Department for Energy Security & Net Zero

NET ZERO INNOVATION PORTFOLIO

Trivane Limited

Semi-submersible trimaran floating offshore wind (FOW) platform with turret

CARBON TRUST | OFFSHORE WIND

Project Lead: Trivane

Partners: London Marine Consultants, Ledwood

NZIP Grant: £1,200,000

TRIVANE LMC LONDON MARINE CONSULTANTS LEDWOOD Engineering. Fabrication. Coating. Construction

Innovation overview

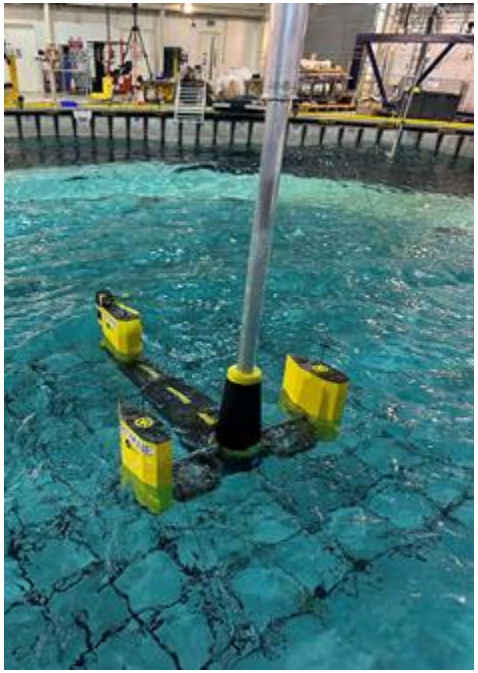
Trivane is a semi-submersible floating offshore wind (FOW) platform, featuring a turret mooring system. This allows the platform to weather-vane in response to prevailing environmental conditions. The unique trimaran foundation design supports the turbine tower with two submersible pontoons and a forward floater equipped with a turret. Additional floaters on each side pontoon provide transverse stability. This configuration allows all floaters to be ship-shaped, reducing mooring forces and minimising tilt and roll under wind loads due to the streamlined design. The project included structural analysis, stability and motion analysis, and model testing at Flowave in Edinburgh.

Potential benefit to the industry

Preliminary cost estimates indicate that constructing the platform using concrete instead of steel will reduce costs by approximately half. Any steel components will be made from stiffened flat plates rather than curved plates. Using concrete, along with any steel parts designed as flat plates, results in an expanded supply chain and lower costs. Additionally, there is no requirement for active ballasting, and the reduced mooring line loads lead to lower mooring expenses.

> “The FOW industry has not converged on an optimum design of platform. After considering many options, over three years, I conclude that Trivane’s streamlined but stable design, with low mooring forces, may be the best solution for worldwide use. My conclusions are based on my long experience in building and towing concrete gravity platforms, fabrication, load outs, marine operations and the design of turret mooring systems as Founder, LMC”

Richard Martin
Director,
Trivane



Results

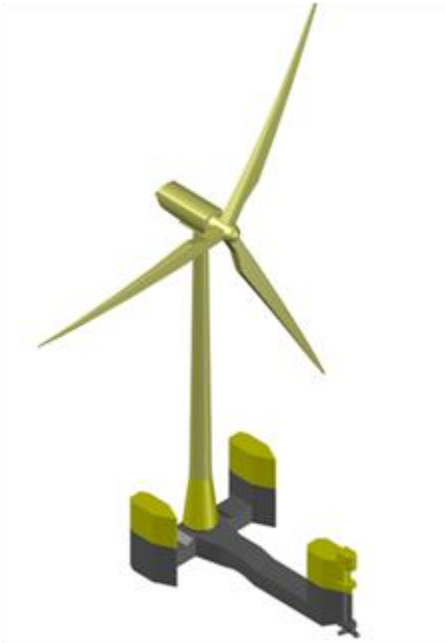
TRIVANE

Overall configuration

The work centred on deployment in an environment such as the Celtic Sea where the extreme sea state is Hs = 13.3m. The initial design aimed to support a turbine with a capacity of 15 MW. Initially, a configuration with three surface barges was considered, but excessive motion levels led the project to explore semi-submersible trimarans instead. Comparisons were made between solutions with a turret and those without, revealing that the turret-moored solutions experienced significantly less inclination. There were two different alternatives for connecting the side floaters to the central pontoon: one design featured pontoons, while the other used trusses. The motions of both designs were found to be similar. Although the truss design slightly reduced the mooring line loads, it may present greater construction complexity.

Build in concrete

A steel version of Trivane contains approximately 6,000 tonnes of steel. The cost of building in concrete is about half the cost of building in steel. Although larger weights of concrete are required, compared to the weight of steel, the unit cost of a tonne of reinforced concrete is less than a tenth that of fabricated steel. Both steel and concrete versions of the platform are identical in displacement and form. Comprehensive model tests and analyses of both designs revealed that they exhibit similar motion characteristics. Concrete pontoons will be prestressed. Thus, the concrete is never in tension and corrosion of its reinforcement is avoided. The minimum acceptable thickness of concrete members is 320mm, dictating the minimum size of a demonstrator foundation.



What happens next?

A demonstrator is being designed that will be identical in form to the 15MW version but reduced in size. The centre pontoon will be made in concrete. It will support a turbine of 3 MW to 4 MW in the tests and be capable of supporting one of 5 – 8MW in subsequent use by others. A consortium is being sought to build and deploy it. UK building sites and deployment locations are being identified. Funding assistance is required.

The Floating Offshore Wind (FOW) Demonstration Programme is a competitive funding initiative supporting the development of floating offshore wind technologies. Through the scheme, the government awarded £31.6 million in grants to 11 projects across five challenge areas: dynamic cables, anchorings and moorings, floaters and foundations, industry-defined innovation, and integrated demonstration of multiple technologies. These projects aim to showcase innovative technologies to reduce costs and accelerate the deployment of floating offshore wind turbines.

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