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

Industries du pétrole et du gaz naturel — Opérations en Arctique — Données océano-météorologiques et données sur les glaces et les planchers océaniques

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Contents

Page

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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For an explanation on 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 the following URL: 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 8, *Arctic operations*.

Introduction

The series of documents on arctic operations (currently ISO 35101 to ISO 35106) addresses operational requirements for use by the petroleum and natural gas industries in arctic and cold regions. Through their application, the intention is to ensure human life safety and to minimize environmental damage. At the same time, the series of documents is intended to provide wide latitude in the choice of operational and design solutions without hindering innovation. Sound engineering judgment is, therefore, necessary in the use of these documents.

This document is developed to provide a coherent and consistent definition of data requirements for operations and designs in arctic and cold regions. With application to offshore, coastal and onshore situations, the document focuses on meteorological, oceanographic, seabed and ice considerations. In addition to the requirements of this document, the requirements of ISO 19901-1 for metocean data, ISO 19906 for ice properties data and ISO 19901-4 and ISO 19901-8 for seabed data also apply.

For many geographical regions, physical environmental data are insufficient for rigorous statistical determination of appropriate extreme and abnormal environmental actions and are insufficiently detailed for the conduct of specialized operations. The determination of relevant operational and design parameters therefore relies on the interpretation of the available data by subject matter experts, together with an assessment of other meteorological, oceanographic, seabed and ice information. In particular, uncertainties can arise from analyses based on limited data sets.

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

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

1 Scope

This document specifies requirements and provides recommendations and guidance for the collection, analysis and presentation of relevant physical environmental data for activities of the petroleum and natural gas industries in arctic and cold regions. Activities include design and operations, which involve planning and actual execution.

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, shelf ice, glaciers, icing conditions, persistent snow cover, frozen surfaces of lakes and rivers, localized and rapidly changing weather systems and/or permafrost.

This document outlines requirements for a range of different operations that have been or are presently being undertaken and for existing design concepts. This document can also be used for other operations and new design concepts in arctic and cold regions as long as it is recognized that all data requirements are not necessarily addressed.

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 12494, *Atmospheric icing of structures*

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

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

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

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

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

ISO 35103, *Petroleum and natural gas industries — Arctic Operations — Environmental monitoring for offshore exploration*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 35101, ISO 35103, ISO 35104, ISO 19900, ISO 19901-1, ISO 19901-6, ISO 19906 and the following apply.

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

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

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

3.1
accretion
accumulation of snow, ice and other forms of frozen precipitation on surfaces

3.2
active layer
soil layer above the permafrost that is subjected to annual freeze-thaw cycles

3.3
arctic jet
low-level wind directed parallel to an ice edge or ice lead

3.4
areal density
number of ice features per unit area

Note 1 to entry: Usually averaged over a specific time interval.

3.5
bergy bit
floating glacial ice mass with waterline length between 5 m and 15 m

3.6
calibration
process by which physical parameter values are related to instrument readings

3.7
calving event
break-up of an iceberg or other glacial ice mass into two or more pieces

3.8
coastal region
offshore region adjacent to the coast where the physical environment is influenced by the coast

3.9
data analysis
data interpretation
expert assessment of physical environmental data to satisfy design or operational requirements

Note 1 to entry: Data analysis can include verification with other data sources or physical process models.

3.10
data storage
organization of physical environmental data into an accessible and documented database

3.11
data collection
data measurement
application of human systems or instruments for recording physical environmental data

3.12
data presentation
provision of physical environmental data in a format suitable to the design process or operational decision-making

3.13
downtime
time interval for which an operation is suspended

Note 1 to entry: Downtime can be planned or unplanned.

3.14
expert
individual who through training and experience is competent to provide advice specific to the subject in question

3.15
first-year ice
FY ice
sea ice formed during the current or prior winter that has not survived one summer melt season

[SOURCE: ISO 19906:—[1)], 3.16]

3.16
floe size
waterline dimension of a sea ice floe

Note 1 to entry: Floe size can be defined as either the maximum waterline dimension or the diameter of a circular floe with the same plan area.

3.17
freezing degree days
FDD
cumulative sum of average freezing daily air temperatures from the start of the winter season

Note 1 to entry: The reference point can be 0 °C or the freezing temperature of sea water.

Note 2 to entry: Usually initiated when the average daily temperature averaged over a specified period, for example, 30 days, falls below 0 °C or the freezing temperature.

3.18
growler
floating piece of glacial ice with waterline length less than 5 m

3.19
ice action
external load, displacement, deformation or acceleration applied to a structure as a consequence of an ice scenario

3.20
iceberg draft
distance between the deepest point in the keel of an iceberg and the water surface

3.21
ice cover
distribution of ice on the surface of a lake, river or ocean

3.22
ice edge
line of demarcation between open water and floating *ice cover* (3.21)

Note 1 to entry: Ice edge can be diffuse or compact, depending on the orientation of wind and current actions on the ice cover.

Note 2 to entry: Ice edge is sometimes based on a minimum concentration threshold over a specified averaging area in satellite imagery.

1) To be published. Stage at time of publication ISO/DIS 19906:2017.

Note 3 to entry: The concentration threshold can be dictated by the tolerance of the operation to *ice actions* (3.19).

3.23
ice encroachment
movement of sea ice onto the surface of a platform or man-made island

Note 1 to entry: Ice encroachment can result from ice ride-up, pile-up, and ride-down processes.

Note 2 to entry: Ice encroachment is typically associated with operational or design criteria.

[SOURCE: ISO 19906:—, 3.26]

3.24
ice feature
continuous mass of ice, floating or grounded, having a greater thickness than the surrounding *ice cover* (3.21)

3.25
ice hazard
ice threat
ice feature (3.24) or conditions associated with operational criteria

Note 1 to entry: In this document, referred to without the "ice" qualifier.

3.26
ice length
accumulated distance travelled by the *ice cover* (3.21) past a point regardless of direction

3.27
ice management
processes and activities used to mitigate risks from ice

Note 1 to entry: Ice management can be used to alter icing, sea ice or iceberg environments or accumulations with the intent of reducing *downtime* (3.13) and reducing or avoiding ice action effects.

Note 2 to entry: Ice management can involve ice detection, forecasting, threat assessment, removal, alteration and destruction.

Note 3 to entry: Ice management is often conducted in the context of operating criteria such as alert procedures (see also ISO 19906 and ISO 35104).

3.28
ice ridge
linear feature formed of ice blocks created by the relative motion between ice sheets

Note 1 to entry: Ice pressure ridges are formed when ice sheets are pushed together and a shear ice ridge is formed when ice sheets slide along a common boundary.

[SOURCE: ISO 19906:—, 3.34]

3.29
ice season
period during the year when sea ice exceeds a specified concentration or when *ice features* (3.24) exceed a specified *areal density* (3.4)

Note 1 to entry: Specified criteria can be different for the start and end of season.

3.30
ice shelf
floating ice sheet of considerable thickness attached to the shore

Note 1 to entry: Ice shelf can be determined based on freeboard in excess of 2 m.

3.31
ice scenario
combination of circumstances involving the presence of ice, resulting in ice events

[SOURCE: ISO 19906:—, 3.35]

3.32
ice thickness
vertical dimension of ice, measured from the bottom surface to the top surface

Note 1 to entry: Ice thickness can be determined as an average or maximum value over a specified horizontal scale or over the plan area of an *ice feature* (3.24).

3.33
ice type
ice identified in WMO categorization according to the stage of development

3.34
icing
ice accretion on the surface of a structure

Note 1 to entry: Icing can involve atmospheric or sea spray processes.

3.35
icing conditions
combination of metocean, ice and operational conditions under which *icing* (3.34) can occur

3.36
katabatic wind
gravity-driven flow of dense cold air from higher to lower elevations

Note 1 to entry: Katabatic winds are often associated with glaciers.

3.37
landfast ice
fast ice
ice that remains attached to a shoreline, island or grounded *ice feature* (3.24)

[SOURCE: ISO 19906:—, 3.37]

3.38
level ice
ice formed primarily as a result of thermal conduction and radiation processes and excluding mechanical processes

Note 1 to entry: Ice subjected to small amounts of rafting during the initial formation process is generally considered as level ice.

Note 2 to entry: Thicker level ice can vary by several centimetres over distances of several metres.

3.39
marginal ice zone
sea ice region affected by waves and swell

3.40
multi-year ice
MY ice
sea ice that has survived at least two summers' melt seasons

[SOURCE: ISO 19906:—, 3.44]

3.41
old ice
sea ice that has survived at least one summer's melt season

Note 1 to entry: Old ice includes both second-year ice and multi-year ice.

[SOURCE: ISO 19906:—, 3.45]

3.42
pack ice
sea ice consisting of discrete floes that is not landfast

[SOURCE: ISO 19906:—, 3.46]

3.43
pack ice pressure
horizontal pressure acting within pack ice

Note 1 to entry: Generally, pack ice pressure is the result of wind and current forcing, but can also result from larger scale mechanics of the *ice cover* (3.21).

Note 2 to entry: Pressure can be measured on an ordinal scale based on the closing rate of icebreaker tracks.

3.44
persistence
duration of a physical environmental parameter with respect to a specified threshold

3.45
rafted ice
ice feature (3.24) formed from the superposition of two or more ice sheet layers

[SOURCE: ISO 19906:—, 3.50]

3.46
region of interest
<design> geographical region around the facility selected to ensure data accuracy and representativeness

3.47
region of interest
<operation> geographical region over which an operation is undertaken and is influenced by ice and metocean processes

3.48
rolling event
distinct and sudden change in the vertical orientation of an iceberg or other floating glacial ice mass

3.49
second-year ice
SY ice
sea ice that has survived one summer's melt season

[SOURCE: ISO 19906:—, 3.62]

3.50
sea ice
thermally-grown ice formed on the surface of saline water bodies

3.51
season boundary
start or end of the *ice season* (3.29) according to specified criteria

3.52
shelf break
seaward extent of the continental shelf characterized by a significant increase in slope of seafloor

Note 1 to entry: Shelf break can be used to determine the average seaward extent of sea ice.

Note 2 to entry: Shelf break can be used to determine the seaward limit of potential iceberg contact with the seabed.

3.53
snow cover
areal distribution of snow on the ground or ice surface

3.54
stability
state of hydrostatic or hydrodynamic equilibrium with respect to vertical orientation, usually with reference to icebergs

3.55
sub-gouge deformation
displacement of seabed soil beneath a gouging *ice feature* (3.24)

3.56
waterline length
maximum dimension of an *ice feature* (3.24) in the plane of the water surface

3.57
waterline width
maximum dimension of an *ice feature* (3.24) perpendicular to the *waterline length* (3.56) in the plane of the water surface

3.58
wind chill
perceived temperature due to the combined effect of low ambient temperature and wind

4 Symbols and abbreviated terms

4.1 Symbols

d	distance from the ice edge
E	wave energy
E_0	wave energy in open water
h	ice thickness
M	ice sample mass
p_t	true precipitation
p_m	measured precipitation
S	salinity
T	air temperature
T_{wc}	wind chill temperature
U_{10}	wind speed at 10 m elevation