NOWITECH Norwegian Research Centre for Offshore Wind Technology

In this issue

NEWSLETTER
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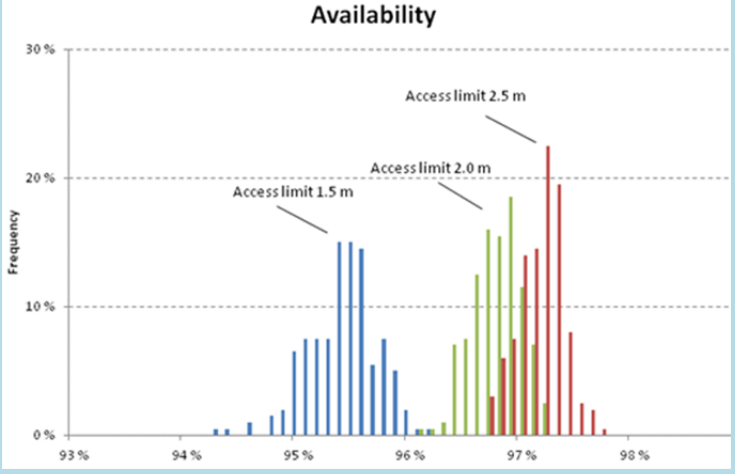
A model reducing the cost of energy from offshore wind farms

A main goal for NOWITECH is to contribute to reducing the cost of energy from offshore wind farms. A task working towards this goal is the development of a framework and model for supporting the optimization of maintenance and logistics activities.

NOWIcob: The NOWITECH life cycle cost and benefit model

The NOWIcob model aims to support two different user groups: researchers and decision makers in the industry. In general the model simulates failures in different components and the maintenance activities needed for service and repairs. It considers weather uncertainty and available vessel types, and therefore different access to the farm. Based on this information the expected downtime and lost production of the wind farm is calculated. Typical results delivered by the model are performance criteria such as availability for different cases.

Example NOWIcob result: Distribution of availability of wind farm for three cases of wave height access limits.



A model reducing the cost of energy … (cont.)

The NOWIcob simulation model has a modular structure to make it easy to implement new functionalities. A first prototype of the model is implemented and due to the on-going development further improvements in terms of functionality can be expected in near future. The NOWITECH industry partners have stated interest in the model and a new IPN research project to be lead by Statkraft is created with support from the Research Council of Norway to develop a model adapted to the needs of the industry.

Contact persons in NOWITECH: Matthias Hofmann (matthias.hofmann@sintef.no), Lars Magne Nonås (LarsMagne.Nonas@marintek.sintef.no)

Read more:

- Matthias Hofmann, "A Review of Decision Support Models for Offshore Wind Farms with an Emphasis on Operation and Maintenance Strategies", WIND ENGINEERING VOLUME 35, NO. 1, 2011, PP 1–16.
- Matthias Hofmann, Jørn Heggset, Lars Magne Nonås, Elin Espeland Halvorsen-Eare, "A concept for cost and benefit analysis of offshore wind farms with focus on operation and maintenance", COMADEM2011; Stavanger; 30 May - 1. June 2011

The papers (A review of.. and A concept for..) are also available at NOWITECH e-room (requires password, for NOWITECH partners only).

NOWITECH introduces a new support structure concept

How does the future of wind energy look like? Present trends suggest that 10 MW machines are within reach, and the next generation of wind turbines will be larger machines of this size. Within NOWITECH a 10 MW turbine has been specified that incorporates a number of state-of-the-art features. The design will be open to the public and completely documented, such that researchers worldwide can analyze the turbine, and compare, exchange and discuss results with a common basis.

The NOWITECH 10 MW reference turbine introduces a new support structure concept

Designed for a water depth of 60 m and a wave climate resembling the Doggerbank site, the support structure consists of a full-height lattice tower. This concept has been developed at NTNU and promises less steel weight and cost than the traditional hybrid solution (where a tubular tower is connected to an offshore jacket by an expensive transition piece). The new design was analyzed with FEDEM Windpower and has been automatically sized and optimized.

Read more at NOWITECH e-room (requires password, for NOWITECH partners only).

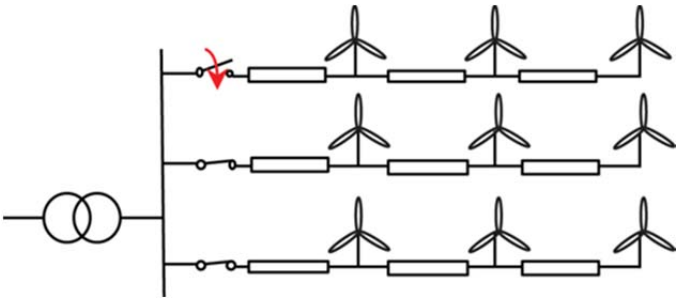
NOWITECH reference turbine	
Nominal power output	10 MW
Design wind velocity	13.0 m/s
Tip speed ratio	7.7
Hub height	93.5 m
Turbine diameter	141 m
Design water depth	60 m

Contact persons in NOWITECH: Prof Ole Gunnar Dahlhaug, ole.g.dahlhaug@ntnu.no (10 MW reference project) and Prof Michael Muskulus, michael.muskulus@ntnu.no (tower design).

Investigating transient overvoltages in wind farms

There have been a number of cases where wind turbine transformers have suffered dielectric failure, with transient overvoltages as a probable cause. This possibility is being researched in the NOWITECH-sponsored PhD study of Amir Soloot at NTNU. The overall goal is to understand the process behind the transient overvoltages and contribute to future avoidance of such failures.

One failure scenario is that a transient overvoltage on a radial causes a very high overvoltage on the low-voltage side of a WT transformer. The cause can be the energization of a radial (illustrated below) or an individual wind turbine, or a ground fault.



In order to provide input to the PhD study, an approach has been developed for systematic analysis of transient overvoltages with systematic variation of one or more cable lengths. The method is based on fast computations via frequency domain and inverse Laplace Transform, followed by detailed studies of selected parameter combinations using time domain simulation.

The focus is on the overvoltages that can occur due do high-frequency resonances between network components.

It is shown that such resonances can lead to excessive overvoltages on the low-voltage side of transformers, due to faults and switching operations (see graph below). The procedure is demonstrated in a first approach for a hydro power station due to the availability of a wide-band transformer model, but it is equally applicable to overvoltage studies in wind parks as well.

Read more:
B. Gustavsen, A. P. Brede, and J.O. Tande, "Multivariate analysis of transformer resonant overvoltages in power stations", IEEE Trans. Power Delivery, vol. 26, no. 4, pp. 2563-2572, October 2011.

The paper is also available at NOWITECH e-room (requires password, for NOWITECH partners only).

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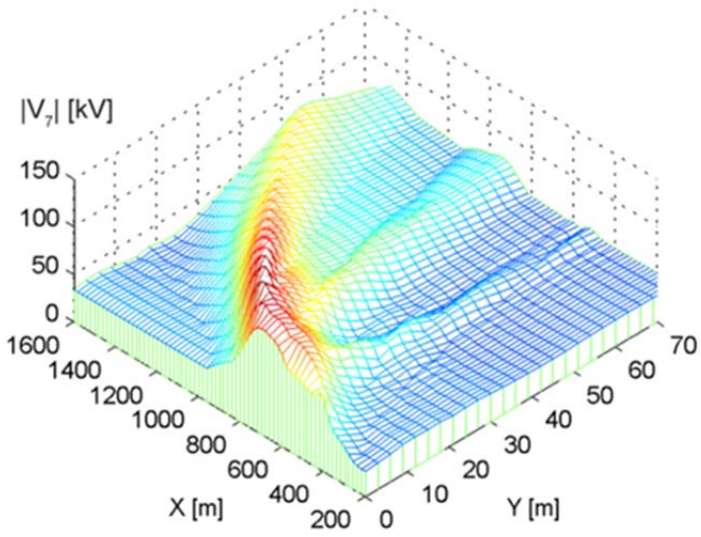
and PhD student Amir Soloot (Amir.H.Soloot@elkraft.ntnu.no)

Maximum transient overvoltage on station transformer as function of the length of feeder (X) and station cable (Y).



Using Norwegian hydro to balance European wind energy

The development of wind energy in Europe sets increasing demand for balancing services. Using Norwegian hydro is often pointed out as the most cost effective option for such balance service, but today limited by the relatively small transmission capacity between Norway and the rest of Europe. However, if the transmission capacity is increased, including also transmission capabilities internally in Norway, the hydro system can be utilized to provide more balancing services.

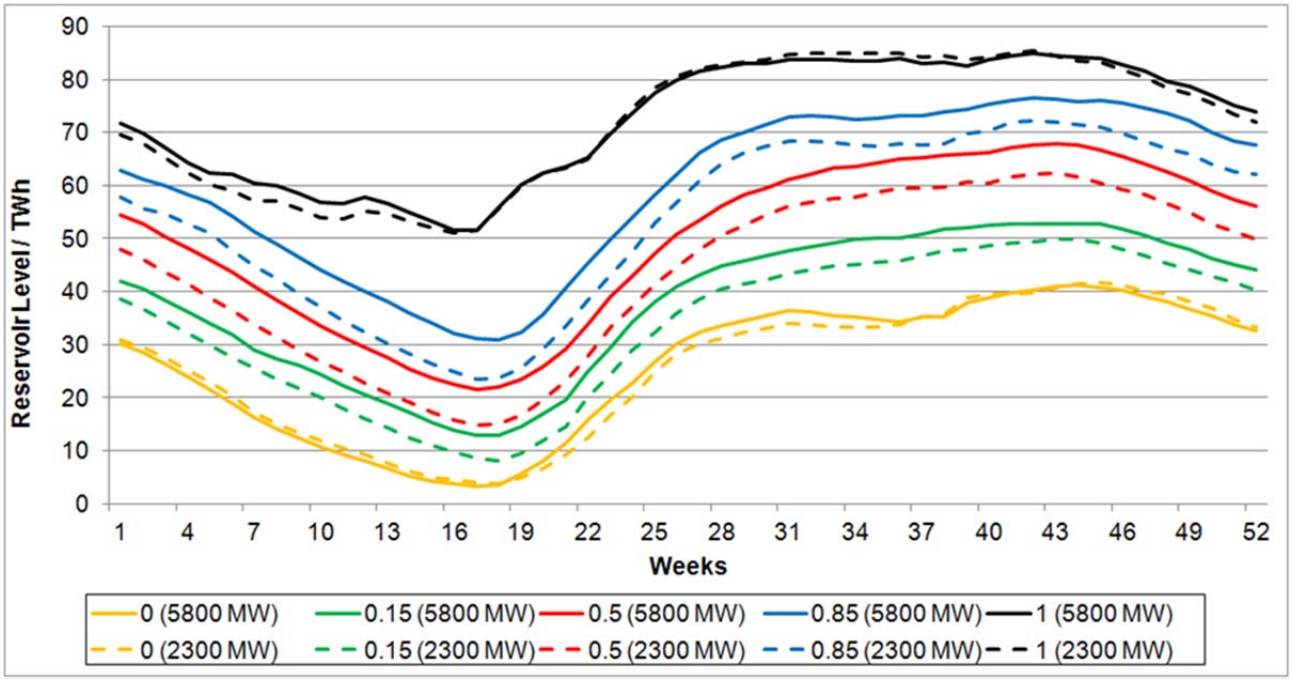
The total Norwegian hydro reservoir size is about 85 TWh and constitutes nearly half of the total in Europe.

The reservoir levels depend on the balance between hydro power production and hydro inflow. The hydro inflow may vary considerable from year to year, depending on wet or dry years possibly +/- 30 %. Generally, dry years giving low reservoir levels leads to higher electricity prices and vice versa.

Assuming two different scenarios, a low (2300 MW) and high (5800 MW) HVDC transmission capacity to mainland Europe and Great Britain (GB), the utilization of the reservoirs and production patterns have been analyzed for a future European power system with large amounts of wind power.

The analyses show that the Norwegian hydro power system is capable to manage the increased exchange with Europe and GB. The figure below shows the reservoir level for both scenarios in percentiles considering 40 years of hydro and wind inflow data. It can be seen that the reservoir level in the 5800 MW transmission capacity scenario in most cases lies clearly above the level of the 2300 MW-scenario. The higher reservoir levels can be said to be beneficial, though there are local environmental consequences caused by more active use of the hydro plants that call for careful considerations.

Read more in article at NOWITECH e-room (requires password, for NOWITECH partners only).
Paper at EWEA Offshore, Amsterdam 2011.



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