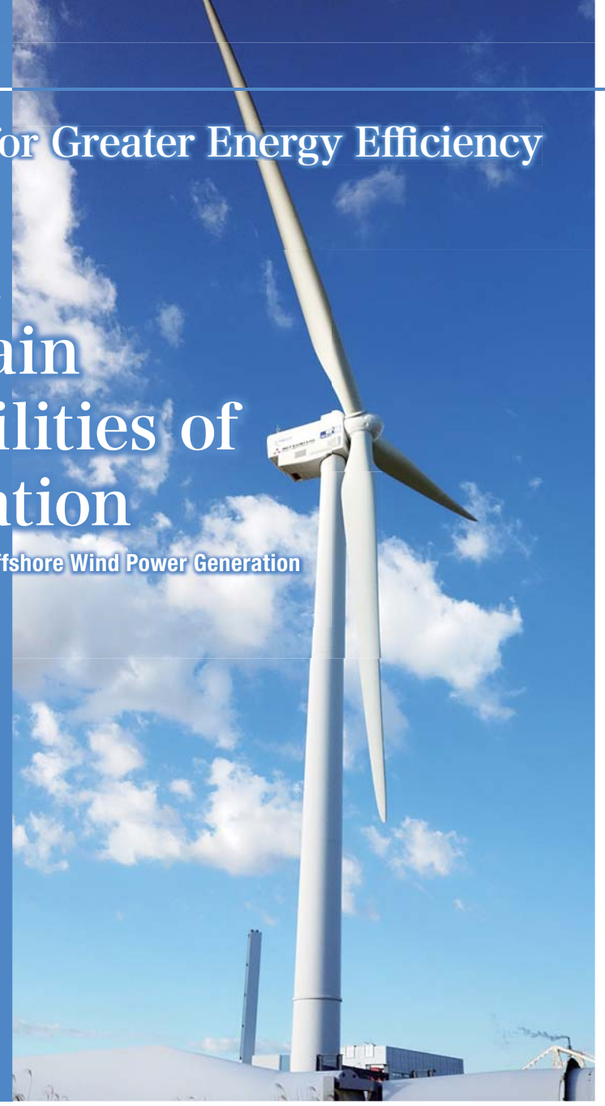
Harnessing the Ocean's Wind for Greater Energy Efficiency

A Global First!

Digitally Controlled Hydraulic Drive Train Expands the Possibilities of Wind Power Generation

New Technology Targets Latest Market Trend: Large-Scale Offshore Wind Power Generation

Demonstration unit "MWT100H" being tested at Yokohama Dockyard & Machinery Works (photo right). The unit's nacelle holds a hydraulic drive train (photo above).

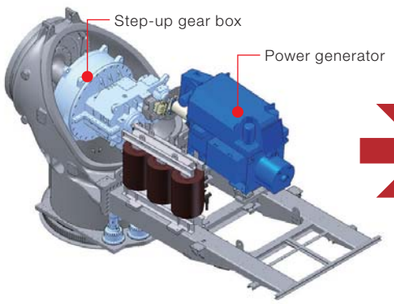


Test Operation of Revolutionary New Technology Begins in Yokohama

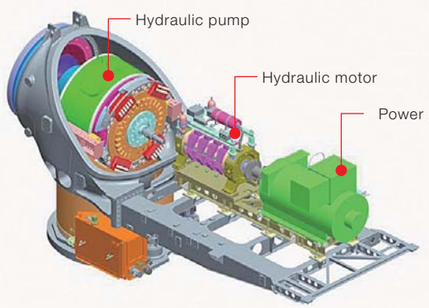
In January 2013, test operations of an innovative wind power generation facility with a hydraulic drive train began at MHI Yokohama Dockyard & Machinery Works.

The adoption of wind power has skyrocketed in recent years due to global demands for renewable energy, and MHI has now developed the world's first hydraulic drive train to use Digital Displacement® Transmission (DDT*) technology. The product was created during the development of a new hydraulic drive train system for offshore wind turbines, a project which began in September 2011 with support from the New Energy and Industrial Technology Development Organization (NEDO). This operation testing will accelerate the realization of the world's largest 7 MW-class wind power generation facility.

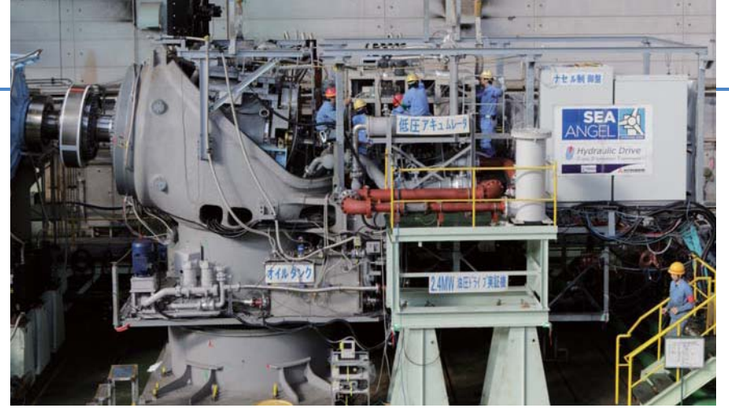
Step-up gear box nacelle (conventional unit, 2.4MW)



Hydraulic drive train nacelle (demonstration unit)



The hydraulic drive train does not require a step-up gear and can use an all-purpose power generator.



DDT performance test conducted in 2012

Floating wind turbines to be used in the offshore floating wind farm project in Fukushima (Conceptual image)

Efficient Energy Production with Digital Control

Current trends are shifting to offshore wind power generation, a more efficient option than onshore generation: there are fewer location requirements offshore, and the wind remains more constant. However, efforts are handicapped by higher construction and maintenance costs. For this reason, wind turbine manufacturers are developing larger models with a rated output of 6 to 8 MW, as opposed to the conventional 3 to 4 MW.

As its conventional gear drive train could cause difficulties in larger units, MHI proceeded to develop the hydraulic device using a revolutionary concept.

To efficiently convert wind power energy into electricity, the rotation speed of the blades must be optimized according to wind speed. In this new method, the wind force that turns the blades is converted into high-pressured hydraulic energy inside the hydraulic pump. This energy is transmitted to the hydraulic motor, which is accelerated to a set speed of rotation by digital control to match the electric power grid frequency. The generator is then connected to the electric power grid and operated. With the hydraulic transmission, the speed of the hydraulic pump and motor can be controlled separately and the frequency converter eliminated.

The DDT hydraulic drive train was based on technology from Artemis Intelligent Power, Ltd., a UK venture company acquired by MHI in 2010. Wind fluctuates with location and climate, and the transmission enables precise, digital control of the wind turbine in response. It also eliminates the need for a step-up gear box, leading to reduced maintenance costs. The wind turbines can be partially operated even when malfunctioning.

Winds of Change Meet Great Expectations

In the autumn of 2013, an onshore 7 MW-class demonstration unit will be installed and begin operations in the UK. The Yokohama demonstration unit is of 2 MW-class, but output can be increased with relative ease by increasing the number of pistons and similar components. The blades of each turbine draw a circle 167 meters in diameter, and the facility will be truly enormous.

Europe's offshore wind power generation market is predicted to grow from its current size of 5 GW to 40 GW by 2020. MHI is aiming for sales of approximately 600 billion yen, and its mass-produced units are scheduled to hit the market in 2015.

Having been involved in wind turbine development since 1980, MHI now has over 30 years of experience and has built up substantial trust, with over 4,000 units delivered around the world with a collective output of 412.4 MW. In addition to the UK demonstration project, MHI is also participating in the offshore floating wind farm project in Fukushima, Japan and plans to provide two 7 MW wind turbines for test operations set to begin in autumn 2014. MHI is steadily making preparations to respond to the strong expectations coming from both Japan and overseas.

*Digital Displacement® Transmission is a registered trademark of MHI.

Members of the manufacturing team from Yokohama Power Systems Manufacturing Department, responsible for assembling the nacelle.

Engineers of the Wind Turbine Business Division, the Shimonoseki Shipyard & Machinery Works, and the Technology & Innovation Headquarters involved in development and testing.

Concentrating Engineers' Expertise, Advancing Towards Demonstration Testing

In addition to MHI's wind turbine technology, a new drive train was adopted that utilizes the company's hydraulic technology. All of the demonstration unit's key elements were developed by MHI, a feat possible only by a comprehensive machine manufacturer.

During development, many unforeseen events are bound to occur. This time, the Wind Turbine Business Division, the Shimonoseki Shipyard & Machinery Works, the Technology & Innovation Headquarters, the Yokohama Power Systems Manufacturing Department, and Artemis Intelligent Power pooled their knowledge and experience to design countermeasures. When the DDT was built into the wind turbine and began to generate power, the Artemis engineers were thrilled to see technology from their lab used in a product which would benefit the world. It was apparent that just like at MHI, "engineering blood" ran in their veins.

As Asian nations become more prominent and market needs evolve, the need to develop more competitive products is growing. The field of offshore wind turbines utilizes a combination of MHI's machinery, hydraulic, marine construction and vessel technologies. The test data accumulated under natural conditions from this demonstration unit will be used to advance the development of the 7 MW commercial unit.

The expansion of wind power, which requires no fuel, is an important step towards resolving the world's energy problem. To this end, we plan to give our best.

Head Engineer
Offshore Wind Turbine Development Project Department
Wind Turbine Business Division, Power Systems
Shin Maekawa