GO WITH THE FLOW

The endurance of turbine blades is vital to keeping costs down in the tidal energy sector – and by utilising the University of Edinburgh's FloWave testing tank, the institution's FASTBLADE facility will ensure the structures are ready to brave the elements. By Colin Cardwell

STRESS in any situation will inevitably take its toll, and in the realm of renewable energy the results can be both dangerous and costly. Professor Conchúr Ó Brádaigh, Head of the School of Engineering and Chair of Materials Engineering at the University of Edinburgh, is Principal Investigator at FASTBLADE, the world's first test facility using regenerative hydraulic technology to offer high-quality, low-cost fatigue testing of tidal blades and other composites structures for research and product development.

It officially opens next month as a fully integrated part of the University of Edinburgh, helping to ensure Scotland's continuation as a global centre of excellence in ocean energy technology and will complement the FloWave Ocean Energy Research Facility – where a 25-metre diameter circular tank recreates complex waves and fast ocean currents focusing on research and development and the testing of clean energy technologies.

While FloWave tests scale models in a programmable and controllable test basin environment, FASTBLADE tests full scale components including tidal blades and other large composite structures and was built by engineering giant Babcock International with funding by the Engineering and Physical Sciences Research Council (EPSRC) and the University of Edinburgh.

"Both facilities provide services to industry and academic project work," explains Dr Tom Davey, test facility manager at FloWave. The facility is working with EuropeWave, an innovative R&D programme for wave energy technology and will be testing four technologies this summer, with an additional three being tested in Spain) which he says is very much industrially led.

FloWave is also working on expanding its floating offshore wind capability with a Research Engineer (doctoral student Anita Nunes-Leite) working on methods for applying aerodynamic (wind) loads in a hydrodynamic test environment.

Prof Ó Brádaigh expands on the role of FASTBLADE: "Essentially, the wind industry has been doing what we're doing for 30 years. The big difference is that that the blades in wind turbines, because of their relative flexibility, are much longer because the power comes from the air which is 800 times less dense than water."

A tidal turbine blade, he adds, is more like an aircraft wing box: short, stiff and bearing a lot of load. "The only way you can test those types of structures for lifetime durability is by using a hydraulic fluid to load the blade then unload it repeatedly. This needs to be accelerated so that we can test the endurance within the product design cycle of the structure in the laboratory, doing in months what nature will do in decades"

This presents a problem: using traditional hydraulics is expensive and generates wasted heat. "At FASTBLADE, the use of digital displacement hydraulics means that each cylinder is controlled separately and allows a much finer degree of control – using regenerative pumping, which is similar to driving a Toyota Prius, which when you brake, sees the energy go into charging the battery rather than heating the brakes."

FASTBLADE's Prof. Conchúr Ó Brádaigh

Both facilities feed knowledge and expertise back to the university's doctoral training centres to inform the training of the next generation of people joining the sector, working in partnership with the universities of Strathclyde, Exeter and Oxford.

FloWave test facility manager Thomas Davey

"We're talking to all the major OEMs (original equipment manufacturers) in tidal energy at the moment," says Prof Ó Brádaigh. "With the UK government's Contracts for Difference scheme (the main mechanism for supporting low-carbon electricity generation) we are going to see tidal arrays in UK coastal waters within the next two or three years."

Already well established as a leading testing site for tidal and wave energy innovations, the University of Edinburgh's FloWave testing tank facility is now working with FASTBLADE to facilitate low-cost fatigue testing of tidal blades

> **"Testing in the laboratory, we do in months what nature will do in decades**

FastBlade aims to reduce design risks for developers

Compared with wind and wave energy, tidal energy also has the advantage of predictability. "The EU's estimate is for more than 10 gigawatts (GW) of marine renewable energy by 2030 and 100GW by 2050. I believe the tidal sector will take the lead in this because of its inherent predictability and the availability of more easily exploited resource," he says. Both FloWave and FASTBLADE are well placed to be at the leading edge of these advances with complex facilities that allow potentially, expensive problems to be anticipated, significantly de-risking the process. Through their doctoral programme placements, they are also helping to deliver the fast-growing skills requirement in the renewables sector.

And, adds Prof Ó Brádaigh, there are many other applications for FASTBLADE, including in the aerospace and infrastructure sectors. "Aircraft structures, ships and composite pedestrian bridges all have to be fatigue tested and certified for a lifetime – so there are a range of exciting prospects for the future." ■