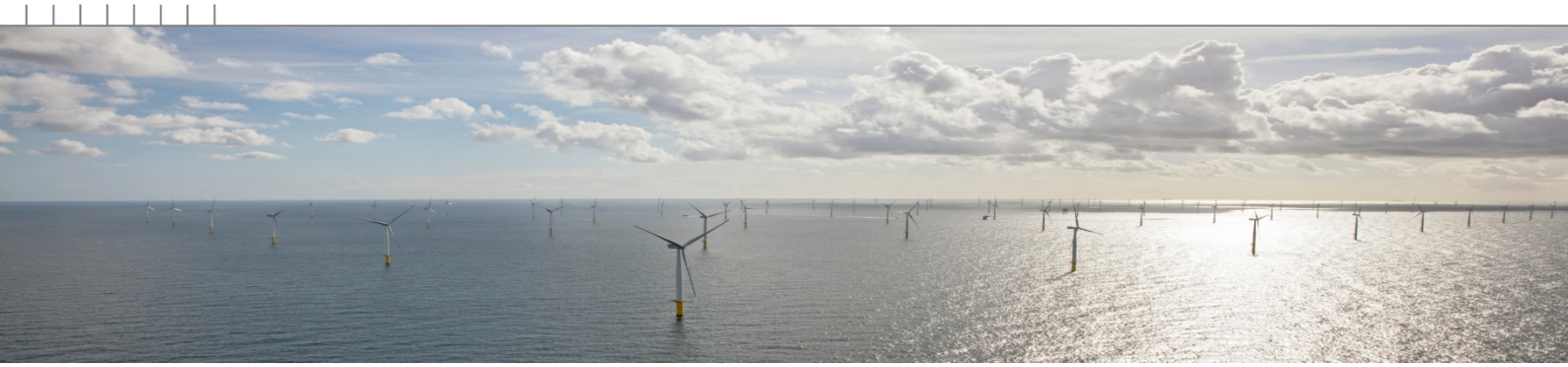


# WiFi JIP: Wave impacts on Fixed turbines

**The objective of the WiFi JIP (Wave impacts on Fixed turbines) is:**
**To improve the way effects of steep (and breaking) waves are taken into account in the design methodology of fixed offshore wind turbines, so that optimised offshore wind turbines can be developed.**

The focus of the JIP will not only be on the extreme breaking waves, but also on more moderate sea states (as their loading is complex and important as well) and waves with specific characteristics, such as steep fronted as they have an important effect on the fatigue life of an OWT. In short the overall focus of the WIFI JIP is:

- Global loading and response, including turbine due to (breaking) waves
- Wave run up and secondary structures loading due to (breaking) waves
- Extreme and fatigue loading of the OWT due to (breaking) waves, in perspective of total design
- Design alternatives: monopiles, jackets
- Improve the design and classification methods in this field

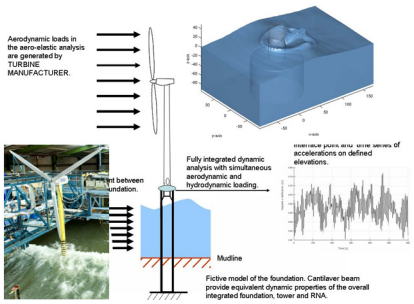
## Background

The effects of operational loads and wind loads on offshore wind turbines (OWT) are reasonably well understood. For most sites, however, the water depth is such that breaking or near-breaking waves will occur causing impulsive excitation of the foundation and, consequently, considerable stresses and displacements in the foundation, tower and turbine. To ensure the integrity and safety of future offshore wind turbines, (extreme) waves should be taken into account in the design. A considerable amount of research has been carried out in this field but further insight is required to take this effect better into account in future wind farms. Obtaining further insight into (extreme) wave loadings and their impact requires a strong cooperation between engineering experts, operating experts, hydrodynamicists and aerodynamicists and reliability specialists.

## Scope of work

The JIP objective is achieved by involving the following specialised companys for various work packages (WP1-WP11):

**Schedule**
The project will have a total duration of 3 years, including the physical model test, numerical modelling, inter-disciplinary workshops and reporting. A progress meeting for all participants will be organised twice a year and results of each work package will be reported after completion of the work package.




**Deliverables**

The output of the WIFI JIP will be a methodology to take extreme waves into account in the design of offshore wind turbine structures. The main deliverable will be an overall report step by step describing the methodology developed:

- Model test, CFD calculation and full scale measurement reports, containing the measurement and calculation results, analysed data, time records in ASCII format, applied calculation grids and discussion and validation of the results
- "Best practice" reference document, guidelines and case study results describing the step-by-step analysis and design approach

Beside this overall report, each Work Package will provide a detailed report of its findings. All the model test results of the project will be available for the participants of the JIP also electronically.

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## Phase 1: Review and research phase

- WP1 leaders DNV and GL, will summarise the state of art methods and design requirements for calculating loads from (breaking) waves on OWT structures provided by different standards and guidelines
- WP2 leaders Ramboll and ECN will select 2 different OWT structures (monopole, tripod, jacket,..) and 2 different (future) wind farm areas for which a base line design study will be performed for the in WP1 summarised methods, which will then be reviewed by offshore specialist
- WP3 leader MARIN will provide model test results for the two selected OWT's for validation of the numerical simulations
- WP4 leader Deltares will determine by means of physical modelling tests the influence of several sensitivity parameters in the North Sea (water depth, local variations of bed forms) on the local wave climate conditions and will provide realistic 2D wave spectra in which extreme breaking waves can occur, their kinematics and their short term statistics
- WP5 leaders GL and MARIN will review the capabilities of available numerical methods for calculating the response of the OWTs and other aspects like wave run-up due to (breaking) waves
- WP6 leaders ECN and MARIN will analyse the hydro-elastic response of a OWT due to wave, wind and current loading based on available full scale measurement results. Furthermore, additional full scale measurements will be prepared, which will be conducted in WP8

### *Phase 2: Evaluation and methodology development phase*

- WP7 leaders ECN and MARIN will provide detailed model test results for the two selected OWTs including sensitivity analysis of various parameters (seabed level, wave height, soil, ..) for validation of the new design methods
- WP8 leaders ECN and MARIN Will provide analyses of the performed detailed full scale measurements on the response of a OWT. The results will be used to compare against the model tests results and for validation of the new design methods
- WP9 leaders GL and MARIN will provide detailed numerical calculation results of the response of OWT's and other aspects like wave run-up due to (breaking) waves calculated by means of (improved) simplified methods up to V.O.F. CFD tools coupled with FEM, against the model test results and full scale data
- WP10 leaders Ramboll, DNV and GL will provide an improved design method for calculating the response of OWTs due to (breaking) waves, validated against the model tests and the full scale measurements

### *Phase 3: Recommendation phase*

- WP11 leaders Ramboll, DNV, GL and ECN will provide a case study of the OWTs selected in WP 2 with the new design method developed in WP10, including sensitivity analysis of different parameters (seabed level, wave height, soil, ...)

## Invitation

The WiFi JIP aims at the following participants:
Turbine designers, offshore enginering companies, Turbine manufacturers, operational contractors, windpark developers, classification societies and (renewable) energy companies.