Acoustic Technology to Help Offshore Wind Industry Adapt to Complex Environments

Nortekâ€™s ADCPs are suitable for monitoring currents and waves around both fixed offshore wind turbines (in shallow areas up to approximately 50 m) as well as floating wind turbines anchored in deeper areas of the ocean (typically greater than 50m). Such ADCPs are typically deployed in a bottom frame or submerged buoy. (ADCPs and wind turbines in this illustration are not to scale)

Nortek is supporting metocean survey and consulting company Partrac to provide floating wind farm developers with detailed and accurate data on metocean conditions at potential development sites. Using acoustic Doppler current profilers (ADCPs), Partrac are able to extend their capabilities and adapt to increasingly complex offshore environments.

As the world seeks to meet increasingly ambitious net zero carbon emissions targets, the need for expansion in the offshore wind sector is clear. Energy generation capacity is forecast to increase eightfold, from 29.1 gigawatts (GW) in 2019 to more than 234GW in 2030, according to the Global Wind Energy Council (GWEC).

Thus far, virtually all offshore wind energy produced globally has come from turbines located in water shallower than 50m, where the turbine tower can be directly attached to the seabed. But with demand for wind power growing fast – and suitable shallow-water sites filling up in some places – the industry is now seeking to move into deeper water. However, these environments create a new set of challenges for developers.

Existing monopile or gravity designs typically used for shallow-water wind farms, which involve attaching the tower directly to the seabed, are not as simple or cost-effective to deploy in deep water. As seen in other industries, it can be more cost-effective and practical for deep-water wind turbines to be located on floating structures tethered to the seabed, potentially opening up a lot more of the ocean to wind farm developments.

Obtaining Accurate Data for Floating Platforms

Despite the advantages of using floating platforms, offshore wind developments remain complex, so obtaining the most accurate data on the metocean conditions at proposed sites is crucial. The wind resource may be plentiful, but ocean conditions in deeper water provide a different set of challenges from those in shallow waters close to shore – and they require different tools and expertise to analyse them.

For Partrac, one of the UK’s leading metocean survey and geoscience consultancy providers, the rising interest in floating offshore wind farms means that the company is increasingly being asked to obtain data that developers can use for site characterization and modelling in deeper water than the norm.

ADCPs have long been a crucial part of Partrac’s toolkit for constructing detailed profiles of current and wave movements around wind farms. These instruments provide highly accurate profiles of water movement using the Doppler effect to measure the shift in sound waves reflected from particles at various depths through a water column; crucially, they are also able to measure the wave climate. However, moving to deeper water now requires a longer-range ADCP solution.

Oceanographic Deployments in Harsh Environments

The Nortek team has been well placed to help with this move, having provided ADCPs and expertise to Partrac over many years. Historically, shallow-water wind farm feasibility studies have been carried out using Nortek's higher-frequency, shorter-range Signature and AWAC instruments. However, collecting data in deeper waters requires equipment designed to withstand, and measure, extreme wave regimes, while accurately measuring currents from surface to near seabed across a greater depth.

With these challenges in mind, Nortek was able to provide Partrac with its Signature250 ADCP and accompanying subsurface buoy. The instrument allows users to measure currents and directional waves up to 200m for current profiling, and 150m for wave height and direction, making it the preferred choice for deeper-water wind turbine sites.

"We needed an instrument for deeper water that could still measure both current profiles and the wave climate. The Signature250 has proven to provide exceptional data thus far," says Pete Wilson, operations director at Partrac.

Nortek has been an innovator since its creation in 1996, constantly developing new acoustic technologies and solutions that enable users to measure water movement ever more accurately. Wilson says he has experienced first-hand how this culture of innovation translates into practice. "We consider Nortek's instrumentation design and technology to be very progressive and adoptive of the developments in information technology in general," he says.

The Nortek Signature250 ADCP is deployed during a wind farm site survey undertaken by Partrac off the Orkney Islands, northern Scotland. Partrac chose the instrument because of its ability to provide highly accurate current profiling data out to 200m, and wave height and direction data up to 150m.

Minimizing Risks by Sharing Knowledge

Oceanographic deployments in harsh environments are, by their nature, a risky business, but those risks need to be minimized. Sensors and ancillary equipment must be robust, reliable and easy to retrieve. Lost or faulty sensors mean lost data, and potentially lost business for companies like Partrac, who are required to deliver accurate data to their clients on time.

This was Partrac's first deployment of the Signature250 in the configuration used, so Nortek ensured the team was well supported with advice, as well as channeling feedback to Partrac from others operating in similar environments.

Pete Wilson says he hopes his company's work will help drive forward the offshore renewables sector in Europe. "The data and the advice we provide is critical in both the early-stage site feasibility and consenting stages and later during the engineering process," he says.

Technology partners such as Nortek have a key role in supporting the exploitation of new sources of renewable energy – their collaboration is critical to the future success of the wind industry.

Floating wind is a niche technology, but it is quickly gaining traction. The GWEC estimates floating wind generation capacity globally could rise to over 6GW by 2030, compared to less than 0.07GW in 2019. Growth could be a lot higher than that if development costs decrease – a likely prospect, as the efficiency and size of turbines increases and companies gain more experience in building floating wind farms.

Nortekâ€™s Signature250 in the accompanying subsurface buoy is simply lowered into the water using a winch deployment from the back of the vessel.