

**HOLLANDSE KUST OWF, SITE CONDITIONS**

**Standards & guidelines related to Hollandse Kust (Zuid) and Hollandse Kust (Noord) wind farm zones**

**Netherlands Enterprise Agency (RVO.nl)**

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#### Task and objective:

The objective is to list which standards related to site conditions that are relevant for the design of offshore wind turbines, high voltage cables, substations and their support structures.

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Reference to part of this report which may lead to misinterpretation is not permissible.

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## 1 EXECUTIVE SUMMARY

The Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland –RVO-), awarded DNV GL the contract for Certification Procedures for the Certification of Site studies for Hollandse Kust (Zuid) and Hollandse Kust (Noord) wind farm zones, which are located in the Dutch Exclusive Economic Zone (EEZ). This report lists which standards related to site conditions that are relevant for the design of offshore wind turbines, high voltage cables, substations and their support structures.

## 2 INTRODUCTION

The Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland –RVO-), awarded DNV GL the contract for Certification Procedures for the Certification of Site studies for Hollandse Kust (Zuid) and Hollandse Kust (Noord) wind farm zones, which are located in the Dutch Exclusive Economic Zone (EEZ). As part of the contract DNV GL is asked to list which standards related to site conditions, that are relevant for the design of offshore wind turbines, high voltage cables substations and their support structures.

The establishment of site conditions for the Wind Farm Zones have to be done according to

- IEC, 61400-1
- IEC 61400-3
- DNV-OS-J101

The principles and methods for:

- data acquisition
- statistical methods applied
- establishment of design parameters

related to

- Geotechnical Site Investigations.
- Geophysics & Hydrographic Geotechnical Site Investigations.
- Metocean Geotechnical Site Investigations.
- Wind Resource Assessment.
- Morphodynamic desk Study.

are described further in the standards/ recommendations presented in this report.

## 3 GEOTECHNICAL SITE INVESTIGATIONS

The geotechnical site investigation and laboratory testing are assumed to be carried out by companies with relevant experience from similar work. The quality of the soil investigation and the test results shall fulfil the requirements given in Eurocode 7 Part 2.

All parts of ISO/IEC 17025 may not necessarily apply to the geotechnical field and laboratory work. In all cases, a description of all test procedures and relevant standards shall be presented by the laboratory.

Guidance and industry practice regarding requirements to scope, execution and reporting of offshore soil investigations, and to equipment

- CEN TC 250/SC 7 Eurocode 7 Geotechnical Design, CEN TC 288. Execution of Special geotechnical Works
- API Recommended Practice 2A-WSD, Planning, Designing, and Constructing Fixed Offshore Platforms —Working Stress Design
- DNV Classification Notes No. 30.4
- NORSOK N-004 (App. K)
- NORSOK G-001.
- ISO 22475-1. Geotechnical investigation and testing — Sampling methods and groundwater measurements —
- ISO International Organization for Standardization (2002), "Geotechnical Investigation and Testing -
- Identification and Classification of Soil - Part 1: Identification and Description", International Standard ISO 14688-1:2002.

- ISO International Organization for Standardization (2004), "Geotechnical Investigation and Testing -Identification and Classification of Soil - Part 2: Principles for a Classification", International Standard ISO 14688-2:2004
- ISO 19901-4:2003, Petroleum and natural gas industries – Specific requirements for offshore structures – Part 4: Geotechnical and foundation design considerations
- ASTM International (2011), "Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)", ASTM D2487-11.
- ASTM International (2009), "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)", ASTM D2488-09a.
- ASTM International (2007), "Standard Classification of Peat Samples by Laboratory Testing", ASTM D4427-07.
- BSI British Standards Institution (1999), "Code of Practice for Site Investigations", British Standard BS 5930:1999.

## 4 GEOPHYSICAL & HYDROGRAPHIC SITE INVESTIGATIONS

**Geophysics Surveys** procedures/principles are presented in

- D6429-99 Standard Guide for Selecting Surface Geophysical Methods
- D6431-99 Standard Guide for Using the Direct Current Resistivity Method for Subsurface Investigation
- D6432-99 Standard Guide for Using the Surface Ground Penetrating Radar Method for Subsurface Investigation
- D5777-00 Standard Guide for Using the Seismic Refraction Method for Subsurface Investigation
- D6639-01 Standard Guide for Using the Frequency Domain Electromagnetic Method for Subsurface Investigation
- D6820-02 Standard Guide for Use of the Time Domain Electromagnetic Method for Subsurface Investigation

**Hydrographic survey** procedures/principles are presented in

- DUTCH STANDARDS FOR HYDROGRAPHIC SURVEYS 1st edition, July 2009 based on IHO STANDARDS FOR HYDROGRAPHIC SURVEYS (S-44) 5th edition, February 2008
- IHO (2008). IHO Standards for Hydrographic Surveys. Special publication No. 44. International Hydrographic Bureau, Monaco

## 5 METOCEAN CONDITIONS

The MetOcean (Metrological and Ocean) conditions provided may be derived from site-specific measurements supported by hindcast. Site-specific measurements shall be correlated with data from a nearby location for which long term measurements exist. The monitoring period for the site-specific measurements shall be sufficient to obtain reliable data for design.

The site-specific measurements shall be carried out and documented as required in IEC 61400-3 / DNV-OS-J101 unless a conservative approach is adopted.

### Wind Data

Evaluation of Site Specific Wind Conditions shall be made according to

- Measnet, "MEASNET Procedure: Evaluation of Site Specific Wind Conditions, Version 1, November 2009.," Tech. Rep. November, Measnet Network of Wind Energy Institutes, 2009.
- Guide to Meteorological Instruments and Methods of Observation WMO-No. 8 Seventh edition 2008

## MetOcean Buoy Measurements

Evaluation of metOcean buoy measurements shall be made according to

- The Quality control (QC) procedures/principles presented in
- NDBC Technical Document 09-02 'Handbook of Automated Data Quality Control Checks and Procedures' National Data Buoy Center Stennis Space Center, Mississippi 39529-6000 August 2009 U.S. DEPARTMENT OF COMMERCE

to ensure the accuracy of buoy measurements for

- Wind direction, speed, and gust
- Air and water temperature
- Wave energy spectra (non-directional and directional)
- Ocean current velocity
- Salinity
- Water level

## 6 WIND RESOURCES

The long-term wind resources shall be based on an evaluation of the Site Specific Wind Conditions, see section 5. It shall be noted that for the energy production it is conservative to use low wind speeds, while for structural design it is conservative to use high wind speeds.

## 7 MORPHODYNAMIC DESK STUDY

The Morphodynamic Desk Study shall be based on long term extrapolation of measured Bathymetries (see the **Hydrographic survey** procedures/principles presented in section 2). The long term extrapolation shall among others be based on

- Bathymetrical measurements
- Uncertainties in Bathymetrical measurements
- The MetOcean conditions in the wind farm area (including long term fluctuations).
- The sediment properties
- The geophysical properties in area

It shall be noted that presently no guidelines/ standards are available for how such extrapolation shall be made.

## 8 CONCLUSIONS

The report presents standards & recommendations for:

- data acquisition
- statistical methods applied
- establishment of design parameters

Related to the

- Geotechnical Site Investigations.
- Geophysics & Hydrographic Geotechnical Site Investigations.
- Metocean Geotechnical Site Investigations.
- Wind Resource Assessment.
- Morphodynamic desk Study.





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