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Petroleum and natural gas industries — Offshore structures —

Part 1:
General requirements

Industries du pétrole et du gaz naturel — Structures en mer — Partie 1: Exigences générales

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Contents

Page

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 13819-1 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum and natural gas industries*, Subcommittee SC 7, *Offshore structures*.

ISO 13819 will consist of the following parts, under the general title *Petroleum and natural gas industries — Offshore structures*:

— *Part 1: General requirements*

— *Part 2: Fixed steel structures*

— *Part 3: Fixed concrete structures*

— *Part 4: Floating systems*

— *Part 5: Arctic structures*

— *Part 6: Site specific assessment of MODUS*

Annex A of the present part of ISO 13819 is for information only.

Introduction

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

International Standard ISO 13819 constitutes a common basis covering those aspects that address design requirements and assessments of all structures used by the petroleum and natural gas industries worldwide. Through its application the intention is to achieve reliability levels appropriate for manned and unmanned offshore structures, whatever the nature or combination of the materials used.

ISO 13819 is intended to provide a wide latitude in the choice of structural configurations, materials and techniques without hindering innovation. It shall, therefore, be used in conjunction with sound engineering judgment.

Part 1 of ISO 13819 applies to offshore structures and is in accordance with the principles of ISO 2394:1986, *General principles on reliability for structures*. It includes, where appropriate, additional provisions that are specific to offshore structures.

Petroleum and natural gas industries — Offshore structures —
Part 1:
General requirements

1 Scope

Part 1 of the Standard specifies general principles for the design and assessment of structures subjected to known or foreseeable types of actions. The principles specified are applicable worldwide.

The general principles are applicable to all types of offshore structures including bottom founded structures as well as floating structures.

The general principles are applicable to all types of materials used including steel, concrete, aluminum, etc.

The Standard is applicable to the design of complete structures including substructures, topside structures, vessel hulls, foundations, and mooring systems.

The Standard specifies design principles that are also applicable to the successive stages in construction (namely fabrication, transportation and installation), to the use of the structure during its intended life, and to its abandonment. Generally, the principles are also applicable to the reassessment or modification of existing structures. Aspects related to quality control are also addressed.

NOTE: The term "action" was introduced into ISO terminology to cover the effects due to imposed deformation as well as loads. The term "load", which is prevalent in some countries, can generally be used with essentially the same meaning as "action". In the past, "load" has often been used to describe direct actions only (see Clause 5.2.1).

2 Definitions

For the purposes of this International Standard, the following definitions apply:

2.1 Air gap:

The clearance between the highest water surface that occurs during the extreme environmental conditions and the underside of the deck.

2.2 Compliant structure:

A structure that is sufficiently flexible, such that applied lateral dynamic actions can be balanced substantially by the inertial reaction.

2.3 Fitness for purpose:

A structure condition describing a structure that meets the intent of this Standard, but does not meet certain provisions of this standard in local areas, such that failure in these areas will not cause unacceptable risks to life-safety or the environment.

2.4 Fixed structure:

A structure that is bottom founded and transfers all actions that act upon it to the sea floor.

2.5 Jack-up:

A mobile unit that can be relocated and is bottom founded in its operating mode. The jack-up reaches its operational mode by lowering the legs to the sea floor and then jacking the hull to the required elevation.

2.6 Return period:

The average time (usually years) between occurrence of events or actions of a specified magnitude or larger.

2.7 Riser:

The piping connecting the facilities or piping on the production deck with the subsea facilities or pipelines.

2.8 Semi-submersible:

A floating unit that can be relocated. A semi-submersible normally consists of a deck structure with a number of widely spaced, large diameter, supporting columns that are attached to submerged pontoons.

2.9 Tension leg platform:

A buoyant structure that is anchored to the sea floor by vertical mooring legs.

2.10 Well conductor:

A tubular pipe extending upward from the sea floor (or below) that contains the pipes (casing) that extend into the petroleum reservoir.

3 General requirements and conditions

NOTE: The requirements and conditions set forth in this section define the objective of the design. Criteria to enable designers and builders to reach this goal are provided throughout this Standard. However, unforeseen events that cause a structure to not achieve its objectives during its service life does not automatically imply a lack of compliance with this Standard.

3.1 Fundamental requirements

A structure and its structural components shall be designed, constructed, and maintained so that it is suited to its intended use. In particular, it shall, with appropriate degrees of reliability, fulfill the following performance requirements:

a) It shall withstand actions liable to occur during its construction and anticipated use (ultimate limit state requirement).

b) It shall perform adequately under all expected actions (serviceability limit state requirement).

c) It shall not fail under repeated actions (fatigue limit state).

d) In the case of hazards (accidental or abnormal events), it shall not be subsequently damaged disproportionately to the original cause (accidental limit state).

e) Appropriate degrees of reliability may depend upon:

- the cause and mode of failure

- the possible consequences of failure in terms of risk to life, environment and property
- the expense and effort required to reduce the risk of failure
- different requirements at national, regional or local level

This standard is set forth to provide criteria so that the above requirements are fulfilled during the intended life of the structure.

A structure designed and constructed in accordance to the present standard is assumed to comply with the above requirements.

3.2 Durability, maintenance and inspection

The durability of the structure in its environment shall be such that the general state of the structure is kept at an acceptable level during its life.

Maintenance shall include the performance of regular inspections, inspections on special occasions (e.g., after an earthquake or other severe environmental event), the upgrading of protection systems and repair of structural components.

Durability shall be achieved by either:

a) a maintenance program, or

b) designing so that deterioration will not invalidate the state of the structure in those areas where the structure cannot be or is not expected to be maintained.

In the first case above, the structure shall be designed and constructed so that no significant degradation is likely to occur within the time intervals between the inspections. The necessity of relevant parts of the structure being available for inspection - without unreasonably complicated dismantling - shall be considered during design. Degradation may be reduced or prevented by providing a suitable protection system.

The rate of deterioration may be estimated on the basis of calculations, experimental investigations, experience from other structures or a combination of these.

NOTE: Structural integrity, serviceability throughout the intended service life, and durability are not simply functions of the design calculations but are also dependent on the quality control exercised in manufacture, the supervision on site, and the manner in which the structure is used and maintained.

3.3 Hazards

3.3.1 General

Hazardous circumstances, that alone or in combination with normal conditions could cause the serviceability or ultimate limit states to be exceeded, shall be taken into account.

Possible hazards to the structure and its components include:

a) an error caused by lack of information, omission, misunderstanding, etc.,

b) effects of abnormal actions, or

c) operation malfunction that could lead to fire, explosion, capsizing, etc.

The measures taken to counter such hazards should basically consist of:

a) careful planning at all phases of development and operation,

b) avoiding the structural effects of the hazards by either eliminating the source or by bypassing and overcoming them,

c) minimizing the consequences, or

d) designing for hazards.

If a specific hazard has to be considered, it shall be used to define a design situation (see Clause 4.2.2). This design situation will normally be dominated by one hazardous occurrence with expected concurrent normal operating conditions.

3.3.2 Accidental events

The possibility of accidental events shall be considered, and suitable criteria shall be established, when appropriate. Possible accidental events include, for example, vessel collision, dropped objects, explosion, fire and unintentional flooding. Design requirements should be established taking account of the operational conditions and the type, function and location of the structure.

3.4 Design basis

The influences arising from the intended use of the structure and the environmental conditions shall be described as the design situations associated with normal use of the structure. The influences arising during construction of the structure and the associated environmental conditions shall also be covered by suitable design situations (see Clause 4.2.2).

All relevant influences and conditions shall be considered in order to establish the design basis for the structure. Sections 3.5 to 3.12 describe the principal influences and conditions that should be considered to establish the design basis for offshore structures.

3.5 Service requirements

The service requirements and the expected service life shall be specified. The structure may be used for drilling, producing, storage, personnel accommodation, or other function or combination of functions.

3.6 Operating requirements

3.6.1 Manning

The manning level for each phase of the structure's life shall be specified.

3.6.2 Well conductors and risers

The number, location, size, spacing and operating conditions of all well conductors and risers shall be specified and taken into account in the structural design. The design and/or layout shall provide protection of conductors and risers from accidental damage.

The design should have provisions to mitigate the consequences of accidental damage to well conductors and risers.

3.6.3 Equipment and material layouts

Equipment and material layouts and their associated weights, centers of gravity, and exposure to environmental actions shall be specified. Consideration should be given to planned future operations.

3.6.4 Personnel and material transfer

Plans for transferring personnel and materials shall be specified. For example:

a) the types, sizes and weights of helicopters,

b) the types, sizes and displacements of supply and other service vessels,

c) the number, types, sizes and locations of the deck cranes and other materials handling systems, and

d) planned emergency personnel evacuation.

3.6.5 Motions and vibrations

Structures and parts of structures shall be designed so that accelerations, velocities, and displacements do not impair safety and serviceability within defined limits.

3.7 Special requirements

All special operational, construction, and maintenance requirements not covered under Clauses 3.6.1 - 3.6.5 that would also affect the safety of the structure shall be specified, together with their expected concurrent environmental conditions.

The limiting environmental conditions specific to certain operations should be specified. This will normally apply to floating units (e.g., limiting environmental conditions for certain drafts) or jack-ups (e.g., limiting environmental conditions when the cantilever is fully extended).

3.8 Location and orientation

The site location and structure orientation shall be specified. For structures designed to be relocatable, the range of limiting environmental conditions, water depths, and soil conditions should be provided.

The site for the structure in latitude and longitude should be identified early in order that the appropriate environmental conditions and soil conditions can be identified.

NOTE: Orientation of the structure refers to its position in plan referenced to a fixed direction such as true north. The orientation is normally governed by the direction of prevailing seas, winds, and currents, as well as safety and operational requirements.

3.9 Structural configuration

3.9.1 General

The choice of the structural system shall be made so that the primary structure is able to maintain adequate structural integrity during normal service and after specified action causing events. The choice of materials, detailing, and method of construction as well as quality control can also influence structural integrity.

3.9.2 Deck elevation

The topside structure shall normally have adequate clearance above the design wave crest. Any topside structure or piping not having adequate clearance (airgap) shall be designed for actions caused by waves and currents. Minor structure or components may be excluded from this requirement.

The deck elevation and airgap shall be determined taking into account the values of and uncertainties in the following parameters as applicable:

a) water depth,
b) tides and surges,
c) crest elevation of extreme waves,
d) wave-structure interaction,
e) structure motion and draft,
f) initial and long-term settlements and inclination, and
g) subsidence.

3.9.3 Splash zone

The splash zone extent shall be established taking into account the values of the platform elevation, motions of floating vessels, tidal ranges, wave crests and wave troughs.

For floating structures with possibilities for draft adjustment, the splash zone shall be defined relative to the extreme draft levels expected.

NOTE: The splash zone is that part of a structure that is intermittently exposed to air and immersed in the sea. The splash zone is important in relation to inspection and maintenance considerations and can have an impact on the design to resist corrosion and fatigue.

3.9.4 Station-keeping systems

Floating structures shall be provided with a station-keeping system, which may be either passive or active or a combination of both passive and active.

The station-keeping system shall be designed to maintain adequate position reference as well as directional control when orientation is important for safety or operational considerations.

Passive station-keeping systems may include catenary mooring, spring buoy, articulated leg, or tension leg systems. Active systems may include dynamic positioning based on thrusters or catenary systems based on changing mooring line tensions.

A mooring system for floating structures may be designed to be disconnectable to mitigate the effects of severe storms, if the disconnection can be accomplished in a controlled manner without (1) impairing the safety of personnel on board the unit or a neighboring infrastructure or (2) creating undue risk to the environment. When disconnected, then other standards may apply.

3.9.5 Compartmentation of structures

Floating structures or structures for which buoyancy is important shall normally be subdivided into compartments to limit the consequences of unintended flooding (see Clause 4.1.5).

The amount of compartmentation should consider special conditions and protection measures that can be used to prevent flooding. Fewer compartments may be justified, if buoyancy is only needed in temporary phases or the consequences of flooding have only minor effects on the overall reliability.

3.10 Environmental conditions

3.10.1 Meteorological and oceanographical information

The phenomena listed in Clauses 3.10.1.1 through 3.10.1.8 shall, where appropriate to the region, be taken into account in the design.

They shall be described by physical characteristics and, where available, statistics. The joint occurrence of different parameters should also be defined when suitable data are available. From this information, appropriate environmental design conditions shall be established that will consider the following:

a) the type of structure being designed,

b) the phase of development, (e.g., construction, transportation, installation, drilling, production, etc), and

c) the limit-state considered.

Usually two sets of conditions have to be established that will consider:

- normal meteorological and oceanographic conditions that are expected to occur frequently during the life of the structure. These conditions are needed to plan field operations such as installation and to develop the actions caused by environment associated with particular operations or serviceability checks, and

- extreme meteorological and oceanographic conditions that recur with a given return period.

Extreme, normal and other meteorological and oceanographic parameters should be determined from actual measurements at the site or by suitable validated model data such as from hindcast models.

NOTE 1: Environmental actions are generally derived from design environmental conditions. The extreme environmental conditions normally have a specified return period for the in-service condition (see Clause 7.2.1). Alternatively, the action associated with extreme environmental conditions can be defined to have a specified return period, if adequate data exist to reliably determine the specified return period, allowing for the joint occurrence of extreme meteorological and oceanographic conditions occurring at the site, and further provided that the partial factors are selected accordingly.

NOTE 2: Normally, the structure's response to actions caused by the environment are investigated for a range of potential combinations of environmental parameters and consideration is given to the relationship considering the closeness of the wave period compared to the natural response period of motion or vibration. For example, for two different seastate conditions, each having the same composite return period, it is possible that the seastate having lower wave heights but a longer or shorter associated period will develop more severe actions acting on some components.

Compliant or floating structures are generally sensitive to more environmental parameters than fixed or bottom-founded structures, since dynamic effects will be more significant for such structures.