Riding the waves of progress

It's no secret that wind turbines are growing in stature and wind farms are developing further and further offshore. So PES was delighted to have the opportunity to speak to Katja Roose, Sales and Marketing Manager at Radac, to find out how it is serving the market, with multiple wave radar and beyond.

PES: It's very good to catch up with you again. In the past we've focused on floating offshore wind and the Tetraspar project. Perhaps today would be a good opportunity to talk about offshore wind farms more generally?

Katja Roose: Of course, it's my pleasure. Offshore wind is front of mind in many countries nowadays. Unfortunately, this is partly forced by external factors like climate change and war. But regardless, we are happy to play a part in the energy transition and to a better world.

Our four key focus areas are offshore wind, offshore oil and gas, vessels and ports. Within these sectors, offshore wind, both fixed and floating, plays an important role in our developments and is our biggest market. The Tetraspar project was one of our kick off projects for floating turbines, and we now serve many floating wind projects around the world.

PES: Since offshore wind farms are getting larger and further offshore, the need for accurate wave data has changed. What is Radac's solution to support users on wave assessment for these large wind farms? And is it possible to combine several of your systems?

KR: Absolutely. Actually, we see a multiple wave radar application in almost all new European wind farms nowadays and we strongly advise this. As offshore wind farm operators and contractors are aiming for the highest efficiency possible and to make optimal use of the weather windows, real time information of the sea state in a wind park is crucial. We see the demand for more and more detailed data increasing.

Years ago, because of the lack of suitable systems, a single wave height radar would be installed in an offshore wind farm. With the introduction of the directional wave radar, we saw the shift of those single systems towards directional ones. It became a replacement for the buoy when there was a suitable construction available to install the system.

Nowadays, wind farms are growing bigger and are located further offshore. As the cost increases with the greater distances, so does the impact of sailing out for nothing, and along with it the importance of real time wave data. Also, as the turbines are growing, the financial impact of a nonfunctional day increases. An investment to increase the insight of suitable weather windows becomes even more interesting and cost efficient.

PES: Can you explain a little more about how that works?

KR: Often it turns out that there can be quite some difference in the sea state between the different sides of the park. Firstly, this is because of the increasing size of the wind farms. But it also has to do with the bathymetry of the seabed. Due to sandbanks, ridges and edges at the sea bottom, the effect on the waves can be substantial.

By installing multiple systems across the park, you get a better and more detailed view of the wave system in the park. Especially on critical days, you can have differences on other sides of the park which makes it suitable to operate on one side and unsuitable on the other.

PES: Beside the increase in operational efficiency, are there other reasons to install multiple wave radars in a wind farm?

Katja Roose

KR: Actually, the need for structural analysis of the turbines is an even bigger driver behind the need for multiple wave sensors in the park. Due to the growing size and capacity of the wind turbines, stress and fatigue analysis are getting more important. To be able to do these analyses, the actual wave data at the location of the turbine is of great value. Typically, we see five or six wave radars spread over a park.

Radac plays an important consultancy role in this case. Together with the client, we check the map of the wind farm for the main wave direction and currents. This indicates the first two or three locations for the sensors. The other sensors will be installed on the turbines which have the sensors for the structural analysis installed.

PES: How do you see the market for real-time wave monitoring develop?

KR: The more activity offshore, the more data is needed. The bigger the turbines, the more important the structural analysis becomes. The larger the wind farms, the more measurement locations are needed.

PES: How can technology be utilised to enhance operational efficiency, reduce costs and prevent workability issues offshore?

KR: Often clients tell us about their experiences with the wave sensor, especially when it was crucial to them. For example, there was one situation at an offshore vessel, where it was unable to work for one day because the DP system couldn't keep the vessel at the right position for landing on a turbine. The crew

interpreted this as unsuitable conditions for the operation. Afterwards, the client confronted the contractor with the suitable forecasts for that day.

It turned out that the wave sensor on board showed suitable conditions. Had the crew had access to this wave data, they probably would have found out that the DP system was in the wrong setting, which they just overlooked. Human error in this case, but the availability of this technology on board could have prevented the situation.

PES: Are there new technologies coming about, perhaps as a result of these changing demands?

KR: It's in our DNA to continuously develop and improve our systems and products. It's hard for us to say no to a request. So our products are designed in cooperation with our clients. This is how the wave radar for floating turbines came to exist, for example.

Recently, we added two new features to our directional wave radar: 2D wave spectrum and surface current. The availability of this data is not new to the market, but certainly a very nice add-on to our directional wave sensor, which is already a very unique system for the wind farms.

The 2D spectrum is the distribution of wave energy for ocean surface waves with frequency and direction. It tells you whether or not there is a secondary wave system active, which might be difficult to spot by eye. The visualisation gives you an immediate feeling of the circumstances at sea. Such difficult to spot swells might significantly affect your operational capabilities. In the case of boat landings for example, it's easier to handle higher waves when they all come from one direction, than a combination of lower wave systems from two directions.

The other new feature is the availability of surface current. Surface currents are a key meteorological and oceanographic parameter for the offshore energy industries. Reliable quantification is a primary requirement in all stages of a project life cycle, including survey, engineering design, installation, operations, maintenance and decommissioning. Think about the safety aspect when looking for the blow-off-drift-off conditions for a crew transfer to the turbine. Both waves and surface currents are often large forces that a CTV or OSV vessel needs to account for.

PES: What do you think the future holds for the industry and the possibilities for technology to be embraced?

KR: Well, I think we're still at the start of the potential of offshore renewable energy. Developments go fast and people are innovative. Scaling up wind farms, floating turbines and other renewables are just the beginning. Hopefully, the current situation in the world won't push us to revert to outdated energy sources.

If you ask me to sketch the future? I see large offshore wind farms with floating platforms supporting kites high up in the sky generating huge amounts of power. Of course, every platform should be equipped with our accurate wave sensors. But without joking, I truly hope that Radac can contribute to all these developments offshore by providing the most advanced and accurate sea state data for safe and efficient operations offshore.

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The sea often has two types of waves relevant to offshore operations; swell and wind-waves. Swells are waves that originate from remote areas like distant storms. Due to their large wavelength they travel fast and can cover several thousands of sea miles before they dissipate completely.

Wind-waves are generated by the wind at the sea surface, and present different patterns. Wind-waves tend to have a larger directional spread and are thus regarded as short-crested, i.e. they travel in different directions.

Generally, the sea is assumed to consist of both wind-waves and swell, or either one of them. When the wind starts to generate waves in one direction, in an area where swell travelling in another direction are present, the sea is typically also termed bi-modal, which implies that the spectrum exhibits two distinct peaks in either the frequency plane or the directional plane, or both. This is even more pronounced for a seaway consisting of two groups of swell travelling in different directions. [Björnsson, 2013].

About the company

Radac is a family business founded 25 years ago by Tom van der Vlugt, a pioneer and innovator. Together with his colleagues he wrote the SWAP method (Standard Wave Analysis Package) for the Dutch Directorate-General of Public Works and Water Management (RijksWaterstaat). Afterwards he developed his first wave radar and Radac was formed.

Driven by curiosity and the urge to create new things, the foundation for all our products was laid. Even the directional system, in no way ready to go to market yet, was already designed in the early days of the company.

In 2016, Tom's son, Rolf van der Vlugt took over. Rolf has a background in Aerospace Engineering and worked on a promotion project with Wubbo Ockels at the TU Delft in the Netherlands, developing a system to generate energy with the use of kites at high altitude, also known as Kitepower.

Together with his partner, Katja Roose, he pushed the company to the next level. It's not a coincidence that both are so passionate about the sea. Both were kitesurfing at the highest level for a long time. Katja became three times World Champion and set the Dutch outright speed sailing record for women. Rolf won a World Cup and several European events. As a team they travelled the world, trained and partly developed their own equipment.

Waves and water are literally part of their lives; both in kitesurfing and in Radac.