

# Sheringham Shoal

by Scira Offshore Energy

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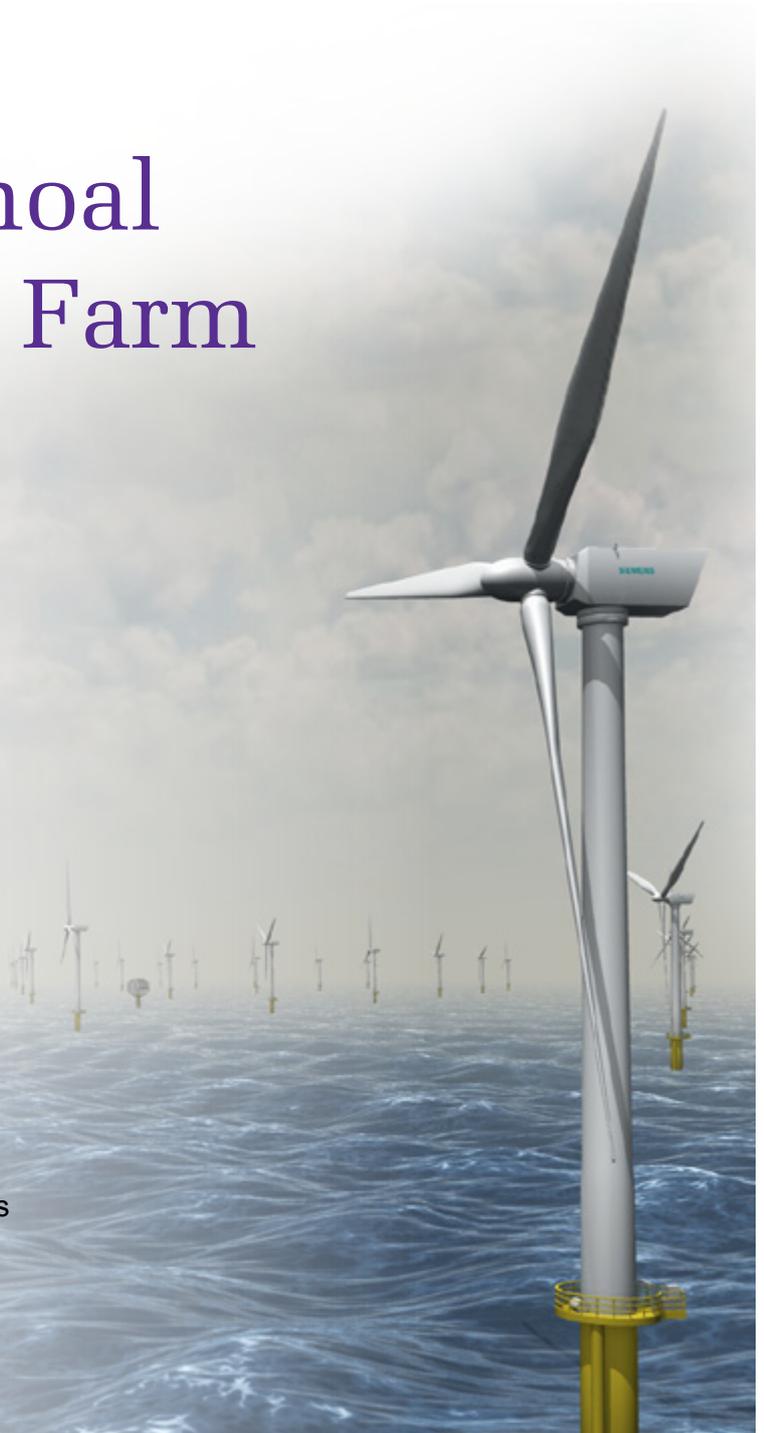
## Sheringham Shoal Offshore Wind Farm

The world needs more energy, and in future ever more of its energy supply will need to be obtained from renewable resources such as hydropower, waves and wind. With around 40% of the EU's entire wind resources available in British waters, it makes sense to harness the wind.

The 317MW Sheringham Shoal Offshore Wind Farm, located off the coast of North Norfolk in the UK, will comprise 88 wind turbines and generate around 1.1TWh per annum. This is enough clean energy to power almost 220,000 British homes. Compared to fossil fuels, it is a reduction of CO<sup>2</sup> emissions by 475,200 tonnes every year.

The project is now in its construction phase and will be fully-operational during 2012.

The wind farm is owned equally by Statoil and Statkraft through joint-venture company Scira Offshore Energy Limited. Statoil is the operator for the project during the development phase and Scira will be the wind farm operator. This project continues to draw on experience from Statoil's longstanding offshore activities and Statkraft's expertise in relation to renewable energy. It has also utilised the specialist knowledge of its key contractors and their supply chain, as well as local companies with local know-how.



# The start

The lease for the diamond-shaped 35 square kilometre site was granted as part of The Crown Estate's Round Two in 2004. It is located in the Greater Wash, between 17 and 23 kilometres (10-15 miles) off the Norfolk coast, north of the seaside town of Sheringham. Waters here are comparatively shallow at between 17 to 22 metres, wind speeds are high and consistent and access is good for both construction and the ongoing operation and maintenance phases.

- The wind farm is now under construction and comprises:
- 88 turbines (3.6MW Siemens)
  - two offshore substations
  - two 132kV submarine export cables of about 22km each
  - a 21.6km onshore cable and new inland substation at Salle, Norfolk

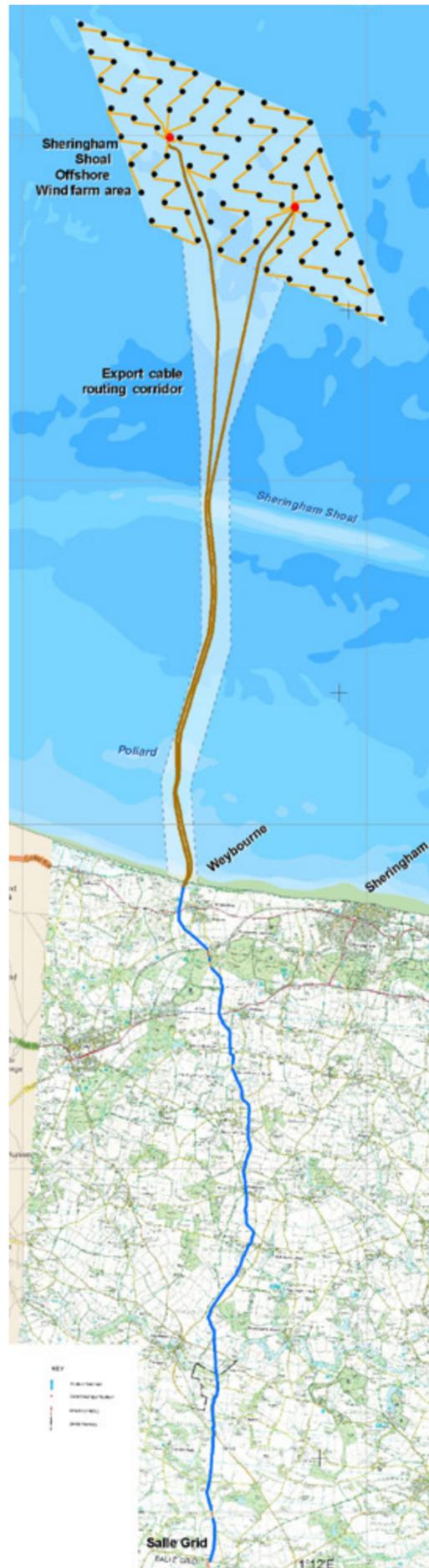
# Wind farm construction

Construction work on the Sheringham Shoal Offshore Wind Farm site began in March 2010 with the arrival of the 164m "Nordnes" vessel, to place rocks at selected foundation locations in preparation for the start of the installation of the giant monopile structures.

Using a precision technique, the "Nordnes" placed 3 to 9 inch filter rocks in a 'donut' shape around the site of 79 of the 90 foundation locations to reduce the likelihood of scour and protect the cables when they are installed.

Scour protection is needed for wind turbine foundations, as well as other types of marine structures, due to changes in water flow patterns that may cause a lowering of the seabed immediately surrounding them. Variations in the condition of the seabed at the Sheringham Shoal foundation locations mean it is only needed at those sites where erosion is most likely.

Dutch company Van Oord was contracted to carry out the first phase filter layer work. After the foundations have been installed, a second phase of scour protection will be required in which larger rocks will be placed in the same pattern to act as armour to the filter layer.



# Foundation installation

The installation of the foundations for the Sheringham Shoal Offshore Wind Farm began in June 2010.

These 90 giant monopile structures, as well as the transition pieces which join the turbines to them, were fabricated in by the Sif group at its plant in Roermond in the Netherlands. The transition pieces were transported to Belgium to the Hoboeken plant of the offshore foundation pioneer, Smulders, for outfitting.

Each foundation consists of a tubular steel monopile, driven 23-37m (75-121 feet) into the seabed, and a bright-yellow transition piece mounted on top. The monopiles are between 44 and 61m long and weigh from 375 to 530 tonnes while the transition pieces are 22m high and weigh about 200 tonnes each.

The state of the art crane vessel crane Oleg Strashnov is being used by Seaway Heavy Lifting Contracting to collect foundations and transition pieces from Vlissingen, bring them to site, where it is used to drive the foundation piles into the seabed, and mount the transition pieces on top. The foundations are placed around 700m apart.

The foundations arrive in a sequential order, and are installed in a pre-determined pattern, each one having been designed and fabricated specifically for its installation site.

# Turbine installation

The self-propelled, self-elevating jack-up barge, the GMS Endeavour, is being used to install the 88 turbines in the Sheringham Shoal Wind Farm. Each turbine consists of an 80m tower, the nacelle and three 52m blades. The first turbine was successfully installed in July 2011.

The turbines are transported by sea from Esbjerg to Great Yarmouth, Norfolk, from where the GMS Endeavour collects two turbines at a time, bringing them to the wind farm field for installation.



# Export and infield cables

The offshore cables have been produced by global cable experts, Nexans in Norway at their manufacturing plant in Halden, south of Oslo, while the fibre optical elements have been produced in Rognan, in the northern part of Norway.

The power and optical cables are bundled together into one unit. The installation of the two long export cables carrying the power from the wind farm to landfall was completed in late 2010. One is 23 kilometres long and the other 21 kilometres, with a weight of 77 kilograms per metre. That's a total weight of 3,388 tonnes!

The route of these export cables was agreed with the then Department for Business Enterprise and Regulatory Reform (BERR) and Marine and Fisheries Agency (MFA) as part of the wind farm's licence conditions. Factors considered included engineering feasibility, seabed geological conditions, sediment movements and the location of sensitive marine organisms and their habitats.

There are two different types of infield cables connecting the turbines and the offshore substations. Type one (27kg/m) has a total length of 26 kilometres and is used to connect the turbines closest to the substations, while type two (18kg/m) has a total length of 56 kilometres and connects the turbines further out.

# Offshore substations

The two large offshore substations, each weighing nearly 1,000 tonnes, were installed at the Sheringham Shoal wind farm in early May 2011. They were constructed by offshore construction specialist Heerema at its yard in Hartlepool in North East England following the award of a contract by ALSTOM. Each substation is 30.5 metres long, 17.7 metres wide and 16 metres high.

The substations were transported from Victoria Quay, Hartlepool aboard the barge Dina Launcher and then lifted onto their individual foundations. These had been installed into the seabed during Autumn 2010.



# Onshore works

In order to feed the electricity generated by the wind farm into the national distribution network, an onshore grid connection is required between the landfall point at Weybourne and the connection point in Salle.

The onshore grid connection project consists of two main components:

- a new substation adjacent to the existing UK Power Network substation at Salle,
- an underground cable system between Weybourne and the substation at Salle (approximately 21.6km in length).

Work on the onshore substation was undertaken by AREVA T&D UK and on the cable installation by Carillion plc. The cable system comprises six power cables, installed below ground in plastic pipes or 'ducts'. Fibre-optic cables for communication purposes have also been installed.

For most of the route, the cables were installed by open-cut trenching across cultivated agricultural land. However the route also crossed the local road network in 14 locations as well as local landmarks and areas of woodland. In these locations open trenching was not appropriate and a technique known as 'directional drilling' was used to install the cable ducts. This technique avoids, or at least minimises, any impact to the surface features.

From the new substation, the power is being transported to the local 132kV UK Power Networks distribution network connecting to the National Grid transmission network in Norwich.



## Construction timetable

|                |  |
|----------------|--|
| June 2010      | First foundation installed   |
| September 2010 | Submarine export cable installation                                |
| Late 2010      | Onshore substation commissioned                                    |
| Spring 2011    | Offshore substations installed<br>Start infield cable installation |
| Mid 2011       | Turbine installation begins  |
| Mid 2012       | Wind farm fully operational  |

# Operation and maintenance

When looking for an operations and maintenance base, Wells-next-the-Sea was the natural choice, being only around 20 nautical miles from the Sheringham Shoal site. There was just one key challenge – its limited accessibility due to tidal restrictions.

The project team began working with the Wells Harbour Master and Commissioners in 2008 to determine whether the tidal challenge could be overcome and this work has culminated in a dredging initiative that has created a new outer harbour and deepened the harbour entrance channel. With the extended tidal window, this project has enabled improved access to the wind farm. The depth of the channel will need to be maintained with regular dredging.

A new commercial outer jetty with pontoons has been constructed so the wind farm vessels will not interfere with established port operations. Scira and the Wells Harbour Commissioners have signed an agreement confirming that the developer will use the harbour as its wind farm operational base for up to 50 years.

Scira will have a large operational base just outside the town where wind farm workers will go every day to change for their offshore duties. A mini-bus will then transport them to the outer jetty where vessels will take them offshore, returning later in the afternoon via the same method. This is to ensure traffic in the town is minimised and additional car parking is not required.



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