MTS

National Renewable Energy Centre (Narec)

CUSTOMER CASE STUDY

Driving Renewable Energy Innovation

MTS Non-Torque Loading (NTL) System accelerates wind and tidal turbine testing

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— Tony Quinn
Operations Director
National Renewable Energy Centre (Narec)
Blyth, Northumberland, United Kingdom

CUSTOMER CHALLENGE

Located in Blyth, Northumberland on a stretch of North Sea coastline, the National Renewable Energy Centre (Narec) is a center of excellence for the research and development of offshore tidal and wind turbines. In a market currently dominated by a few large global organizations, Narec plays a key role in helping new entrants more easily evaluate and validate designs, prompting greater industry-wide competition and innovation.

According to Tony Quinn, operations director for Narec, one formidable obstacle for new entrants is the time and cost associated with testing new turbine designs. "Traditionally, the only way developers could test new turbines was by putting them in the sea," said Quinn. "Of course, the equipment isn't usually ready to go offshore, and is easily damaged. That means the developer has to recover it from the seabed, bring it back to shore, repair it and redeploy it – an extremely expensive process, and a serious barrier to market entry."

In addition to being costly and time-consuming, this method is non-repeatable and often yields limited usable data; there is no guarantee that even a 12 month offshore trial will yield all the conditions needed for a rigorous evaluation of a turbine's reliability and durability. "That process is very dependent on the wind or tidal conditions the device happens to experience in that year's time," Quinn said. "You're waiting for certain tidal or wind events to happen a couple of miles offshore, or at the bottom of the sea. It's not a very robust – or fast – way of validating a design."

MTS SOLUTION

To help tidal and wind turbine developers overcome the costs and uncertainty of offshore testing, Narec has developed a complex of laboratories, including two facilities capable of testing drive trains for turbines up to 3 megawatts (MW) and 15 MW, respectively. Equipped with innovative MTS Non-Torque Loading (NTL) Systems, these facilities allow developers to subject full-scale tidal and wind turbine drive trains to complex, real-world loads and accurately replicate a wide array of offshore conditions in controlled and repeatable laboratory settings.

"With the NTL systems from MTS, we can replicate a one-in-100-year tidal event or a one-in-100-year wind event at will," Quinn said. "We can recreate wind or tidal forces in three orthogonal axes, and we can apply a force along any axis or a bending moment around any axis in three dimensions simultaneously. We can use a time history to subject turbine designs to 10 years' worth of real-world events in just six months."

NTL systems employ state-of-the art MTS hydraulics and controls to introduce very large off-axis (or non-torque) forces and moments into a rotating turbine drive train with high degrees of control and precision. The NTL system housed in Narec's 3 MW facility is particularly suited to tidal turbine drive trains, while the system under construction in the 15 MW facility will be ideal for testing larger offshore wind turbine drive trains.

According to Quinn, the off-axis forces required to effectively test turbine drive trains are enormous. "A 7 MW wind turbine has a diameter of approximately 160 meters, with 80 meter blades. If you can imagine the wind hitting that blade full on, it puts a huge overturning moment on the drive train. For marine turbines, the effect is similar but the relative forces are even higher because they are underwater." To meet these needs, the NTL system that will operate at Narec's 15 MW facility will be capable of applying an overturning moment of 56 meganewton-meters (MNm), while the system in the 3 MW facility can apply a force up to 15 MNm.

To house such powerful equipment, both drive train facilities feature massive, specially designed foundations. For example, the 15 MW facility sits on a base comprising 1,000 tons of structural steel and 100 piles buried 20 meters deep. "We had to bury the piles that deep because of the tremendous forces the MTS equipment is able to apply," Quinn said.

Photo courtesy of National Renewable Energy Centre, Narec, in the United Kingdom

CUSTOMER BENEFITS

The ability to replicate real-world tidal and wind events in controlled settings enables Narec's customers to more efficiently gain critical insight into the reliability and durability of new turbine designs, significantly accelerating their development and validation processes. This has a ripple effect on the competitiveness of the offshore renewable industry as a whole, as well as the overall unit cost of wind and tidal energy.

"Ultimately what we're seeking to do is drive down the cost of offshore energy and make it more competitive with natural gas and coal," Quinn said. "The faster developers learn about their products, the faster they drive reliability and cost improvements, and the faster we deliver a lower cost of energy. The higher the reliability the greater confidence we give to investors, which is vital and more competition results in a healthier market."

Quinn credits the highly collaborative relationship between Narec and MTS engineers for the establishment of Narec's drive train testing capabilities. "The whole design is a fantastic effort between us and MTS," Quinn said. "We're taking on some engineering challenges that quite frankly haven't been addressed by anyone else in the world. It has truly required world-leading engineering."

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ISO 9001 CERTIFIED QMS

100-273-845 Narec • Printed in U.S.A. • 09/21