Installation and maintenance of offshore wind parks requires the highest accuracy and safety

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Advanced weather awareness optimises asset management

INSTALLATION AND MAINTENANCE Monitoring the meteorological conditions with the right equipment optimises offshore wind farm installations and maintenance operations, writes Mikko Nikkanen, head of Maritime at the Finnish specialist in weather, environmental, and industrial measurements, Vaisala

As the global offshore wind energy industry moves further out to sea because prime resource locations closer to shore are already occupied, offshore wind farm development faces a number of operational challenges that extend beyond the assessment of offshore wind resources to the transportation, installation, maintenance and service of wind turbines. Project owners and constructors are looking for ways to mitigate weather-related risks and optimise installation and maintenance operations with advanced weather insights.

While measuring what the wind is actually doing is critical to the success of any offshore wind farm, turbine blades are growing larger and already reach heights of up to 200m above sea level to capture the available wind resources effectively and produce as much electricity as possible. However, the construction and maintenance operations at these heights also becomes more challenging in terms of weather impacts, such as wind bursts, thunderstorms and lightning.

Most offshore wind farm installations are carried out by specialised ships that must be hired for the duration of the construction operation: wind turbine installation vessels (WTIVs). WTIVs are massive vessels capable of carrying the onboard crane and lengthy component parts necessary to build 150m-plus turbines, from the port to the installation site. These jack-up vessels are equipped with legs that reach down to the seafloor to steady the ship and lift it up out of the water so it can serve as a stable platform while avoiding direct wave impacts during installation.

The immense demand for offshore wind means not enough WTIVs exist to support the rapidly growing market. Renting a WTIV can cost USD 20,000 per half-hour, and up to USD 300,000 per day, and building a new vessel for this application

comes with an enormous price tag of up to USD 500 million. Minimising downtime is critical.

Not only are WTIVs limited in availability and costly, but meteorological and oceanic conditions are also noticeably more unforgiving in deeper waters. Before any electricity is even generated, WTIVs have to contend with the elements to maximise the value of an offshore wind farm. Wind farm locations are determined by the likelihood of strong winds on a daily basis, and while strong winds are vital to the success of offshore projects, wind and weather generally can have a significant impact on the ability of operations teams to install and maintain wind turbines in the most efficient, cost-effective and safest manner possible.

Strong winds have the potential to endanger crew safety, seriously delay installation operations and prolong construction times, costing millions of dollars in downtime and repairs, and posing a significant safety risk to everyone involved. In addition to strong winds, waves can destabilise both semi-submersible and fixed platforms. Other meteorological conditions can dramatically prolong the duration of wind farm construction.

In fact, a study revealed precipitation, freezing cold temperatures, and rain, fog, snow or other obscurants can create serious delays [1]. Furthermore, as extreme weather events involving lightning happen more frequently, the potential for damage to wind energy infrastructure increases. With crane lifting operations at greater heights attracting lightning, the likelihood of a safety hazard, fire or explosion increases.

Determining whether it is safe to have a crane lifting turbine components, crew members installing blades, or a helicopter transporting maintenance crews and/or replacement components to the site depends on the wind, lightning, waves, visibility and other meteorological conditions at any given moment. Turbine installation is weather-critical and the process can take up to five days for each individual turbine, so if installation takes longer than anticipated, the added daily cost of hundreds of thousands of dollars is often untenable.

As a result, project owners and constructors are minimising the threats strong winds and inclement weather conditions pose to operations staff and a project's budget by leveraging localised meteorological and forecast information and the latest innovations in advanced weather sensing technology.

Optimising operations while minimising risks

Mitigating the impacts of wind, thunderstorms, sea state and visibility effects is essential to construction and maintenance operations, but without accurate and reliable weather information, ameliorating the challenges inclement weather conditions create effectively is next to impossible. From the latest wind lidar and helideck monitoring systems (HMS) to global storm-sensing networks and weather sensors, offshore weather awareness improves operations, avoids costly delays and increases safety.

Reliable and easy-to-deploy and position almost anywhere on a vessel, wind lidars measure wind speed and direction at a range of heights simultaneously to deliver a holistic view into how winds are blowing up to 300m above WTIVs, covering the full rotor sweep of even the largest offshore turbines. During craning and mounting operations, lidar helps ensure the proper timing for cranes to lift turbine components on offshore location or at loading port, improving safety and situational awareness.

In addition to wind speed and direction, the weather sensor technologies integrated into HMS, including barometer, temperature and humidity probes, visibility sensor, cloud sensing ceilometer and wave measurement radar, can help ensure effective flight planning and safe landings on offshore installations. HMS are often required according to the CAP 437: Standards for offshore helicopter landing areas.

Calm weather conditions are to be favoured for the installation and maintenance of offshore wind parks

Modern HMS are frequently equipped with software that includes a real-time data display, reporting tools and critical alarms, ultimately enabling operators to make more informed decisions during critical weather situations.

A global lightning detection sensor network identifies thunderstorms in real time, tracks their trajectory and intensity, and supports hazardous weather warnings. By delivering accurate and dependable lightning information for warning applications, lightning detection networks can help minimise lightning-related safety concerns before or during the transport of helicopters and operations crews to and from offshore installation sites. Early warnings allow project operators to anticipate a lightning threat more accurately before it poses a problem, thereby helping keep workers safe from strikes while reducing the duration of safety shutdowns.

Offshore weather awareness systems utilising the latest innovations in advanced weather sensing technologies are vital in the following tasks:

- Alerting decision-makers on board before sudden winds or thunderstorms hit, allowing advanced time to secure cranes and position vessels for safety;
- Providing helicopter pilot and traffic control with accurate weather and sea state information 24/7;
- Optimising the maximum weather window for safe and efficient wind farm accessibility during installation and for longer-term maintenance operations;
- Increasing crew and asset safety with early alerts;
- Minimising downtime and delays;
- Making improvements and updating protocols at offshore sites, which enhance safety and decrease damage and downtime;
- Improving weather transparency between project owners and constructors.

From worker injury/death to crane and turbine damages, halted crane activity and increased delays, severe weather, strong winds and lightning all pose serious risks to WTIVs, helicopters and supporting vessels and ports. Clearly, having more reliable weather window estimates and weather information is critical to wind farm construction and maintenance operations. ›

From the WindCube Offshore wind lidar to Vaisala's Thunderstorm Manager, Global Lightning Detection Network GLD360 and Helideck Monitoring System (HMS), wind farms and other offshore projects have for years trusted weather management systems from Vaisala to meet their evolving needs.

Maintaining safety and performance while minimizing damage, downtime and liability requires new tools and techniques as the wind industry keeps moving into harsher environments with increasingly challenging weather conditions. Because the safety of employees and assets is critical, monitoring the meteorological conditions that impact daily operations with wind lidar, HMS and lightning detection sensor networks truly optimises wind farm installations and maintenance operations, maximising the value of offshore projects.

Reference

[1] https://www.sciencedirect.com/science/article/pii/S209267821630437X

Thunderstorms and other severe weather conditions may impact the safety of offshore wind parks

Plans for second offshore wind port in Massachusetts

COMMONWEALTH WIND | A public-private partnership has been set up to develop Massachusetts' second offshore wind service hub in Salem. Subject to State of Massachusetts approval, Vineyard Wind intends to develop the Salem site to provide an offshore wind port on the state's North Shore. A purpose-built terminal has already been established at New Bedford on the state's South Coast.

The agreement, part of the "Commonwealth Wind" proposal, is contingent upon the company winning an award by the State of Massachusetts, which is currently evaluating offshore wind procurement bids.

Partners in Vineyard Wind – Avangrid Renewables and Copenhagen Infrastructure Partners – have entered into an agreement with the City of Salem and Crowley Maritime Corporation to redevelop the port site, creating an estimated 900 full-time-equivalent job years.

Lars T. Pedersen, Vineyard Wind CEO, commented: "As offshore wind continues to expand, new purpose-built ports will be key to the success of this industry. By constructing the nation's first purpose-built offshore wind port in New Bedford, Massachusetts has been leading the way. With a new offshore wind port in Salem, the Commonwealth can ensure that it is ready to face the demands of a rapidly growing industry.

"With both New Bedford and Salem capable of delivering port operations needed for offshore wind," Pedersen continued, "the state can ensure that both the South Coast and the North Shore can benefit from the creation of new, highly skilled and good paying jobs, something that will cement Massachusetts' position as a leader in the new and growing offshore wind industry."

The terms of the proposed agreement set out that Crowley's newly established subsidiary, Crowley Wind Services, will buy the 42-acre site surrounding Salem Harbor Station that is currently owned by Footprint Power LLC. It will also become the long-term operator of the offshore wind port. Avangrid Renewables and Copenhagen Infrastructure Partners will become the port's anchor tenants.

Avangrid Renewables' head of Offshore Wind, Bill White, said: "This partnership is a great example of how sites that once supported coal can be transformed into sustainable infrastructure to support the vital clean energy transition. Commonwealth Wind is a transformational project that will create good jobs, economic opportunity, and clean electricity for Massachusetts, facilitated by this important partnership with the City of Salem and Crowley."

President Biden's Administration has placed new emphasis on offshore wind as a source of sustainable power. Block Island, the country's first offshore wind farm located off Rhode Island, was established by Denmark-headquartered Ørsted and commenced operations in December 2016. Although there are plans to develop offshore wind off both US coastlines, the relatively shallow waters of the north-east offer suitable sites for fixed-bottom installations in the near term.

The US Bureau of Ocean Energy Management recently announced plans for up to seven new offshore wind lease sales by 2025. Auctions are planned for various areas – Gulf of Maine, New York Bight, Central Atlantic, Gulf of Mexico, North and South Carolina, California, Oregon – as part of the Administration's target of installing 30 GW of offshore wind infrastructure by 2030.

Rendering of the new site

Source: Crowley Maritime Corporation