OSTERILD
NATIONAL TEST CENTRE FOR
LARGE WIND TURBINES

DTU Wind Energy
Department of Wind Energy
The National Test Centre for Large Wind Turbines in Østerild is home to seven of the world’s largest and newest wind turbines, and there are many good reasons why these impressive structures are erected here in northwestern Denmark. The terrain and wind conditions at Østerild Test Centre are unique for the testing of wind turbines. Manufacturers also choose to test their offshore wind turbines on land at the Østerild Test Centre instead of at sea because of the ability to have permanent direct access to the turbines, as technicians often have to replace components and perform maintenance and service during testing. Access at sea is more complicated and, for long stretches at a time, weather conditions make it impossible for technicians to use cranes to work on the turbines. At the test centre, wind turbine manufacturers are able to complete the development and testing of new turbine designs – typically over a period of just 6-12 months – ensuring that the wind turbines are optimized for the conditions they typically face and capable of producing clean and climate-friendly energy for years to come.

The test centre in Østerild is an outstanding facility, unlike any other in the world, and is geared to test the largest offshore wind turbines – now and in the future. In other words, Østerild Test Centre is an essential part of what makes Denmark the Silicon Valley of wind energy.
DID YOU KNOW THAT...

› The Tvind turbine, built from 1976-1978, was one of the first large wind turbines, with a 54-metre concrete tower?

Activists demonstrate against the felling of trees in Østerild Klitplantage. The trees were felled to clear ground for the test centre.

HISTORICAL BACKGROUND

In the 1800s, Danish pioneers developed small wind turbines that could utilize wind power to generate electricity. The great dedication of people like Poul la Cour and Johannes Juul helped build the foundation for the advanced and specialized wind turbine industry, which serves as the basis for 28,000 jobs in Denmark today.

The wind turbine industry has taken great strides since the 1970s. The energy crisis spurred idealists to develop and build the famous Tvind turbine and Risø, the National Laboratory for Sustainable Energy, opened its first wind turbine test station in the 1970s. Since then, wind turbines have evolved into large and efficient power plants that are erected on shore and offshore. These turbines are so large that they require special testing facilities.

ØSTERILD - THE MAKING OF A TEST CENTRE

In 2010, a political decision was made to establish a new test centre for wind energy, where industrial players could test modern wind turbines. After extensive investigations and studies, Østerild Test Centre for Large Wind Turbines, located in the northwestern Danish region of Thy, was selected as the most optimum location due to the terrain and wind conditions. The government's goals included ensuring that Denmark remains the leader in the development of new wind turbine technology, creating jobs, maintaining competitiveness and reducing dependence on fossil fuels.

With the new test centre, Danish and international wind turbine manufacturers and research institutions can continue their research and development collaborations to design and build the world's largest full-scale wind turbines. Today, even small changes such as altering the control strategy, require full-scale test measurements to be determine whether the changes have the desired effects on factors such as energy output and operational lifetime.
ABOUT ØSTERILDL

The northern end of the National Test Centre is situated about 4 km from the coast and stretches to the southern end of the testing area, ending at around 7 km from the coast.

The seven turbine test pads are placed in a straight north-south line. In addition to the turbines’ location, the area around the test centre is divided into different zones that comprise the testing area: a measurement area, a wind field and a protection zone.

- There are seven pads, with 600 metres between each of them.
- Each pad has a testing area with space for a measurement mast, which is located 500 metres in front of each turbine.
- The maximum height of the wind turbines is 250 metres.
- At each end of the test centre is a 250-metre-tall light and measurement mast.
- The masts are fitted with advanced measuring instruments and calibration tools, as well as mandatory lighting for air traffic safety.
WHY TEST OFFSHORE WIND TURBINES ON LAND?

One of the reasons for testing the large offshore wind turbines on land is that turbine testing requires rapid and easy access to the turbines, both for the many participating engineers and technicians, and for equipment, replacement parts, etc. Another reason is that very precise data regarding wind measurements is required for data modelling comparisons. This data is much easier to collect on land, where the wind is measured with precision instruments, and at the Test Centre these are mounted on the meteorological masts. It is also an advantage when testing the wind turbines that the wind conditions are more turbulent on land.

Scan the QR code to read more about the wind conditions.

DID YOU KNOW THAT...

In 2014, Danish wind turbines supplied the equivalent of 39.1% of Danes’ electricity consumption? This is a new record in Denmark, which has the largest share of electricity from wind energy in the world.
A modern wind turbine is a power plant that can supply thousands of households with electricity. The significant investment required to purchase a wind turbine brings with it high demands for meeting quality, noise and performance targets. The Danish Energy Agency’s Order no. 73 (25 January 2013) describes the technical certification programme for wind turbines erected in Denmark. In the certification process, prototype turbines are thoroughly tested to demonstrate compliance with all requirements.

Wind turbine testing at Østerild is conducted according to international standards. These standards exist to ensure replicable results independent of time and place, while also establishing standards for the accuracy and uncertainty of measurements.

DID YOU KNOW THAT...

› The V164 8MW from Vestas at test pad 2 is currently the world’s largest wind turbine, with an annual energy output that can power more than 7,500 households.
The wind turbines at Østerild are tested according to applicable international standards for the approval of wind turbines, WTO1 IEC System for Conformity Testing, which sets out the requirements and procedures for assessing and testing wind turbines.

POWER CURVE MEASUREMENTS

A wind turbine's power curve shows the turbine's performance at different wind speeds and enables calculation of its annual energy production in various locations with different wind resources. The power curve is an important tool in assessing the turbine’s efficiency and it is important that the instruments used to collect data are as accurate as possible.


Data collected during the measurement of a turbine's power curve include wind speed and direction, temperature, barometric pressure and humidity, as well as the turbine's net production, i.e. the turbine's output to the grid. Wind speed is measured with different types of instruments: cup anemometers, laser anemometers and sonic anemometers.

Since the 1920s, the cup anemometer has been the wind turbine industry's most important tool for measuring wind speed. This relatively simple instrument comprises three “cups”, an axle and a sensor for measuring the instrument's revolutions. The cup anemometer has not been the subject of much innovation since its invention, but the focus on wind energy in recent decades has led to the development of improved cup anemometers and new high-tech instruments, such as the laser anemometer, which from ground level can measure wind speeds at heights up to the highest tip of a wind turbine’s blades.

Laser anemometer technology is based on measuring the speed of particles in the wind with a laser, while the sonic anemometers measures wind speed by measuring the speed of sound in the air stream.

A wind turbine is designed to have the lowest possible price compared to total energy output during its lifetime. As a result, all turbines are regulated to produce maximum power at a wind speed of approximately 10-12 m/s. Even though the power contained in the wind increases exponentially by three-fold, and thus is eight times greater at 20 m/s than at 10 m/s, it is not economically prudent to scale the turbines to produce 8 times as much power. Wind speeds rarely reach 20 m/s. Typically, the turbines will not begin producing electricity until the wind reaches a speed of 3-4 m/s. The exact power curve for a given turbine depends on the local wind conditions, e.g. low wind area or offshore. The turbine’s own power consumption when stationary is also included in the power curve calculations.

DTU Wind Energy is accredited to perform power curve measurements by DANAK (the Danish Accreditation Fund) and is a member of MEASNET, an industry network of European wind turbine testing centres whose mission is to perform comparable tests and calibrations, while ensuring uniform interpretation of standards.
Load measurements are conducted according to the applicable international technical specification: TS IEC61400-13 – Measurement of mechanical loads. DTU Wind Energy is accredited by DANAK to perform load measurements by this standard.

LOAD MEASUREMENTS

A wind turbine consists of a foundation and thousands of structural details made of fiberglass and steel, including many bolts and welds. It is vital to have precise knowledge of the loads to which each of these is subjected in order to dimension all components for a minimum lifetime of 20 years.

During the design phase, a detailed load basis is calculated for the turbine using advanced computer models; this load basis is then used to design and build the prototype. It is then critical to verify this load basis by measuring loads on the prototype turbine, which is an integral part of the certification process. Loads on the turbine primarily depend on wind speed, turbulence and wind shear (the wind speed depending on height). Measurements and calculations in identical wind conditions are used in the verification of load models. Therefore, highly detailed and accurate data regarding inflow is needed so that the model can calculate loads under the same conditions. This process provides good verification of the load model’s accuracy.

NOISE MEASUREMENTS

A very important parameter in the assessment of a wind turbine’s environmental impact is how much noise it generates. Therefore, noise measurement is an important test in the certification of a new type of turbine. In Denmark, turbines must not exceed the mandatory noise limits at wind speeds of 6 m/s and 8 m/s. The noise limits are established in the Danish Ministry of the Environment’s Order no. 1518 (14 December 2006) on Noise from Wind Turbines. The order refers to the applicable international standard: IEC61400-11 - Acoustic noise measurement techniques. The order’s annexes describe general rules for measuring noise emissions from a wind turbine.

All wind turbines emit a faint, but characteristic noise from the blades’ movement through the air and from the turbine’s machinery. In recent years, however, developments have focused on reducing noise from wind turbines. As a result, proportionate to their size, modern wind turbines produce significantly less noise than their predecessors erected in the 1970s, 80s and 90s. The blade design and machine housing insulation are important factors for turbine noise emissions.
Visit Thy and enjoy world class green experiences

It is in Thy you find Denmark’s first National Park – Denmark’s greatest wilderness. It is also here you find our two National Testing Centers for renewable energy.

Testing Center for Large Wind Turbines
At the National Testing Centre for Large Wind Turbines in Østerild Klitplantage the world’s largest offshore wind turbines are tested and developed before they are put into production.

Testing Center for Wave Energy
In Hanstholm, it is possible to experience the Danish Wave Energy Center (DanWEC), which is a full-scale test centre for wave energy testing.

Folkecenter for Renewable Energy
And furthermore we have Nordic Folkecenter for Renewable Energy in Ydby, who has been testing and developing green technologies of tomorrow for more than three decades.

In short: Thy is Denmark’s green lab
Go to green.thisted.dk and thisted.dk/energi for more information

At green.thisted.dk you can also book guided tours to green sights in Thy.

DATA IN THE TABLE ABOVE IS FROM 2015.
Danish innovation with a global output

Envision Energy thinks smart

Envision Energy are a leading smart energy solution provider that transforms the industry by using innovative hardware and software technologies which lowers the costs of energy and combats climate change. Our speed of recognition is impressive. In 2014 we were the number 9 supplier on the annual wind turbine supplier top 10 list and are the top 3 wind turbine supplier in China. Furthermore, we are the largest offshore turbine supplier in China. Envisions business spans the design and manufacturing of smart wind turbines, smart energy management software and smart energy technology services.

Technology with a global output

Envision’s R&D capacity and technology has been established with global presence by setting up its Global Innovation Centre in Denmark, and working closely with internationally recognized suppliers. Envision are present in all major global hotspots for development of renewable technology e.g. China, Denmark, Silicon Valley and Japan.

International market access

Envision’s 3 MW wind turbine will be the new international product for the global market. It’s development being based on profound mapping of vast areas ready for wind power in Europe. Using an industry recognized supply chain it is a competitive, cost effective turbine with a high energy yield.

The turbine features a 120 meter rotor, a power rating of 3MW and is build based on proven well known components. The turbine will together with coming platforms serve the European market together with Envision’s SMART Wind Software offering a different philosophy of not just selling a materialized product but instead working with our customers to optimize output and yield generation on a learning technology platform.
An experienced partner
At Thy-Mors Energi we have 35 years of experience in connecting wind turbines to the power grid onshore and we connect wind turbines to the power grid all over Denmark.

Our background in electricity supply means that we have a solid knowledge of the procedures for connecting wind turbines to the power grid. Therefore, we also offer to assist our customers in contacting power grid companies all over Denmark and to help them understand the difficult rules associated with connecting wind turbines.

Today we are operator of 92 wind turbines all over Denmark.

They are committed and they place great emphasis on service and follow-up tasks

Michael Hybschmann
WTG Test & Validation Engineer
Vestas Technology R&D

... i kraft af fællesskabet

Find more information on our website
www.thymors.dk
DTU, the Department of Wind Energy is one of the world's largest centres of wind energy research and knowledge, with a staff of more than 230 people from 37 countries working in research, innovation, research-based consulting and education. The department's cross-disciplinary research is organised through strategic research programmes that collaborate with Danish and international universities, research institutions and organisations, as well as the national and global wind industry.

DTU Wind Energy is a department under the Technical University of Denmark, DTU.

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Scan the code with your mobile phone to access the website directly.