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## Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

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## Submission of Comments

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- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

## Template for comments and secretariat observations

|                  |                        |
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| 1  | 2                                          | (3)                          | 4               | 5                                                                                                                                  | (6)                                                                      | 7                                                  |
|----|--------------------------------------------|------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------|
| MB | Clause No./ Subclause No./Annex (e.g. 3.1) | Paragraph/ Figure/Table/Note | Type of comment | Comment (justification for change) by the MB                                                                                       | Proposed change by the MB                                                | Secretariat observations on each comment submitted |
|    | 3.1                                        | Definition 1                 | ed              | Definition is ambiguous and needs clarifying.                                                                                      | Amend to read '...so that the mains connector to which no connection...' |                                                    |
|    | 6.4                                        | Paragraph 2                  | te              | The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK. | Delete reference to UV photometer.                                       |                                                    |



# DRAFT International Standard

## ISO/DIS 19900

### Oil and gas industries including lower carbon energy — General requirements for offshore structures

ICS: 75.180.10

ISO/TC 67/SC 7

Secretariat: **BSI**

Voting begins on:  
**2025-10-01**

Voting terminates on:  
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This document has not been edited by the ISO Central Secretariat.

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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](http://www.iso.org/directives)).

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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](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 67, *Oil and gas industries including lower carbon energy*, Subcommittee SC 7, *Offshore structures*.

This fourth edition cancels and replaces the third edition (ISO 19900:2019), which has been technically revised. The main changes compared to the previous edition are as follows:

- ensuring the provisions herein are appropriate for offshore renewable energy, in particular, offshore wind turbine and sub-station structures;
- specifying clear, concise and verifiable requirements, while providing more extensive supporting background and informative guidance in the informative [Annex A](#);
- providing greater explanation for design and assessment in situations where the semi-probabilistic partial factor approach is not appropriate.

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](http://www.iso.org/members.html).

## Introduction

The International Standards for offshore structures prepared by ISO TC 67/SC 7 comprise:

- ISO 19900, the unifying International Standard for offshore structures.
- ISO 19901 series<sup>[6 to 12]</sup>, providing specific requirements for offshore structures.
- ISO 19902,<sup>[13]</sup> ISO 19903,<sup>[14]</sup> ISO 19904,<sup>[15]</sup> ISO 19905<sup>[16 to 19]</sup> and ISO 19906<sup>[20]</sup>, “structure type” standards.

NOTE These are collectively referred to as the “ISO 19900 suite” for offshore structures.

[Figure 1](#) illustrates the relationships between the standards in the ISO 19900 suite.

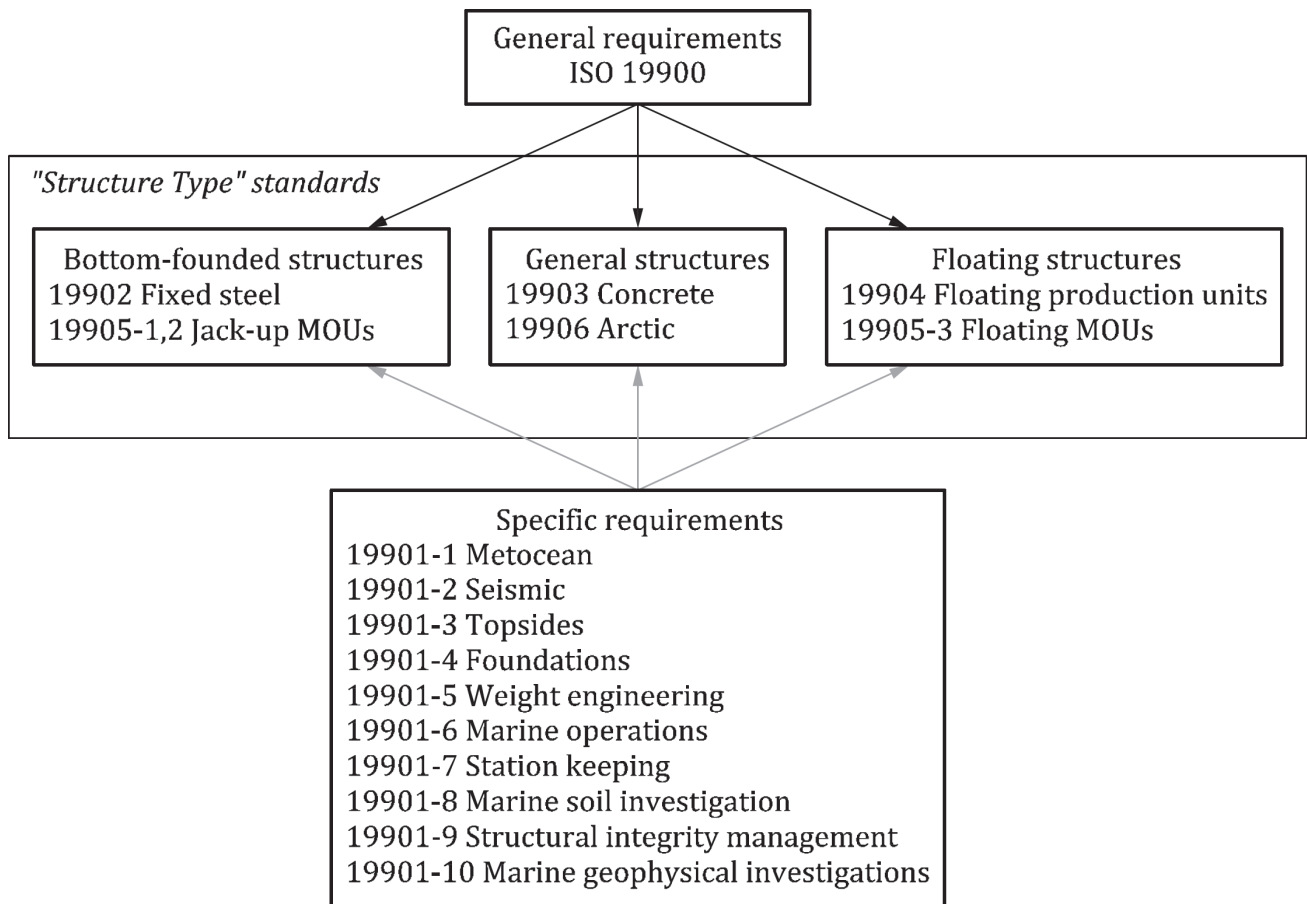


**Figure 1 — Relationship of Standards for offshore structures prepared by ISO/TC 67/SC 7**

The ISO 19900 suite follows the principles of ISO 2394<sup>[1]</sup> and ISO 22111<sup>[21]</sup> and constitutes a common basis for addressing design and assessment of all types of offshore structures used by the energy industries worldwide. Additional information and guidance are given in [Annex A](#), where the clause numbering mirrors the normative clauses to facilitate cross referencing.

In ISO International Standards, the following verbal forms are used:

- “shall” and “shall not” are used to indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted;
- “should” and “should not” are used to indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is

preferred but not necessarily required, or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited;

- “may” is used to indicate a course of action permissible within the limits of the document;
- “can” and “cannot” are used for statements of possibility and capability, whether material, physical or causal.

Statements containing requirements, recommendations or permissions are collectively referred to as provisions.



# Oil and gas industries including lower carbon energy — General requirements for offshore structures

## 1 Scope

This document specifies general provisions for the design and assessment of fixed (bottom-founded) and floating (buoyant) offshore structures.

This document contains general provisions for the design of new structures and site assessment of existing structures.

This document is applicable for all phases of the life of the structure, including:

- pre-service (e.g., fabrication, transportation, installation),
- service in-place, both during originally specified design service life and during any life extensions,
- functional upgrade, repurpose and reuse, and
- decommissioning, and removal.

This document focusses on primary and secondary load bearing structure but also provides some provisions for tertiary and ancillary structure.

NOTE ISO 24201<sup>[22]</sup> covers the design of stairs, gratings and handrails.

This document was initially created for offshore oil & gas structures but is now also applicable to renewable energy offshore structures.

This document does not apply to pipelines, risers or subsea systems.

## 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.

NOTE Regional or national adoptions of ISO standards are equivalent normative references to those listed below. In USA, API SC2 *Offshore Structures*, publish a mix of standards that are adoptions of ISO standards and standards that are unique API SC2 publications. The cover page to each ANSI/API Standard clarifies if it is an ISO adopted standard.

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

ISO 19901-2, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 2: Seismic design procedures and criteria*

ISO 19901-3, *Oil and gas industries including lower carbon energy — Specific requirements for offshore structures — Part 3: Topsides structure*

## 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 <https://www.electropedia.org/>

### 3.1

#### **abnormal environmental event**

environmental *hazardous event* (3.31) having probability of occurrence not greater than  $10^{-3}$  per annum (1 in 1 000 years)

### 3.2

#### **accidental event**

non-environmental *hazardous event* (3.31) having probability of occurrence not greater than  $10^{-3}$  per annum (1 in 1 000 years)

Note 1 to entry: Accidental events, as referred to in this document, are associated with a substantial release of energy, such as vessel collisions, fires, and explosions.

Note 2 to entry: Lesser accidents that could be expected during the life of the structure, such as dropped objects and low energy vessel impact, are termed incidents and are addressed under operational design situations.

### 3.3

#### **action**

external load applied to the *structure* (3.60) (direct action) or an imposed deformation or acceleration (indirect action)

EXAMPLE An imposed deformation can be caused by fabrication tolerances, differential settlement, temperature change or moisture variation. An imposed acceleration can be caused by an earthquake.

### 3.4

#### **action effect**

result of *actions* (3.3) on a *structural component* (3.57) (e.g. internal force, moment, stress, strain) or on the *structure* (3.60) (e.g. deflection, rotation)

### 3.5

#### **air gap**

distance between the highest water elevation and the lowest exposed part of the primary deck *structure* (3.60) not designed to withstand associated environmental *action effects* (3.3) for a defined *return period* (3.50)

Note 1 to entry: This definition can be refined for different facility types in their respective standards.

### 3.6

#### **appurtenance**

accessory or attachment to the *structure* (3.60) which typically assists installation, provides access or protection, or carries fluids or gas

Note 1 to entry: Appurtenances do not normally contribute to the stiffness of the structure but can attract significant hydrodynamic loading.

EXAMPLE Riser, caisson, boat landing, fender, and protection frames.

### 3.7

#### **basic variable**

variable representing physical quantities which characterize *actions* (3.3) and environmental influences, geometric quantities, or material properties including soil properties

Note 1 to entry: Basic variables are typically uncertain random variables or random processes used in the calculation or assessment of representative values of actions or resistance.

### 3.8

#### **caisson**

vertical cylindrical steel component within or mounted on an offshore *facility* (3.26)

Note 1 to entry: Caissons serve many different functions at different locations on an offshore facility. More specific definitions for each type of caisson are specified within the other standards in the ISO 19900 suite of standards.

### 3.9

#### **calibration**

process used to determine and optimize partial factors using *structural reliability analysis* (3.59) and target reliabilities

### 3.10

#### **characteristic value**

value assigned to a *basic variable* (3.7) with a prescribed probability

Note 1 to entry: In some design situations, a variable can have two characteristic values, an upper value and a lower value.

### 3.11

#### **conductor**

tubular pipe set into the ground to provide the initial stable structural foundation for setting the surface casing and protecting the internal well string from metocean actions

Note 1 to entry: The conductor provides lateral and, in some cases, axial support, enables circulation of drilling fluid, and guides the drill string to facilitate setting of the surface casing.

### 3.12

#### **consequence level**

classification system used to establish relevant criteria for a *structure* (3.60) based on consequences of failure

### 3.13

#### **damage state**

discrete state that describes the level of impairment

Note 1 to entry: Damage states can be categorized between no damage and complete loss of structure or marine systems.

### 3.14

#### **decommissioning**

process of shutting down a *facility* (3.26) enabling preparations for cleaning, dismantling and removal from location at the end of its *design service life* (3.17)

### 3.15

#### **design criteria**

#### **assessment criteria**

quantitative formulations describing the conditions to be fulfilled for each *design situation* (3.18)

### 3.16

#### **design resistance**

resistance limit calculated using factored *representative values* (3.48) of *basic variables* (3.7) or from factored expressions based on unfactored *representative values* (3.48) of *basic variables* (3.7)

EXAMPLE Examples of basic variables relevant to resistance are material properties.

### 3.17

#### **design service life**

design life

planned period for which a *structure* (3.60) is used for its intended purpose with anticipated maintenance, but without substantial repair being necessary

Note 1 to entry: The originally specified design service life can be updated during the operating phase to include any life extension period(s).

### 3.18

#### **design situation**

set of physical conditions for which the *structure* (3.60) or its components are verified

### 3.19

#### **design value**

value derived from the *representative value* (3.48) for use in *limit state verification* (3.37)

Note 1 to entry: Design values can be different in different design situations due to different partial factors.

### 3.20

#### **deterioration**

process that adversely affects *structural integrity* (3.58) over time

Note 1 to entry: Deterioration can be caused by naturally occurring chemical, physical, or biological actions including corrosion, by severe environmental actions, by incidents and accidental actions, by repeated actions such as those causing fatigue, by wear due to use, and by improper operation and maintenance of the structure.

### 3.21

#### **ductility**

<material> ability of a material to deform and absorb energy beyond its elastic limit

### 3.22

#### **ductility**

<structural component> ability of a *structural component* (3.57) to sustain *action effects* (3.4) beyond yield

### 3.23

#### **ductility**

<structural system> ability of a structural system to deform and dissipate energy, and to redistribute *action effects* (3.4)

### 3.24

#### **durability**

ability of a *structure* (3.60) or *structural component* (3.57) to maintain its function throughout its *design service life* (3.17)

### 3.25

#### **extreme environmental event**

environmental *hazardous event* (3.31) typically having probability of occurrence of  $10^{-2}$  per annum (1 in 100 years)

### 3.26

#### **facility**

constructions, pieces of equipment, and services that are provided for the offshore energy sector

Note 1 to entry: The facility includes the structure and non-structural systems such as topsides equipment, piping and accommodation.

Note 2 to entry: A hydrocarbon facility (platform) includes the structural conductors and risers but does not include the non-structural components of the hydrocarbon wells.

Note 3 to entry: The facility does not include the geological strata supporting the foundation. However, site-specific geotechnical parameters provide the boundary conditions necessary to model the facility's foundation or anchoring.

### 3.27

#### **fit-for-service**

fulfilling defined *structural integrity* (3.58) and *performance* (3.43) requirements

Note 1 to entry: A structure not meeting all the specific provisions can be fit-for-service, provided it does not cause unacceptable risk to life-safety or the environment.

**3.28**

**fixed structure**

*structure* (3.60) that is bottom founded and transfers most of the *actions* (3.3) on it to the *seabed* (3.55)

**3.29**

**floating structure**

*structure* (3.60) where the full weight is supported by buoyancy

**3.30**

**hazard**

potential source of harm

Note 1 to entry: Harm is typically differentiated between harm to people, harm to the environment, or harm in terms of costs to organization(s) or society in general.

**3.31**

**hazardous event**

event which occurs when a *hazard* (3.30) interacts with a *structure* (3.60)

EXAMPLE Wave impacting the structure, iceberg impacting the structure, excessive topside weight added to the structure, vessel collision, fire, explosion, and landslip in the vicinity of structural anchors (piles).

**3.32**

**ice gouge**

ice scour

incision in the *seabed* (3.55) or removal of seabed material by an ice feature

**3.33**

**incident**

non-environmental *hazardous event* (3.31) considered in an operational *design situation* (3.18)

Note 1 to entry: Incident, as referred to in this document, is a lesser accidental event, associated with possible local damage or damage to structural components, occurring with low probability, most typically associated with probabilities not less than  $10^{-2}$  per annum (1 in 100 years).

**3.34**

**integrity management**

systematic multi-step cyclic process intended to assure integrity of a *structure* (3.60) or a *marine system* (3.38)

**3.35**

**jack-up**

mobile offshore unit with a buoyant hull and one or more legs that can be moved up and down relative to the hull

Note 1 to entry: A jack-up reaches its operational mode by lowering the leg(s) to the seabed and then raising the hull to the required elevation. The majority of jack-ups have three or more legs, each of which can be moved independently and which are supported in the seabed by spudcans.

**3.36**

**limit state**

state beyond which the *structure* (3.60) or *structural component* (3.57) no longer satisfies the *design criteria* (3.15)

**3.37**

**limit state verification**

demonstration that the total design *action effect* (3.4) in each *design situation* (3.18) does not exceed the *limit state* (3.36) *design resistance* (3.16)

**3.38**

**marine system**

auxiliary system contributing to the structural safety, stability and position keeping ability of the *facility* (3.26)

### 3.39

#### **marine system integrity**

ability of a *marine system* (3.38) to maintain *performance* (3.43) throughout the *design service life* (3.17), with respect to structural safety, *robustness* (3.52), serviceability, and *durability* (3.24)

### 3.40

#### **nominal value**

value assigned to a variable specified or determined on a non-statistical basis, typically from acquired experience or physical conditions, or as published in a recognized code or standard

Note 1 to entry: In some design situations, a variable can have two nominal values, an upper value and a lower value.

### 3.41

#### **offshore**

situated in water some distance from the shore

Note 1 to entry: Alternatively, near shore can be used to specify locations next to the coast or in mouths of rivers.

### 3.42

#### **owner**

operator

duty holder

principal company or company representative leasing the offshore site from a government

### 3.43

#### **performance**

ability of a *structure* (3.60) or a *structural component* (3.57) to fulfil specified requirements

Note 1 to entry: Specified requirements include requirements for structural functionality, structural integrity and functionality of critical systems.

Note 2 to entry: Performance levels are established as a means of mitigating risk associated with life-safety, environmental damage, reliability of energy supply and business disruption.

### 3.44

#### **principal action**

action caused by the hazardous event or other source of action for which the design situation has been established

Note 1 to entry: Principal actions can consist of operational, extreme, abnormal and accidental action classes.

Note 2 to entry: Companion actions are of the same class as the principal action.

Note 3 to entry: Accompanying actions are of another class than the principal action.

### 3.45

#### **recognized classification society**

RCS

member of the international association of classification societies (IACS), with established rules and procedures for classification and certification of floating structures used in energy activities, located at a specific site, for an extended time period

### 3.46

#### **reference period**

time period used as a basis for determining the *representative value* (3.48) of operational, environmental, accidental and/or repetitive *actions* (3.3)

### 3.47

#### **reliability**

*performance* (3.43) over a specified time period

Note 1 to entry: When reliability is used in the context of limit states, it can be expressed as the probability that the limit is not exceeded.

Note 2 to entry: The specified time period is typically one year.

### 3.48

#### **representative value**

value assigned to a *basic variable* (3.7) for *limit state verification* (3.37) in a *design situation* (3.18)

Note 1 to entry: Two types of representative value used in design verification are characteristic value and nominal value.

### 3.49

#### **resistance**

ability of a *structure* (3.60), or a *structural component* (3.57), to withstand *action effects* (3.4)

### 3.50

#### **return period**

average time between occurrences of an event

Note 1 to entry: The offshore industry commonly uses a return period measured in years for environmental events. The return period in years is equal to the reciprocal of the annual probability of occurrence of the event.

Note 2 to entry: For the purpose of this definition, events include both discrete hazardous events as well as exceedances of a threshold value of a relevant variable.

### 3.51

#### **riser**

part of an offshore pipeline, including any subsea spool pieces, which extends from the *sea floor* (3.54) to the pipeline termination point on a *facility* (3.26)

Note 1 to entry: For fixed structures, the termination point is usually the topsides.

Note 2 to entry: For floating structures, the riser can terminate at other locations on the facility.

### 3.52

#### **robustness**

ability of a *structure* (3.60) to withstand *hazardous events* (3.31) without being damaged to an extent disproportionate to the cause

### 3.53

#### **scour**

removal of *seabed* (3.55) material caused by currents and/or waves

### 3.54

#### **sea floor**

interface between sea and *seabed* (3.55)

### 3.55

#### **seabed**

materials below the *sea floor* (3.54)

### 3.56

#### **splash zone**

part of a *structure* (3.60) that is intermittently exposed to air and immersed in the sea

### 3.57

#### **structural component**

discrete part of a *structure* (3.60)

Note 1 to entry: For this document, a component can include an assembly of components, e.g. a subsystem.

EXAMPLE Examples of components include columns, beams, stiffened plates, tubular members and joints, mooring lines and tendons, gravel fill, foundation anchors and piles, but not the geological strata.

### 3.58

#### **structural integrity**

ability of a *structure* (3.60) or a *structural component* (3.57) to maintain *performance* (3.43) throughout the *design service life* (3.17), with respect to structural safety, *robustness* (3.52), serviceability, and *durability* (3.24)

### 3.59

#### **structural reliability analysis**

probabilistic methodology for determining *limit state* (3.36) or damage limit exceedance probabilities

### 3.60

#### **structure**

combination of physically connected *structural components* (3.57)

### 3.61

#### **topsides**

*structure* (3.60) and equipment placed on a supporting structure [fixed or floating] to provide some or all of a *facility's* (3.26) functions

Note 1 to entry: For a ship-shaped floating structure, the deck is not part of the topsides.

Note 2 to entry: For a jack-up, the hull is not part of the topsides.

Note 3 to entry: A separate fabricated deck or module support frame is part of the topsides.

## 4 Symbols and abbreviated terms

### 4.1 Symbols

|                   |                                                                        |
|-------------------|------------------------------------------------------------------------|
| $A$               | accidental action                                                      |
| $a_d$             | design value of geometric variable                                     |
| $a_r$             | representative value of geometric variable                             |
| $C_d$             | design value of the deformation or constraint                          |
| $E$               | environmental action                                                   |
| $E_R$             | repetitive environmental action                                        |
| $F_{\text{comb}}$ | combination value of an action                                         |
| $F_d$             | design action                                                          |
| $F_k$             | characteristic value of an action                                      |
| $F_{\text{nom}}$  | nominal maximum or minimum value of an action                          |
| $F_R$             | repetitive operational action                                          |
| $F_r$             | representative value of an action                                      |
| $f_d$             | design value of material property (for example strength)               |
| $f_r$             | representative value of material property (for example yield strength) |
| $G$               | permanent action                                                       |
| L1, L2, L3        | consequence levels of structures                                       |

|            |                                                                                                                                                         |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| $N$        | numbers of cycles to failure for different stress, strain or action levels                                                                              |
| $P$        | annual probability of occurrence or probability of exceedance                                                                                           |
| $p_f$      | probability of failing to meet a limit state                                                                                                            |
| $Q$        | operational action                                                                                                                                      |
| $Q_1$      | operational action of long duration                                                                                                                     |
| $Q_2$      | operational action of short duration                                                                                                                    |
| $R$        | reliability of a structural system                                                                                                                      |
| $R_d$      | design value of resistance                                                                                                                              |
| $R_r$      | representative value of resistance                                                                                                                      |
| $S_d$      | total design action effect                                                                                                                              |
| $T$        | annual return period of an event or an action                                                                                                           |
| $\gamma_f$ | partial action factor the value of which reflects the uncertainty or randomness of the action                                                           |
| $\gamma_m$ | partial material factor the value of which reflects the uncertainty or variability of the material property                                             |
| $\gamma_R$ | partial resistance factor the value of which reflects the uncertainty or variability of the component resistance including those of material properties |
| $\Delta a$ | additive partial geometric quantity the value of which reflects the uncertainties of the geometric variable                                             |

## 4.2 Abbreviated terms

|       |                                     |
|-------|-------------------------------------|
| ALARP | as low as reasonably practical      |
| FLS   | fatigue limit state                 |
| IMO   | International Maritime Organization |
| SLS   | serviceability limit state          |
| ULS   | ultimate limit state                |

## 5 Design considerations

### 5.1 Functional and operational requirements

**5.1.1** Functional and operational requirements for the facility, including its design service life, **shall** be specified.

NOTE 1 Requirements set by regional, national, and local regulations can be different from those given in this document. While such requirements can take precedence, conformance to this document can be claimed only if the requirements of this document are met.

NOTE 2 Requirements for personnel safety set by flag states and coastal state authorities can have a substantial effect on the design of a floating structure.

NOTE 3 Modifications can be made to mitigate risks in non-structural disciplines.

NOTE 4 The design service life is used to determine the time-dependent performance of the structure.

EXAMPLE Time-dependent performance can include durability, fatigue, and deformation due to consolidation of the soil.

**5.1.2** Post-design, the design service life **may** be amended, e.g. life extension, provided the requirements in this document are still achieved.

**5.1.3** A lower design service life **may** be used for replaceable structural components to verify fatigue and durability (see [5.4](#)), provided that replacement of the component is explicitly accounted for in design.

## 5.2 Consequence levels

**5.2.1** Prior to design, the whole structure (or separate sub-structures) **shall** be classified for in-place conditions by consequence level: L1 (highest consequence), L2 (moderate consequence) or L3 (lowest consequence), based on [Table 1](#).

NOTE Different consequence levels can be justified for different parts of the facility, with some further guidance provided in the structure type documents (see Introduction).

**5.2.2** Consequence levels **may** be revised during the life of a structure to account for changes in its function, location, or consequence mitigation measures.

**5.2.3** Structures **may** be classified using different consequence levels for different design situations.

EXAMPLE A structure can be classified to the most onerous consequence L1 on the expectation of being occupied (manned) during hazardous events (e.g., vessel collision, seismic), but a lesser consequence L2 during events that can be forecast (e.g., iceberg impact and hurricane events) where all personnel can be safely evacuated or a floating structure safely relocated to avoid such hazardous events.

**5.2.4** The consequence level for a structure that is, or will be, located adjacent to an existing or planned facility, **shall** account for their possible harmful interaction during a hazardous event.

NOTE Adjacent facilities can include workover facilities, local facilities, transport lines, and subsea structures. Harmful interaction includes structure collapse or drift from location.

**5.2.5** The owner **may** align the qualitative descriptors in [Table 1](#) to their in-house classification of risk severity to confirm alignment between life safety, environmental and economic consequences for the three consequence levels.

NOTE 1 The consequence level can be used in the direct assessment of the design values for ULS verifications.

NOTE 2 The consequence level can be used to determine the management measures to achieve the intended safety.

NOTE 3 The consequence level can be used to choose design methods for enhancing robustness, see [5.3](#).

Table 1 — Qualification of consequence levels in reasonably foreseeable events

| Consequence level                                                                                                                                                                                 | Impairment of life safety and harm to the environment | Economic and societal harm                                                   | Examples                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| L1                                                                                                                                                                                                | Significant potential                                 | <b>Large potential</b><br>Long term loss of substantial energy supply        | Normally occupied facility.<br>Potential flowing oil pollution beyond contents of pipelines & containers, widespread harm to marine life.<br>Shut in well, loss of majority of wind farm, loss of majority of production for over a month.                                                                                                                                                                                                      |
| L2                                                                                                                                                                                                | Moderate potential                                    | <b>Substantial potential</b><br>Short term or moderate loss of energy supply | Planned evacuation of normally occupied facility before foreseeable event <sup>a</sup> or maintenance crew visits planned for durations resulting in negligible probability of occurrence during the specified hazardous events.<br>Oil pollution limited to pipelines & containers, local harm to marine life.<br>Shut down well or wind substation for up to one month, or loss of less than 25 % total field production for longer duration. |
| L3                                                                                                                                                                                                | Negligible potential                                  | <b>Moderate potential</b><br>No or small loss of energy supply               | Occasional maintenance crew visits with no overnight stays.<br>Loss of unoccupied facility with negligible pollution, loss of single wind turbine or loss of less than 5 % total field production for longer duration.                                                                                                                                                                                                                          |
| <sup>a</sup> Foreseeable events would include severe storms but exclude seismic and vessel impact events.<br>NOTE Further recommendations for classification are given in <a href="#">A.5.2</a> . |                                                       |                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

### 5.3 Robustness

**5.3.1** A structure or a critical system **shall** be designed to have a level of robustness such that during its life it will not be damaged by unforeseen adverse hazardous events to an extent disproportionate to the original cause.

NOTE 1 Progressive collapse is an example of a damage that is disproportionate to the original cause.

NOTE 2 For most structures, design in accordance with the ISO 19900 suite of Standards (see Introduction) is assumed to provide an adequate level of robustness without the need for any additional design measures to enhance structural robustness.

**5.3.2** Design measures to enhance structural or system robustness **should** be applied when specified by the relevant authority or, where not specified, as agreed for a specific project by the relevant parties.

### 5.4 Durability

**5.4.1** The structure **shall** be designed, assessed, inspected, monitored, maintained and repaired such that any damage due to hazardous events and from degradation mechanisms over its life does not impair its intended performance.

**5.4.2** The degree of corrosion, abrasion, or other forms of degradation mechanisms that can cause damage affecting the structural resistance **may** be estimated using calculation, experimental investigation, experience from earlier constructions, or a combination of these methods.

NOTE 1 Damage can also be caused by operational incidents such as dropped objects and spillage of corrosive or refrigerated fluids.

NOTE 2 The rate of degradation can be estimated based on calculations, experimental investigations, experience from other structures, or a combination of these. Damage due to degradation mechanisms can be reduced or prevented by providing suitable protection systems.

## 5.5 Sustainability

**5.5.1** The structure **should** be designed and operated to limit its adverse impact on non-renewable environmental resources, on society, and on the economy during its entire life, as specified by the relevant authority or, where not specified, as agreed for a specific project by the relevant parties.

NOTE 1 The topic of sustainability is something that covers all disciplines beyond engineering.

NOTE 2 The adverse impact of a structure on its environment, on society, and on economy can be minimized by, for example, appropriate choice of construction process and environmentally compatible materials, including their manufacture, design solutions, durability, recyclability, and reusability.

**5.5.2** At the design stage, consideration **should** be given to repurposing, reusing, decommissioning and removing the structure or parts of the structure at the end of their life.

NOTE Removal is conducted in accordance with the owner's specifications and can be subject to local and international legislation and IMO rules.

## 5.6 Quality management

**5.6.1** Design, fabrication and installation of offshore structures **should** be performed in accordance with a documented quality management system conforming to an industry quality management system (QMS) standard.

NOTE ISO 29001<sup>[23]</sup> is an energy sector specific standard, building upon the generic QMS standard, ISO 9001<sup>[2]</sup>.

**5.6.2** The extent of the quality management process **should** be commensurate with the structure's consequence level (L1, L2 or L3).

**5.6.3** If a structure is one of a series built to a standard design, the extent of quality management **may** be reduced to reflect commonality.

**5.6.4** As a minimum, the quality management process **should** confirm that the site-specific foundation requirements are accounted for, that the production system weights and actions are correctly identified and are within the design capability of the structure, and that the structure is fabricated to the quality requirements of the standard design.

## 6 Basis of structural and geotechnical design

### 6.1 Facility location and orientation

**6.1.1** A single Project datum (reference point) **shall** be specified to which all elevations and positions can be related<sup>[51]</sup>.

**6.1.2** The facility and ancillary systems (see 6.7) **shall** be positioned and oriented with respect to the project datum to tolerances that are consistent with Project requirements.

**6.1.3** A specified the system of units **shall** be consistently applied throughout each Project<sup>[51]</sup>.

NOTE ISO default is to use SI units (e.g. m, kg, N).

## 6.2 Weights

**6.2.1** Self-weight, variable weights, temporary weights, and their corresponding centres of gravity and tolerances **should** be initially estimated and subsequently refined as the design and construction phases progress.

NOTE ISO 19901-5<sup>[7]</sup> contains provisions for managing weight throughout its life as more specific data becomes available, allowing contingencies to be reduced.

**6.2.2** Site-specific marine growth characteristics, associated basic variables and mitigation processes **shall** be established.

NOTE 1 Marine growth forming on structure and appurtenances that are submerged or in the splash zone can affect the magnitude of some metocean actions.

NOTE 2 Marine growth criteria are contained within ISO 19901-1 and the associated structure-type standard.

NOTE 3 Marine growth cleaning protocols and anti-fouling systems can be part of the structural design.

## 6.3 Geotechnical and geophysical conditions

**6.3.1** Marine site investigations **should** be performed at the proposed location of all structures in accordance with ISO 19901-4<sup>[6]</sup>, ISO 19901-8<sup>[10]</sup> and ISO 19901-10<sup>[12]</sup>.

NOTE 1 Additional foundation considerations for wind turbines are found in IEC 61400-6<sup>[30]</sup> along with IEC 61400-3-1<sup>[28]</sup> and IEC 61400-3-2<sup>[29]</sup>.

NOTE 2 For floating structures, foundations for anchoring systems are addressed in ISO 19901-7<sup>[9]</sup>.

NOTE 3 In most offshore areas, geological processes associated with movement of the near surface sediments can occur within the design service life.

**6.3.2** Foundation design **shall** account for the possibility of disturbance to the seabed arising from scour and, in arctic and cold regions, ice gouge.

NOTE 1 Scour extent in ISO 19901-4<sup>[6]</sup> is based on previous records from sites with similar seabed features, model tests or calculations calibrated by prototype or model tests.

NOTE 2 Ice gouge characteristics and extent are addressed in ISO 19906<sup>[20]</sup> and ISO 35106<sup>[25]</sup>.

**6.3.3** Marine geophysical investigations in ISO 19901-10<sup>[12]</sup> **should** be performed in advance of, and be used to help establish, marine soil investigation programmes in ISO 19901-8<sup>[10]</sup>.

NOTE 1 Marine soil investigations include borehole logging, in situ testing, and soil sampling for laboratory testing.

NOTE 2 Marine geophysical investigations and marine soil investigations can be (and often are) carried out as separate exercises, the results of which can be integrated into a ground model.

**6.3.4** Seabed features and hazards that can impact a structure and its components **should** be considered locally and in the relevant area adjacent to the soil-structure interface.

NOTE 1 Focussing on soil parameters and input for calculations without understanding the wider seabed can lead to misunderstanding hazards and risk across the wider site.

NOTE 2 A wind farm can cover a large seafloor area with significant variation in seabed composition.

## 6.4 Environmental conditions

**6.4.1** The metocean conditions applicable at the site-specific location or region **shall** be specified in accordance with ISO 19901-1.

NOTE For cold regions, reference can be made to ISO 19906<sup>[20]</sup> and ISO 35106<sup>[25]</sup>.

**6.4.2** The possible effects of global or regional changes in water level and on the frequency and magnitude of metocean hazardous events **should** be incorporated.

**6.4.3** The seismic conditions applicable at the site-specific location or region **shall** be specified in accordance with ISO 19901-2.

## 6.5 Accidental conditions

**6.5.1** Design, control and mitigation of vessel and helicopter impact events and dropped objects **should** be determined in accordance with the specific structure type standard, see Introduction, e.g., ISO 19902,<sup>[13]</sup> 19903,<sup>[14]</sup> 19904-1<sup>[15]</sup> and 19905-1<sup>[16]</sup>.

**6.5.2** Design, control and mitigation of fires and explosion events **shall** be determined in accordance with ISO 19901-3.

## 6.6 Topsides structures, air gap and splash zone

**6.6.1** Facilities that include a topsides deck structure **shall** have the topside designed and assessed in accordance with ISO 19901-3.

NOTE 1 Provisions of ISO 19901-3 can be applied to gravel island structures.

NOTE 2 Winterization of topsides is covered in ISO 19906<sup>[20]</sup>.

**6.6.2** The deck elevation and, where relevant, air gap **shall** be verified for a range of design situations, accounting for the values and uncertainties of the site-specific basic variables.

NOTE 1 Air gap is addressed in ISO 19902,<sup>[13]</sup> ISO 19903,<sup>[14]</sup> 19904-1<sup>[15]</sup> and 19905-1<sup>[16]</sup>.

NOTE 2 Air gap typically does not apply to gravel islands.

**6.6.3** The extent of the splash zone and the drainage of splashed water **shall** be established accounting for: deck elevation, tidal ranges, wave crests, wave troughs, motions of floating structures, and subsidence of bottom founded structures.

NOTE 1 The splash zone is important in relation to inspection and maintenance considerations, can impact the design for wave slam, corrosion and fatigue, and also on the extent of marine growth.

NOTE 2 The splash zone is defined relative to the expected maximum and minimum draught for floating structures.

## 6.7 Ancillary systems

**6.7.1** Ancillary systems include: piles, mooring lines, anchors, conductor pipes, risers, offloading systems, tendons, berms, movable protection barriers, temporary refuges and evacuation systems.

NOTE Provisions can be found in ISO 19901-4<sup>[6]</sup> for foundations, ISO 19901-7<sup>[9]</sup> for stationkeeping systems, and API RP 2T<sup>[34]</sup> for TLP tendons.

**6.7.2** The number, location, size, spacing, and operating conditions of caissons, conductors and risers **should** be established in parallel with the structural design.

NOTE Metocean and ice actions on caissons, conductors and risers can significantly contribute to both local and global loading on the structure.

**6.7.3** As a priority, ancillary systems should be protected from damage due to hazardous events or, alternatively, the consequences of potential damage should be mitigated.

**6.7.4** Accessibility **should** be considered for servicing and maintenance equipment, and vessels or equipment used to deal with emergency situations or special operations (e.g. jack-ups for well remediation).

## 6.8 Inspectability

**6.8.1** The structure **shall** be designed so that expected damage due to degradation mechanisms remains below defined thresholds within the time intervals between inspections.

**6.8.2** The design **should** allow inspection access to safety-critical parts of the structure without unnecessary, or unreasonably complicated, dismantling.

## 6.9 Jack-ups

**6.9.1** Site-specific assessment of temporarily located jack-ups **should** follow the provisions in ISO 19905-1<sup>[16]</sup>.

NOTE ISO 19905-1<sup>[16]</sup> applies only to jack-ups holding valid certification as self-elevating units from a recognised class society (RCS), or equivalent.

**6.9.2** Permanently located jack-ups **should** be designed to ISO 19902<sup>[13]</sup>.

**6.9.3** Jack-ups designed to ISO 19902<sup>[13]</sup> **should** also be checked against the requirements of ISO 19905-1<sup>[16]</sup>:

- a) for foundation strength, foundation preload, overturning, leg chord strength and the strength of the holding system; and
- b) relating to the determination of environmental actions and action effects due to dynamic response, structural behaviour and foundation behaviour, modified as necessary to ensure an equivalent level of structural integrity to that intended in ISO 19902<sup>[13]</sup>.

## 6.10 Non-oil & gas facilities

**6.10.1** Offshore wind turbines **should** be designed to IEC 61400-1<sup>[41]</sup>.

NOTE 1 IEC 61400-3-1<sup>[42]</sup> and IEC 61400-3-2<sup>[43]</sup> provide design requirements for fixed and floating offshore wind turbines, respectively, while IEC 61400-6<sup>[44]</sup> provides design requirements for foundations. Many of these IEC 61400 requirements reference the ISO 19900 suite of standards.

NOTE 2 The general philosophy for offshore wind is for the IEC 61400 series of standards to take precedence for matters relating to actions, while the ISO 19900 suite of standards (see Introduction) take precedence for general requirements and resistances.

**6.10.2** Other offshore energy facilities **may** be designed to the provisions herein, provided stakeholders recognising that limited consideration has been given to facilities beyond those used in the offshore oil & gas and offshore wind sectors.

## 7 Development of design situations

### 7.1 Hazardous events

**7.1.1** All hazards **shall** be identified that are reasonably foreseeable, relevant to structural safety, and that can occur during any phases in the life of the structure.

NOTE The engineering judgement test of 'reasonably foreseeable' is required when identifying hazards, and can be based on decades of construction, installation, and operation experience with offshore facilities.

**7.1.2** All hazardous events, which can arise from the identified hazards in [7.1.1](#) **shall** be documented.

**7.1.3** Strategies and specific measures **should** be considered to prevent the occurrence of hazardous events and to counter or mitigate the possible consequences of hazardous event.

NOTE Principles and strategies to prevent the occurrence of hazardous events and to limit the possible consequences are provided in ISO 17776[5].

**7.1.4** Specified hazardous events **may** be used to initiate operational measures to mitigate the potential risk.

EXAMPLE Forecasts of metocean and ice events can be used to initiate evacuation of a structure or to invoke ice management protocols.

**7.1.5** Uncertainties associated the magnitude and frequency of hazardous events and the potential success of operational measures **shall** be taken into account when deciding which hazards can be mitigated by operational measures.

NOTE A hazard curve is one tool that can be used to quantify and visualise a range of hazardous events (see [Figure A.1](#)).

### 7.2 Design situations

**7.2.1** Design situations **shall** be established and categorized according to [Table 2](#).