Design and Verification of Offshore Wind Turbines

Offshore wind moves into deeper water to get access to larger areas for energy production and floating support structures are therefore becoming more attractive. Several floater concepts, such as semi-subs, tension leg platforms, SPAR platforms and barges, are currently being developed and some have already reached a high technology readiness level. Reducing the levelized cost of energy (LCoE) is essential in making offshore wind a viable source of renewable energy. Design and verification methods for offshore wind turbines will enable development of rational concepts where the investment cost (CAPEX) is sufficiently low and thereby contributing to reduced LCoE.

SINTEF Ocean has had an important role in the development of concepts for offshore wind turbines since 2005, when the first model of Hywind Demo was tested in SINTEF Ocean's Ocean Basin. Since then, SINTEF Ocean has had offshore wind as a prioritized research area and constantly developed numerical and experimental methods for design and verification of offshore wind turbines.

Our expertise and services

SINTEF offers several services related to offshore wind turbines:

- Global analysis, conceptual evaluation and design optimization
    - Experimental and theoretical studies
    - Assessment of foundations and floater configurations including mooring system
    - Optimization of concepts
    - Model tests for system verification
    - Hydrodynamic loads
    - Structural responses (ULS/ALS/FLS)
    - Analysis of motions and loads of marine structures
    - Mooring analysis
- Component analysis/testing:

    - Hydrodynamic model tests for components
    - Specialist studies (CFD)
    - Assessment of wave loads on bottom fixed and floating wind turbines
- Development and application of numerical methods and simulations tools
- Development of experimental methods
    - ReaTHM for aerodynamic loads
    - Slamming loads, extreme events

The **Ocean Basin Laboratory** is used for basic and applied research on marine structures and operations. A total environmental simulation including wind, waves and current offers a unique possibility for testing of models in realistic conditions. Model tests of both fixed and floating offshore wind turbines can be performed in the basin. Challenges with simultaneous scaling of wind and wave forces have led to the development of a novel experimental method called Real-Time Hybrid Model Testing ReaTHM®. This technique enables high fidelity experiments where physical waves are combined with actuated wind forces based on numerical simulations.

Ongoing research projects

- WindMoor KPN
- WAS-XL KPN (https://www.sintef.no/projectweb/was-xl/)
- Hybrid KPN (https://www.sintef.no/en/projects/real-time-hybrid-model-testing/)
- LIFES50+ (https://lifes50plus.eu/)

Links

- SIMA (https://www.sintef.no/en/software/sima/)
- Ocean Laboratoy (https://www.sintef.no/en/all-laboratories/ocean-laboratory/)
- Towing Tank (https://www.sintef.no/en/all-laboratories/towing-tanks/)

- Real-Time Hybrid Model Testing – ReaTHM® (https://www.sintef.no/en/projects/real-time-hybrid-model-testing/)
- Real-Time Hybrid Model Testing – ReaTHM® (in LIFES50+) (https://youtu.be/l3gQeD_rVe8)

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