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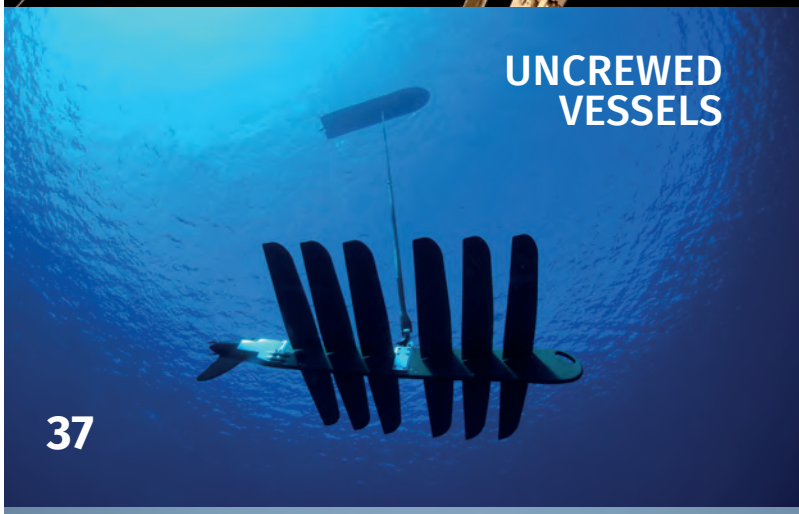

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DON'T DITCH BRITAIN'S USV PROGRESS

We have a special emphasis on uncrewed vessels in this issue, and particularly on some of the struggles that UK-based uncrewed surface vessel (USV) developers have faced in bringing their products to market.

As is often the case, regulation is proving a significant barrier to progression: as two of our interviewees – both experts in USV design and operation – have identified, no USV has so far managed to meet the requirements of the Maritime and Coastguard Agency's (MCA's) Workboat Code Edition 3 Annex II, which has made it difficult for these companies to launch new uncrewed boats in UK waters. A combination of politics and outdated regulations may be hampering the UK USV sector's ability to grow.

Of course, the MCA is under its own pressures, but it would be a colossal shame, and a squandered opportunity, if UK-based USV developers were to look overseas to pursue their activities. A lack of action and regulatory clarity risks stifling innovation in what has shaped up to be a critical technology sector, which would weaken Britain's position as a global leader in maritime and defence tech (and which would also be quite at odds with government ministers' calls for an autonomous solutions rally).

Losing talent and investment could shrink the industry, costing high-skill jobs and economic growth. This brain drain could also undermine national security, as domestic expertise in autonomous maritime systems dwindles. This point is particularly salient given the dramatic escalation in Middle East tensions since we started work on this issue – but lost opportunities in the offshore and research/survey segments would also hit the UK hard.

Luckily, as Uncrewed Survey Solutions CEO James Williams reveals, there are now plans to collect and collate important USV data from the industry to feed on to the MCA in advance of the development of an 'Edition 4' of the Workboat Code – which should hopefully address these thorny issues and help the UK USV sector to effectively compete with its overseas counterparts. ■

Martin Conway,
Managing Editor

UK USV manufacturers worry that their businesses are being held back by regulations (image: Zero USV)

MULTIPURPOSE VESSELS

VERTOM NEWBUILDS IN THE PINK

Chowgule Shipyard, India says it is on track to deliver four 10,700dwt geared multipurpose (MPP) tweendeckers to Dutch shipowner Vertom Group between 2027-2028. Each newbuild's particulars include an overall length of 135m, a moulded breadth of 16.6m, a depth of 10.1m and a maximum draught of 7.25m. Each features a gross hold volume of 14,243m^3, for the storage of dry cargo, breakbulk and project cargo operations.

Chowgule Shipyard will deliver the multipurpose tweendeckers between 2027-2028

Additionally, each vessel will be fitted with two MacGregor electric cargo cranes, featuring a SWL of 80tonnes at 18m apiece. The powertrain for each vessel includes: an IMO Tier III-compliant main engine, incorporating an SCR system and generating 2,250kW at 1,000rpm; two diesel-electric generator sets; and a 910kWh battery pack.

The four newbuilds will also be fitted with fuel monitoring systems, and each will have the capacity to store 636m^3 of MGO, 88m^3 of fresh water and 3,850m^3 of ballast water.

According to Vertom CEO Arjan de Jong: "Recognisable by their pink design, these ships will become a distinctive presence on their route between Europe and the northern coast of South America." Upon delivery, the quartet will serve the Europe Caribbean Line (ECL) that Vertom runs in partnership with Vertraco Shipping. ■

TUGS

FIRST VOLTRA UNDER CONSTRUCTION

Turkish shipbuilder and tug operator Med Marine has commenced work on its first VoltRA-class electric tugboat. Developed in cooperation with Caterpillar and its Turkish division, Borusan Cat, the VoltRA has been designed for dual-fuel operations, combining diesel generators with advanced lithium iron phosphate (LFP) battery packs, supplied by Caterpillar.

The bollard pull of the VoltRA series will range from 40-90tonnes

The LFP batteries come with a battery management system, to regulate temperature, voltage and current control. Med Marine tells *The Naval Architect* that the VoltRA will feature a length of 25m and that five separate VoltRA models will be made available, with bollard pull rankings spanning 40-90tonnes. This series will handle duties "from compact harbour operations to large-scale terminal support", Med Marine says.

The VoltRA is designed by Canadian naval architect Robert Allan Ltd (RAL); the companies originally signed a memorandum of agreement for Med Marine to produce the hybrid-electric vessels in 2023. Yıldız Bozkurt Ozcan, Med Marine general manager, comments: "VoltRA represents more than a technical achievement – it's a clear statement about the direction our industry must take."

In late May, Med Marine also launched the first of six RAmparts 2800-series ASD tugboats, also designed by RAL, for Tunisia's Office of the Merchant Marine and Ports (OMMP). Each of the six sisters is designed to meet FiFi-E requirements, and features a length of 28.2m, an 11.5m beam, a draught of 5.4m, a bollard pull of 60tonnes and the capacity to carry eight crew members. ■

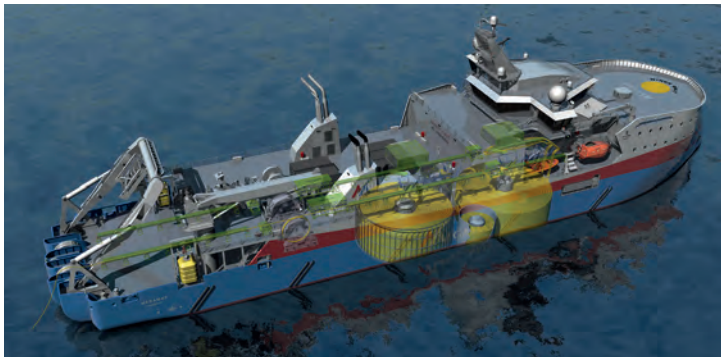
CABLE-LAYING VESSELS

MEGAMAS CABLE-LAYER DUE IN 2027

Megamas Resources, a Malaysia-based lifecycle services provider focused on the marine and offshore oil and gas sectors, has contracted Ulstein Design & Solutions to begin the engineering phase for a new fibre-optic cable-laying vessel (CLV). The forthcoming vessel, based on Ulstein's SX228 cable-layer class, is under construction at German shipyard Lloyd Werft Bremerhaven with an anticipated delivery date of 2027.

The 8,200dwt CLV will feature a cable capacity of 5,500tonnes, with a carousel integrated into the cable tanks beneath the deck. The cable-handling equipment, plus two firing lines, will be housed within an enclosed working area. The vessel will also be fitted with an ROV hangar, storing a cable trencher, and a 50tonne A-frame, and its bollard pull ranking of 120tonnes will enable it to undertake subsea ploughing operations.

Onboard accommodation will be arranged for 80 persons, and the vessel will draw 7.2m max and be able to achieve a top speed of 14knots.



The 8,200dwt CLV will feature a cable capacity of 5,500tonnes

Captain Tiew Sien Kheng, managing partner at Megamas, says the CLV is intended to address a current global shortage in "specialised offshore vessels". The Ulstein SX228 will primarily undertake cable-laying operations related to offshore renewable energy and subsea telecommunications. Kheng adds: "The vessel is designed to meet DNV's Clean (Design) and Recyclable class notations". ■

SUBSEA TECHNOLOGY

NATURAL HAZARDS THREATEN SUBSEA CABLES

Cable-laying and repair ship *C.S. Sovereign*: 25% of subsea cable damage is caused by natural hazards (image: Dan Bourne, NOC)

A recent study by the UK's National Oceanography Centre (NOC) reveals that natural hazards caused about 25% of subsea cable damage from 1965 to 2019.

While human activities like fishing and anchoring remain the main culprits (albeit in shallower waters), the study, published in *Earth-Science Reviews*, claims that climate change is intensifying natural risks such as earthquakes and underwater currents from river floods, all of which can break, bury or disable cables critical to internet and communication networks. Another natural risk is submarine landslides, in which masses of sediment, rock or debris slide down the seafloor.

Dr. Isobel Yeo, researcher at NOC and co-lead on the project, notes that climate-driven extreme weather, rising sea levels and sediment-heavy river discharges are likely to increase the frequency and severity of these hazards. The 2022 Hunga Volcano eruption in Tonga, which severed the nation's only international cable, and repeated cable damage in West Africa's Congo Canyon, triggered by flooding-induced currents, highlight the vulnerabilities, the report states.

To address these risks, the report recommends improved cable routing, "enhanced repair readiness" and investment in back-up means of communications, like satellite systems.

The comprehensive NOC study was conducted with partners including the National Grid, Victoria University of Wellington, Ocean-IQ, Tonga Cable Ltd, Durham University and the International Cable Protection Committee. ■

RULES AND REGULATIONS

FAME B100 CERTIFICATION FOR *WHITCHAMPION*

***Whitchampion* has become the first bunker tanker certified to load, carry and blend FAME B100 on board**

The 85m loa *Whitchampion* has become the first bunker tanker certified to load, carry and blend fatty acid methyl ester (FAME) B100 on board, according to classification society Lloyd's Register (LR). The 2003-built vessel, operated by UK-based John H. Whitaker, secured this certification from LR on behalf of the Isle of Man Flag Administration, and under the International Bulk Chemical (IBC) Code and MARPOL Annex II regulations.

As a result, *Whitchampion*'s personnel can now perform onboard blending of biofuels with petroleum distillates and residual fuel oils within UK coastal waters. LR comments: "Bunker tankers certified under MARPOL Annex I are limited to carrying blends [of] no more than 30% FAME under IMO regulations. Oil fuels with higher bio-content fall under the IBC Code and MARPOL Annex II, typically requiring full chemical tanker status. That regulation has, in effect, frozen out a significant portion of the conventional bunker tanker fleet from supporting mid-to-high-range biofuel blending.

"*Whitchampion* is the first LR-classed vessel to bridge that gap. Through comprehensive gap analysis and risk assessment against the IBC Code and MARPOL Annex II requirements, LR developed an approach which involved mitigation of the assessed risks. This led to obtaining waivers/exemptions from the flag administration, allowing this Annex I bunker tanker to gain chemical certification to carry FAME as cargo, without needing to convert to full chemical tanker status."

A second Whitaker tanker, *Whitchallenger*, will undergo a similar approval process, with certification anticipated later this year, LR adds. ■

GAS CARRIERS

ETHANE CARRIER GETS THE GREEN LIGHT

Korean Register (KR) is teaming up with HD Hyundai Heavy Industries (HD HHI) to jointly develop a very large ethane carrier (VLEC). The two companies signed a memorandum of understanding (MoU) to this effect at Nor-Shipping 2025.

KR says: "[The VLEC] will be designed to maximise cargo volume while minimising changes to the main specifications of conventional vessel designs." The vessel will be able to transport various cargoes, including LPG and propylene, "enhancing operational flexibility and market responsiveness for shipowners", the class society adds. The proposed ship's cargo capacity is expected to exceed 100,000m³.

HD HHI will oversee the VLEC's hull design, while KR will review the safety and regulatory compliance of the design in accordance with its latest structural rules for gas carriers and international standards, with the aim of granting an approval in principle (AiP).

KR comments: "Ethane carriers are high value-added vessels designed to transport liquefied ethane at ultra-low temperatures of around -100°C. These ships require advanced engineering capabilities and highly specialised design expertise due to the complexity of their cargo. This joint effort marks a meaningful starting point in the development of next-generation ethane carriers." ■

KR and HD HHI signed the MoU for the very large ethane carrier at Nor-Shipping

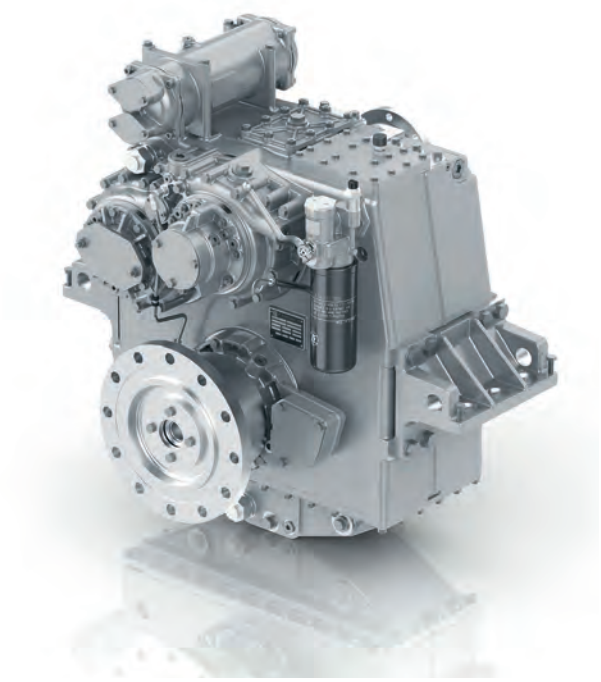
ELECTRIC PROPULSION

CLUTCH-FREE TRANSMISSIONS FOR E-SHIPS

ZF has introduced its ENC series, described as the company's first marine transmission designed specifically for fully electric ships. The 'ENC' stands for 'electric non-clutchable', which, ZF says, allows a reduction in oil supply by eliminating the clutch, a major oil consumer, and lowering system oil pressure.

Aimed at vessels such as ferries, river cruisers, tugs and supply boats, the ENC series can be combined with all current ZF drive solutions, spanning a power range of 650-3,900kW, and with fixed-pitch/variable-pitch propellers and waterjet drives. "The ENC series was designed [so] that the drive power of the electric motor is optimally transferred to the propeller even at high speeds and high ratios – a common scenario in electric shipping," says ZF. "This improved efficiency reduces energy consumption, delivering a greater range." The ENC transmission series has also been developed to weigh up to 10% less than similar drives.

ZF adds: "According to forecasts, the global market for electrically powered ships is expected to grow to US$17.2 billion by 2032. By comparison, it was just US$4.33 billion in 2024...electromobility in shipping is not a short-term trend." ■



ZF's ENC transmission series was developed specially for use with electric vessels

ENGINES

JAPAN AND BELGIUM TEAM UP ON HYDROGEN POWER

A new partnership comprising BeHydro – the hydrogen engine-building venture established by Anglo-Belgian Corporation and CMB.TECH – and Japanese companies JPNH$_2$YDRO, DAIHATSU INFINEARTH and Mizuno Marine intends to accelerate the deployment of hydrogen engines aboard Japanese vessels.

Consequently, BeHydro will supply two sets of its V12 dual-fuel hydrogen engines to a tugboat under construction at Tsuneishi Shipbuilding in Japan, scheduled for delivery in July. BeHydro will also deliver three sets of its inline 6-cylinder, pure-hydrogen engine to a zero-emission ship scheduled to be built by JPNH$_2$YDRO. The engines for both projects have been adapted for local Japanese requirements, and will be supplied under the branding of BEH$_2$YDRO INFINEARTH. Both vessel orders have been financially supported by the Nippon Foundation Zero Emission Ships Project.

JPNH$_2$YDRO will act as BeHydro's agent in Japan, while DAIHATSU INFINEARTH will assist BeHydro in obtaining local regulatory approval for the engines. Mizuno Marine, meanwhile, will provide engine commissioning and maintenance services. In July 2021, JPNH$_2$YDRO took delivery of the 80-pax vessel *HydroBingo*, billed as the world's first hydrogen-powered ferry (see *Significant Small Ships of 2021*). ■

JPNH$_2$YDRO, BeHydro, DAIHATSU INFINEARTH and Mizuno Marine are partnering to roll out more hydrogen engines for Japanese vessels

OFFSHORE SURVEYS

FIRST REAV-47 BOUND FOR NIGERIA

GOSL will use the battery-hybrid REAV-47 for hydrographic and geophysical survey operations

HydroSurv has sold its first REAV-47 USV to Geodetic Offshore Services Ltd (GOSL), a Nigeria-based offshore survey services provider. The drone will be supplied with a payload including a Ping DSP 3DSS-IDX interferometric sonar, which uses sound waves to make highly detailed 3D maps of the ocean floor, as well as Innomar's compact sub-bottom profiler. According to HydroSurv: "This payload configuration will enable concurrent wide-swath bathymetric mapping and high-resolution sub-bottom imaging for comprehensive landfall survey capability on offshore infrastructure projects."

First launched by HydroSurv in 2024, the REAV-47 is powered by a battery-hybrid system comprising a 12kW Mastervolt battery pack and a 4kW Fischer Panda generator, providing power to a 5kW e-motor provided by Rim Drive Technology. This set-up enables an endurance of 72 hours. The USV also incorporates HydroSurv's Virtual Watchkeeper vessel control system, Dynautics' autopilot tech, plus situational software solutions from Furuno and TimeZero.

GOSL will station the REAV-47 at its operating base in Port Harcourt, from which it has previously delivered surveys for Chevron, ExxonMobil and Shell, among others. The USV will operate as a standalone data-gatherer, or in combination with a smaller REAV-28 inland multipurpose USV supplied by HydroSurv. ■

HUMAN-MACHINE INTERFACE

CMT: "DON'T LEAVE HUMANS OUT OF THE LOOP"

Diagnostics systems developer Condition Monitoring Technologies (CMT) has warned that 'human-in-the-loop' involvement remains essential for effective ship condition monitoring programmes, cautioning against over-reliance on AI assistance.

David Fuhlbrügge, CMT MD, says: "AI has a role to play, especially when it comes to analysing huge datasets. But there are critical limitations in relying on technology alone. A sensor can tell you a pressure reading or temperature value. It cannot smell burning oil, feel excessive vibration or recognise an unusual sound in the engine room. That's where human intuition, experience and judgement come in...human engineers are not a relic of the past."

Fuhlbrügge suggests that a "hybrid model" will likely evolve, involving continuous monitoring during voyages, supported by mobile maintenance teams in port and "holistic insight" provided by shore-based experts. "We anticipate a set-up similar to today's engine manufacturer service models," he says. "Sensors might identify a fault mid-voyage, and a flying repair team would meet the vessel at the next port. But, without someone qualified to interpret those readings correctly, there's a serious risk of false alarms or overlooked faults."

CMT adds that training AI systems for ship condition monitoring will necessitate vast, diverse and context-rich datasets, while advanced neural networks have "enormous energy requirements" that current technologies are struggling to meet. ■

Condition monitoring programmes still require human-in-the-loop involvement, says CMT

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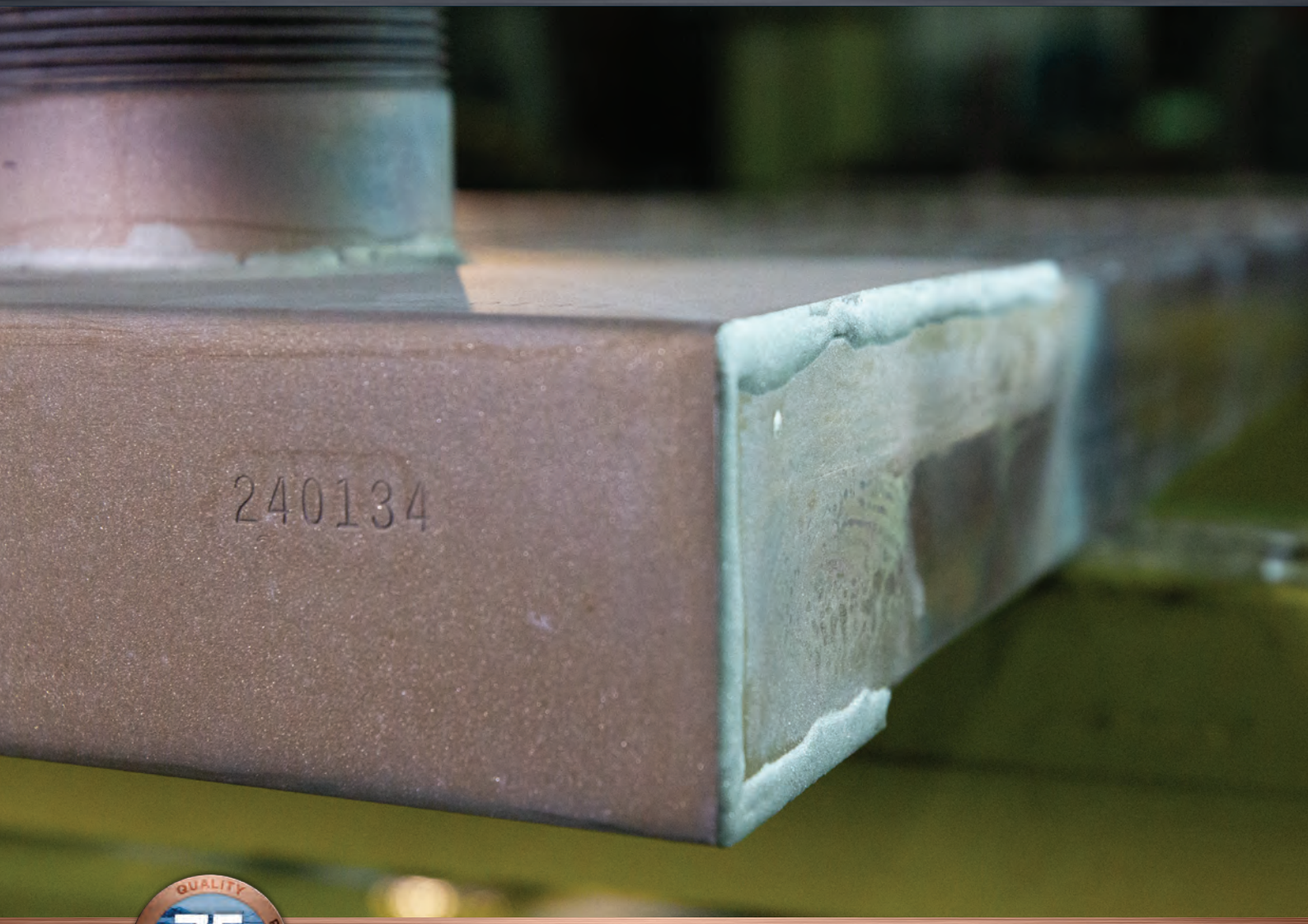

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FLOW MOTION

A proposed methanol-fuelled floating wind installation vessel devised by a UK consortium could deliver significant energy savings while slashing greenhouse gas and CO_2 emissions compared to a conventional vessel of this type, writes **Martin Conway**

A UK consortium comprising Morek Engineering, Solis Marine Engineering, Tope Ocean, First Marine Solutions and Celtic Sea Power has devised a new class of floating wind installation vessel, primed for energy efficiency and sustainable operations. Having formally unveiled the concept at a Society of Maritime Industries event in London in May, the partners say they are now "advancing toward the next design stage" in the hope of attaining approval in principle (AiP) for the concept from a major class society by December.

Dubbed the Future FLOW Installation Vessel (FFIV) (the 'FLOW' standing for 'floating offshore wind'), this reimagined anchor-handling tug supply vessel (AHTSV) would run on methanol and feature a hydrodynamically optimised hull, azimuth thrusters and a DP2-rated dynamic positioning system. The vessel would also feature expanded mooring line capacity, care of a sizeable below-deck cable tank for synthetic mooring ropes, and lockers capable of holding "kilometres of chain", the consortium states.

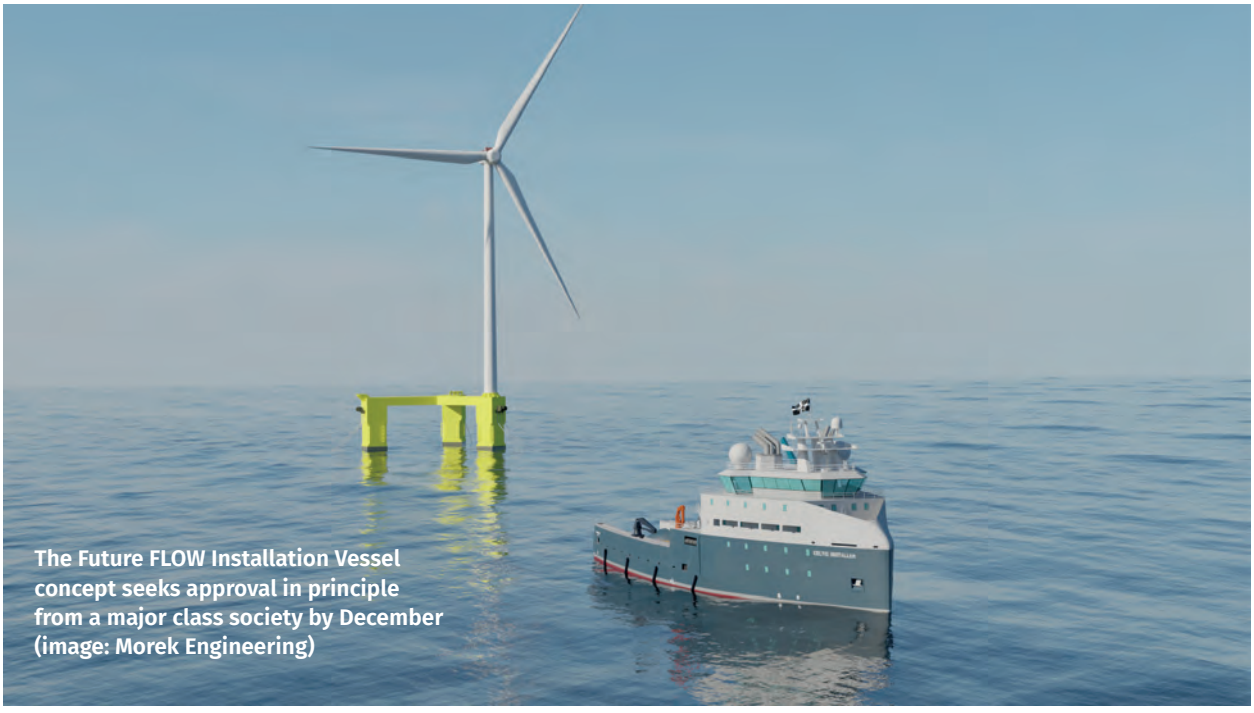
The project was conducted as part of the Clean Maritime Demonstration Competition Round 4 (CMDC4), a £206 million initiative to decarbonise the UK domestic shipping sector, funded by the UK Department for Transport and delivered by Innovate UK.

TECHNICAL PARTICULARS
CELTIC INSTALLER

Length	95m (oa)
	88m (bp)
Breadth, moulded	25m
Draught	8.5m
Main engines	4 x MAN 175D gensets
Output of each engine	2,880kW
Bollard pull	104tonnes equivalent
Accommodation	42 POB
Onboard capacities	
Methanol	1,323m^3
Ballast water	1,275m^3
Chain locker	2,520m^3
Cable locker	1,295m^3

Optimised hull

So, why craft a new installation vessel design? Bob Colclough, MD and naval architect at Morek Engineering, explains: "We know 'business as



The Future FLOW Installation Vessel concept seeks approval in principle from a major class society by December (image: Morek Engineering)

normal' isn't going to cut it for floating wind. We are constantly challenged on the cost of energy – developing solutions to deliver future renewable energy at scale will require huge amounts of innovation." Primarily, the development of the FFIV is intended to "identify where best we can apply low-emission technology to deliver lower-cost alternatives", Colclough tells *The Naval Architect*.

The envisaged vessel type, the first-in-class being provisionally named *Celtic Installer*, would feature a length of 95m overall, a moulded breadth of 25m and a draught of 8.5m, with onboard accommodation provided for 42 personnel. The FFIV is also set to feature a bollard pull capacity of 104te.

One of Morek Engineering's first goals was to develop a hydrodynamically optimised hull for the vessel. "The hullform is a fairly radical departure from a standard anchor-handler," Colclough continues "Rather than keeping a traditional operational remit of the vessel and adding a cleaner propulsion system, we opted to explore the tasks suited to modern low-emission fuels and design a vessel to deliver these. As a result, we have a low power requirement, grouping together the low-duty aspects of the mooring installation and delivering in more of a 'serial production' mentality."

The consortium adds: "[The vessel] will work with any of the three main anchor types for floating wind turbines being considered by the industry: drag embedment anchors, which require installation by high-bollard pull anchor-handling vessels; suction piles; and driven piles, which require large subsea cranes to install them into the seabed. In each case, the FFIV meets the requirements of the next phase by installing the mooring lines onto the installed anchors, enabling quick connection to floating foundations towed to the offshore site."

Deck equipment is set to include: a 150te SWL tow winch; a 150te SWL anchor-handling winch; two 5te SWL cargo rail cranes; and a 4m stern roller. The FFIV will also carry and deploy a work-class ROV.

Emissions reductions

Assessing the vessel's expected impact on emissions and energy consumption, Ian Godfrey, MD at Tope Ocean, tells *The Naval Architect*: "Forecast energy savings delivered by this vessel undertaking mooring line ['leg'] installations, compared to the same task carried out by a baseline anchor-handler tug supply vessel type, are principally the result of improvements in overall vessel energy efficiency – most significantly, hull form efficiency – and improvements in operational efficiency, most significantly,

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ABOUT THE CONSORTIUM

Morek Engineering MD Bob Colclough describes the consortium as "a multi-disciplinary team of businesses from south-west England", and adds: "In joining our constituent parts, we are able to tackle a much wider remit than we could independently." Morek Engineering is a consultancy specialising in providing naval architecture and marine engineering services for the offshore renewables sector, with a focus on mooring design, dynamic cable systems, marine operations and port strategy.

The company is joined by: Tope Ocean, an engineering and project management consultancy; Solis Marine Engineering, which offers marine engineering and consultancy services focused on vessel assurance, incident investigation and offshore project support; Celtic Sea Power, part of Cornwall Council, which is focused on driving floating offshore wind development in the Celtic Sea by coordinating infrastructure, research and supply chain development; and First Marine Solutions, which provides mooring equipment rental and marine consultancy services – and which, Colclough says, represents "a likely end client of the FFIV".

increasing vessel mooring leg carrying capacity and thereby reducing time and energy spent in transit to port activity."

Godfrey adds: "Exact reductions in GHG emissions depend on the provenance of the methanol – for example, whether it is grey, blue or green – although, even in worst-case scenarios, the GHG reduction is significant, at approximately 44%. As an example, a floating offshore wind farm was modelled for comparison purposes, using an MGO-fuelled AHTSV for the baseline compared with the methanol-fuelled FFIV. This example farm consisted of 60 floating turbines, each with six synthetic mooring legs of 750m in length, located 145km from port.

"For the example farm, the FFIV demonstrated a 14% reduction in total time to completion and a 25% reduction in energy compared to the baseline approach. For the grey methanol example used in the modelling work, this corresponds to a GHG emission reduction of 44% or 3,200tonnes of carbon dioxide equivalent [tCO_2e] for the mooring leg installation component of the example farm. For green methanol, this could more than double to 7,000 tCO_2e."

Colclough says: "We can't pretend the future fuels are ready to use immediately; in fact, detailing the demand will provide the case to invest in the infrastructure required for the full supply chain." As such, Morek Engineering and its partners have not yet focused on a specific region for the FFIV's operations.

"We have a full iteration of design planned for this year," Colclough concludes. "During this time, we expect to focus on validating the overall design, both in terms of naval architecture and in much more detail on the operational aspects of such a vessel. This should result in a well-defined overall ship system, and most importantly, it will be validated by including top industry expertise in the project." ■

The 95m x 25m vessel is set to feature a draught of 8.5m, accommodation for 42 personnel and a bollard pull capacity of 104te (image: Morek Engineering)

NOT JUST PROPS

New research shows propulsion-related energy-saving devices could deliver up to 10% fuel reduction, but less than 2% of the global fleet is currently so equipped, writes **Clive Woodbridge**

Demand for advanced propeller retrofits and energy-saving devices (ESDs) has nearly quadrupled since 2020 as shipowners and operators look to enhance energy efficiency to meet tightening emissions regulations.

However, according to *The Energy Saving Devices Retrofit Report*, recently published by class society Lloyd's Register (LR), while high-efficiency propellers can deliver fuel savings of between 3-10%, and popular devices such as rudder bulbs can achieve 3.5% reductions, only 1.74% of the global fleet currently features the rudder bulb.

Moreover, the proportion of new vessels on the current global orderbook fitted with a particular EDS is between two and six times higher than for those vessels already in service, LR's research has found.

Consequently, the report identifies bulk carriers, tankers and container ships as prime candidates for retrofitting, with these vessel segments showing the highest adoption rates due to their substantial fuel consumption profiles. For example, 16.87% of bulk carriers on order feature rudder bulbs, compared to just 6.74% of the existing fleet.

LR accepts that the number of retrofit installations on existing vessels is growing, showing nearly 400% growth since 2020. The report also reveals a trend towards retrofitting newer vessels, with more than one-third of 2024 retrofits performed on ships less than 10 years old, compared to just 16% in 2020. By 2024, 12% of retrofits were performed on vessels built less than six years ago, a category that saw no retrofits in 2020.

The scope to use propeller retrofits to generate fuel and emissions reductions remains relatively untapped, LR's research suggests

Regulatory pressure

Regulatory pressure is the primary catalyst driving this surge in retrofits. IMO's Carbon Intensity Indicator (CII) and GHG strategy, combined with the EU Emissions Trading System and FuelEU Maritime, directly link vessel performance to financial penalties. LR projects that a 20% fuel consumption reduction could save an Aframax tanker operator nearly US$3 million over 10 years through reduced exposure to European regulations alone.

Despite the benefits, LR's research highlights challenges in retrofit selection and implementation. Many operators struggle with technology selection due to potential interactions between different devices, unverified performance claims and incomplete understanding of vessel-specific requirements. The report notes that some highly promising technologies fail during full-scale validation, despite excellent model test results.

Biofouling is also identified as a threat to retrofit performance, with marine growth on propeller blades and ESDs potentially negating efficiency gains through increased surface roughness and altered hydrodynamic profiles.

To address these challenges, LR recommends a five-step approach: comprehensive vessel assessment; hydrodynamic analysis using CFD; consideration of technical factors including torsional vibration and underwater radiated noise; robust performance monitoring; and long-term maintenance planning.

"Proven pathway"

Claudene Sharp-Patel, global technical director at LR, says: "Our research reveals that propeller and ESD retrofits offer ship operators a proven pathway to significant fuel savings, extended regulatory compliance and meaningful emissions reductions. However, successful propeller and ESD retrofits require far more than simply bolting on additional equipment. They demand sophisticated analysis, careful integration with existing systems and ongoing performance management."

The Energy Saving Devices Retrofit Report forms part of LR's Retrofit Research Programme. Combined with LR's 'Fuel for Thought' series, this aims to provide insights into adapting existing vessels for cleaner and greener shipping. ■

BARGING INTO GREENER TERRITORY

Lube oil barge *Tristar Eco Voyager* has the capability to cut its emissions by anywhere between 50-100%, writes **Clive Woodbridge**

The new hybrid tanker can run on MGO, biofuel or battery power (image: Akdeniz Shipyard)

Tristar Eco Voyager, built in Turkey by Akdeniz Shipyard, a unique new design of bunker tanker, has recently been delivered to UAE-based Tristar Eships. The company will deploy the vessel, owned by Tristar Transport and technically managed by Fleet Management, out of Fujairah, where it will be well positioned to meet the lube oil needs of vessels at the nearby anchorage.

The new hybrid, battery-driven lube oil barge was handed over by the yard in June 2025, and is expected to commence operations in the UAE in July. The 46.5m-long, 9.5m-beam and 3m-draught vessel will have a 730m^3 bunker fuel capacity and an estimated service speed of 10knots.

The Bureau Veritas (BV)-classed, 499gt *Tristar Eco Voyager* is the first hybrid tanker to operate in the Middle East Gulf, and is expected to lower carbon emissions significantly compared to existing tonnage deployed by the company. Tristar Eships CEO Tim Coffin says: “The vessel will be very positive for the local environment. We will closely monitor its performance over the first year of operations so that we have an accurate comparison.”

The vessel can run on MGO, biofuel or battery power, the latter being a notable innovation for a vessel of its type. This not only adds to operational redundancy but also enhances sustainability through the reduction of carbon emissions. Tristar has installed a 1.4MW battery from Yinson EV on board, and in routine operations it is expected that this will last for six to eight hours before needing recharging, depending on weather conditions and the precise nature of the operation. The battery will take around eight hours to charge up to about 95% capacity, and this should permit the vessel, which will be chartered to Total, to make two bunker deliveries a day on battery power alone.

New notations

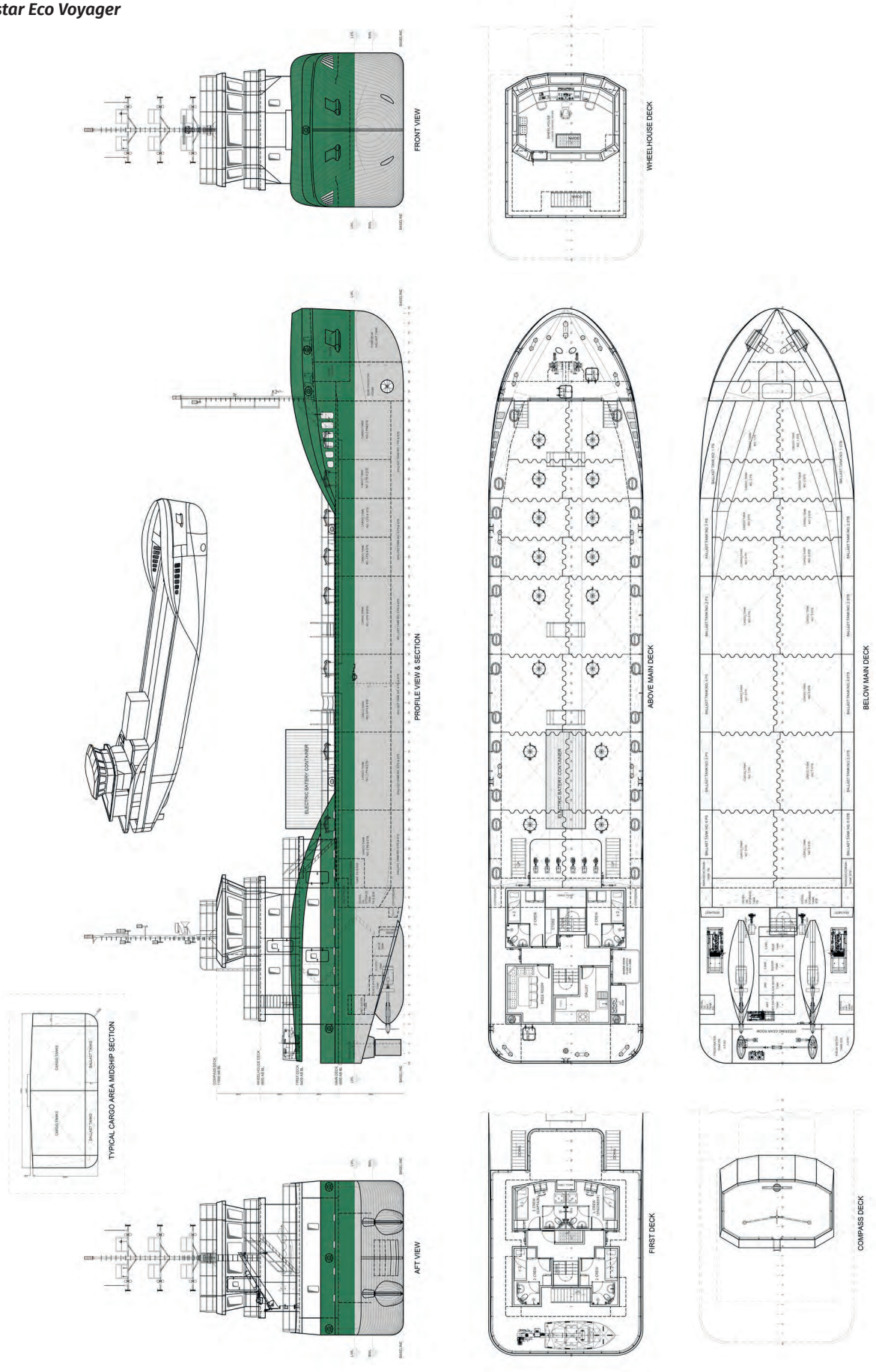
The battery will be used for propulsion as well as for the hotel load on board the vessel, which has the capacity for 10 crew members. The vessel has been designed so that it can operate on battery alone, diesel fuel alone or a combination of both. A propulsion motor, supplied by Danfoss, has been installed to offer a high degree of redundancy, supported by two 300kW Volvo Penta gensets.

Tristar has opted not to have a main engine on the vessel, with the propulsion motor using power from either the gensets or the battery to propel the tanker. Tristar has calculated that there will be a carbon emissions reduction of more than 50% compared to conventional vessels of this type. Moreover, if operated on B100 biofuel, this could be increased to a 100% reduction in emissions.

While the core element of the design, in terms of sustainability, is the battery power provision, the vessel has been designed following CFD tests to ensure minimum drag and high levels of efficiency for its class. BV has added the notations ‘PM’ (power management) and ‘ZE’ (zero emissions) to the standard notations of a vessel of this type.

Coffin says: "We currently operate eight conventional coastal tankers, and this is an effort to test the hybrid systems that are available. All things being well, we are looking to replace all of the current fleet with hybrid vessels over the next five years or so.” ■

The general arrangement of
Tristar Eco Voyager



A FRESH LEASE OF LIFE

Mark Barton celebrates the work of engineer John Puddy in saving the 1946-built, Fresh-class naval vessel SS *Freshspring*, for which Puddy was recently awarded the Society for Naval Research Victory Medal

In Exeter this June, alongside the Heritage Harbour Festival and a series of naval history events, the Society for Nautical Research (SNR) presented its annual Victory Medal, given for exceptional dedication to the preservation of maritime heritage, to John Puddy for his phenomenal long-term service in saving the registered historic vessel and ex-Royal Navy Fresh-class water carrier, SS *Freshspring*.

Built in 1946 by Lytham Shipbuilding and Engineering Company, the vessel is not only the last surviving example of the 14 in her class, but is also of particular significance for still being largely intact, including having her original steam machinery and boiler still *in situ*. Thanks to John Puddy, a qualified mechanical engineer with over 35 years of professional experience in a diverse range of heritage, maritime, disadvantaged support and learning sectors, SS *Freshspring* has an important story to tell about the immediate post-war period and the vessels that provided the Royal Navy's warship support, both in home ports and abroad.

Furthermore, the proposals to bring SS *Freshspring* back to operational condition for sustainable future use, while retaining her external form and sympathetically converting her internal water tank spaces, mean she will be the only operational vessel of this type.

STEM hub

After her working life ended in 1977, SS *Freshspring* gradually fell into disrepair and, with breaches in her hull, was about to be demolished where she lay. Becoming aware of her immediate plight in 2010, however, Puddy created a charity in 2013, purchasing her for £1 and undertaking the difficult task of seeking a permanent berth for the ship. With Bideford ultimately secured as a berth in 2016, Puddy went on to raise £155,000 from the National Heritage Memorial Fund to move her to dry dock for emergency repairs, before having her towed, at no cost, to her current long-term home.

John Puddy (left), receiving the Victory Medal from SNR chairman Dr David Davies in June

SS *Freshspring* in dock: the 37m x 7.5m, 1946-built vessel was purchased for £1 in 2013, saving her from demolition

Puddy continues to lead efforts to fund the vessel's restoration and to use her to host public and educational events

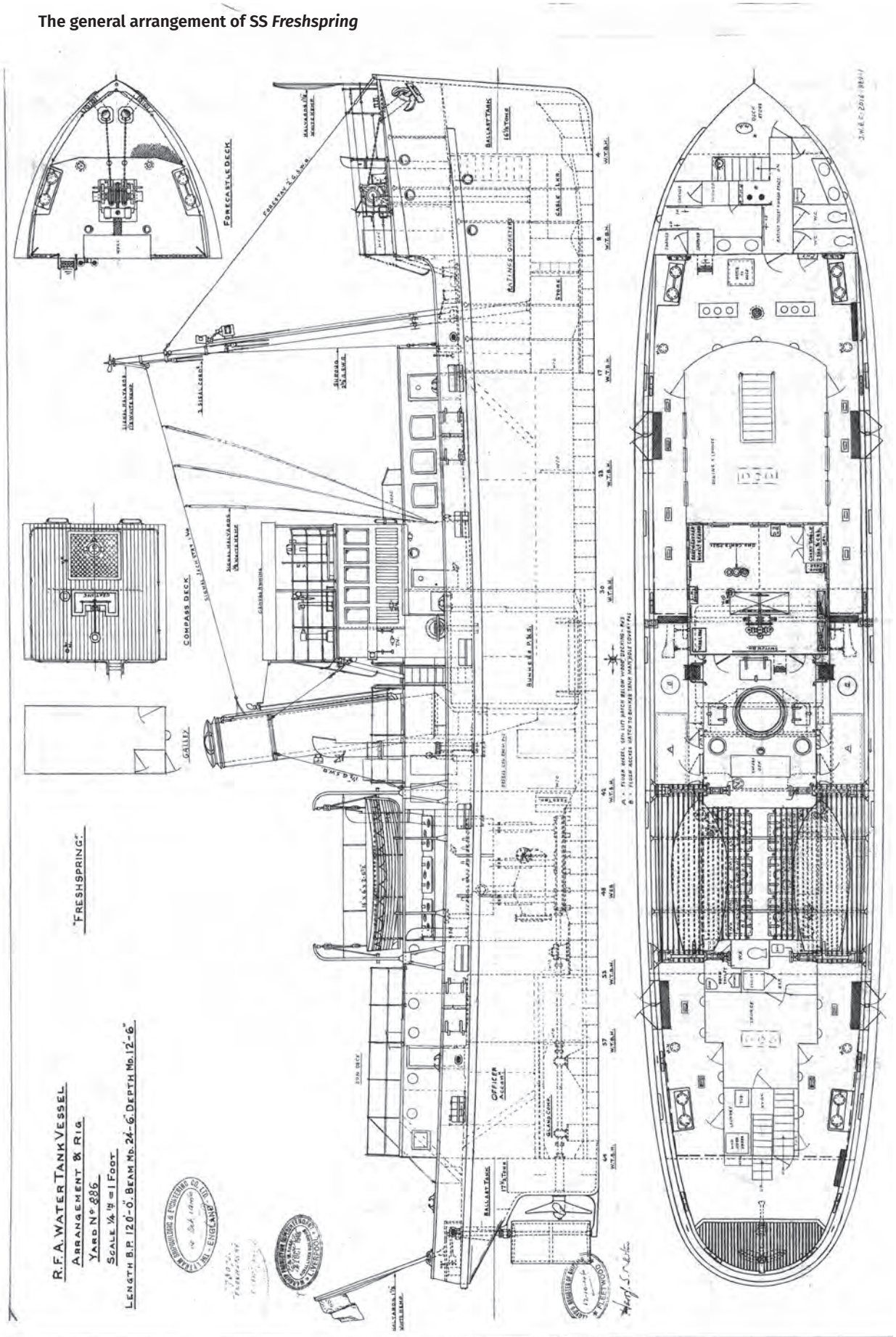
Puddy continues to lead the campaign to fund her restoration, as well as opening her to the public and staging events on board. This also resulted in the recruitment of a permanent community learning officer to provide training and education in science, technology, engineering and maths (STEM) subjects, with an emphasis on careers in the maritime sector. Her being berthed in Bideford, along with John's input, made a notable contribution to this North Devon port being awarded Heritage Harbour status in 2024 [1].

Like all historic ships, the team welcomes both financial and practical support as it negotiates its way through certification, and is extremely appreciative of BMT's support on its journey.

The SNR is a charity supporting maritime historical research, and was instrumental in saving HMS *Victory* for the nation in 1922 and in establishing the National Maritime Museum. It has its own journal, *The Mariner's Mirror*, and runs a maritime history-focused podcast of the same name. ■

[1] see the Maritime Heritage Trust: https://maritimeheritage.org.uk/

The general arrangement of SS *Freshspring*



BOLD TYPE

The first-in-class in the UK Royal Navy's new Type 31 series of frigates features enhanced capabilities and optimised, expanded mission space. **David Foxwell** reports

The first of the UK Royal Navy's Type 31 frigates, HMS *Venturer*, has emerged from the build hall at Babcock's yard in Rosyth in advance of entering the water for the first time. The ship was manoeuvred out of the build hall at Rosyth using self-propelled modular transporters in advance of float-off into the River Forth later this year.

After the ship has completed float-off, it will return to Rosyth to undergo outfitting and systems integration in dock before sea trials and entering operational service.

The shipbuilding programme for the new class is due to see all five Type 31 frigates – *Venturer*, *Active*, *Formidable*, *Bulldog* and *Campbeltown* – completed within 10 years of the initial contract award. Babcock was awarded a design and build contract for the frigates in 2019. The £10 billion investment in the vessels will provide a replacement for the Royal Navy's Type 23 frigates. The new ships are 60% larger than the Type 23 frigates but have a smaller crew: around 120 compared to 180-200 on the older vessels.

Additional capabilities

Based on Babcock's Arrowhead 140 design, the Type 31 (aka Inspiration-class) frigates form a core part of the future Royal Navy fleet. Designs based on the Arrowhead 140 have also been exported to Indonesia and Poland.

Sir Nick Hine, CEO of Babcock's marine sector, says: "We are building five complex warships in a single yard. This is an incredibly proud moment for everyone in Babcock and the wider programme partners." Minister for armed forces, Luke Pollard MP, says: "HMS *Venturer* will be at the heart of the Royal Navy fleet, deterring aggression and supporting our armed forces. She also represents the best of Britain's world-class shipbuilding heritage."

In April 2025, Babcock was awarded a £65 million contract to deliver what is known as a 'capability insertion period' (CIP) for the Type 31 frigates it is building. The CIP will add capabilities that will support the ships throughout their life and includes the insertion, testing and enhancement of a number of upgrades that will enhance their military capability.

Babcock Arrowhead MD Paul Watson says the contract will provide additional military capability for the vessels beyond the initial design and build contract. "The detailed knowledge that we have of these ships, combined with our forward-thinking design, will enable an efficient installation and through-life support of the systems and equipment," he explains.

Systems and space

The vessels are due to be fitted with Mk41 vertical launch systems capable of launching a range of missiles, including the Standard Missile SM-2, SM-3 and SM-6 variants, Tomahawk cruise missiles, SeaSparrow, Evolved SeaSparrow and Vertical Launch Anti-Submarine Rocket.

Boat bays and a flight deck will greatly expand the capabilities of Type 31s. The boat bays will launch and recover three PAC-24 boats that will be used to support boarding operations, anti-narcotics and anti-piracy missions, as well as rendering assistance to other craft. The flight deck at the stern of the new class of frigates will provide the capability to operate with a Merlin or Wildcat helicopter.

Each of the new frigates also has sufficient mission space to accommodate up to six 20' ISO containers, enabling them to change or enhance their capabilities to suit the requirements of specific missions.

In 2020, Babcock invested £31.5 million in a new assembly hall at its Rosyth site, part of a £55 million investment programme designed to enhance its shipbuilding capability. The assembly hall has been used initially for the construction of the Type 31 frigates. ■

HMS *Venturer* is the first of five Type 31 frigates that will replace the Royal Navy's Type 23 frigates

NO PASS FOR PLASTICS

A series of cheap, low-tech floating barriers are set to prevent the outflow of plastic trash from Indian rivers to the ocean, as part of a three-year project

A three-year initiative launched jointly by marine engine manufacturer Everllence (formerly MAN Energy Solutions) and counter-pollution start-up Plastic Fischer has set itself the ambitious but laudable goal of removing approximately 450-500tonnes of plastic pollution from select Indian rivers.

The project will see Plastic Fischer establish seven floating barriers, known as 'TrashBooms', in rivers close to Everllence locations in the cities of Vadodara and Bangalore, preventing the outflow of plastic rubbish into the ocean. Everllence is also bankrolling the initiative, and Plastic Fischer will use this funding to open two material-recovery facilities, which will sort and recycle the collected materials. "In the first year alone, these measures will create 20 local jobs," Everllence states.

Recyclable materials

Plastic Fischer was founded in Cologne in 2019, with the mission of combatting ocean plastic pollution while creating jobs in developing countries. The start-up has used its floating barriers to collect more than 2,000tonnes of plastic across eight project sites since 2021, creating more than 80 jobs in Asia along the way. Approximately 80% of ocean plastic originates from rivers, the company says, making the TrashBooms a critical intervention point.

The TrashBooms are built using locally available, low-tech and often recyclable materials, to keep costs low and minimise waste. For example, Plastic Fischer used repurposed plastic chemical drums to create TrashBooms in Indonesia, and PVC/high-density polyethylene (HDPE) pipes, iron wire and woven fishing nets in other locations. The company has also produced a construction manual, freely accessible online.

Each barrier is anchored (often with concrete blocks or tethers) to withstand river currents and fitted with a steel collection mesh, extending to approximately 0.5m below the water surface. Essentially, then, each TrashBoom acts as a modular, floating fence that traps debris as it flows downstream.

Debris is manually removed by local workers, transported to sorting facilities and processed daily. Recyclable materials, comprising about 5% of collected waste, are sold to local recyclers. Non-recyclable plastics, such as bags or multi-layer plastics, are used as alternative fuel in cement plants, replacing coal. Everllence describes this latter outcome as "a more environmentally friendly alternative to landfill or incineration, as it produces no residues like ash".

Credits system

Plastic Fischer funds operations through a 'plastic credits' system, where sponsors (including Allianz, KNIPEX and Covestro) finance the collection of specific amounts of plastic. Each credit represents 1tonne of plastic removed and processed, verified under standards like the Ocean Bound Plastic Certification.

As part of the new partnership, regular joint-collection campaigns with employees will take place at Everllence locations in India. The company operates at four sites domestically, manufacturing four-stroke engines and steam turbines. As well as its production facilities in Aurangabad and Bangalore, Everllence manages a PrimeServ service workshop in Vadodara and a sales office in Mumbai.

Karsten Hirsch, CEO and founder of Plastic Fischer, comments: "We are very pleased to take our next big step with Everllence and expand into two new locations at once. This long-term support will help us build infrastructure and drive sustainable change on site.

"Over the coming years, we will remove hundreds of tonnes of ocean and river plastic, create dozens of jobs and explore new ways to properly process river plastic." Prior to the Everllence partnership, Plastic Fischer had deployed TrashBooms in Kanpur, Trivandrum, Mangalore and Varanasi, as well as in Bandung and Bali in Indonesia. ■

Plastic Fischer will deploy seven of its TrashBooms in rivers in Vadodara and Bangalore, through its joint initiative with Everllence

PRECISION, INNOVATION AND MARITIME EXCELLENCE

Hoppe Marine provides an overview of its multiple services for shipbuilders, managers and fleet operators

Headquartered in Hamburg, Germany, Hoppe Marine GmbH is a globally recognised leader in maritime measurement and control technologies. For over seven decades, the company has stood for precision, reliability and innovation in the shipping industry. With a comprehensive portfolio of systems and services, Hoppe Marine plays a crucial role in supporting shipbuilders, ship management companies and fleet operators worldwide.

Founded in 1949, Hoppe Marine began its journey by developing high-precision instruments for ships. What started as a family business has since evolved into a global player with a strong reputation for engineering excellence. The company has remained true to its founding principles: delivering robust, accurate, innovative systems tailored to the harsh and demanding conditions of marine environments.

Today, Hoppe Marine continues to be family-owned and proudly independent, with a clear focus on long-term value creation for customers and partners.

Product portfolio

Hoppe Marine offers a wide range of highly specialised solutions designed to optimise vessel performance, enhance operational safety, and support digital transformation at sea. The product portfolio includes:

- **Anti-heeling systems**: Hoppe Marine specialises in all types of heel control systems. Our experienced marine engineers customise our hardware and software to the customer's desired application, making Hoppe solutions the first choice for the largest crane vessels. Expandable with Zero-Flow and Load Moment Control, we ensure maximum stability for any loading operation.
- **Anti-rolling systems**: Our highly effective, cost-efficient and low-maintenance systems are customised for each vessel and increase safety, comfort and loading capacity. FLUME's passive roll damping tank solutions improve the safety of cargo and crew without consuming energy. Our customised tank designs are optimised and validated in our test facility.
- **Valve and pump remote control systems**: With Hoppe's proven automation solutions, ship operators benefit from enhanced control and monitoring of fluid transport on board. These systems are crucial for operations such as ballast water management and cargo handling.
- **Tank measurement systems**: Hoppe's high-accuracy tank level measurement systems ensure safe and reliable cargo, ballast and fuel management. Their solutions are based on various measuring principles, such as pressure, radar or capacitive sensors, depending on the application and vessel type.
- **Data integration and ship-to-shore connectivity**: In line with the industry's digital transformation, Hoppe Marine offers solutions that connect onboard systems to shore-based platforms. This enables remote monitoring, performance analytics and decision-making based on real-time data.

Innovation and digitalisation

In an era of rapid technological change, Hoppe Marine positions itself as a front-runner in maritime digitalisation. By integrating smart sensors, automation, and cloud-based technologies, the company enables customers to unlock new levels of transparency and efficiency.The Hoppe Data Cloud and its associated services allow fleet operators to visualise, analyse and benchmark performance data across vessels. This digital ecosystem provides actionable insights for predictive maintenance, voyage optimization and environmental reporting.

Through strategic partnerships with classification societies, shipyards and software providers, Hoppe Marine contributes to shaping the digital future of the maritime industry.

Hoppe Marine serves a broad international clientele, with systems installed on thousands of vessels across all major ship types, including tankers, bulk carriers, cruise ships, offshore units and naval vessels. The

Valve and pump remote control systems are crucial for operations such as ballast water management and cargo handling

The low-maintenance anti-rolling systems are customised for each vessel

compliance. Its systems contribute directly to emission reduction, efficient fuel usage and environmentally responsible ship operations. By enabling better control over vessel dynamics and fluid management, Hoppe technologies help reduce energy consumption and minimize ecological impact.

Furthermore, the company maintains a strong quality and safety culture, certified according to ISO standards and aligned with the latest maritime regulations. Compliance and sustainability are not mere obligations, but integral components of Hoppe Marine's identity.

company maintains a worldwide presence through its offices and service partners in Europe, Asia and the Americas. With this global reach, Hoppe ensures reliable technical support and fast response times wherever its customers operate. The company's dedicated service team provides commissioning, training and lifecycle support to maximise system availability and customer satisfaction.

Commitment to sustainability

Hoppe Marine supports the maritime industry's commitment to decarbonisation and regulatory

Looking ahead, Hoppe Marine continues to invest in research and development to address future challenges in the maritime domain. Whether through advanced automation, enhanced digital services, or hybrid solutions, the company aims to remain a key enabler of safe, smart and sustainable shipping.

Hoppe Marine is not only a system supplier but a long-term partner in maritime innovation. With its blend of tradition and technology, the company upholds its mission to deliver 'proven systems – digital solutions'. ■

Join us in Glasgow for The Naval Architect 2025, RINA's new flagship annual membership event, bringing together maritime professionals to explore industry advancements, tackle challenges, and shape the future of naval architecture.

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THE FUEL OVERVIEW

Has the US stopped funding research into the use of low-enriched uranium fuel to power nuclear subs? **David Foxwell** investigates

After several years of doing so, the US is believed to have ceased funding research into low-enriched uranium (LEU) fuel for nuclear-powered submarines, just as demand for nuclear-powered submarines is set to grow and as US allies gear up to build their own nuclear-powered subs.

Experts argue that using LEU rather than highly enriched uranium (HEU) in the US' next-generation nuclear-powered attack submarine, the SNN(X), and in next-generation nuclear-powered attack submarines built for US allies, such as Australia, would address concerns that using HEU presents a proliferation risk, because HEU can be used to make nuclear weapons.

At the same time, they argue, budget limitations are set to defer procurement of the first of the SSN(X) submarines until 2040, rather than 2035 as originally envisaged, which would leave time for the development of a new reactor for the SSN(X) – and allied submarines – using LEU.

The US Navy has been acquiring Virginia-class nuclear-powered attack submarines (SSNs) since FY 1998. Now, a new class of submarines is needed to replace the Virginia class. But, despite a delay to the programme forced on the US Navy because of budget limitations, experts say the additional time available to develop the new subs – a version of which will also be built for the Royal Australian Navy under the AUKUS programme – is unlikely to be used to develop LEU fuel to the point at which it can be used in the SSN(X) and designs built for US allies.

The HEU 'cleanout'

Since 11 September 2001, the US Government had been seeking to remove weapons-useable HEU from as many locations as possible, because of concerns about the possibility of nuclear terrorism. President Barack Obama worked to make this effort a global priority, but the primary focus of the HEU 'cleanout' was on replacing HEU fuel in civilian research reactors.

As Professor Frank von Hippel, senior research physicist and professor of public and international affairs emeritus in the Programme on Science and Global Security at Princeton University, explains, eliminating the use of HEU in naval fuel was not originally on the agenda, even though naval reactors account for more than half of global HEU.

"The proliferation implications of the acquisition of nuclear-powered military vessels by non-nuclear-weapon states has been a cause of concern for almost 30 years," von Hippel says. "Since 1995, there has been a debate in the US as to whether the effort should be extended to the nuclear navy, which fuels its propulsion reactors with weapons-grade uranium. In 2021, that debate became more urgent, after the US and UK committed to help Australia – a non-nuclear-weapon state – build nuclear-powered attack submarines fuelled with US weapons-grade uranium."

In 2023, Democrat politicians requested that a report to Congress be produced regarding the US government's naval fuel research and development of LEU for reactors for submarines. "Bolstering research into low-enriched uranium will help minimise the use of nuclear weapons-grade HEU where non-essential," they said. In a letter to the then national nuclear security administrator Jill Hruby and secretary of the navy Carlos Del Toro, they wrote: "Reports from both the Office of Naval Reactors and JASON [an independent group of scientists that advises the US government] indicate that it may be feasible for the Navy to use LEU fuel for naval nuclear propulsion, as France and China already do." They noted that, to support this R&D effort, the FY2023 National Defense Authorisation Act (NDAA) signed by President Biden included authorisation of US$20 million for nuclear fuels development.

Advocates of LEU fuel suggest AUKUS submarines could be designed to use LEU rather than HEU

The US Navy needs a new class of nuclear-powered attack submarines to replace the Virginia class (pictured)

"Minimising the global presence of HEU by reducing its use in military applications would reduce the risks associated with making and transporting HEU and demonstrate significant leadership on non-proliferation," the Democrats said. "It is more important than ever to promote the safe, secure and peaceful use of nuclear technologies."

Programme suspended?

However, experts questioned by *The Naval Architect* suggest that work on LEU is no longer taking place, even as the US Navy develops the design of the SSN(X), which will form the basis of the Royal Australian Navy's AUKUS submarines, and the UK Government commits to increasing its attack submarine force to 12 boats.

Alan J Kuperman, associate professor at the LBJ School of Public Affairs and coordinator of the Nuclear Proliferation Prevention Project at University of Texas, Austin, tells *The Naval Architect*: "I suspect the LEU programme was suspended in March 2025, but prior to that it received continuous funding, starting in 2016. It is hard to know for sure if the programme is suspended because Congress did not provide the usual documentation on appropriations this year."

Kuperman says he believes funding probably continued in the first half of FY 2025, through March 2025. He explains that, in 2023, he obtained two internal US Government progress reports on the programme, "which were encouraging". However, in mid-June this year, he explained: "I was told by a knowledgeable official that the LEU conversation is starting back up again, at least for exported submarines, spurred in part by the growing number of countries that say they want SSNs – such as Turkey.

"Delays in SSN(X) and SSN-AUKUS would provide additional time to determine if LEU is feasible for next-gen US/UK/Australian propulsion reactors, and France and China already have demonstrated that LEU is feasible in principle," he added. "I also noticed that your prime minister recently announced the UK might increase its purchase of SSN-AUKUS submarines from seven to 12. That would require extra tonnes of HEU. I wonder if he asked the US Navy whether it would provide that HEU before he made the announcement, because the US Navy is running out of HEU."

Lost interest?

Hans Kristensen, director, Nuclear Information Project and associate senior fellow to the Stockholm International Peace Research Institute, says he isn't aware of current LEU research funding, but that he would be surprised if it isn't being researched "at a basic level".

"In terms of programmes, it's not my impression there's any real move toward LEU," he says. "The US Navy doesn't seem to want it and the AUKUS/British connections don't include it. The delay in the SSN(X) programme is about shipyard capacity and overall funding challenges.

"The LEU issue has been discussed in Congress for years and some favour it, as do some outside experts, because of the connection to non-proliferation issues. But the Trump administration is not interested in those issues, so that will probably be less of a motivator in the next few years." He said that, in 2024, the US Navy made it clear it wasn't interested in LEU, and voiced the opinion that adopting it would take much longer than using HEU, cost more money, be less efficient and probably further delay the SSN(X).

In a paper due to be published shortly, provided to *The Naval Architect*, Professor von Hippel explains that the Department of Energy's (DOE's) Office of Naval Reactors initially rejected the idea of designing naval reactors fuelled with LEU but between 2014-2016 it was briefly open to launching an R&D programme for the development of high-density LEU fuel, as had been done in converting research reactors – "but then turned against that idea during the first Trump Administration".

International outlook

Professor von Hippel says six countries currently possess nuclear-powered naval vessels: the US, Russia, China, France, India and the UK, and, since all are nuclear-weapon states, their nuclear activities are not subject to International Atomic Energy Agency (IAEA) safeguards. At times, he notes, several other states have expressed interest in acquiring nuclear-powered submarines, the most worrying being Iran.

Another is Brazil which, since the 1980s, has justified its acquisition of a uranium enrichment capability by its interest in developing nuclear-powered attack

submarines (SSNs). More recently, Brazil put its enrichment activities under IAEA safeguards and under a bilateral nuclear transparency arrangement with Argentina, and has indicated that any propulsion reactors will be fuelled by LEU containing less than 20% U-235.

Professor von Hippel says the Republic of Korea also has an interest in acquiring nuclear-powered attack submarines and is developing a naval propulsion reactor compact enough to power a nuclear attack submarine. The reactor is to be fuelled by uranium enriched to less than 20% U-235. An agreement on peaceful nuclear cooperation with the US includes a US agreement in principle that the Korea can enrich uranium to less than 20%.

"Most recently, in 2025, the commander of Turkey's Navy announced that Turkey would build nuclear submarines," von Hippel explains in the paper, "although no indication was given as to whether Turkey would seek to acquire its own enrichment capacity."

AUKUS subs

Regarding the AUKUS submarines, von Hipple explains that, to allay international concerns and facilitate IAEA verification that Australia does not divert any of the HEU fuel to other purposes, the AUKUS agreement stipulates that the fuel is to be supplied in "completed, welded power units". "This would limit the IAEA's inspection task to verifying that access to the contained HEU is indeed made impossible by the welds and that no power unit has been opened after delivery to Australia," he explains.

"The AUKUS agreement stipulates, however, that, 'Australia shall be responsible for the management, disposition, storage and disposal of any spent nuclear fuel and radioactive waste resulting from the operation of naval nuclear propulsion plants...including radioactive waste generated through submarine operations, maintenance, decommissioning and disposal.' If the spent HEU fuel is left in Australia's custody, the IAEA's task of verifying the non-diversion of the HEU would have to continue indefinitely," he explains.

Like the US Navy, the UK Royal Navy uses HEU in its submarines

"The US employment of weapons-grade uranium fuel in its naval propulsion reactors establishes a precedent for non-nuclear-weapon states to do the same, creating a nuclear-weapon option via the diversion of some of the fuel," von Hippel argues. "The commitment to supply Australia with weapons-grade uranium fuel for its nuclear submarines as part of the AUKUS pact creates the additional precedent of a transfer of weapon-grade material to a non-nuclear-weapon state outside of safeguards.

"A joint Navy-NNSA naval nuclear propulsion programme and its supporters in Congress argue that changing to LEU would be costly and would require an abandonment of lifetime cores for nuclear submarines...and a return to refuelling, with the associated infrastructure costs and loss of time at sea. The Office of Naval Reactors, however, has itself identified a possible pathway to transition the US Navy to LEU fuel while retaining lifetime cores and no refuelling."

Conversion goal

"That pathway, involving a shift to high-density LEU fuel, would emulate the conversion route that has been developed over 50 years for research reactors and in one important respect, conversion would be easier for naval reactors," von Hippel explains in the soon-to-be-published paper. "Very few research reactors are being built today and the conversion of existing research reactors required the development of fuel that could replace the existing HEU core without altering the reactor design. In contrast, attack submarines are in a continual process of ageing out and replacement. So, if it were found that lifetime LEU-fuelled naval cores must be somewhat larger than the HEU cores in the preceding class of submarines, that could be built into the design of the next class."

It is possible, he agrees, that a new high-density LEU fuel might not be ready for production in time for the first boats in the SSN(X), new UK SSN or AUKUS submarines, but reactor pressure vessels for the submarines could be designed to accommodate somewhat larger LEU cores in later vessels in the class, when such cores become available. "The larger-volume hulls these next-generation attack submarines are expected to have would make it easier for them to accommodate larger-volume reactor pressure vessels," von Hippel says.

"In parallel, the US and UK could signal to Australia, Brazil, South Korea – and any other non-nuclear-weapon state interested in acquiring nuclear-powered submarines – that the US has adopted the same policy it adopted in the past for research reactors, giving high priority to the development of high-uranium density LEU fuel for its naval reactors, and that it expects them to do the same." ■

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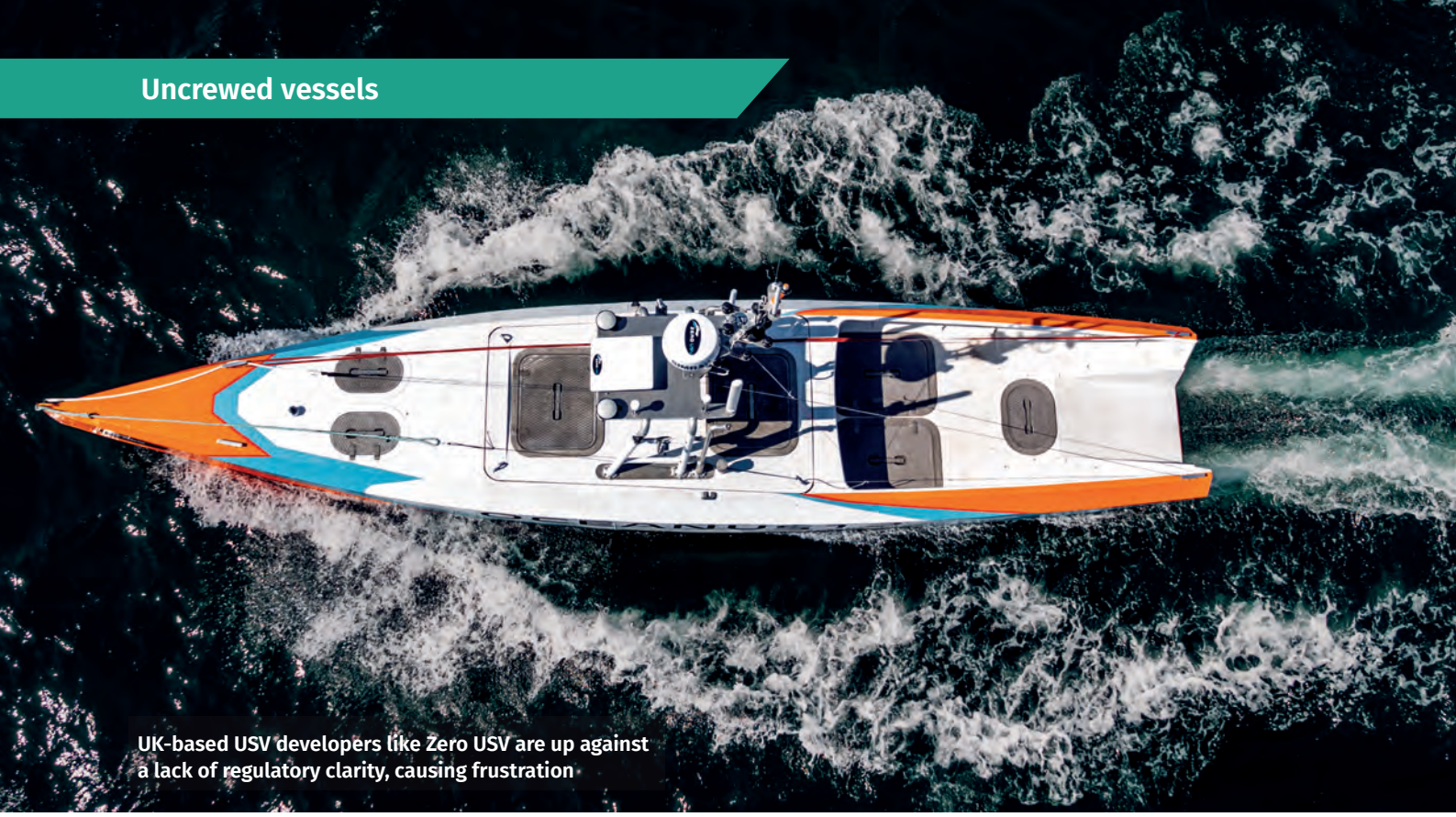


UK-based USV developers like Zero USV are up against a lack of regulatory clarity, causing frustration

FIGHTING TO THRIVE

Britain has the talent and technology to be a world leader in uncrewed vessels production – but does it have the political will to support this thriving sector? **Martin Conway** speaks to Matthew Ratsey, MD of Zero USV

In purely technological terms, the UK could be described as a leading hub in the development of uncrewed surface vessels (USVs) and autonomous and remote-control craft. From the recent pledge by prime minister Keir Starmer to make the UK NATO's fastest innovator, to the Ministry of Defence's NavyX programme and Defence Drone Strategy, Britain appears bullish on the future of autonomous solutions.

And yet, from a regulatory point of view, some UK-based USV developers are "tearing their hair out in frustration", because the urgent pace of development being achieved by industry is not being matched with the necessary support from the Maritime & Coastguard Agency (MCA), the UK's leading maritime regulatory authority, thus hindering their efforts to get these uncrewed vessels commercially operational on the water, says Matthew Ratsey, naval architect and MD of Plymouth-based Zero USV. Evidently exasperated, it comes as a shock when Ratsey ponders the possibility of relocating his business, stating: "If the regulators can't find a way to implement their own rules in a timely manner, then we'll be left with no choice but to relocate out of the UK and go somewhere where our technological developments are valued and welcomed."

How did it come to this? For Ratsey, the stinger is "entirely to do with regulation". He tells *The Naval Architect*: "Over the past few years, the entire space for commercial vessels under 24m in length was operating under Workboat Code Edition 2" – a safety code developed by the MCA, which came into force in 2018, replacing Edition 1. Ratsey continues: "The MCA spent 18 months updating that to Workboat Code Edition 3 – nine months of which was spent rewriting the code but with a significant period where they refused to share what had / had not been included in the final cut. So, there was a massive vacuum where nobody in the UK had any real clue regarding the scope of the regulation they needed to follow to be able to design, build and operate their USVs or ROVs.

"Edition 3 of the Workboat Code was published in December 2023. But, as of today, nobody has managed to get a USV through Workboat Code Edition 3 Annex 2. Meanwhile, industry, as demanded by the politicians, has been bold and brave and has put its money where its mouth is.

"We're at the stage now where there is a clear choice to be made: either the MCA backs the certifying authorities, which are meant to be empowered to act on its behalf, thereby allowing this industry to thrive, or the risk is that the lack of any action or progress will literally stop the industry dead in its tracks – which means companies like us will be forced to walk and set up elsewhere.

"We have a viable business, with two USVs built and sold to Australia and Canada, and two more vessels currently in build. But it's no accident that our first sales were overseas. The real nub of the frustration

is that the certifying authorities are not getting the necessary support or response to clarifications they require from the MCA in administering the rules, which then impacts directly on businesses such as ourselves, as nothing ever gets over the line and with the necessary certification to actually operate commercially."

Regulatory pains

Ratsey adds that, although the first edition of the Workboat Code (1998) was originally published for under-24m boats to set safety and compliance standards while allowing operators a cost-effective alternative to the rigours of putting a vessel through class, "we've now gone full circle". "I got a price from one of the classification societies the other day for putting our USV through Workboat Code 3, and all in, with the software compliance price, it was close to six figures," he says. "It's getting to the point where it would almost be cheaper for me to put a boat through class than through the Workboat Code 3. Somehow we have ended up with such a top-heavy, onerous system that actually going through class would be more transparent, and very likely quicker and more cost-effective.

"As for the USV we sold to Canada, it'll probably be certified by Transport Canada and commercially operational within a month to six weeks, and that alone should show our regulators what is possible when industry and regulator combine with a 'can do' attitude. Keir Starmer says we need to lead NATO in autonomy on the water, and we are massively capable of doing that – but not when industry is being held back by regulation which itself is so out of step with where industry has got the technology to, and what it needs.

Matthew Ratsey, Zero USV (left, pictured with Dan Hook of RAD Propulsion): "Why, after 18 months, has nobody got a USV through Workboat Code 3?"

"We have a viable business, with two USVs built and sold to Australia and Canada, and two under build. But it's no accident that our sales were overseas."

"We've been invited by the Royal Navy to take our USV, the Oceanus12, to REPMUS, the NATO autonomous solutions showcase, in Portugal in September, and it will be the biggest UK-built USV at the event. But the MCA is still telling us we have to restrict our testing and development to a small categorised area of water in Cawsand Bay, in Plymouth. How can we meaningfully trial and test new technology unless we are given the tools and wherewithal to able to do it properly? We need change fast, or business will simply be forced to vote with its feet."

"Held back"

The other barrier to wider USV adoption in the UK, Ratsey says, is the risk-averse nature of larger businesses. "These businesses have to answer to investors and shareholders, or to the bank, and these bodies do not like the unknown," he muses. "If, however, there was a clear regulatory path forward, it would enable investors to pile in and get behind this technology. We're demonstrating a great product, but then potential investors are asking us, 'What about the regulations? We've heard there are difficulties?'. We have the people and the skills, but we're being held back and boxed in the corner by regulations that are simply out of step with the level to which industry has managed to bring the technology.

"If people think this is just a case of me whining or getting on my soapbox, they only have to talk to the various maritime clusters across the UK, like ours in Plymouth, to get the same view in terms of how frustrated everyone is.

"Ask yourself the question: why, after 18 months, has nobody got a USV through Workboat Code 3? Clearly something is seriously wrong with the system for this to be the case."

MAS to Oceanus12

Zero USV was founded in the wake of the Mayflower Autonomous Ship (MAS) project, in which a solar-powered, AI-driven trimaran, designed and built by Plymouth-based MSubs, embarked on a transatlantic voyage in 2022, to commemorate the 400th anniversary of the original *Mayflower*'s journey. Departing Plymouth, England, the MAS reached Halifax, Nova Scotia after a 3,500nm, 40-day trip. The crewless vessel also collected ocean data on climate change and marine life on its journey. After this successful crossing, Zero USV was formed to draw on the skills, hardware and software that had been developed between MSubs and MarineAI (see *The Naval Architect* March 2025), and subsequently

The company's Oceanus12 is designed for 20-day missions, but a forthcoming 'extra-long-range' version could up this to more than 60 days

launched its first uncrewed boat, the Oceanus12, in March 2025.

Featuring an overall length of 11.55m (or 11.4m on the waterline) and a 2.33m beam, the Oceanus12 draws 1.76m, displaces 6tonnes and has a 1tonne payload capacity. The USV's dimensions were specifically restricted so that the complete boat, including its strut, radar arch and cradle, can be stored inside a 40' container – the preferred means of transportation in the defence sector, says Ratsey, and just as handy for civil customers. "This is how we've ended up with nearly a 5:1 length: beam ratio," he adds.

The boat incorporates a hybrid diesel-electric powertrain, with the capacity to store up to 1,200litres of fuel. Operating a USV doesn't just equate to substantial savings on crew costs, Ratsey points out: fuel efficiency is significantly enhanced. "The Oceanus12 consumes less than 5.8litres an hour," he says. "Whereas most crewed boats use 2,000litres a day, we're burning 1,200litres of diesel on a 20-day mission. Day rates may be similar for crewed/uncrewed vessels, but the fuel costs for our USVs are orders of magnitude lighter: generally halved." Each boat is fitted with twin 40kW drives, enabling a cruise speed of 6knots, and has an endurance of approximately 2,500nm.

Strength and stability

Each Oceanus12 is also designed with a long, slender hull, for enhanced pitch and reduced roll. A yacht-style strut is another important feature of the series, providing additional vessel stability. "We can put steel ballast plates on the bottom of the strut to trim it, depending on the loads the boat is carrying – it's very flexible," Ratsey says. "The strut's 1.8m-long, so it's quite a long lever arm from the centre of buoyancy." As such, the USV can handle a wide variety of conditions.

More recently, Zero USV unveiled plans for an extra-long-range (XLR) version of the Oceanus12 (see *The Naval Architect* June 2025), designed for remote missions with limited refuelling access. The XLR Oceanus12 will boost the original model's endurance to 7,500nm and more than 60 days, as well as increasing the length to 13m and the fuel capacity to 4,000litres. Larger USVs may be in the pipeline: as Ratsey highlights, there are limits to what you can do in, say, the North Atlantic, where treacherous conditions necessitate a bigger build. "We have done the initial design study and are seriously looking at the build of a 24m USV, though this would probably be several times the cost of producing the Oceanus12, so ideally we would have a customer on contract first," he says.

The Oceanus12 range is constructed in aluminium, chosen over GRP for its superior end-of-life recyclability. As well as making for a strong, resilient hull, Ratsey explains that aluminium helps to get the boats to market more quickly. "You can supply the boat as a laser-cut kit with pre-formed panels so that, when it gets to the shop floor, any competent, coded welder can assemble the hull, even if they don't necessarily know anything about building boats," he says. "In the most simple terms, you just tack-weld it together before fully welding the structure. This opens the door to being able to construct these boats anywhere in the world."

Swarm benefits

While Ratsey acknowledges that a single 12m USV "isn't necessarily going to have the capability of a 24-30m crewed offshore survey boat", he emphasises the need for a mindset shift to fully appreciate the advantages of uncrewed craft.

"When you start looking at using these things in swarms, as force multipliers, that's where the game really changes," he says. "For example, one of the priorities in offshore wind is reducing the consenting times for new sites. We've had meaningful discussions with The Crown Estate [the body that manages the UK seabed and leases sites to offshore wind farm developers] in relation to how Zero USV can assist. Our proposal was that we could make 10 Oceanus12s available to the survey companies so that, instead of surveying in 400m-wide swaths, they're surveying areas of 4km swaths per survey line.

"We can also reduce the time required to survey a consenting field from weeks to days. This means surveyors can afford to wait for the best weather window, so that the quality of the data is much better, as they now have extra days to spare." Zero USV has also had requests from fisheries looking to use the Oceanus12 to detect fish stocks in certain areas. "It's better for them to have a USV, or a fleet of USVs, out there, patrolling the sea – it's far more economical," he says. "Once the USV picks up whatever fish it's looking for with the forward-facing sonar, it pings back a message, the fishers jump into their boat,

head out to the patch and are able to catch their fish, with minimum crew time and fuel usage."

USV evolution

The expansion of USV development has been fuelled by growth in other technologies. Ratsey identifies the launch of NVIDIA's small form factor GPUs as a major leap for USV capabilities, due to their ability to process data quickly while drawing minimum power and fitting into tight spaces – essential for boats such as these, where onboard space is at a premium. These GPUs can run AI models, handling tasks such as object detection and real-time decision making, and can process sensor data inputs from the boats' cameras, radar and AIS. "They're very powerful and there's no need for an always-on satellite connection with them installed," says Ratsey. "It's a technology we'll see embraced more and more."

As for the future of USV operations, Ratsey views wider adoption as inevitable. "One CTV operator we've spoken to, building a 150m vessel, is interested in adopting MarineAI's Guardian autonomy stack – the same tech is the brain behind Oceanus12 – for straightforward back-and-forth journeys between the shore and wind farms," he says. "On a straight route like that, the chances of anything unwanted happening are very low. You could run the boat as if it was on a train track."

Additionally, while many in this sector believe that human-in-the-loop/human-on-the-loop (HIL/HOL) approaches to autonomous shipping will always be relevant, Ratsey opines that it's a case of using whichever concept best suits the vessel, its operational area and its mission. Naturally, this can vary widely. "For example," he says, "when we sent the MAS across the Atlantic, we had HIL operatives keeping an eye on the boat, remotely. We found, though, we struggled to keep the operators awake and had to set alarms for them. The reality is, once the vessel leaves the UK and enters the big blue, not a lot happens quickly." Five-hour and eight-hour stretches between any significant events were common.

"On the flipside," Ratsey continues, "if you're entering a harbour with massive container ships trying to offload their cargo, and yachts and powerboaters all around, you wouldn't choose to perform the operation autonomously. Just because you can do it, why would you want to increase your level of risk disproportionately? You'd switch to remote control or use some sort of escort vessel. It's about being sensible and adapting to the situation at hand – for the same reason you might put a Tesla into autonomous mode on a motorway but resume control when driving along winding country lanes."

Creating a framework

Still looming like a storm cloud, however, is the regulatory "stranglehold" that Ratsey fears might scupper the UK's long-term autonomous maritime tech outlook. At the time of writing, the UK is on a heightened state of readiness, and tensions between Israel (and, invariably, the US) and Iran were escalating. Ratsey's message to the regulators is: "We need speed of action. We cannot work with a system as protracted and difficult to navigate as that which is currently in play. If we don't seize the opportunity that industry has worked extremely hard to create, before we know it, others will have caught up and overtaken us, leaving the UK USV industry long behind and very much in their wake.

"If nothing changes on the regulatory front, then ZeroUSV will have to seriously consider moving its manufacturing base out of the UK to somewhere like Canada, where demand for USV technology is high and our business would be welcomed with open arms. But it's not just Zero USV, there are many other UK-based USV companies who are also very much at their wits' end, who simply cannot continue with the status quo, and who could likely be forced to retrench to their mother countries.

"We need to get the regulators to understand what is proportionate and what is acceptable in terms of a framework for maritime autonomy, so on the one hand business can be allowed to thrive, whilst maintaining that safety-first stance we all very much practice running our day-to-day businesses." The UK's shipbuilding and offshore oil and gas prowess has taken a severe denting in recent years – will it relinquish its skilled autonomous solutions developers too? ■

The Oceanus12 features a long, slender hull, for enhanced pitch and reduced roll

BREAKING THE 'VICIOUS CYCLE'

Through his involvement with the FAST Cluster, James Williams, CEO of Uncrewed Survey Solutions, is keen to engage with the industry and the MCA to ensure the next version of the Workboat Code gives UK USV developers a fair chance of certifying their boats and realising their potential. **Martin Conway** reports

Another mover in the UK USV tech cluster is Cornwall-headquartered Uncrewed Survey Solutions (USS). The company specialises in designing, building and operating modular USVs as part of a marine data acquisition service package, and has produced two main units: the monohulled Accession class, designed for larger payloads and offshore environments, and available in lengths of 3.5m, 4.25m and 5m; and the Inception catamaran, better suited to inland and harbour surveys, and available with a length of 2.1m.

Things have been on the up for USS as of late: James Williams, CEO, tells *The Naval Architect* that the last financial year, in which the company quadrupled its turnover, was USS' "best to date" and that "this year's booming as well". In June, the company added Michael Casey to its advisory board, Trish Buxton to the role of business development manager and Liam Eagling to the post of field engineer, signalling a phase of expansion as the company eyes up new memorandums of understanding with strategic partners in Singapore, Malaysia and Brunei.

It hasn't always been this way, though. Williams recalls darker days when the ongoing lack of adequate UK regulations for USVs put his company under immense commercial pressure. Echoing the experiences of Zero USV (see pages 30-33), Williams tells *The Naval Architect* that this issue is now a "common ground" for much of the dialogue between USV clusters around the UK.

Regulatory hurdles

"The MCA didn't have anything in place to deal with this innovative technology until they brought out Workboat Code Edition 3 in December 2023," Williams explains. While the MCA did engage with stakeholders (including the Future Autonomy at Sea Technologies [FAST] Cluster, where Williams chairs the Surface Autonomy sub-group) prior to revising the Code, the result was "a bit of a tick-box exercise, as the MCA hardly made any major changes to the draft edition of the new Code, despite a lot of pushback from the USV sector", he recalls. "Since then, not one company has managed to comply with everything the MCA

Business is booming for Uncrewed Survey Solutions but, like many, the company is concerned about the lack of regulatory clarity for USVs in the UK

requires under the Code to issue a full certificate for a working USV."

The situation became so bad that USS went on to place its boats under the San Marino flag, just to ensure that they could take on work outside UK waters – a move, Williams believes, that several other USV developers have followed.

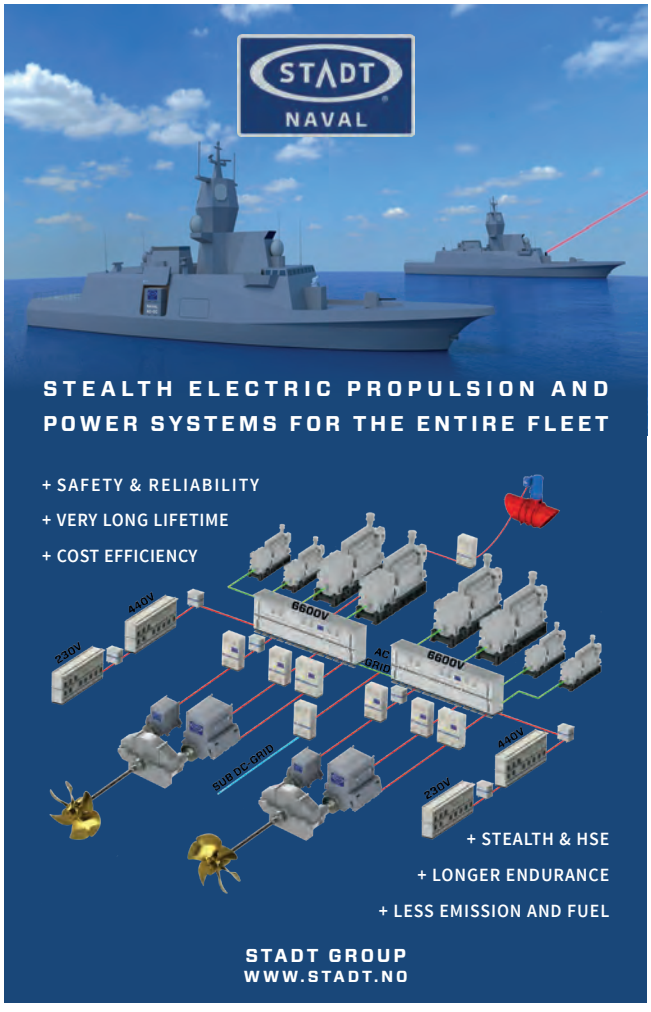
Another hurdle is related to vessel size. "We especially pushed for there to be some recognition for the smaller end of the USV market, because Workboat Code 3 covers every commercial boat size under 24m," Williams notes. "It didn't matter how you were working, what you were doing and what size you were – the same rules had to be applied to all vessels within that category. There was no proportionality between a 24m boat and a 1m boat, although you obviously can't physically put complex payloads onto smaller boats.

"Also, 24m and 1m boats are very different risk models. So, we pushed for special consideration for what we call 'mini-maritime autonomous surface ships' [mini-MASS]." As a likely result of this pushback, the MCA introduced two marine guidance notes (MGNs) in 2024: MGN 702 and 705. The first provides a general exemption for MASS under 2.5m in length, while the latter does so for remotely operated unmanned vessels between 2.5m and under 4.5m overall. Williams says that, while this move was welcome, it doesn't currently go far enough.

USS' Accession class measures 5m in length, meaning modules had to be removed to meet the requirements of MGN 705

Size and compromise

"Up until the end of 2024, all of our offshore operations were overseas, because we couldn't work



"We have back-up for every primary system...that can be challenging at times, given our largest USV is only 5m"

in our own territorial waters," he says. "When MGN 705 came out, we could meet the requirement. As our USVs are modular, we could take the Accession apart, remove the back end and take out one of the payload modules, then put it back together. That got us from 5m to below the 4.5m length overall, so we could then operate it in UK waters.

"The problem now, though, is that removing a payload module reduces the scope for what we can do with the USV, work-wise. So, instead of doing 100% of the tasks we want to go for, we can only do 50%. As a result, we're still pushing for more proportionality when it comes to vessel size."

There is also the concern that politics may be at play. "The MCA didn't determine the MGN 705 maximum length of <4.5m on safety grounds, but because it didn't want to upset the existing crewed workboat market," Williams says. "It was more of a political decision than a safety-based decision. However, USVs and crewed workboats are very different – you're not comparing like for like. If I had a 4.5m crewed RIB that I wanted to put through Workboat Code 3, I'd probably only spend £5,000 or £10,000, but companies are being asked for £100,000 to £150,000 to get a USV through the Code, with no guarantee of success."

This creates a vicious cycle, which, Williams opines, could kill the UK USV market if it is not addressed. "People are not applying for USV certification because they believe they won't get through – but, because they're not applying, the MCA is not getting the data it needs to understand why the current regulations aren't working."

Design considerations

Unfortunately, the above detracts from what USV developers like USS should be spending their time doing: honing their vessels to perform as efficiently as possible. As with any vessel type, USV design involves a fair amount of trade-offs: "You have to pick your wins and work out your application, then design the boat accordingly," says Williams. "You can't have speed and endurance, or stability and a planing hull: everything is a compromise." As a hydrographic surveyor by trade, Williams and his team have transferred this expertise into the design of USS' USVs. "We build this knowledge into the design spec, which the naval architect then takes to design the boat," he says.

Importantly, USS' boats aren't built to sell. "We build them to operate ourselves," Williams explains. "Anyone can buy a USV, but that's just 10% of the journey: the real expertise, the real IP, is the other 90%, which is the safe, efficient and effective operation of these vessels. It's not as easy as people may think – once the boat goes over the horizon, beyond the line of sight, it's a whole new game."

There is also pressure to reduce carbon emissions, even though 'dirty' diesel still guarantees an operational effectiveness that batteries alone cannot fulfil. All the same, Williams highlights that USS' hybrid-power boats, incorporating a small diesel generator to recharge the batteries, have managed to reduce diesel emissions by up to 95% in many applications.

Resilience is also a key consideration when designing and building USVs. "We have to ensure there are back-up systems on board, especially for communications and the power supply," he says. "We have back-up for every primary system and every weak point. That can be challenging at times, given our largest USV size is only 5m. And then, on top of all that, you've got to remain cost-competitive."

One game-changer in this respect has been the Starlink satcom system, which Williams identifies as having "revolutionised our ability to work safely offshore, providing operators the bandwidth they require to safely operate at a fraction of the price it would usually cost". He adds: "Unless it's a military vessel, it's very rare now not to see a Starlink aboard a smaller USV. Low earth orbit [LEO] satellite systems are definitely the way forward for what we want to do; you can't fall back on a 4G/5G network, which only really works when you're operating around a coastline."

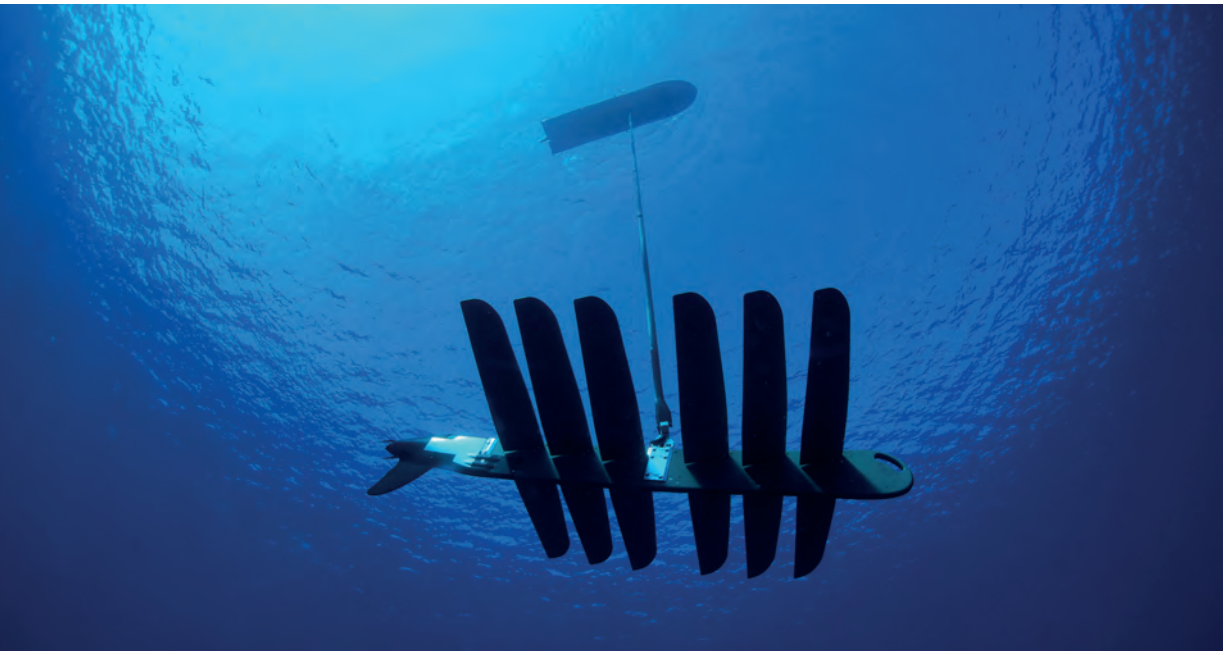
Future hopes

Looking to the future, Williams predicts that the levels of autonomy demonstrated by USVs will largely depend on their applications and end goals. "I think, where you don't have people on board, autonomy will excel; where you do have people on board, autonomy will be more of an assistive tool for lean-crewed operation. The technology required for fully autonomous solutions will be available in the market within five years, maybe nearer a decade – but in terms of regulations? We won't get near to full autonomy for at least a decade, or maybe for 20 years, with how the MCA's currently doing."

To break the abovementioned 'vicious cycle', the FAST Cluster now intends to approach industry for anonymous feedback, including info on the challenges USV developers face, before sending this data on to the MCA. "The MCA will then use this feedback to inform changes for the next Workboat Code Edition, which I predict we'll see enter force by 2030," Williams says. Hopefully, this time round, the updated Code will make it easier for developers to certify their products, and maybe even consider placing them under the UK flag – meaning that Britain's autonomous solutions sector can realise its clear potential while nurturing the expertise of the professionals driving uncrewed operations. ■

IN THE WAVES OF PACIFIC FISHERIES

Environmentalists are using a fleet of autonomous surface vessels to obtain vital but elusive data related to biological hotspots in the Pacific. **Stevie Knight** reports



Wave Gliders convert the energy from rise and fall of the waves into forward motion

This spring saw the return of some interesting visitors to the waters around Hawaii. They've been travelling in a loose pack, circling the islands hunting for chlorophyll, among other things, even at depths of 150m.

These are Wave Gliders, autonomous surface vessels developed by Liquid Robotics, used by NOAA's Pacific Islands Fisheries Science Center (PIFSC) to fill an information gap concerning biological hotspots: something that research ships and satellites can't resolve. In May and June, three Wave Gliders were continuously swimming around each of the big Hawaiian islands, between 1-6km away from the shore, measuring variables such as temperature, salinity, oxygen and chlorophyll fluorescence.

So, why chlorophyll? According to PIFSC oceanographer and project co-lead Dr Jamison Gove: "It provides a good estimate of phytoplankton biomass in the ocean...the basis for productive and healthy marine ecosystems". In short, it signals what's happening across the marine food-web.

Generally, tropical waters tend to have low phytoplankton levels, but, close to islands, it increases significantly. These 'hotspots' are essential to local fisheries as they provide the base of the marine food chain. And, in this part of the world, fishing remains an important resource.

However, there are now uncertainties about how the climate-related rise in water temperature is impacting the ecosystem, making fisheries management challenging. As Liquid Robotics succinctly points out in its whitepaper *The New Economics of Marine Environmental Monitoring*, "you can't manage what you don't measure".

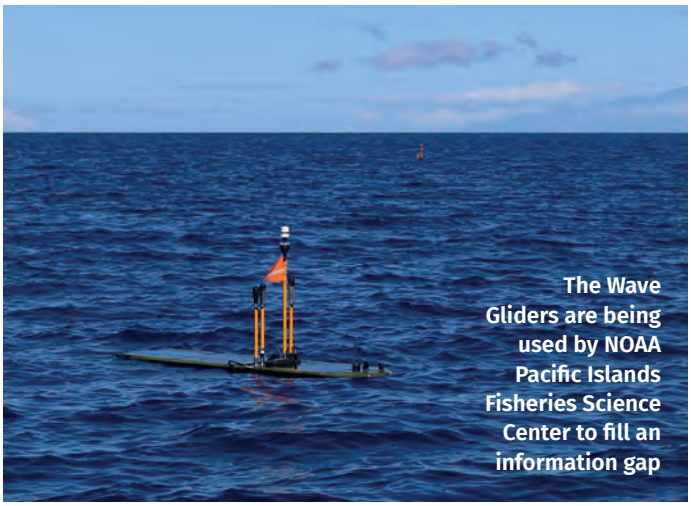
But traditional survey and sampling equipment is usually either expensive or too restricted. Manned missions can provide a snapshot, but they're not economically viable for long-term data collection. Buoys, on the other hand, while able to take continuous measurements, are limited to a relatively small area.

Parallel 'wings'

Given this, long-endurance USVs like Liquid Robotics' Wave Gliders might be the answer.

Despite their place in providing a solution, these gliders are not that eye-catching: from above, they seem like oversized surfboards (the SV3 measuring 3m and the SV5 coming in at 5.15m), albeit with a few masts and solar panels on the top. However, there's a lot going on below.

In fact, most of the power is generated beneath the surface. Attached by umbilical is a device that, at first glance, appears to be a rudimentary, 2.2m aircraft fitted with several parallel 'wings'. When seen in motion, this sub begins to look more like a venetian blind, endlessly opening and closing its shutters. It's a rather creative idea: as waves move the surface float above, the sub below is pulled up and down. This rise and fall pivots its wings: a flipper action that propels the sub forward, towing the surface vehicle behind.



The Wave Gliders are being used by NOAA Pacific Islands Fisheries Science Center to fill an information gap

Additionally, relatively small waves are enough to provide the motive force, the gliders having a water speed of between 0.8-2knots, varying with the sea's energy.

Multi-speed 'thrudder'

On board the float are data collection devices, an array of communication systems including satellite, cell, WiFi, line-of-sight radio and, of course, substantial computing power. Top-side solar panels harvest up to 0.225kW on board the smaller glider and 0.525kW on the larger; these charge batteries rated 6.8kWh and 15.7kWh respectively.

The stored energy can be utilised to deploy sensors. For the PIFSC mission, the gliders have fluorometers fitted to winches, dropping them down to 150m below the surface five or 10 times a day. It can also be used to power what Liquid Robotics calls a multi-speed 'thrudder' – a combined thruster and rudder – giving the glider a top speed of 3knots when necessary.

Given the relatively compact, self-sufficient nature of the design, it's no surprise that these Wave Gliders can work continuously for months at a time – potentially, the endurance could be as long as a year.

This year's effort in Hawaii is the region's third Wave Glider survey: when the results are analysed, it's hoped the information will help PIFSC to understand the impacts of changing ocean conditions on fisheries and the marine ecosystem. As Liquid Robotics concludes in that same whitepaper: "Transformative technologies such as unmanned systems allow [...] cost-effective approaches to better assess the health of ocean. A more complete understanding [...] will drive initiatives and projects that are both sustainable and profitable." ■

CREW-FREE SURVEYS ON THE SHELF

Gondan's first uncrewed newbuild, *USV Challenger*, is set to shake up inspection, maintenance and repair work on the Norwegian Continental Shelf, deploying an ROV and a fishing trawler-inspired LARS

Early May saw Spanish shipbuilder Gondan deliver its first ever USV, in the form of *USV Challenger*. Designed by Salt Ship Design, and built entirely in-house by Gondan, the 262tonne, diesel-electric vessel was ordered by USV AS, a joint venture between Solstad Offshore, Østensjø Rederi and DeepOcean, to undertake a variety of offshore tasks, including inspection, maintenance and repair (IRM), mapping and survey work, with no crew on board.

Gondan tells *The Naval Architect*: "The project took 22 months, from contract signing in July 2023. Although the vessel is compact, its complexity exceeded that of many larger ships. For example, all key onboard systems related to manoeuvrability, power distribution and energy generation had to be designed from scratch, to achieve both high redundancy and a very compact layout.

"The technical definition of key aspects of the project was still preliminary during the period of the signing, so many technical decisions were made along the way. It was a dynamic process, with constant collaboration between the owner, suppliers and the shipyard." Upon delivery, *USV Challenger* travelled to DeepOcean's facility in Haugesund, Norway, to obtain regulatory approval to operate fully remotely.

ROV LARS

The USV features an overall length of 26.9m (or 22.4m between perpendiculars), a breadth of 7.5m and a draught of 2.3m. Its hybrid propulsion system includes: two Volvo Penta D16 MH engines, both IMO III-compliant and rated 588kW apiece; a pair of 1,400kW battery packs; twin Schottel SRP150 LFP propellers, rated 360kW each; and a 190kW Schottel PumpJet. This arrangement grants *USV Challenger a* speed of 10knots. Gondan adds: "Thanks to its diesel-electric propulsion system and its ability to operate at sea for up to 30 days, the vessel will reduce CO_2 emissions by more than 90% compared to conventional vessels."

Other features include an ROV launch and recovery system (LARS) designed by DeepOcean, capable of deploying an all-electric, work-class ROV that can operate at depths descending to 1,500m. The

ROV will also carry tools and sensors, enabling it to perform tasks such as underwater cable-laying, pipeline surveys, seabed mapping, annual inspections, cleaning work and 3D scanning of assets. The LARS, meanwhile, comprises an electric winch, a sheave wheel trolley, and kicker and rear hatch. The ROV is launched and recovered over the stern of the USV.

DeepOcean adds: "When launching, the ROV is simply pushed in, while the USV moves forward... when recovering, the ROV is pulled in, like a trawl, while the USV moves forward. We know what the challenges and limitations are with moonpool or A-frame solutions, so we have chosen a solution inspired by fishing and trawling." The LARS was subject to scale tests in rough seas as part of its development. *USV Challenger* is also fitted with a gyrostabiliser system, to reduce vessel movements during ROV deployments and retrievals, and enabling launch and recovery of the bot in significant wave heights.

Digital twin

Both *USV Challenger* and its ROV will be controlled from the same remote operations centre (ROC) at Killingøy, near Haugesand. DeepOcean has also provided a digital twin platform where a model of the ROV can be operated in seabed areas with restricted visibility. While developed for crew-free operations, the USV features a wheelhouse and is certified for four crew members on board within 20nm of the Norwegian coastline.

DeepOcean views the vessel as "a highly cost-effective supplement to larger subsea vessels", adding: "Rather than mobilising large vessels for every offshore task, operators can leverage the USV and its onboard ROV for parts of subsea installation, survey or IMR scope. By reducing the need for repeated transits of larger vessels, the USV offers significant cost savings." DeepOcean has also stated its ambition to shift 30% of its IMR operations from traditional vessels to USVs.

Now, DeepOcean is speaking to other operators on the Norwegian Continental Shelf (NCS) regarding demos and trials for *USV Challenger*. So far, the company confirms, Vår Energuu has signed up to assess the USV this year, and the vessel will undergo further inshore trials and installation work in Haugesund.

Gondan adds: "The USV segment is a very interesting and strategic market for [us]...we are working on new ideas and concepts, but our priority right now is to confirm the operational validity of this first prototype, which is modern and, in many ways, revolutionary. We want to observe several months of real-world operation to identify possible improvements and anticipate regulatory developments that could impact future designs.

"If all goes as expected, we aim to have a clearer roadmap by 2026, which would allow us to move forward with the next steps." ■

***USV Challenger* boasts the ability to operate at sea for up to 30 days**

A NEW *GUARDIAN* EMERGES

CTV know-how, exported from the offshore wind turbine fields, fed into the development of NEIFCA's latest newbuild, writes **Stevie Knight**

The new *North Eastern Guardian* had to be extremely capable and based on a proven, sub-24m design. So, what better architecture than an established crew transfer vessel (CTV)?

In fact, the North Eastern Inshore Fisheries and Conservation Authority (NEIFCA) had been planning a replacement for its forerunner, *North Eastern Guardian III*, for some years, and the hopes were to make its successor faster as well as providing more detailed information on marine life. As Chartwell Marine technical director Chris O'Neill relates, a trip out on a CTV sold NEIFCA on the platform's suitability and landed the contract. However, there was still a lot to do before it became a reality – including some healthy debate.

Chartwell's flagship CTV platform has a length of 24.4m and a beam of 8.65m above twin hulls shaped for both transit pace and stability in demanding conditions. "It's an extremely adaptable design," says O'Neill. Despite this, there's a big difference between wind farm support and fishery operations.

Further, while the hull spaces and working areas are designed to hold quite a bit of equipment, it was only when Chartwell got down to the details – after winning the tender and meeting the operating team – that it became clear how much they wanted to pack in. "However, it was clear this is the team that runs the boat: they had a lot of good experience and ideas about what they wanted to implement," says O'Neill. "So, at that point, we had to really try to incorporate what they were after."

Truly multipurpose

The nub of the issue, he explains, was the need to fulfil two rather different functions: on one side there is research, on the other, fishery patrols. So, while there may be substantial survey work, data collection and so on, there's also comprehensive regulation enforcement: that requires radar and plotting systems to monitor fishing vessels around prohibited areas along with the ability to move quickly.

Therefore, the boat had to be both agile and truly multipurpose. "We tried to keep the hull as similar as possible with regard to resistance and performance," says O'Neill. "However, above deck the design changed quite significantly."

Certainly, one of NEIFCA's main goals was to gain more load capacity. While the previous *North Eastern Guardian III* is a very capable vessel, it's a monohull with a much smaller rear deck tucked in behind the deckhouse. But taking a CTV platform, which normally operates from the bow, and creating a much larger aft deck meant relocating the superstructure, bringing it forward. While that involved "quite a lot of work on weight distribution", says O'Neill, the result has been worth it: it's opened up an 80m^2 working space at the rear.

Despite this, *North Eastern Guardian IV*'s deckhouse has also remained sizeable, the floor area measuring 70m^2. Its layout embraces a pantry, mess area, skipper and crew cabin, changing room, wet room, storage space, shower and comfort facilities, as well as access to the 35m^2 wheelhouse above. Here, along with the skipper's console and associated equipment, are both wing and aft operating stations, along with crew seats plus a sofa and table area.

Below deck are the engines, bow thrusters, fuel and other tanks fore and aft: the forward voids hold four berths, two in each hull. However, room has also been made for built-in imaging systems including multi-beam echosounders: together, these provide detailed, 3D pictures of the seabed and underwater activity. Interestingly, as these hull spaces are utilised much more frequently than during typical CTV operations, a further change was the introduction of full, easy-access staircases.

The challenges didn't stop there: alongside all this came a request for a thicker, more resilient hull. That meant increasing the bottom plating by 2mm with a 1mm rise in the thickness of the topside, main

The Chartwell Marine-designed *North Eastern Guardian IV* underway (image: Paul Armstrong)

and wet deck areas. While this didn't affect balance, it did hit both the kilo and cost budgets. As a result, O'Neill admits that there were "lively discussions" about exactly how far the parameters could be pushed without seriously impacting the vessel's performance.

Onboard analysis

However, these debates – and Chartwell's experience – eventually pulled NEIFCA's diverse requirements into a cohesive form.

Firstly, there is a useful array of equipment on the aft deck: a big, hydraulic net drum winch capable of a 2.5tonne pull, three smaller trawling winches plus a large A-frame at the transom. Even with its increased hull thickness, the boat retains the ability to carry 10tonnes of cargo, including research equipment, and a high-speed, 6m RIB that the team can launch as a response craft. Interestingly, NEIFCA describes how the RIB allows near-shore working of survey equipment in less than accessible locations, while also being able to work independently by virtue of having its own trailer.

Significantly, *North Eastern Guardian IV*'s deck also houses a wet lab, which enables samples to be analysed on board, rather than demanding a return to base. This means decisions can be made in the field. Finally, the IMO Tier III-compliant MAN12V 1,066kW engines in each hull, coupled with fixed-pitch propellers, yield the necessary 24knot sprint speed alongside an 18knot cruise speed: this slower pace minimises disruption to digital image capture and marine life.

O'Neill underlines the debate led both teams to evaluate what was necessary and what could be changed, the learning curve helping to refine the Chartwell Ambitious fishery patrol vessel (FPV) design. He remarks: "To be honest, it's quite exciting to be creating something like this...there was a lot of respect on both sides of the table, so we got on very well – and the boat is successful because of this."

Finally, *North Eastern Guardian IV* was recently delivered by UK-based builder Parkol: built in accordance with UK Workboat Code Edition 2 (and consideration given to Edition 3), it allowed the Whitby yard to expand its skillset as well as broadening its own industry appeal. The builder writes that since "similar challenges" to NEIFCA's are being faced around the UK, it hopes the boat "will become a blueprint for fellow inshore fisheries and conservation authorities".

That may well be true, given Chartwell's knack of collaborating on effective designs.

SHIP ENERGY EFFICIENCY

Bridging the Gap Between Theory and Practice

17th-18th March 2026
Athens, Greece

THE ROYAL INSTITUTION OF NAVAL ARCHITECTS

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HIGH ON THE DECKING ORDER

Work to modernise the interior and exterior areas of Royal Caribbean's *Allure of the Seas* was recently completed, prior to the start of a newbuild project, launching a newly developed material, writes **Clive Woodbridge**

Dutch maritime decking specialist Bolidt has recently completed its largest ever retrofit project, installing around 18,000m^2 of decking on the Royal Caribbean International (RCI) cruise vessel *Allure of the Seas*. The sheer scale of the project presented a number of challenges, which the company worked with the client, the shipyard – Navantia Cadiz – and other subcontractors to overcome.

Originally delivered in 2010, as at the time the largest cruise ship in the world, the 362m-long, 5,500-passenger capacity *Allure of the Seas* was scheduled for a major refit just before the COVID pandemic struck. However, this meant it had to be postponed by RCI, which last year decided to reactivate the project, to modernise the vessel and keep it competitive with new-generation ships now entering service.

Consequently, having been contracted by RCI to carry out the decking elements of the refit, Bolidt started the necessary preparatory work in July 2024. Gerben Smit, head of operations, global maritime business, says: "This was by some way the biggest project we had undertaken to date, surpassing our previous most extensive contract in the maritime sector, which involved a refit of RCI's *Adventure of the Seas*. The lengthy preparation period was vital, as it enabled us to build up a close understanding with not only the client and shipyard, but other subcontractors that were going to be working in the same spaces as us, to ensure the job went smoothly."

Prefabricated kit

Bolidt was contracted to supply a range of different products, including Bolideck Future Teak, Select Soft and Hard Soft, in 34 different areas onboard, both indoors and outdoors, across decks 5 to 17. On the 4,000m^2 pool deck, Bolidt installed its lightweight and hard-wearing Bolideck Future Teak, resurfacing existing installations, and fitted a new kids' pool area with Bolideck Select in various designs. It also repaired and resanded the 1,950m^2 jogging track, while installing Future Teak and Select Soft on 115 balconies spanning 1,900m^2, and soundproofing a new 800m^2 extension to the solarium on Deck 15.

Bolidt recently completed its largest ever decking refit project aboard *Allure of the Seas*

Gerben Smit, Bolidt's head of operations, global maritime business: "The biggest challenge was the sheer scale of the project"

To ensure that the work could be completed within the required time window, around 120 Future Teak-manufactured items were prefabricated in the Netherlands, in partnership with local resin systems specialist Boteka. Bolidt had worked with Boteka for around 15 years on different projects, and recently acquired the business in order to integrate its operations more closely into the group.

Around 320 pallets of materials, including the prefabricated items, were transported by road from Bolidt's manufacturing facilities in the Netherlands to Cadiz. In total, over 60 truckloads of components were moved between the Netherlands and Spain for this one project.

Weight balance

The preparation period also enabled the various stakeholders to iron out some potential issues well before the start date. One of the most significant was the fact that the 18,000m^2 of new Bolidt materials would have added a significant amount of weight to the vessel, impacting operational efficiency.

Consequently, Bolidt and RCI were able to plan for Bolidt technicians to remove around 10mm of the existing surfaces and underlay prior to installation of the new materials, to achieve a broad weight balance between the pre- and post-refit situation. Smit observes: "As well as adding in new decking, we removed a significant amount of existing materials. The benefit of the work we did collaboratively in advance was that the overall increase in weight was kept to an absolute minimum."

The project also involved complex logistics: not just in terms of product delivery and maintaining

WIND PROPULSION CONFERENCE

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17th-18th February 2026
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✅ Industry associations
✅ Leading academics

The new Future Teak Signature Premium product has been formulated to be as close as possible an alternative to high-grade natural teak

an agile supply chain, but also to support and manage the large number of staff on site. At the project's peak, Bolidt had around 150 skilled technicians on *Allure of the Seas* and managing this team required intense support from Bolidt's Netherlands-based operations team, who supervised all the necessary hotel, flight and other bookings to ensure the technicians could focus on the task in hand.

Smit adds: "The biggest challenge was the sheer scale of the project, which tested our capabilities in many different aspects, and required not only extensive pre-project preparation but ongoing liaison during the refit with all the other contractors. But, while you can plan for most things, you can't plan for the weather, and the project was negatively impacted by a lengthy period of rain while the ship was in drydock. This required us to become even more agile and flexible, and to intensify cooperation with the other contractors, to ensure the project did not overrun."

Newbuilding projects

Overall, the installation took place over a week at sea and 43 days in dock. It was concluded, on schedule, towards the end of April.

Allure of the Seas is one of nine RCI ships Bolidt has refurbished since mid-2024 amid surging demand for the company's refit expertise in the cruise sector. However, the company is also involved in a number of newbuilding projects, one of the most notable being work on Accor's *Orient Express Corinthian*, a 220m-long sailing yacht under construction at Chantiers de l'Atlantique in France. This will be the launch vessel for a new product, Bolideck Future Teak Signature Premium, that Bolidt has developed, together with the client and shipyard, to provide a high-quality, lightweight and hard-wearing synthetic material that is as close as possible in look and feel to real teak.

Future Teak Signature Premium is said to offer improved colour stability and be less prone to the fading effects of sustained UV exposure. It also includes new pigment elements designed to cool the product by 10-12°C, so that when the vessel is sailing in warmer climates, it is more comfortable for passengers to walk on in bare feet.

While the installation has recently commenced in France, product development work has been underway for the past 18 months. This has included the development of a new protective sealer, creation of several mock-ups using the new material at Bolidt's facilities in the Netherlands, as well as some trial balcony constructions at Chantiers de l'Atlantique. Finally, a large-scale mock-up of an area onboard was created by Bolidt in the Netherlands and this allowed the new product to be signed off by Accor and Chantiers.

The next stage involved extensive training of Bolidt's France-based technical team in handling the new product. An intensive two-week programme was held at the Bolidt Academy, within the Bolidt Innovation Centre in Hendrik-Ido-Ambacht in the Netherlands, so that the installation team gained the necessary experience in working with Future Teak Signature Premium and were able to prepare and familiarise themselves with the new material before starting work on the newbuild project in France in May this year.

The scope of the project will involve the installation of Bolidt solutions totalling around 6,500m^2, including 3,326m^2 of Future Teak Signature Premium within the ship's balcony areas, as well as the main deck, pool deck and upper decks. Work on the decking areas is expected to be completed by the end of 2025, with *Orient Express Corinthian*, the largest sailing yacht in the world, due to enter service in 2026. ■

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NELSON'S NAVAL ARCHITECT

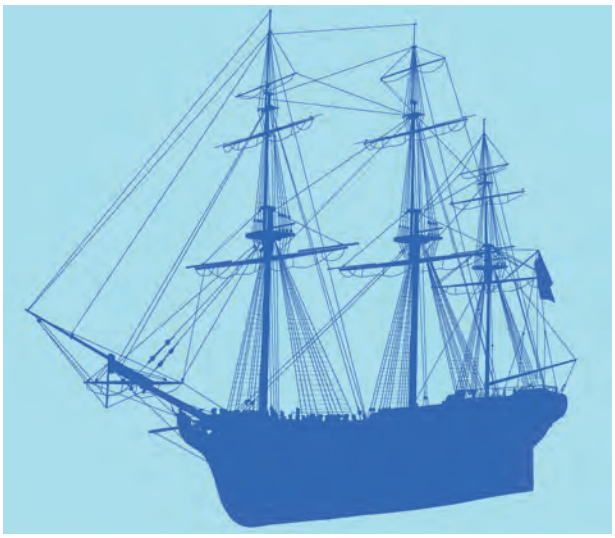
Sir Thomas Slade may be best known for designing Nelson's flagship, HMS *Victory* – but who was Slade, and what else did he achieve? **Peter Turner** profiles this prolific warship designer

At the Battle of Trafalgar, nearly a quarter of Nelson's fleet, bearing nearly a third of the fleet's guns, was designed by Sir Thomas Slade (1703/4-1771), who is buried in Ipswich, Suffolk.

Thomas Slade was born into a well-established family of Ipswich and Harwich shipbuilders, while his uncle, Benjamin Slade, was master shipwright at Plymouth Dockyard. He probably began his apprenticeship at Deptford Yard, on the River Thames, in 1718. He became the naval overseer to the building of fourth-rate *Harwich* in Harwich, in 1742, and two years later surveyed Sandwich Harbour and helped the planning of improvements to Sheerness, after which he was appointed assistant master shipwright at Woolwich.

When Benjamin was ordered by Admiral Anson, First Lord of the Admiralty, to examine the lines of some French prizes, he commissioned Thomas to make plans of them. As a result, Thomas became the protégé of Anson, and was moved in turn from Plymouth, where he had replaced his deceased uncle, to Woolwich, Chatham and finally to Deptford in 1753, from where he continued to advise Anson.

In 1747, Thomas Slade married Hannah Moore of Ipswich (d. 1763) and they had one son, Thomas Moore Slade. When, in 1755, the incumbent surveyor of the navy, Sir Thomas Allin, was taken ill, the Admiralty appointed Thomas Slade joint surveyor with William Bately. By this time, Thomas Slade was already designing ships and his early designs included the first British-designed '74's: a new type that became the staple of the British fleet until after the Napoleonic Wars ended in 1815. These were an evolution of previous British ships built to compete with the new French vessels of the same number of guns. There were at least forty-six 74s built to his designs.



Sir Thomas Slade's early designs included the first British-designed '74's, which became a staple of the British fleet until after the Napoleonic Wars ended

Increased size

Slade started designing smaller ships in 1756 and developed the true frigate, which still comprised two decks but with an unarmed lower deck, and with guns on the upper deck of a larger size than those on previous ships of this rating.

It was Slade who designed HMS *Asia*, the first true 64-gun ship. As a result, the Royal Navy ordered no further 60-gun ships but instead commissioned more 64s. Because these incorporated alterations learned from trials with *Asia*, subsequent ships Slade designed were bigger and would become the Ardent class of 64-gun ships of the line.

The first HMS *Ardent* was ordered in 1761, and six more would built over the following two decades. These included HMS *Indefatigable*, which was converted to a 44-gun razee frigate before being launched from Buckler's Hard in 1784. A razee frigate is one that has had the upper gun deck removed, based on the French word *rasé*. This was because time had shown that while these were excellent ships, they were too small for use in the line of battle and so were converted to successful frigates.

Indefatigable had a series of illustrious commanders, including Captain Edward Pellew's action with the much larger French 74-gun *Droits de l'Homme* and Commodore Graham Moore's capture of the Spanish treasure fleet in 1804, among many other actions. Both captains would rise later to admiral. *Indefatigable* would overall be credited with a part in 92 captures of enemy vessels.

HMS *Indefatigable* was converted to a 44-gun razee frigate before being launched in 1784 (silhouette image: Peter Turner)

***Victory* is considered Slade's greatest memorial, as she is still preserved to this day**

Two more of these ships were involved in the career of Nelson: HMS *Raissonable* and HMS *Agamemnon*. *Raissonable* was built at Chatham and was Nelson's first ship, although she only operated in the Medway at that point. *Agamemnon* was also built at Buckler's Hard and was Nelson's favourite ship, and where he spent most of his time as a captain. Nelson was on board *Agamemnon* from January 1793 to June 1796 and lost his eye while in command.

In 1756, Slade began work on the design of the ship most associated with Nelson. It was to be the only first rate that he designed and which would become HMS *Victory* (100 guns). *Victory* was not launched until 1765 but, despite having exceptionally good sailing qualities, she did not see service during Slade's life.

Enduring designs

Slade was a prolific ship designer, for which he was knighted in 1768, but he died in Bath in 1771. His designs continued to be used until well after his death, with *Victory* being Slade's greatest memorial, as she is still preserved to this day, at Portsmouth Historic Dockyard. However, his designs of many 74-, 64-, 32- and 28-gun ships were also very successful.

Sir Thomas Slade's body was brought back to Ipswich and buried in St Clement's churchyard, where a plaque commemorating Thomas and Hannah is displayed today. Buckler's Hard in the New Forest is a still-preserved 18th century shipbuilding village, and this and Chatham Historic Dockyard are now operated as museums and are open daily. Chatham is also home to the historic ships HMS *Gannet*, HMS *Cavalier* and the submarine *Ocelot*, while Portsmouth remains one of the main naval bases and the home of many current warships but has the historic dockyard with *Victory*, *Mary Rose* and HMS *Warrior* open to the public daily. ■

A memorial plaque in St Clement's churchyard for Sir Thomas Slade and his wife

Peter Turner is the editor of The 1805 Club's magazine 'The Kedge Anchor'. The 1805 Club is a society, open to all, which was formed to preserve and care for the memorials and graves of those associated with the sailing state navy of the Georgian era. In recent years it has established the Trafalgar Way, which runs from Falmouth in Cornwall to the Admiralty in central London and follows the route of Lieutenant Lapenotiere's journey to deliver news of the victory. Additionally, the 1805 Club has undertaken the preservation of Nelson's marriage register, now displayed at the church in Nevis.

CALENDAR

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https://rina.org.uk/events/events-programme/dry-dock-training-2025-online/

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2-5 SEPTEMBER, 2025
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https://www.offshore-europe.co.uk/

10-12 SEPTEMBER, 2025
INMEX SMM INDIA
International conference and exhbition
Mumbai, India
https://www.inmex-smm-india.com/

15-19 SEPTEMBER, 2025
LONDON INTERNATIONAL SHIPPING WEEK 2025
International maritime event
London, UK
https://londoninternationalshippingweek.com

21-24 OCTOBER, 2025
KORMARINE 2025
International exhibition
Busan, Korea
www.kormarine.com/en-gb.html

4-6 NOVEMBER, 2025
INDO PACIFIC 2025
International exhibition
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www.indopacificexpo.com.au

4-7 NOVEMBER, 2025
EUROPORT 2025
International exhibition
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18-20 NOVEMBER, 2025
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MEMBERSHIP UPDATE

RINA is pleased to confirm the following new members, who have achieved Member (MRINA), Fellow (FRINA), Chartered Engineer (CEng) and Incorporated Engineer (IEng) status

Member (MRINA)

Kirsten Leigh Shoesmith

Peter Jordan van der Spuy

Gareth Thomas Clark

Thomas Mawson

Robin Lawrence Saunders

Cong Tien Nguyen

Catherine Rosemary Shewell

Henry Fenton

Gustavo Enrique Iturbe Rosas

Giles Brown

Joseph Hodgson

Claudio Alexis Rodriguez Castillo

William Blake

Umberto Jose Varbaro

Wan Mohd Nazdmi Bin Wan Mohd Nasir

Prosanto Roy Choudhury

Fellow (FRINA)

Peter William Dow

Mohammad Tareq Alam

Daniel Smith

Michael Anthony O'Connor

Amitavo Chowdhury Wye

Michael James Ridley

Christopher Cozens

John Irving

Chartered Engineer (CEng)

Ashley Walker

Douglas Meagran

Christopher Carl

Daniele Caruso

Ian Nimmo-Smith

Jack Gifford

Jamie Perez-Martinez

Vinod Vijayamahon

Harold Manlangit

Jeffrey Roberts

Avinash Kumar

Anbarasan Muthiah

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