The construction and maintenance of offshore wind farms requires several kinds of specialist vessels.
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Driving Development

Increased offshore wind farm activity is helping to grow the specialist vessel sector

BY WEI HUANG

Demand for wind farm support vessels in the United States is set for a boost from an increase in construction projects for both fixed and floating offshore wind farms off the east and west coasts, the Great Lakes, and Hawaii. The United States Department of Energy recently stated that offshore wind power could reach 22 gigawatts (GW) of installed capacity by 2030 and 86 GW—roughly equal to current U.S. capacity of onshore wind—by 2050.

The construction and maintenance of offshore wind farms calls for a combination of expertise that is comparatively new to the U.S. market and requires a variety of specialist support tonnage. These include jack-up construction units, survey vessels, service operation vessels, cable laying ships, and crew transport craft. My organization, ABS, is well positioned to support this trend. By providing asset classification and advising on regulatory and operational issues, we're able to put our global experience in offshore energy and power projects at the disposal of project developers.

Developing market

The most mature offshore wind farm markets can be found in Europe and Asia, which both have developed the capability to support increasingly large projects over a period of decades. So far, the U.S. is home to a single offshore wind farm installation—Block Island, which provides 30 megawatts (MW) of capacity. However, several states have plans in hand.

Massachusetts aims to install 1.6 GW of offshore wind by 2027 with projects including Vineyard Wind Farm, which features 100 turbines of 8 MW each on track to start construction in 2019. The same state's Baystate Wind project is in the concept/early planning stage with the first power due for delivery in the 2020s. Local construction on the Revolution Wind project could start in Rhode Island in 2020 with commercial operations by 2023. The 750 MW 187-turbine Maryland Offshore Wind Project will be constructed over three phases, with the first phase scheduled for completion in 2020. In New York state, Equinor Empire Wind plans one hundred 10-15 MW turbines to supply power by 2030. To meet required efficiency demands and reduce project costs, these projects will see single turbine size increase from the typical 4-8 MW capacity up to 10-15 MW, such as the turbine of 12 MW capacity recently announced by General Electric.

Developers of offshore wind farms face a number of challenges in addition to the environment in which they

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The most mature offshore wind farm markets can be found in Europe and Asia.
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are constructed. These include the regulatory regime that lays out strict rules on cabotage trade and safety requirements that encourage the concept of "walk to work" for technical teams working on the construction and during subsequent maintenance. New wind farm development also is driving the flexibility of vessels that support installation, operation, and maintenance, with construction jack-ups typically of four-leg design rather than the familiar three in the oil and gas sector.

A wind farm service operation vessel (SOV) is a unique purpose-built vessel for the deployment and accommodation of offshore support and maintenance engineers. The SOV is highly adaptable, operating as a means of transport, but is also a hotel, a warehouse, and a workshop. It transports large quantities of supplies, equipment, and tools.

An SOV has onsite work and storage facilities plus accommodation for maintenance personnel, management, and crew and it must be able to undertake voyages and stay on station for several weeks at a time using dynamic positioning. It also will be equipped with a motion-compensated transfer gangway to enable maintenance personnel to walk between the vessel and offshore structure.

In comparison to traditional offshore wind service operations using crew transfer vessels (CTVs) or helicopters, an SOV promises a range of operational benefits for both wind farm operators and service teams. These include enhanced safety and comfort for technicians, accelerated onsite service, increased weather availability, and improved productivity for the project. SOVs offer increased operational flexibility through the ability to include modular accommodation modules on the deck area—making them suitable for multiple offshore construction projects, potentially including conventional oil and gas developments.

The biggest safety challenges in offshore turbine service work arise from the use of CTVs, which are the traditional means of transferring technicians to and from the wind turbines. The gangway system (which employs motion compensation technology to keep it in a fixed position relative to the turbine) reduces the risk in crew transfers, can operate in almost any weather conditions, and can cope with high wave heights.

However, the main advantage that an SOV offers is the ability to concentrate skills and resources. Because the service team and technicians can be based offshore, no additional travel time to or from the wind farm is necessary. With warehouse space immediately below the main cargo deck, an SOV carries almost every spare part that a project requires in order to respond quickly to component failures and minimize turbine downtime. In addition to the hydraulic gangway arrangement, an SOV provides further flexibility by acting as the mothership for additional crew transfer boats, which can also be used to move technicians to and from the wind turbines in a range of different weather conditions.

Meeting regulations

U.S. cabotage law (the Jones Act) requires any vessel transporting people and cargo between U.S. ports be built and flagged in the U.S. Under the terms of act, a fixed offshore wind farm is considered a U.S. port. For the Block Island wind farm project, all vessels were Jones Act-compliant except the wind turbine installation vessel, which is exempt provided that it remains onsite and does not move people or cargo.

The capacity exists within the U.S. shipbuilding sector to construct new assets, with shipyards that previously built conventional OSVs adapting designs and experience to SOVs. Operators also may choose to convert some of the existing idle OSV tonnage by adding modular accommodation, workshop capacity on the cargo deck area, or offshore access gangway. With the ramp-up in large scale offshore wind projects following the completion of Block Island and increasing demand for high quality construction assets, we may also potentially see the construction of a Jones Act-compliant jack-up installation vessel.

Vessel conversions or newly-constructed assets would also have to be compliant with the U.S. Emission Control Area, so owners could choose to employ conventional low sulphur fuel or investigate alternatives such as hybrid battery power or LNG as fuel, both of which are proven in the Gulf of Mexico.

Following on from its classing of the first LNG-powered OSVs for Harvey Gulf, ABS has classed the first OSV in the Gulf of Mexico to operate using hybrid power. SEACOR Marine requested the ABS BATTERY-Li notation for SEACOR *Maya*, currently operated by MEXMAR, its joint venture in Mexico. Modifications to the OSV were completed in May 2018, upgrading SEACOR *Maya* to use lithium battery power, a hybrid power solution that has the potential to reduce fuel consumption by as much as 20%.

Local construction on the Revolution Wind project could start in Rhode Island in 2020 with commercial operations by 2023.

While integrating new technologies is complex, SEACOR was able to realize the benefit of using cutting-edge hybrid power by working with ABS to class the lithium battery system and help demonstrate its viability. The storage system is designed to keep the generators running at between 75% and 80% of the maximum continuous rating. At higher power demands, the batteries supply power and, at lower power demands, the generators recharge the battery.

The Corvus batteries are enclosed in a 20 ft. container with a weight of approximately 28 tons. When the system is operated by MEXMAR's experienced crews, charter clients are expected to benefit from a reduction in fuel oil consumption and emissions. SEACOR also expects the electric-hybrid propulsion system to result in quieter ship operations for both the crew and the external marine environment.

Assessing this type of system is a complex process. The system enables the use of alternative energy sources, which can store energy as a backup for the main power source. Part of their attractiveness is that they can enhance safety by allowing a response to emergency scenarios where all main power is lost. The operational savings gained from a hybrid power solution also will reduce emissions and facilitate compliance to environmental regulations. A further three SEACOR vessels will be upgraded with a hybrid battery package later this year. Having proved the concept with a conversion of an existing vessel, SEACOR Marine also recently signalled its intention to install the hybrid propulsion technology onboard six additional vessels that it has under construction at COSCO Heavy Industries in Guangdong, China.

ABS's experience in the construction vessel sector also includes classification of *Seajacks Scylla*, the world's largest and most advanced wind farm installation and offshore construction vessel, constructed by Samsung Heavy Industries in South Korea. Based on the Gusto MSC NG14000X design, *Seajacks Scylla* has more than 8,000 metric tons of flexible, variable deck load. Equipped with a 1,540-metric-ton leg-encircling crane and a usable deck space in excess of 5,000 m^2, the unit is outfitted with 105 m legs with the ability to install components in water depths to 65 m. The rig is capable of meeting the installation needs of jumbo monopiles, jackets, and turbines of future wind farms in deeper waters further offshore.

Seajacks Scylla complies with ABS classification requirements for self-propelled jackup units, including DPS-2 for dynamic positioning capability as well as notations for automatic centralized control unmanned units and crane register certificate.

Supporting innovation

We're also playing a role at ABS in supporting the development of innovative concepts for future floating wind farm projects. Late in 2017, we completed the design review of the front end engineering and design for the University of Maine's floating offshore wind turbine concept, VolturnUS.

The patented VolturnUS, developed by the University's Advanced Structures and Composites Center, is based on a concrete four-column semi-submersible hull concept. In 2013, the University of Maine team successfully tested the feasibility of the concept by developing a 1:8 scale model and deploying it offshore Maine.

The current pilot project consists of two full-scale semi-submersibles, each with a 6 MW turbine that are designed to be onsite for 20 years. Both units will be connected to the Maine power grid by subsea cables. **MT**

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