THE PROJECT TEAM BEHIND HORNS REV 3

The team behind Horns Rev 3 met for the first time at a start-up meeting in Kolding in December 2016 and again at a team event in June 2017. The meetings were primarily of a professional nature, but there was also ample opportunity to get to know each other socially.

Nearly 50 employees in five countries are involved in the establishment of Horns Rev 3 and are working together closely to ensure the success of the project. The majority (28) are based in Kolding, whilst the remainder are distributed between Vattenfall's offices in Hamburg (8), London (4), Esbjerg (4), Stockholm (2), Berlin (1) and Amsterdam (1).

The employees have got together at two workshops/events in Kolding held at six-month intervals in order to get to know each other.

"Communication is the be-all and end-all. It isn't enough to be good at designing foundations. You also need to be able to communicate the different interfaces to your other colleagues. As a result, our workshops have combined strong technical content with a really good chance to socialise,"

says project director Jens Hansen.

TIMETABLE

2013 – 2014:
The Danish Energy Agency drafts an Environmental Impact Assessment (EIA).

2015 – 2016:
Vattenfall Wind Power is granted the concession on Horns Rev 3. Air systems, cable plants and substations are established on land and a submarine cable is installed at sea. The transformer platform is installed at the centre of the offshore wind farm area.

2017 – 2018:
Scour protection – a protective layer of stones on the seabed – is established in order to ensure that ocean currents do not erode the seabed around the foundations. The foundations are then driven through this layer of stone.

2018 – 2020:
Installation of wind turbine towers, engine housings and rotor blades. The wind turbines will be put into operation in phases and thus begin to produce renewable energy. Installation of the wind turbines and connection to the electricity grid are expected to be completed in 2019.

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HORNS REV 3 UPDATE

NR 1

DENMARK'S LARGEST OFFSHORE WIND FARM

HORNS REV 3 WELL ON ITS WAY
WHO DOES WHAT AT HORNS REV 3
TIMETABLE FOR CONSTRUCTION
MEET THE TEAM BEHIND HORNS REV 3

Foto: A2Sea

49 wind turbines
MHI Vestas
8.3 MW
Maximum height: 187 m
Rotor diameter: 164 m

Production
= electricity consumption of 425,000 households

Foundation engineering
Monopiles

Total capacity
406.7 MW
Annual production
1.7 billion kWh

Transformer platform
3300 tonnes
Converts voltage from
33 kV to 220 kV

HORNS REV 3

WELL ON ITS WAY

At the beginning of 2015 Vattenfall Wind Power was granted consent for the construction of what will be Denmark's largest offshore wind farm once complete by the end of 2018. Since winning the consent, our team of specialists in Germany, the UK, the Netherlands, Denmark and Sweden have been working hard to ensure that Horns Rev 3 will be a success. We have drawn up and followed a well thought out schedule that has enabled us to accelerate construction. As a result, this autumn we will already be in a position to begin driving the foundations down into the seabed for the wind farm's 49 wind turbines.

Since consent, with what was at the time the lowest ever kWh price of 77 øre – and also one of the lowest in the world in recent years – most of the work has been undertaken within our team of nearly 50 employees and by the project's subcontractors.

The only visible evidence of the wind farm at present is the three-storey high, 1800-tonne transformer platform, installed by Energinet.dk at the centre of the 90 km^2 wind farm area off the west coast of Jutland in 2016. 33 km of 220 kV submarine cable was installed in the seabed, from the transformer platform to the shore at Henne Strand, from where it was connected to 45 km of onshore cables and the electricity grid. Special

Foto: VBMS

vessels have – in addition to the job of laying the submarine cable – been frequent visitors to the offshore wind farm area.

- In August 2016 minehunters from Danish Defence detonated three unexploded naval mines by means of a remote-controlled unmanned mini submarine. The mines had been discovered the previous year during a geophysical survey of the seabed in the area.

- Subcontractor GeoSea (B) is charged with delivering the foundations, and in the early summer of 2017 the company installed scour protection at the points where the foundations will be driven into the seabed. Production of the foundations and transition pieces for the tower itself have been taking place during the summer, so that establishment of the foundations can commence at the end of 2017.

- Subcontractor VBMS (NL) is to install 33 kV cable connections between the turbines and the transformer platform, while Norwegian Seaproof will supply cable protection at the foundations. The cables are produced in Spain and Norway.

- Danish-Japanese MHI Vestas is delivering 49 V164 8.3 MW wind turbines, which will be the largest ever installed in Danish waters. The nacelle is being produced at Lindø Industripark, whilst the rotor blades are manufactured in Nakskov (DK) and on the Isle of Wight (GB). A2SEA (DK) will commence installation of the wind turbines during the summer of 2018.

The wind turbines will become operational in phases, with completion due at the beginning of 2019, when Horns Rev 3 will be up and running at full power.

Horns Rev 3 has represented a turning point in terms of making offshore wind power cheaper by means of new methods and larger wind turbines, in addition to optimisation of operations. Horns Rev 3 has thus shown the way towards a future scenario without the need for state subsidies. The project has also paved the way for Vattenfall's most recent success, which has involved acquiring the rights to construct a further three Danish offshore wind farms at Kriegers Flak, Vesterhav Syd and Vesterhav Nord respectively.

Welcome to the first edition of Horns Rev 3 Update

FACTS ABOUT HR3

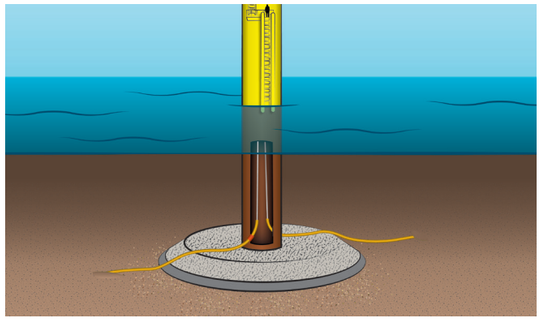
Denmark's largest offshore wind farm

Horns Rev 3 will have 49 wind turbines with a total capacity of 406.7 MW. Energy production corresponds to the annual electricity consumption of 425,000 Danish households. The wind turbines and transformer platform are located over an area of 70-90 km^2 that lies 20-40 km west of Houstrup Strand on the west coast of Jutland. The area is limited due to considerations concerning water depths, with the area chosen having depths ranging between 10 and 21 metres.

Foto: MHIVestas

MHI Vestas delivers 8.3 MW wind turbine

Horns Rev 3 will have 49 of the world's most powerful wind turbine model, MHI Vestas V164 8 MW, which is being upgraded to 8.3 MW. The wind turbine has a rotor diameter of 164 metres, thus sweeping out an area, or around 21,000 m2. The hub height is 105 metres and the nacelle is 20 metres long and measures 8x8 metres in height and width. The main bearings, clutch, gearbox and generator can be lifted out of the housing in connection with servicing and maintenance.



Reinforcing the seabed with stones

Using its special vessel, "Flintstone", subcontractor GeoSea has laid out a protective layer of stones and rocks on the seabed, known as scour protection. This protection is necessary, to prevent ocean currents from eroding the sandy seabed around the foundations. The first layer is 60 centimetres thick and has a diameter of around 35 metres. A one-metre thick reinforcement layer of stones is then laid. The foundations (monopiles) are driven between 25 and 39 metres down through the centre of the layer of stones.

From wind blowing across the sea to plug sockets onshore

Energinet.dk has the task of transferring power from Horns Rev 3 to consumers onshore. The plant consists of the transformer platform out at sea, to which the cables from the wind turbines are connected and the electrical voltage is increased from 33 kV to 150 kV. A 33-km long submarine cable transports the wind power to Houstrup Strand on the west coast. From here, this power is sent on to an existing transformer substation onshore.

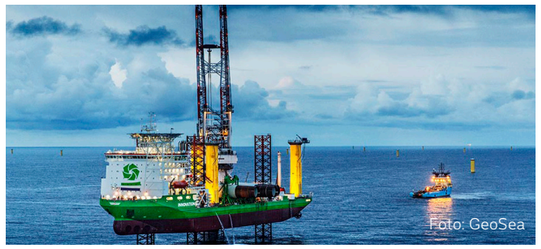


Foto: GeoSea

Foundation engineering with monopiles

GeoSea and its sub-suppliers are charged with the manufacturing, transport and installation of the offshore wind farm foundations. The Horns Rev 3 wind turbines will stand on a solid foundation of monopiles, which are driven down into the sea bed from a jack-up vessel. Each monopile is between 43 to 54 meters in length and weighs 410 to 610 tonnes. The monopile is then extended with a 32.3 metre long transition piece.

Foto: Prysmian

105 km of cables between the wind turbines

Sub-supplier VBMS is responsible for installation of the cables between the wind turbines and the transformer platform. A special agreement between DONG Energy and Vattenfall means that in addition to 105 km of cables between the wind turbines, an 8-km long 33 kV back-up power cable is installed between two wind turbines at Horns Rev 2 and Horns Rev 3 respectively. This cable ensures a back-up power supply to both offshore wind farms in the event of failure of one of the export cables running to the shore.