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Printed in Wales by Stephens & George Magazines.

CONTENTS

March / April 2024

NEWS 6-12

IN-DEPTH 14-20

A 2024 subscription to Ship & Boat International costs:

SHIP & BOAT INTERNATIONAL SUBSCRIPTION (6 issues per year)		
LOCATION	DIGITAL	PRINT + DIGITAL
UK	£135	£215
Rest of Europe	£135	£225
Rest of World	£135	£245

Includes P+P / Inclusive of VAT

Average Net Circulation 3,800 (total)
1 January to 31 December 2022
ISSN 0037-3834

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International Conference on Computer Applications in Shipbuilding

10-12 September 2024, Genoa, Italy

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20-21 November 2024, Copenhagen, Denmark

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

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- Maritime remote-control technology
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FEATURES 22-36

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NEWS

SUPERYACHTS AND MEGAYACHTS

SPRING LAUNCH FOR GOZZO 38 CABIN

The Gozzo 38 Cabin is scheduled for launch this spring

Boutique boatbuilder Apreamare is planning a spring launch for the new 11.45m cabin version of its Gozzo superyacht brand, to be dubbed the Gozzo 38 Cabin. The layout is aimed at owners looking for a greater degree of "interior habitability" and protection from the elements, with a special emphasis on sailings in Northern European, Turkish and Mediterranean seas and the US' Great Lakes, Apreamare says.

The Gozzo 38 Cabin will feature greater distribution of onboard space: for example, its bathing platform has been extended by 0.25m compared to Apreamare's existing Gozzo 35 model. Apreamare adds: "The high sides allow the increase in internal volumes without compromising the lines of the boat through the reduction of the gunwale by approximately 0.2m, and with the addition of a guardrail for greater safety."

The deckhouse features a partly closed cockpit, as well as perimeter windows to offer 360° panoramic views and to illuminate the lounge area. A large sundeck is positioned at the bow, while the cockpit features an L-shaped sofa for six people, with a retractable table and large lateral gangways. Two cabins and a head are located below deck; the guest cabin, situated amidships, will contain a 0.14m-wide bed. Apreamare says that owners will be able to select from various Volvo Penta stern drive and shaft drive configurations. ■

EDUCATION AND TRAINING

SUPERYACHT BATTERY SAFETY COURSE

Maritime security training provider Virsec has launched a new online safety awareness course for superyachts carrying lithium-ion battery-operated tenders, toys and equipment. The course was developed in partnership with Seascope France, largely in response to last year's Maritime & Coastguard Agency (MCA) MGN 681 update on fire safety and the storage of small electric-powered craft on yachts. This update called for the creation of a 'competent person' role to oversee onboard battery safety management.

The course is primarily aimed at yacht crew, officers and managers, and comprises "eight short lessons" drawn from real-world examples and designed to cover the electrochemistry and associated hazards of these battery types. The entire course should take 2.5 hours to complete, Virsec estimates, adding: "The course will provide the learner with the detailed knowledge required to: safely conduct battery-charging operations; identify hazardous or suspect batteries; and recognise the necessary steps to mitigate the risk until these batteries are removed from the yacht."

The course will also cover areas such as: identifying where Li-ion batteries are commonly situated aboard yachts; understanding the hazards and challenges linked to thermal runaway events; the types of specialist equipment used to suppress and contain Li-ion fires; and identifying the requirements for battery charging stations. Virsec says that the course has been produced in compliance with the ISM Code and STCW Convention. ■

Virsec's new safety course is focused on lithium-ion battery risk management aboard superyachts (image: iAqua)

ELECTRIC VESSELS

FIRST TRIP FOR THE PHANTOM

Vision Electric Boats, the boatbuilding division set up by Canadian electric outboard manufacturer Vision Marine Technologies, unveiled its new "unsinkable" polyethylene boat, the Phantom, at the 2024 Miami International Boat Show in mid-February.

The bright blue boat was produced using rotational moulding (aka rotomoulding): a technique used to create large, one-piece, complex shapes, typically with uniform wall thickness and stress-free sections to help prevent cracking and/or warping. Other stated advantages of rotomoulded boats include end-of-life recyclability and a low maintenance requirement.

The Phantom measures 5.05m x 2.1m; has a 0.2m draught and a dry weight of 363kg; and can carry up to 10 persons. Although the Phantom was designed for electric propulsion, owners can specify a petrol/diesel engine up to 50hp (37kW). The boat will be made available in various colours and in three formats: a hull-only build (without a motor), costing US$14,995; the ePropulsion version, which will offer a range of five hours, for US$24,995; and the ePropulsion Extra Range variant, which offers 10 hours of range and retails at US$29,995.

Vision Electric Boats comments: "The Phantom [is] recyclable up to nine times...its thick, rotomoulded plastic hull offers a very high impact strength and a lifetime warranty. [The boat should] remain in service on the water for decades to come before ever needing to be recycled." The company will initially produce 300 Phantoms each year, and reportedly at a 70% lower cost than an equivalent production run of fibreglass boats. Florida-based boat dealer Nautical Ventures says it has ordered 50 Phantoms, which it intends to market as recreational and sports-fishing craft. ■

The polyethylene Phantom is reported to be "recyclable up to nine times"

OFFSHORE SUPPORT VESSELS

WINDEA CTV ROLLOUT COMMENCES

North American operator WINDEA CTV has taken delivery of two bespoke crew transfer vessels (CTVs), ordered to support its offshore wind farm support activities. Both were designed by Australian naval architect Incat Crowther, with *WINDEA Intrepid* having been built by Gulf Craft, Louisiana and *WINDEA Courageous* by St Johns Ship Building, Florida (see *Ship & Boat International* January/February 2024, pages 24-25, for more on St Johns' CTV-building activities and outlook). A further three sister CTVs are due: two to be built by St Johns, and one currently under build at Breaux Brothers' facility in Louisiana.

Each of the five aluminium CTVs measures 30m x 10m, has a depth of 4.35m and draws 1.4m. Each can transport 24 turbine technicians and features a deadweight of 50tonnes. Other attributes include a 100m² forward deck, a 35m² aft deck, an elevated wheelhouse and four cabins (two single, two double) for six crew members.

Each CTV's propulsive set-up includes four Volvo D13 diesel engines, rated 515kW apiece, and a quad Volvo IPS system, permitting a service speed of 25knots. Onboard tank capacities come to 36,000litres of fuel oil, 3,500litres of fresh water and 2,500litres of sullage. All five CTVs meet/will meet the US Coast Guard's (USCG's) Subchapter L requirements for offshore support vessels. ■

WINDEA CTV is boosting its fleet capacity with five 30m x 10m newbuilds

PATROL AND RESCUE BOATS

LIGHTNING STRIKES TWICE

The Lightning-class tenders will serve as launchable tenders from a mothership

Glasgow-based boatbuilder Ultimate Boats has been contracted to build two military-style, high-speed RIBs for an unnamed UK "maritime security client", with both vessels to be constructed in Ultimate's recyclable composite material DANU. Designed to serve as launchable tenders from a mothership, the Lightning-class vessels will measure 11m in length, 2.7m in breadth and 1.29m in depth, with a draught of 0.65m and a displacement of 4.2tonnes. Each RIB will have a payload capacity of 1tonne.

Each boat will be fitted with two Suzuki DF350 outboards, enabling a cruising speed of 35knots (the top speed remains classified at the time of writing). The outboards will feature counter-rotating propellers for optimal thrust and stability, Ultimate Boats says. The RIBs will undertake tasks related to counter-terrorism, strategic reconnaissance, border patrols and direct action raids.

Each Lightning RIB will also host a Raymarine radar with target identification/collision avoidance capabilities, plus a chart plotter and a Teledyne FLIR thermal imaging camera. SHOXS will supply both boats' suspension seats, which will incorporate a deck track system to help personnel reconfigure the wheelhouse layout for specific missions.

Colonel Tom Ryall MBE, MD for defence at Ultimate Boats' parent company ExoTechnologies, comments: "One of the biggest challenges was balancing high-speed performance with stability in diverse sea conditions. Achieving this required proprietary hull technology, developed by Ultimate Boats' chief engineer John Moxham and derived from advanced aeronautical and fluid dynamics principles. This innovation reduces cavitation, enhances propulsion efficiency and ensures agility and manoeuvrability." ■

SUPERYACHTS AND MEGAYACHTS

BRIGHT *SPARK* ON THE WATER

Bilgin Yachts' first 2024 newbuild, *Eternal Spark*, has a range of approximately 5,000nm

Turkish boutique yachtbuilder Bilgin Yachts has launched its four-deck charter yacht *Eternal Spark*, apparently the yard's first newbuild of 2024. The 499gt vessel's naval architecture and exterior design were arranged by compatriot firm Unique Yacht Design, while the interior design was handled by Milan-based studio Hot Lab.

Eternal Spark has a steel displacement hull and an aluminium superstructure, and measures 49.95m in overall length (or 48.26m on the waterline, fully laden) and 9.25m in beam. At full load, the yacht draws 2.6m and displaces 495tonnes. The vessel boasts six cabins for 12 guests, though has the onboard space to host more than 100 persons for stationary parties.

Onboard features include five separate bars, seven divided socialising areas, gym equipment, a beach club (with sauna) and indoor/outdoor cinema facilities. Berkay Yılmaz, commercial director of Bilgin Yachts, comments: "You can spend time in a number of different areas on the yacht for numerous entertainment experiences." Meanwhile, Hot Lab contributed a floating staircase, plus a full-height, round glass wall between the lobby and main living room.

Power is provided by twin CAT C32 engines, each rated 1,081kW, gifting *Eternal Spark* a cruise speed of 12knots and a maximum speed of 17knots. Fuel and water capacities of 55,000litres and 11,000litres, respectively, have helped the yacht to achieve a range of approximately 5,000nm. ■

EQUIPMENT

ENGINES

YAMAHA CONFIRMS TORQEEDO BUY-OUT

Yamaha Motor has acquired electric marine propulsion manufacturer Torqeedo, obtaining control of the latter group's range of inboards, outboards, pod drives and batteries – as well as its patents and R&D capabilities. Yamaha says that the takeover will boost its efforts to achieve carbon neutrality in the marine sector, and will "birth synergies for creating mid-range electric outboard motors" within the small boat segment.

Founded in Germany in 2005, Torqeedo enjoyed a long run as a leading (if not *the* leading) manufacturer of electric propulsion solutions – to the extent that analyst IDTechEx once warned: "[Torqeedo's] high level of experience and developed product line-up makes it difficult for other start-ups to compete"(see *Ship & Boat International* September/October 2020, pages 35-36). In more recent times, however, manufacturers such as Honda, Mercury, Yamaha and China's ePropulsion have increased their ranges of boat electrification options, creating a healthier level of commercial competition.

The acquisition by Yamaha is expected to be completed at the end of Q1. Meanwhile, on the diesel power side, January saw Yamaha launch its 350hp V6 outboard, intended to "bridge the gap" between the group's V6 and V8 models. The 4.3litre engine has been designed with larger intake and exhaust valves and a "new robust crankshaft" with a longer stroke, intended to enable more torque at lower speeds. Yamaha elaborates: "The new engine manages air displacement using tailored intake manifolds equipped with 40% larger surge tanks to maximise the amount and timing of air rushing into the intake ports, while also ensuring even distribution of air into each cylinder." ■

The acquisition grants Yamaha control of Torqeedo's inboard and outboard engines and drives

TENDERS AND TOYS

SURFING WITH SPEED

Watercraft manufacturer iAQUA has launched its X-Jet Extreme electric surfboard, which draws on a 20kW jet drive to achieve speeds up to an eye-watering 68km per hour (nearly 37knots) – making it the world's fastest e-surfboard, the group claims.

The carbon-fibre surfboard weighs 23kg and has a weight capacity of 160kg, allowing it to support two surfers. iAQUA reveals: "On a single charge, the X-Jet Extreme can cover a distance of more than 30km." The board is equipped with a 3,670kW battery and a wireless throttle, and features two full-length stabilising keels, two side thruster fins (made of fibreglass) and one deep centre fin (made of carbon fibre). The fins have been incorporated into the design to keep the surfboard "rock steady and true in a straight line or carving turn", iAQUA states. The centre fin will also enable users to turn sharply at the top of a wave.

The X-Jet Extreme offers four power levels, and also comes with a balance leash and a magnetic kill switch, to automatically shut down the board in the event of a fall. For its promotional campaign, the e-board has been endorsed by 19-times (and current) Thailand National Surfing Champion and three-times World Flow-Board Champion Annissa Flynn (pictured). The board currently retails for €10,990 (approx. US$11,975). ■

The X-Jet Extreme e-surfboard has a range of more than 30km on a single charge

STEERING SYSTEMS

STEERING RESPONSE FOR SMALL CRAFT

Dometic has released its Optimus 3000-series electric steering system for single- and twin-rudder inboard-powered vessels up to 12m in length, including yachts, catamarans and sports-fishing boats. The system is intended to provide end users quicker steering response compared to equivalent hydraulic or mechanical systems, the company says.

The 12V solution incorporates a fluid-free design and comprises four components: a feature intended to simplify installation, Dometic explains. These components include: an electronic actuator; an LCD CANtrak display; a wiring harness; and an electronic helm. "[The system] can easily be adapted for single-helm vessels or inboard boats with up to three helm stations – making it practical for a wide variety of uses both recreational and professional," Dometic adds.

The Optimus 3000's electronic helm is designed to automatically adjust wheel turns and steering effort based on vessel speed. Dometic says: "The number of turns lock-to-lock varies from 3.5 to 8.5, based on speed and application." The CANtrak display enables users to set the system's steering parameters to suit both their individual preferences and the vessel-handling characteristics. Dometic adds: "This system is designed and built for the harsh marine environment, with a fully sealed controller integrated into the actuator." The Optimus 3000 can also be networked with other compatible vessel components, including third-party autopilots. ■

The Optimus 3000 can be adapted for single-helm vessels or inboard boats with up to three helm stations

ENGINES

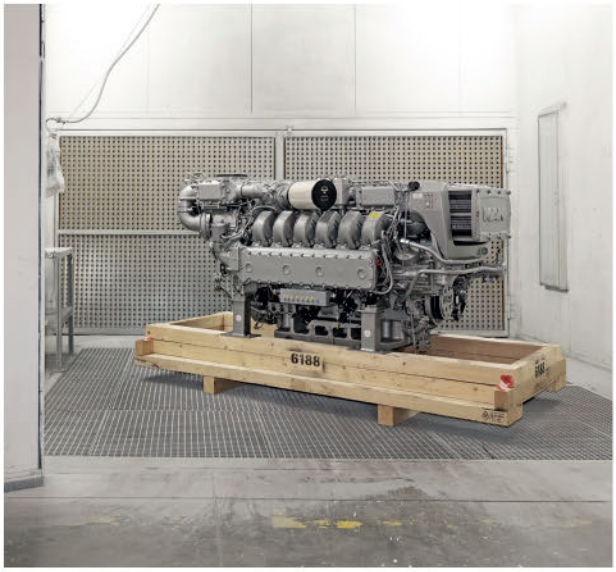
MAN BOOST FOR COMMERCIAL WORKBOATS

MAN Engines is set to launch a new V12 diesel engine, the MAN D3872, which has been developed for medium- and heavy-duty commercial workboat applications involving 3,000 hours of operation per year.

The first model in the MAN D3872 series, the LE432, will feature a 30litre displacement for medium-duty applications and two-stage turbocharging with an output of 1,650hp (1,213kW) at 2,100rpm. Measuring 2.2m x 1.25m x 1.3m, the D3872 is described as "completely new", although its design was based on findings gathered from MAN's D2862 V12 series – which featured a displacement of 24.2litres and a power output of 1,450hp (1,098kW). In addition to its increased displacement and output, the MAN D3872's modifications include a new crankcase (featuring larger bearing diameters and thicker walls) and a new common rail injection system with an injection pressure of 2,200bar.

The MAN D3872 also comes with a new coolant pump and exhaust gas aftertreatment system, the latter enabling compliance with EPA Tier 4/IMO Tier III requirements. Additionally, the engine is approved for HVO and has been prepared to meet EU Stage V requirements for non-road emissions. The engine has a dry weight of 2.72tonnes.

The first LE432 will be made available in late 2024. MAN says: "Further power gradations with single-stage charging for heavy-duty applications and aggregates are being planned." The new engine has undergone both bench tests and sea trials aboard a passenger vessel, the manufacturer adds. ■



The MAN D3872 was built for medium-/heavy-duty workboat applications involving 3,000 annual operational hours

DRONE TECH

SEARCH AND RESCUE

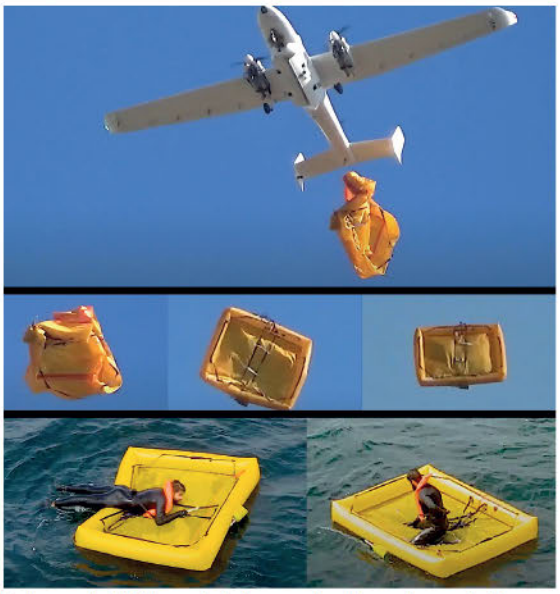
UAV SUPPORT FOR EU SEA RESCUES

Aerospace firm Tekever reports that its AR5 unmanned aerial vehicle (UAV) successfully deployed an eight-person life raft at sea in a search and rescue (SAR) exercise, conducted by the Italian Coast Guard in partnership with the European Maritime Safety Agency (EMSA).

The 7.3m x 4m AR5 has a cruise speed of 100km per hour and a payload capacity of 50kg. Tekever explains: "With fully automatic operation, sensors on board the drone enable the detection of vessels or humans on the water. Using AI, the drone calculates the optimal time to release the lifeboat close to the vessel or person in distress without human intervention, enabling the lifeboat to be deployed at a close enough, but safe, distance."

The company continues: "The system automatically considers weather conditions and flight plan restrictions, allowing the lifeboat to be easily used in a wide range of situations." The drone is also equipped with optical and infrared cameras, a radar, an AIS receiver and an EPIRB antenna. In this particular trial, the life raft was dropped to a person in the water, simulating a casualty. A coast guard helicopter then arrived at the scene and a rescue swimmer was lowered down by harness, who reached the raft "within minutes", Tekever says. The rescue swimmer then brought the casualty back on board the helicopter.

In 2021, Tekever teamed up with satellite systems operator CLS Group to provide joint maritime surveillance services to EMSA as part of a four-year contract. According to EMSA stats published in October 2023, some 2,500 marine casualties are reported by the EU member states each year. Beyond SAR missions, Tekever and CLS say that aerial drone surveillance will aid European nations in detecting oil and chemical pollution of the sea, and combatting illegal fishing. ■



Tekever's AR5 aerial drone deployed an eight-person life raft to a casualty in an Italian Coast Guard exercise

BOT BUSINESS

GREEN-TECH FUNDING FOR SEA MACHINES

Boston-based Sea Machines reports that it has secured US$12 million in its latest funding round for the development of its autonomous control solutions for vessels. The investors currently include green-tech venture capital firm Emerald Technology Ventures, Nabasco Technology Ventures (NTV), Chevron Technology Ventures, Ingram Industries, RKKVC, Level 2 Ventures and IMC Ventures. Sea Machines says that it also received financing in 2023 from the Geekdom Fund, which provides funding to pre-seed and seed tech start-ups.

Sea Machines' SM300 autonomous-command and remote-helm control system has been adopted by Zelim's uncrewed Guardian-class SAR craft (see *Ship & Boat International* May/June 2023, pages 48-49, for more on that vessel), as well as by US shipbuilder Metal Shark, which incorporated the system into its Sharktech 29 Defiant patrol boat class. Sea Machines has previously stated that it expects the autonomous vessel sector to grow by 9.6% annually in the run-up to 2030.

Sea Machines comments: "Key considerations behind the shift toward autonomy include cost pressures, labour shortages, safety, fuel savings and greenhouse gas reductions. The latter is a particularly pressing concern, given the challenges of decarbonising the sector—an area that Emerald is engaged in.

"While clean fuels like hydrogen could serve as a long-term catalyst for a greener industry, they will need to be paired with leaps in operational efficiency along the lines of [autonomous] solutions in order to help the sector achieve Paris Agreement-aligned emissions reductions." ■

EDUCATION AND TRAINING

COLLEGE COLLABS FOR ROBOSYS

South Hampshire College Group (SHCG) – a newly merged 'consortium' of three Further Education colleges from Southampton, Eastleigh and Fareham, UK – confirms that it has ordered a pair of 'digital training vessels' (DTVs). The DTVs will enable students to learn skills related to remote surveying, patrolling, monitoring and even search and rescue (SAR): via line-of-sight, using a local wireless controller, or from a classroom-based remote operations centre.

SHCG's hope is that, when the students leave college, "they will be better equipped to enter a broad spectrum of fast-growing maritime sectors, including offshore wind farm support, hydrography, aquaculture, defence and marine sciences".

The DTVs are effectively REAV-28-class inland USVs, produced by HydroSurv. Each of these aluminium catamarans measures 2.8m in length and 1.25m in breadth; has a lightship mass of approximately 200kg; and relies on twin Torqeedo 1103 electric outboards for a speed of 5.5knots. Each DTV will also be powered by Robosys Automation's Voyager AI software, which offers IMO Degree 4-level autonomy, plus features such as collision avoidance, anti-grounding and smart object avoidance.

Robosys comments: "Whilst it can be operated remotely from any site operating Robosys' fully mobile Ground Control System, the DTV can be easily relocated for immediate deployment in shallow lakes, swimming pools or Solent's waters, being highly suited to training operations."

The REAV-28 USVs will serve as digital training vessels for SHCG

Meanwhile, HydroSurv tells *Ship & Boat International*: "The first DTV will be delivered from HydroSurv to Robosys in April, with the second scheduled for May/June."

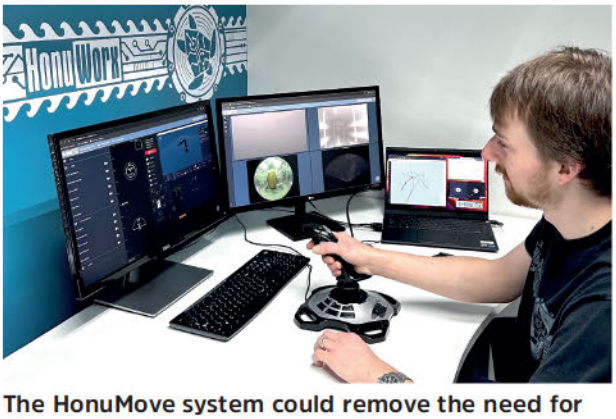
This isn't Robosys' only college deal: in Q4 2023, the group announced a three-year partnering agreement with AMC Search, the training and consultancy division of the Australian Maritime College, which is responsible for providing autonomous maritime systems training and engineering services to the merchant shipping and defence sectors. This partnership aims "to drive pioneering remote operator training on a worldwide scale", incorporating procedures for joint human-AI operations. ■

REMOTE PILOTING

DRONE CONTROL 'FROM ANYWHERE'

Scottish remote robotics firm HonuWorx says it has developed a new cloud-based system, HonuMove, to remotely control and supervise underwater drones at offshore wind farms. HonuMove was devised to allow pilots to control these robots from anywhere with an internet connection, eliminating the need to travel to offshore locations and/or control centres, thus reducing travel costs, improving personnel safety and minimising environmental impact, HonuWorx says.

Tests saw HonuWorx use HonuMove to link multiple remote pilots to a real Seatronics VALOR-class ROV. The group says: "From a test tank in Aberdeen, remote control was demonstrated from multiple locations in the UK and the US using various different communications modes, including satellite and 4G LTE." According to HonuWorx, HonuMove builds on the capabilities of the company's original cloud architecture, first developed in 2021, adding live video streaming, remote system access and embedded team collaboration.



The HonuMove system could remove the need for drone pilots to travel to operation centres

HonuWorx continues: "Thanks to the scalable cloud architecture, HonuMove users are not limited to a single physical location to access live operations." The system's evolution was supported by an Offshore Wind Growth Partnership development grant. ■

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NEW VESSEL DESIGNS

SWIMMING AGAINST THE TIDE

HydroWing's forthcoming Quad Hull Barge is intended to get tidal stream turbines onto site without the exorbitant costs – and heavy emissions – typically incurred by heavy-lift ship hire

HydroWing's 41m loa Quad Hull Barge could reduce the cost of each wave turbine installation from £500,000 to £20,000

Whatever happened to the tidal energy sector? Given the relatively muted press coverage, compared to the column inches devoted to offshore wind farms, you'd be forgiven for thinking that tidal energy capture projects had tailed off somewhat in the past few years – though this is far from being the case. Perhaps wave turbines are not as visually exciting as wind towers and banks of solar panels, but they still have major potential to assist the energy transition in the coming decades.

For example, industry analyst Technavio forecasts a CAGR of 29.5% for the wave and tidal energy market, expecting it to reach just under US$1,398 million by 2028. That's not so far off predictions made by Market Research Future, which foresees a CAGR of 25% for the tidal energy market. The sector still faces some hurdles, however – among them, limited locations for turbine installations and (arguably) less enthusiastic government backing. The biggest barrier, though, is linked to cost.

Expensive day rates

"Commercialisation of the tidal energy sector has so far been held back by high operations and maintenance costs," states Richard Parkinson, MD of Inyanga Marine Energy Group, which is the parent company of HydroWing, developer of a tidal stream energy generation turbine of the same name. "Deployment, recovery and operations and maintenance [O&M] are large factors in determining the levelised cost of electricity," Parkinson continues. "However, offshore construction vessel availability is very weak, with expensive day rates. This means that the cost of planned and unplanned offshore operations is very high."

At present, offshore HydroWing installations require the hire of a heavy-lift vessel, which certainly doesn't come cheap. Parkinson tells *Ship & Boat International*: "The cost of using an offshore construction vessel is around £50,000 [US$63,390] per day, not including the cost of fuel oil. It also takes three days to get to the site and then one day to mobilise. Typically, the entire operation would cost around £500,000."

Unsurprisingly, Inyanga Marine is keen to reduce these costs as much as possible: an approach that has led the company to draw up plans for a new means of transporting the HydroWing turbines onto site. This has led to the group's HydroWing division developing what it calls the 'Quad Hull Barge' – an innovative design with the potential to reduce the cost of each operation to just £20,000, Parkinson predicts.

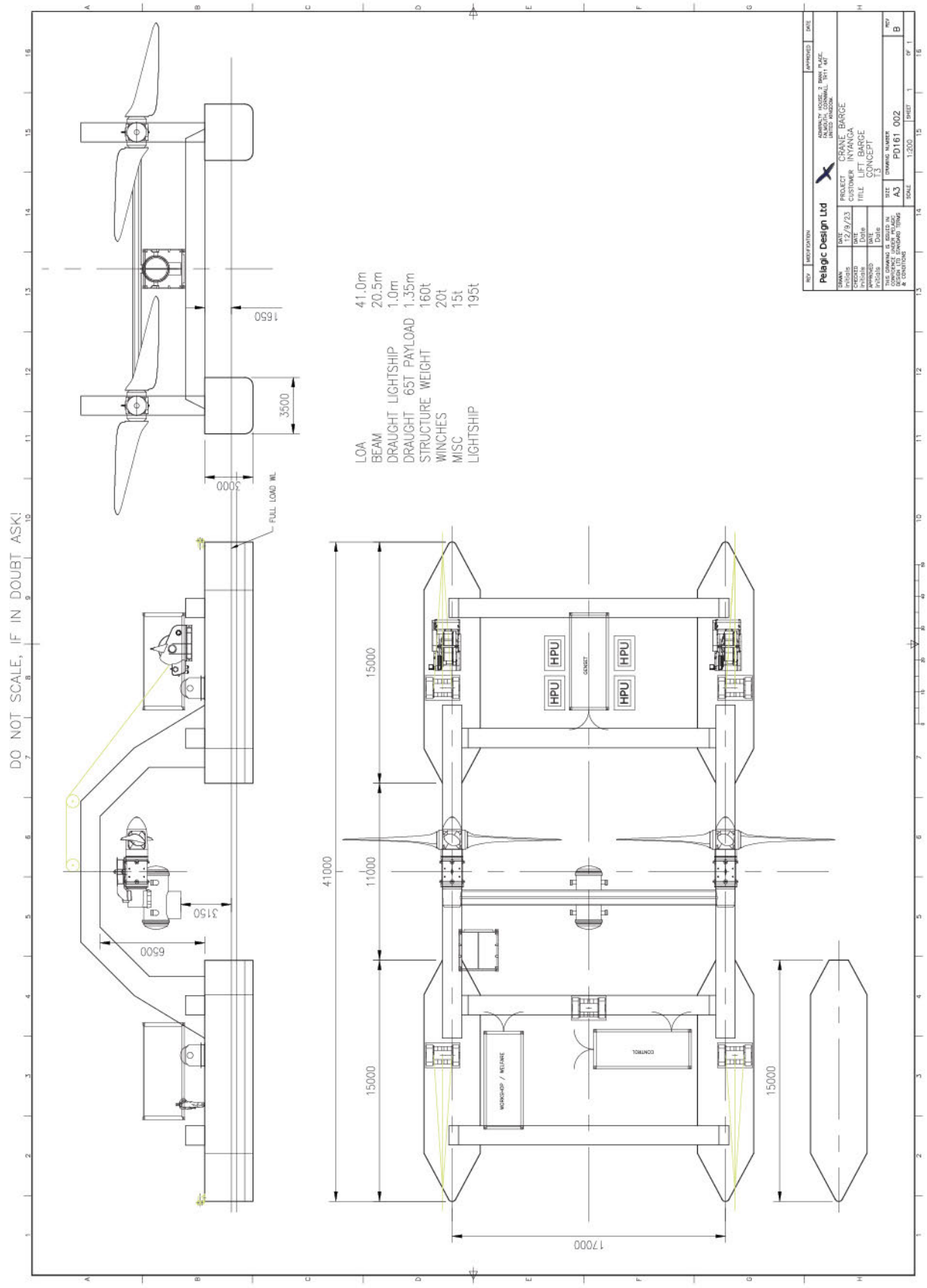
Turbine design

Firstly, let's take a closer look at the HydroWing itself. The base of this solution is a supporting structure that sits on the seabed, under its own weight. Turbines, equipped with 'wings' for ease of deployment, are then lowered into position on the structure. The solution can be scaled to suit various locations and use cases. Parkinson adds: "The turbines are bi-directional, so they generate power as the tide comes in and as it goes out."

What's also interesting about the wing system is that it simplifies the removal of sets of tidal energy turbines without the need to touch the foundations. As such, Parkinson estimates, recovery of the turbines takes 30 minutes. Combined, the foundation and turbine weigh 65tonnes.

The HydroWing technology is set to play a major role at the Ynni'r Lleuad project, part of the wider Morlais tidal stream energy development. The Morlais site

The general arrangement of the Quad Hull Barge



is spread across 35km² of seabed, some 2.7nm off the coast of Holyhead. These HydroWing units will be positioned at depths of 35m, and will generate approximately 10MW of low-carbon, wave-captured energy for the shoreside community.

The site is about an hour's journey from shore, which would normally mean exorbitant heavy-lifter hire costs. However, HydroWing envisages significant savings by using its Quad Hull Barge to help install and maintain its turbines at this location.

Barge benefits

The Quad Hull Barge will feature an overall length of 41m and a breadth of 20.8m and will weigh 160tonnes overall, excluding its winches and generators. In lightship mode, the barge will draw 1m, increasing to 1.35m when carrying a 65tonne payload. The vessel concept was shaped in partnership with Falmouth-based Pelagic Design, which developed the case-loads, stresses and scantlings for the design.

"We originally started looking at a catamaran barge," Parkinson reveals, "but this had issues with pitching and trim during operations. By bringing the lift centrally, we can avoid the effects of pitch and trim and reduce steel weights accordingly." Another bonus is that this approach can significantly lower the cost of manufacture, he adds. "It also eliminates any manual handling and pendulum motions that can occur with heavy lifts. The hull sections can be transported easily, so the barge can be assembled in more remote regions."

Each of the four hulls weighs 25tonnes. "By using four hulls connected by crossbeams and arch support beams, the limit to load width is dramatically increased," says Parkinson. "Where commercial vessels would typically need to place the load onto the deck with little to no overhang of the load, the Quad Hull Barge locks the load after lifting to the arch. This reduces offshore handling and makes the operation much safer – and means that the width of the load can be independent of the vessel width." Intended for operations in shallow harbours or port waters, the barge can safely operate in water depths of 1.5m.

Assembly and deployment

The Quad Hull Barge will be fitted with six winches: four 20tonne-capacity units for mooring and positioning, and two 65tonne units for launch and recovery. "The recovery winches are connected to an intelligent launch and recovery system [LARS] which has seabed positioning – USBL, subsea cameras and sonar systems to guide the HydroWing turbine onto the substructure," Parkinson explains. The HydroWing also features a wet mate connection backpack. "The wet mate connectors are mated by the weight of the HydroWing, resulting in instant connection of the device," he says. "The LARS is released from the surface through hydraulic actuators."

As the vast majority of turbine installation/maintenance/removal operations will be conducted in less than four hours, there was no need to factor personnel accommodation into the design, though the barge will be fitted with twin 450kVA generators and a control cabin.

As to how the barge would be used to support the Ynni'r Lleuad project, Parkinson predicts: "The HydroWing is assembled on the assembly pontoon in port, which reduces the need for heavy-lift cranes. The HydroWing is then transferred to the Quad Hull Barge in port, or in sheltered waters."

The barge is designed to be "low drag and easier to tow", Parkinson says. As such, personnel can say goodbye to expensive heavy-lift ship hire and instead utilise "small, locally available tugs". He estimates that, at 6knots tow speed, the barge will have 6tonnes of drag, "so we will require a minimum bollard pull of 12tonnes" – a capability that should be in wide supply in most global port and harbour tug fleets.

"All of these factors will help to lower the cost of each intervention," Parkinson continues. "In addition, it is on permanent standby and can be deployed quickly, which will help operators to reduce production downtime. The Quad Hull Barge will mean that our HydroWing tidal energy arrays can be serviced by existing port infrastructure, rather than requiring major new investment, which is one of the keys to ensuring that the sector achieves profitable growth into the future."

Availability boost

As mentioned, Parkinson foresees a cost of £20,000 using the Quad Hull Barge, in contrast to the £500,000 bill that's become standard for heavy-lifter assistance. He expands: "Each HydroWing is recovered for planned maintenance at five-yearly intervals, and we will have 14 systems initially, all based at the Morlais site. This reduces our O&M budget from £2 million to £300,000 per annum...allowing us to expand the site significantly with minimal increase in O&M cost."

The implications of this 85% cost decrease could prove a real game-changer within this renewable energy sector, and especially so for operations in developing countries. At the same time, HydroWing has calculated that the Quad Hull Barge could boost availability by as much as 95% in some territories.

Swapping from heavy-lift vessels to this new barge type will also cut annual fuel consumption from an estimated 300m³ to 30m³. Beyond the obvious implied cost savings, this leads to another important benefit: the barge is expected to reduce CO_2 emissions from 804,000kg to 80,400kg each year.

The plan is to have the Quad Hull Barge ready for action in early 2027. As the vessel is modular in form, it can be fabricated "at any manufacturing base", Parkinson notes, meaning that end users don't necessarily need to place an order at a shipyard. Further, the sections of the barge can be directly assembled in water, removing the time and expense of hiring a drydock and slipway. At the time of writing (late January), the Quad Hull Barge's final design was going through the approval phase. "We are planning to finalise procurement by Q2 2024, and build time will be approximately six months," he says. **SBI**

ELECTRIC PROPULSION

ELECTRIC MAINE

The forthcoming electric commuter boat *Isobel* will serve a remote lake in rural Maine free of noise, smoke and noxious emissions

Despite her classic lines and '1950s Riva' aesthetics, forthcoming US commuter boat *Isobel* will be ditching the petrol and running on all-electric propulsion. The 8.5m craft, designed by Maine-based naval architect Stephens Waring Design, is scheduled for launch in autumn this year, whereupon it will operate in a small, remote lake – approximately 3km long – in rural Maine, servicing a small island residential compound with several daily trips. In addition, *Isobel* will enable recreational activity, including light water-skiing.

The boat will be built from cedar strips sheathed in fibreglass for the hull, matched with a plywood-foam-plywood sandwich for the deck and cockpit, producing a lightweight form. Power-wise, the owner has opted for an electric drive produced by UK-based RAD Propulsion, constituting the group's first deal in the US boat market.

Drive installation

Weighing 100kg, the RAD 40 was designed to be easy to install inside the hull. This model features a continuous power rating of 40kW and a tilt range of 0-80°. RAD Propulsion tells *Ship & Boat International:* "The drive is fitted in the same way as an ICE outboard – through a transom – but, because of the form factor, it appears more like a stern drive. The RAD 40 is bolted to a full structural transom that's located forward of the slipper stern and under a lifting cowl portion of the slipper stern – so, in operation, the drive is not visible.

"The lifting cowl portion includes a segment of the stern platform, and is operated by electric linear actuators. When the motor is tilted, the propeller is accessible from the stern platform." As a result, there are no protrusions into the vessel over the transom, even when fully tilted upwards, the group says. Additionally, the entire steering system is built into the drive, removing the need to route external hydraulic systems through the boat. "The RAD drive-by-wire steering wheel adds to the ease of installation, with no need for hydraulic linkages between the helm and the drive," the company adds.

Charge estimates

Isobel will also be fitted with a 55kWh battery pack. "There will be a charger at the boat's berth on the island, but it can pick up a charge anywhere there is a mains shore supply," the manufacturer says. "It depends on the speed of travel but, at cruising speed [approximately 12-15knots], the battery will comfortably last all day." *Isobel* will have a 220V standard Level 2 electric vehicle charger at her dock on the mainland, with the capability to charge the battery from 20-80% in about five hours.

TECHNICAL PARTICULARS

Isobel

Length, oa	8.48m
Length, wl	7.4m
Breadth	2.4m
Depth	1.17m
Draught	280mm (hull only)
	680mm (motor down)
Displacement	1,300kg (2 crew)
Hull weight	1,140 kg (no crew)
Max speed	21knots

RAD Propulsion adds: "She is equipped with the ability to use fast DC chargers [EV level 3], but these are few and far between on the US waterfront as of now." However, these chargers would be able to raise *Isobel*'s battery charge from 20-80% "in about 30 minutes", the company estimates. Solar panels could be incorporated on board to top up the batteries, though the group warns: "The gains would be relatively small with the solar panels currently available on the market."

The supply package includes a battery monitoring system, which can shut off the battery if an issue is detected. RAD Propulsion explains: "In terms of safety, the RAD proprietary throttle lever has a mechanical lock that prevents the drive being accidently engaged when stationary, which is a common concern among boat users where the silence of an electric motor doesn't act as a natural warning." *Isobel* features a low sheer line to facilitate boarding from the side, as well as a stern platform for access and swimming, and seating has been provided for up to seven persons. The boat's construction will begin in late spring. **SBI**

***Isobel* will carry a 55kWh battery pack**

BATTERY TECHNOLOGY

FURTHER CHARGES

Sodium-ion (Na-ion) battery tech is still at an early stage of development, but could possibly present a low-cost, easy-to-source and safer alternative to lithium-ion cells – as long as manufacturers can address energy density concerns, a report by IDTechEx argues

While lithium-ion (Li-ion) batteries have certainly contributed to the maritime sector's sustainable energy mix, this solution still faces challenges linked to thermal instability and resource scarcity. Consequently, a report compiled by industry analyst IDTechEx suggests that demand for emerging sodium-ion (Na-ion) battery technology could bloom over the next decade, with these alternative battery types potentially offering several advantages over their Li-ion counterparts.

These advantages include abundance and cost. Writing in the report *Sodium-ion Batteries 2024-2034: Technology, Players, Markets and Forecasts*, Shazan Siddiqi, senior technology analyst at IDTechEx, states: "[Na-ion] batteries can be made with widely available, inexpensive materials, with sodium being significantly more abundant than lithium". Sodium is primarily sourced from seawater and the Earth's crust, and, according to logistics consultant GEP, may be 500 times more abundant than lithium, which is typically sourced from a small number of countries, primarily China and Argentina.

Siddiqi continues: "Na-ion batteries can use aluminium for the anode current collector instead of copper, which is used in Li-ion cells. This ultimately reduces the supply chain risks." Over the past few years, the price of copper has risen to be three to four times more expensive than aluminium. At the same time, he highlights, while producing Na-ion batteries is currently more expensive, the manufacturing process for Na-ion cells is very similar to that for Li-ion cells – "meaning that the scale-up of the technology can benefit from existing Li-ion battery production lines".

Complementary solution

Thermal runaway is another worry linked to Li-ion battery technology, as highlighted in previous issues of *Ship & Boat International*. Siddiqi notes that Na-ion batteries can be stored at zero volts, making them a less risky proposition during transportation. "Traditional Li-ion batteries are generally stored at around 30% state of charge," Siddiqi writes. "Also, the electrolytes used in Na-ion systems generally have a higher flashpoint than Li-ion battery systems, reducing flammability risks."

Additionally, the manufacture of Na-ion batteries does not depend on cobalt, which is often associated with unethical mining practices and local environmental degradation. Another benefit, GEP says, is that Na-ion batteries have a three times higher lifecycle than Li-ion batteries – though it should be noted that not everybody is on board with this claim.

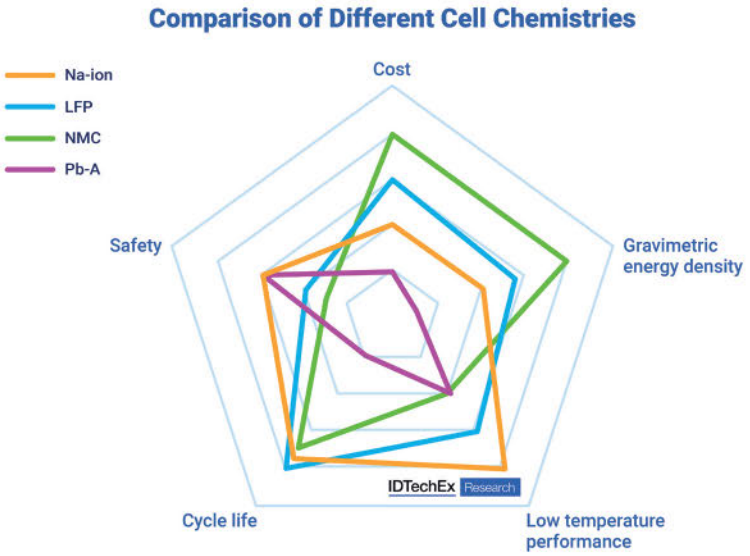
Either way, Na-ion batteries are unlikely to replace Li-ion cells in the foreseeable future. In fact, the IDTechEx report opines that Na-ion batteries may be "well-suited to complement, rather than displace, the existing and future Li-ion technologies in many applications" – perhaps with Na-ion cells being used for low-to-medium speed applications and energy storage, while Li-ion batteries deliver the 'kick' required by most vessel operations.

> "Sodium-ion (Na-ion) batteries can be made with widely available, inexpensive materials"

This is because sodium ions are larger and heavier than lithium ions, meaning that Na-ion batteries have a lower energy density than Li-ion batteries – thus, they store less energy per unit weight, translating to shorter ranges for electric vessels. Sodium ions also move slower than lithium ions, which can lead to slower charging/discharging times – not ideal for vessels facing tight turnaround times. The larger size of sodium ions could mean shorter lifespans for Na-ion batteries compared to Li-ion units, meaning they need to be replaced more frequently.

As such, it may be too ambitious at present to expect Na-ion cells alone to fuel vessels, unless, perhaps, we are talking narrowboats. However, Siddiqi writes: "[While] the energy density for sodium-ion batteries is still lower than lithium-ion cells, which use nickel, they are approaching the energy density of high-power lithium iron phosphate [LFP] cells. Sodium-ion batteries can have quite high power characteristics with reports of ~1,000W/kg, which is higher than nickel manganese cobalt [NMC] [~340-420W/kg] and LFP [~175-425W/kg] cells."

A comparison of Na-ion battery tech with other cell chemistries (image: IDTechEx)



He adds: "Na-ion cells also exhibit better low-temperature performance." As the technology matures, the energy density of Na-ion batteries will most likely increase, he hints.

Global research

Quite a few industry sectors are optimistic about this emerging battery tech. The IDTechEx report reveals that the leading countries for patented Na-ion battery research include China (53%), Japan (16%) and the US (13%), with Chinese manufacturers CATL and HiNa making strides in this market. Research firm BloombergNEF predicts that, by 2030, Na-ion batteries could account for 23% of the stationary storage market, equating to more than 50GWh. Siddiqi adds: "That forecast could be exceeded if technology improvements accelerate and manufacturing advances are made using similar or the same equipment as for Li-ion batteries."

The IDTechEx report also addresses cost. "A sodium-ion battery with a layered metal oxide cathode and hard carbon anode will have approximately 25-30% lower material costs than an LFP battery," Siddiqi predicts. "Two of the main differences between a sodium-ion cell versus a lithium-ion cell is that they replace lithium and copper with cheaper sodium and aluminium, which gives around a 12% cost reduction, with most of this being due to the aluminium current collector." **SBI**

UNCREWED VESSELS

CLEARING THE WAY

Battery-powered trash collection drones are set to clean up India's waterways

The battery-powered Clearbot is being used to tackle riverine pollution in India

India is having a big problem with riverine pollution: according to stats released by UNESCO, the country is currently responsible for 12.9% of global ocean plastic pollution (second only to the Philippines, which contributes 36.4%), while the World Economic Forum estimates that 70% of surface water in India is unfit for consumption as a result of pollution and contamination.

Deploying boats to clear up India's rivers is far from straightforward. The floating debris comprises a diverse mix, from plastic bottles and bags to organic matter and agricultural/industrial waste, all of which needs to be separated. Depending on the river's width and depth, typical clean-up craft (usually comprising paddle boats with nets) can struggle to access certain river sections, especially when these are heavy with vegetation. There's also the fact that multiple boat trips equate to higher levels of emissions.

However, March 2024 sees the rollout of a series of battery-powered, waterborne trash collection bots across selected Indian rivers. The project is being coordinated by Clearbot, a start-up founded in 2019 by graduates from the University of Hong Kong with an initial focus on helping surfers in Bali to clean up their beachfront. Clearbot tells *Ship & Boat International* that, as of late February, it has built approximately 15 of its self-titled drones in total.

AI-enabled

The Clearbot comes in two sizes: a 2.9m x 1.3m x 0.56m version, which weighs 170kg; and a 4.04m x 2.3m x 1.68m, 600kg model. The smaller version can collect up to 200kg of waste, including plastic trash and invasive plant species, at a typical rate of 80kg per hour. When fitted with a specially developed boom, the bot can also collect up to 15litres of oil.

Remote users control the Clearbots via 4G, over an (unobstructed) range of up to 15km, aided by cameras fitted at the front of the drone. Meanwhile, the larger Clearbot variant has been designed and built to handle up to 1,500kg of trash, collecting it a rate of 200kg per hour, the company says.

Each unit is constructed in FRP and draws on a 5kWh lithium-ion battery for smokeless, emissions-free propulsion, with four hours of battery life. Solar panels have been integrated into the boat's design to facilitate charging throughout the day, and the Clearbot has a typical service speed of between 3-10knots, the company says.

The Clearbots also utilise patent-pending, Lidar-enabled anti-collision technology, which will cause the drones to slow down, reverse and avoid objects within a 100m radius, the company says. The systems also use AI to identify the objects they retrieve from the water (such as plastic bottles, bags, cans, etc), to help users to build up data sets of the concentrations of certain types of trash in particular areas. The company adds: "With Clearbot, you can provide a set of GPS waypoints – for example, a set of latitude/longitude pairs – and have the robot autonomously navigate from its current location to each of the defined waypoints to collect trash."

The bot also comes with a 'return to home' (RTH) feature, so that it will come back to its home point if it loses signal. "With the RTH function, you can ensure safe marine operations even in larger water bodies," Clearbot says.

Delivery by drone?

Sidhant Gupta, CEO and co-founder of Clearbot, has big ambitions for the brand, commenting: "In the next decade, Clearbot plans to position itself as the largest fleet of electric boats in the world and prepare the industry for the change towards sustainability. The vision for Clearbot is to bring the same impact in the marine services industry as electric cars did in the automotive industry." The company intends to make further inroads into Asia to stem the region's tide of trash.

Interestingly, the Clearbot's remit may expand beyond clean-up jobs. Given the drone's ability to move a trash payload of 200kg, its developers say it can also function as an "autonomous delivery bot", carrying the equivalent of that weight in cargo. For vessel managers, Clearbot suggests, the drones could serve as "cheap and environmentally friendly alternatives to launch boats when delivering supplies to their ships" – as well as a waterborne means of transporting medicines, etc to more far-flung, isolated locations. **SBI**

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Principal Guest & Speaker

Mr Arsenio Dominguez

Secretary-General

International Maritime Organization

Mr. Arsenio Dominguez was elected Secretary-General of the Organization by the 129th session of the IMO Council in July 2023 for a four-year period beginning 1 January 2024.

The election was endorsed by the IMO's Assembly at its 33rd session in December 2023. Mr. Arsenio Dominguez (Republic of Panama) is the tenth elected Secretary-General of the International Maritime Organization.

Prior to starting his position as Secretary-General, Mr. Arsenio Dominguez Velasco was a Director of IMO's Marine Environment Division. He joined the IMO Secretariat in 2017, first as Chief of Staff to the Secretary-General, Kitack Lim, before being appointed in 2020 as Director of the Organization's Administrative Division.

His maritime career began in 1996 as a port engineer at Armadores del Caribe in Panama before moving to become a Drydock Assistant Manager at Braswell Shipyard.

In 1998 Mr. Dominguez Velasco moved to London to join the Panama Maritime Authority as Head of the Technical and Documentation Regional Office for Europe and North of Africa. He went on to represent Panama in a variety of roles at the organization, culminating in 2014 with his appointment as Panama's Ambassador and Permanent Representative to IMO until 2017.

Between 2014 and 2017, Mr. Dominguez Velasco chaired IMO's Marine Environment Protection Committee (MEPC), and in 2015 he chaired the Technical Committee of the 25th session of the IMO Assembly. Prior to this, between 2010 and 2014, he chaired the Maritime Security – Piracy and Armed Robbery Working Group under the auspices of the organization's Maritime Safety Committee.

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URBAN CRAFT

GOING TO TOWN ON GREEN POWER

Optima Electric Yachts' forthcoming battery-powered water taxi intends to give "underutilised large ferries" a run for their money, while taking more traffic off the roads

Optima's electric water taxi concept could cut CO_2 by 600tonnes per vessel each year

The first quarter of 2024 saw the fourth round of the UK government's Clean Maritime Demonstration Competition (CMDC4), which was established by the UK Department of Transport (DoT) and Innovate UK to develop green technologies for ships and ports. This latest funding round saw £33 million (US$41.9 million) shared across 33 UK maritime/offshore projects, with the aim of unlocking clean maritime technologies such as battery-electric systems, wind power and alt-fuels.

Among the recipients of this funding is a collaborative project spearheaded by Optima Electric Yachts – a company dedicated to producing 100% electric boats with energy-saving hullforms – and including partners Seabird Technologies (developer of the E1 foiling electric race boat), propeller manufacturer Teignbridge Propellers and marine coatings firm Edwards & Renouf, among others. The project will develop a 13m version of Optima's hull technology for urban riverine transport, as well as future leisure and commercial applications.

David Kendall, Optima CEO and designer of the water taxi, tells *Ship & Boat International*: "There is potential interest in areas that have not previously utilised water transport, but which are keen to do so to provide more sustainable means of transport, relieve road congestion and promote tourism." Considering the boat's target markets, Kendall adds: "We are particularly interested in the Solent region...[and] also see significant opportunities in the Middle East, in areas such as the UAE and Saudi Arabia."

Focus on energy

The 13m x 4.4m water taxi will feature a 1m draught and the capacity for 12 passengers and two crew members. "The vessel produces low wake, which is an additional benefit in urban areas for both shoreside erosion and the benefit of other water users," says Kendall.

Although the propulsion system was still being determined at the time of going to press, Optima is aiming for a 100kW, 400V, water-cooled lithium-ion battery system. This would grant the vessel a range of 50-100nm depending on speed, Kendall says, "with its wave piercing hull providing much greater comfort and safety compared to a conventional planing hull". Photovoltaic panels will be installed on the roof, to cover some of the hotel electrical loads.

Kendall explains that the partners are keen to preserve energy where possible. One example, he says, is the cabin, which will be climate-controlled for passenger comfort. However, he highlights, this arrangement constitutes "a significant extra electrical demand, so we are taking measures to minimise this with insulation, reflective surfaces to reduce heat gain, and so on". Overall, Kendall predicts that the craft will realise CO_2 savings of approximately 660tonnes per year. "If small water taxis replace underutilised large ferries that are often running less than half-full, then the CO_2 savings will be significantly greater," he states.

Composite propeller

The project will also give Teignbridge an opportunity to test its new composite propeller type. Saeed Javdani, design and development manager at Teignbridge, explains: "Prototypes of the propeller are currently being constructed, allowing the required manufacturing techniques to be trialled, assessed and perfected. Once the finalised propeller design has been completed, it will be manufactured and fitted to the [water taxi]. Extensive sea trials will then be undertaken to prove its performance and durability."

The development of the propeller stems back to 2021, when Teignbridge partnered with the UK's National Composites Centre. The two groups commenced a design feasibility study (funded by the first CMDC round) for the prop, incorporating CFD and finite element (FE) analysis software.

Javdani highlights various benefits in using composite propellers over their metallic counterparts. "The construction of the composite uses carbon fibres and resin to create a durable carbon-fibre structure," he says. "The orientation and thickness of the fibres can be tailored to achieve the required mechanical properties – strength and stiffness – where they are most needed, but also allows flexibility to be designed into the propeller." As such, they can be manufactured thinner and lighter than steel propellers without compromising on performance, he adds.

Damping effect

"The lighter weight of the propeller means that smaller-diameter shafts can be utilised as the moment of inertia is reduced," Javdani continues. "This puts less loading on the other parts of the driveline, which helps to increase the longevity of the whole propulsion system. The flexibility of the composite material can be specified during the design phase so that the loading on the propeller during use allows controllable blade deflection, meaning that cavitation inception is restrained.

"This creates a damping effect that yields lower vibration and substantial noise reduction compared to metallic propellers" – good news for a water taxi in an urban setting, working long hours and perhaps even night shifts near commercial and/or residential properties. "The damping effect also helps reduce engine overload conditions which can be experienced during stormy weather and harsh acceleration, causing premature wear on equipment," he adds. "Composite propellers are also non-magnetic, so can be applied where using magnetic materials would be problematic."

ICE vs electric

As important, the composite propeller should prove a good match for the battery-powered boat. Javdani elaborates: "Power and torque curves between electric motors and internal combustion engines [ICE] are radically different; electric motors produce maximum torque from zero revolutions.

"The physical properties of the composite propeller allow for an optimum propeller design that can absorb all of the power supplied by the electric motor throughout the defined working range of revolutions. Electric motors can rotate much faster than ICE powerplants, and, with the composite propeller being lighter in construction than a metal equivalent, it allows the propeller to spin faster if a higher-speed design is dictated."

The propeller developed for the water taxi features five blades and a 300mm diameter, and weighs 7kg. Future composite props would be tailored to meet the unique requirements of each vessel in subsequent orders, Javdani says, "to provide the maximum efficiency and the least noise and vibration." Although this is possible, it may not be the most cost-effective approach, he adds – "therefore, a size range will be specified that the propeller will be suitable for".

Kendall concludes: "The increased efficiencies developed during the project will keep us ahead of our competitors in terms of energy efficiency and range, and enable our 13m electric vessels to be ready for production in 2025." **SBI**

CLEANER RIDES IN KIEL

The 33.5m *Laboe* draws on a hybrid powertrain to move passengers around the German city

The commuter ferry concept is taking off in Western European cities, where some local authorities have set targets to cap road traffic while decarbonising riverine public transport services. This is particularly true of Kiel in Germany, which has been hosting initiatives to promote low-emission water taxis since the start of the 2020s. Perhaps the best-known of these is the Clean Autonomous Public Transport Network (CAPTN), which led to the launch of the 'Wavelab' – an uncrewed vessel prototype outfitted to study the feasibility of autonomous water taxis (see *Ship & Boat International* March/April 2022, pages 20-21).

Joining this urban ecosystem, the hybrid-electric ferry *Laboe* was delivered to operator Schlepp-und Fährgesellschaft Kiel (SFK) by Holland Shipyards Group (HSG) in November 2023. The vessel will provide zero-emission commuter services to the city of Kiel, while also serving as a tourist boat for excursions to the scenic Kieler Fjord.

Laboe incorporates a similar design to a series of 24.95m, 140-pax, all-electric ferries that HSG previously built for SKF. However, *Laboe* measures 33.54m in overall length (or 33.48m between perpendiculars), enabling the vessel to transport up to 300 passengers. The vessel has two decks, a moulded breadth of 8.8m and a moulded depth of 3.7m, and is arranged for a draught of 2.4m.

***Laboe* will provide zero-emission commuter services to the city of Kiel**

Longer sailings

The ferry's dual-power system can run on both generators and a battery bank, comprising a 546kWh Octopus High Energy pack supplied by EST-Floattech, which will enable the boat to sail for longer in full-electric mode. The propulsive package includes: two Baumuller DST2-315 engines, rated 385kW apiece; two Vetus DT-brand, 1,200mm-diameter propellers; and permanent magnet motors supplied by Hybrid Ship Propulsion. Additionally, the ferry carries a Scania DC13 auxiliary engine and two Sandfirden Technics EU Stage V-compliant generators. **SBI**

(Laboe is one of RINA's Significant Small Ships of 2023: see rina.org.uk/publications/significant-small-ships)

TUGS

SMALL BUT SAFE

Clutter-free decks and shatterproof windows, alongside features to reduce unscheduled maintenance and docking periods, are some of the benefits promised by Damen's 18.25m-long ASD Tug 1810 class

Damen's ASD Tug 1810 has been designed to prevent seawater from entering the vessel

Damen has expanded its Compact Tugs range with the recent launch of the Azimuth Stern Drive (ASD) Tug 1810 class – a safety-conscious newcomer designed to pack a powerful punch within a relatively compact frame.

The ASD Tug 1810 was developed to "answer the challenge of increasingly large seagoing vessels in ports", Damen explains. "This creates a seemingly paradoxical situation whereby a tug is required to have more power, and yet has less space to operate in." Measuring just over 18m in length, this new tug type can nonetheless exhibit 30tonnes of bollard pull (bp) ahead and 28tonnes of bp astern.

Obviously, adding four crew members to a vessel of this size meant that Damen had to factor in a high degree of risk mitigation. Siebe Cieraad, Damen product portfolio manger for tugs, says that onboard safety was a key factor "throughout the entire design of the tug", adding: "For example, the vessel boasts a high freeboard, keeping water on deck to a minimum. It also has the tumblehome [ie, the inward slope of the hull sides above the waterline] so characteristic of the Compact Tugs range, enabling it to get safely up close when assisting a vessel."

Stowable deck gear

One important safety consideration was the provision of a 360° view from the wheelhouse, granting the crew optimal visibility both fore and aft. The windows were fashioned from Damen Safety Glass: a shatterproof glazing that will protect the bridge team from harm in the event of a line snapping, for instance.

To eliminate trip hazards, the ASD Tug 1810 was also designed with "clutter-free decks", Cieraad explains. Regular items of deck gear (including the winch) have instead been incorporated into the tugboat's deck house and bulwark. Damen says: "The winch is installed in the deck house so that towing operations both fore and aft can be undertaken with a single winch." One side-bonus of this approach, Cieraad adds, is that this equipment is therefore protected from the elements, which should help the crew to avoid kit failure and unplanned maintenance.

"The same applies to the tug's closed-loop cooling system," Damen says. "In this, fresh water runs in a series of channels on the underside, radiating heat away from the vessel. As such, no seawater enters the vessel and the internal system is protected from the abrasiveness of saltwater." The group reckons that such features could help to reduce docking intervals, "sometimes by as much as up to seven years".

NOx reduction

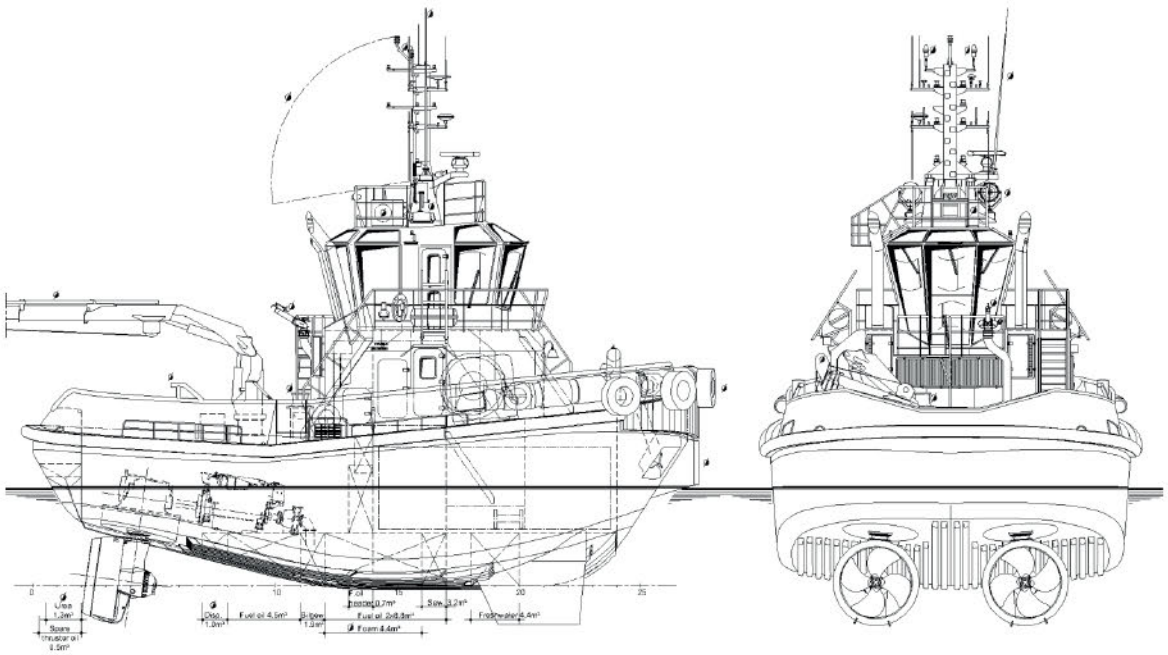
The ASD Tug 1810 incorporates Caterpillar C32 main engines generating a combined output of 1,940kW at 1,800rpm, and Schottel has supplied this new tug class with its SRP 270 FP azimuth thrusters. The vessel also features Damen's patented Twin Fin skeg, which has become a common feature across all vessels in the builder's Compact Tugs series. The skeg "has demonstrated

TECHNICAL PARTICULARS

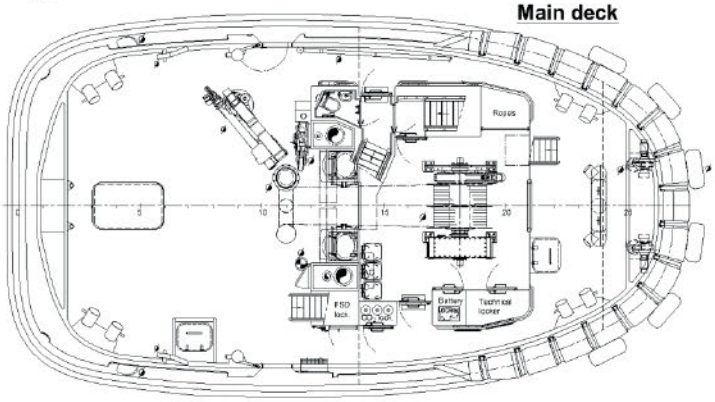
ASD Tug 1810

Length, oa	18.25m
Breadth, oa	10.23m
Depth	3.75m
Draught, aft	4m (approx.)
Bollard pull	30.5tonnes (ahead)
	28.1tonnes (astern)
Speed	10.7knots
Tank capacities:	
Fuel oil	23m³
Fresh water	4.3m³
Sewage	3.2m³
Bilge water	2m³
Foam	4.4m³
Dispersant	1m³
Spare thruster oil	0.6m³
Crew	4
Classification society	Lloyd's Register
Notations	✠ 100 A1 Tug (Bollard pull = 30 t)
	✠ LMC UMS IWS Ø Green Passport EU

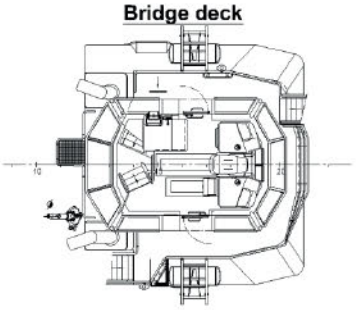
The general arrangement of the Damen ASD Tug 1810



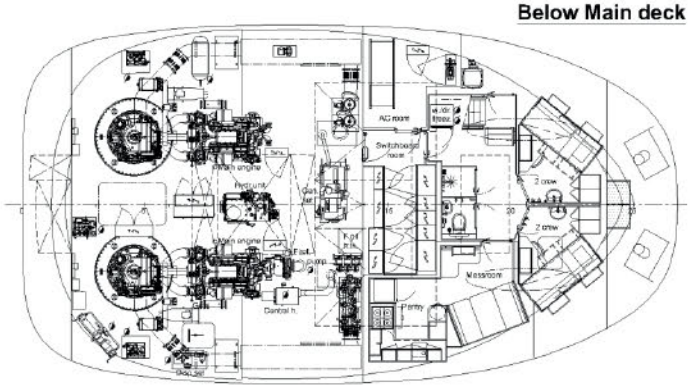
Main deck



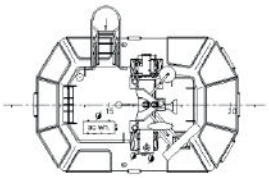
Bridge deck



Below Main deck



Top deck



its ability to boost course-keeping, manoeuvrability and predictable sailing behaviour during operations, improving both efficiency and safety," Damen says.

Cieraad continues: "Rather than the typical arrangement featuring two diesel generator sets, the system includes two shaft generators, one fitted to each powertrain, and a back-up diesel generator. This diesel generator can also be used when the vessel is alongside a quay where there is no shore connection available.

"The system draws on power from the main engines to create electricity. With this, there is no requirement for a third diesel engine to provide electrical power when the vessel is sailing." The elimination of this requirement has also aided Damen in keeping the vessel compact.

The ASD Tug 1810 has also achieved IMO Tier III compliance care of an in-house-developed exhaust gas aftertreatment solution, reducing the vessel's NOx emissions, which can be fitted in the existing exhaust silencers. The four-person accommodation has a floating floor and acoustical ceiling, and has been insulated to keep noise and vibrations to a minimum.

Greener to come

Additionally, end-user customers will be granted the option and equipment to be remotely connected to Damen's IoT-enabled Triton performance monitoring system. If required, Triton can be set up to determine the vessel's optimal speed and route, so as to guide the crew through operational decisions that could lower fuel consumption and emissions.

Speaking of which, future models in the Compact Tugs range may further limit, or eradicate altogether, emissions during operations. Cieraad says: "The aim of the Compact Tugs range is to serve the needs of today's ports and harbours. That means addressing multiple questions in a single platform.

"Such vessels need increasing amounts of power, situated in increasingly compact vessels, with zero compromises on safety and reliability, while advancing maritime sustainability." **SBI**

AIRING A GRIEVANCE

A new Californian emissions regulation with the potential to severely hamper tugboat operations has sparked a backlash, writes May Chan

Late 2023 and early 2024 have seen California and the US Coast Guard (USCG) locked in a tug-of-war over a regulation aimed at reducing emissions from tugboats operating in the state's ports.

The California Air Resources Board (CARB) implemented a rule mandating cleaner engines and the use of diesel particulate filters (DPFs) on existing tugs by 31 December 2024. However, the USCG has responded by highlighting concerns about the safety and feasibility of DPFs in maritime applications, and has even stated its intention to refuse to enforce the regulation.

California has a certain notoriety for enforcing the strictest air quality regulations in the US. CARB argues that diesel emissions, particularly from tugs operating in close proximity to populated areas such as ports, pose a significant health risk, and claims that the new regulation, requiring Tier 4 engines and DPFs, is necessary to curb NOx and particulate matter (PM) emissions. According to CARB, the rule will significantly improve air quality in port communities, leading to reduced respiratory illnesses and other health complications.

DPF concerns

While acknowledging the environmental benefits, the USCG has expressed safety concerns surrounding the use of DPFs on tugs. These filters require periodic regeneration cycles, which involve reaching extremely high temperatures. The USCG fears that these temperatures could pose fire risks aboard vessels, especially in confined spaces like engine rooms.

Additionally, the USCG has emphasised that DPFs currently lack specific maritime safety certifications, raising concerns about their reliability and potential for malfunctions in harsh marine environments.

The American Waterways Operators (AWO), representing the tugboat industry, has sided with the USCG, arguing that the current timeline for compliance is unrealistic, considering the limited availability of compliant engines and DPFs. The situation has the potential for major economic disruption if tugs are forced out of service due to non-compliance, the AWO warns.

Need for collaboration

On one side, California appears steadfast in implementing its regulation, aiming to protect public health. Meanwhile, the USCG stands firm on safety concerns and refuses to enforce the DPF mandate. This standoff has left tugboat operators caught in the middle, facing potential financial and operational hurdles.

Finding a solution will likely involve collaborative efforts. Open communication between CARB, the USCG and the industry is crucial. Exploring alternative emission reduction technologies that address both environmental and safety concerns could be a viable solution, as could providing financial assistance to tugboat operators to facilitate the transition to cleaner technologies.

Whether a compromise can be reached before the December 2024 deadline remains to be seen, but open dialogue and collaboration may prove essential to resolve this complex tug-of-war. **SBI**

The Royal Institution of Naval Architects Presents:

Human Factors 2024 Conference

8-9 October 2024, Wageningen, The Netherlands

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The Human Factors 2024 International Conference will provide an opportunity for human factors experts, naval architects, bridge officers and others to get together and discuss the recent developments. It will focus on lessons learned from interventions and applied research that were successful, or even more interesting, unexpected or bad results. For example, implementation of new automation on board that worked out differently or behavioural interventions that had unexpected effects. It is all about applied research that provides learned lessons for future Human Factor research, specifically for the Maritime domain. As part of the conference, the delegates will have a unique opportunity to visit the new Seven Oceans Simulation centre of MARIN.

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Conference topics will include:

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

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

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

Scan the QR Code for more information

https://rina.org.uk/events/events-programme/wind-propulsion-2024/

AHEAD OF THE PACK

Crowley Maritime's new electric tug *eWolf* should satisfy the stringent environmental requirements of the Port of San Diego, without massively sacrificing bollard pull power

US tug and workboat operator Crowley Maritime has taken delivery of *eWolf*, a vessel hailed as being the country's first Jones Act-compliant, all-electric ship-assist harbour tug. Commencing operations at the Port of San Diego's Tenth Avenue Marine Terminal, the 25m vessel, first announced in 2021, is expected to remove 178tonnes of NOx, 2.5tonnes of diesel particulate matter (PM) and 3,100tonnes of CO_2 from the atmosphere over a 10-year period. In fact, when it comes to CO_2 alone, the tug's all-electric arrangement could potentially eliminate the equivalent of more than 100 cars' worth of CO_2 pollution per year, systems supplier ABB predicts.

These anticipated results should please the San Diego County Air Pollution Control District, the California Air Resources Board, the Port of San Diego, the US Environmental Protection Agency and the US Maritime Administration, all of whom financially supported *eWolf*'s development. The electric tug was designed by Crowley and constructed by Alabama-based Master Boat Builders. The newbuild replaces an older tug which, Crowley estimates, typically consumed 13,560litres of diesel per annum.

Electrification concept

eWolf draws its propulsive power from an integrated system supplied by ABB. This includes a 6.2MWh Corvus Orca energy storage system, providing enough kick for a service speed of 12knots and an estimated bollard pull capacity of 70tonnes ahead, emissions-free. ABB estimates that the tug can trudge through a full day of work on a single charge, which would be supplied overnight when the boat is normally inactive anyway. ABB says: "The electrification concept also contributes to safety on board. For example, because the electric drive eliminates the traditional exhaust system, the captain has a 360° panorama from the pilothouse and an uninterrupted view of deck activity."

Schottel supplied *eWolf* with two electrically driven Schottel SRP 430 LE-type RudderPropellers, each rated 2,050kW and featuring a propeller diameter of 2.5m. The 'LE' in the name refers to 'embedded L-drive', reflecting the unit's compact design and low installation height, enabled by the omission of the upper gearbox. Schottel claims that this design has increased mechanical efficiency by approximately 3%. "The [onboard] batteries can supply power to the propulsion system almost instantly, ensuring effective ship support and harbour escort services without emissions," Schottel says.

IT add-ons

The vessel features two switchboards (a DC grid and an AC switchboard). Two gensets, rated 300kW apiece, have been included to provide back-up power for longer transits or emergency use. Additionally, the e-tug features Schottel's MariHub solution, which gathers data collected by onboard sensors and machinery for analysis by its shore-based engineers. MariHub can be used in tandem with Schottel's ProCMS condition monitoring tool to pick up on any irregularities and potential problems within the propulsion system.

The US' first all-electric tug, *eWolf*, features a 6.2MWh Corvus Orca energy storage system

ABB has also bolstered *eWolf*'s AI capabilities with its ABB Ability Marine Pilot Vision situational awareness package, which enables 360° visibility from the pilot's station, and its ABB Ability Marine solution, which enables manoeuvring support and future remote operations.

Other onboard features include a deck-mounted Markey Machinery DEPC-48-50 electric recovery winch, as well as sufficient tankage for 37,097litres of fuel oil and 2,839litres of fresh water. Crowley has announced that it intends to build a microgrid shoreside charging station at the Port of San Diego, which will enable the e-tug to liberally draw on power in its own backyard. The port has invested heavily in shore power infrastructure, allowing docked vessels to plug into clean, shore-based electricity instead of running their diesel engines, and has also been a proponent of vessels adopting hydrogen and biofuels. **SBI**

TECHNICAL PARTICULARS

eWolf

Length	**24.99m**
Breadth	**12.2m**
Depth	**5.46m**
Draught	**5.02m**
Gross tonnage	**200tonnes**
Service speed	**12knots**
Bollard pull	**70tonnes**

SUPPORTING THE "GREEN ENERGY GATE"

The Port of Antwerp-Bruges has ambitious plans for carbon-neutrality – making it a fitting location to test the new hydrogen-powered, dual-fuel workhorse *Hydrotug 1*

Hydrotug 1 **could eliminate the emissions equivalent of 350 cars each year, says CMB.Tech**

The world's first hydrogen-powered tugboat, *Hydrotug 1*, has set sail in the Belgian port of Antwerp-Bruges, marking a significant step towards a cleaner future for maritime operations. Built by Armon Shipyard in Spain, and designed by Belgium's CMB.Tech, the 496gt, double-hulled tug is currently operating as a demonstrator vessel, showcasing the viability of hydrogen as a clean fuel for maritime applications.

Hydrotug 1 is something of a hybrid powerhouse, boasting combustion engines that chug along on a blend of hydrogen and traditional marine fuels. Two BeHydro V12 dual-fuel, medium-speed engines, rated 2MW apiece, provide the brawn. According to CMB.Tech: "With these engines, the vessel uses clean fuels, resulting in an overall reduction of 65% of traditional fuel consumption and associated emissions in the tugboat's overall cycle." In addition to hydrogen, the engines can burn diesel and hydrotreated vegetable oil (HVO), granting it a strong element of operational flexibility and ensuring ongoing availability even when the hydrogen infrastructure isn't readily available.

The company BeHydro was founded by CMB.Tech and compatriot engine manufacturer Anglo Belgian Corporation (ABC), and launched its first hydrogen dual-fuel engine in 2020. BeHydro estimates that, in time, it may be able to scale up the design to produce engines of up to 10MW. The group has also produced a 100% hydrogen engine variant. The dual-fuel V12 type, as installed on *Hydrotug 1* (in fact, the first vessel installation for this model) received type approval from classification society Lloyd's Register in the fourth quarter of 2023.

Deck storage

The pioneering vessel's green credentials don't stop there: the engines feature particulate filters and selective catalytic reduction (SCR) systems to meet EU Stage V emissions requirements. Even the auxiliary engines, supplied by Volvo Penta, are scrubber-equipped and IMO Tier III-compliant, minimising their environmental impact. An electrically driven deck winch rounds off the boat's environmentally friendly aspects.

Six stillages on the deck permit the tug to store up to 415kg of compressed hydrogen, contained in 54 individual Type C cylinders. CMB.Tech estimates that *Hydrotug 1* could eliminate the emissions equivalent of 350 cars each year – which aligns perfectly with the Belgian port's ambitions to achieve climate neutrality by 2050, becoming a "green energy gate to Europe", according to Port of Antwerp-Bruges president of the board Annick De Ridder. The end result is a clean propulsive set-up that nonetheless grants the tug a bollard pull of 65tonnes and speeds in excess of 14knots.

The vessel measures 30m x 13m, has a moulded depth of 5m and a draught of 6m, and can accommodate up to three crew members. The depth increases to 5.9m when one factors in the twin Schottel SRP 460-type RudderPropellers, each rated 2,000kW and featuring a prop diameter of 2.4m. **SBI**

FISHING VESSELS

FIT FOR FARMING

Aquaculture support vessels have their own specific design challenges, in line with changing offshore fish farm layouts. Macduff Ship Design tells Stevie Knight how it is optimising its newbuilds for this market

***Turas a 'Bhradain*, delivered to Bakkafrost in 2023, incorporated stability and capable deck kit while avoiding being 'brick-shaped' (image: Macduff Ship Design)**

The aquaculture industry is growing in more ways than one, says Ian Ellis of Macduff Ship Design; fish pen sizes are rising inexorably, with some now reaching more than 50m in diameter. In turn, their support boats are grappling with increasing forces – "so, where you used to work the cages and mooring systems manually with rope, now you need specialised equipment to keep the array stable and safe", he explains.

All this has inevitably impacted vessel design. Take the 24m x 9m *Turas a 'Bhradain*, which Macduff Shipyard built and launched for Bakkafrost in summer 2023. This was a project with flexibility at its heart: putting the superstructure on the port side has given starboard deck operations an open run. There's also a sturdy hydraulic bow ramp at the front, which makes accessing the cages rather easier.

Turas a 'Bhradain's power arrangement also supports a broad range of operations. A pair of IMO Tier-III compliant, six-cylinder Doosan engines, each capable of delivering over 370kW, turn the nozzled 1,500mm Teignbridge propellers at the rear. When combined with a Kort stern thruster, the result is both efficient bollard pull and enough low-speed manoeuvrability to navigate the fish farm cages.

On deck there are three capstans, anchor windlass and hydraulic rams supporting the lowering and raising of the bow ramp, plus a tow winch situated on the centre line (the package powered by a hydraulic genset below). Ellis explains that the layout is the result of quite a bit of thought: for example, the offset superstructure allows the winch to work both aft over a stern roller or forward across another, narrower roller built into the ramp. To cap it all, there are two HS Marine cranes to starboard: one AK30 HE3 and a bigger AK61 4E model.

Expanded beam

However, the boat was initially conceived with a beam closer to 8.5m, Ellis admits: interestingly, it was the larger, client-specified knuckle boom crane that drove this significant change.

"The owners wanted unrestricted lifting capability, right up to the crane's full 60tonne limit at 10m reach in any given orientation," he explains. Combine that with a truly huge 125tonne deck load and the crane's location on the starboard side requiring lifts clear across the deck: in short, it meant assimilating some very tricky demands.

As a result, the vessel's beam had to be expanded to 9m to provide the necessary stability. But meeting these requirements had yet another knock-on effect.

The steel hull is a shallow 2.35m, with broad, flat areas to support grounding on a remote (and possibly uneven) slipway – so you have a design "that could end up brick-shaped", points out Ellis. That had to be avoided, especially since the boat has to transit between Bakkafrost's Scottish sites on the west coast and its Hebridean fish farms.

In short, the boat needed a hullform optimised for hydrodynamic efficiency that still met the rather sturdy landing-craft requirements. Happily, this is something that the Macduff design company had been working on for some time, developing a forward shape with a long sweep upward to the bow plus a stern that delivers an effective water flow to the propellers.

So, when all this has been put together, does it actually work? The answer has to be 'yes' since *Turas a 'Bhradain*'s twin sister, due to emerge from the Macduff Shipyard in a few months' time, has seen little-to-no change. You can't say more than that.

Capable catamaran

Despite the fair size of the landing craft, it isn't always a case of 'bigger is better' says Ellis, adding that the company is also seeing a rising demand for smaller vessels – but these are likewise being squeezed to yield as much capability as possible.

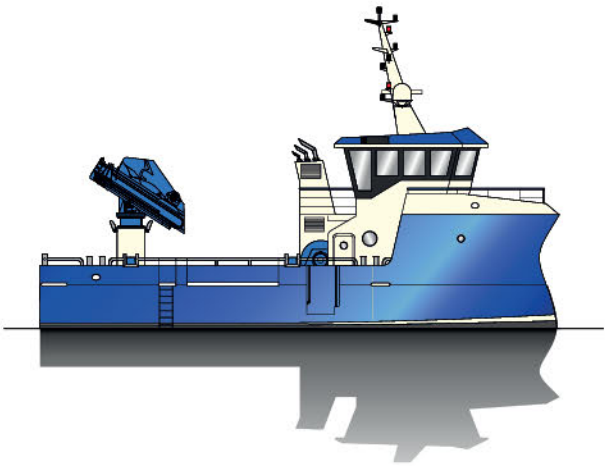
Take, for example, a new 18.5m aquaculture design also currently under build at the Macduff yard. Many of the demands remain consistent with the larger vessels: there's the need for a big clear deck with kit including a high-capacity HS Marine AK72 knuckle boom. In this case, there are two removable bulwarks, the aftmost allowing access to a 3m stern roller which lines up neatly with the main winch. However, in this case it's all settled into a catamaran hull.

In partnership with the Macduff yard, the company has recently brought significant investment to tank-testing various hullforms, arriving at a rather extended, curved bow profile which minimises the wet areas while hitting the sweet spot for reduced resistance, improved motion and crew comfort. It has to be said, although these slim hulls raise efficiency and seakeeping during transits, they leave less room below: even the draught is constrained to a maximum of 2.8m, to avoid interfering with the broad spread of the mooring array.

Hefty deck load

Still, there's just enough room below, in the forward section of the twin hulls, for WCs, a laundry, stores and fuel, water and ballast tanks. Behind that, each side accommodates a 4L Doosan engine (similar to the landing craft) and a 129kW auxiliary engine: the hydraulic pump is fitted in one hull while the other has the harbour set. The rear sections hold the aft ballast tanks and stern gear.

That's a fair amount to pack in, and, Ellis points out, the design still needs enough room to allow for maintenance. That obviously leaves the main deck with more to do: the superstructure accommodates the lounge and galley and tucks in four cabins, along with a dry locker and workshop – plus, of course, the bridge above.



All this sits alongside a demand for enough room to haul in the cage sections or mooring elements; it's worth noting the deck load has been set at a pretty hefty 70tonnes. "I'd say the biggest drivers on these aquaculture vessel designs are the main deck's working area and the requirement for larger, more capable deck cranes," says Elllis. To allow it all, he adds, the boat has likewise seen its beam expanded to a stately 9m.

Still, the final result is a compact and very capable vessel. As Ellis remarks: "It really does fit two quarts into a pint pot."

However, he points out that the rise in loads has meant there are "additional safety concerns" for all types of aquaculture support boat. One of the most important innovations seen on this 18.5m vessel is deceptively simple: it's a cutaway boarding platform, set in a niche created in the starboard hull. This sits 0.5m above the water, with metal steps arranged fore and aft that run up to the main deck.

"This platform gives you a much safer access on and off the fish farm installation: you're not in danger of falling between the cages and the boat," says Ellis. While a new addition, this boarding platform may cross over into other Macduff designs, simply because it's an eminently sensible idea. He adds that he expects the first unit of the 18.5m catamaran to be ready for operation in 2025.

Electric concept

These builds are far from the company's only aquaculture projects: also on the boil is a repeat of the 21m landing craft that Macduff built for Inverlussa Marine Services (*Geraldine Mary*, 2022), plus another two 18.5m versions of that design. Work with Skagen Ship Consulting has resulted in a pair of mussel harvesting boats which should soon emerge from Etkin Marin's shipyard in Turkey, with contracts for another three vessels of differing arrangements following behind. There's also a completely new 14.95m 'ensilage' design for the necessary removal and processing of dead fish, alongside other more general duties.

Finally, the need for clean, green operation has led to the development of a fully electric support catamaran with an advanced hydraulic deck package. "It's nearing completion and we hope to see it launched in the next few months," says Ellis.

In conclusion, there's growth across the entire aquaculture portfolio that Ellis doesn't see letting up any time soon. Alongside this is an inevitable pushing of design boundaries as these vessels are called on to match the rising demands of the fish farm industry. It should prove an interesting development to watch. **SBI**

Macduff Ship Design's forthcoming 18.5m aquaculture support cat incorporates an extended, curved bow profile (image: Macduff Ship Design)

ALT-FUELS

TRAINING FOR THE TRANSITION

Widespread adoption of alt-fuels will require a significant amount of crew training and education if decarbonisation of the global fleet is to come off without a hitch, e-learning provider OneLearn Group has warned

Introducing viable alternative fuels for vessels comes with plenty of challenges, mostly related to performance, availability and cost. However, the maritime sector has identified another potential problem: the need to update Standards of Training, Certification and Watchkeeping (STCW) requirements to ensure that crew are adequately trained in the correct handling and storage of these novel zero-emission and near-zero-emission fuels.

Across the global fleet, this could necessitate the training of as many as 800,000 seafarers by the 2030s, according to research commissioned by the Maritime Just Transition Task Force: an initiative set up in late 2021 by IMO, the International Transport Workers' Federation (ITF), the UN Global Compact and the International Labour Organization (ILO). Even though the vast majority of seafarers currently handling alt-fuels are employed in the small-to-medium-sized vessel segment, it won't be so long before more widescale training for bigger ship types becomes necessary – barring a drastic reversal of international regulatory policy.

Marinos Kokkinis, MD of e-learning provider OneLearn Global (OLG), is an advocate of amending the STCW requirements as soon as is reasonably possible. He explains: "There is still so much we need to learn about green fuels, but we need to be looking at the framework of our training now, and the STCW standards need to be updated to reflect how our landscape is changing." It's not just about the alternative fuels themselves, Kokkinis adds: energy storage systems, alternative propulsive arrangements and safety protocols need to be properly understood, to ensure that operations proceed without major disruption.

"Noticeable lag"

With regard to safety, for example, it's known that ammonia is toxic and can result in burns, respiratory problems and even death for crew members in the event of a leak or spill. Ammonia is also corrosive and highly flammable. Similarly, methanol has a low flashpoint of 11°C, meaning it can ignite easily and therefore requires specially designed tanks, double-walled piping and close-to-hand fire suppression systems. Methanol fuel fires are also worrying as they typically don't produce smoke, and the flame is so dim as to appear 'invisible' – another high-risk element for crew to consider. Likewise, batteries, and especially lithium-ion batteries, need to be stored and monitored carefully to mitigate the risks of overheating, thermal runaway and battery cell degradation.

Marinos Kokkinis, CEO, OneLearn Group: "IMO must be alerted of the dangers of leaving the training standards for alternative fuels unregulated"

Kokkinis tells *Ship & Boat International*: "Despite the amendments to the seafarers mandatory training requirements by the IGF code, covering mainly the use of LNG on dual-fuel ships, there is a long way to go in covering more detailed operations such as bunkering, and to cover other alt-fuels such as ammonia, methanol, biofuels, hydrogen and battery-electric systems. There is a noticeable lag in the marine sector concerning green fuel awareness and training."

He continues: "This deficit could raise concerns. The lack of preparation, if not promptly addressed, has the potential to impede progress and become a risk factor to the safety of crew and the environment.

"It is imperative that the OEMs and shipyards delivering vessels with [these] new technologies should cooperate closer with regulatory bodies such as IMO and the maritime educational institutes, as well as with shipowners and ship managers, to develop and deliver training solutions."

Mood for change

On one hand, Kokkinis believes that adoption of suitable revisions to STCW standards should be accomplishable by 2030. However, he opines: "This is already too late; we would have wished for these amendments to be delivered much faster and earlier. IMO and member governments must be alerted of the dangers of leaving the training standards for alternative fuels unregulated."

The success of such training courses will largely depend on industry appetite, of course. Kokkinis says: "The mood among shipowners and crews regarding the necessary

extra training varies. I believe that the majority within the industry recognise the importance of upskilling for the transition to green fuels and view it as an investment in the sector's future and especially in safety.

"A few others may perceive it as an additional hassle and operational burden. Overall sentiment in the maritime sector suggests a growing awareness of the necessity for training, although with a spectrum of attitudes towards embracing change and sustainability initiatives."

It will be important to avoid sudden, urgent spikes in demand for these courses, and potential bottlenecks, Kokkinis adds. "We must also admit there is a limited number of experts in this subject matter, since not many seafarers have gained such experience, which results in a lack of qualified trainers and instructors," he states.

The need to standardise

As for the current state of play, Malevi Maneti, OLG learning solutions programme manager, comments: "When it comes to new fuels, training courses are scattered and not yet aligned." In Maneti's opinion, training programmes must be standardised, to ensure a cohesive approach across the globe. "More and more information on new fuels is going to be developing and coming out continuously, so it is vital we promote a culture of continuous learning for seafarers," she says.

OLG intends to stay on top of the latest developments through its participation in various technical committees and working groups, including those affiliated with the International Chamber of Shipping (ICS), IMO and other members' organisations.

Given the aforementioned perceived lack of qualified trainers, OLG believes that its e-learning courses can go some way towards plugging any gaps in the system. "Unsynchronous training courses and simulators [can] play a pivotal role in enhancing seafarers' understanding and management of green fuels," Kokkinis concludes. "The e-learning solutions...facilitate an immersive learning experience via interactive and engaging tools, allowing seafarers to simulate scenarios related to green-fuel operations, emergency responses and maintenance procedures.

"Furthermore, training through simulators contributes to a more effective and comprehensive learning process, preparing seafarers for real challenges."

2025 target

IMO does not appear to be slacking on OLG's call for change: in December 2023, during COP 28 in Dubai, the Maritime Just Transition Task Force announced a new project to accelerate the roll-out of alt-fuel handling training to seafarers. The project will be led by IMO and the Maritime Just Transition Task Force secretariat, with Lloyd's Register developing the training framework for seafarers and officers, as well as a handbook for training institutions. The Malmö-based World Maritime University (WMU) will also assist the project.

The aim is to develop the necessary training materials by mid-2025. Following initial testing of these materials in Asia, to be coordinated by the WMU, a final, comprehensive training package will be approved and made available to all IMO member states for potential use by their maritime education and training institutes.

Speaking in December, Ruth Boumphrey – CEO of the Lloyd's Register Foundation, which provided initial funding to the Maritime Just Transition Task Force – commented: "Moving towards a low-emission future will require new green jobs and reskilling... there is a vital need to up-skill all seafarers." In turn, Guy Platten, ICS secretary general, said: "2030 is just around the corner and we cannot be complacent about the needs of our seafarers and the appropriate training being in place to support them during our transitioning." If the groups involved stay committed to this level of support, preparedness for green fuel handling should be one less worry in the steady march towards global fleet decarbonisation. **SBI**

Areas to consider

While training courses will have to take into account factors such as the size and prior experience of the crew, plus the vessel type and its operational routine, some key training elements for future marine alt-fuel management, particularly regarding safety awareness and technical know-how, are bound to include:

- Understanding the specific hazards associated with each fuel, including toxicity, flammability, corrosivity and potential for thermal runaway, for example;
- Emergency response procedures related to firefighting, spill containment and medical treatment in the event of exposure;
- Determining the right type(s) of personal protective equipment (PPE) for each alt-fuel;
- Safe handling practices for each fuel, from bunkering operations to onboard storage and maintenance procedures, through to waste disposal;
- Engine/fuel system operational principles for the specific alt-fuel being used;
- Troubleshooting and maintenance procedures for fuel systems and related equipment;
- Fuel quality control measures and monitoring protocols; and
- Regulatory requirements and compliance related to alternative fuel use in the maritime sector.

SMALLER, CHEAPER FUEL CELLS...NOW

The technology for more cost-efficient, compact fuel cells is here, courtesy of printed circuit board manufacturing techniques – and is currently being tested on the water, writes Stevie Knight

The 17.4m Hytime demonstrator boat may be modest, but the ambitions for this project are anything but. It's far more fundamental than Bramble Energy's work with engine builder Barrus to combine a battery and fuel cell onboard a narrowboat: it's not even to show how hydrogen could add a range extender to a purely electric system, removing the reliance on charging infrastructure.

In fact, the Hytime project demonstrates how leveraging standard, industrial technology can make PEM fuel cells smaller, cheaper and much, much smarter. Not at some point in the future, but right now.

"Traditional fuel cells are made of conductive layers – either metal, like stainless steel or titanium, or carbon-based materials," explains co-founder and head of Bramble Energy, Dr Tom Mason. These are assembled into a sandwich, with different layers taking on a different part of the process: gas distribution plates introduce the hydrogen on one side and the oxygen on the other and also reap the charge, while the gas diffusion, catalyst and membranes do the business of transporting protons and stripping off electrons to create the electric current.

Although the working surfaces are very fine, they demand a lot of extras: for example, a supply of reactants, as well as efficient heat removal and start-stop procedures. So, despite the relative simplicity of the physics, a typical PEM system is extremely complex with compressors, humidifiers, radiators, valves, pumps, batteries and so on.

"The supporting technologies work out much larger than the core of the fuel cell stack itself, which can be as little as 1,000 or 2,000 microns," says Mason. "In fact, given a stack of 400 cells, you're going to have at least 1,600 components. And some of these can be very bulky and pricey." Further, putting them together to yield a meaningful power contribution to, say, a workboat results in a steep rise in size and complexity.

Bramble's PCBFCs leverage standard, industrial technology to make fuel cells smaller, cheaper and much smarter (image: HyTime/Bramble)

PCBFC stack

However, Bramble's approach departs from traditional design principles by utilising well-established printed circuit board (PCB) manufacturing processes (arriving at the 'PCBFC' moniker). Mason explains: "The beauty of the PCB is that it has a dielectric structure...that is, a non-conductive component, that's the base of your PCB, and a conductive part: copper, which can be etched into different shapes and patterns." That allows you to iron out a lot of the complications, either by incorporating the process or removing the requirement entirely.

Take, for example, the cooling channels. "A typical metallic or graphitic plate structure has very low-conductivity, de-ionised water-based coolants flowing between the conductive surfaces," says Mason. But you have a problem: as these elements leach into the liquid they risk creating a short circuit. So far, the answer has been to introduce deionisation loops to clean up.

By contrast, the PCBFC's coolant pathways (along with other channels) are integrated into the machined, glass-reinforced resin base, "so these flows never actually touch a conductive surface", allowing the engineers to ditch the whole system, Mason explains.

The inherent safety benefits also extend to the entire PCBFC stack: these resin laminates lend structural integrity while the non-conductive outer surfaces mitigate the risk of short circuits, streamlining packaging and installation. Also, unlike conventional fuel cell stacks where layers must be meticulously aligned, PCBs are far easier to assemble on a factory line – the electronics industry has been doing it for years.

Distinct zones

However, the advantages of this approach go well beyond simplified assembly, cooling systems and packaging. "Typical fuel cells are limited to one voltage across each layer," explains Mason. But following standard PCB production techniques – for example, etching conductive pathways directly onto the substrate – translates into a cell and stack design that simply cannot be achieved in metallic or graphitic versions.

That's partly because the PCB's inherent flexibility also enables the segmentation of fuel cell modules.

The Hytime project in Sheffield, UK has utilised Bramble's PCBFC aboard a 17.4m narrowboat

Dividing a layer into distinct electrical zones, each with its own profile, means that it is possible to tailor current and voltage outputs. This matters because getting the most out of these hybrid systems means taking advantage of the very different characteristics of both batteries and fuel cells – so, although the battery may not be able to store huge amounts of energy, "it can chuck it out really quickly...while a fuel cell is really good at providing efficient energy, it's not that great at meeting sudden high demand", says Mason.

"Therefore, a tug would probably have a big battery and a relatively small fuel cell so it doesn't have to stop to recharge," Mason adds. On the other hand, a slower boat might find a bigger hydrogen store and smaller battery more effective, though he adds there will likely be as many combinations as types of vessel, scaling up in multiples for larger ships or right down for domestic leisure vessels.

Hytime project

In fact, it could extend to a narrowboats, like the one being tested in the Hytime project in Sheffield, UK. This combines a 15kW fuel cell and a 22kWh battery pack with solar panels contributing additional energy. Mason explains: "A decent-sized battery is necessary for leisure boats, so you can turn on the heating, kettle and oven simultaneously." He also notes that, whatever the application, analysing the demand and playing to the strengths of each energy source "may well show you that you don't need a big, dirty engine". In fact, the narrowboat's 14kg of stored hydrogen is expected to give it an impressive range of around 600 miles (nearly 1,000km).

However, integration needs particular attention. Each of the contributors has to dance in step with the other – for example, the battery acting as a transient and additional load support for the fuel cell which can take time to ramp up (PEM cells do get damaged by repeated, fast loading), while the battery will likely need the fuel cell's input to maintain a sustainable charge. But they each have somewhat different operating parameters.

"Coupling these elements together usually requires a lot of DC-DC converters," says Mason. These can be considered as step-up transformers with electronics to ensure stable output voltages – but he adds: "These are also very heavy, very bulky, very expensive components...in fact, in all of our earlier demonstrators, these have worked out to be heavier and bigger in volume than the fuel cell stacks themselves."

However, the PCB approach could make the DC-DC conversion simpler, or even absorb it completely. In fact, Bramble's white paper describes how a PCBFC allows for dividing a layer into five distinct segments: that can increase the voltage of a fuel cell module five times, from 0.6V to 3V.

Size reduction

That scales up. So, a fairly typical 100kW stack comprising around 350 plates might operate at roughly 210V, but a similar 100kW PCBFC could yield an output around 1,050V (albeit with a drop in current). In short, this neat segmentation trick could embed the normal DC-DC conversion inside the stack itself, allowing a 30-100kW energy output at around 1,000V.

That might prove useful for workboats where higher-voltage architectures would avoid resistance losses. As Bramble notes, batteries operating above 400V are becoming more common, "with significant advantages seen by those operating at above 800V" as this allows for the use of significantly lower currents. That, in turn, enables reductions in cable size, the thinner copper wiring resulting in significant weight savings – and it's physically much easier to install.

It's an approach that not only reduces system mass and volume but also enhances overall efficiency and cost-effectiveness. "With our PCBFC, you end up with about a quarter of the components...and these can be customised to fit," adds Mason. In fact, all this allows the new PCBFC technology to be manufactured in almost any size or arrangement at much greater speed and scale than traditional electrochemical stacks, at a much lower cost.

Most importantly, it shows a clear way to completely upend the usual production rationale – instead of trying to start from scratch, Bramble's patent-protected fuel cell can be manufactured in almost all printed circuit board factories, worldwide.

"It gets rid of the chicken and egg issue, where no-one will invest in a huge plant until there's enough demand...instead, we utilise factories that already exist," says Mason. "It's all about creating fuel cells in a globally standardised supply chain – and, most importantly, at a cost-effective price point that's able to leverage 50 years of PCB development." **SBI**

BLEND RESULT

Mixing agricultural waste with leftover cooking oil or lamb fat could produce an ISO-compliant marine alt-fuel, a team of researchers has discovered

Scientists at Aston University in Birmingham, UK believe they may have found a viable alternative to traditional marine bunker fuels, care of a blend of leftover cooking oil, lamb fat and agricultural waste.

The research project – undertaken in cooperation with colleges in Brighton, UK and Madras and Chennai, India – saw the scientists take delivery of agricultural waste pellets, supplied by a Dutch anaerobic digestion (AD) plant. These pellets – each measuring approximately 20mm in length and 6mm in diameter – were then treated in Aston University's pyrolysis-based reactor, which heated them up to 500°C to convert them into bio-oil. Solvents were then added to the bio-oil, which was blended with the used cooking oil or lamb fat to create the alt-fuel. The lamb fat was sourced from a local butcher and processed on site at the university.

Five blends

Dr Abul Kalam Hossain, senior lecturer in Aston University's Department of Mechanical, Biomedical and Design Engineering, tells *Ship & Boat International* that it was necessary to create this blend as attempting to turn the waste pellets into bio-oil, and using this as an alt-fuel alone, would have resulted in high acidity and low energy content/low viscosity.

"Bio-oil is a complex mixture of many compounds, many of which are acidic in nature – for example, acetic acid," he says. "The bio-oil is often unstable as it is formed from homolytic fission of carbon-carbon [C-C] bonds that generate free radicals. These radicals continue to react over many months, often leading to phase separation and the formation of an aqueous and organic layer."

The researchers created five blends, using differing amounts of bio-oil, solvent and oil or fat for each. "The blend preparation time was only 10-15 minutes, but we stored it to check the phase separation or miscibility for at least 72 hours," says Hossain. All five blends then were stored in the dark for a period of eight months, and at ambient lab temperatures in the range of 18±2°C. "The samples were stored in the dark for two reasons: to reflect the onboard storage condition; and, from a scientific perspective, to avoid photooxidation of fuel," Hossain explains.

Researchers at Aston University in the UK have been experimenting with alternative marine fuel blends (Image: Aston University)

Pros and cons

At the end of the eight months, the blends had improved their heat value, viscosity and density by around 25-40%, the university reports. As a result, the new alt-fuel complies with ISO 8216 and ISO 8217 marine fuel standards for diesel engines and boilers.

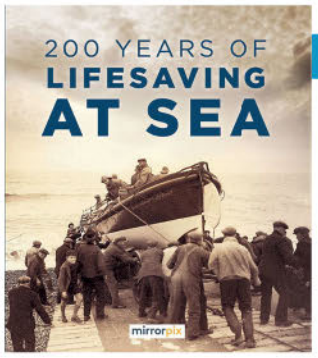
"The improvement of heat value, viscosity and density have a direct relationship with the engine performance and exhaust emissions," says Hossain. "The engine performance will improve, and the level of engine pollution will decrease. Potentially, these blends can be used directly in standard marine diesel engines."

However, he cautions: "These blends are potentially more corrosive than petrochemical-sourced fuel, whereas toxicity and flammability are like petrochemical fuels, so long-term studies on the use of this fuel blend would be required to establish engine performance against time."

Cost-wise, would the blends be more expensive than diesel, which is well-established and easy to obtain globally? Hossain replies: "The fuel produced in this study is for research purposes only, and is at small scale. A detailed economic production analysis would be required to scale up both AD bio-oil and animal fat to fully answer this question. Given that algal oil is about 10 times more expensive than petroleum oil, it is likely that this fuel will be another order of magnitude higher again."

When it comes to the supply chain, Hossain is optimistic that waste plant facilities are becoming more widespread. "For example, Severn Trent Water has a food waste plant on the outskirts of Birmingham, which we have used the slurry from to start up our own AD reactors," he notes. "Many small farm holdings have also set up their own AD on site facilities in order to generate biogas for local use." The university team now plans future research into maritime applications. **SBI**

BOOK REVIEW



SEARCH AND RESCUE

200 Years Of Lifesaving At Sea

Compiled by Mirrorpix
Publisher: Mirrorpix

On 4 March 1824, the London Tavern in Bishopsgate hosted a gathering of 30 philanthropists, among them abolitionist William Wilberforce and Charles Manners-Sutton, Archbishop of Canterbury. This meeting effectively approved the establishment of a new charity, initially named the Royal National Institute for the Preservation of Life from Shipwreck, with the remit of rescuing casualties in British and Irish waters.

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

This year marks the RNLI's 200th anniversary, commemorated in this book published by London photo library Mirrorpix. The book starts off with a little pre-RNLI history, reproducing a drawing of the presciently named *The Original*, credited as Britain's first purpose-built lifeboat, produced by Henry Greathead in 1789. Grace Darling and her father also get a mention for their heroic efforts in rescuing nine casualties from the wreck of the steamer *Forfarshire* in 1838 (a future RNLI lifeboat was named after Grace).

Although the emphasis of *200 Years Of Lifesaving At Sea* is on the pictorial, there are plenty of notes throughout, providing a clear timeline of developments. The reader gets to see the evolution of boat designs, technological aids and lifejackets and clothing, in ways that make you realise (and appreciate) how far we've come. Take, for example, the description of the 1928 launch of the lifeboat *Caroline Richardson*: "She was believed to be the only bottomless lifeboat in the UK, having two banana-shaped hulls that were joined together by a grate. This gave her excellent stability, but would result in the crew being soaked to the skin soon after leaving the shore."

By 1947, the RNLI was regularly replacing its sailboats with motorised lifeboats such as *St Albans*, pictured here (although the charity's first petrol-powered boat was actually delivered in 1905), and the early 1960s saw the launch of the six-person lifeboat *Zodiac*, intended to serve as an auxiliary to the RNLI's main boats. One particularly striking image shows the 1972 sea trial of the inflatable Atlantic 21 class: described here as "inflatable boats that were twice as fast as a conventional craft and only one-sixteenth of the cost".

The book takes us right up to 2021 migrant rescues off Dungeness, plus a tribute display following the death of Queen Elizabeth II in September 2022. *200 Years Of Livesaving At Sea* provides a neat visual record of one of Britain's most recognisable institutions, and shows how far we've come in the fight to respond to coastal accidents and incidents. **SBI**

Review by:
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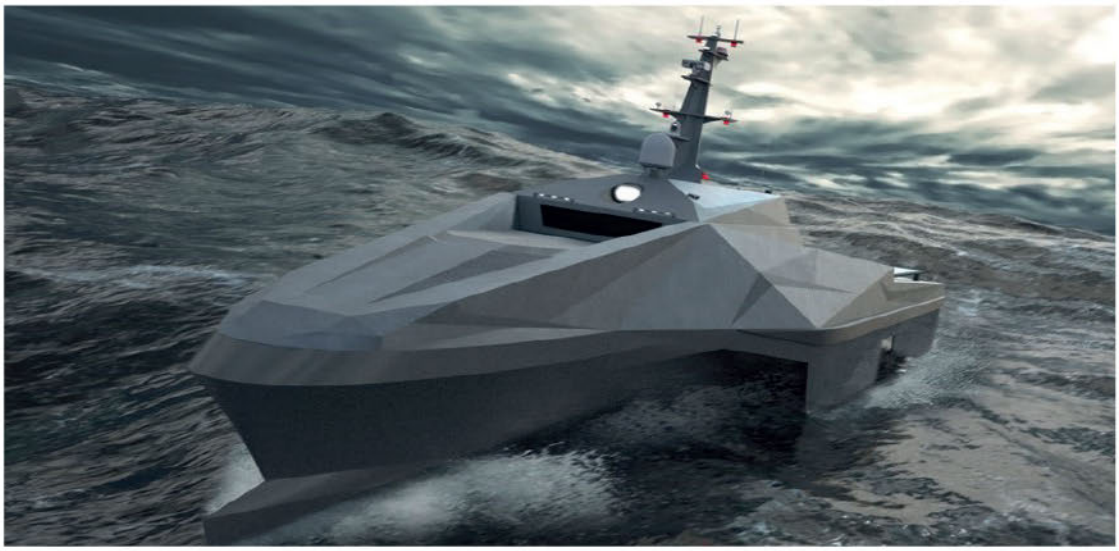

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