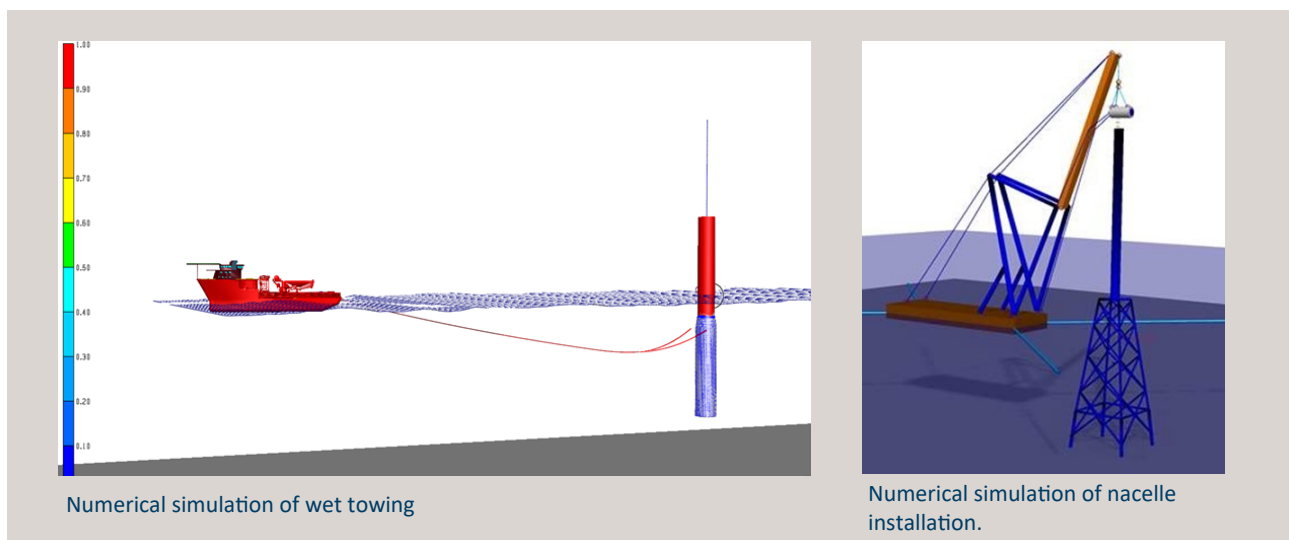


Marine Operations for Installation and Maintenance of Offshore Wind Turbines

The development of large offshore wind farms far from the mainland is challenging and involves many installation and maintenance operations which are sensitive to weather conditions. Understanding and precise prediction of these operations by tests and/or numerical simulations are important to ensure safety and efficiency in these operations. Based on this knowledge, possible solutions for further reducing the installation and maintenance costs for offshore wind industry may be formulated.



Several wind farm concepts with different challenges regarding installation and maintenance exist or are under development. New ideas for cost effective and safe installation concepts must be verified and tested.

Depending on concept, the following operations may be needed:

1. Installation phase

- Wet towing of completely or partly assembled wind turbine
- Transportation on vessel or barge of foundations, tower, blades and nacelle

- Upending of wind turbine foundation/tower at offshore site
- Lifting and installation operations of foundation, tower, nacelle and blades inshore or at offshore site
- Mooring system connection
- Power cable laying and connection

2. Operation and maintenance phase

- Repair and replacement of blades and other components
- Transfer of personnel between maintenance vessel and tower for maintenance operations
- Wet towing of complete wind turbine to sheltered area for replacement of large components like blades and nacelle

3. Decommissioning phase

This phase consists basically of the same operation tasks as in the installation phase, but in reverse orders.

OUR EXPERTISE AND SERVICES

SINTEF provides solutions to analyze different marine operation scenarios for offshore wind application. The solutions can be provided by two means: model tests and numerical simulation.

The SINTEF developed tool SIMA offers possibilities for numerical modelling of hydrodynamic response of slender marine structures and large volume floating structures. Coupling wires for towing and lifting, winches, cranes, fender/bumper/docking cone contact and ballast system can be modelled. Combination of the tools provide solution for numerical simulation of the different marine operations with body motion and line tension reported.

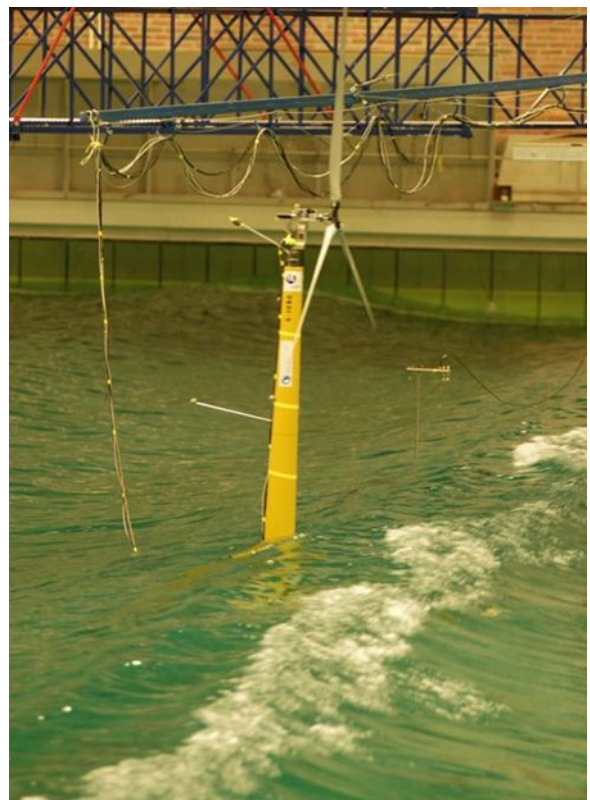
With upper limit of the allowed motion and tension specified, the limiting sea states of performing a particular operation can be identified. 3D visualization of the simulation is available.

PROJECTS/RESEARCH FIELDS

- Installation methods for fixed and floating offshore wind turbines
- Tow out and upending
- Repair and replacement methods for large components on offshore turbines
- Transfer of personnel from vessels to offshore wind turbines (walk-to-work)

ONGOING RESEARCH PROJECTS

- [SFI MOVE](http://www.ntnu.edu/web/move/move-marine-operations-center) (www.ntnu.edu/web/move/move-marine-operations-center)
- [i4Offshore](http://www.cordis.europa.eu/project/rcn/218282_en.html) (www.cordis.europa.eu/project/rcn/218282_en.html)
- [Installer](http://www.sintef.no/projectweb/installer/) (www.sintef.no/projectweb/installer/)
- WindMoor KPN



Model testing of Hywind in the Oean basin in 2005

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