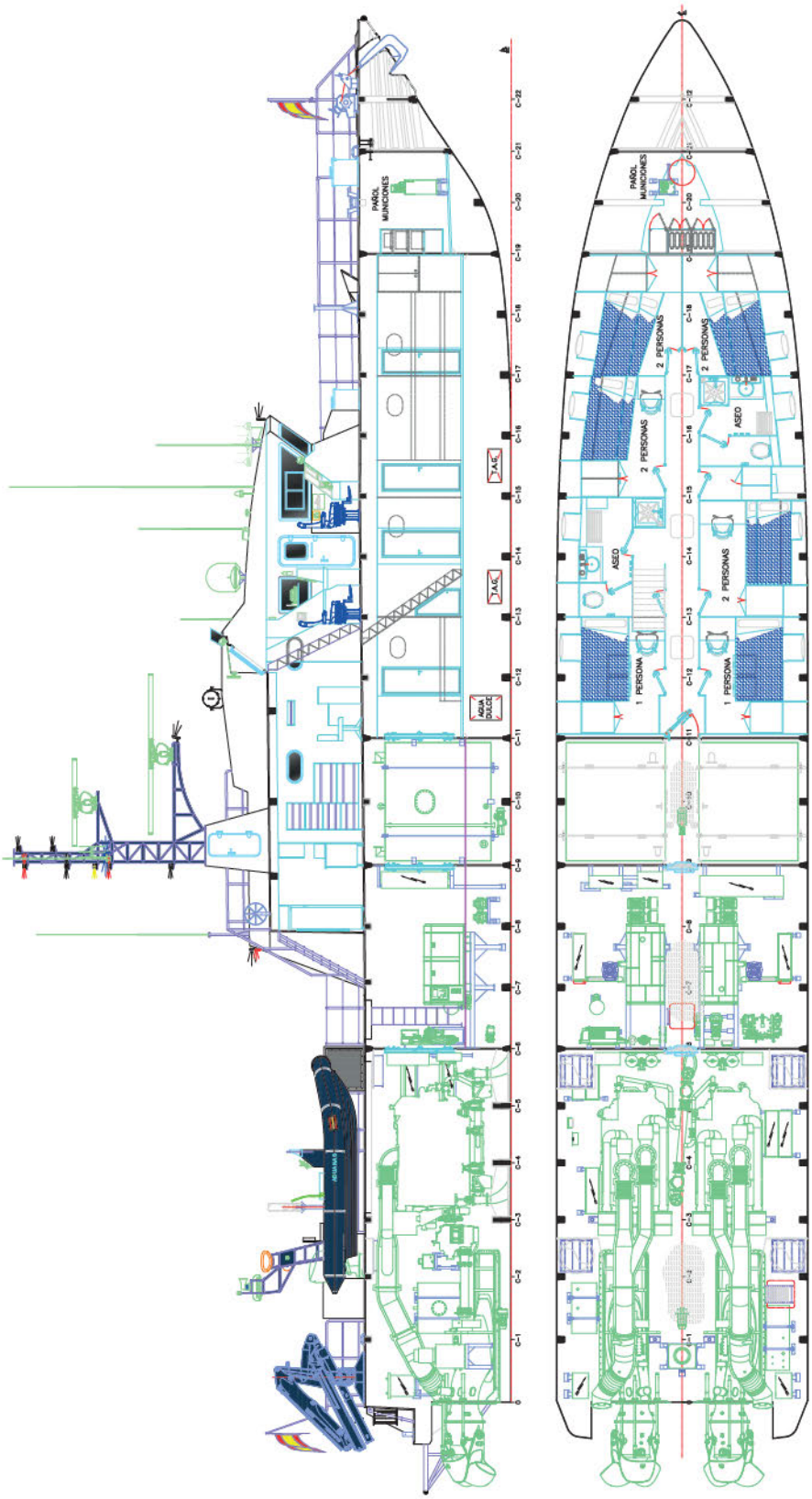
Peregrino I is powered by two Cummins QSK60-M main diesel engines, each rated 1,864kW, driving twin Kamewa S63-3/CA waterjets through integrated ZF 8000 gearboxes. This powertrain allows the boat to attain a top speed of 35knots. Featuring a fuel capacity of 24,000litres, split between two tanks, and a fresh water capacity of 800litres, the boat has a claimed range of 1,432 miles at its 'economy speed' of 19knots, thereby enabling its crew to stay out at sea for extended missions, enabling them to really bring the fight to waterborne criminals.

Safety considerations

Crew safety and boat integrity were also important considerations for the new trio. Rodman Polyships says that the 111 series was designed to fully comply with DNV's safety requirements, and particularly in accordance with the class society's E0 notation. This notation acknowledges that the boats have systems in place to ensure safety and efficiency with reduced crew involvement in routine operations, and that all systems are automated and monitored and can be operated from the wheelhouse. The builder adds: "A thorough study has been carried out on the Rodman 111's stability in the event of a breakdown in any of the vessel's compartments, in order to make her unsinkable."

Each Rodman 111 is and will be fitted with weapon mounts, at Agencia Tributaria's request, though said weapons will be commissioned separately by the owner. *Peregrino I* features an extensive suit of navcom equipment, including but not limited to: a Furuno FAR-2228-NXT radar and SC-130 satellite compass; a Simrad S3009 echosounder; Inmarsat C and FleetBroadband 500 satcom terminals; an Airmar WX-220 weather station; and multiple portable VHF radiotelephones. Each boat will also carry a rescue RIB, which can be hoisted or lowered while the vessel is underway and with people on board.

A general arrangement of the Rodman 111 offshore patrol class



The lead ship in the Arafura-class programme will undergo further tests before being formally delivered (source: Royal Australian Navy)

ARAFURA BATTLES DELAYS

The Royal Australian Navy's first Arafura-class OPV has at long last been accepted, but is not yet delivered, nor operational, writes **David Foxwell**

In January 2025, the Australian Department of Defence accepted its first Arafura-class offshore patrol vessel, NUSHIP *Arafura*, for test and evaluation ahead of delivery to the Royal Australian Navy. *Arafura* is the first-of-class vessel delivered under project SEA 1180, built by Luerssen Australia at the Osborne Naval Shipyard in South Australia, and is part of a wider 'Navy Minor War Vessel Fleet' supporting civil maritime security and enhanced regional engagement in the Southwest Pacific and Southeast Asia.

The project will deliver six Arafura-class vessels to the Royal Australian Navy, the programme having been slashed from the 12 intended ships after significant delays; delays originally attributed to problems caused by the Covid pandemic, but which continued afterwards.

The programme's original aim was to replace Australia's Armidale-class and Cape-class patrol boats with a single class of vessels. Construction of the first vessels commenced in November 2018, and a contracted keel-laying milestone for *Arafura* was achieved in early 2019. Production of the second vessel, *Eyre*, commenced in June 2019, two months ahead of schedule, with a keel-laying ceremony on 9 April 2020.

The third vessel, *Pilbara*, commenced construction ahead of schedule on 27 March 2020 and the fourth, *Gippsland*, commenced construction on schedule on 4 January 2021, with the keel-laying ceremony held on 30 July 2021. Construction of the fifth Arafura-class vessel, *Illawarra*, commenced on 1 November 2021.

'Projects of Concern'

Arafura was launched in 2021, the first hull sections for the vessel having been joined as long ago as May 2020. Contractor sea trials with the first vessel did not get underway until August 2024 and such were the delays in the programme that the Department of Defence was forced to order several, somewhat smaller Cape-class and Evolved Cape-class patrol boats to fill a growing gap in capability. In 2023, the Arafura-class programme was also added to the Department of Defence's list of 'Projects of Concern.'

With a length overall of 80m and a beam of 13m, the new vessels have a displacement of 1,640tonnes and two 4,250kW diesel engines apiece. This provides them with a maximum speed of 20knots and a range of 4,000nm. They are equipped with two 8.5m Boomeranger FRB 850 crane-launched RIBs and a stern-launched 10.5m Boomeranger C 1100 RIB. Each is lightly armed with a 25mm gun and two 50-calibre machine guns, and has a crew of 40 and accommodation for up to 60 personnel in total.

The programme has been criticised on several occasions, but not just because of the time it has taken to get the vessel into service. Although accepted by the Royal Australian Navy, the first

Twelve Arafura-class OPVs were due to be built but the programme has been cut to six boats (source: Royal Australian Navy)

of the Arafura-class vessels is still not ready for service, with further testing of its reverse osmosis unit and crane yet to be undertaken, along with noise monitoring and, it is understood, the installation of soundproofing measures.

Design criticisms

The design has also been criticised for being too lightly armed. Although these vessels were intended to have an OTO Melara 40mm main gun, the gun could not be successfully integrated into the design. Instead, they are being equipped with the 25mm guns mentioned above, which are being removed from the Armidale-class ships as they are decommissioned. Other criticisms of the design have focused on its lack of self-defence capability and on the selection of a RIB from a Finnish company rather than a locally-sourced Australian boat manufacturer. The vessels have a helicopter landing deck but do not have a hangar for aircraft, so cannot embark a helicopter.

Despite these criticisms, deputy secretary for naval shipbuilding and sustainment Jim McDowell said the delivery of the first Arafura-class offshore patrol vessel is "an important milestone in the Australian Government's investment in naval shipbuilding and sustainment." He said: "Delivery of the first-of-class vessel provides critical capability to our Australian Defence Force that was built here in Australia."

NUSHIP *Arafura* will now sail to its homeport at HMAS Stirling in Western Australia before commissioning into the Royal Australian Navy fleet later in 2025.

***Captain Arctic* is predicted to reduce CO_2 emissions by 90% compared to conventional cruise ships of this size**

ARCTIC ADVENTURES

Developed to run on a brew of wind and solar energy and HVO, forthcoming polar expedition vessel *Captain Arctic* will enable unique cruises into pristine waters without the harmful emissions

According to the Association of Arctic Expedition Cruise Operators (AECO), in 2019, the total number of passengers on expedition cruise ships in the Arctic region reached 32,356, with popular destinations including Svalbard, Greenland and Baffin Island.

Similarly, there has been a notable trend towards sustainability, with cruise lines investing in greener technologies and practices, and an increase in passenger demand for tailored experiences, combining cruise vessel opulence and comfort with unique, educational trips into far-flung places.

Soon to join the vessels venturing into the far north will be *Captain Arctic*: an innovative, eco-friendly, 69m polar expedition vessel on build for French owner/operator Selar, a company promising excursions into "the most remote, pristine parts of the globe, exploring fragile ecosystems that must be respected and preserved".

Construction is being overseen by Goltens – which laid the vessel's keel at its facility in Dubai Maritime City in November 2024 – and with assistance from its Mauritius-based shipbuilder client, Chantier Naval de l'Ocean Indien (CNOI). Goltens' scope of input includes thorough design and fabrication of the vessel's steel hull, in addition to detailed engineering.

Speaking at *Captain Arctic*'s keel-laying ceremony, Selar CEO (and a seasoned captain and ice pilot of 17 years) Sophie Galvagnon commented: "This vessel is not only an investment in sustainable tourism, but also a commitment to preserving the natural wonders of our planet." She was joined by Goltens CEO Sandeep Seth, who added that building the hull constitutes a first for both Goltens and the UAE, "and aligns with the government's vision for a sustainable future".

Solar and wind

Of course, Goltens may be more familiar to readers for its vessel repair and refit work than its shipbuilding activities. Seth tells *The Naval Architect*: "Since we had a dedicated team assigned for this project, we were able to manage both this newbuild and our regular docking repair business, which was one of the main challenges we had to address. Coordination between the CNOI and Goltens Dubai teams panned out well due to good cooperation between both companies."

The three-deck *Captain Arctic* has been designed to harness solar and wind power for propulsion,

TECHNICAL PARTICULARS
CAPTAIN ARCTIC

Length	69m
Breadth	14m
Depth	4.65m
Draught	3.5m
Gross tonnage	2,000tonnes
Cruising speed	7knots (all-electric)
Crew	24
Passengers	36
Classification society	Bureau Veritas
Notations	Passenger ship, Unrestricted navigation, Polar Cat B, Polar class 7, Battery system, Electric hybrid (ZE), WPI

ensuring emissions-free cruises in and out of the sensitive polar waters. The vessel will feature five retractable rigid, 35m-high aluminium sail masts covered with a 2,000m² spread of photovoltaic panels.

"The sails will be raised and lowered through an electro-hydraulic system," says Seth. "The sails can pivot up to 180° to catch the wind, or fold down when not required." In total, the five solar sails will be capable of generating a combined 181kW.

In addition to the sails, the vessel will be built with a pair of propeller shafts that act as hydro-turbines, providing another source of green power.

HVO back-up

This clean power will feed the ship's two lithium iron phosphate (LFP) batteries, each of which is rated 700kWh. These will in turn provide the power for two main gensets, rated 420kW apiece, and a single 90kW auxiliary genset on a resilient-mounted skid.

Seth estimates that wind and solar energy will power *Captain Arctic* "90% of the time". For the remaining 10%, mostly comprising vessel manoeuvres, the ship will burn hydrogenated vegetable oil (HVO). In case of systems failure and/or an urgent need to return to the nearest haven, the ship will also be fitted with a 100kW emergency diesel generator set, located on the third deck alongside an emergency switchboard and a fuel tank.

This propulsive arrangement will be sufficient to grant *Captain Arctic* a speed of 7knots when running purely on electric motors in zero-emission mode, and 11.5knots when solely using the diesel engines.

Seth continues: "The hull will be designed, built, tested and delivered in compliance with the rules of Bureau Veritas [BV] in order to sail as a 36-passenger/24-crew sailing polar cruise ship." The newbuild's BV notations will include Polar Cat-B and Polar class 7. "Polar Cat-B is assigned to ships designed for operations in polar waters in at least thin first-year ice, which may include old ice inclusions, but in ice conditions less severe than for Polar Cat-A."

As such, *Captain Arctic* will be able to operate in polar waters in summer and autumn, when the maximum ice thickness will be in the range of 0.5-0.7m, Seth adds.

The ship's inventory of green tech doesn't stop there. *Captain Arctic* will be equipped with a reverse osmosis system, converting sea water into fresh water, and a specially commissioned pellet boiler, using recycled wooden waste pellets for the ship's heating, rather than energy-intensive fuel boilers. The vessel will also make use of an organic food digester and a treatment tank capable of transforming black and gray water into potable water.

Emissions reduction

For the guests' comfort and entertainment, the ship will feature a spacious lounge, a 1920s-style bar, a library, a gym and a sauna, with design provided by interiors specialist Josephine Fossey. The vessel will also carry a selection of kayaks, skis, Zodiacs and snorkelling gear, as well as life-saving equipment and firefighting systems, and the lower decks will house a scientific lab and an expedition room, for those who wish to mix their luxury cruising with serious research.

Accommodation is laid out to sleep guests across 16 cabins, one of which has been designed for wheelchair-friendly access. There will also be quarters for a team of five guides, who will organise on-land and on-water expeditions for the cruise ship's guests.

"Since this ship will navigate the wild environment in the Arctic, it will attract the adventure-seekers, the nature lovers and scientific parties," says Seth. "Swimming with the Orcas, and the possibility of getting to watch a polar bear at close range, will be an adventure to treasure." On top of this, the aforementioned green propulsion set-up should help *Captain Arctic* to reduce CO_2 emissions by 90% compared to conventional cruise ships of this size, Goltens predicts.

Each tailor-made expedition will be led by a team of polar navigators and explorers, selected by Selar, with destinations set to include East Greenland and Svalbard. The ship's first charter voyage is scheduled for autumn 2026. ■

Wind and solar energy will power *Captain Arctic* "90% of the time"

CRUISE REFIT FOCUS PAYS OFF

In a relatively short space of time, Damen has become one of the market leaders in the specialist cruise repairs sector, writes **Clive Woodbridge**

Until 2017, Damen Shipyards Group had a relatively small-scale involvement in cruise ship repairs and retrofitting. That year, however, the company recruited the experienced industry professional Rogier van der Laan as product manager to head up a new cruise division within Damen Shiprepair (DSR) as part of a strategic corporate decision to focus more on this segment.

Cruise has now become one of the most important markets for DSR. Last year, DSR handled 16 cruise ship drydocking projects at various yards in the Netherlands, including its facilities in Rotterdam and Amsterdam, as well as at the Damen Brest yard in France and Damen Curacao in the Caribbean. This year, the pipeline of cruise refit projects will remain at a similar level, with at least 14 cruise vessels scheduled to dock at Damen yards before 2025 come to an end.

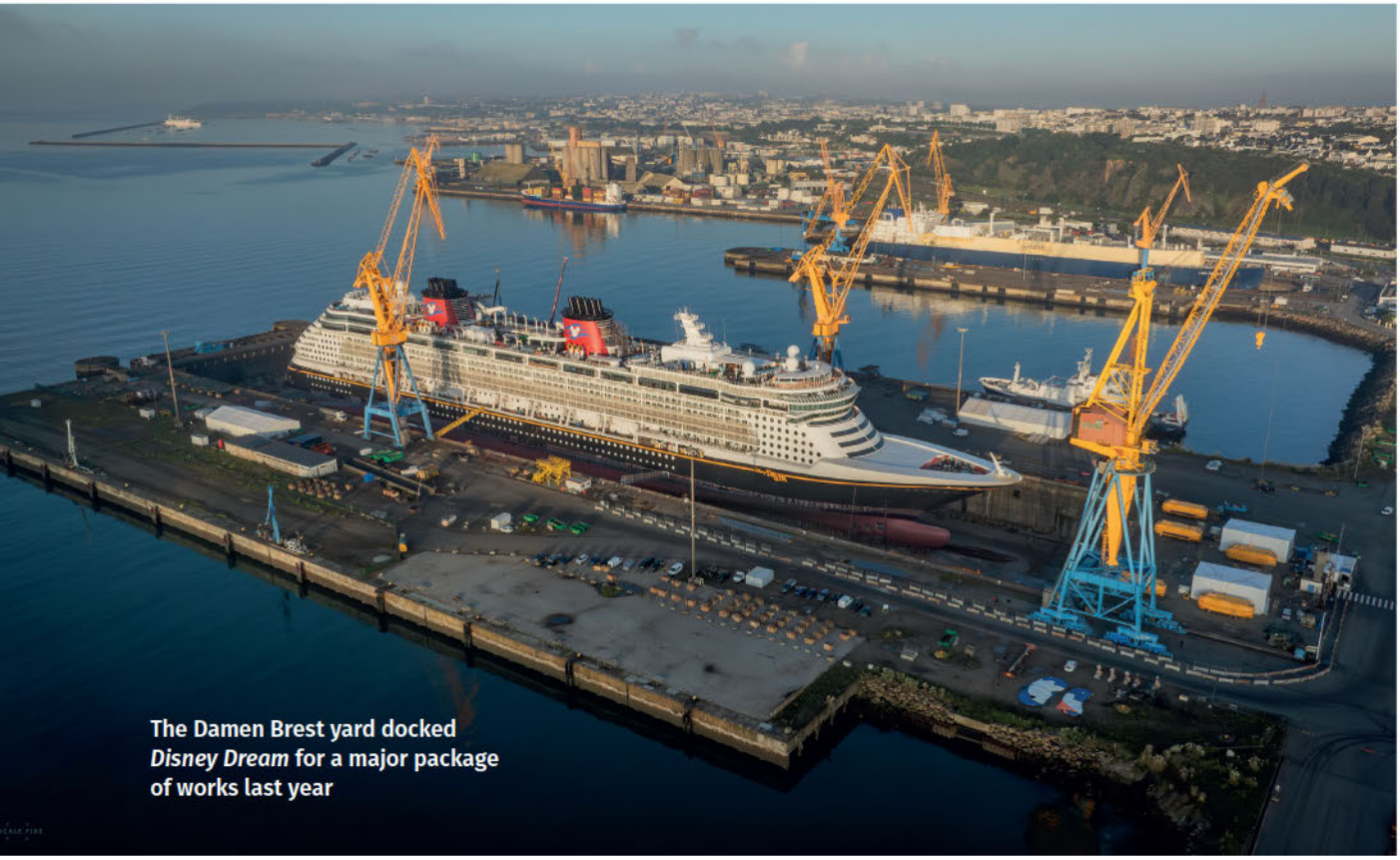
The longer-term strength of DSR's cruise order book has been bolstered further by recently signed framework agreements with Carnival UK and Norwegian Cruise Line (NCL), which will see vessels for several brands within these groups, including Princess Cruises and Holland America Line, docking ships with Damen over the next few years.

Dream contract

One of the highlights of 2024 was the docking of NCL's *Norwegian Joy* at Damen's Botlek yard in Rotterdam. This was followed by similar programmes of work for *Norwegian Getaway*, *Norwegian Star* and *Norwegian Encore* last year in Brest, with *Norwegian Bliss* and *Norwegian Breakaway* docking, also in Brest, in early 2025.

The biggest cruise project handled by DSR last year, however, was *Disney Dream*, which entered the Brest yard for a 32-day drydocking in September 2024. This programme covered technical and class-related works, including steel repairs, tail shaft and stabiliser overhauls and the replacement of the thrusters, as well as upgrades to the public spaces on board. One of the biggest challenges of this project was the need to meet the complex logistics requirements of the refit, with over 1,000 20' containers' worth of materials entering and leaving the yard during the vessel's stay.

The success of this project has resulted in Damen being awarded a contract to carry out a similar package of works on *Disney Fantasy* this autumn, which will enter Brest for another month-long docking. On this occasion, however, DSR has been



The Damen Brest yard docked *Disney Dream* for a major package of works last year

NCL is one of Damen's biggest cruise operator customers, with recent projects including *Norwegian Joy*, which underwent repairs in Rotterdam

contracted to carry out more work within the same demanding time schedule. In particular, the Brest yard will remove the existing bulbous bow and replace it with a new one, weighing 170tonnes (designed and engineered by the ship's original builder, Meyer Werft) to deliver significant fuel savings.

Regional differences

In another notable project, DSR handled an extensive drydocking for the Saudi cruise vessel *Aroya*, formerly *World Dream*, which spent around 36 days in drydock in Rotterdam, where it underwent work to its azipod thrusters, new coatings and extensive interior refurbishment.

DSR primarily handles cruise ships serving the North European market, including those operating out of the UK, the Netherlands and Germany. "It makes sense for the vessels to dock close to their home ports," says van der Laan, "and Damen has been able to successfully gear up to meet the growing need for cruise ship servicing in this region."

The Curacao yard has picked up some notable cruise ship projects as well. Capacity is limited by local infrastructure to vessels up to around 250m in length. However, its location makes it well-suited to meet the needs of expedition cruise ships operating in the Southern Atlantic and Antarctic regions especially.

Sustainable solutions

One trend DSR has noted is for cruise ship owners to focus even more on environmental sustainability during drydocking stays. As van der Laan points out: "We are handling a lot of extra work because of cruise operators' decarbonisation and energy-efficiency drives, with new technologies being retrofitted to achieve these goals. We are, for example, seeing a lot of interest in the Damen Air Cavity System [DACS] air cushion system, which can be retrofitted during longer drydockings of around three weeks. Overall, this trend means the average value of cruise ship drydocking is increasing, which is a positive for DSR."

Another important trend is the willingness of cruise ship operators to commit to forward bookings, with some dock slots at DSR yards now allocated through to 2029. "The fact that more slots are being booked well in advance gives us a solid basis to make investments to help meet [the owners'] needs and to do more work in shorter time frames," says van der Laan. "As turnover is more predictable, we can prepare well ahead and justify more investments in areas such as shore power, which is particularly beneficial environmentally for cruise ship projects." DSR already has shore power facilities at some of its smaller Dutch yards, but the aim is to install these environmentally friendly technologies in Amsterdam and Rotterdam too over the next few years.

Also being evaluated is the installation of a direct ramp leading into the drydock, allowing materials to be moved alongside the cruise ship by truck, as an alternative to using cranes. This way of working is already possible in Brest and has proved highly successful. The intention is to install a similar ramp in Rotterdam as well. ■

FALMOUTH YARD PICKS UP FRED. OLSEN PROJECT

Another shipyard group servicing the North European market is UK-based A&P, with its Falmouth yard completing an extensive programme of works for Fred. Olsen Cruise Lines' *Balmoral* towards the end of 2024. During its stay *Balmoral* went through a two-week programme of maintenance, including an ultra-high pressure water blast of the underwater hull, the application of silicone paint to improve fuel efficiency and the installation of new propellers and bow thrusters.

A workforce of more than 700 people helped to complete the programme, including 350 Fred. Olsen crew and 30 apprentices at A&P Falmouth.

Samantha Stimpson, CEO of Fred. Olsen Cruise Lines, says: "This is our third schedule of work to be completed by the team at A&P Falmouth, and continues our commitment to using UK shipyards, supporting the local economy and supply chain, and providing valuable experience to the workforce and its apprentices."

A&P's Falmouth yard undertook a wide range of work on *Balmoral*, including blasting and coating of the hull

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REACH FOR THE FUTURE

Reduced overheads and emissions, matched to increased job opportunities in offshore, are some of the key benefits of the uncrewed survey vessel *REACH REMOTE 1*, developed by Reach Subsea and Kongsberg Maritime

Demand for dependable research, survey and intervention vessels is booming, positioning this sector as one of the fastest-growing in the maritime industry in recent years.

This demand is being driven by numerous factors, including: a surge in offshore wind farm projects, necessitating detailed seabed mapping and environmental impact assessments prior to turbine installations; ongoing exploration needs within the oil and gas sector; and the growing requirement for vessels capable of supporting research projects focused on ocean health, climate change and biodiversity.

Utilising these vessels efficiently isn't always straightforward, though. "We're in an industry that's quite volatile when it comes to markets," explains Bjørg Mathisen Døving, VP for the REACH REMOTE fleet at Norwegian operator Reach Subsea. Seasonal changes in demand, combined with multi-year charter agreements, heighten the risk that some vessels may suffer periods of non-utilisation. Additionally, there is significant pressure on survey vessels to run efficiently and reduce emissions, particularly in ecologically sensitive areas.

ROV carrier

Formed in 2008, Reach Subsea specialises in deploying work-class ROVs (complemented by offshore personnel and land-based engineering support) to gather ocean data for clients. "We were looking for something that could make us a bit more competitive in this market," Døving tells *The Naval Architect*, "and we also wondered why we were utilising a big vessel for what were quite easy ROV deployment tasks."

A chance encounter with Kongsberg Maritime in 2015, during a research programme funded by the Norwegian Research Council, led Reach Subsea to consider the use of a remote-controlled uncrewed surface vessel (USV). This uncrewed craft would not only taxi a work-class ROV from site to site, but also act as a communications platform and 'energy carrier', providing the power required by the ROV for its offshore tasks.

The USV and ROV would be operated from remote operations centres (ROCs), which could be on land or on another ship, and nobody would physically board the vessel during its missions. This concept would evolve into Reach Subsea's *REACH REMOTE 1* USV, which was launched this January.

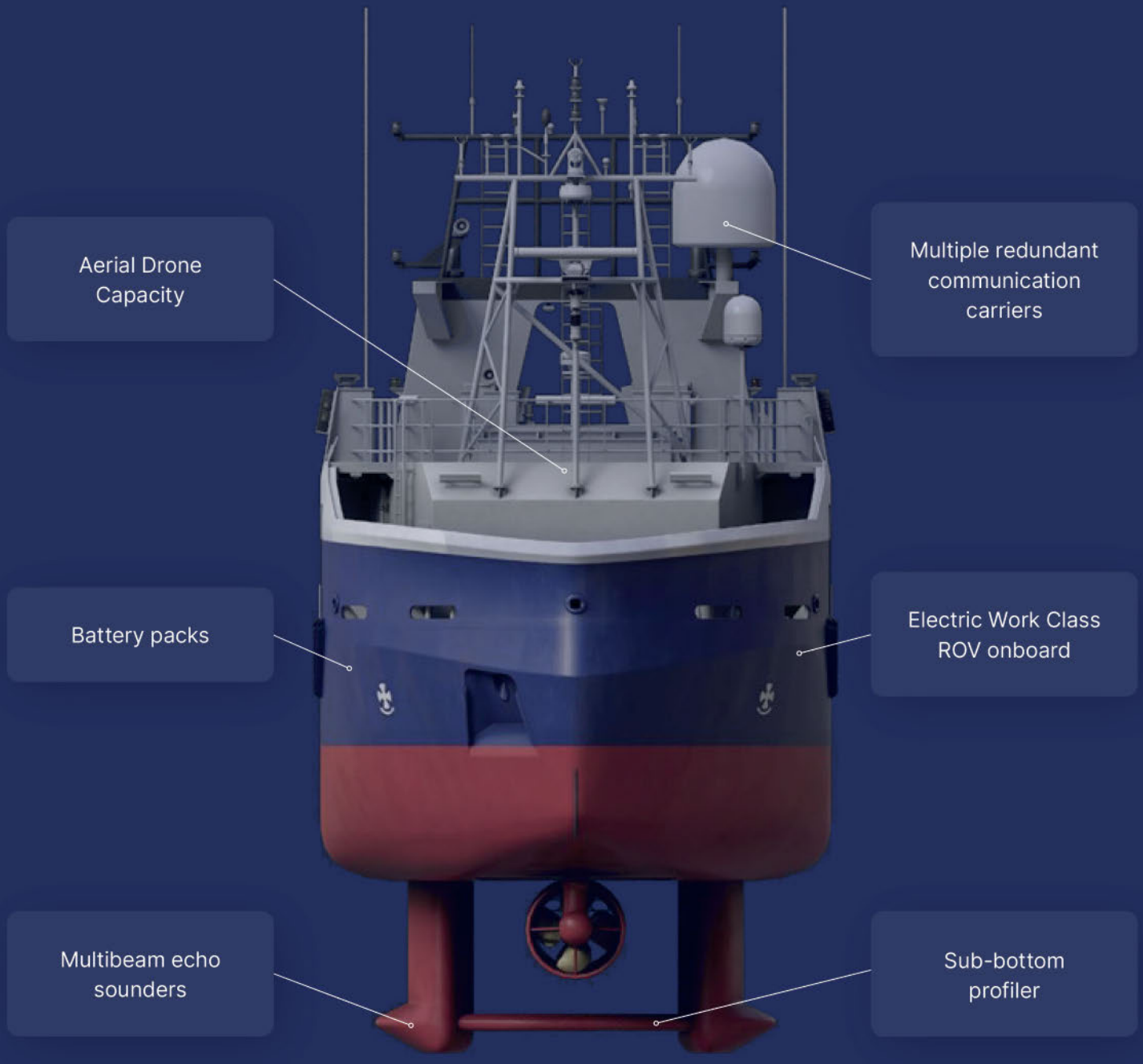
"We started off with a prototype programme, using a model basin at the Norwegian University of Science and Technology in Trondheim, where we tested the vessel's hull and the ROV, and their movements," says Døving. "From there, we worked with Kongsberg on a front end engineering design [FEED] study. At Reach Subsea, we have years of experience and knowledge of ROV operations, so we were able to add a lot of details for the final concept, especially regarding the onboard ROV launch and recovery system [LARS]."

***REACH REMOTE 1* was developed for purely remote-control operations**

Crew-free benefits

For Døving, the vessel offers numerous benefits compared to traditional crewed vessels. For instance, the smaller overall vessel size (think no need for heads, crew berths, fresh-water tanks or a galley), combined with the use of hybrid electric propulsion, spells lower rates of fuel consumption per operation, minimising the boat's environmental impact. Reach Subsea and Kongsberg decided to restrict the USV's length to just under 24m, to meet the UK Maritime & Coastguard Agency's (MCA's) Workboat Code 3 requirements.

An overview of the USV *REACH REMOTE 1*
(image: Reach Subsea)



Marthe Kristine Sand, Kongsberg (left) and Bjørg Mathisen Døving, Reach Subsea: the companies collaborated on the development of the USV for nearly 10 years

From a safety perspective, moving operations to onshore ROCs also removes the dangers faced by human crews in rough offshore environments and protects them from hazardous atmospheres. Additionally, as smaller, quieter vessels, USVs significantly reduce underwater noise, minimising disturbance to sea life.

There is also the benefit of reducing unplanned downtime by using shipboard predictive maintenance technologies to keep tabs on the performance of vital equipment and systems. Moreover, remote-controlled operations open up new job opportunities for a more diverse workforce.

"The remote operators don't need to 'physically' travel to board the ship, which creates openings for people with various restrictions to travel offshore, or people who may have other reasons – there are no obstacles to hinder them from working offshore," says Døving. "Also, we know that there are not enough crew in the world to actually man all the vessels – or, for example, the ferries currently working between the fjords in Norway – so we're increasing the amount of maritime personnel from a remote viewpoint."

Survey capabilities

Kongsberg then contracted shipbuilder Trosvik Maritime to fabricate the USV. This was an unusual arrangement for Kongsberg. As Marthe Kristine Sand, Kongsberg senior project manager, explains: "Normally, Kongsberg would supply the systems directly to the yard for outfitting – but this time, the yard acted as our subcontractor. This meant we were able to offer *REACH REMOTE 1* as a complete package, including the vessel, its systems and navcom package."

Sand, Døving and Kongsberg senior ship designer Erik Leenders (who headed up the USV's design) oversaw the development of the newbuild from the earliest design phase to the fabrication stage.

REACH REMOTE 1 isn't just dependent on its ROV for underwater tasks; the USV can also perform its own surveys, using two Kongsberg EM2040 multibeam echosounders and a Topas PS120 sub-bottom profiler, which has the capability to gather data up to 500m-deep.

The ROV is an electric work-class ZEEROV model, produced by Norwegian tech specialist Kystdesign. Rated 150hp (112kW), the vehicle measures 2.75m x 1.7m x 1.69m, weighs 3,800kg and can carry up to 600kg of sensors and scientific equipment. The ZEEROV can descend to depths of 2,000m, and has been specially developed for 30 days' worth of prolonged immersion, matching the USV's range.

Leenders says: "We've packed a lot of technology into this 24m vessel. It was quite a challenge to find a place for everything, but it's impressive to see how much we've managed to get into this small space. The vessel areas are a lot more spacious than I thought, despite having to shoehorn everything in." The sheer amount of power electronics, onboard systems and navigational equipment necessitated cooperation across three of Kongsberg's four divisions, Leenders and Sand reveal.

Equipment selection

As a result, *REACH REMOTE 1* is fitted with a range of Kongsberg automation solutions, including the company's K-Chief, K-Safe and K-Thrust systems, plus situational awareness software and hardware from Kongsberg Seatex and a Kongsberg HiPAP 502 hydro-acoustic positioning system.

Other equipment includes two Kongsberg Seatex video cameras (with 360° rotatability), a pan-tilt-zoom cam and a series of CCTV cameras, inside and outside – all of which provide real-time video streams to the crew in the ROC. The vessel is also equipped with Kongsberg's SpotTrack positioning device, which uses a rotating laser sensor to monitor multiple onboard targets to ensure that the boat maintains its position, even in rough seas.

Sand comments: "A lot of the systems we're using have been proven aboard conventional, crewed vessels and implemented all over the world. It's just a case of adapting these navigation systems to this new remote-control reality."

The partners are currently considering what to do with the USV's flat top deck. Døving hints that this area could be prepared for an aerial drone garage, which would enable *REACH REMOTE 1* to launch UAVs to assist in offshore wind turbine blade inspections, perhaps. The top deck is outfitted with a top hatch, as a contingency whereby the ROV can be hoisted out for maintenance when alongside a quay, but is also a suitable surface for a spread of solar panels, to provide additional clean energy to the battery packs.

Power supply

Described by Leenders as "the heart of the vessel", the Kongsberg-supplied LARS has been customised for crew-free operations, deploying the ROV beneath the surface through a 5m x 3m moonpool. Døving adds: "The umbilical that runs with the ROV is also a lifting umbilical with a SWL of 8.6tonnes. So, in principle, it acts like a winch. We could use the LARS with any drone or underwater vehicle that fits." The USV's deck area also contains two garages dedicated to ROV tooling, and which can store any additional special equipment if required.

The engine room houses two Volvo Penta diesel engines with permanent magnet alternators (see Technical Particulars), which provide power for both the vessel and the ROV. Using the diesel generators, *REACH REMOTE 1* can attain an endurance of 30 days. Kongsberg supplied the USV's two lithium-ion battery banks, which can be used for peak shaving and added spinning reserve in the event of engine failure, or to power the vessel in pure-electric mode.

Running solely on batteries would limit the vessel's endurance somewhat – perhaps to between half a day and a day, Leenders estimates – but this is an important feature that should also reduce underwater radiated noise when the boat has to enter waters with fragile ecosystems. The USV uses two ZF azimuthing thrusters, one fore and one aft, to maintain its redundant dynamic positioning (DP) capability.

Sea trial

Shortly before delivery to Reach Subsea, *REACH REMOTE 1* participated in a sea trial in Eidangerfjorden and offshore Langesund. The USV's remote pilots operated from a containerised ROC that had been temporarily installed aboard a 15m tug, *Avant*. This 'floating ROC' comprised a portable 'twin' of the shore-based ROC at Horten, which was launched last year by Massterly AS – a joint venture set up by Kongsberg and Wilhelmsen in 2018 to test and support remote-controlled vessel operations – which also holds the DOC and ISM for the Reach Remote vessels.

Avant remained within 200m of the USV throughout the trial, and this proximity gave the remote pilots good line-of-sight coverage when controlling the USV. To ensure effective connectivity, *REACH REMOTE 1* has been equipped with VSAT, StarLink, Iridium and Pointlink terminals, as well as 4G/5G and Maritime Broadband Radio capacities. The sea trial was also supervised by class society DNV and the Norwegian Maritime Authority (NMA), for whom the experience provided extra valuable insights into how remote-controlled ships perform in the field.

TECHNICAL PARTICULARS

REACH REMOTE 1

Length, overall	23.9m
Breadth, moulded	8m
Draught, max	5.5m
Gross tonnage	230tonnes
Deadweight	105 metric tonnes (with open moon pool)
Engines	2 x Volvo Penta D13 MH
Output of each engine	441kW@1,900rpm
Thrusters	2 x ZF ATL 4014 WM-FP, L-drive
Rating for each thruster	342kW
Service speed	9knots
Max speed	11knots
Min endurance	30 days
Fuel oil capacity	74.1m³
Urea	5.5m³
Bilge water	3.4m³

Kongsberg senior ship designer Erik Leenders: "I think we've produced the most redundant vessel in the 24m class"

Kongsberg contracted shipbuilder Trosvik Maritime to fabricate *REACH REMOTE 1*, which was delivered in January 2025

The USV will begin its working life later this year, conducting underwater surveys off the coast of Haugesund, on the west coast of Norway, where Reach Subsea maintains its Nexus Command Centre. Masters and qualified marine personnel at the Massterly ROC in Horten will focus on remote operation of the USV, while remote pilots at the Nexus Command Centre will handle the ROV intervention work.

Døving says: "We will have an 'offshore manager' responsible for the ROV operations – in other industries, he would typically be called the 'diving supervisor' – situated in the Nexus Command Centre. He will have control of the scope of work and the work permits we've been given by the clients if we're entering a field.

"He will liaise with the captain at the Massterly ROC, who is basically the 'transporter', responsible for taking the USV from A to B. When the USV is in position, the captain hands over to the offshore manager, who then controls the subsea operation and gives the remote ROV pilots info on where to go and what to do."

Allocation of duties

For the immediate future, within the Massterly ROC, work will be distributed so that each captain is responsible for one REACH REMOTE USV. In the longer term, though, as the ROC builds up its capabilities, the plan is to provide "such a degree of autonomy and automation that one captain can remotely control several vessels at the same time", Leenders says.

It should also be possible for the ROC-based captains to transfer a vessel between themselves as the need arises. For example, should the USV face a challenging situation – such as entering confined waters with lots of traffic – a more experienced captain could step in to take temporary control of the USV and manage any tricky manoeuvres, and then hand the vessel back to his colleague once these moves have been completed.

Døving imagines the perfect team at the Massterly ROC would include "one master, one navigator, and one chief engineer," with additional navigators on hand to ensure round-the-clock operations. She adds: "From our side at the Nexus Command Centre, we'll have an offshore manager and a team of six ROV pilots, plus two staff to assist with monitoring the ROV's position and some special specialist personnel, depending on the mission. So, if the ROV is carrying special equipment, we may have specialist advisors sitting next to the pilots, providing advice.

"We will also have an offline team, responsible for quality assurance and providing the acquired data to the client; producing the maps following seabed mapping exercises, for example."

Global rollout?

Avoiding excessive workloads and crew fatigue remains a challenge, even for crew members who work their shifts on shore. Reach Subsea's long-term goal, Døving says, is to establish more ROCs at strategic locations around the world. "These would assist with remote operations, so that we don't have Norway-based ROC personnel working night shifts," she explains. "Instead, we can transfer control of the vessel to a country where it is currently daytime."

However, Døving acknowledges that this approach introduces some legal uncertainties. Specifically,

there might be issues with splitting remote-controlled operations across different countries. She notes: "It may be the case that we need to keep the USV and its master within the same country, similar to what would be required in a traditional set-up."

Of course, international regulations for uncrewed vessels are far from being fleshed out, and this did present a few challenges during the development of *REACH REMOTE 1* – again, making the participation of DNV and the NMA essential. Leenders reflects: "We didn't follow the SOLAS requirements completely; only what was significant for this vessel. Normally, you have set rules, but these have all been written for manned vessels. Trying to match those to a USV is very difficult, sometimes impossible.

"For this project, we had to study the rules in more detail and write a concept of operation, taking in design and safety philosophies, and then get that approved by class and the NMA. Normally with ship design, the automation systems are something you drop in, but here, the automation, safety and communication systems all had to be connected and to work in parallel."

Leenders continues: "It was a long process, with a lot of back and forth with the authorities, and we had to really explain what we wanted to do. But I think we've produced the most redundant vessel in the 24m class – and, likely, the safest."

Future plans

As well as putting *REACH REMOTE 1* to work in Haugesand, the partners are also working on a follow-up sister USV, *REACH REMOTE 2*, which is currently nearing completion at Trosvik Maritime. Sand says: "This second vessel will undergo the same test regime as *REACH REMOTE 1*, but the process may be simpler, given the learnings we've gained from the production of the first unit." *REACH REMOTE 2* is scheduled to enter service in summer this year.

Reach Subsea will concurrently pursue a "scale-up programme" for the REACH REMOTE series, including the possibility of alternative designs, Døving hints. "We may need to have some sort of training and learning period first, which we hope to obtain over the next six months with *REACH REMOTE 1*," she says. "The scale of the technology will remain the same, but the size and attributes of the USV may change. We built these vessels 'on speculation' to reach a broader market, but it is our utmost desire to gain the interest of maritime clients with specific needs, so we will customise the REACH REMOTE series for specific long-term strategic relationships."

There will also be ongoing meetings with the NMA, drawing on the experience gained from the project so far. "We have a strong commercial interest in getting to the end game, where you actually have over-the-horizon control of the vessel," says Døving. "That's where, together with our partners and the authorities, we need to clarify the rules."

Døving concludes: "The USV concept that Kongsberg presented to Reach Subsea is just a case of using existing technology in a new way. These systems have been manufactured and tested for years, which gives us an advantage... we're not using technologies that have been newly developed, but ones that have been proven over time." As the maritime sector's adoption of uncrewed ship technology becomes more inevitable by the month, the REACH REMOTE project may come to be seen as a key milestone or 'lighthouse' project in establishing crew-free, remotely controlled vessel operations. ■

***REACH REMOTE 1* will now conduct underwater surveys off Haugesund, Norway**

AUTONOMY IN THE UK...AND BEYOND

The UK government has pledged to back the rollout of AI across the nation, but what does this mean for maritime developers working with this technology? *The Naval Architect* speaks to Marine AI

Artificial intelligence (AI) was back in the UK news in January, when prime minister (PM) Sir Keir Starmer pledged to make the UK a world leader in AI and to leverage the technology to fuel economic growth and enhance UK living standards.

The intention is for the UK to adopt all 50 recommendations set out by entrepreneur (and now, advisor to the PM on AI opportunities) Matt Clifford in his *AI Opportunities Action Plan*. Goals include: a "20-fold increase" in the amount of AI computing power under public control by 2030; the creation of a new National Data Library; establishment of an AI Energy Council; and the roll-out of a series of datacentres, dubbed 'AI growth zones', to speed up planning for AI infrastructure.

The government has also promised to support what it calls "national champion" AI firms and private-sector players within this field. The *AI Opportunities Action Plan* estimates that, if AI is properly embraced, it could come to boost productivity by 1.5% per year, equating to gains of £47 billion annually to the UK over the course of a decade.

"The AI industry needs a government that is on their side, one that won't sit back and let opportunities slip through its fingers," Starmer commented in January. "In a world of fierce competition, we cannot stand by...our plan will make Britain the world leader." The PM emphasised the benefits that AI is expected to bring to sectors such as healthcare and education.

Conspicuous by its absence, though, was any mention of how AI might provide a boost to the British maritime sector. Similarly, while the UK government was quick to canvass and publish the responses of multiple businesses and organisations to the news – including the UK Atomic Energy Authority, Amazon Web Services, Microsoft UK and Wayve Technologies, among others – it seemed to bypass the thoughts and opinions of marine players across the land.

Tom Rooney, Marine AI: "A lot of AI tech in the UK is privately funded or funded by venture capitalists... there's not a massive amount of government investment"

Maritime: overlooked?

Fortunately, this didn't daunt UK maritime tech firm Marine AI, which instantly greeted the news with the statement: "We fully support plans to leverage this transformative technology to drive economic growth. In the maritime sector specifically, we're leveraging the same cutting-edge techniques that power breakthroughs in other domains – machine learning, predictive analytics and real-time data processing – to open new efficiencies, strengthen global operations and realise opportunities for the UK's blue economy."

However, Marine AI also warned: "For AI to achieve its full potential, trust and transparency are paramount. Regulators, technology providers and end users must come together to establish robust standards that promote accountability, ensure ethical data-handling and encourage responsible AI development."

Tom Rooney, Marine AI general manager, tells *The Naval Architect*: "It's not so much that the maritime sector is ignored, but it's not considered as highly as some of the other sectors, such as automotive, general engineering and aerospace – especially when it comes to support for STEM programmes. Britain is an island nation, but government policy tends to look 'inward', even though there's a lot of investment and opportunity in the blue economy.

"Organisations like Maritime UK are constantly lobbying the government, so the policy-makers are aware of maritime...but our sector never really features specifically when these grand announcements come out."

Despite that, Rooney views the government statement as a step forward. "There's not a lot of money going round at the moment," he says, "so, it's good to see some investment coming out, though we don't expect to see this for a couple of years yet; we need to balance the books before we start seeing real investment in this sector. But it shows intent, and that is a positive."

AI "not going away"

Rooney continues: "Industry associations like Maritime UK, Innovate UK, Make UK and Society of Maritime Industries [SMI] are aware of the importance of AI. Innovate UK funding for further development and trials of AI technology would be welcomed. A lot of AI tech in the UK is privately

Marine AI is investigating how various autonomous systems can reduce the cognitive workloads of mariners in the commercial vessel sector

funded or funded by venture capitalists but, to my knowledge, there's not a massive amount of government investment in this technology. I'm hoping that Keir Starmer's announcement means that there may be more government funding available for development programmes for AI."

Oliver Thompson, director of engineering at Marine AI, adds: "One of the things we have to constantly do as a company is educate people to the benefits of AI. This technology has clear demonstrable value, in cutting down the amount of dirty and dangerous jobs to which we expose human crew – and that fact has been recognised at the highest level of government." Thompson especially welcomes the UK government's AI plan as "not only does it make our messaging easier, but, from a regulatory perspective, it means we can focus on the acceptance of risk from these AI systems".

This is crucial, Thompson highlights, because "these systems aren't going away". In his opinion, the pace of regulatory progress regarding AI in shipping has been "very limited", due to many companies sitting back and waiting for results from other sectors, or for others to take the lead. "But that approach doesn't really cut it anymore, as we have the technology here, today – it exists, but the challenge is in getting maritime companies to recognise its value," Thompson says.

Oliver Thompson, Marine AI: "Our experience of working with the US Coast Guard and UK MCA was like chalk and cheese"

Naval pedigree

Marine AI's software packages are built around its core GuardianAI offering, with some of the company's options including: GuardianAI Vision, for real-time vessel and floating object detection; GuardianAI Helm, designed to keep bridge watchkeepers updated on weather conditions and navigational info; and GuardianAI Integration, a high-res imaging solution incorporating LiDAR sensors provided by US tech group Ouster.

Historically, Marine AI's roots have been firmly in the naval and defence segments, and this legacy continues today. For instance, the group is currently involved in the US-based, DARPA-sponsored No Manning Required Ship (NOMARS) project – an initiative that has seen Marine AI supply its smart navigation technology (including enhanced situational awareness and collision avoidance tools) to an uncrewed 50m frigate. At the time of writing, the frigate was days away from hitting the water.

Marine AI has also supplied its autonomous tech to the UK Royal Navy's extra-large uncrewed autonomous vehicle (XLUAV) *Cetus*, which is being manufactured by Marine AI's parent company, MSubs, in Plymouth. This battery-powered, 12m x 2.2m subsurface drone will be able to cover up to 1,000 miles in a single mission, working alongside human-crewed submarines. Sea trials for the XLUAV are scheduled for March/April this year.

The company has also supplied its GuardianAI Helm software to the UK Royal Navy's 42m testbed vessel XV *Patrick Blackett*, a modified fast crew supplier. The software will be used to deliver real-time route recommendations based on full situational awareness and advanced tactical path-planning, giving the Royal Navy's NavyX division a chance to play with and analyse this technology in the field.

Entering the commercial zone

At the same time, Marine AI has gradually tailored its software to suit commercial vessel operations too, and Rooney and Thompson believe the time is right to cross over into the commercial sector.

Thompson says: "We're applying a mature defence offering with an established codebase to commercial vessel operations. This software and some elements of the system go back 20 years." Rooney adds: "It was important for us to get this right; it was only towards the end of 2024 that we reached the point where we were confident enough in the product's stability and performance when applied to commercial vessels."

While Marine AI's end goal is to provide a software suite that supports complete vessel autonomy, Rooney concedes that this will be a long path, best tackled in various stages. "Although the maritime industry is interested and working towards uncrewed vessels, the regulations

Marine AI has supplied its software to the UK Royal Navy's testbed vessel XV *Patrick Blackett*, in a contract with the RN's NavyX division

and the culture aren't ready yet," he says. "Our products were originally developed for defence programmes, where they are a bit more ambitious and able to run autonomous vessels without the necessary regulations that commercial vessels must stick to."

As such, a fair bit of mission-specific adaptation is to be expected. Thompson comments: "You can't avoid the classical approaches to control system design. You need to have a foundation of being able to write solid control code that is highly robust and assured – that's the start. Then you can start to layer in elements of AI and machine-learning tools.

"We spend a lot of time during product development in bounding those pieces of AI so that they can be as highly regulated and assured as the rest of the system. It's important to note that everything is modular, so you can swap out various components and not treat the package as one 'AI blob'."

Earning trust

For now, at the beginning of the maritime sector's AI journey, Rooney expects that most commercial vessel operators will utilise AI as "a very smart Sat Nav, or a tool to support traditional navigational methods – identifying potential obstacles and traffic around the ship, and providing a COLREGS-compliant, safe route," he says.

With time, though, as crew members become more familiar with these solutions and realise that they can fulfil a master's role on board, they may further incorporate AI into daily operations.

"AI can help ease mariners' cognitive burden, handling those tricky, complicated situations where you're in busy waters with traffic all around you, or it's night-time," Rooney points out. "When the operators are ready for it, they can start to apply conditional control, where the AI automatically takes control of the vessel if you're heading towards a dangerous collision situation, or a potential grounding situation. The AI system can take the ship out of danger, then hand control back to the human crew again, in the same way an AI-enhanced car might autonomously apply its brakes if you're about to smash into the back of someone."

The next and final leg on the path to full autonomy, once AI systems have demonstrated their reliability and earned the trust of crew members, is to "step off the vessel" and run zero- or minimal-crewed operations remotely, from a shore-based station or with the vessel set on a pre-defined course. "If the communications link between the ship and shore breaks down, we must be able to trust the system to look after itself in the time it takes for the remote crew to regain communications," Rooney says. "We can configure the system so that the ship either continues with its tasks during this communications blackout; stops operations and just holds station; or transits to a safe haven, where the operator can recover it."

Completely uncrewed, autonomous operations are "several years down the road", Rooney says, but he adds: "Our point of view is that we'll invest in the technology now and start using it, making the water safer and supporting the crews and what they

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do." The rest of the decade, then, might be seen as a period of testing and pre-emptive planning, to address potential barriers at a relatively early stage and to prevent delays to the widespread adoption of autonomous tech adoption.

"Of course, we are also looking to the future," says Rooney. "Our current-gen AI products are bleeding-edge tech but we're already looking to the future for their replacements. We must continue to develop – and that takes resources, time, people and effort. Writing the code isn't the hard part, we can train people to do that...the important part is sourcing people with innovative ideas of how to apply this technology."

Regulatory challenges

There are still regulatory hurdles to overcome – a task made more difficult given that various countries are applying their own maritime autonomous surface ships (MASS) rules and regulations independently of each other, and at varying pace. Rooney says: "The UK regulations are very nascent – autonomy and uncrewed operations are where the UK regs are still catching up with the tech."

In a way, there is a bittersweet irony to this; as Rooney puts it: "The world has always looked to the UK and the Maritime and Coastguard Agency [MCA] for regulation in the maritime space and has followed our lead. The MCA is aware of AI, but they are under-resourced – and they know that. So, right now, in this maritime autonomy space, much of the world is striding ahead and working on its own local regulations, while the MCA is still catching up" (Thompson cites Norway as an example of a country that has been more progressive, perhaps, in embracing maritime AI applications). Rooney credits the MCA with addressing uncrewed vessels in Edition 3 of the Workboat Code, but the problem, as he sees it, is that "there are parts of the Code that don't apply when you don't have people on the vessels...you're not going to need working heads or bathrooms, for example".

Thompson says: "Revising the Code isn't a streamlined process; you need to do a gap analysis and then seek exemptions for every single non-compliance and for every point that is not applicable at all to that platform." Naturally, this will be an extremely laborious, time-consuming process.

There are also cultural differences to consider. For instance, reflecting on Marine AI's work on the NOMARS project, Thompson continues: "Our experience of working with the US Coast Guard [USCG] and MCA was like chalk and cheese. The USCG reps were more than happy to talk about and walk through our safety systems to ensure that the USCG, as the competent risk-taker, would be satisfied with our procedures. They were present during our trials in the coastal waters and worked with us throughout the whole thing."

This experience stood in contrast to Marine AI's previous encounters with the MCA. "We were all but booted out of the country," he recalls. "This is because we have a platform that doesn't marry up to the MCA's legislation." However, he and Rooney are sanguine about the situation. "Neither approach is wrong," says Thompson. "One approach, it could be argued, is more progressive than the other, but there's also a question of short-term vs long-term gain. As Tom says, the world looks to the UK for the rulebook. The important thing we think is that, as a company, we have a foot in both camps, so we're benefitting from both methods of doing things – and, when it all ties together, we'll be well-placed for it."

Future predictions

To this end, Marine AI is also collaborating with members of the UK's Future Autonomous at Sea Technologies (FAST) cluster, based in England's south-west, which is bringing together industry experts and academics who are keen to evolve the development of uncrewed surface and subsurface vessel systems, as well as sensor systems, power systems and communications networks. "These things are best done collaboratively," says Rooney. "The maritime sector is a hugely collaborative sector where the different players know each other. Although we may be competitors in certain areas, we all understand the greater benefit of working together, especially when it comes to actions like lobbying the government to consider change."

Which brings us back to the UK government's January pledge to "turbocharge" the growth of AI. Looking to the future, Thompson predicts: "One big factor will be our ability to meet net-zero targets when it comes to wind farm technology, which is one of the country's most immediate needs. If we have to rely on crewed boats to go out to these sites and do all the early survey work, meeting those net-zero goals will be incredibly difficult; from our perspective, we don't see how it would even be possible."

Additionally, Rooney sees "collaborative AI" as a potential game-changer for offshore and underwater monitoring and surveillance. This methodology has also been described as 'swarm technology' in (mostly) naval circles, though that description has become somewhat associated with hostile operations. Rooney explains: "It involves multiple hulls working together as a single unit, so you can really spread your capability when conducting UXO surveys or sea-bottom surveys, or monitoring wind farms and wave hubs, for example. If you need to survey the seabed rapidly, using a number of uncrewed vessels, spread over an area and working autonomously as a team, there are potentially massive fuel, time and environmental savings. The industry recognises this, and that's why there is interest in this technology." ■

US LAGGING IN USV ADOPTION

A new strategy is sorely needed to introduce USVs more quickly to the US Navy fleet. **David Foxwell** reports

Uncrewed surface vessels (USVs) are already being developed and tested by several navies, and have played an increasingly important role in the war in Ukraine. However, a report submitted to the Secretary of the Navy suggests that the US Navy needs to rapidly accelerate investment in USVs and speed up the transition to a "hybrid fleet" consisting of conventional crewed and uncrewed units.

The US Navy will only be able to do so, the report suggests, if technology can be introduced much more quickly than at present, and at much greater scale.

Published in December 2024 by the Department of the Navy Science and Technology Board, the report, titled *The Path Forward on Unmanned Systems*, says naval planners and allies of the US (and potential adversaries) "all anticipate that future forces will employ hybrid manned-unmanned fleets, with at least one-third of forces being unmanned systems".

The report adds that navies are "just beginning to understand the full potential of uncrewed systems" but suggests that the US Navy's approach to developing USVs and introducing them into service needs to change.

USVs "needed now"

In the view of the Science and Technology Board, it is essential that the US Navy "moves as fast as the relevant supporting technologies generate opportunities, rather than at a pace that is bureaucratically comfortable".

According to the report, companies in the supply chain are ready to respond to the need for USVs, but are "confused and even despondent" that the US Navy has a 15-year plan for USV technology when it is needed now, and when the Ukraine conflict has demonstrated that USV technology "is imperative and evolving in real time".

The authors of the report add: "We believe that the development and integration of unmanned systems into war planning is particularly imperative because it offers the promise of relatively low-cost deterrence or, if necessary, warfighting in the event of conflict in the Taiwan Straits or South China Sea."

"Articulate goals"

Addressing the Secretary of the Navy, the report says: "We recommend that you direct an implementation plan that emphasises prompt fielding of unmanned vessels, using an iterative process of experimentation, prototyping, learning and acquisition that involves warfighters at every step and plans for continuous upgrades to capability."

To pursue this goal, the Science and Technology Board recommends that the US Navy should engage in "conceptual path-clearing" and "articulate goals, strategies and priorities, and operational steps involving immediate decisions about budgets, structures and programmes". The authors of the report add that the US Navy urgently needs to decide: what uncrewed systems will do operationally; how they will be deployed; how they will remain deployed and ready for conflict; how much they will they cost; whether USVs should be defended and sustained, or replaced and reused; and how they be acquired at scale.

Five areas

"The fleet has identified five operational areas where unmanned systems are valuable, and we recommend that you focus development efforts in these areas," the report continues. These areas are: maritime domain awareness and C4ISRT; fires; logistics, particularly contested logistics; resilient communications; and deception.

"However," the report says, "a path to acquisition is far from clear, particularly at scale. Acquisition of these systems competes with an already overstretched budget...and there is no broad acceptance that uncrewed systems will play a vital role in fleet operations and are worthy of focused investment."

In the Science and Technology Board's view, the Secretary of the Navy should ensure that there is sufficient budget for the operational deployment of USVs, theatre-specific experimentation and the development of concepts of operation. The Commander Unmanned Surface Vessel Force should be provided with a budget to enable "tech scanning" and system testing in advance of delivery to the fleet.

The Board also recommends that up to US$100 million of funding be allocated to support tech scouting and delivery to the fleet, and that the US Navy explore options for a dedicated uncrewed systems testbed. ■

The US Navy's Science and Technology Board says USVs need to be introduced into service more rapidly (image: US Navy)

MULTI-MISSION *HERNE* COMPLETES SEA TRIALS

Modular XLAUV *Herne* is designed for a wide range of missions and can be reconfigured according to requirements, writes **David Foxwell**

The XLAUV *Herne* was successfully tested on the south coast of the UK in late 2024

A team of British engineers in Portsmouth, UK has successfully demonstrated a new type of autonomous underwater vehicle (AUV) developed specifically for military use.

The unit, monikered *Herne*, is an extra-large autonomous underwater vehicle (XLAUV) configured by BAE Systems to enable military forces to monitor and protect underwater infrastructure on the seabed, support anti-submarine warfare missions and provide a means for them to undertake covert surveillance missions.

The trials, which took place in early November 2024, saw the AUV conduct a pre-programmed intelligence, surveillance and reconnaissance mission, powered by Nautomate, the company's platform-agnostic autonomous military control system. This follows successful trials of the technology on a surface vessel earlier in 2024.

The company describes *Herne* as a 'modular, highly configurable XLAUV' at the core of the design of which is innovative battery, propulsion and autonomy technology, providing maximum mission endurance.

Modular design

With large, adaptable payload modules comprising underwater and surface capability, *Herne* is capable of hosting a wide range of mission-specific payloads that can be configured to meet various mission profiles, including defensive and expeditionary roles.

NAVAL GROUP UNVEILS SEAQUEST S SURFACE DRONE

Naval Group in France has unveiled the SeaQuest S, the first in a series of surface drones designed and built by Naval Group subsidiary Sirenha, in partnership with the shipyard Chantier Naval Couach.

The USV's modular design is suited to the operational needs of users, whether civil or state, including those required to carry weapons, and to deliver optimal performances, even in challenging sea states (up to 4.5m Hs). It can operate as a single unit or with other USVs, and can be embarked on frigate-size platforms and support ships equipped with a dock or lifting equipment.

With a modular design, the Seaquest S range can be adapted to different types of operational needs such as electronic warfare (EW), anti-ship missiles (ASM) and intelligence, surveillance and reconnaissance (ISR). The range includes platforms of varying size that are suitable for various missions.

"The design of Seaquest S was possible thanks to the combined experience of Sirenha and Chantier Naval Couach," said Naval Group.

BAE Systems describes *Herne* as a "highly configurable XLAUV", combining battery-propulsion and autonomous technology

"*Herne*'s sophisticated command chain design is underpinned by years of pedigree in surface autonomy," says BAE Systems. "Its software has been specifically designed to have the ability to be reconfigured for each operation and every component has been intrinsically designed to have a low signature.

"Robust and secure data and communications packages sit at the core of the design, to enable effective communication with the host platform. With BAE Systems' proven experience in payload integration, *Herne*'s modular design allows for multiple potential payload options including ROVs, range extenders and advanced sonars."

A modular and agnostic approach to XLAUV design allows for flexible design and/or platform size, providing capability enhancements where required. *Herne* was designed with multiple launch and recovery options in mind, including from a harbour, a ship or a submarine. The flexible modules enable easy access to all internal components for easy maintenance.

Nautomate offers a range of standard and configurable features that can be tailored to a surface or subsurface vessel. It 'mimics' the way a human considers potential collision risks and identifies safe avoidance manoeuvres, and is designed to be cyber-secure and future-proofed. It combines inputs from different sensors to improve the accuracy and integrity of its surrounding world model, and can be controlled from a portable command and control suite.

Safe from harm

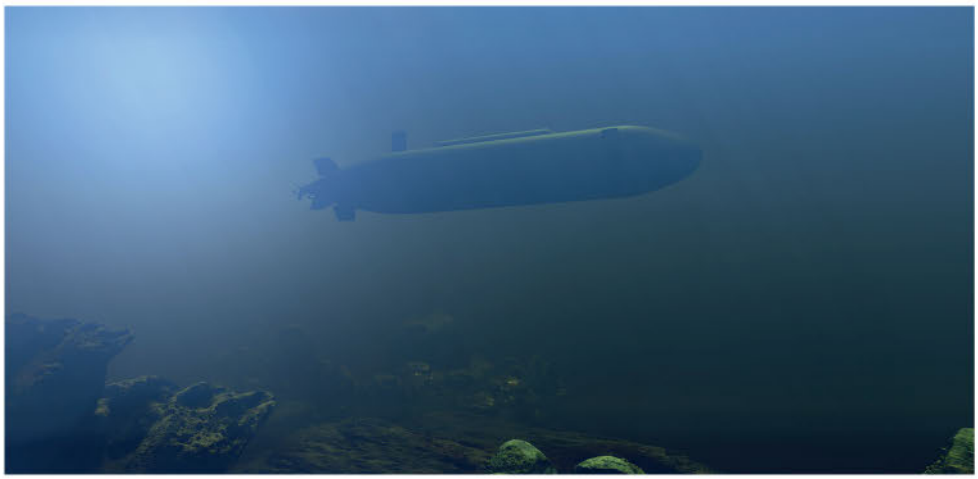
Scott Jamieson, MD for maritime services at BAE Systems, comments: "*Herne* is a game-changer in the underwater battlespace. It will give our customers a cost-effective autonomous capability that will allow for a wide range of missions, ending the reliance on crewed platforms, keeping people out of harm's way and boosting endurance."

BAE Systems adds: "Able to be fitted to existing or newbuild vessels, Nautomate gives users a cost-effective option to boost their autonomous capabilities, allowing them to operate with greater scale, endurance and persistence, whilst removing the need for human crews to operate in arduous or dangerous conditions. This can free up skilled personnel to focus on the tasks where people add most value.

"An added benefit of underwater autonomy is that, without the need to resupply or carry life support systems, *Herne* will be able to patrol the subsurface domain for far longer than a crewed alternative. It can also be upgraded as new technology or ways of working evolve by using open-architecture mission plug-ins."

BAE Systems collaborated with Canadian company Cellula Robotics to deliver the demonstrator configuration of the *Herne* XLAUV. This successful collaboration resulted in a 'whiteboard to water' capability within just 11 months.

Now that the technology has been successfully demonstrated, the BAE Systems team will continue to refine *Herne* with further trials, depending on customer requirements. ■



***Herne* is configured for roles ranging from protecting underwater infrastructure to supporting anti-submarine warfare**

RISE OF THE REACTORS

Nuclear microreactors, especially new Gen-IV designs, could help commercial ships meet decarbonisation goals faster than expected, as attitudes towards nuclear energy undergo a significant shift

One of the most significant shifts in the maritime sector has been the consideration of nuclear energy as a potential fuel for commercial vessels. In just six to seven years, this idea has transformed from an unlikely prospect to one that is gaining considerable support in various circles.

This turnaround reflects what's happening on land, where high energy costs and doubts about the long-term feasibility of other fuel options have renewed interest in nuclear energy for its plentiful energy. For decades, nuclear power has been portrayed as something dirty and highly dangerous, but it seems that opinion is shifting – and rapidly.

On the maritime side, a fuel energy comparison produced by class society Lloyd's Register concluded that uranium and thorium, both potent nuclear fuels, can generate over 80.6 million MJ and 79.4 million kilojoules (KJ)/kg respectively, compared to 142KJ/kg for hydrogen, 46KJ/kg for diesel fuel and 19KJ/kg for liquid ammonia. In the energy stakes, nuclear power clearly has a lot to deliver to an industry that's up against fast-approaching emissions deadlines and, in many cases, tight budgets.

Shift in mindset

One expert watching these developments closely is Jonathan E. Stephens, professional nuclear engineer and manager at BWX Technologies (BWXT), who delivered a presentation, *Nuclear Technology for Commercial Maritime Propulsion,* at the most recent RINA President's Invitation Lecture, hosted in London in November 2024. Headquartered in Virginia, BWXT manufactures all the nuclear reactors used by the US Navy's aircraft carriers and submarines, having supplied over 400 reactors to date, and produces nuclear fuel and components for commercial, research and test reactors.

Jonathan Stephens, BWXT: the maritime industry can expect to see a "phased approach" to nuclear energy adoption in the coming years

Stephens works in the Advanced Technologies segment of the company, which develops commercial advanced reactor technology separate from navy-related operations.

For Stephens, it's not a case of whether the wider maritime sector embraces nuclear power, but when. "We've seen a definite shift in civil maritime, driven by the IMO decarbonisation mandates," he tells *The Naval Architect*. "A lot of shipping companies are looking at ways they can meet the 100% decarbonisation target and concluding that there are no other viable options.

"The only ways operators can meet that target is either with e-fuels, such as hydrogen and ammonia, or an onboard nuclear plant. With the former, you need to show that you're generating those fuels with emissions-free sources of energy – and that's an entire other challenge. So, many ship operators are concluding that it's at least worth looking at onboard nuclear plants, especially as this technology has been installed on vessels before."

The right isotope

Nuclear power at sea is nothing new, of course – navies have been tapping this energy source to fuel submarine and aircraft carrier operations since the 1950s. According to the World Nuclear Association, more than 160 ships are currently powered by more than 200 small nuclear reactors.

It's not as simple as transferring submarine reactor tech to the ferry, cruise ship, yacht and container ship sectors, though. Stephens explains: "Naval vessels can run on nuclear plants for a very long time without refuelling – up to 20 years, typically – but that's because they are using highly-enriched uranium [HEU]."

In fact, he adds, most of these military ships use what we might call 'weapon-grade' uranium, having been enriched to contain more than 90% of the uranium-235 (U-235) isotope. "That's the type of stuff that, if you have the wherewithal to do so, you can use to build a bomb," Stephens says, "so, for proliferation reasons, it's not really on the table for commercial use."

BWXT and Crowley have signed an MoU to develop the concept for a series of 115m, microreactor-equipped ships to deliver power to shoreside facilities (see box, page 65)

In contrast, most commercial powerplants on land use low-enriched uranium (LEU), which usually features U-235 isotope content as low as 5%. For commercial vessels, though, Stephens sees high-assay low-enriched uranium (HALEU) as the most viable option. This is uranium that has a U-235 content higher than 5% but lower than 20%, which can be added to the 'Gen-IV' range of advanced reactors and small modular reactors (SMRs).

"HALEU is enriched to just under 20% because that's the threshold at which it's considered a proliferation issue," says Stephens. "So, most of the advanced reactor concepts out rely on the use of HALEU. The downside is that HALEU features one-fifth of the enrichment of HEU, so you're also going to get shorter cycle lengths out of it." While not widely used commercially yet, HALEU is steadily being adopted by various industries; to produce medical isotopes, for example.

New reactors

A major advantage of nuclear power for ships is that once a nuclear reactor has been installed on board, the ship has enough fuel to last for the entire operational lifespan of the reactor's design cycle, Stephens says.

This contrasts with sourcing e-fuels such as ammonia and hydrogen at regular intervals, as the supply chains for these alternative fuels are still underdeveloped in places. "For the earlier reactors that are out there, I would guess we're talking five-year cycles," he adds. "Ideally, you would line that up with the vessel's overhaul schedule anyway, and either replace the reactor's entire core or refuel the core – but you wouldn't need to do anything fuel-wise in the interim."

Stephens is especially excited about some of the opportunities that the emergent Gen-IV reactors may offer. "Some of the advanced reactor concepts out there aren't quite ready for prime time yet," he says, "but we envision that one day we'll have reactors capable of continuous online refuelling." This is a design feature where the operator can keep the reactor running at full power while adding new fuel and removing spent fuel, thereby avoiding downtime. It would also enable users to extend the reactor's operational cycle – just as one tops up a car with diesel as required, without first draining the whole tank.

"These reactors would either take fuel in the form of billiard-ball-sized pieces, or in a liquid form," Stephens predicts. However, he concedes, continuous online refuelling at sea would be a technically challenging process, and comes with safety and training issues. "I think we're years away from that at the moment," he says.

Straightforward installations

Another key issue for shipowners considering nuclear power is deciding from where they would obtain the nuclear reactors or fuel. As Stephens points out, this would largely depend on each shipowner's location and their country's government policy, in the absence of an international regulatory framework.

"There are still a lot of unanswered questions," says Stephens. "This is why we're trying to push this first inside the US or UK; it'll be easier than trying to figure out how this will work internationally, especially when you start talking about countries that don't even have a nuclear regulator."

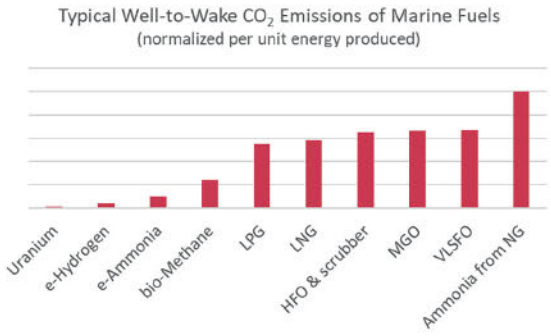
Additionally, he sees the reactor installation process as being hassle-free. "The thinking is, you would build the vessel without the nuclear reactor in it, then bring the vessel to either an existing port in the US or UK that has been outfitted to support it – or maybe to a special port built specifically for the purpose of installing nuclear reactors," he says. "These advanced reactors are largely factory-manufactured, so it wouldn't take a big construction effort on site.

"The manufacturer would make the package and then you would 'drop it in' to where it's going to go aboard the vessel. So, it's a relatively straightforward operation, especially given what these vessels and shipyards are used to doing in terms of handling installations. There's no radioactivity in a fresh reactor core, so there would be no real problem regarding exposure to radiation."

Regulatory challenges

There are hurdles when it comes to licencing this technology, though. "I don't think the US Nuclear Regulatory Commission [NRC] is certain yet how it's going to actually licence commercial maritime reactors until somebody submits one. My guess is the NRC would use similar principles to licencing any other reactor; there would be a certain safety

The typical well-to-wake CO_2 emissions of marine fuels, compared (image: BWXT)



analysis to demonstrate that if the ship sinks, the reactor will be kept in a safe state and not jeopardise public safety. There aren't a lot of details out there, though, until someone takes the next big step and commits to building one of these maritime reactors."

Part of Stephens' work is to try to encourage marine sector players to take that step. BWXT is one of the founding members of the Nuclear Energy Maritime Organisation (NEMO), an NGO focused on getting international regulations for commercial vessel-borne reactors up to par.

"When you get into international space, there are no regulations in many cases – and, if there are, they're usually specific to the older, traditional reactor technologies, which are generally not being considered going forward," Stephens says. He cites the example of pressure water reactors (PWRs), which require significant downtime for refuelling.

He adds: "The Gen-IV reactors are characterised by their passive coolability [the ability to cool themselves down without external intervention] and 'walk away safe' design philosophy; they are designed so they cannot melt down if something goes wrong. That's why these new designs are appealing for maritime cases. I'd hate to say they're 'foolproof' but they come pretty close.

"For these new technologies we're looking at – such as gas-cooled reactors and molten salt reactors – there are no regulations for maritime applications, though. So, NEMO has taken on the challenge of trying to encourage regulatory updates, both with the International Atomic Energy Agency [IAEA] and IMO."

As well as addressing the regulatory aspects, Stephens and his industry colleagues stress the need to consider the commercial side of adopting nuclear power. For example, nuclear-fuelled ships could provide clean power to ports, harbours and ferry terminals, generating additional revenue for this service. Similarly, nuclear vessels could provide power to remote island communities, or to areas where the electricity may have been knocked out. "Supplying power to shore is definitely of interest, but nobody has published an ironclad business case for it so far," says Stephens.

Floating plants vs vessels

In addition to nuclear-fuelled ships, participants in NEMO have also been assessing the feasibility of floating nuclear power plants. Stephens says: "Most people believe that the floating nuclear plants are likely to come first because there is a little less to deal with regulations-wise, as they will be positioned in one place."

This brings up the issue of reactor waste disposal. "The answer to that also depends on which country you're in," says Stephens. "The challenge nuclear power plants have now is that they need a permanent repository for the waste. Right now, though, they're leaving it on their operating sites. I think the expectation is that, as required by US law, we will have a permanent geological repository, and you would simply dispose of the fuel there, in the same way we currently do with commercial nuclear fuel. The day might come when we are better able to reprocess or recycle some of that waste, but that's further down the line."

Consequently, the "silver lining" for maritime applications is that ships would effectively take the waste away with them. "This could be seen as a benefit for small island countries with floating nuclear power plants who are worried about being stuck with this waste in their territory," Stephens says.

Project development

BWXT is currently involved in Project PELE, a US Department of Defense initiative to develop and demonstrate a mobile, small-scale nuclear reactor for military use in remote environments. While much of the project is confidential, Stephens shares that BWXT is building a gas-cooled reactor (GCR) for PELE, which will represent "the first microreactor to be built in the US for decades". The prototype GCR will be built in Lynchburg, VA and operated for testing at the Idaho National Lab. He adds: "We're learning a lot from this project, some of which we will be able to apply to our commercial activities."

These learnings will certainly feed into the BWXT Advanced Nuclear Reactor (BANR) programme, which aims to develop a high-temperature gas-cooled microreactor. Although BWXT will initially use this reactor to support industrial mining efforts, the long-term goal is to deploy it for maritime and terrestrial applications. The high temperature of the reactor will enable direct use of heat for processes such as desalination and even hydrogen and synthetic fuel production, potentially widening the scope of operations and activities available to vessels.

It's also worth noting BWXT's Project DRACO, which stands for 'demonstration rocket for agile cislunar

Jonathan Stephens: "Once somebody commits to maritime nuclear power financially, you could get it out there within five to six years"

operations' – which will develop a reactor that may eventually propel shuttles to Mars. "Nuclear propulsion gives you a lot more flexibility for getting material and people to Mars than a chemical rocket does," Stephens explains – and we can certainly think of a few high-profile entrepreneurs who might take an interest in that concept.

Achievable within years

As Stephens notes, though, for all this progress (and in a relatively short amount of time), there is still a distinct shortage of commercial nuclear vessels – so what would be a reasonable timeline to adoption?

Industry opinions tend to vary on this topic. For instance, asking that question in 2019 may have prompted a likely answer of 'within a few decades'. In 2024, however, law firm HFW told RINA publication *Ship & Boat International* that the industry could expect to see nuclear-powered vessels (and, in particular, nuclear-powered superyachts) on the water within as little as "five to six years".

Stephens agrees with this latter assessment, commenting: "I wouldn't be surprised to see this happen within the next decade." However, he highlights, we won't witness a sudden shift to nuclear power. "There tends to be confusion over the different reactor generations," he says. "It's unlikely that some of the Gen-IV reactor concepts, such as molten salt reactors, are going to be ready for commercial maritime use within the decade.

"So, we'll probably see a phased approach, starting with the application of mature but maybe not quite as fancy technologies, like PWR-based technologies. Then, as the really cool developments like continuous online refuelling become ready, they'll be introduced in the next phase."

The maritime industry may have to overcome a degree of hesitancy to make nuclear-fuelled operations a reality. "There are a lot of people at the starting line, ready to go on this – including BWXT," Stephens says, "but it's a matter of 'when is somebody going to really commit?'. A lot of companies have contracted nuclear industry groups to conduct feasibility studies and economic studies, but we're still on the edge of somebody actually saying, 'Here's enough money to get a detailed engineering, design and licencing effort underway'.

"That, I think, is the next dam that we're waiting to break – and, when that happens, this can move pretty quickly. I'd say, once somebody commits to maritime nuclear power financially, you could get it out there within five to six years. But, until that happens, that timeframe is going to slide.

"A lot still needs to happen. A lot of regulations don't exist yet, and there are lots of questions about which ports and vessels will be involved – but I can't see a single barrier that couldn't be overcome with sufficient motivation." ■

BWXT has signed a memorandum of understanding with Crowley to develop the concept for a series of zero-emissions ships equipped with factory-fabricated microreactors. The proposed 115m vessels would supply small-scale nuclear energy to shoreside facilities, such as military bases in remote island locations, and would provide back-up to utility grids after disasters.

For this concept, BWXT envisages the use of a modular reactors of between 5-50MW, which would be activated upon arrival at the destination and then deactivated and transported after the power supply is discontinued. "Buoyed power delivery cables will enable the ships to deploy energy connections to shore," says BWXT. "Shallow-draught hulls allow the vessels to manoeuvre to strategically deliver power for military activities, or if disasters limit harbour access."

WAPS RETROFITS GAIN MOMENTUM

The year ahead could see a step change in demand for wind-assisted propulsion systems, as more owners accept the evidentiary support for harnessing wind power to meet environmental regulatory requirements, writes **Clive Woodbridge**

A recent report from UCL Energy Institute suggests that a rapid transition to alternative, decarbonised fuels could lead to the "premature scrapping" of over a third of the current ocean-going fleet, valued at more than US$ 400 billion, unless they undergo costly retrofits to remain competitive in the wake of new greenhouse gas policies and wider energy transition.

There are signs that shipowners are stepping up action to address such concerns, and there has been a significant upturn in environmental retrofits generally over the past few years, with one of the fastest growing segments being the installation of wind-assisted propulsion systems (WAPS). The International Windship Association recently stated that it anticipates there will be more than 100 large wind-assisted powered vessels by the end of 2025 – about double current numbers – and much of this growth is being achieved through retrofitting, although newbuild orders with WAPS are also on the rise.

It is estimated that around 75% of the current WAPS-equipped fleet are retrofits, mainly involving tankers and general cargo ships. Rotor sails have been the preferred option for tankers, accounting for about 54% of this sector, while suction sails are the main choice for general cargo vessels, at 67%.

Retrofit surge

In a recently published white paper on WAPS, classification society DNV noted that wind-assisted propulsion has already delivered annual fuel savings of between 5-20% for certain ships, resulting in reductions in greenhouse gas (GHG) emissions in the same ratio. “An increased adoption of WAPS by larger cargo ships in the deep-sea segment, which are responsible for approximately 80% of global shipping emissions, would contribute significantly to achieving IMO GHG reduction goals,” it concludes.

The white paper also points out that retrofitting WAPS can be technically achieved on almost any ship that offers sufficient deck space and unobstructed airflow, even if the ship was not originally designed to accommodate sails. This adaptability allows for the implementation of

BAR Technologies has reported an increase in enquiries for its WindWings system over the past 12 months

bound4blue presented an interesting case study involving the chemical carrier *Bow Olympus* at RINA's CII conference, held in London in January

WAPS across a diverse range of existing ships and ship types, the paper concludes.

According to Knut Ørbeck-Nilssen, CEO, maritime at DNV: "As we navigate the maritime energy transition, it's crucial to consider all options for decarbonisation. As more verified data comes in, the business case for WAPS technologies is building. They are already delivering significant fuel savings when matched to the right vessel type and operational profile. And, as part of the suite of new energy efficiency technologies, WAPS are stepping up to deliver immediate emissions reductions and play a growing role in the maritime decarbonisation journey."

Even those owners not ready to commit now should be preparing for later retrofitting to wind propulsion on current newbuilds, DNV suggests. The white paper states: "This may be relevant due to the unavailability of WAPS at the time of construction or at the newbuild location. Such preparation may include providing structural foundations, ensuring intact stability compliance, and addressing navigational considerations such as maintaining an unobstructed line of sight.

"By taking these steps, the goal is to minimise or eliminate the need for significant modifications when the WAPS is eventually installed, reducing costs." DNV's additional 'WAPS ready' class notation takes a modular approach, offering compliance verification in different technical areas, the society points out.

"Abundant resource"

Not surprisingly perhaps, suppliers of WAPS technology are urging more shipowners to take the leap and invest in WAPS upgrades.

"We're at a pivotal moment," John Cooper, CEO at BAR Technologies, says. "The shipping industry must now take wind propulsion seriously as a keystone resource and engage more deliberately to debunk concerns around operational complexity and reliability.

"As a natural resource, the amount of wind available for harvesting on each voyage will fluctuate, but the data is very clear: when averaged out over time, wind represents a steady, reliable and highly abundant resource, which can be effectively 'bunkered' along many trade routes."

BAR Technologies reports "a dramatic increase in enquiries" in 2024 with regard to its WindWings wind-assisted propulsion system. Cooper adds: "It has been inspiring to witness the shift in attitudes as the global focus has sharpened on decarbonisation. BAR Technologies' solutions, such as WindWings, directly address the urgent need for solutions that reduce emissions and align with regulations such as FuelEU Maritime, the EU Emissions Trading System and other global carbon taxes. These policies highlight the increasing demand for efficient, eco-friendly products that meet compliance requirements and drive operational cost savings for our clients."

Following testing between August 2023 and March 2024, a WindWings retrofit demonstrated that energy consumption on the main engine of Mitsubishi Corporation's *Pyxis Ocean*, a 229m Kamsarmax bulk carrier, was reduced by 32% per nautical mile, following independent assessment by DNV Maritime. Building on this success late last year, BAR Technologies announced the signing of an MoU with Mitsubishi Corporation and Nihon Shipyard. The MoU will set a framework for further collaborations between the three businesses following the *Pyxis Ocean* WindWings installation.

To meet growing demand, BAR Technologies is investing heavily in expanding its workforce. This has included four additional naval architects and 13 engineers – with expertise spanning software development, systems control and composite design – over the past year.

Tanker project

Also pushing the case for WAPS retrofits is bound4blue, which recently gave an interesting presentation to the RINA *Managing CII and*

***Sohar Max* is claimed to be the largest vessel yet to be fitted with WAPS**

Associated Challenges technical conference, held in London in January this year. This highlighted the technology's ability to assist with CII compliance through a simulation undertaken in connection with *Bow Olympus* a 30,488gt chemical tanker operated by Odfjell and constructed in 2019, which will be retrofitted this year with four 22m eSAILs, a technology developed by bound4Blue.

To illustrate the impact of the technology, bound4blue utilised historical data, from 2023, of the vessel's routes, operational experience, wind and other weather and ocean conditions, feeding the information into an advanced simulation and modelling system. When combined with the company's own proprietary aerodynamic modelling of the planned eSAILs, this unlocked a clearer understanding of how the vessel would perform following the installation, and the effect on CII ratings.

Based on *Bow Olympus*' effective days at sea in 2023, bound4blue's simulation showed a forecast potential reduction of some 1,616tonnes of CO_2 per annum with the four planned eSAILs. Furthermore, if advanced weather routing were to be introduced, the suction sail technology could enable an average increase in CO_2 reductions of up to 80%, or around 2,908tonnes of CO_2, bound4blue claims.

The company compared how the vessel would perform over the coming years with and without the planned retrofit, and with a 3% annual reduction in CII limits from 2027 onwards. With the eSAILs, bound4blue says *Bow Olympus* would achieve a B rating up to, and including, 2026, with a C rating afterwards. Without the eSAILs, operations from 2024 to 2028 would all be rated C, falling to a D in 2029 and 2030.

According to Simone Saettone, vessel performance manager, bound4blue: "eSAILs drastically reduce fuel consumption and emissions, unlocking both commercial and environmental benefits. In doing so, they open up a practical, cost-effective pathway to compliance with a new generation of maritime regulations.

"This is important today and absolutely essential tomorrow, as these regulations [including CII] grow increasingly stringent over time, penalising underperformers with a sliding scale of penalties. This means vessels scraping by now will not make the grade in the years ahead, leaving 'wait and see' shipping companies with a major compliance headache."

In November 2024, bound4blue secured its biggest contract yet from Maersk Tankers. A total of 20 of its eSAILs will be retrofitted onboard five medium range (MR)-type tankers – *Maersk Tacoma, Maersk Tampa, Maersk Tangier, Maersk Teesport* and *Maersk Tokyo* – in 2025 and 2026.

Rotor sails

Another technology supplier, Anemoi Marine Technologies, recently completed the installation of five of its Rotor Sails onboard the 400,000dwt very large ore carrier (VLOC) *Sohar Max*, making it what is claimed to be the largest vessel to receive wind propulsion technology to date.

Sohar Max, a first-generation Valemax built in 2012 in China's Rongsheng shipyard, was retrofitted with five 35m-tall, 5m-diameter Rotor Sails at the COSCO Zhoushan shipyard in China. In addition, Anemoi installed a bespoke folding deployment system, which will enable the sails to be folded from vertical to mitigate any impacts on the vessel's cargo-handling operations. With the installation of the Rotor Sails, it is expected that *Sohar Max* will now be able to reduce its fuel consumption by up to 6% and cut carbon emissions by up to 3,000tonnes annually.

Another notable recent retrofit project involved a Rotor Sail developed by the Finnish company Norsepower being installed onboard the bulk carrier *Yodohime*. The installation work was carried out during a docking in December 2024, and the first voyage after the installation was successfully completed in January this year.

The 24m x 4m Norsepower Rotor Sail was installed on the forecastle deck of the vessel. AI technology automatically controls the rotation, direction and speed of the rotor sail, using real-time meteorological information, such as wind direction and wind speed, detected by sensors. The Magnus effect, generated when wind meets the rotating cylindrical sail, produces a powerful thrust which, in combination with the voyage optimisation system, is expected to reduce fuel consumption and CO_2 emissions by approximately 6-10%, Norsepower states.

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Econowind has upgraded the WAPS on board a Marfret vessel to its latest VentoFoil design

Late last year, three Norsepower Rotor Sails were installed and commissioned on board the 100,449dwt Post-Panamax bulk carrier *Chinook Oldendorff*, at CSSC Chengxi Shipyard, China. The installation and commissioning processes were performed simultaneously with the vessel's hull painting and other necessary repairs.

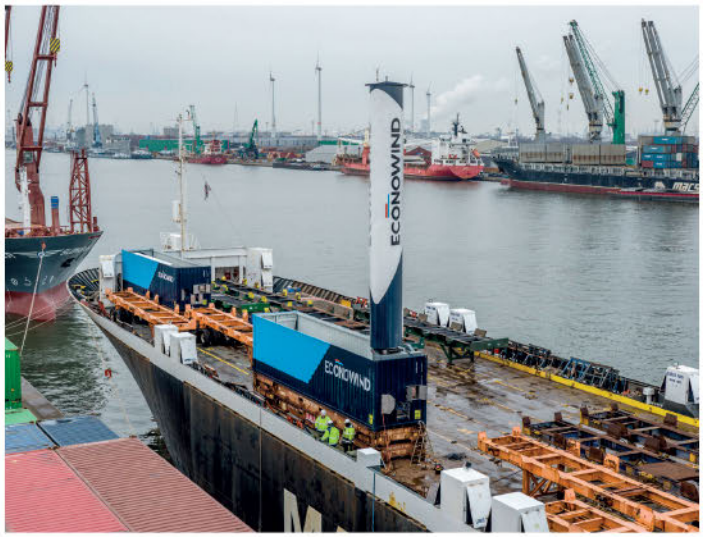
Tractive force boost

In an interesting project, Dutch company Econowind has upgraded the existing wind propulsion system on the 123m multipurpose vessel *Marfret Niolon*, replacing the original Ventifoils with its latest-generation VentoFoils system.

According to Econowind, these new rigid sails provide a significant improvement in performance and durability. With a simplified design compared to the previous version, the company has been able to achieve a 10% increase in tractive force, while reducing fuel consumption. More robust, and capable of being used in winds of up to 35knots (compared to 22knots for the previous sails), they allow better exploitation of the trade winds throughout the routes most frequently used by the vessel. The Ventofoils also have fewer moving parts, for easier maintenance and better longevity; optimised aerodynamics, for maximum propulsion efficiency; and less power consumption, thanks to a more efficient design.

Econowind recently passed an important milestone, with 100 VentoFoil units sold since the first two units were installed in 2018. Today, 32 VentoFoil units are in operation; 33 are currently in production or ready for installation; and another 37 have been ordered, including contracts for bulk carriers, tankers, ro-ro vessels and container vessels.

To meet growing demand, Econowind is scaling up production at its Zeewolde facility. The expanded space and optimised processes are expected to allow for higher output and shorter lead times.



Quality concerns

According to marine insurance specialist Gard, there is a risk that, as WAPS equipment is manufactured at scale and more shipyards undertake these activities, the quality of components and installations may drop. However, Gard says this should be balanced by greater knowledge of potential problems from the prototype projects both in terms of the equipment itself and its operation.

Gard senior executive Neil Henderson says: "To date, there have been relatively few incidents and claims involving WAPS; fewer than might have been expected with the introduction of new equipment, especially when they are as large and exposed as the sails and rotors being fitted on decks are, and when often positioned alongside hatch covers and other cargo-related equipment. These incidents have included failures during the installation and testing phase, heavy weather damage and collisions with berth equipment. The former two should be reduced through alterations to designs or their operation, whilst the latter are likely to be reduced through changes to ship-shore interactions."

Henderson continues: "The proliferation of WAPS on board existing vessels and scheduled for newbuilds and retrofits means that insurers will inevitably be approached during the 2025 renewal season to provide insurance for the equipment. Their willingness to do so should ensure that 100 installations are passed during 2025."

If this level is achieved, there will be more confidence in installing WAPS based on the growing amount of real data being generated. Shipyards will increasingly see such projects as another valuable source of revenue during docking periods and will be gearing up to ensure they have the facilities and expertise in place to carry out such work. ■

A Norsepower Rotor Sail was recently installed aboard the bulk carrier *Yodohime*

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CII: STRIKING THE RIGHT BALANCE

Stacking up smaller gains through equipment retrofits and various strategies could prove a viable short-term/medium-term alternative to switching to alternative fuels, Wärtsilä Marine suggests

The IMO Carbon Intensity Indicator (CII) gives ship operators wide freedoms on how to reduce their vessel and fleet carbon intensity. However, according to recent analysis carried out by Wärtsilä Marine, 47% of the global merchant fleet will need to upgrade their emissions performance to avoid slipping into the C to E CII bands across their expected lifetime.

Companies can choose to change the fuels they use, implement operational measures such as reducing speed, or install one or more of the 44 energy-saving measures listed in IMO's fourth Greenhouse Gas Study. The key challenge for owners and operators, then, is not just to familiarise themselves with these measures – a daunting task given the number available – but also to decide when it makes sense to invest in them.

According to Peter Hanstén, director for business development at Wärtsilä Marine: "The question of timing is key because CII compliance requires only a few percentage points in improvement each year. That means, for many vessels, the targets could be met by installing new technologies or employing operational solutions every year or few years, to deliver incremental gains. Alternatively, several years' worth of targets could be banked in a single jump – for example, by switching to clean fuels."

Peter Hanstén, Wärtsilä Marine: " A new propeller design, along with reduced vessel speeds and engine power, can lead to propulsive efficiency improvements of up to 15%"

Which options work best for a company will depend on many factors, says Hanstén, not least the vessel's current carbon intensity, its remaining lifetime and the operator's ability to invest. Considerations will also need to include fuel availability and market expectations.

The long-term view

It is clear, for example, that reducing reliance on fossil fuels and substituting them with alternative fuels will be the big change needed for vessels to meet the long-term carbon intensity reductions required by CII. But that shift will be expensive and its timing uncertain, as the widespread availability of alternative fuels remains unsettled.

Similarly, reducing vessel speed may be an effective way of conserving energy for some vessels, but will be impractical for the many that rely on speed to fulfil contracts and remain competitive.

Hanstén suggests: "On the other hand, stacking marginal energy gains from other measures can keep ships compliant with short- and medium-term targets. These can be planned in advance so that investments are made in line with the required stepped improvements.

"Beyond compliance, these measures cut current fuel costs and give operators an optimised baseline of vessel efficiency that will minimise future fuel costs once vessels do make the leap to cleaner power. This also needs to be factored into calculations of return on investment [ROI]."

The starting point for developing a longer-term CII investment plan needs to involve a rigorous analysis of the existing fleet. "This is the approach adopted by Wärtsilä Decarbonisation Services when supporting shipowners including Princess Cruises, Dubai-based Tristar Eships and Brazilian energy company Raizen," says Hanstén. "Together, we build a complete picture of the current state of play by gathering data from a variety of sources, including vessel operational profiles, technical characteristics and fuel consumption reports, or from Wärtsilä data collection units installed on board. Machine-learning techniques are then used to process this data and predict how vessels' emission performance will degrade over time."

Once processed, the data can be used to build a digital model of each vessel, which is used to simulate the effects of different energy-saving measures, or different combinations of technologies and how they interact with each

Wärtsilä will supply its EnergoFlow solution and fixed-pitch propellers to three pure car/truck carrier (PCTC) vessels owned by Sallaum Lines

other. The final step involves determining which measures are technically and economically feasible. This will depend on the vessel's drydocking schedule, the cost of installation for each technology and the age of the vessel.

Overlooked areas

Big efficiency gains can come from some surprising areas, which are sometimes overlooked, Hanstén points out, one example being the propeller. He says: "Propellers are typically designed at newbuild stage to meet a single speed point that may not remain optimised to the vessel's operating profile in later years. A new propeller design, along with reduced vessel speeds and engine power, can lead to combined propulsive efficiency improvements of up to 15%."

Another high-gain area that Wärtsilä believes is often overlooked is the harnessing of wind power to assist propulsion. Rotor sails, for example, can reduce a vessel's fuel consumption and associated GHG emissions by up to 30%, based on Wärtsilä's experience through its license and cooperation agreement with Anemoi Marine Technologies for the latter's Rotor Sail system (see pages 66-70). "This area offers outsized benefits as it not only saves fuel but is also granted favourable reward factors in the EU's FuelEU Maritime regulation," suggests Hanstén. "This means that in addition to lower fuel spend, operators can significantly reduce their exposure to the penalties for surplus energy use under that regime."

For two-stroke engines, Wärtsilä offers radical derating, a specific approach to augmenting existing two-stroke engines to extend their lifecycle and improve emissions performance. This intervention, called the Fit4Power solution, involves removing the top part of the engine and reducing the bore sizes, thereby reducing the fuel consumption significantly. This improves engine efficiency by up to 15%, or even up to 20% when done in combination with propulsion upgrades. Furthermore, Wärtsilä points out that the conversion with Fit4Power can be completed in less than four weeks.

Combining big-ticket items can quickly mount into significant improvements in both fuel use and regulatory compliance. As an example, a recent Wärtsilä case study showed how a capesize bulk carrier fitted with an optimised propeller, shaft generator and four rotor sails could reduce fuel consumption by up to 28% compared to a conventional propulsion arrangement. This translates to a more than seven-year extension to the vessel's CII compliance, and an instant 17% improvement to its EEXI calculation.

Small gains add up

According to Hanstén: "In line with the marginal gains philosophy, it's not just the big-gain measures that deliver returns. For many, the most appropriate solution will be to find ways to stack up small improvements." As an example, he says, the Wärtsilä EnergoFlow pre-swirl stator can deliver savings of 2-7% on propulsion energy demand, while the EnergoProFin propeller cap delivers 2-5% savings.

"Using the capesize example, a vessel fitted with an optimised propeller, as well as EnergoFlow and EnergoProFin, delivers a 5-9% reduction in fuel use and emissions, extending CII compliance by three years and improving the vessel's EEXI rating by 3%," states Hanstén.

His advice for ship operators, therefore, is simple: before making potentially big investments, make sure you understand your vessel's true performance, the targets that will apply across its lifecycle and the impact each measure will have. "Only then can you make informed decisions about the cost effectiveness across an expansive selection of energy-saving measures and ensure that your assets continue to deliver value to your business," he concludes. ■

Data analysis is key to ensuring CII compliance, Wärtsilä emphasises

KLAIPĖDA'S HYDROGEN REVOLUTION

The busy Lithuanian port will become the first in the Baltic to offer a green hydrogen refuelling service, while its new waste collection tanker runs on a hydrogen-battery mix

The Port of Klaipėda, Lithuania is fast becoming a trailblazer for green marine fuel, having announced plans to host a hydrogen refuelling station for ships, and having overseen the recent launch of the country's first hydrogen-electric vessel.

The hydrogen station is being developed by engineering, procurement and construction (EPC) contractor MT Group, and is expected to go live later this year. Its installation at Klaipėda will make it the first port in the Baltic region to produce green hydrogen on site.

Sardinia-headquartered engineering firm IMI will supply one of its VIVO-branded proton exchange membrane (PEM) electrolysers to the refuelling station, which is expected to produce 0.5tonnes of green hydrogen daily: "equivalent to 127tonnes per year while using an electrical input of 3MW", IMI says. As Lithuania's primary port, and one of the few ice-free ports in northernmost Europe, with the capacity to handle 200,000dwt dry-cargo ships and 170,000dwt tankers, the installation of the hydrogen station is significant, permitting a year-round supply of this clean alt-fuel.

Modular configuration

"With the European Green Deal requiring ports to achieve a 90% reduction in transport emissions by 2050, operators are under pressure to make advances towards greener solutions," IMI states. "The hydrogen produced by the electrolyser will be used to fuel vessels as well as shore-side equipment."

By producing the hydrogen directly at source, the Klaipėda State Seaport Authority (KSSA) expects to reduce the need for long-haul transportation and on-site storage of the fuel, leading to a significant reduction in vehicular emissions and freeing up of port space.

The VIVO uses electrolysis to produce green hydrogen. Put simply, the process involves putting water into the PEM electrolyser and adding electric current. The machine uses a membrane to separate the water into hydrogen gas on one side and oxygen gas on the other. The VIVO uses clean, renewable electricity from sources such as wind, solar and geothermal energy to power this process.

IMI tells *The Naval Architect*: "The VIVO PEM electrolyser supplied to Klaipėda will be a 1.25MW version, and its footprint is equivalent to a 40' container. However, as it is a customised skid manufactured by IMI, it includes auxiliaries like coolers and power rectifiers, bringing the footprint to 12.6m x 11.7m."

IMI says that it can customise the size, capacity and configuration of each VIVO electrolyser to match client requirements, with power options ranging from 100kW to 5MW, though IMI adds: "There is potential for further expansion to 20MW through a modular configuration."

"Benchmark for the industry"

The green hydrogen is then compressed and delivered to the vessel via an H2 dispenser installed close to the vessel bay. "The hydrogen can be used immediately or stored for later use, providing a flexible and reliable energy source," IMI explains.

IMI says that the Klaipėda contract is the first time a VIVO has been ordered for a maritime port installation. The company's previous electrolyser installations have involved trains, trucks, buses, cars, refineries and chemical plants. As well as supplying its VIVO electrolysers to customers, IMI provides training to the personnel who will be operating them. "General training is available free of charge," the firm says. "Specific and customised training on the VIVO is performed by IMI's specialised trainers after the installations. IMI can

The 42m waste collection tanker is Lithuania's first hydrogen-electric vessel (image: KSSA)

The tanker will be able to sail for eight hours at 8knots continuously in full-electric mode (image: KSSA)

also organise class training at end user locations or at our manufacturing facility in Italy."

The company is also a founding partner of Green Energy Park, a venture created in 2023 with the aim of producing cost-competitive green hydrogen, at the gigawatts scale, to support the decarbonisation of multiple sectors, including transport, globally. For example, Green Energy Park has announced plans to build the world's largest hydrogen and ammonia production plant in Brazil, and says it is in discussions with several ports in Europe.

For now, though, the Port of Klaipėda VIVO installation could accelerate the uptake of green hydrogen in the Baltic region, demonstrating that alt-fuel bunkering can be efficient and scalable. Mindaugas Zakaras, CEO of MT Group, comments: "As part of our vision to encourage sustainability, we are committed to making the new hydrogen refuelling station in Klaipėda a benchmark for the entire industry. This will be achieved by using the most innovative technology to maximise capacity while meeting the highest quality and safety standards."

The electrolyser will be installed later this year, with manufacturing and factory acceptance tests set for completion within July 2025. The VIVO will then be delivered to the port in August, and installation, commissioning and site acceptance tests will take place in October.

Lean-crewed tanker

The Port of Klaipėda isn't restricting its environmental drive to portside bunkering, however. In January, the KSSA officially launched a new waste collection tanker, billed as Lithuania's first-ever vessel to run on a mix of green hydrogen and battery power.

This propulsive arrangement means the tanker will be able to collect waste from ships arriving at the port – including sewage, sludge, storm water and general garbage – without producing emissions in the area. Given the port's high volume of traffic, the clean-up tanker will spend a considerable amount of time on the water, sometimes working around the clock, the KSSA hints.

The steel tanker – whose name, as of early February, was still to be confirmed – was built jointly by Western Baltija Shipbuilding, Lithuania and Baltic Workboats, Estonia, at a reported cost of €12 million. Designed for a three-person crew, the 42m x 10m newbuild has the capacity to store 400m³ of liquid waste, and its features include a range of special tanks and treatment systems, including a rainwater treatment plant, to filter the water before it is moved to treatment facilities on shore.

Hydrogen-electric

The vessel's powertrain includes two electric motors, supplied by Danfoss Editron, fed by 2,000kWh of battery power. The batteries were provided by EST-Floattech. Combined with the hydrogen fuel cell system, the tanker will be able to sail for eight hours at 8knots continuously in full-electric mode, and to operate non-stop in port for up to 36 hours, Western Baltija claims. The vessel has a reported top speed of more than 10knots.

IMI will supply a 1.25MW version of its VIVO PEM electrolyser to Klaipėda's forthcoming hydrogen refuelling station (image: IMI)

Speaking in January, KSSA director general Algis Latakas remarked: "We have not only launched a tanker, but also a new approach to port operations – cleaner, smarter and more environmentally friendly. This first ever hydrogen- and electricity-powered ship is not only an innovative technological solution, but an important step in strengthening Lithuania's image as a modern maritime nation."

Construction of the tanker commenced in June 2024. At the time of writing, the yards had fabricated the tanker's hull and completed outfitting of its valves, shaft lines, rudder feathers and pipework, with installation of the electric engines, the engine room equipment and the hydrogen fuel cell system to come. The KSSA says it expects the tanker to commence its seaport clean-up work later this year. ■

Although capable of higher speeds, the Aircat 35 Crewliner is at its most economical at between 38-40knots

SAFE AND SMOOTH

The development of the Aircat 35 Crewliner drew on proven surface effect ship technology for energy-efficient and stable offshore operations. **Stevie Knight** reports

The three new Surface Effect Ships (SES) recently delivered by Singaporean shipbuilder Strategic Marine to the Energy Craft fleet in Angola are remarkable in more ways than one: sea trials demonstrated a top speed of 53knots but at a similar nautical-mile fuel consumption as far slower boats.

The 35 Crewliner also delivers personnel without making them feel as if they've been travelling by cocktail shaker. However, the design's inception was actually sparked by two dramatic crashes.

First, in 2014, came the sudden decline of the global oil and gas market. This meant day rates dropped like a stone for most vessels, says Eduard Ercegovic, technical director and co-founder of Aircat Vessels – and who was then managing a fleet of chartered vessels for an offshore support company. "So, we started looking for new solutions in the business areas that were still growing," Ercegovic explains. Personnel delivery was one of the most resilient market areas because, even if profits plunge, offshore platforms still need to be manned.

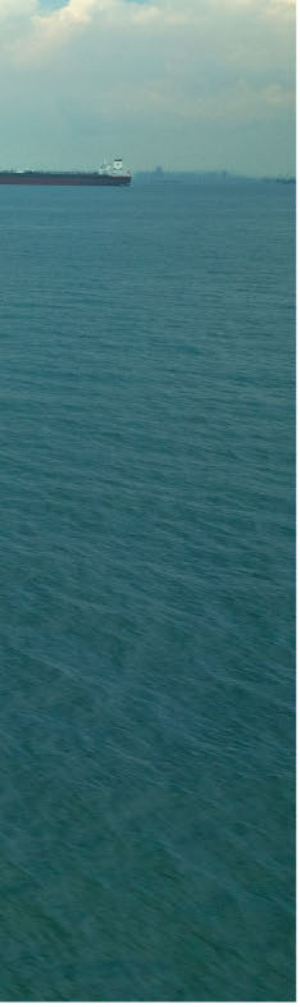
The second was the 2016 Bond Offshore Helicopters Super Puma helicopter disaster in Norway, which claimed the lives of all 13 on board. This was followed by a sudden fall in helicopter availability, as "all of the Super Pumas were grounded until the authorities had completed the investigation", Ercegovic says.

Further, in the background was the ageing state of the long-range, 60-90-pax fast crew vessel (FCV) fleet – the vessel types that Ercegovic often chartered. The speed that is asked of FCVs means they can't run forever, he explains: "They just get exhausted."

Hovercraft-cat hybrid

That left a niche in the market: what was needed was a more cost-effective alternative to helicopter transport and a more efficient, faster boat than a standard FCV. A lot of research uncovered the surface effect ship (SES) design – an established but under-utilised technology that could benefit from an update.

So, Ercegovic and his colleague, Aircat Vessels managing director Jérôme Arnold, partnered with Norwegian naval architecture firm and SES specialist ESNA to create the Aircat 35 Crewliner. These vessels are basically a cross between a hovercraft and a catamaran; they generate an air cushion between the hulls to reduce resistance by lifting up to 80% of the boat's weight out of the water. The effect is to reduce the vessel's draught from 2.4m to a mere 0.8m.



This is achieved by a pair of large, 478kW fans, integrated into the forward half of the hulls. "These are not really custom-made – they're actually the same blowers that you use for factory ventilation," Ercegovic reveals. The dual fans push the air into the cushion that's captured between two skirts; one fore, one aft of the boat's high tunnel – but these have quite different characteristics.

The forward skirt matches the bow angle and is made up of seven vertical, finger-like folds all nestled together, rather than a single sheet. If one of these fingers gets damaged, it will naturally deflate – but its sisters will automatically crowd in to take up the space, providing redundancy.

The rear skirt, however, is very different and should be better described as a tiered structure of horizontal bags, which are maintained at just a little more pressure than the main cushion.

These stern lobes, with the help of two vents, passively adapt to the waves by forming and reforming around the waves, to reduce pitching and even a certain amount of roll – although that's also minimised by the vessel's generous 13.9m beam.

Maximised lift

However, the main cushion is more actively modulated by four damper cassettes (vents) controlled by a computerised SES management system, which gathers data from multiple pressure sensors in the tunnel as well as from a motion reference unit (MRU). Since the electric actuators that open and close the dampers allow instant adjustment, the result is high-speed ride control.

"You can change the setting to maximise the lift and minimise the draught when you are going full speed in relatively calm seas," says Ercegovic, adding that this leaves just enough draught for the propulsion and cooling to be effective.

Jérôme Arnold (left) and Eduard Ercegovic, Aircat: "These new boats should be 40% more efficient than the fast crew vessels they're replacing"

It's also possible to dial it down since different, preset modes allow the crew to choose a 'ride control sensitivity'. "There is some penalty to the speed if you increase the comfort, but it's usually just a few knots," Ercegovic says.

Most importantly, personnel transfers usually require pushing-on (a fairly standard practice for offshore activities in Angola). Therefore, the landing mode ties sensor and MRU data together with very sophisticated software.

"The idea is that the vessel's compensation is calculated by the wave's characteristics, height, direction and frequency," says Ercegovic. "So, waves of 3m feel less than 2m." Importantly, the boat's weight has also been kept to under 160tonnes displacement for bow-pushing onto landings.

Planing effect

The architecture is also worth noting, as well as how it performs. The twin hulls form a high tunnel under the deck, with flat, parallel inner sides. This helps both retain an even pressure and allows the skirts to form a loose but effective seal when inflated. More, Ercegovic points to their very fine entry which thickens further back: this angles the 35 Crewliner's form out toward the rear since the increased volume is retained on the outer, seaward side of the hulls.

The result is a planing effect during fast transits. At high speeds, both the bow and the bow skirts are typically just a few centimetres above the water, leaving only a triangle at the rear of each hull still submerged. However, Ercegovic explains, wind speed retains the cushion pressure.

A rendering of the Aircat 35 Crewliner (image: Strategic Marine)

The boat's weight was kept to under 160tonnes displacement for bow-pushing onto landings

As you'd expect, it does demand a lot of power: there are four meaty, 1,440kW MTU 16V2000 M72 engines, two in each leg. The extra space at the rear is necessary to accommodate the four S50-3/CA Kongsberg waterjets.

Having said that, compared to similar-sized fast supply vessels, the 35 Crewliner wins hands-down on fuel efficiency. That's because, while hull resistance tends to increase sharply above 25knots for more typical transfer boats, these SES designs maintain far greater efficiency at high speeds.

TECHNICAL PARTICULARS
AIRCAT 35 CREWLINER

Length, oa	35.1m
Beam, oa	13.9m
Depth, moulded	3.55m
Draught	2.2m (off cushion) 0.8m (on cushion)
Cargo deck area	82m²
Main engines	4 x 1,440kW
Airlift system	2 x 441kW with air blower system
Cruising speed	50knots (with consumption of 1.4mt/h)
Economical speed	38knots (with consumption of 1.3mt/h)
Range	700nm+
Fresh water capacity	3m³
Crew	4-6
Passengers	80
Classification	Bureau Veritas
Notations	✠HULL ●MACH HSC/ passenger carrier, Sea Area 2, Unrestricted Navigation -DP2

The numbers tell an interesting tale. While the 35 Crewliner consumes approximately 32.6litres per nautical mile at its top transit pace of 50knots, the vessel is at its most economical at between 38-40knots. Paradoxically, sailing at a lower speed (such as 30knots) results in higher fuel consumption than at 39knots.

"40% more efficient"

So, the Aircraft 35 Crewliner design really is built for speed. And, of course, for the bottom line.

"These new boats should be 40% more efficient than the FCVs they're replacing," says Ercegovic, though he adds, out of fairness, that 10% of this total is likely down to the age of the previous boats: a decade is getting on a bit given the tough life of an FCV.

Interestingly, there has been thoughtful design around repairability since the boats will be working without the kind of support normally expected in Europe. For example, if a skirt finger is damaged, you can slide it out on the guide rail and slide the new one in – this process shouldn't take more than a day, says Ercegovic.

And most of the big hardware is accessible through a hatch: fan blowers, main engines – crane one out, crane another in, connect it up and you're ready to go. "You don't have to cut the plating or remove a section of the superstructure," Ercegovic says.

Onboard comfort

Finally, how does the 35 Crewliner compare for comfort? The reclining, business-class seats in the broad saloon are equipped with leg rests, folding table, reading light, cup holder and individual USB connections, and, of course, there are the other, necessary facilities.

But that's not really as much of a deal as how it feels onboard for the 80 passengers, who might be travelling distances up to 160nm one-way – not to mention the four to six crew members who will doubtless be travelling a lot further. After all, the vessel has a range of 700nm.

Aircat did investigate the design's overall effect and returned what was nicknamed 'vom-o-meter' scoring. They found that the ride control together with the other measures halved the incidence of seasickness.

However, Ercegovic has his own tale to tell. During delivery, one of the new 35 Crewliner units met rough conditions – sea state 5, says Ercegovic – but the boat continued at 38knots. "It was a bit bumpy, but you could still walk around," he says. "It's not like you need to chain yourself to the chair to avoid concussion." ■

AIRCATS ON THE PROWL

Military versions of ESNA's surface effect ship (SES) concept have been proposed for missions ranging from landing craft to USVs. **David Foxwell** reports

Eureka Naval Craft, a US-based company, has launched a series of naval and coast guard vessels, including an uncrewed surface vessel (USV), based on surface effect ship (SES) technology developed by Norwegian independent ship design company ESNA.

ESNA specialises in SES designs, in which a catamaran hullform is borne by the combination of an air cushion between the side hulls and the buoyancy of the hulls. Fans blow air into the air cushion, which is sealed with bow fingers and an inflated stern bag. The resulting cushion pressure lifts the vessel upwards, reducing the draught and the wetted surface.

As Bo Jardine, CEO of Eureka Naval Craft, tells *The Naval Architect*, Eureka Naval Craft's naval and coast guard vessels leverage proven technology that ESNA previously applied to the offshore energy sector. Jardine explains that he first became aware of the ESNA SES when working for Shell, when the oil major was looking at alternatives to helicopters for high-speed crew transfers.

"We tested all kinds of designs," Jardine explains, "and of all of the designs we looked at, ESNA's SES was the best. I quickly realised that same hullform had plenty of military potential, as a landing craft and other roles, with a package from established military suppliers integrated into it.

"We took the name for this new range of cost-effective vessels from the 'Higgins Boats' or 'Eureka Boats' that Andrew Higgins developed, which were used in large numbers during World War II."

Interestingly, before the war, Higgins had been building shallow-draught workboats for the oil and gas business in Louisiana. He adapted his design to meet an urgent requirement for landing craft. Eureka Naval Craft has adapted a commercial design for military applications.

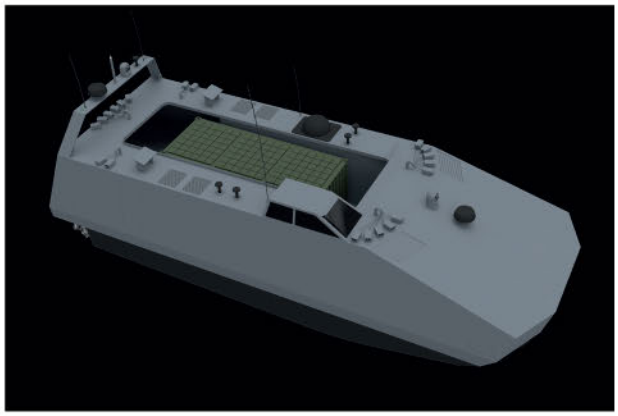
Evolving tech

The SES concept is not a new one, having been used before in the military sphere on vessels such as the Royal Norwegian Navy's Skjold-class fast missile boats. However, Jardine points out, the technology has developed significantly since earlier-generation SES craft, with new-generation lift fans, new materials and better skirt design all making for much more efficient and resilient vessels.

These advantages were demonstrated by an early 2024 agreement between ESNA and Singapore-based shipbuilder Strategic Marine to develop crew transfer vessels for the offshore wind industry using the company's hullform. Working with another company – France-based Aircat Vessels, whose MD, Jérôme Arnold, is Eureka Naval Craft's COO – they built a crew transfer vessel with ESNA's SES hullform for All Energy Services, which has been chartered by TotalEnergies for operation in Angola (see pages 76-78).

With the hullform and its benefits adopted and proven in offshore wind, Jardine, Arnold and Eureka Naval Craft's other principals – Mike Jankowski (a shipbroker at Braemar Shipbroking) and ESNA co-founder Trygve Espeland – believe it is the right time to launch a series of naval vessels "engineered for critical missions such as patrol and interdiction, reconnaissance and attack, providing agile defence of infrastructure and naval bases in diverse environments". Fitted with modular systems developed in collaboration with leading defence companies, the SES craft are designed to provide comprehensive protection against threats from the surface, air and underwater, and to demonstrate operational resilience even in the most contested waters.

The 36m AIRCAT Bengal is designed for patrol, interdiction and reconnaissance and a range of related roles



The USV version of Aircat's AIRCAT Panther, is designed for multiple roles such as logistics, reconnaissance and electronic warfare

Three AIRCATs

Jardine says that the vessels that Eureka Naval Craft is introducing to market include the AIRCAT Bengal, AIRCAT Lynx and the AIRCAT Jaguar – plus an uncrewed version of the design, the AIRCAT Panther.

The AIRCAT Bengal is a 36m joint patrol/interdiction, reconnaissance, attack/air defence, logistics and medivac vessel, with a 1,000nm range at 38knots (and a maximum speed of 46-50knots, depending on load). This class has a crew of five to seven, depending on mission; can accommodate 15-17 additional personnel; and can be equipped with defence systems and armed for contested littoral operation with drone and anti-ship missile threats. Optional primary armament includes three 30mm remote weapon stations, as well as onboard drones and remote/manual machine guns. The vessel has space on its aft deck for two 20' ISO mission/weapon payload containers capable of carrying drones, anti-ship missiles, air defence equipment, torpedoes, mines and/or mine countermeasure systems.

The AIRCAT Lynx, a 36m coast guard/border patrol/fisheries patrol vessel, has a range of 1,000nm at 38knots and a maximum speed of 46knots. With a crew of four to seven and accommodation for 15-17 people, it is suitable for a range of missions, including search and rescue, medivac, vessel traffic monitoring, pollution response and readiness, maritime law enforcement, counter-piracy and counterterrorism. Armament includes optional 30mm and 12.7mm remote weapon stations with a 360°, 4D hemispheric radar and full spectrum optronics, a drone and manually operated machine guns. The vessel has space on its aft deck for two 20' ISO mission/payload containers capable of carrying drones, RIBs, pollution response equipment and survey/scientific packages.

Finally, the AIRCAT Jaguar is a 17.5m vessel that the company describes as a 'landing craft vehicle personnel improved (LCVP(I))'. It has a range of 350nm at 38knots and a maximum speed of 48-50knots. The LCVP(I) can transport up to 24 marines or two ATVs with their crew, and is optionally equipped with active countermeasures and armed with a 12.70mm remote weapon station for contested littoral operations with pervasive drone and anti-ship missile threats.

Uncrewed option

The USV that Eureka has proposed, the AIRCAT Panther, is a 17.5m design intended for use in high-risk environments. The autonomous vessel has a range of 400nm at a cruising speed of 38knots, and the ability to exceed 50knots. The company foresees its use in roles such as frontline logistics, reconnaissance, electronic warfare, defensive missions and attack.

"One of the Panther's standout attributes is its versatile payload capacity," says Jardine, noting that the design "includes a low-signature hull and superstructure". The AIRCAT Panther has payload space for a 20' ISO container carrying cargo, a mission module or a weapons system.

"By removing the necessity for crew on board during operations, the AIRCAT Panther enhances safety, reduces operating costs and allows for continuous operation," Jardine concludes. "This flexibility enables it to undertake missions without the limitations associated with crew fatigue or the logistical challenges of manned vessels." ■

ESNA's SES hullforms have been adopted by a number of maritime clients, including operators in the offshore wind farm sector

A LEGACY OF LIFESAVING

Mark Barton reflects on the development of the Royal National Lifeboat Institution, which celebrated its 200th anniversary last year

In 2024, the Royal National Lifeboat Institution (RNLI) celebrated its 200th anniversary. To mark the event, an exhibition of the RNLI's history was hosted at Chatham Historic Dockyard, inside its historic building No 1 Smithery. This was housed with another exhibition to mark the 40 years since Chatham closed as a naval dockyard, and just how far it had come in its regeneration plans as a historic site.

Chatham Historic Dockyard was a natural choice for the RNLI exhibition as it also hosts the Historic Lifeboat Collection in one of its covered slipways. As it also hosts three historic ships and the National Maritime Museum's collection of ship models, it is an excellent day out for anyone interested in vessel design.

Lifeboats predate the RNLI; Lionel Lukin patented the world's first unsinkable lifeboat in 1785, and China is reputed to have run the world's first lifeboat service at the mouth of the Yangtse in the mid-18th century. The arrangements were piecemeal, with Lloyd's of London funding several lifeboats and lots of local societies.

However, that all changed on 4 March 1824, when Sir William Hillary presented his vision for a national service dedicated to saving lives at sea with a meeting at the London Tavern in Bishopsgate. That year, the Royal National Institute for the Preservation of Life from Shipwreck (as the RNLI was then called) was formed, and it awarded its first gold medal for gallantry to Charles Fremantle, who swam out to a Swedish brig stranded off the coast near Christchurch, protected only by a shoreline attachment.

The RNLI (pictured undertaking drills) has saved an estimated 144,000 lives at sea since its formation

Network of stations

It's a strange thing to consider that, back in the early 19th century, most coastal communities around the British Isles lacked any sort of capacity to assist vessels in distress. This was despite substantial casualty figures: in this period, the authorities recorded an estimated 1,800 shipwrecks each year. That this lack of response seems incredible in hindsight is largely a testament to the effectiveness of this charity – which rebranded as the Royal National Lifeboat Institution in 1854. Over the decades and centuries, the RNLI has saved an estimated 144,000 lives at sea and built up a network of rescue stations that most UK citizens now largely take for granted.

The oldest surviving lifeboat, *Zetland*, which was built in 1802 and stationed at Redcar, is on display in a dedicated museum. In 1858, Tees Bay Lifeboat Society handed over their rest of its boats to the RNLI, keeping *Zetland* as a commemoration. To this day, there are over 80 independent lifeboat organisations around the UK, providing nearly a quarter of the stations.

However, it is the RNLI that provides the national service. Over the years it has had its heroes, heroines and disasters that remind everyone just how costly this can be. For example, Grace Darling became a national heroine when she risked her life to save stranded survivors from the wrecked steamship *Forfarshire* in 1838; while, during a winter storm in February 1936, RNLI Ballycotton lifeboat volunteers endured 49 hours at sea to save the crew of the Daunt Rock lightship.

Perhaps the three most remembered lifeboat disasters are: the capsize of the Whitby lifeboat in February 1861; the Southport and St Annes disaster in December 1886; and the Penlee lifeboat disaster in December 1981. From these three, just one member of the Whitby crew and two of the Southport boats survived; 47 volunteers died. In all, more than 600 names are on the RNLI memorial commemorating those who gave their lives to save others.

The RNLI has also led the way in innovation. In fact, it was an RNLI inspector, Captain Ward, who broke new ground in maritime lifesaving in 1854 with his design for a cork lifejacket. Additionally, the RNLI always led the way in design of lifeboats, including the first steam-powered lifeboat in 1890. Between them, the RNLI's three hydraulic steam-driven lifeboats were in service for over 40 years and are credited with having saved 570 lives. ■

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