NOWITECH Norwegian Research Centre for Offshore Wind Technology

NEWSLETTER
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Make sure to mark your calendar!

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This can be a game changer for offshore wind in Norway

There is no doubt that Norwegian companies can contribute greatly to the development of offshore wind farms. This is by drawing on experience and competence from offshore oil and gas exploitation, marine and energy industries. A challenge however for Norwegian companies aiming to bring forward new technology and solutions for offshore wind, has been the lack of a home market. This may now come to a change.

According to Mr Harald Dirdal, the Norwegian Oil Taxation Office just confirmed that offshore wind farms can be developed applying the petroleum taxation regime. A key condition is that the offshore wind farm is used for supplying electricity to an oil and gas installation. This means making oil and gas exploitation cleaner and good for the environment. Dirdal explains that the oil company can by leasing the wind farm get a 78 % tax reduction, and making offshore wind a profitable option. This opens for an offshore wind market in Norway and accelerated development of new technology.

Mr Harald Dirdal, partner in Havgul Clean Energy and general manager of Siragrunnen Vindpark AS.

Read more in Aftenbladet.no (in Norwegian)

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Large Superconducting Wind Turbine Generators

One of the major challenges for the realization of large (>10 MW) direct-driven off-shore wind turbines is to provide drive trains which can comply with the large torque appearing when the turbine rotor diameter is scaled up and the rotational speed is lowered to limit the tip speed of the blades.

The ability of superconducting materials to carry very high current densities with very low losses might facilitate a new class of generators operating with an air gap magnetic flux density considerably higher than conventional generators and thereby having a smaller size and weight.

Two new superconductor materials are entering the commercial market, YBCO and MgB_2, with prospects of meeting performance and cost requirements. These materials need to be wound into coils and tested under application-like conditions, both for electrical and mechanical performance and for reliability including the cryogenic cooling. Once the technology is developed and proven, it may enable a necessary step change for wind turbine generators.

YBCO superconducting generator coil. (Courtesy DTU)

Read more in presentation from DeepWind'2012.

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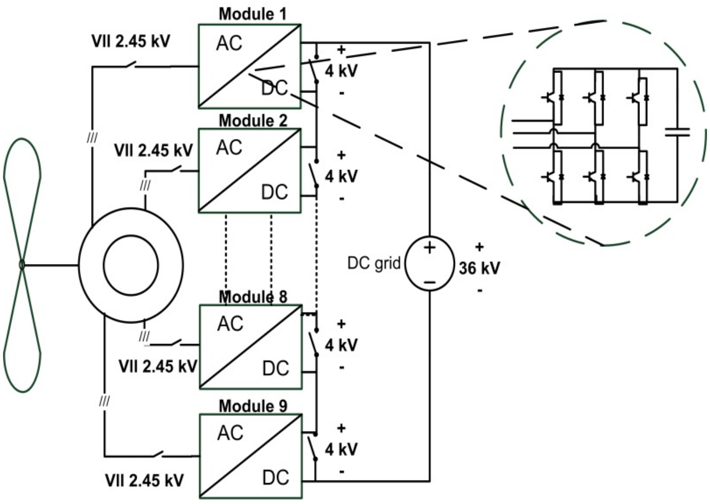
High-Voltage Transformer-Less Generator Drive

Direct driven 10 MW wind turbines for offshore applications face challenges like: Weight of the generator, low generator voltages with corresponding high currents, and following from this, placement of transformer. This work addresses these issues by proposing an electrical drive train with direct high voltage output without a transformer.



A modular power electronic AC/DC-converter, with series connected DC-sides for 36 kV DC output voltage, is under development. It has been constructed around a special, segmented generator. The result is a total output voltage which one normally would need a transformer to achieve.

The advantages are weight saving in the nacelle, and multiple small power converters instead of one large transformer. Therefore, maintenance operations can be performed without the need of a heavy lifting vessel. In addition, fault tolerance can be achieved with low additional cost. The result is a turbine with increased up-time and low weight.

The work deals with the realization of the concept, as small differences in the electrical parameters of the components, will result in drifting voltages across the modules. If these are not regulated, this difference might result in hazardous operating conditions for some of the converter modules. In the presentation, a system for controlling this parameter, which is not influencing the turbine operation, is presented.

Read more in presentation from DeepWind'2012.

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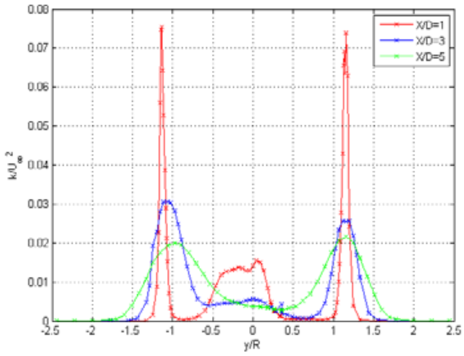
Results of the NOWITECH/NORCOWE wake blind test

The flow conditions experienced by an individual turbine in a wind park are complex. Depending on the wind direction, weather conditions and operating points of the other turbines in the park, the wind conditions seen by two turbines in the same park can therefore be very different. A lot of work is being put into developing numerical models capable of predicting the flow conditions inside wind parks.



An important input in the process of validating such models is experimental data obtained under controlled conditions in a wind tunnel. The NOWITECH/NORCOWE wake blind test provided any modeler interested in testing their model with a test case and delivered data on the development of the wake of a single wind turbine.

The experimental investigations were carried out in the large wind tunnel at the fluid mechanics laboratory at NTNU.

Data on mean velocities and turbulent stresses in the wake were acquired for a wide range of operating conditions and positions. The figure shows the turbulent kinetic energy in the wake for different downstream positions at optimum operating condition. This exemplifies the decay of the turbulence level as the wake develops. It also shows very clearly that the majority of the turbulent energy is generated near the tip of the turbine blade.

In October 2011 the participants met up in Bergen to compare their results.

Read more in presentation from DeepWind'2012.

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Hydrodynamic modeling of a semi-submersible wind turbine

When calculating wave forces on floating wind turbines (FWTs) the majority of the available software use Morison's equation, which assumes that the structure is so slender that its presence will not influence the waves. Certain concepts, such as the spar buoy FWT, are slender enough to justify this. For larger volume structures such as barges or semi-submersibles, however, the structure's effect on the waves may be significant. In these cases wave forces must be calculated using potential theory.

Morison's equation and the potential theory were compared for a semi-submersible wind turbine concept similar to WindFloat applying the SIMO-RIFLEX-AeroDyn code. This code is a new coupled simulation tool for floating wind turbines that was developed in cooperation between CeSOS/NOWITECH and Marintek.

Illustration of WindFloat concept by Principle Power (http://www.principlepowerinc.com/)

The study showed that the assumption of a slender structure is reasonable in a certain wave range for the FWT in question, provided that the mass coefficients in Morison's equation are properly determined.

Read more in presentation from DeepWind'2012.

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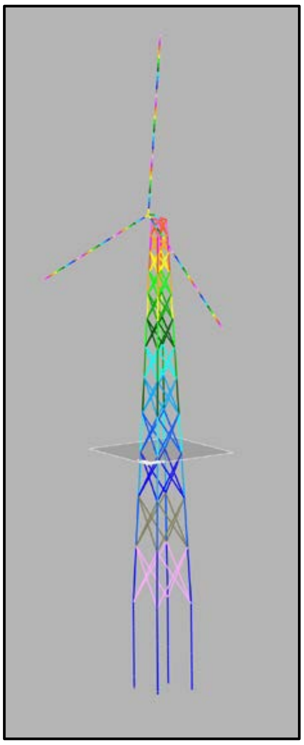
Design of full-height lattice towers for offshore wind turbines



The NOWITECH 10MW reference turbine introduces a new support structure concept. The design of a full-height lattice tower provides directly support for the turbine nacelle, without transition to a tubular tower.

Since several design parameters lead to significant changes in the tower topology of a full-height lattice tower and time-domain analyses are time consuming and expensive, an effective optimization approach is needed to be able to reduce the number of necessary simulation runs. The iterative optimization approach is based on two main steps. First the analysis of a specific tower design with a multi-body solver, and second the post-processing of calculated time-series of forces and moments for each member and joint.

Simulations of a fully-coupled offshore wind turbine model, including rotor nacelle assembly, support structure and foundation piles were analyzed with the multi-body solver software FEDEM Windpower.

Read more in poster from DeepWind'2012.
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First announcement 10th Deep Sea Offshore Wind R&D Conference, DeepWind'2013, 24-25 January, Trondheim, Norway

The conference has been developing every year since 2004, and is established as an important venue on deep sea offshore wind R&D. It has been fully booked for the last few years with about 200 delegates from Europe, Japan, USA, Korea, Singapore and China.

The conference includes a mix of plenary presentations with broad appeal and presentations in parallel sessions on specific technical themes. Ample time is planned for a special poster session, opportunities for discussions and networking.

Call for papers and registration will open in June. More information will follow at www.nowitech.no.

Presentations from this year's DeepWind'2012 and previous conferences in the series are available at http://www.sintef.no/deepwind_2012

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