NOWITECH Norwegian Research Centre for Offshore Wind Technology

In this issue

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www.nowitech.no

DeepWind'2013, Trondheim 24-25 January, Norway

DeepWind'2013 is the 10th Deep Sea Offshore Wind R&D Conference to be held in 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. This year the conference is continuing as last year with an international scientific committee and call for papers. The aim is to present the latest and best on-going R&D on deep sea offshore wind farms.

The program includes a mix of plenary presentations with broad appeal and presentations in parallel sessions or by posters on specific technical themes. The program is exiting with 55 oral presentations and 26 posters, all with high quality and relevance.

Read more and register at www.sintef.no/deepwind_2013.

Focus on people – First NOWITECH PhD graduated

Lars Frøyd defended his PhD thesis at NTNU on 17 October 2012: «*Wind Turbine Design: Evaluation of Dynamic Loads on Large Offshore Wind Turbines*». Read the thesis at the NOWITECH e-room.

Professor Ole Gunnar Dahlhaug, Department of Energy and Process Engineering, was the candidate's main supervisor.

The Faculty had appointed the following Assessment Committee to assess the thesis:

- Professor Gerard van Bussel, Delft University of Technology, The Netherlands
- Professor Tor Anders Nygaard, Norwegian University of Life Sciences, Norway
- Professor emeritus Jan M. Øverli, NTNU

The trial lecture was on «*Wind and Hydro: How Can Norway Utilize its Hydro Storage Capacity in the European Energy perspective?*»

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Lars Frøyd was the first PhD candidate to graduate within NOWITECH. In total, twenty-five PhD and Post Doc candidates are fully financed through NOWITECH. See the full list at NOWITECH public web. All will be finished within 2014.

NOWITECH welcomes Kongsberg Maritime as a new industry partner

Kongsberg Maritime AS has become a new industry partner in NOWITECH from January 2013. Kongsberg Maritime delivers dedicated wind energy products within control and monitoring and transfers experience and technology from their ship and offshore sector into the wind energy sector.

Kongsberg Maritime delivers systems for dynamic positioning and navigation, marine automation, safety management, cargo handling, subsea survey and construction, maritime simulation and training, and satellite positioning. Kongsberg Maritime's solutions enhance efficiency and safety throughout the whole maritime technology spectrum. Kongsberg Maritime offers additional competence in providing turnkey engineering services within the shipbuilding and floating production sectors. http://www.km.kongsberg.com/

The NOWITECH management considers Kongsberg Maritime to be a strategic important new partner and look forward to future collaboration.

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Ironless generator in NOWITECH

The ironless generator concept being developed in NOWITECH may enable floating wind turbine technology rated above 10 MW.

The weight of the drive train components installed in the nacelle (usually generator and gearbox) defines the top head mass and directly influences total turbine mechanical design and cost. Direct drive train improves the reliability by eliminating the gearbox while bringing a heavier generator. There is the need and potential to decrease the generator mass in direct drive train solutions.

The mass of a generator generally consists of two parts: the active part which directly produces the torque, and the inactive part which holds the active material in position and keeps the air-gap clearance. Normally the larger the rating of the generator, the heavier and bigger the machine is. However, as the power rating grows, the mass of the active part and inactive part increases differently. For example, 20% of inactive mass in a 1.5 MW machine turns into more than 70% in a 10 MW machine.

The huge mass of inactive material makes application of conventional generators at power levels above 10 MW infeasible as the generator gets very heavy and expensive.

In NOWITECH, the ironless technology is under investigation and development (Fig.1). Because of no iron in the stator, there is reduced tension between the stator and the rotor, hence less need for the strength of the inactive part.

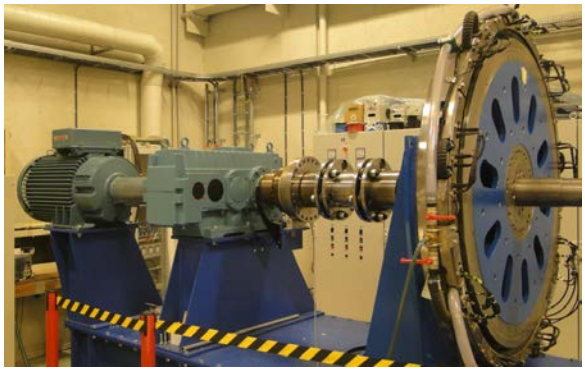

Fig. 1: Lab setup with ironless PM machine.

An ironless design has less mass than current technology frontier (Fig.2). In addition, this generator technology is intrinsically friendly to the high voltage transformer-less generator drive for direct connection to HVDC grid (see NOWITECH newsletter published in April 2012), which can further decrease the nacelle weight and increase the turbine availability. By enabling the lightweight turbine, ironless technology makes the floating turbine concept (>10MW) more viable.

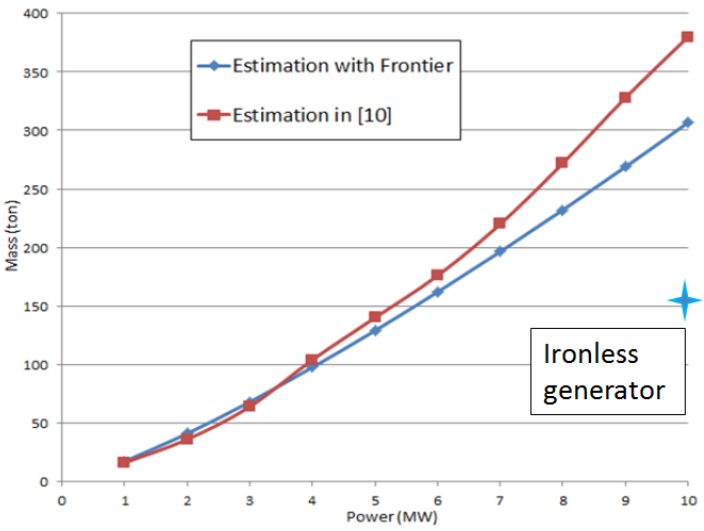

Fig. 2: Estimated mass of direct drive generators.

Notes to Fig. 2:
"Estimation with Frontier" is based on survey of technology frontier assuming

$$M = \frac{0.0977 P_n}{\sqrt{N}}$$

Here M is mass [kg], P_n is rated power [W] and N is rotational speed per minute.

[10] G. Shrestha, H. Polinder, D. Bang, J. A. Ferreia, ‘‘Structural Flexibility: A Solution for Weight Reduction of Large Direct-Drive Wind-Turbine Generators’’, IEEE Transaction on Energy Conversion, vol.25, no.3, 2010, pp. 732-740.

Read more at the NOWITECH e-room.

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Blind Test 2 - CFD trends in wind energy

Due to the rapid increase in computational power and to the improvement in code parallelization, CFD simulations in the wind energy area are slowly becoming a reliable and precise tool to evaluate rotor and wind park performances. While blade element method codes like FAST, FOCUS, GH Bladed or FLEX5 are still the standard for rotor design, fully resolved RANS (Reynolds Averaged Navier Stokes), and URANS (Unsteady Reynolds Navier Stokes) simulations are starting to be more common and more precise.

Vorticity field simulated with the TAU-DLR code behind the NREL 5MW reference turbine

In wind parks design, basic analytical models that rely on the typical self-similarity nature of the wakes are the standard in the industry. However, recently, more accurate models where either actuator disk or actuator line codes to represent the rotor coupled with RANS or LES (Large Eddy Simulations) methods for the wake are starting to be used. In these types of simulation the rotor is simplified as either a disk or series of lifting lines. Drag and lift curves for the airfoils in the blade are used to calculate the thrust and thus the velocity deficit in the wake. The wake is then resolved with a volume mesh using either LES or RANS methods. Full CFD computations where both the rotor and the wake are represented using volume meshes are currently not feasible due to the large computational power required.

At IFE, CFD simulations are carried out to estimate rotor efficiency and aerodynamic loads on wind turbine rotors using the compressible URANS code TAU developed at DLR in Gottingen and currently one of the standard codes in the aerospace industry.

Blind tests comparing calculations and measurements are carried out as part of NOWITECH and in cooperation with NORCOWE. A first workshop was prepared in October 2011 (see NOWITECH newsletter April 2012) and the second, **Blind Test 2**, was prepared in October 2012. The idea of the blind tests is for research groups to compute the performance and wake development of turbine models, and to compare these with measurements on the models performed in the wind tunnel at NTNU. The first workshop considered a single turbine, whereas Blind Test 2 considered two turbines in a row. Read more at the NOWITECH e-room. IFE and NTNU also participates in the MexNext (IEA wind task 29) project for comparing their codes with experimental results, www.mexnext.org.

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Industry meets Science 14 February 2013

A new seminar in the "Industry meets Science"-series is scheduled for Trondheim 14 February 2013. The topic for the seminar is "Europe – your home market". The programme includes overview on R&D programs in EU and the possibilities to influence their future calls, possibilities in Germany for Norwegian industry, and possibilities for qualification of Norwegian industry with Siragrunnen offshore wind park. See "Industry meets Science" at www.nowitech.no for detailed program and registration.

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