

Horns Rev

- a wind power station in open sea

Speak:

A group of wind turbine construction workers are going to work at "Horns Rev" on the west coast of Jutland. In the summer half of 2002, hundreds of men challenged the North Sea. They have built the world's largest offshore wind farm.

80 wind turbines are now standing tall above the sea. At the same time the farm is the world's first wind farm, as it is possible to regulate electricity production, which amounts to a maximum of 160 megawatt.

It is still more expensive to produce renewable energy – compared to ordinary electricity production. However, the fuel – that is the wind – is for free and non-polluting. The turbines are getting still larger and more efficient – They show the way to reducing global CO₂-emission.

The construction of the offshore wind farm is part of Denmark's climate policy. The work was initiated in accordance with an instruction by the Danish government for the power producer Elsam and transmission system operator Eltra. Elsam has erected the turbines. Eltra took care of the transformer platform and cables for the transmission grid on land.

The wind farm can produce over 600 million kilowatt-hours a year. That corresponds to almost 2 per cent of Denmark's total electricity consumption.

The wind farm is placed on the horizon west of Blåvands Huk and covers an area of 20 square kilometres.

Far out at sea – but still visible from land in clear weather.

Scene 1:

Seamen used to call Horns Rev for "The devil's horn", as many a sailing ship came to an end on the reef.

The offshore wind turbine project is the result of many years of Danish development work with onshore and offshore wind power.

For 14 years, Elsam collected experiences from a test turbine at Tjæreborg Enge near the town of Esbjerg. It gave room to a prototype of the turbine, which towers above Horns Rev today.

Technology was tested on the prototype – and the maintenance staff got to practice routines, before construction on Horns Rev began in the spring of 2002.

Three years earlier, Elsam erected a meteorology-mast on Horns Rev. Measurements proved the area to be ideal for wind turbines. The average wind speed is close to 10 meters a second. This means that the energy content of the wind is 1½ times bigger than on the best locations on land.

At Horns Rev the waves are so high most of the time that maintenance ships can't put in at the turbines.

In these situations maintenance staff will be hoisted down from the air.

Independent research institutes have mapped the wind farm's impact on fauna and flora. Here biologists place a satellite transmitter on a seal. The transmitter reveals the migration of the animals in the wind farm area. It looks dramatic - but the equipment will fall off in the course of three months - all by itself. Researchers will follow the development even after construction has been completed.

Near Oksbøl – where the cable from the wind farm will be led over land – archeologists have made astonishing discoveries. They found a settlement from the iron ages – and on the beach they found remains of a fishing settlement from the 1500s.

Scene 2:

Until a few decades ago wind mills used to be a task for the village smithy. Today, it is a technological challenge for specialists.

The turbines are constructed in Denmark and each have an output of two megawatt. They measure 110 metres from the sea surface to the tip of the blade.

Offshore wind turbines are subjected to a huge strain – on account of the harsh weather conditions. This places very high demands on construction. It is both costly and difficult to carry out repair works at sea.

The turbine towers are made of three sections of sheets that are rolled into cylinders. The iron sheet here alone weighs 7.5 tonnes.

A large part of the work, e.g. like the powder welding, is done by robots. However, when it comes to hardware, doors and fitting it is necessary with people who can handle tools.

Every single welding is controlled by ultra sound. The tiniest weakness – and the entire welding must be redone.

The nacelle – as the turbine cabin is called – is filled with advanced but reliable technology.

The rotor blade is 39 metres long and weighs 6.5 tonnes. When the rotor is included the total blade span of the turbine is 80 metres.

The blade is cast in glassfibre impregnated with epoxy. PVC is used to enforce the blade, which measures only a couple of millimetres at its thinnest place.

Scene 3:

The Dutch ship "Buzzard" is driving foundation piles for the turbines into the seabed.

"Buzzard" is a jack-up vessel. When positioned exactly above the place where the piles are to be driven in, it submerges its four legs onto the seabed and lifts itself up into a stable position. The sea depth varies from six to fourteen metres.

The foundation – or monopile, which is to carry turbine no. 43, is driven 22 metres into the sand here – through a filtering layer of 900 tonnes of gravel. Later, larger stones are placed around the pole. The layers prevent the sand from being washed away and the sand keeps the foundation in place.

Half an hour prior to the beginning of the pole driving, the so-called "pingers" and "seal-scarers" are activated. This is to scare off seals, porpoises and fish before the action starts.

A transition piece with platform, cable tubes and a landing ladder is fitted on top of the mono piles. On the very top, the transition piece has a ring with bolts, onto which the turbine tower is fitted.

Scene 4:

In Esbjerg lies the 1200-tonne heavy transformer platform. It has been sailed here from a Dutch shipyard and is to be placed on the Horns Rev. The platform is to collect the production from the 80 wind turbines and increase the voltage before the electricity is sent into the grid on the mainland.

Eltra is responsible for this part of the project.

The floating crane "Asian Hercules" towed the platform to the northeast corner of the wind farm.

The floating crane is ready for the final lift - 40 minutes later the platform is in place 14 metres above sea level.

The platform holds a 150 kilovolt-transformer, surveillance equipment, staff facilities, a helicopter deck and a ship landing facility.

Scene 5:

Meanwhile crane vessels are working on erecting wind turbines. Under favourable weather conditions 2 turbines a day may be erected.

The space on board is cramped – and heavy winds may stop the work entirely.

There are 560 metres between the turbines. The entire wind farm covers an area of 20 square kilometres, which corresponds to 4,000 football fields. The large distance between the turbines ensures that they don't take wind from each other.

On the quay in Esbjerg the upper tower sections are pre-assembled as well as the nacelle and two of the blades prior to leaving for the construction site. The preparatory work on land reduces offshore work. However, the lifts will be heavier. Tower and nacelle combined weigh 240 tonnes – and the foundation a bit more, which means that the entire turbine weighs close to 500 tonnes.

When the weather permits it fitting is done around the clock. Here the navigator puts the crane vessel "Ocean Hanne" in position at the turbine foundation.

The crane vessels also lean on the bottom of the sea during erection of the turbines. Nevertheless, the position of the ship has to be adjusted according to the tide and the current.

Finally the last blade is lifted into place with a specially constructed suspension.

Inside the tower is the lift going up to the nacelle – however, it only works when there is electricity in the turbine. So during fitting the staircase is the only way to the top.

A tough climb of 10-15 minutes - depending on the shape you're in.

On top of the nacelle there is a platform, onto which maintenance staff can be hoisted from a helicopter.

In each wind turbine there is a bunk and emergency rations, which may be used by the staff stranded here on account of the wind.

Scene 6:

The 150 kilovolt-cable to the mainland is almost 20 cm in diameter and is so the world's thickest sea cable. It is 21 kilometres long and is made in one piece by the factory in Norway. It weighs 72 kilos per metre.

Cable pulling begins 800 metres off the coast of Oksby. The sea cable is pulled ashore from the cable vessel "H.P. Lading", however, the weight makes it necessary to float the cable to the beach. And the current makes work difficult.

By means of a couple of thousand pulleys the sea cable is pulled the last kilometre across the dune and through the marsh to the cable station near Oksby where it is connected to the land cable.

The last obstacle is the dike, under which the cable is led through a tube. This is only done with some extra aids.

Then the cable vessel sets course for the platform.

The cable pulling is favoured by exceptionally calm weather. A couple of days later the cable has reached the platform. Now the only thing remaining is to wash the cable one metre into the seabed.

Scene 7:

A 90-tonne electric coil has arrived by ship from the factory in Istanbul. It has to be transferred from Esbjerg to Oksby on roads that are not meant for transports as long as this.

90 tonnes of electronic equipment has to be prised the last remaining way on to the cable station foundation.

The coil is to ensure a stable voltage on the 57-kilometre long cable connection from Horns Rev to the transformer station Karlsgårde northeast of the town of Varde.

Scene 8

There is a high level of security at all times. The construction site at Horns Rev is a dangerous and difficult work place. When accidents happen, help is to be fetched from far away.

So the entire work force and others with business at the wind farm have taken a security course.

Here a group of Norwegian, German and British workers are taught to survive.

Scene 9:

The wind farm is divided into five sections with 16 wind turbines in each. From each section a cable on the seabed is leading to the transformer platform.

The turbines are internally connected with cables.

The British cable vessel is preparing for cable pulling. The vessel can neither sail nor manoeuvre, but has to be helped by towing boats and anchors before the cables can be trenched into the sea.

A diver inserts the cable into a protection tube at the turbine foundation. From here the cable is pulled up inside the turbine where it is fitted.

When the cable is in place it is washed a metre into the seabed by means of this vessel here.

Scene 10:

Most of the fitting of the transformer platform is done on land, however, the final details have to be done after the platform is placed on Horns Rev. Fortunately the weather plays along.

German engineers work side by side with Danish colleagues. But later there will be no permanent staff on the platform. Maintenance staff may only stay on board over night in case of an emergency.

The transformer's main function is to increase the voltage from 33 to 150 kilovolt.

Most of the equipment for the transformer platform is sailed from Esbjerg. This easily takes a couple of hours – so it is important to remember everything.

The platform has its own back-up power system, which is tested here one last time before the first turbine is put into operation.

Scene 11:

This happens here – at the end of July of 2002. At the same time engineers in Elsam's control centre at Esbjerg register the first electricity from the world's first wind power station.

A good four months later – in mid-December, all of the 80 turbines are in operation.

The turbines are automatically activated when the wind speed exceeds 4 m/s – and stop when the wind speed exceeds 25 m/s. This happens for security reasons.

From the control centre the turbine operation may be monitored 24 hours a day.

Being a wind power station, the wind farm is constructed in a way that makes it possible to regulate production from land – which means you can “turn” the electricity up and down according to need.

Furthermore advanced technology makes it possible to use the wind farm to regulate voltage and frequency in the main grid.

The construction of the wind farm at Horns Rev has given the Danish energy sector important knowledge, which may be used in future offshore wind farms – in Denmark and abroad.

As there will be many of those.

Everything points in that direction.

(Afmelding:)

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