

A photograph of an offshore wind farm in the ocean. The sky is blue with scattered white clouds. The water is dark blue with white foam from a boat's wake in the foreground. Five wind turbines are visible in the distance, stretching across the horizon.

# METOCEAN DESIGN DATA

APPLICATION FOR OFFSHORE WIND FARM FOUNDATIONS

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## APPLICATION FOR OFFSHORE WIND FARM FOUNDATIONS

In the design of offshore wind farms as well as other offshore structures, it is important to have accurate and complete metocean data on wind, waves, water level and current so that when setting up a design basis, the design process and the verification process are not compromised.

As the foundation design basis (which is highly dependent on the metocean study) is usually subject to verification/certification, it is extremely important that the scope of and requirements for the metocean study are agreed upon with the verification body prior to initiating the design basis work. Failing to do so may result in delays in highly inconvenient phases of the design process.

In most cases the wind climatic conditions are described in a separate report. The wind climatic conditions are mostly used by the wind turbine manufacturers in their

load calculations and design, whereas the metocean conditions are mostly used by the foundation designers. However as these data sets have to be fitted together to some degree, it is highly recommended, at an early stage in the project, to ensure that those responsible for the wind climatic conditions and the metocean conditions agree on essential issues, such as directional intervals, as the interaction between wind turbine manufacturer and foundation designer is extensive in the detailed design.

It is estimated that the total steel quantity required for the foundations may be reduced by up to 25% when using the most detailed requested data rather than an inadequate and incomplete data set. In other words, the cost of the metocean study can easily save much more in the steel purchase.

### Examples of inadequate data

- Raw time series to be post-processed by e.g. the foundation designer. The foundation designer cannot take any responsibility for the raw data, but only the post-processing they are in control of. Certifying bodies will have to do exactly the same post-processing as the designer.
- It is a time consuming challenge if the raw data are from two different sources that are not synchronised e.g. wave data from a buoy and wind data from a metmast.

### Example of incomplete and inconsistent data

- Missing tables making it difficult to establish the design basis.
- Different total count in various tables.
- Different values specified for the same property in different tables.
- In essence this will have to be commented on by the foundation

designer as well as the certifying body and rectified by the metocean/wind assessment contractor, making the certification process more time consuming than necessary.

### Metocean study

In order to ensure that the background data for the foundation design are adequate and complete, Ramboll can offer to produce a complete metocean report applicable for a specific project site. The metocean report will include all data analyses and presentations to form the fundamental background data for a reliable foundation design.

The necessary background data to be used for the metocean data analysis will consist of validated and certified long duration time series of hindcast data from highly experienced data providers using state-of-the-art numerical models in

combination with meteorological input data from recognised institutions.

A metocean report will include a description of all necessary background data such as:

- Bathymetry
- Morphology
- Wind
- Water levels and current
- Waves
- Additional parameters (e.g. temperature, salinity, ice), if available

The analyses carried out for the metocean report will include the following elements:

- Rose plots
- Extreme value analyses for selected return periods (typically 1, 10, 50 and 100 years)
- Scatter tables and plots
- Exceedance and persistence probabilities

- All analyses will be made with respect to directional intervals as well as seasonal analyses.

All data analyses and presentations are made using software from the recognized DHI MIKE package as well as software developed in-house.

### Metocean study references, offshore wind farms

- Gode Wind II, Germany
- Atlantic City, US
- Humber Gateway, UK

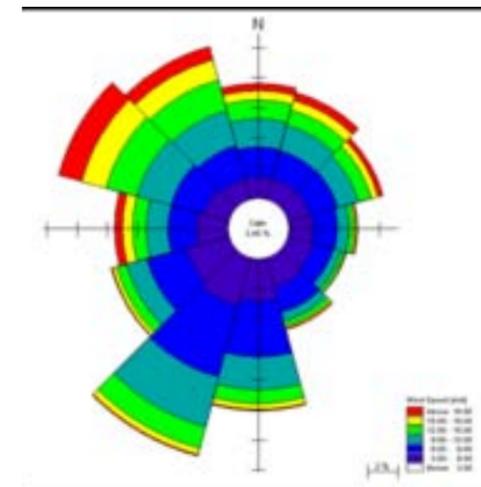
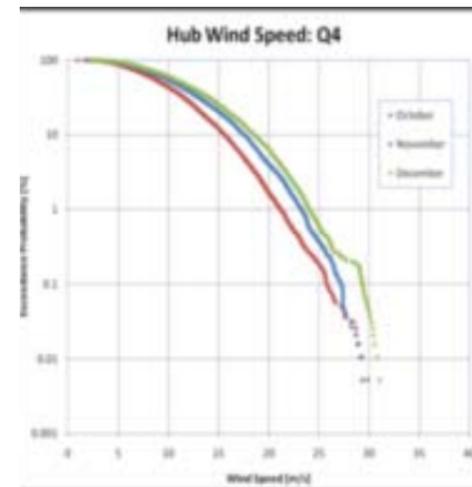
### RISK MATRIX

In short the quality of the Metocean Background Data versus Risk Level and Extra Costs is summarized in the below table:

Risk Level and Extra Costs:	Background Data:
HIGH	Inadequate, Incomplete AND Uncertified.
MEDIUM	Inadequate, Incomplete OR Uncertified.
LOW	Adequate, Complete AND Certified.

### FACTS ABOUT OFFSHORE WIND

Ramboll is a leading engineering, design and consultancy company founded in Denmark in 1945. We employ close to 10,000 experts, and with more than 200 offices in 23 countries we emphasise local experience combined with a global knowledge base. We constantly strive to achieve inspiring and exacting solutions that make a genuine difference to our customers, the end-users and society as a whole. Ramboll operates within the areas of: Buildings & Design, Infrastructure & Transport, Energy & Climate, Environment & Nature, Industry & Oil/Gas, IT & Telecom and Management & Society. Ramboll's Offshore Wind division has almost 100 dedicated employees situated in our three main offices in London, Copenhagen and Esbjerg as well as in our hub offices in Hamburg and New York.



**FURTHER INFORMATION**  
For further information on Metocean studies and our capabilities please contact:  
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