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Second edition
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Petroleum and natural gas industries — Arctic offshore structures

Industries du pétrole et du gaz naturel — Structures arctiques en mer

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Foreword

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

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

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

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

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

This document was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries,* Subcommittee SC 7, *Offshore structures.*

This second edition cancels and replaces the first edition (ISO 19906:2010), which has been technically revised. The main changes compared to the previous edition are as follows:

— revisions to definitions and provisions to reflect updates in the general requirements standard ISO 19900 since the publication of the first edition of ISO 19906;

— significant revisions to provisions related to operational and emergency response measures, see 5.5, 8.2.7, clauses 13, 17, and 18;

— significant changes throughout the document to reflect user input on the first edition of the standard, notably with respect to ice actions in A.8.2;

— reference to the new data requirements standard ISO 35106 and corresponding revisions to Clauses 6 and 14, including significant deletion of now redundant content in Clause 14;

— reference to the new ice management (IM) standard ISO 35104 and corresponding revisions to Clause 17, including significant deletion of now redundant content;

— reference to the new EER standard ISO 35102 and corresponding revisions to Clause 18, including significant deletion of now redundant content.

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

Introduction

ISO 19906 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 These are sometimes referred to as the ISO 19900 series on offshore structures.

The International Standards on offshore structures prepared by TC 67/SC 7 addresses 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 manned and unmanned offshore structures, regardless of the type of structure and the nature or combination of the materials used.

The International Standards on offshore structures prepared by TC 67/SC 7 consist of the following documents:

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

— ISO 19901 (all parts), *Petroleum and natural gas industries — Specific requirements for offshore structures*

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

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

— ISO 19904-1, *Petroleum and natural gas industries — Floating offshore structures — Part 1: Monohulls, semi-submersibles and spars*

— ISO 19905 (all parts), *Petroleum and natural gas industries — Site-specific assessment of mobile offshore units*

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

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 modification 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.

These documents applicable to the various types of offshore structure 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 was developed in response to the offshore industry's demand for a coherent and consistent definition of methodologies to design, analyse and assess arctic and cold region offshore structures within the Scope.

Structures capable of resisting ice have been in use in temperate regions for well over a century. These include bridge piers and navigation aids in ice-covered rivers and estuaries. In fact, bridge codes in cold

countries have included methods for addressing ice actions dating back many decades. In more severe arctic and cold regions, ice-resistant structures are more recent. But much experience has been gained commencing in the 1960s, and this knowledge is incorporated into this document. Where uncertainties still exist, conservative approaches and methods have been recommended.

Annex A provides background to and guidance on the use of this document and it is intended that it be read in conjunction with the main body of this document. The clause numbering in Annex A follows the numbering in the normative text to facilitate cross-referencing.

Annex B provides regional information on the physical environment of specific offshore areas in arctic and cold regions.

Some symbols in this document are not in accordance with the system of quantities on which the International System of Units is based, due to the need to conform with current ice literature. This might change in future editions of this document.

To meet certain needs of industry for linking software to specific elements in this document, a special clause-based numbering system has been permitted for figures, tables and formulae.

Petroleum and natural gas industries — Arctic offshore structures

1 Scope

This document specifies requirements and provides recommendations and guidance for the design, construction, transportation, installation and decommissioning of offshore structures related to the activities of the petroleum and natural gas industries in arctic and cold regions. Reference to arctic and cold regions in this document is deemed to include both the Arctic and other locations characterized by low ambient temperatures and the presence or possibility of sea ice, icebergs, icing conditions, persistent snow cover, and/or permafrost.

The objective of this document is to ensure that complete structures, including substructures, topsides structures, floating production vessel hulls, foundations and mooring systems, in arctic and cold regions provide an appropriate level of reliability with respect to personnel safety, environmental protection and asset value. Value includes value to the owner, to the industry and to society in general.

This document does not contain requirements for the operation, maintenance, service-life inspection or repair of arctic and cold region offshore structures, unless the design strategy imposes specific requirements such as ice management (IM) to reduce ice actions.

Provisions for the operation, maintenance, service-life inspection and repair of mobile units are given in ISO 19905-1 and ISO 19905-3, supplemented by the provisions relating to ice actions and IM in this document.

This document does not apply to mechanical, process and electrical equipment or any specialized process equipment associated with arctic and cold region offshore operations except in so far as it is necessary for the structure to sustain safely the actions imposed by the installation, housing and operation of such equipment. This document applies to equipment used for the positioning and disconnection of floating structures (see Clause 13).

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 17776, *Petroleum and natural gas industries — Offshore production installations — Major accident hazard management during the design of new installations*

ISO 19900:2013, *Petroleum and natural gas industries — General requirements for offshore structures*

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

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

ISO 19901-3, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 3: Topsides structure*

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

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

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

ISO 19901-8, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 8: Marine soil investigations*

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

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

ISO 19904-1, *Petroleum and natural gas industries — Floating offshore structures — Part 1: Monohulls, semi-submersibles and spars*

ISO 35101, *Petroleum and natural gas industries — Arctic operations — Working environment*

ISO 35102, *Petroleum and natural gas industries — Arctic operations — Escape, evacuation and rescue from offshore installations*[1]

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

ISO/TS 35105, *Petroleum and natural gas industries — Arctic operations — Material requirements for Arctic operations*

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 19900, ISO 19901-1, ISO 19901-2, ISO 19901-4, ISO 35102, ISO 35104, ISO 35106 and the following apply. ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
abrasion
effect of ice grinding against the surface of a structure thus removing paint, surface protrusions and coatings, oxidized material, or concrete particles and aggregate

[1] Under preparation. Stage at the time of publication: ISO/DIS 35102:2019.

3.2
action combination
expression in which values of individual simultaneous actions for a design situation are summed to obtain the total *design action* (3.10) for design verification of a structure for a specific limit state

3.3
action effect
effect of actions on structural components

EXAMPLE Internal force, moment, stress or strain.

3.4
adfreeze
freezing of ice or soil onto the surface of a structure

3.5
aspect ratio
ratio of structure diameter or width to ice thickness

3.6
broken ice
ice pieces of varying size, broken up as a result of natural processes, or active or passive intervention

Note 1 to entry: Active intervention includes IM resulting in managed ice; passive intervention includes the channel, or wake, caused by a stationary structure in moving ice cover.

3.7
companion environmental action
environmental action applied simultaneously with the principal environmental action

3.8
consolidation
process of freezing of pore water in voids within ice rubble or between floes

Note 1 to entry: For soils, consolidation involves drainage of pore fluid as a result of overburden pressures.

3.9
consolidated layer
portion of an *ice ridge* (3.35) keel, *rubble pile* (3.58), *rubble field* (3.57) or *stamukha* (3.66) below the waterline formed by the ice freezing process

3.10
design action
sum of design values of individual simultaneous actions for an *action combination* (3.2)

3.11
design resistance
resistance limit calculated from factored representative values of basic variables, or from factored expressions based on unfactored representative values of basic variables

Note 1 to entry: Material properties are examples of basic variables relevant to resistance.