MacGregor technologies propel **offshore wind energy production**

MacGregor technology is supporting the renewable fuel economy through novel innovations geared towards advancing commercially viable, ecologically sustainable wind power systems

The renewable energy sector has seen a number of significant developments in recent years; advances that are helping to provide greater global energy security. With an abundance of space and plentiful resources, offshore wind farming is one aspect of renewable power-generation that encourages the development of innovative solutions for environmental engineering.

Offshore wind speeds tend to be higher and less variable than on land and any increase in speed of only a few miles per hour can significantly strengthen the amount of energy produced.

By the end of 2016, Europe commanded approximately 88 percent (12,631 MW) of all offshore wind installations with the remaining 12 percent comprising China, Japan, South Korea and the United States.

Currently, numbers stand at 14,384MW of installed offshore wind power capacity in 14 markets worldwide. According to the Global Wind Energy Council (GWEC), 2017 is forecast to surpass 2015's record total, with roughly 60GW of additional installed grid-connected capacity globally; 3GW is scheduled to be installed across Europe alone. This figure is predicted to rise to an annual market total of around 75GW in 2021, resulting in a combined worldwide total of 800GW by the end of the year.

The substructures (pictured) of Hywind's five new 6MW floating wind turbines will each feature a Pusnes substructure mooring connection system

Photo: Nils Petter Midtun/Statoil

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>
> Jan Martin Grindheim

Capitalising on a growing market

Today's widespread focus on a more diverse energy mix to reduce emissions is conducive to greater offshore wind opportunities across the world and as such, the global market forecast is promising. According to market analyst Westwood Global Energy Group, the UK, Germany and China are expected to spearhead future offshore wind spend, collectively accounting for 39 percent of the EUR 402 billion total global capital expenditure (CAPEX) over the next decade; a result of increased installation activity and investments in new European projects.

The Group forecasts a peak CAPEX of EUR 47 billion for 2020, propelled by emerging markets in Europe (including France, Sweden, Denmark, the Netherlands and Poland), the US and South Korea. It also predicts that between 2017 and 2026, these markets will contribute more than 14.5GW of additional capacity; a CAPEX of EUR 69 billion.

Winds of change

MacGregor continually strives to foster new approaches to support the renewable energy industry. At the end of 2015, it made the notable shift into this sector when it secured an order to supply mooring systems for the world's first floating wind farm; Statoil's 30MW Hywind pilot wind farm, in Scotland, UK.

Following six years of testing and a successful demonstration project off the coast of Norway, the floating farm has reached its final destination; an area known as the Buchan Deep – 25km off the coast of Peterhead in Aberdeenshire, Scotland.

All MacGregor's Pusnes substructure connection mooring systems were delivered to the site in 2016, in preparation for the installation of the five wind turbines. "The offshore installation of the last wind turbine was completed in mid-August," says **Jan Martin Grindheim**, Director, Floating Solutions at MacGregor. "Our equipment met all expectations and the installation process went smoothly."

The Hywind pilot farm is now operational, powering up to 20,000 households in the UK. "This contract represents a step change for MacGregor in terms of entering a new industry sector," adds Mr Grindheim.

"The project hinges on applying proven technology in new applications," he continues. "MacGregor was chosen for the task because of its long history of designing and delivering very reliable mooring solutions for offshore floating production units operating in harsh North Sea conditions."

Hywind is designed to demonstrate cost-efficient solutions that will enable the commercial capture of wind energy in harsh environments. MacGregor was contracted to deliver a Pusnes substructure mooring connection system to each of

the pilot project's five new 6MW floating wind turbines. The ballast-stabilised turbine structures are each equipped with a three-point mooring system employing site-specific anchors.

The wind farm covers an area of approximately 4.2km² and operates in waters over 100m deep, with average wave heights of 1.8m. Wind speeds in the area are roughly 22mph (10m/s).

Turning the tide on energy efficiency

Despite the abundance of offshore wind energy, lowering the levelised cost of this type of energy capture and also smoothing any fluctuations in its power-generation profile is the ultimate aim for an energy supplier.

Continuing its participation in innovative projects, in 2016 MacGregor won a contract to supply highly-specialised winches for use in the Nemos enterprise, an innovative project that uses established offshore substructures, such as wind turbines, to anchor specially-shaped floating structures that capture up to 80 percent of available wave energy.

The Nemos floating structures are approximately 20m long and are moored using two fibre ropes controlled by MacGregor winches. They move in a controlled trajectory, delivering the optimum degree of movement to maximise energy capture.

Following several years of initial endurance and performance testing, the first commercial Nemos pilot project was installed in 2016 at the Danish Wave Energy Centre (DanWEC) in Hanstholm, Denmark. Operations began in early 2017, with the project set to be fully operational by the end of the year.

Pioneering crane technology

Efficient construction coupled with regular maintenance and turbine inspections are paramount to safe and effective wind energy capture. MacGregor is at the helm of developing and delivering innovative technologies to support this industry.

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All five Hywind wind turbines are now operational

MacGregor recently introduced its award-winning 3D Motion Compensator (3DMC), a flexible retrofit device designed to enhance the load-handling precision of an offshore crane in challenging offshore environments.

The 3DMC compensates for the roll, pitch and heave motions of a vessel to minimise any movement of the load in relation to a fixed point in space. Therefore, during operations that require a greater degree of precision than that available from a standard crane, such as transferring equipment to or from offshore wind turbine structures or any small fixed platform, the operator can opt to use the 3DMC jib.

"A diverse range of load handling capabilities means that the crane and therefore the vessel can be used for more assignments and owners will be able to bid on a wider range of contracts," says **Geir Roland**, Director, Global Product Support at MacGregor.

The 3DMC comprises a main boom that can be hoisted, lowered, slewed and extended and is fitted to the knuckle-jib of new or existing MacGregor subsea/offshore cranes. It has been designed for easy installation and makes use of the existing hydraulic power unit and control system of the crane. The unit can also be swiftly mobilised to a crane with the relevant fittings. This allows the 3DMC to be shared within a fleet.

When not in use, the compensator can remain fixed to the side of crane's knuckle-jib to allow full operational use of main and whip winches.

The 3DMC uses similar motion-compensating technology as MacGregor's first-of-its-kind offshore three-axis crane, which gives extremely accurate load positioning.

"Turbine platforms are about 20m above the water and they are often only a few square metres, so precise load handling is necessary," Mr. Roland continues. ■

Photo: Roar Lindefjeld /Statoil

Strengthening solutions through strategic partnerships

Demonstrating its continued commitment to strengthening offshore solutions and drive to enable wide-ranging collaborative capabilities, towards the end of 2016 MacGregor acquired majority shares of Flintstone Technology – a UK-based specialist in advanced technology and products for the mooring and fluid handling industries.

MacGregor has a long and successful history of delivering capabilities that often exceed customer expectations, but sometimes the technology needed for specific requests simply does not exist.

"At this point, we can either embark on developing technology especially for the customer, which we have done many times in the past, or we search the market for those hidden gems, which is exactly what Flintstone is," says **Høye Høyesen**, Vice President, MacGregor Advanced Offshore Solutions.

"It has seen gaps in the market where offshore operators are seeking new or more advanced capabilities and has invested in highly-specialised technology that can make these operational wishes a reality," adds Mr Høyesen.

Initially established in 2012 as a product design consultancy in Dundee, Scotland, Flintstone Technology has since completed several projects and, in 2013, the company developed its first product; the buoy turret connector. In 2014, Flintstone won its first major contract to supply mooring connectors to two offshore energy developments in the North Sea.

"We are very happy to join MacGregor," says **Andrew Clayson**, Managing Director at Flintstone Technology.

"We are a small team with very competent and innovative engineers. We see great potential to add value for customers. We like to challenge existing solutions and look for ways to improve, exactly what MacGregor is renowned for. Becoming part of a bigger company also brings many benefits, both for customers and our employees," adds Mr Clayson. ■