IEC 61400-3-2

Edition 1.0 2025-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Wind energy generation systems –
Part 3-2: Design requirements for floating offshore wind turbines

Systèmes de génération d'énergie éolienne –
Partie 3-2: Exigences de conception des éoliennes en mer flottantes

IEC 61400-3-2:2025-01(en-fr)

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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WIND ENERGY GENERATION SYSTEMS –

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FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 61400-3-2 has been prepared by IEC technical committee 88: Wind energy generation systems. It is an International Standard.

This first edition cancels and replaces IEC TS 61400-3-2, published in 2019. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC TS 61400-3-2:

a) The relevant contents of IEC 61400-3-1 have been migrated into IEC 61400-3-2, making IEC 61400-3-2 a self-standing document that does not have to be read directly in conjunction with IEC 61400-3-1.

b) Several modifications have been made regarding metocean conditions in Clause 6 considering the nature of FOWT and the offshore site where FOWT will be installed, including: (1) the importance of wave directional spreading has been highlighted as it may result in larger loads for FOWT, including the addition of the new informative Annex O and Annex P and (2) the characteristic of swell has been explained, which may be relevant for some FOWT projects, including the addition of new informative Annex R regarding the characteristic of swell.

c) Subclauses 7.1, 7.2, 7.3, 7.4 and 7.5 have been changed to include a revised DLC table and its related descriptions, including amongst others updated requirements on directionality, wave conditions, redundancy check and damage stability cases, and a robustness check case; further updates are made related to guidance and necessities provided on load calculations and simulation requirements.

d) Subclause 7.6 has been updated with guidance on fatigue assessment along with clarifications on serviceability analysis and the applicable material for WSD; related Annex L has been updated and a new Annex M has been added for clarification of the safety factors and load and load effect approach for floating substructures.

e) The concept of floater control system that will interact with the wind turbine controller has been introduced in Clause 8.

f) Clause 11 has been renamed from "Foundation and substructure design" to "Anchor design" and requirements for the transient conditions have been added.

g) A more detailed clause regarding concrete design has been added to Clause 16 together with an informative Annex Q.

h) Clause 15 has been updated with the aim to improve ease of use, using experience from oil and gas and considering unique wind turbine characteristics; updates included guidance for TLPs, damage stability, dynamic stability, testing and the addition for Annex S regarding how to analyse collision probability.

This International Standard is to be read in conjunction with IEC 61400-1, *Wind energy generation systems – Part 1: Design requirements*.

The text of this International Standard is based on the following documents:

Draft	Report on voting
88/1028/FDIS	88/1050/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This publication was drafted in accordance with the ISO/IEC Directives, Part 2, and developed in accordance with the ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts of the IEC 61400 series, published under the general title *Wind energy generation systems*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

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INTRODUCTION

This part of IEC 61400 outlines the minimum design requirements for floating offshore wind turbines (FOWT) and is not intended for use as a complete design specification or instruction manual.

Several different parties may be responsible for undertaking the various elements of the design, manufacture, assembly, installation, erection, commissioning, operation and maintenance of a FOWT and for ensuring that the requirements of this document are met. The division of responsibility between these parties is a contractual matter and is outside the scope of this document.

Any of the requirements of this document may be altered if it can be suitably demonstrated that the safety of the system is not compromised. Compliance with this document does not relieve any person, organization, or corporation from the responsibility of observing other applicable regulations.

WIND ENERGY GENERATION SYSTEMS –

Part 3-2: Design requirements for floating offshore wind turbines

1 Scope

This part of IEC 61400 specifies requirements for assessment of the external conditions at a floating offshore wind turbine (FOWT) site and specifies essential design requirements to ensure the engineering integrity of FOWTs. Its purpose is to provide an appropriate level of protection against damage from all anticipated hazards during the planned lifetime.

This document focuses on the engineering integrity of the structural components of a FOWT but is also concerned with subsystems such as control and protection mechanisms, internal electrical systems and mechanical systems.

A wind turbine shall be considered as a FOWT if the floating substructure is subject to hydrodynamic loading and supported by buoyancy and a stationkeeping system. A FOWT encompasses five principal subsystems: the RNA, the tower, the floating substructure, the stationkeeping system and the onboard machinery, equipment and systems that are not part of the RNA.

The following types of floating substructures are explicitly considered within the context of this document:

- ship-shaped structures and barges,
- semi-submersibles (Semi),
- spar buoys (Spar),
- tension-leg platforms/buoys (TLP / TLB).

This document can be utilized for structural types other than listed above, but special consideration may be needed to support novel features to achieve the same target safety level. These other structures can have a great range of variability in geometry, materials and structural forms and, therefore, can be only partly covered by the requirements of this document. In other cases, specific requirements stated in this document can be found not to apply to all or part of a structure under design. In all the above cases, conformity with this document will require that the design is based upon its underpinning principles and achieves a level of safety equivalent, or superior, to the level implicit in it.

This document is applicable to unmanned floating structures with one single horizontal axis turbine. While generally applicable, additional considerations may be needed, e.g., for multi-turbine units on a single floating substructure, vertical-axis wind turbines, FOWTs with shared moorings, spinning spars, floating structures without a stationkeeping system, or combined wind/wave energy systems.

This document is to be used together with the appropriate IEC and ISO standards mentioned in Clause 2. In particular, this document is fully consistent with the requirements of IEC 61400-1. In the event of requirements that may conflict between this document and the normative references, the requirements stated in this document supersede those of the references.

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 dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60721 (all parts), *Classification of environmental conditions*

IEC 61400-1:2019, *Wind energy generation systems – Part 1: Design requirements*

IEC 61400-3-1, *Wind energy generation systems – Part 3-1: Design requirements for fixed offshore wind turbines*

IEC 61400-13, *Wind turbines – Part 13: Measurements of mechanical loads*

IEC 61400-15-1, *Wind energy generation systems – Part 15-1: Site suitability input conditions for wind power plants*[1]

IEC 61400-24, *Wind turbines – Part 24: Lighting protection*

IEC TS 61400-30:2023, *Wind energy generation systems – Part 30: Safety of wind turbine generators – General principles for design*

ISO 2394, *General principles on reliability for structures*

ISO 2533, *Standard Atmosphere*

ISO 18692-1, *Fibre ropes for offshore stationkeeping – Part 1: General specification*

ISO 18692-2, *Fibre ropes for offshore stationkeeping – Part 2: Polyester*

ISO 18692-3, *Fibre ropes for offshore stationkeeping – Part 3: High modulus polyethylene (HMPE)*

ISO 19900, *Petroleum and natural gas industries – General requirements for offshore structures*

ISO 19901-1, *Petroleum and natural gas industries – Specific requirements for offshore structures – Part 1: Metocean design and operating conditions*

ISO 19901-4, *Petroleum and natural gas industries – Specific requirements for offshore structures – Part 4: Geotechnical and foundation design considerations*

ISO 19901-6, *Petroleum and natural gas industries – Specific requirements for offshore structures – Part 6: Marine operations*

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 19902, *Petroleum and natural gas industries – Fixed steel offshore structures*

[1] Under consideration. Stage at the time of publication: IEC/AFDIS 61400-15-1:2023.

ISO 19903, *Petroleum and natural gas industries – Concrete offshore structures*

ISO 19904-1, *Petroleum and natural gas industries – Floating offshore structures – Part 1: Ship-shaped, semi-submersible, spar and shallow-draught cylindrical structures*

ISO 19906, *Petroleum and natural gas industries – Arctic offshore structures*

ISO 29400, *Ships and marine technology – Offshore wind energy – Port and marine operations*

API RP 2T, *Planning, Designing, and Constructing Tension Leg Platforms*

IMO *International Code on Intact Stability*, 2008 (2008 IS CODE), 2020 Edition

IMO *2009 MODU CODE*, 2020 Edition

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61400-1 and the following apply.

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

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

3.1
air gap
clearance between the highest water surface that occurs during the extreme environmental conditions and the lowest exposed part not designed to withstand wave impingement

3.2
anchor
device attached to the end of the mooring line or tendon and partially or fully buried in the seabed to limit the movement of the mooring line or tendon and to transfer loads to the seabed

Note 1 to entry: Available options for anchoring floating structures include drag anchors, anchor piles (driven, jetted, suction, torpedo/gravity-embedded and drilled and grouted), and other anchor types such as gravity anchors and plate anchors.

3.3
blade pitch
rotational motion of the blade relative to the hub to control the angle between the blade and the wind

3.4
co-directional
acting in the same direction