

FINAL
DRAFT

INTERNATIONAL
STANDARD

ISO/FDIS
19905-1

ISO/TC 67/SC 7

Secretariat: BSI

Voting begins on:
2023-08-08

Voting terminates on:
2023-10-03

Oil and gas industries including lower carbon energy — Site-specific assessment of mobile offshore units —

Part 1:
Jack-ups: elevated at a site

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Reference number
ISO/FDIS 19905-1:2023(E)

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CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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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).

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This document was prepared by Technical Committee ISO/TC 67, *Oil and gas industries including lower carbon energy*, Subcommittee SC 7, *Offshore structures*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 12, *Oil and gas industries including lower carbon energy*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 19905-1:2016), which has been technically revised.

The main changes are as follows:

- updates regarding operations in arctic areas in: Scope, 5.1.5, Figure 5.2-1, 6.7, 7.2, 7.6, 7.8, 10.8, Table 10.3-1 and A.10.8, and added 8.8.9;
- need for Classification revised in Scope and expanded in 5.1.8;
- Clause 3 updated to align with 19900 and other sources. Further definitions added;
- added definitions of symbols for undrained shear strength in 4.1.2;
- added definitions of symbols for horizontal and moment capacity coefficients and cyclic degradation factors in 4.1.5;
- interaction with SSA-I explained in 5.1;

- exposure levels (in 5.5) revised to align with ISO 19900:2019;
- requirements and information on earthquake response analysis gathered in 10.7 and A.10.7 respectively and referenced from 8.6, 8.7, 8.8, A.8.6.3, A.8.7;
- 9.3, A.9.3.1.2, A.9.3.3.1 and A.9.4.1 expanded to include foundation capacities and stiffnesses based on strength parameters rather than applied preload. Clause E.4 added to address the former;
- clarifications of Step 2 foundation checks in 9.3.6;
- 9.4.6 on cyclic mobility expanded to address liquefaction and liquefaction-induced lateral flow and A.9.4.6 expanded accordingly;
- earthquake analysis requirements (in 10.7) revised; reference to 5.5.5 added and text moved from other clauses inserted;
- minor update to alternative analysis methods (see 10.10, formerly 10.9);
- minor clarifications in 13.2;
- clarified that the $H_{\max}$ to H_{srp} relationships in A.6.4.2.2 are defaults in the absence of site-specific data; the application of kinematics reduction in A.6.4.2.3 is no longer by means of wave height reduction;
- most probable peak enhancement factor in A.6.4.2.7 now given as a range;
- default current profile in A.6.4.3 revised;
- alternative wind profiles now permitted in A.6.4.6.2;
- added references to ISO 19901-10 and ISO 19901-8 in A.6.5.1.1;
- added reference to liquefaction-induced lateral flows in Table A.6.5-1;
- the requirements for the geotechnical report in A.6.5.1.5.3 have been revised and expanded especially in respect of shear strength;
- penetration in clays in A.9.3.2.2 updated to address strain rate dependency and strain softening;
- squeezing of clay in A.9.3.2.6.2 revised;
- punch-through for sand overlying clay in A.9.3.2.6.4 clarified and formula revised;
- major update to the ultimate vertical/horizontal/rotational capacity interaction function in A.9.3.3.2 for spudcans in sand and clay due to the addition of a caveat on the need to consider the effects of cyclic loading on foundation capacities;
- the effect of cyclic loading on the yield surface has been added in A.9.3.3.7; incorporates text that was in A.9.3.4.2.2;
- revised guidance on the selection of shear modulus for clay in A.9.3.4;
- Step 2a foundation capacity and sliding checks in A.9.3.6.4 revised and the figures corrected;
- guidance on Cyclic mobility in A.9.4.6 significantly expanded, and this clause now also addresses liquefaction and liquefaction-induced lateral flow;

- guidance on structural and foundation modelling expanded in A.10.7.3.2 with particular reference to modelling for earthquake response analysis;
- guidance on ice added in A.10.8;
- guidance in A.12.2.3.2 on non-circular prismatic member classification and in A.12.2.3.3 on reinforced components clarified in respect of slender components;
- sketch in Table 12.3-1 b) corrected;
- clarifications in Table A.12.4-1 and correction to formula in Figure A.12.4-1;
- guidance on strength of tubular members in A.12.5 updated to align with ISO 19902:2020 (combined axial and bending loading in A.12.5.3 of cosine interaction form instead of previous form using linear interaction) and simplified combined axial, bending, beam shear and torsion checks have been added;
- clarified calculation for e in A.12.6.2.3 on axial compressive local strength check;
- clarified F_y in A.12.6.2.5.4 on Class 4 slender-section bending moment strength;
- beam shear area formulations updated for chord cross sections updated in A.12.6.3.4;
- Table B-2: revised partial resistance factor for horizontal foundation capacity for total stress (clay/undrained) and added partial resistance factors for vertical-horizontal foundation bearing capacity when considering material factored representative soil strength and for calculated foundation capacities.
- corrections to formulae in Figure C.2.4-1, "The drag-inertia method including DAF scaling factor";
- Figure E.1-1 corrected;
- Figure E.3-1 b) corrected;
- added Clause E.4 on calculated foundation capacities approach;
- added Clause E.5 providing an example of a simplified free-field liquefaction assessment calculation method;
- Norway regional requirements in H.2 updated. H.2.2 Regulatory framework and H.2.4 Technical commentary deleted. Added new H.2.3 Technical requirements for jack-up rigs operating close to a permanent occupied installation.
- US Gulf of Mexico requirements (H.3) metocean data replaced by reference to hurricane data from API RP-2MET, 2019. General updates. Unoccupied post-evacuation case expanded.

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Introduction

This document is one of the International Standards on offshore structures prepared by TC 67/SC 7 (i.e. ISO 19900, the ISO 19901 series, ISO 19902, ISO 19903, ISO 19904-1, the ISO 19905 series and ISO 19906).

NOTE 1 These are sometimes incorrectly referred to as the ISO 19900 series on offshore structures.

The International Standards on offshore structures prepared by TC 67/SC 7 address design requirements and assessments for all offshore structures used by the petroleum and natural gas industries worldwide. Through their application, the intention is to achieve reliability levels appropriate for attended and unattended offshore structures, regardless of the type of structure and the nature or combination of the materials used.

It is important to recognize that structural integrity is an overall concept comprising models for describing actions, structural analyses, design or assessment rules, safety elements, workmanship, quality control procedures and national requirements, all of which are mutually dependent. The modification of one aspect of design or assessment in isolation can disturb the balance of reliability inherent in the overall concept or structural system. The implications involved in modifications, therefore, must be considered in relation to the overall reliability of all offshore structural systems.

The International Standards on offshore structures prepared by TC 67/SC 7 are intended to provide wide latitude in the choice of structural configurations, materials and techniques without hindering innovation. Sound engineering judgment is, therefore, necessary in the use of these documents.

This document, which has been developed from the Society of Naval Architects and Marine Engineers (SNAME) Technical & Research Bulletin 5-5A (2002)^[170], states the general principles and basic requirements for the site-specific assessment of mobile jack-ups; it is intended to be used for site-specific assessment and not for jack-up design.

NOTE 2 For the exposure level 1 (L1) assessment and, where appropriate, the exposure level 2 (L2) assessment prior to evacuation being effected, this document requires the use of 50 year independent or 100 year joint probability metocean extremes, together with associated partial action factors. It is based on extensive benchmarking and best practice in the international community.

Site-specific assessment is normally carried out when it is intended to install an existing jack-up unit at a specific site. The assessment is not intended to provide a full evaluation of the jack-up; it assumes that aspects not addressed herein have been addressed using other practices and standards at the design stage. In some instances, the original design of all or part of the structure could be in accordance with other International Standards on offshore structures prepared by TC 67/SC 7, and in some cases, different practices or standards could have been applied.

The purpose of the site assessment is to demonstrate the adequacy of the jack-up and its foundations for the assessment situations and defined limit states, taking into account the consequences of failure. It is important that the results of a site-specific assessment be appropriately recorded and communicated to those persons required to know or act on the conclusions and recommendations. Alternative approaches to the site-specific assessment can be used, provided that they have been shown to give a level of structural reliability equivalent, or superior, to that implicit in this document.

Annex A provides background to and guidance on the use of this document. The clause numbering in Annex A is the same as in the main text in order to facilitate cross-referencing. ISO/TR 19905-2 provides additional background to some clauses and a detailed sample 'go-by' calculation.

NOTE 3 ISO/TR 19905-2:2012 is based on ISO 19905-1:2012. The second edition of ISO/TR 19905-2 will be based on this document.

Annex B summarizes the partial factors. Supplementary information is presented in Annexes C to G. Annex H presents regional information.

NOTE 4 The site-specific assessment (SSA) of a jack-up normally comprises the two parts: an elevated SSA (SSA-E), addressed in this document, and an installation and removal SSA (SSA-I), which is planned to be addressed in an International Standard as part of the ISO 19905 series.

In this document, the following verbal forms are used:

- “shall” indicates a requirement;
- “should” indicates a recommendation;
- “can” indicates a possibility or a capability;
- “may” indicates a permission.

Oil and gas industries including lower carbon energy — Site-specific assessment of mobile offshore units —

Part 1: Jack-ups: elevated at a site

1 Scope

This document specifies requirements and provides recommendation and guidance for the elevated site-specific assessment (SSA-E) of independent leg jack-up units for use in the petroleum and natural gas industries. It addresses:

- a) occupied non-evacuated, occupied evacuated and unoccupied jack-ups;
- b) the installed (or elevated) phase at a specific site.

It also addresses the requirement that the as-installed condition matches the assumptions used in the assessment.

This document does not address the site-specific assessment of installation and removal (SSA-I).

To ensure acceptable reliability, the provisions of this document form an integrated approach, which is used in its entirety for the site-specific assessment of a jack-up.

When assessing a jack-up operating in regions subject to sea ice and icebergs, it is intended that the assessor supplements the provisions of this document with the relevant provisions relating to ice actions contained in ISO 19906 and procedures for ice management contained in ISO 35104. This document does not address design, transit to and from site, or installation and removal from site.

This document is applicable only to independent leg mobile jack-up units that are structurally sound and adequately maintained, which is normally demonstrated through holding a valid recognized classification society, classification certificate. Jack-ups that do not hold a valid recognized classification society certificate are assessed according to the provisions of ISO 19902, supplemented by methodologies from this document, where applicable.

NOTE 1 Well conductors can be a safety-critical element for jack-up operations. However, the integrity of well conductors is not part of the site-specific assessment process for jack-ups and is, therefore, not addressed in this document. See A.1 for guidance on this topic.

NOTE 2 RCS rules and the IMO MODU code (International Maritime Organisation Mobile Offshore Drilling Unit code) provide guidance for the design of jack-ups.

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.

ISO 19900:2019, *Petroleum and natural gas industries — General requirements for offshore structures*

ISO 19901-1:2015, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 1: Metocean design and operating conditions*

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

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

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

ISO 19906:2019, *Petroleum and natural gas industries — Arctic offshore structures*

ISO 35104, *Petroleum and natural gas industries — Arctic operations — Ice management*

ISO 35106, *Petroleum and natural gas industries — Arctic operations — Metocean, ice, and seabed data*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 19901-2, ISO 19901-4, ISO 19906 and the following apply.

ISO and IEC maintain terminology 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)

[SOURCE: ISO 19900:2019, 3.1]

3.2

abnormal wave crest

wave crest with probability of typically 10^{-3} to 10^{-4} per annum

3.3

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.

[SOURCE: ISO 19900:2019, 3.2]

3.4

action

external load applied to the *jack-up* (3.36) (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.

[SOURCE: ISO 19900:2019, 3.3, modified — "structure" changed to "jack-up".]

3.5

action effect

result of *actions* (3.4) on a *structural member* (3.87) or *structural component* (3.86) (e.g. internal force, moment, stress, strain) or on the *jack-up* (3.36) (e.g. deflection, rotation)

[SOURCE: ISO 19900:2019, 3.4, modified — "structural member" added and "structure" changed to "jack-up".]

3.6

assessment

site-specific assessment

evaluation of the stability and structural integrity of a *jack-up* (3.36) and, where applicable, its seabed restraint or support against the actions determined in accordance with specific requirements

Note 1 to entry: The specific requirements are given in this document.

Note 2 to entry: An assessment can be limited to an evaluation of the components or members of the structure which, when removed or damaged, could cause failure of the whole structure, or a significant part of it.

3.7

assessment criteria

quantitative formulations describing the conditions to be fulfilled for each *assessment situation* (3.9)

[SOURCE: ISO 19900:2019, 3.15, modified — References to "design" deleted.]

3.8

assessment resistance

resistance limit calculated using factored *representative values* (3.64) of *basic variables* (3.13) or from factored expressions based on unfactored *representative values* (3.64) of *basic variables* (3.13)

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

[SOURCE: ISO 19900:2019, 3.12, modified — "design" changed to "assessment".]

3.9

assessment situation

set of physical conditions for which the *jack-up* (3.36) or its components are verified

Note 1 to entry: For discussion on configuration, see 5.4.1.

Note 2 to entry: The assessment situations are checked against the acceptance criteria of this document to demonstrate that the relevant limit states are not exceeded.

[SOURCE: ISO 19900:2019, 3.16, modified — Reference to "design" deleted and "structure" changed to "jack-up".]

3.10

assessor

entity performing the site-specific assessment

3.11

backfill

submerged weight of all of the soil that can be present on top of the spudcan

Note 1 to entry: Backfilling can occur during or after preloading. $W_{BF,o}$ refers to the submerged weight of the backfilling that occurs up to achieving the preload reaction. $W_{BF,A}$ refers to the submerged weight of the backfilling that occurs after the maximum preload has been applied and held. Both $W_{BF,o}$ and $W_{BF,A}$ can comprise backflow and/or infill. For discussion of the effects, see A.9.3.2.1.4.

3.12

backflow

soil that flows from beneath the spudcan around the sides and onto the top

Note 1 to entry: Backflow is part of *backfill* (3.7).

3.13

basic variable

variable representing physical quantities which characterize *actions* (3.4) 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.

[SOURCE: ISO 19900:2019, 3.7]

3.14

boundary conditions

actions and/or constraints on a structural member (or a group of structural members) by other structural members or by the surrounding environment

Note 1 to entry: Boundary conditions can be used to generate reaction forces at locations of restraint.

3.15

characteristic value

value assigned to a *basic variable* (3.13) with a prescribed probability

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

[SOURCE: ISO 19900:2019, 3.9]

3.16

chart datum

CD

local datum used to fix water depths on a chart or tidal heights over an area

Note 1 to entry: Chart datum is usually an approximation to the level of the lowest astronomical tide.

[SOURCE: ISO 19901-1:2015, 3.2]

3.17

consequence category

classification system for identifying the environmental, economic and indirect personnel safety consequences of failure of a platform used to determine *exposure level* (3.21)

[SOURCE: ISO 19902:2020, 3.11]

3.18

dynamic amplification factor

DAF

ratio of a dynamic action effect to the corresponding static action effect

Note 1 to entry: For a jack-up, the dynamic action effect is best simulated by means of a concentrated or distributed inertial loadset. It is usually not appropriate to factor the static actions to simulate the effects of dynamic actions.

Note 2 to entry: In this document the DAFs used are either $K_{DAF,SDOF}$ for a single degree of freedom analogy or $K_{DAF,RANDOM}$ for a stochastic simulation, see 4.1.1.

3.19

deterministic analysis

analysis in which the response is determined from a single combination of actions

3.20

earthquake response spectrum

function representing the peak elastic response for single degree of freedom oscillators with specific damping ratios in terms of absolute acceleration, pseudo velocity, or relative displacement values against natural frequency or period of the oscillators

[SOURCE: ISO 19901-2:2022, 3.13, modified — "earthquake" added to term.]

3.21

exposure level

classification system used to establish relevant criteria for a *jack-up* (3.36) based on consequences of failure

Note 1 to entry: An exposure level 1 (L1) jack-up is the most critical and exposure level 3 (L3) the least (see ISO 19900:2019, 7.3).

[SOURCE: ISO 19900:2019, 3.20, modified — "structure" replaced with "jack-up" and Note to entry added.]

3.22

extreme storm event

extreme combination of wind, wave and current conditions used for the assessment of the *jack-up* (3.36)

Note 1 to entry: This is the metocean event used for ULS storm assessment (see 5.5.4 and 6.4).

3.23

field

general area where the *jack-up* (3.36) is intended to operate

Note 1 to entry: The field is a general area as opposed to the *site* (3.74) which is specific.

3.24

fixed load

permanent parts of the *jack-up* (3.36), including hull, legs and spudcans, outfit, stationary and moveable-fixed equipment

Note 1 to entry: Moveable-fixed equipment normally includes the drilling package structure and associated permanently attached equipment.

3.25

footprint

sea floor depression that remains when a *jack-up* (3.36) is removed from a site

3.26

foundation

soil and spudcan supporting a *jack-up* (3.36) leg

3.27

foundation fixity

rotational restraint offered by the soil to the spudcan

3.28

foundation stability

ability of the foundation to provide sufficient support to remain stable when subjected to actions and incremental deformation

3.29

global analysis

determination of a consistent set of internal forces and moments, or stresses, in a structure that are in equilibrium with a defined set of actions on the entire structure

Note 1 to entry: When a global analysis is of a transient situation (e.g. earthquake), the inertial response is part of the equilibrium.

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.

[SOURCE: ISO 19900:2019, 3.26]

3.31

hazardous event

event that occurs when a *hazard* (3.30) interacts with a *jack-up* (3.36)

EXAMPLE Wave or iceberg impacting the *jack-up*, excessive weight added to the *jack-up*, vessel collision and scour in the vicinity of the *jack-up*.

[SOURCE: ISO 19900:2019, 3.27, modified — "structure" changed to "jack-up", Example modified to include iceberg and to exclude fire, explosion, and landslide.]

3.32

independent leg jack-up

jack-up unit with legs that can be raised and lowered independently

3.33

inertial loadset

set of actions that approximates the effect of the inertial forces

Note 1 to entry: An inertial loadset is used only in quasi-static analyses.

3.34

infill

soil above the plan area of the spudcan arising from sediment transport or hole sidewall collapse

Note 1 to entry: Infill is part of *backfill* (3.11).

3.35

intrinsic wave frequency

wave frequency of a periodic wave in a reference frame that is stationary with respect to the wave

Note 1 to entry: If there is no current, the reference frame is also stationary with respect to the sea floor. If there is a current, the reference frame moves with the same speed and in the same direction as the current.

3.36

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.

3.37

jack-up owner owner

representative of the company or companies owning or chartering the jack-up

Note 1 to entry: The energy company, the *operator* (3.53), contracts the jack-up and is generally not the owner or charterer.

3.38

joint probability metocean data

combinations of wind, wave and current that produce the action effect that can be expected to be exceeded at a site, on average, once in the return period

3.39

leaning instability

instability of an independent leg jack-up that can arise when the rate of increase of actions on the foundation with jack-up inclination exceeds the rate of increase of foundation capacity with depth

3.40

limit state

state beyond which the *jack-up* (3.36) or a *structural member* (3.87) no longer satisfies the assessment criteria

3.41

load case

compatible load arrangements, sets of deformations and imperfections considered simultaneously with permanent actions and fixed variable actions for a particular design or verification

3.42

long-term operation

operation of a jack-up on one particular site for more than the recognised classification society special survey period

3.43

lowest astronomical tide

LAT

level of low tide when all harmonic components causing the tides are in phase

Note 1 to entry: The harmonic components are in phase approximately once every 19 years, but these conditions are approached several times each year.

[SOURCE: ISO 19901-1:2015, 3.17]

3.44

mat-supported jack-up

jack-up unit with the leg(s) rigidly connected by a foundation structure, such that the leg(s) are raised and lowered in unison

3.45

mean high water spring tidal level

arithmetic mean of all high water spring tidal sea levels measured over a long period, ideally 19 years

3.46

mean low water spring tidal level

arithmetic mean of all low water spring tidal sea levels measured over a long period, ideally 19 years

3.47

mean sea level

MSL

arithmetic mean of all sea levels measured at hourly intervals over a long period

Note 1 to entry: Seasonal changes in mean level can be expected in some regions and over many years the mean sea level can change.

[SOURCE: ISO 19901-1:2015, 3.20]

3.48

mean zero-upcrossing period

average intrinsic period of the zero-upcrossing waves in a sea state

Note 1 to entry: In practice, the mean zero-crossing period is often estimated from the zeroth and second moments of the wave spectrum as given by Formula (3.41-1):

$$T_z = T_2 = \sqrt{m_0(f)/m_2(f)} = 2\pi\sqrt{m_0(\omega)/m_2(\omega)} \quad (3.41-1)$$

where

f is the frequency in cycles per second (Hertz);

m_0 is the zeroth spectral moment and is equivalent to σ^2 , the variance of the corresponding time series;

m_2 is the second spectral moment;

T_2 and T_z are the average zero-upcrossing period of the water surface elevation, defined by the zeroth and second order spectral moments, ($T_2 = T_z$);

ω is the wave frequency in radians per second.

[SOURCE: ISO 19901-1:2015, 3.22, modified — "intrinsic" deleted, "(up or down) zero-crossing" changed to "upcrossing" and definitions of terms in the equation added]

3.49

most probable maximum extreme

MPME

value of the maximum of a variable with the highest probability of occurring over a defined period of time

Note 1 to entry: A defined period of time can be, for example, X hours.

Note 2 to entry: The most probable maximum extreme is the value for which the probability density function of the maxima of the variable has its peak. It is also called the mode or modulus of the statistical distribution.

[SOURCE: ISO 19901-1:2015, 3.24, modified — Added "over a defined period of time" and note 1 to entry.]

3.50

nominal strength

strength calculated for a cross-sectional area, taking into account the stress raising effects of the macro-geometrical shape of the component of which the section forms a part, but disregarding the local stress raising effects from the section shape and any weldment or other fixing detail

3.51

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/assessment situations, a variable can have two nominal values, an upper value

3.52

operating manual

marine operations manual

latest approved document that defines the operational characteristics and capabilities of the jack-up

Note 1 to entry: The *assessor* (3.10) is should ensure that any updated weight data are provided.

3.53

operator

representative of the company or companies leasing the site

Note 1 to entry: The operator is normally the oil company acting on behalf of co-licensees.

[SOURCE: ISO 19900:2019, 3.35, modified — Note 2 to entry deleted.]

3.54

performance

ability of a *jack-up* (3.36) or a *structural member* (3.87) and the foundation to fulfil specified requirements

Note 1 to entry: Specified requirements include requirements for structural and foundation integrity and functionality.

[SOURCE: ISO 19900:2019, 3.36 modified — Added "and the foundation", and "structure" replaced with "jack-up" and " structural component" replaced with "structural member".]

3.55

preloading

installation and embedment of the spudcans by vertical loading of the soil beneath a jack-up leg spudcan with the objective of ensuring sufficient foundation capacity under assessment situations through to the time when the maximum load is applied and held

Note 1 to entry: While three-legged jack-ups preload by taking water ballast on board, jack-ups with four or more legs typically achieve foundation preload by carrying the hull weight on pairs of legs in turn. This procedure is known as pre-driving and generally does not require the addition of water ballast. For the purposes of this document, no distinction is made between preload and pre-drive.

3.56

preload reaction

maximum vertical reaction under a spudcan supporting the in-water weight of the jack-up during the entire preloading operation

Note 1 to entry: The in-water weight is the full weight of the hull, variable load and preload ballast, plus the legs and spudcans and any contained water, reduced by the buoyancy in water of the legs and spudcans (calculated from their external dimensions). Soil buoyancy and the weight of any soil backfill above the spudcan are neglected. It is necessary to take care when accounting for water contained in the spudcan (in some cases this can be included in the quoted leg weight).

Note 2 to entry: This is the maximum reaction on a spudcan which would be obtained during preloading if the jack-up were installed on an infinitely rigid foundation.

Note 3 to entry: The preload reaction is a key parameter in the geotechnical analysis of independent leg foundations. Assessors consider values that can be reasonably achieved during preload operations. The assessment is invalidated if the value considered in the site assessment is not achieved during preload operations.

3.57

punch-through

rapid, uncontrolled vertical leg movement due to soil failure in strong soil overlying weak soil

3.58

quasi-static

static representation of a dynamic process

Note 1 to entry: In some cases, the influence of structural accelerations can be approximated by using an equivalent inertial loadset.

3.59

rack phase difference

RPD

relative difference in the position of adjacent leg chords within a leg measured parallel to the longitudinal axis of the chords

Note 1 to entry: This is the out-of-plane distortion of the plan-frame.

3.60

recognized classification society

RCS

member of the international association of classification societies (IACS), with recognized and relevant competence and experience in jack-ups, and with established rules and procedures for classification/certification of such units used in petroleum-related activities

[SOURCE: ISO 19901-7:2013, 3.23, modified — "floating structures" replaced by "jack-ups", "installations" replaced by "such units".]

3.61

redundancy

ability of a structure to find alternative load paths following structural failure of one or more components, thus limiting the consequences of such failures

Note 1 to entry: Statically determinate structures, contrary to statically indeterminate structures, do not generally exhibit redundancy.

[SOURCE: ISO 19902:2020, 3.38]

3.62

regulator

authority established by a national governmental administration to oversee the activities of the offshore oil and natural gas industries within its jurisdiction, with respect to the overall safety to life and protection of the environment

Note 1 to entry: The term "regulator" can encompass more than one agency in any particular territorial waters.

Note 2 to entry: The regulator can appoint other agencies, such as marine classification societies, to act on its behalf, and in such cases, regulator as it is used in this document includes such agencies.

Note 3 to entry: In this document, the term "regulator" does not include any agency responsible for approvals to extract hydrocarbons, unless such agency also has responsibility for safety and environmental protection.

[SOURCE: ISO 19902:2020, 3.39]

3.63

reliability

performance (3.54) over a specified period of time

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 period of time is typically one year.

[SOURCE: ISO 19900:2019, 3.39]

3.64

representative value

value assigned to a *basic variable* (3.13) for verification of a *limit state* (3.40) in an *assessment situation* (3.9)

Note 1 to entry: Two types of representative value used in verification are *characteristic value* (3.15) and *nominal value* (3.51).

[SOURCE: ISO 19900:2019, 3.40, modified — "Design" deleted.]

3.65

resistance

ability to withstand *action effects* (3.5)

Note 1 to entry: When undertaking an assessment, the resistance checks normally include: Overturning stability, foundation, holding system, *structural members* (3.83) and *structural components* (3.82).

3.66

return period

average period 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.

[SOURCE: ISO 19900:2019, 3.42]

3.67

scatter diagram

joint probability of two or more (metocean) parameters

Note 1 to entry: A scatter diagram is especially used with wave parameters in the metocean context, see ISO 19901-1:2015, A.5.8. The wave scatter diagram is commonly understood to be the probability of the joint occurrence of the significant wave height (H_s) and a representative period ($T_{z,i}$ or $T_{p,i}$).

[SOURCE: ISO 19901-1:2015, 3.29, modified — In Note to entry, "(for example in fatigue assessments)" replaced by ", see ISO 19901-1:2015, A.5.8".]

3.68

scour

removal of seabed material from the foundation due to current and waves

3.69

sea floor

interface between the sea and the *seabed* (3.71)

[SOURCE: ISO 19900:2019, 3.46]

3.70

sea state

condition of the sea during a period in which its statistics remain approximately stationary

Note 1 to entry: In a statistical sense the sea state does not change markedly within the period. The period during which this condition exists is usually assumed to be three hours, although it depends on the particular weather situation at any given time.

[SOURCE: ISO 19901-1:2015, 3.31]

3.71

seabed

materials below the *sea floor* (3.69)

[SOURCE: ISO 19900:2019, 3.47]

3.72

shallow gas

gas pockets or entrapped gas below impermeable layers at shallow depth

3.73

significant wave height

statistical measure of the height of waves in a sea state

Note 1 to entry: The significant wave height was originally defined as the mean height of the highest one-third of the mean zero upcrossing waves in a sea state. In most offshore data acquisition systems, the significant wave height is currently taken as $4\sqrt{m_0}$ (where m_0 is the zeroth spectral moment, see ISO 19901-1:2015, 3.37) or 4σ , where σ is the standard deviation of the time series of water surface elevation over the duration of the measurement, typically a period of approximately 30 min.

[SOURCE: ISO 19901-1:2015, 3.35]

3.74

site

specific position and orientation at which a *jack-up* (3.36) operates within a *field* (3.23)

3.75

skirt

vertical bulkhead(s), closed in plan view, beneath the main body of a *spudcan* (3.81)

3.76

skirted spudcan

spudcan (3.81) with a *skirt* (3.75)

3.77**sliding**

horizontal movement of a spudcan

3.78**special survey**

extensive and complete survey carried out at each nominal year interval, which closes a cycle of annual classification and mandatory surveys

Note 1 to entry: This is also referred to as “renewal survey” by some IACS members. The special survey period is normally between five and eight years.

3.79**spectral density function****spectrum**

energy density function

measure of the variance associated with a time-varying variable per unit frequency band and per unit directional sector

Note 1 to entry: Spectrum is a shorthand expression for the full and formal name of spectral density function or energy density function.

Note 2 to entry: The spectrum is, in general, written with two arguments: one for the frequency variable and one for a direction variable.

Note 3 to entry: Within ISO 19901-1, the concept of a spectrum applies to waves, wind turbulence and action effects (responses) that are caused by waves or wind turbulence. For waves, the spectrum is a measure of the energy traversing a given space.

Note 4 to entry: Not to be confused with an earthquake response spectrum.

[SOURCE: ISO 19901-1:2015, 3.39, modified — Deleted first sentence of Note 2 to entry. Added Note 4 to entry.]

3.80**spectral peak period**

period of the maximum (peak) energy density in the *spectrum* (3.79)

Note 1 to entry: In practice, there is often more than one peak in a spectrum.

Note 2 to entry: There are two types of spectral peak period used within this document: intrinsic and apparent. The distinction is discussed in A.7.3.3.5, which is, in turn, based on ISO 19901-1:2015, 8.4.4 and A.8.4.3.

[SOURCE: ISO 19901-1:2015, 3.38, modified — Added Note 2 to entry.]

3.81**spudcan**

structure at the base of a leg supported by the soil

3.82**squeezing**

lateral movement of weak soil between the spudcan base and an underlying stronger layer, or of weak soil between two stronger layers

3.83**stochastic analysis**

analysis in which a probabilistic approach is taken to model the random nature of the variables of interest

Note 1 to entry: In general, a linear(ized) stochastic analysis can be performed in the frequency domain or in the time domain, whereas non-linear stochastic analysis can only use time domain simulations. This document does not support frequency domain stochastic analysis.

3.84

stress concentration factor

SCF

factor relating a local stress to the nominal stress at a detail

[SOURCE: ISO 19902:2020, 3.49, modified — Note 1 to entry deleted.]

3.85

structural analysis

process or algorithm for determining action effects from a given set of actions

Note 1 to entry: Structural analyses are performed at three levels [global analysis of an entire structure, analysis of part of a structure (e.g. a leg), local analysis of a structural member and local analysis of a structural component] using different structural models.

[SOURCE: ISO 19902:2020, 3.50, modified — Note 1 to entry with added example and reference to "structural member".]

3.86

structural component component

physically distinguishable part of a member cross-section of uniform yield strength

Note 1 to entry: The cross-section of a non-tubular member is usually comprised of several structural components. A component consists of only one material. Where a plate component is reinforced by another piece of plating, the reinforcement can be of a different yield strength. See also further discussion in A.12.1.1.

3.87

structural member member

physically distinguishable part of a braced structure connecting two joints

Note 1 to entry: A structural member can also be defined as the leg of a non-truss leg jack-up.

Note 2 to entry: See also further discussion in A.12.1.1.

3.88

sudden hurricane

sudden cyclone

sudden typhoon

sudden tropical revolving storm that forms locally and, due to speed of formation and proximity to infrastructure at time of formation, might not allow sufficient time to evacuate occupied facilities within the time required by the emergency evacuation plan

Note 1 to entry: The intent is that the jack-up be assessed to L1 for the specified sudden tropical revolving storm, see 5.5.2 and 5.5.3.

3.89

sustained wind speed

time-averaged wind speed with a defined averaging duration of 1 min or longer at a specified elevation

[SOURCE: ISO 19901-1:2015, 3.43, modified — Duration changed from "10 min or longer".]

3.90**undrained shear strength**

maximum shear stress at yielding or at a specified maximum strain in an undrained condition

Note 1 to entry: Yielding is the condition of a material in which a large plastic strain occurs at little or no stress increase.

Note 2 to entry: Strain softening is also to be considered.

[SOURCE: ISO 19901-8:—¹, 3.42, modified — Added Note 2 to entry.]

3.91**utilization****member utilization****foundation utilization**

maximum absolute value of the ratio of the generalized representation of the assessment action effect to the generalized representation of the assessment resistance in compatible units

Note 1 to entry: Utilizations are calculated for each limit state of the assessment situation being considered.

Note 2 to entry: Only utilizations smaller than or equal to 1,0 satisfy the assessment criteria for a particular limit state.

Note 3 to entry: The assessment action effect is the response to the factored actions. The assessment resistance is the representative resistance divided by the partial resistance factor.

Note 4 to entry: For members and foundations subjected to combined forces, the internal force pattern and the resistance combine into an interaction formula. If the interaction formula governing the assessment check is, or can be, reduced to an inequality of the form $U \leq 1,0$, then the utilization is equal to U .

3.92**variable load**

items carried by the jack-up to support its operation that are not included in the fixed load

3.93**water depth**

vertical distance between the sea floor and still water level

Note 1 to entry: As there are several options for the still water level (see A.6.4.4), there can be several water depth values. Generally, assessment water depth is determined to the extreme still water level.

Note 2 to entry: The water depth used for calculating wave kinematics varies between the maximum water depth of the mean high water spring tide plus a positive storm surge, and the minimum water depth of the mean low water spring tide less a negative storm surge, where applicable.

[SOURCE: ISO 19901-1:2015, 3.47, modified — Notes to entry rewritten.]

¹ Under preparation. Stage at the time of publication: ISO/FDIS 19901-8:2023.

4 Symbols and abbreviated terms

4.1 Symbols

4.1.1 General

A_{Fd}	action effect due to factored actions
B_S	soil buoyancy of spudcan below bearing area, i.e. the submerged weight of soil displaced by the spudcan below D_{embed} , the greatest embedment depth of maximum cross-sectional spudcan bearing area below the sea floor
C_{mr}	moment reduction factor
D_{embed}	greatest embedment depth of maximum cross-sectional spudcan bearing area below the sea floor
D_e	equivalent set of inertial actions representing dynamic extreme storm effects or ground motion effects due to earthquakes
E_e	metocean actions due to the extreme storm event
f_{FD}	fatigue damage design factor
F_d	assessment load case (see 8.8)
F_H	horizontal force applied to the spudcan due to the assessment load case (see 8.8)
F_V	gross vertical force acting on the soil beneath the spudcan due to the assessment load case F_d (see 8.8)
G_F	actions due to the fixed load positioned such as to adequately represent their vertical and horizontal distribution
G_V	actions due to maximum or minimum variable load, as appropriate, positioned at the most onerous centre of gravity location applicable to the configurations under consideration
K	effective length factor
$K_{DAF,RANDOM}$	DAF from random wave time domain (stochastic) analyses, including the mean values, obtained from a random wave calculation. It is the ratio of the absolute value of a dynamic action effect to the absolute value of the corresponding static action effect, each including their mean value
$K_{DAF,SDOF}$	DAF from single degree-of-freedom representation of dynamic behaviour, excluding the mean values, obtained from a single degree-of-freedom (SDOF) calculation. It is the ratio of the amplitude of a dynamic action effect to the amplitude of the corresponding static action effect for periodic excitation of a linear one degree-of-freedom model approximation of jack-up behaviour
L_1	length of the vector from a specified origin to the action effect
L_2	length of the vector from the origin specified for L_1 to the factored interaction surface
L_{b1}	length of the vector from origin used for establishing the bearing utilization $(F_H, F_V)_{ORG}$ to the environmental response point (determined from the factored actions) (F_H, F_V)

L_{b2}	length of the vector from origin used for establishing the bearing utilization $(F_H, F_V)_{ORG}$ and passing through (F_H, F_V) to the factored vertical-horizontal capacity surface $Q_{VH,f}$
L_{s1}	length of the vector from origin used for establishing the sliding utilization $(F_H, F_V)_{ORG}$ to the environmental response point (determined from the factored actions) (F_H, F_V)
L_{s2}	length of the vector from origin used for establishing the sliding utilization $(F_H, F_V)_{ORG}$ and passing through (F_H, F_V) to the factored vertical-horizontal capacity surface $Q_{VH,fv}$
L_{AE}	length of the vector from a specified origin to the action effect
L_{IS}	length of the vector from the same origin to the factored interaction surface
M_{OTM}	overturning moment due to factored actions
N	number of cycles to failure in fatigue of a specified constant amplitude stress range
Q_H	maximum horizontal foundation capacity
R	factored resistance
$R_{d,OTM}$	factored stabilizing moment
$R_{r,OTM}$	representative stabilizing moment
T_n	jack-up natural period
T_p	apparent modal or peak period of the wave spectrum
$T_{p,i}$	intrinsic modal or peak period of the wave spectrum
$T_{z,i}$	intrinsic mean zero-upcrossing period of the water surface elevation in a sea state
U	utilization
$U_{S,pl}$	utilization of preload
$U_{S,sl}$	utilization of foundation resistance to sliding
$U_{S,vhm}$	utilization of vertical and horizontal foundation capacity
V_{Lo}	maximum vertical reaction under the spudcan considered required to support the in-water weight of the jack-up during the entire preloading operation (this is not the soil capacity; see 3.56)
V_{st}	vertical force applied to the spudcan due to the assessment load case (see 8.8) (includes effects of leg weight and water buoyancy but excludes effects of backfill and spudcan soil buoyancy)
$W_{BF,A}$	submerged weight of the backfill that occurs after the maximum preload has been applied and held
$W_{BF,o}$	submerged weight of the overburden on top of the spudcan from backfill during preloading
$\gamma_{f,D}$	partial action factor applied to the inertial actions due to dynamic response
$\gamma_{f,E}$	partial action factor applied to the metocean or earthquake actions
$\gamma_{f,G}$	partial action factor applied to the actions due to fixed load

$\gamma_{f,V}$	partial action factor applied to the actions due to the variable load
$\gamma_{R,H}$	partial resistance factor for holding system strength
$\gamma_{R,Hfc}$	partial resistance factor for horizontal foundation capacity
$\gamma_{R,OTM}$	partial resistance factor for stabilizing moment
$\gamma_{R,PRE}$	partial resistance factor for preload
$\gamma_{R,S}$	partial resistance factor for spudcan strength
γ_{VH}	partial resistance factor for foundation capacity

4.1.2 Symbols used in A.6

D_1	directional spreading function as a function of n
D_2	directional spreading function as a function of s
D_3	directional spreading function as a function of σ
d_w	water depth
$F(\alpha_w)$	directionality function
f	wave frequency
H_{max}	individual extreme wave height
H_s	increased significant wave height to account for wave asymmetry
H_{srp}	significant wave height for the assessment return period
h_{ref}	reference depth for wind-driven current
L_w	wave length of the wave with H_{max} and T_{ass} in water depth d_w , according to the periodic wave theory used
N	inverse exponent of the power law wind profile
n	parameter exponent in D_1
S_y	smallest spacing between the legs of 3-legged jack-ups
$S_{PM}(\omega)$	Pierson-Moskowitz wave spectrum for a sea state
$S_{JS}(\omega)$	JONSWAP wave spectrum for a sea state
$S_{\eta\eta}(f)$	wave spectral density function expressed as a function of wave frequency
$S_{\eta\eta}(f, \alpha_w)$	directional short-crested power density spectrum
s	parameter in D_2
$s_{u,ave}$	average undrained shear strength = $(s_{uC} + s_{uD} + s_{uE})/3$
s_{uC}	static triaxial compression undrained shear strength
s_{uD}	static DSS undrained shear strength
s_{uE}	static triaxial extension undrained shear strength
T_{ass}	intrinsic wave period associated with H_{max}
T_p	apparent modal or peak period of the wave spectrum

$T_{p,i}$	intrinsic modal or peak period of the wave spectrum
$T_{z,i}$	intrinsic mean zero-upcrossing period of the water surface elevation in a sea state
V_C	current velocity as a function of z
V_s	downwind component of associated surge current (excluding wind-driven component)
V_{ref}	1 min sustained wind speed at elevation Z_{ref} (normally at 10 m above MSL)
V_t	downwind component of mean spring tidal current
V_w	wind generated surface current
V_Z	the wind speed at elevation Z above SWL under consideration
Z	elevation above SWL under consideration
z	vertical coordinate relative to SWL under consideration, positive upwards
Z_{ref}	reference elevation above MSL
α_w	angle between the direction of elementary wave trains and the dominant direction of the short-crested waves
γ	shape parameter of the peak enhancement factor in the JONSWAP spectrum
κ	kinematics reduction factor
ϕ	directional spreading factor based on latitude
σ	standard deviation of the normal distribution in D_3
ψ	latitude

4.1.3 Symbols used in A.7

A_{cs}	cross-sectional area of member
A_e	equivalent area of leg per unit height
A_i	equivalent area of member or gusset i
A_{Wi}	projected area of the block i perpendicular to the wind direction
C_A	added mass coefficient
C_{De}	equivalent value of the drag coefficient of a leg bay
C_{Dei}	equivalent value of the drag coefficient of member i
C_D, C_{Di}	drag coefficient, drag coefficient of member i
$C_{Dpr}(\theta)$	drag coefficient related to the projected diameter
C_{D0}	drag coefficient for a tubular with appropriate roughness
C_{D1}	drag coefficient for flow normal to the rack related to projected diameter, W
C_m, C_{mi}	inertia coefficient, inertia coefficient of member i
C_{me}	equivalent value of the inertia coefficient of a leg bay
C_{mei}	equivalent value of the inertia coefficient of member i
C_s	shape coefficient
D_r, D_i	reference diameter, reference diameter of member i

D_e	equivalent diameter of leg
D_F	face width of leg, outside dimensions, orthogonal to the flow direction
$D_{pr}(\theta)$	projected diameter
d_w	water depth
H_s	increased significant wave height to account for wave asymmetry
L_w	wave length
l_i	length of member i node to node centre
m_a	added mass contribution (per unit length) for a member
P_i	pressure at the centre of block i
s	height of one bay, or part of bay considered
T_i	intrinsic period of a periodic wave (in a reference frame that is stationary with respect to the wave, i.e. with no current present)
T_n	first natural period of surge or sway motion of the jack-up
T_p	apparent modal or peak period of the wave spectrum
$T_{p,i}$	intrinsic modal or peak period of the wave spectrum
T_z	apparent mean zero-upcrossing period of the water surface elevation in a sea state
$T_{z,i}$	intrinsic mean zero-upcrossing period of the water surface elevation in a sea state
t_m	marine growth thickness
W	projected width
$\dot{r}_n$	velocity of the considered member, normal to the member axis and in the direction of the combined particle velocity
$\ddot{r}_n$	acceleration of the considered member, normal to the member axis and in the direction of the combined particle velocity
u	wave particle velocity
u_n	wave particle velocity resolved normal to the member axis
$\dot{u}_n$	wave particle acceleration resolved normal to the member axis
V_C	current velocity for use in the hydrodynamic model
V_f	far field (undisturbed) current velocity
V_{zi}	wind velocity at the centre of block i
v_n	fluid particle velocity resolved normal to the member axis
z'	modified coordinate for use in particle velocity formulation
z	vertical coordinate relative to SWL under consideration, positive upwards
α_i	angle between flow direction and member axis projected onto a horizontal plane
β_i	angle defining the member inclination from horizontal
ΔF	wave action per unit length

ΔF_{drag}	drag action per unit length
$\Delta F_{\text{inertia}}$	inertia action per unit length
ρ_a	mass density of air
ρ_w	mass density of water
θ	angle in degrees
ζ_w	instantaneous water level (same axis system as z)

4.1.4 Symbols used in A.8

A_{eq}	axial area of equivalent leg model beam
A_{seff}	effective shear area of the equivalent leg model beam
E	Young's modulus of steel
F	applied axial action
G	shear modulus
I	second moment of area
K_{hh}	horizontal leg-to-hull connection stiffness
K_{rh}	rotational leg-to-hull connection stiffness
K_{vh}	vertical leg-to-hull connection stiffness
L_c	cantilevered length (from the hull to the seabed reaction point)
L_{ub}	distance from the spudcan reaction point to the hull vertical centre of gravity
M	applied moment
P	applied shear
P_g	sum of the leg forces due to functional actions on legs at hull, including the weight of the legs above the hull
Δ	axial deflection (shortening) of the leg at the point of force application from the detailed leg model
Δ_c	axial end displacements of the combined leg and leg-to-hull connection model
Δ_M	lateral deflection of the cantilevered leg at the point of moment application from the detailed leg model
δ_c	lateral deflection of the cantilevered leg at the point of moment application from the combined leg and leg-to-hull connection model
δ_M	lateral deflection of the cantilevered leg at the point of moment application from the detailed leg model
θ_c	slope of the end of the cantilever from the combined leg and leg-to-hull connection model
θ_M	slope of the cantilever at the point of moment application from the detailed leg model
θ_P	slope of the cantilever at the point of shear application from the detailed leg model

4.1.5 Symbols used in A.9 and Annex E

A	spudcan effective bearing area based on cross-section taken at uppermost part of bearing area in contact with soil (see Figure A.9.3-3)
A_s	spudcan laterally projected embedded area
a	depth interpolation parameter
a_s	bearing capacity squeezing factor constant
B	effective spudcan diameter at uppermost part of bearing area in contact with the soil (for rectangular footing B equal to width)
$B_{\max}$	diameter of the contact area in plan when the spudcan is fully seated
B_S	soil buoyancy of spudcan below bearing area i.e. the submerged weight of soil displaced by the spudcan below D_{embed} , the greatest embedment depth of maximum cross-sectional spudcan bearing area below the sea floor
b_s	bearing capacity squeezing factor constant dependent on spudcan diameter
C_H	horizontal capacity coefficient
$C_{H,NC}$	horizontal capacity coefficient for the normally consolidated case per A.9.3.3.2 a) i)
$C_{H,U}$	horizontal capacity coefficient for the uniform strength case per A.9.3.3.2 a) ii)
$C_{H,\text{shallow}}$	horizontal capacity coefficient at shallow embedment
$C_{H,\text{deep}}$	horizontal capacity coefficient at deep embedment
C_M	moment capacity coefficient
$C_{M,NC}$	moment capacity coefficient for the normally consolidated case per A.9.3.3.2 a) i)
$C_{M,U}$	moment capacity coefficient for the uniform strength case per A.9.3.3.2 a) ii)
D_{embed}	greatest embedment depth of maximum cross-sectional spudcan bearing area below the sea floor (see Figure A.9.3-3)
D_b	depth of backflow; infill should not be considered
D_R	relative density of sand (percent)
d	depth beneath sea floor
d_c	bearing capacity depth factor
d_{crit}	depth at which maximum bearing resistance occurs (layered case)
d_q	depth factor on surcharge for drained soils
d_γ	depth factor on self weight for drained soils
$f_{cy,V}$	cyclic degradation factor on vertical capacity
$f_{cy,H}$	cyclic degradation factor on horizontal capacity
$f_{cy,M}$	cyclic degradation factor on moment capacity
F_H	horizontal force applied to the spudcan due to the assessment load case (see 8.8)
F_M	moment force applied to the spudcan due to the assessment load case (see 8.8)
F_V	gross vertical force acting on the soil beneath the spudcan due to the assessment load case F_d (see 8.8)

$(F_V/Q_V)_t$	vertical load at intersection of adhesion yield surface and foundation yield surface
f_1	factor applied to horizontal capacity used in yield surface formula for embedded spudcans on clay
f_2	factor applied to moment capacity used in yield surface formula for embedded spudcans on clay
f_r	foundation rotational stiffness reduction factor
$G_{\max}$	maximum value of the shear modulus (of the foundation soil) which occurs at small strain
H	distance from spudcan maximum bearing area to weaker layer below
H_{cav}	limiting depth of cavity that remains open above the spudcan during penetration
h_1	embedment depth to the uppermost part of the spudcan, (if not fully embedded, $h_1 = 0$)
h_2	spudcan tip embedment depth
I_{rNC}	rigidity index for normally consolidated clays
I_p	plasticity index
j	dimensionless stiffness factor
k_a	active earth pressure coefficient (for $s_u = 0$)
k_p	passive earth pressure coefficient
K_1, K_2, K_3	stiffness factors for vertical, horizontal and rotational foundation stiffness respectively
K_{d1}, K_{d2}, K_{d3}	depth factors for vertical, horizontal and rotational foundation stiffness respectively
K_s	coefficient of punching shear
L_s	length of strip footing
m	parameter to define effect of adhesion on the foundation yield surface envelope
n_s	load spread factor for sand overlying clay
N_c	bearing capacity factor, taken as $N_c s_c = 6,0$ for circular footings
N_q	bearing capacity factor for a flat rough circular footing
N_γ	bearing capacity factor for a flat rough circular footing
p_o'	effective overburden pressure at greatest embedment depth, D_{embed} , of maximum bearing area
p_a	atmospheric pressure
Q_0	spudcan bearing capacity at sea floor
Q_H	maximum horizontal foundation capacity
Q_{Hs}	foundation sliding capacity
Q_M	ultimate moment capacity of foundation
Q_{Mp}	increased ultimate moment capacity due to further spudcan penetration under environmental actions
Q_{Mps}	ultimate moment capacity when further spudcan penetration leads to full contact of the entire underside of the spudcan with the seabed

Q_{Mpv}	ultimate moment capacity under further spudcan penetration, when the applied vertical force is too low to achieve full contact of the entire underside of the spudcan with the seabed
Q_{peak}	maximum bearing capacity at $d = d_{crit}$
$Q_{u,b}$	ultimate vertical foundation bearing capacity assuming the spudcan bears on the surface of the lower (bottom) clay layer with no backfill
Q_V	gross ultimate vertical foundation capacity
Q_{Vnet}	net ultimate vertical foundation capacity
Q_{Vo}	initial gross ultimate vertical foundation capacity established by preload operations
r_f	failure ratio
R_{OC}	over-consolidation ratio
s_c	bearing capacity shape factor
s_u	undrained shear strength
$s_{u,a}$	undrained shear strength of backfill material above the spudcan
s_{uo}	undrained shear strength at greatest embedment depth of maximum bearing area, D_{embed} , below sea floor
s_{uH}	undrained shear strength at depth of H_{cav} below sea floor
$s_{u,l}$	undrained shear strength at the spudcan tip
s_{um}	undrained shear strength at the sea floor
$s_{u,b}$	undrained shear strength of lower clay layer below spudcan
$s_{u,t}$	undrained shear strength of upper clay layer below spudcan
$s_{u,ned}$	minimum undrained shear strength near (within $\frac{1}{4}$ spudcan diameter below) the embedment depth
$s_{u,nml}$	minimum undrained shear strength within $\frac{1}{4}$ spudcan diameter below the mudline.
T	thickness of weak clay layer underneath spudcan
V_D	volume of the spudcan below the maximum bearing area that is penetrated into the soil
V_L	available spudcan reaction
V_{Lo}	maximum vertical reaction under the spudcan considered required to support the in-water weight of the jack-up during the entire preloading operation (this is not the soil capacity; see 3.56)
V_{st}	vertical force applied to the spudcan by the assessment load case, see 8.8, (includes effects of leg weight and water buoyancy but excludes effects of backfill and spudcan soil buoyancy)
V_{spud}	the total volume of the spudcan beneath the backfill
V_{sw}	gross vertical spudcan reaction under still water conditions for the spudcan being considered (includes effects of backfill and spudcan soil buoyancy)
W_{BF}	submerged weight of the backfill

$W_{BF,A}$	submerged weight of the backfill that occurs after the maximum preload has been applied and held
$W_{BF,0}$	submerged weight of the overburden on top of the spudcan from backfill during preloading
$W_{BF,0min}$	minimum value of the submerged weight of the backfill, due to backflow during preloading
α_s	adhesion factor
β	equivalent cone angle
δ	steel/soil friction angle in degrees
$\gamma_{R,Hfc}$	partial resistance factor for horizontal foundation capacity
$\gamma_{R,VH}$	partial resistance factor for foundation capacity
γ'	submerged (effective) unit weight of soil
ρ_{su}	rate of increase in undrained shear strength with depth
ϕ'	effective angle of internal friction for sand in degrees
ν	Poisson's ratio

4.1.6 Symbols used in A.10

B	effective spudcan diameter at uppermost part of bearing area in contact with the soil
C_{rd}	radiation damping coefficient of a dashpot (force per unit velocity)
D_e	equivalent set of inertial actions representing dynamic extreme storm effects or ground motion effects due to earthquakes
E_e	metocean actions due to the extreme storm event
$F_{BS,Amplitude}$	single amplitude of quasi-static base shear over one wave cycle
$F_{BS,(QS)Max}$	maximum quasi-static wave/current base shear
$F_{BS,(QS)Min}$	minimum quasi-static wave/current base shear
F_{in}	magnitude of the inertial loadset
G	shear modulus
G_F	actions due to the fixed load positioned such as to adequately represent their vertical and horizontal distribution
G_0	shear modulus of the foundation soil
G_v	actions due to maximum or minimum variable load, as appropriate, positioned at the most onerous centre of gravity location applicable to the configurations under consideration
$K_{DAF,RANDOM}$	DAF from random wave time domain (stochastic) analyses
$K_{DAF,SDOF}$	DAF from single degree-of-freedom representation of dynamic behaviour
K_{eff}	effective system stiffness
M_{eff}	effective system mass
O_T	total horizontal offset of the leg base with respect to the hull

O_1	offset due to leg-to-hull clearances
O_2	offset due to maximum hull inclination permitted by the operating manual
T_n	first natural period of surge or sway motion of the jack-up
T_p	apparent modal or peak period of the wave spectrum
$T_{p,i}$	intrinsic modal or peak period of the wave spectrum
ν	Poisson's ratio (of the foundation soil)
Ω	ratio of jack-up natural period to wave excitation period
ρ	total, saturated, (mass) density of the foundation soil
ζ	damping ratio or fraction of critical damping
ζ_{rd}	radiation modal damping ratio to account for spudcan vertical motion
ω_n	natural frequency (rad/s)

4.1.7 Symbols used in A.11

$D_{c,e}$	calculated existing fatigue damage prior to arriving at site
$D_{c,s}$	calculated fatigue damage during planned operations on site
$f_{FD,e}$	fatigue damage design factor applicable to $D_{c,e}$
$f_{FD,s}$	fatigue damage design factor applicable to $D_{c,s}$
N	number of cycles to failure in fatigue of a specified constant amplitude stress range, S
S	constant amplitude stress range

4.1.8 Symbols used in A.12

A	gross cross-sectional area
A_{ec}	total effective area of a slender section in compression of a non-circular prismatic member
A_c	cross-sectional area for use in the assessment of a non-circular prismatic member in compression
A_{eff}	effective area of a plate with reinforcement
$A_{eff,i}$	effective area of a component i of a non-circular prismatic member in compression
A_f	cross-sectional area of a semi-compact section of a non-circular prismatic member
A_i	cross-sectional area of the i th component comprising the structural member
A_o	the area enclosed by the median line of the perimeter material of a section
A_p	fully plastic effective cross-sectional area of a non-circular prismatic member
A_t	cross-sectional area for use in the assessment of a non-circular prismatic member in tension
A_v	effective shear area of a non-circular prismatic member in the direction being considered
B_{maf}	member moment amplification factor for the axis under consideration
B_s	overall breadth of cross-section
b_w	width of the wall of a component forming the closed perimeter of a section

b	effective width of a component
b_1	width of base plate
b_2	width of reinforcing plate
C_{mr}	moment reduction factor
C_x	critical elastic buckling coefficient
D	outside diameter of a tubular
D_s	overall depth of cross-section
$d_{w,lim}$	limiting equivalent head of water
d_i	distance between the centroid of the i th component and the plastic neutral axis
E	Young's modulus of steel (elastic modulus)
e	eccentricity between the axis used for structural analysis and that used for structural strength checks
e_a	effective eccentricity between the axis used for structural analysis and that used for structural strength checks for class 3 members
F_{cr}	reduced material strength
F_y	yield strength in stress units
F_{yeff}	effective yield strength of the cross-section of a non-circular prismatic member in stress units
F_{yi}	yield strength of the i th component of the cross-section of a non-circular prismatic member in stress units
F_{ymin}	minimum yield strength of all components in the cross-section of a non-circular prismatic member (minimum value of F_{yi} , in stress units)
$F_{y,ltb}$	yield strength, F_y of the material that first yields when bending about the minor axis
g	acceleration due to gravity
h	subscript referring to the component that produces the smallest value of P_{pl}
I	second moment of area
I_e	effective second moment of area of a non-circular prismatic member cross-section
I_f	second moment of area of a plastic, a compact or a semi-compact section of a non-circular prismatic member cross-section
I_{pt}	polar moment of inertia of a tubular
I_{pp}	polar moment of inertia a non-circular prismatic member
I_1	major axis second moment of area of the gross cross-section
I_2	minor axis second moment of area of the gross cross-section
J	torsion constant
K	effective length factor
L_b	effective length of a beam-column between supports

L_p	limiting plastic length
L_r	limiting unbraced length for inelastic torsional buckling
L_{ub}	unbraced length of member for the plane of flexural buckling
M_b	representative bending moment strength of a tubular or a non-circular prismatic member
M_{by}, M_{bz}	representative bending moment strength about member y- and z-axes, respectively
M_p	plastic moment strength of a tubular or a non-circular prismatic member
M_{py}, M_{pz}	plastic moment strengths of a tubular or a non-circular prismatic member about member y- and z-axes, respectively
M_u	bending moment in a member due to factored actions determined in an analysis that includes global P-Δ effects
M_{ua}	amplified bending moment determined from M_{ue}
M_{ue}	corrected effective bending moment determined from M_u
M_{uay}, M_{uaz}	amplified bending moments due to factored actions about member y- and z-axes, respectively
M_{uey}, M_{uez}	corrected bending moments due to factored actions about member y- and z-axes, respectively
M_{uy}, M_{uz}	bending moments due to factored actions about member y- and z-axes, respectively, determined in an analysis that includes global P-Δ effects
P_a	representative axial compressive strength of a tubular
P_E	Euler buckling capacity
P_n	representative axial compressive strength based on local strength for column buckling of a non-circular prismatic member
P_p	representative axial strength of a non-circular prismatic member
P_{pl}	representative local axial compressive strength of non-circular prismatic member prismatic members
P_t	representative axial tensile strength of a non-circular prismatic member
P_u	axial force in a member due to factored actions determined in an analysis that includes global P-Δ effects
P_{ut}	axial tensile force due to factored actions
P_{uc}	axial compressive force due to factored actions
P_v	representative shear strength of a tubular
P_{vy}, P_{vz}	are the representative shear strengths in the local y- and z-directions of a non-circular prismatic member, respectively
P_{xe}	representative elastic local buckling strength of a tubular
P_y	plastic strength of a non-circular prismatic member
P_{yc}	representative local buckling strength of a tubular
p	depth below sea floor (zero if above sea floor)

r_{ltb}	radius of gyration about the minor axis when used for lateral-torsional buckling considerations
r	radius of gyration for the plane of flexural bending
r_t	maximum distance from centroid to an extreme fibre for torsional shear check
S_e	reduced effective section modulus of a slender section of a non-circular prismatic member
S_f	elastic section modulus of a semi-compact section of a non-circular prismatic member
S_y, S_z	section moduli for use in the assessment of a non-circular prismatic member in flexure
T_u	torsional moment due to factored actions
T_v	representative torsional strength of a tubular
t	wall thickness of a tubular
t_1	thickness of base plate
t_2	thickness of reinforcing plate
t_f	thickness of a flange component
t_w	thickness of a web component
V	beam shear due to factored actions
V_y, V_z	beam shears due to factored actions in the local y- and z-directions, respectively
y_i	distance from the neutral axis associated with I_e to the critical point i
Z_p	fully plastic (effective) section modulus
α	factor that varies depending on the applied loading
γ'	submerged (effective) unit weight of soil
$\gamma_{R,Pa}$	partial resistance factor for axial strength of a non-circular prismatic member
$\gamma_{R,Pb}$	partial resistance factor for bending strength of a non-circular prismatic member
$\gamma_{R,Pcl}$	partial resistance factor for local axial compressive strength of a non-circular prismatic member
$\gamma_{R,Pt}$	partial resistance factor for axial tensile strength of a non-circular prismatic member
$\gamma_{R,Pc}$	partial resistance factor for axial compressive strength of a non-circular prismatic member
$\gamma_{R,Pv}$	partial resistance factor for torsional and beam shear strength of a non-circular prismatic member
$\gamma_{R,Tb}$	partial resistance factor for bending strength of a tubular
$\gamma_{R,Tt}$	partial resistance factor for axial tensile strength of a tubular
$\gamma_{R,Tc}$	partial resistance factor for axial compressive strength of a tubular
$\gamma_{R,Tv}$	partial resistance factor for torsional and beam shear strength of a tubular
k	buckling coefficient
λ	column slenderness parameter
λ_h	ratio b/t or $2R/t$ as applicable for component h
λ_c	prismatic column slenderness parameter for a non-circular prismatic member

λ_T	elastic plate slenderness parameter
λ_p	plastic plate slenderness parameter
λ_{plim}	limiting plate slenderness ratio
λ_{po}	plate slenderness ratio coefficient
η	exponent for biaxial bending, a constant dependent on the prismatic member cross-section geometry
ρ	reduction coefficient
ρ_w	mass density of water
σ_1	compressive stress if σ_2 tensile or the larger compressive stress if σ_2 is also compressive
σ_2	tensile stress if σ_2 tensile or the smaller compressive stress if σ_2 is compressive
ψ	ratio of compression to bending stress

4.2 Abbreviated terms

ALE	abnormal-level earthquake
ALS	abnormal/accidental limit state
BS	base shear
BSTF	base shear transfer function
CD	chart datum
DAF	dynamic amplification factor
ELE	extreme level earthquake
FE	finite element
FLS	fatigue limit state
IACS	International Association of Classification Societies
LAT	lowest astronomical tide
LRFD	load and resistance factor design
LTB	lateral torsional buckling
MPM	most probable maximum
MPME	most probable maximum extreme
MSL	mean sea level
OCR	over-consolidation ratio
PDF	probability density function
PSIIP	project specific in-service inspection programme
RCS	recognized classification society
ROV	remotely operated vehicle

RPD	rack phase difference
SCF	stress concentration factor
SDOF	single degree-of-freedom
SLS	serviceability limit state
SSA-E	site-specific assessment for the elevated condition
SSA-I	site-specific assessment for installation and removal
SWL	still water level
TRS	tropical revolving storm
ULS	ultimate limit state
VIV	vortex induced vibration

5 Overall considerations

5.1 General

5.1.1 Interaction with SSA-I

The site-specific assessment of a jack-up normally comprises the two parts, an SSA-E, addressed in this document, and an SSA-I. While different personnel can carry out these assessments, much of the same information is used in both, including:

- jack-up data;
- geotechnical data;
- geophysical information.

Conversely, there is other data that is only used in an SSA-E or only used in an SSA-I. For example, the metocean extremes are used in an SSA-E only whereas the normally expected metocean conditions and propensity for squalls are used in an SSA-I only.

Complicating the issue is that much of the data used for the SSA-I is most efficiently obtained at the same time as the data collected for the SSA-E (e.g. soil data). Failure to collect all the data required for both analyses at the same time can be costly and inefficient.

The normal expectation is that the SSA-E will be undertaken before the SSA-I. However, there can be cases in which this order is reversed, e.g. when the SSA-E is likely to produce a favourable conclusion but emplacing the jack-up could be problematic.

There can be cases in which the results of the SSA-E can affect how the jack-up is to be emplaced on site. Some examples include:

- required heading;
- required preloading level;
- proximity to adjacent structures;

- limits on cantilever extension;
- site remediation e.g. gravel bags, etc.

These limitations should be passed on to those undertaking the SSA-I.

5.1.2 Competency

Assessments undertaken in accordance with this document shall be performed only by persons competent through education, training and experience in the relevant disciplines.

5.1.3 Planning

Adequate planning shall be undertaken before a site-specific assessment is started. The planning shall include the determination of all assessment situations relevant for the site under consideration. The assessment criteria shall be in accordance with Clause 13.

5.1.4 Assessment situations and associated criteria

The assessment situations shall include both extreme events and operational modes because the critical mode of operation is not always obvious. The assessor shall use site-specific metocean, earthquake and geotechnical data, as applicable, for the assessment. The assessment situations and associated criteria are jointly specified in the remainder of this document. They form one whole and shall not be separated from one another.

For mobile offshore drilling units operating in regions subject to sea ice and icebergs, the requirements of this document shall be supplemented with the relevant provisions relating to ice actions contained in ISO 19906 and procedures for ice management contained in ISO 35104. See 10.8 and A.10.8.

NOTE In some cases, ice actions can be mitigated by an ice management plan and/or seasonal operations.

5.1.5 Reporting

The assessor should prepare a report summarizing the inputs, assumptions and conclusions of the assessment. A recommended contents list is given in Annex G.

5.1.6 Regulations

Each country can have its own set of regulations concerning offshore operations. It is the responsibility of the operator and jack-up owner to identify the applicable rules and regulations, depending upon the site and type of operations to be conducted.

5.1.7 Classification of unit

This document is applicable to independent leg jack-ups that are structurally sound and adequately maintained. To achieve this, the unit shall either:

- hold a valid classification society certification from an RCS throughout the duration of the operation at the specific site subject to assessment; or
- have been verified by an independent competent body to be structurally fit for purpose for elevated situations and are subject to periodic inspection, both to the standards of an RCS.

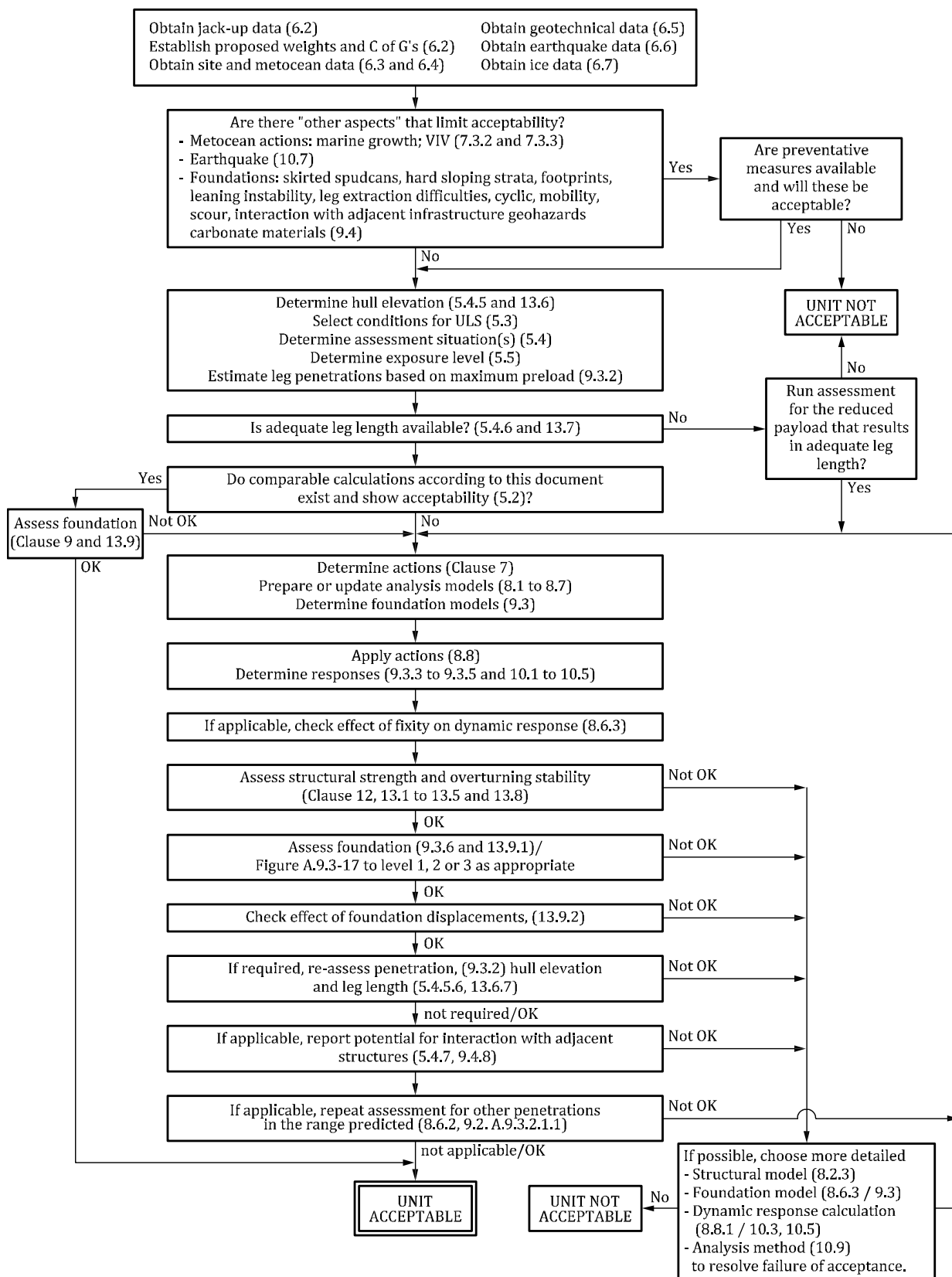
Jack-ups that do not conform with this requirement shall be assessed in accordance with the provisions of ISO 19902, supplemented by methodologies from this document, where applicable.

5.2 Assessment approach

This subclause provides an overview of the data required, the assessment methodology, and the acceptance criteria. An example of a flow chart for extreme storm assessment is shown in Figure 5.2-1. Annex A provides additional information and guidance, including detailed calculation methodology. Annex B specifies the partial factors for use in the assessment. Annexes C to F provide supplementary information or alternative calculation methodologies. Annex G provides a recommended contents list for the assessment report. Annex H provides regional information and provision for Norway and US Gulf of Mexico. ISO/TR 19905-2 provides background to some of the recommendations given in this document and a detailed sample calculation. Other assessment methodologies may be applied, provided that they have been shown to give a level of structural reliability equivalent, or superior, to that implicit in this document.

The assessment of the jack-up can be carried out at various levels of complexity as expanded in a), b) and c) (in order of increasing complexity). The objective of the assessment is to show that the acceptance criteria of Clause 13 are met. If this is achieved at a certain complexity level, there is no requirement to consider a higher complexity level. In all cases, the adequacy of the foundation shall be assessed to level b) or c).

- a) Compare assessment situations with design conditions or other existing assessments determined in accordance with this document.
- b) Carry out appropriate calculations in accordance with the simpler methods (e.g. pinned foundation, SDOF dynamics) given in this document. Where possible, compare results with those from existing more detailed/complex (e.g. secant or yield interaction foundation model, time domain dynamics) calculations.
- c) Carry out appropriate detailed calculations in accordance with the more complex methods (e.g. secant, yield interaction or continuum foundation model, time domain dynamics) given in this document.



NOTE 1 A cross-referenced clause number includes reference to the corresponding clause in Annex A.

NOTE 2 This figure does not fully address: Long term applications (Clause 11); Temperature (13.10); Earthquake (6.6, 7.7, 8.8.8, 10.7)

Figure 5.2-1 — Flow chart for the overall extreme storm assessment

5.3 Selection of assessment situations

ISO 19900 divides the assessment situations into four categories as described in this subclause.

a) Operational and Extreme assessment situations.

The site-specific assessment shall include evaluation of extreme assessment situations with combinations of extreme level metocean actions and the associated storm mode gravity actions. Earthquake and ice actions shall also be considered in combination with the associated permanent and operational gravity actions; however, evaluation is required only in some areas of the world. The applicable partial action and resistance factors for the extreme assessment situation and exposure level shall be as summarized in Annex B. For the associated Ultimate Limit State (ULS), the integrity of the structure should be unimpaired, but damage to the non safety-critical (secondary) structure of the jack-up can be tolerated.

Extreme assessment situations shall be assessed with the jack-up in the most critical operating configuration (increased variable load, cantilever extended and unequal leg loads) when the extreme level metocean conditions are

- within the defined serviceability limits for the jack-up (i.e. the metocean conditions are less severe than those defined for changing to the elevated storm configuration), or
- severe weather occurs with insufficient warning for the unit to be put in to storm configuration, e.g. squalls.

Consideration of the operating configuration is particularly important when the factored functional actions are close to the preload reaction and a small additional leg reaction due to metocean actions can cause significant additional penetration.

Operational assessment situations use the operational metocean conditions with the associated operating mode gravity actions and configuration. For jack-ups where the operations manual permits increases in, or redistribution of, the variable load with reduced metocean conditions (operating configuration, nomograms, etc.), the assessor shall establish an operational assessment situation. Where nomograms are used, a representative selection of situations applicable to the site shall be assessed (e.g. the extreme storm event and one or more less severe metocean conditions).

NOTE The situations above are often found in benign areas where the extreme level metocean conditions are within the defined serviceability limits for the jack-up and do not exceed the limits for changing the jack-up to the elevated storm configuration.

b) Serviceability assessment situations

Serviceability assessment situations are normally covered by the limits specified in the operations manual and, therefore, it is not necessary to assess it unless the operational configuration requirements for the site are outside those limits. However, the requirements of a) above always apply.

c) Fatigue assessment situations

The FLS is generally addressed at the design stage. It is not necessary to evaluate fatigue unless the jack-up is to be deployed for a long-term operation (see Clause 11).

d) Abnormal/Accidental assessment situations

Accidental assessment situations, addressing abnormal environmental events or accidental events, are generally addressed at the design stage and it is not necessary to evaluate them in the

assessment unless there are unusual risks at the site under consideration. Abnormal situations shall be assessed when necessary e.g. abnormal level earthquake (ALE) or abnormal level ice assessment (ALS).

5.4 Determination of assessment situations

5.4.1 General

A jack-up can be used in various modes at a single site (e.g. drilling mode/workover mode/tender mode/production mode). In each mode, the jack-up can be in the operating or storm survival configuration. Where more than one configuration is contemplated, the differences (e.g. the varying hull elevations required for each, skidding the cantilever in for a storm, reducing variable deck load) shall be considered in the assessment. The practicality of any required configuration change shall be evaluated and appropriate assumptions incorporated into the assessment calculations. Any required restrictions on the operations shall be included in the operating procedures. The assessment situations shall be determined from appropriate combinations of mode, configuration and limit state.

Where the assessment indicates that an assessment situation does not meet the acceptance criteria of Clause 13, the assessment configuration may be adjusted to achieve acceptability, providing that any resulting deviations from the standard operating procedure of the jack-up are practically achievable, are documented and are communicated by the jack-up owner to their offshore personnel and, if relevant, to the operator. Alternatively, metocean data applicable to the season(s) of operation may be considered.

5.4.2 Reaction point and foundation fixity

The assumed reaction point at the spudcan shall be documented in the assessment report. The jack-up's legs are normally assumed to be pinned at the reaction point. Any divergence from this assumption shall be stated.

NOTE The assumption of pinned footings is a conservative approach for the bending moment in the leg in way of the leg-to-hull connection; see 8.6.3.

5.4.3 Extreme storm event approach angle

The critical extreme storm event approach angles relative to the jack-up are usually different for the various checks that shall be made (e.g. strength versus overturning checks). The critical direction for each check shall be used.

5.4.4 Weights and centre of gravity

For each limit state and configuration being assessed, the appropriate magnitude and position of the fixed and variable loads shall be used. The tolerances on both magnitude and position shall be considered when determining the weights and centres of gravity to use in the assessment.

Where the location of the cantilever, substructure, etc., or the hull elevation, differ between the elevated operating and storm survival configuration, the practicality of making the changes required to achieve the storm survival configuration shall be established.

5.4.5 Hull elevation

The hull elevation used in the assessment shall conform with the requirements specified in 13.6. Generally, this is the larger of that required to maintain adequate clearance with

- adjacent structures, such as a fixed platform, and
- the wave crest.