



DNV-OS-J101

DESIGN OF OFFSHORE WIND TURBINE STRUCTURES



Introduction

For design of support structures for offshore wind turbines DNV has developed a new design standard.

The title of the new standard is 'Design of Offshore Wind Turbine Structures', DNV-OS-J101.

The DNV standard is based on experience with more than 20 offshore wind projects as well as general rule development from the maritime and offshore industry for decades.

Content of the DNV Offshore Standard

The standard focuses on structural design, manufacturing, installation and follow-up during the in-service phase for the support structure, i.e. all structural parts below the nacelle including the soil.

The standard includes the following chapters:

- Introduction
- Design principles
- Site conditions
- Loads and load effects
- Load and resistance factors

- Materials
- Design of steel structures
- Design of concrete structures
- Grouted connections
- Foundation design
- Inspections during manufacturing
- Corrosion protection
- Transport and installation
- In-service inspection, maintenance and monitoring

Following some main aspects are described in brief.



Design Principles

The target safety level aimed for in the standard is an annual probability of failure of 10^{-4} for primary structure and 10^{-3} for secondary structure.

The above is valid for structures with ductile failure modes with no reserve capacity.

For comparison it should be noted that the target safety level for manned offshore oil & gas structures typically is in the order of 10^{-6} (annual probability of failure) where clearly the risk for loss of human life as well as the risk for pollution to the environment should be in focus.

This fact makes the DNV-OS-J101 a cost effective design standard while at the same time living up to the safety levels required by authorities and other parties involved in offshore wind projects.

Site Conditions

The chapter regarding site conditions covers among other topics how to determine an extreme design wave in a consistent manner as well as how to define a soil investigation programme sufficient for design and construction purposes.

Important site conditions are:

- wind climate
- wave climate
- current
- water level
- ice
- soil
- other

Determination of the site conditions is typically the responsibility of the wind farm developer and should be performed at an early stage in the project.

Loads and Load Effects

Typically loads to be considered includes breaking waves and ice loads in addition to the normal wind, wave and permanent loads.

Load combination are described in detail.

Steel structures

Design of steel structures are often mainly governed by fatigue. Updated fatigue design rules are therefore described in details.

Foundations

Design of foundations are comprehensively covered in detail with focus on monopile and gravity foundations – solutions that are typically used for offshore wind turbines. However, other foundation concepts are included in the standard.

Grouted Connections

A solution often chosen for monopile foundations is the grouted connection between the monopile and corresponding transition piece. Design requirements for such grouted connections are included in the DNV standard.

Manufacturing, Installation and In-service Phase

Requirements to the manufacturing, installation and in-service phases are given with focus on the structural integrity of the installed structure.

The above is just a short description of the content – please refer to the DNV Offshore Standard for a full description.

How to acquire the standard

The DNV Offshore Standard may be ordered at :

DNV Global Wind Energy

Email:

windenergy@dnv.com

Tel. +45 39 45 48 00

Fax. +45 39 45 48 01

For a full list of available DNV rules and standards, please refer to our web page:

www.dnv.com/publications.



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