NOWITECH Norwegian Research Centre for Offshore Wind Technology

In this issue

NEWSLETTER
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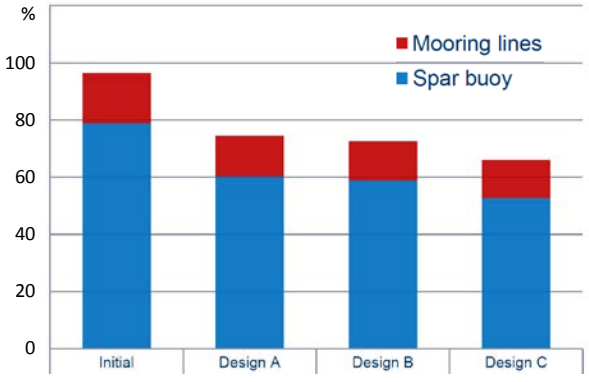
www.nowitech.no

Optimization of floating support structure

An efficient tool for optimization of floating support structure for deep water wind turbines has been developed in NOWITECH.

WINDOPT is a program for conceptual optimization of floating wind turbine support structure of the spar buoy type, including mooring system and power cable. Optimization in this context is the same as minimizing the material cost while satisfying functional and safety related design requirements.

Relative cost of spar and mooring



Test cases show that WINDOPT can give savings in the spar buoy design, mooring system and power cable.

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

The program utilizes efficient design tools for analysis of mooring system forces and vessel motions, and combines this with a gradient method for solution of non-linear optimization problems with arbitrary constraints.

Paper presented at EWEA2011, Brussels, March 14-17 2011
Paper presented at OMAE2011, Rotterdam, June 19-24 2011

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Focus on people

Dr. Madjid Karimirad is a Post Doc in NOWITECH with the research title "Alternative offshore wind turbines for moderate water depths". He achieved his PhD with www.cesos.no this spring on "Stochastic Dynamic Response Analysis of Spar-type Wind Turbines with Catenary or Taut Mooring Systems" under supervision of Prof. Torgeir Moan. The thesis is available online through NTNU' library.

The original scientific contributions of the thesis are:

- Comparison of computer codes: HAWC2, USFOS/vpOne and Simo/Riflex (DeepC)
- Comparison of alternative hydrodynamic models for CMS and TLS (tension leg spar)
- Sensitivity study of the hydrodynamic model with respect to stochastic wave generation
- Integrated dynamic response analysis
- Investigation of the servo-induced negative damping of TLS
- Effect of rotor configuration on wind turbine performance
- Extreme value estimation for spar-type wind turbines

NOWITECH has engaged 25 PhD students and post docs dedicated to research on deep sea offshore wind technology. All are listed at the NOWITECH web.

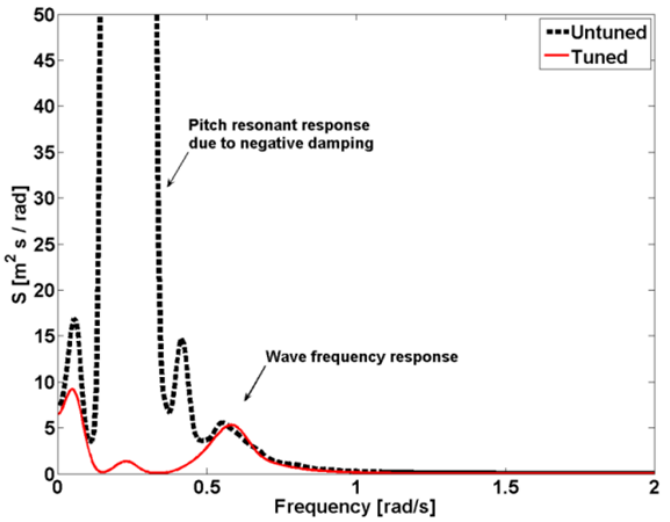
Dynamic response of TLS with downwind turbine

A glimpse of Dr Karimirad's thesis is given here.

The blade pitch control of an operating turbine can introduce negative damping in a floating wind turbine and cause additional excitation.

The figure shows the spectrum of nacelle surge motion (front/back) of a tension leg spar (TLS) with a downwind wind turbine under simultaneous wave and wind loading, and operating above rated wind speed.

Negative damping is observed for the case of assuming a standard blade pitch control. The negative damping gives significant nacelle surge motion, variations in the power production and other responses.



By tuning the controller, the pitch resonant motion was reduced, and power production was significantly improved.

These results show that negative damping adversely affects the performance and structural integrity of a floating wind turbine and should be avoided.

The ratio between the standard deviations of the nacelle surge motion with un-tuned and tuned controllers was 14.5. Analogous ratios for power production and the other responses were also large.

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A conceptual HSE framework for offshore wind farms

During installation and maintenance of offshore wind farms accidents and near-accidents have happened, which also have led to fatalities. **This challenge must be dealt with seriously and systematically by all involved actors in order to minimize both the number and consequences of unwanted events.** A general status on challenges is given in an open SINTEF report (February 2011).

In NOWITECH this work in continued by a new activity related to Health, Safety and Environment (HSE) issues, and the first aim of the task is to describe a conceptual framework for an HSE management system for offshore wind farms. The framework shows what principles and elements that should be present in HSE management systems for offshore wind farms e.g. collection and use of experience data; training; collaboration between actors, including international partners; risk assessment and communication; and emergency preparedness.

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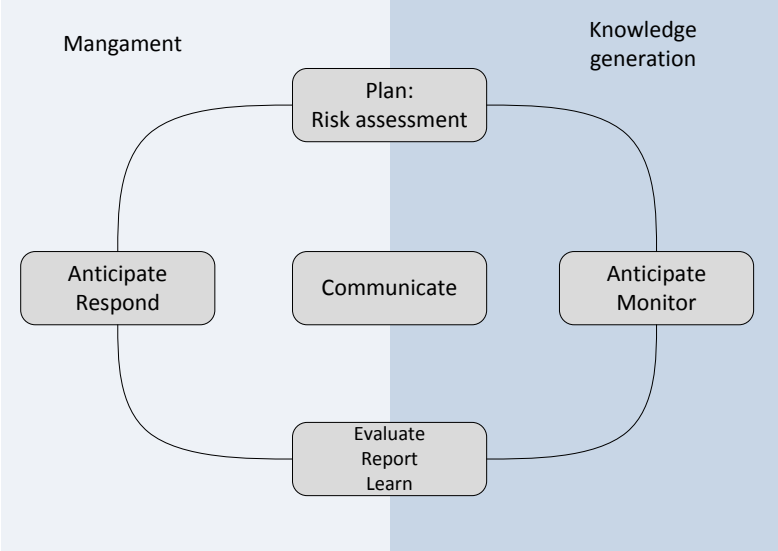
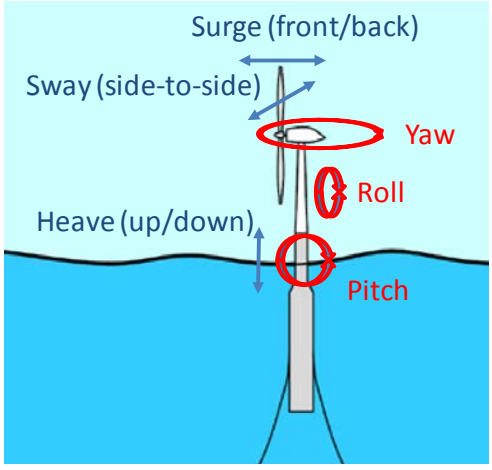
The conceptual framework relates to all life cycle phases of an offshore wind farm including design, engineering and modifications / repowering / decommissioning. Different phases require different risk indicators and focus, but interaction between phases when it comes to sharing information and cooperation for safer work conditions etc. is important in order to build a good HSE framework. An HSE framework is constructed and built and re-built as long as the industry exists.

Read more in report at NOWITECH e-room (requires password, for NOWITECH partners only). Further work on the issue within NOWITECH is pending on industry interest and prioritizing R&D.



Fact file: motions in six degrees of freedom



The motions of a floating wind turbine are defined by the six degrees of freedom:

1. Heave: linear movement up and down
2. Sway: linear movement side-to-side
3. Surge: linear movement forward - backward
4. Pitch: angular movement forward-backward
5. Yaw: angular movement around vertical axis
6. Roll: angular movement side-to-side

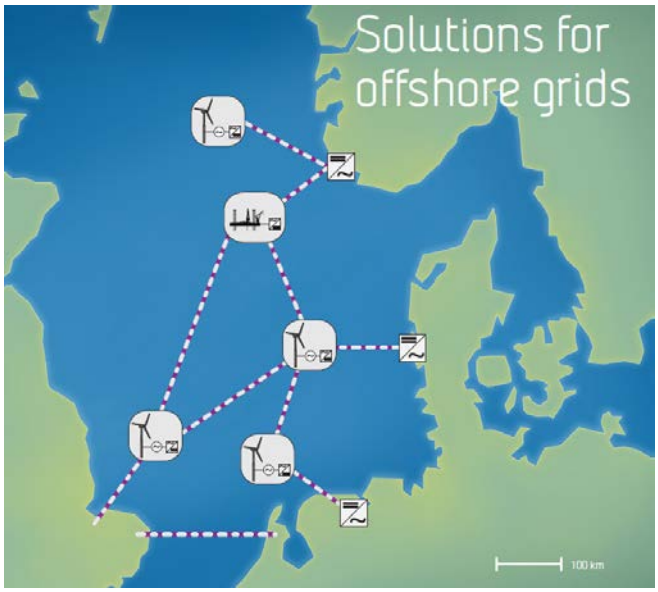
Stabilization of motions to an acceptable level is achieved by design, e.g. ballast, mooring and control system. The Tension Leg Spar has constrained heave.

A offshore grid can improve the security of supply

A North Sea Multi-terminal High Voltage DC grid has the potential to improve security of supply when interconnecting offshore wind farms and oil and gas platforms with the European power grids. This is one of the visions presented by NOWITECH at the **UK-Norway Forum and Roadmapping Workshop, 6-8th June 2011, London.** Click to see summary and presentations.

A key challenge is to identify cost-effective offshore grid configurations. This is addressed in NOWITECH.

A method is developed extending the mixed-integer linear programming approach to transmission expansion planning and accounting for variations in wind power generation and load. The method is demonstrated by a case study of the North Sea region. The method can be further developed for optimization of grids between wind farms in clusters. See article in Wind Energy, 2011, at NOWITECH e-room for further reading (requires password, for NOWITECH partners only).



A meshed HVDC grid can improve security of supply:

- A multi-terminal HVDC grid in the North Sea can effectively integrate the UK, UCTE and Nordic power systems
- Can be operated as ***one*** control area (if desirable)
- Reserves can be shared without "technical constraints"
- Fast control and protection will enable network splitting to avoid risk of cascading outages and complete blackouts
- Integrate the power markets across the asynchronous areas.

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9th Deep Sea Offshore Wind R&D Seminar, Trondheim, 19-20 January 2012 - make sure to be there!

The deep sea offshore wind potential is huge, but will only be realised if costs are reduced to a competitive level. This R&D seminar addresses exactly this, organised by the research partners in NOWITECH in cooperation with leading research institutes and universities. The presentations will be a mix of plenary presentations with broad appeal and presentations in parallel sessions and by posters on specific technical themes.

Register well in advance. The maximum number of participants is 200. NB: Sold out in previous years.

The seminar has been developing every year since 2004, and is established as an important venue on deep sea offshore wind R&D.

This year the seminar is progressing with an international scientific committee and call for papers. Abstracts for about a hundred papers are received. The papers will be published on-line in Energy Procedia (Elsevier) after careful review of relevance, quality and originality. Topics include:

- ✓ New turbine and generator technology
- ✓ Grid connection & system integration
- ✓ Met-ocean conditions
- ✓ Operation and maintenance
- ✓ Installation and sub-structures
- ✓ Wind farm modelling

For more information, registration and further details see www.sintef.no/deepwind_2012