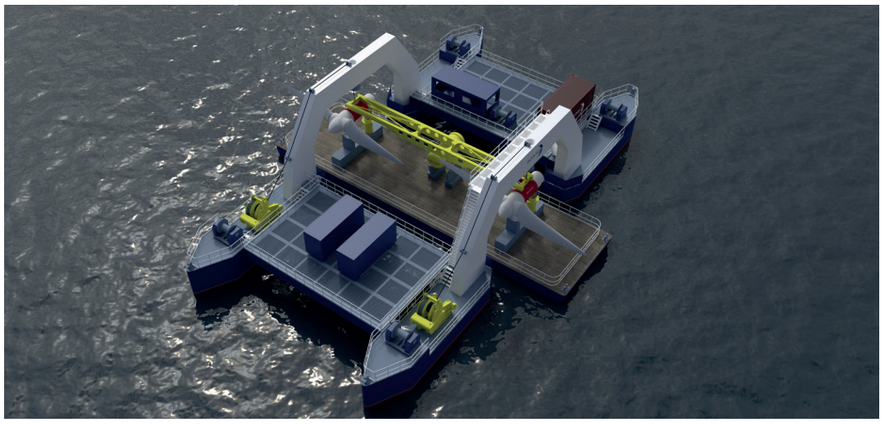
NEW VESSEL DESIGNS

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.

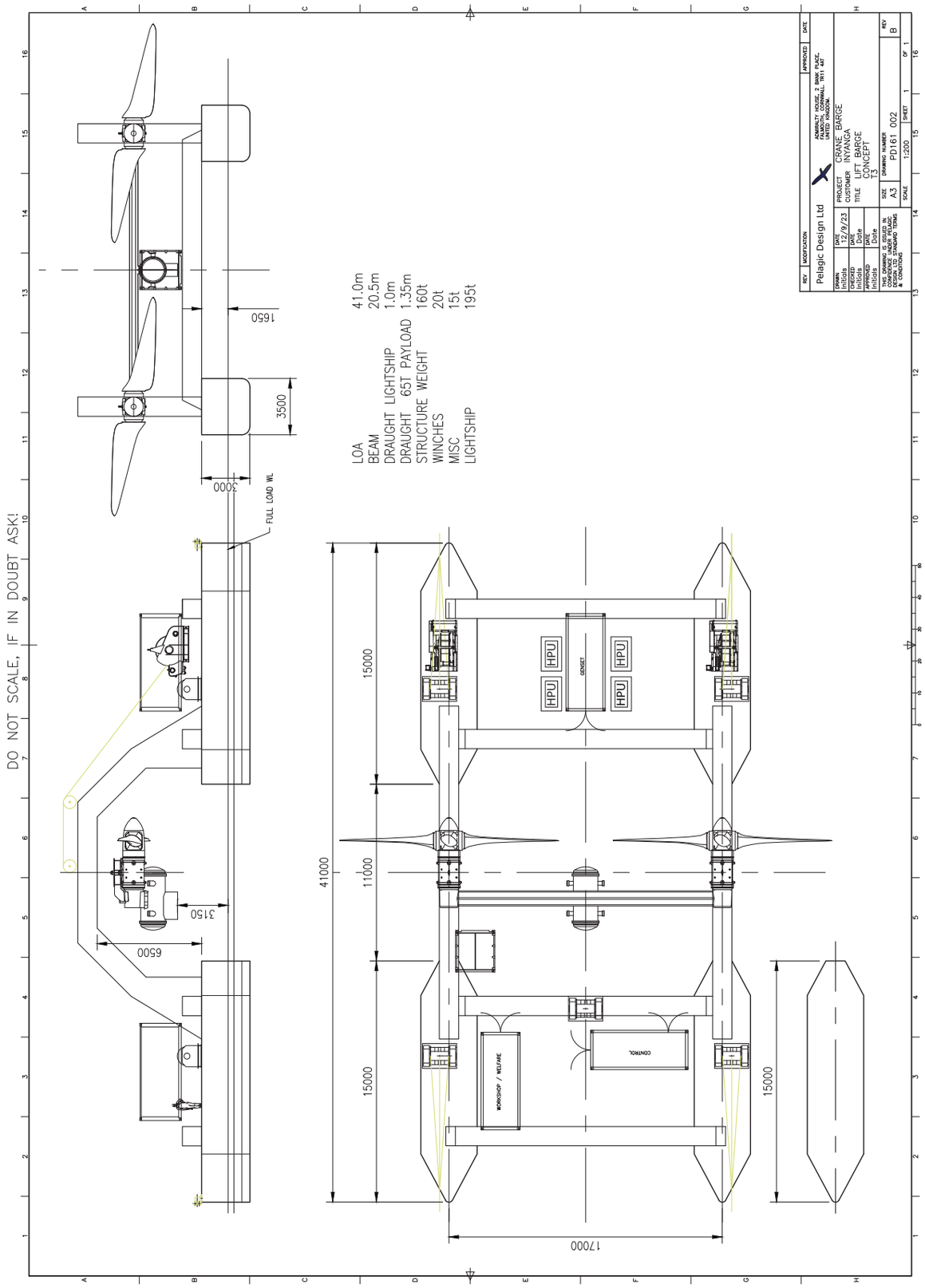
Turbine design

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 35km^2 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 300m^3 to 30m^3. 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**