
**Ships and marine technology —
Offshore wind energy — Port and
marine operations**

*Navires et technologie maritime — Énergie éolienne offshore —
Opérations portuaires et maritimes*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*.

This second edition cancels and replaces the first edition (ISO 29400:2015), which has been technically revised.

The main changes compared to the previous edition are as follows:

- [Clause 3](#): terms and definitions revised; new entries inserted;
- [Clause 7](#), “Metocean requirements”: fully revised;
- [Clause 20](#), “Cable loadout and offshore transfer”: new subclause added;
- revisions made throughout most other clauses;
- [Annex A](#): revised.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document applicable to the offshore wind industry constitutes a comprehensive and common basis covering port and marine operations of all offshore structures installed and maintained by the offshore wind industries worldwide. Through its application, the intention is to achieve reliability levels appropriate for offshore wind farm components, whatever the type of structure and the nature or combination of materials used.

It is important to recognize that during port and marine operations the structural integrity of the component is an overall concept comprising models for describing actions, structural analysis, design rules, safety elements, workmanship, quality control procedures and national requirements, all of which are mutually dependent. The modification of one aspect of design in isolation can disturb the balance of reliability inherent in the overall concept or structural system. It is necessary, therefore, to consider the implications involved in modifications in relation to the overall reliability of structures in offshore wind farms.

This document applicable to offshore wind farms is intended to provide a wide latitude in the choice of structural configuration, material and techniques without hindering innovation. Sound engineering judgment is, therefore, necessary in the use of this document.

This document was developed to provide comprehensive requirements and guidance for the planning, engineering and safe execution of port and marine operations for all types of offshore wind farm components including cable-laying and burial operations and installation and operation of floating turbines moored to the seabed.

Port operations for installation of components of offshore wind farms cover all component transport to the ports, whether marine or via inland waterways, any intermediate storage, as well as preassembly activities at the ports until placing the components close to any quayside for subsequent marine operations to start.

Marine operations for offshore wind farm structures cover loadout from the quayside, offshore transportation and installation phases when the structure is at risk from the marine environment including any marine logistics during offshore commissioning works, operation and maintenance, component exchange, repair operations and decommissioning or redeployment.

This document describes the principles of, and provides requirements and guidance for, port and marine operations associated with foundations, substructures, WTG, cables and topsides installed in offshore wind farms, from the point of view of planning, engineering, construction and documentation. Alternative requirements, methods and provisions can fulfil the intention of this document and may be applied, provided it can be demonstrated that they achieve at least the same level of assurance and reliability. The overall objective of this document is to ensure that port and marine operations are conducted within defined and recognized safety and reliability levels, wherever they are performed. Additional standards, codes and guidelines should also be taken into account, where applicable. Special attention should be paid to national regulations governing the area in which the port and marine operations are performed.

It is not the intent of this document to govern the design of structures, systems and components used in port and marine operations, beyond the principles given. Recognized codes and standards are normally accepted as the basis for the detailed design and the fabrication requirements of such components.

[Annex A](#) provides some background and some additional information to the main body of the document and it is intended that it be read in conjunction with the main body of the document.

This document is based on ISO 19901-6 while adapting it extensively to the specific requirements of the offshore wind industry.

NOTE Port and marine operations of offshore wind farms are covered in local, national and international regulations.

Ships and marine technology — Offshore wind energy — Port and marine operations

1 Scope

This document provides comprehensive requirements and guidance for the planning and engineering of port and marine operations of offshore wind farms, encompassing all documents and works related to such operations, e.g. the design and analysis of the components, systems, equipment and procedures required to perform port and marine operations, as well as the methods or procedures developed to carry them out safely.

This document is intended to be comprehensive, covering all relevant information related to port and marine operations necessary for loadout, offshore transport, installation, offshore commissioning works, operation and maintenance, component exchange, repair operations and decommissioning or redeployment of offshore wind farms.

This document is applicable to port and marine operations for offshore structures including:

- lattice structure foundations made from steel;
- concrete gravity base structures (GBS);
- piled steel foundation or mixed steel and concrete foundation structures;
- subsea templates and similar temporary structures or installation aids;
- steel or mixed material towers, nacelles and blades forming part of the wind turbine generators (WTG);
- floating turbines moored to the seabed;
- self-elevating offshore units for offshore substations or offshore accommodations platforms;
- launching systems at sea from quay side or onshore;
- array cables within the wind farms as well as export cables connecting the wind farm to the grid.

This document is also applicable to modifications of existing structures, e.g. installation of additional modules, exchange of components or decommissioning, and to marine operations during the service life of the windfarm related to the technical maintenance works.

It is not applicable to the following operations:

- construction activities, e.g. in a fabrication yard onshore, where there is no exposure to the marine environment;
- road transport onshore;
- diving.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 29400:2020(E)

ISO 19901-1, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 1: Meticulous design and operating considerations*

ISO 19901-7, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 7: Stationkeeping systems for floating offshore structures and mobile offshore units*

ISO 19905-1, *Petroleum and natural gas industries — Site-specific assessment of mobile offshore units — Part 1: Jack-ups*

IMCA LR 008, M 179, *Guidance on the Manufacture and Safe Use of Cable Laid Slings and Grommets*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 action

external load applied to the *structure* (3.153) (direct action) or an imposed deformation or acceleration (indirect action)

Note 1 to entry: An imposed deformation can be caused by fabrication tolerances, settlement, temperature change or moisture variation.

Note 2 to entry: An earthquake typically generates imposed accelerations.

[SOURCE: ISO 19904-1:2006, 3.5]
<https://standards.iteh.ai/catalog/standards/sist/72ef301d-0882-4155-8cb5-5632bb14fc0f/iso-29400-2020>

3.2 action effect

effect of *actions* (3.1) on structural components

EXAMPLE Internal forces, moments, stresses, strains, rigid body motions or elastic deformations.

[SOURCE: ISO 19904-1:2006, 3.5]

3.3 adverse weather

meteorological and oceanographic conditions which can affect people, operations, equipment or facilities, to such an extent that precautionary measures must be taken to safeguard the facility to maintain a safe system of work

Note 1 to entry: Adverse weather includes, snow, ice, hail, lightning, heavy rain, high wind, low cloud base, poor visibility, severe sea states and strong *currents* (3.32). Weather conditions can change quickly and the effects of short-term variations such as wind gusts must be considered.

3.4 air cushion

air pumped into underbase compartments of the *structure* (3.153)

Note 1 to entry: An air cushion is normally applied in order to reduce the draught and increase the freeboard and/or to alter the structural loading.

[SOURCE: ISO 19903:2006, 3.10, modified - Note 1 to entry has been slightly reworded for clarity.]

3.5**alpha factor****metocean reduction factor**

maximum ratio of operational criteria/design environmental condition for weather restricted *marine operations* (3.82) to allow for weather forecasting inaccuracies

Note 1 to entry: See also 3.91.

Note 2 to entry: [SOURCE: Reference [56], modified for clarity.]

3.6**array cable**

cable between *wind turbine generators* (3.176) (WTG) and between a WTG and the *offshore substation* (3.102) connecting the WTGs with the *offshore substation* (3.102)

3.7**as-built data****as-laid data**

data coming from final as built survey once every cable or *structure* (3.153) have been connected and tested and possibly corrected or repaired

Note 1 to entry: Final as built report includes final status of the field.

Note 2 to entry: "as-laid data" are coming from survey performed just after laying the cable or after structure installation before any test and connection. Data includes position in 3D, status, possible damages location and picture if possible, possible debris location around within target box or corridor including picture if possible.

3.8**assembly**

designed and fabricated group of bulk and equipment items that form one unit

[SOURCE: ISO 19901-5:2016, 3.1.1]

ISO 29400:2020

<https://standards.iteh.ai/catalog/standards/sist/72ef301d-0882-4155-8cb5-5632bb14fc0f/iso-29400-2020>

3.9**ballast**

variable solid or fluid content in order to change the draught, stability, trim and/or heel of a *structure* (3.153) afloat

[SOURCE: ISO 19901-5:2016, 3.1.2, modified for clarity.]

3.10**ballast system**

system used to change the draught, stability, trim and/or heel of a *structure* (3.153) afloat

3.11**barge**

simple floating vessel, normally non-propelled, on which material components of an *offshore wind farm* (3.103), material, people and equipment can be transported

3.12**basic variable**

one of a specified set of variables representing physical quantities that characterize *actions* (3.1), environmental influences, geometrical quantities or material properties, including soil properties

[SOURCE: ISO 19900:2013, 3.7]

3.13**bending efficiency factor**

factor by which the calculated breaking strength of a rope is reduced to take account of the reduction in *strength* (3.152) caused by bending around a shackle, *trunnion* (3.165), *padear* (3.108) or crane hook

[SOURCE: ISO 19901-6:2009, 3.9]