
**Petroleum and natural gas
industries — Arctic operations —
Environmental monitoring**

*Industries du pétrole et du gaz naturel — Opérations en Arctique -
Surveillance de l'environnement*

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Contents

	Page
Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Abbreviated terms	5
5 General requirements for environmental monitoring	6
5.1 Application of ISO management system standards.....	6
5.2 Objectives of environmental monitoring.....	6
5.3 Specification for monitoring.....	6
5.4 Planning a monitoring programme.....	7
5.4.1 Programme specification.....	7
5.4.2 Programme adjustment.....	8
5.4.3 Action on non-compliance.....	8
5.5 Spatial scales.....	8
5.5.1 General.....	8
5.5.2 Near-field.....	8
5.5.3 Far-field.....	8
5.5.4 Regional.....	8
5.5.5 Transboundary.....	8
5.6 Temporal scales.....	8
5.6.1 Design.....	8
5.6.2 Variation in environmental aspects.....	9
5.6.3 Natural fluctuations.....	9
5.7 Environmental aspects.....	9
5.7.1 Types of environmental aspects.....	9
5.7.2 Normal, abnormal and emergency conditions.....	9
5.7.3 Control aspect in response to monitoring.....	10
5.8 Environments and components.....	10
5.9 Baseline conditions.....	10
5.10 Parameters.....	10
5.10.1 Selection of parameters.....	10
5.10.2 Accuracy.....	10
5.10.3 Detection limits.....	11
5.10.4 Units and other specifications.....	11
5.10.5 Physical parameters.....	11
5.10.6 Chemical parameters.....	11
5.10.7 Biological parameters.....	11
5.10.8 Associated measurements.....	12
5.10.9 Position fixing.....	12
5.11 Modelling.....	12
5.12 Sampling.....	13
5.13 Analytical methods.....	13
5.14 Toxicity tests.....	13
5.15 Statistical methods.....	13
5.16 Costs of monitoring.....	13
5.17 Environmental monitoring report.....	13
6 Factors to be considered for Arctic offshore environments	14
6.1 Characteristics of the Arctic.....	14
6.2 Polar location.....	14
6.2.1 Remoteness.....	14
6.2.2 Positioning.....	14

6.2.3	Day/night cycle	14
6.3	Low temperatures	14
6.4	Seasonal characteristics	15
6.5	Ice environments	15
6.6	Endemic species	15
6.6.1	General	15
6.6.2	Identification	16
6.6.3	Ice flora and fauna	16
6.7	Human communities	16
6.7.1	General	16
6.7.2	Indigenous peoples	16
6.7.3	Local and traditional knowledge	16
7	Monitoring requirements for offshore oil and gas sector in the Arctic	16
7.1	General	16
7.2	Offshore life cycle phases	16
7.3	Offshore environmental monitoring programme design	17
7.3.1	Objectives of offshore environmental monitoring	17
7.3.2	General aspects of environmental monitoring programme	17
7.3.3	Offshore environmental aspect and environmental impact identification	17
7.3.4	Sampling and analysis	18
7.3.5	Reference sampling	18
7.3.6	Near-field sampling	19
7.3.7	Far-field sampling	19
7.3.8	Regional sampling	20
7.3.9	Field specific stations	20
7.3.10	Marine toxicity testing	20
7.4	Environmental monitoring programme implementation	20
7.4.1	Pre-development	20
7.4.2	Exploration	21
7.4.3	Construction and commissioning	22
7.4.4	Production phase	22
7.4.5	Decommissioning and facility removal	23
7.4.6	Site restoration	23
7.4.7	Logistics, air and sea transport and accommodation	23
7.4.8	Monitoring during emergency conditions	24
	Bibliography	25

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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 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*.

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Introduction

General

This document has been developed in order to promote internationally agreed approaches to environmental monitoring of oil and gas operations in Arctic offshore environments. The monitoring of onshore environments is not included in this document, except where relevant to an offshore development.

Environmental monitoring

Environmental monitoring includes:

- a) monitoring of environmental aspects for normal, abnormal and emergency conditions:

The environmental aspects of an organization under all conditions are determined by its environmental management system (EMS) procedures and can include:

- 1) emissions to air;
- 2) releases to water;
- 3) releases to land;
- 4) use of raw materials and natural resources, including physical presence of facilities;
- 5) use of energy;
- 6) energy emitted, including heat, radiation, vibration, noise and light;
- 7) generation of waste and/or by-products;
- 8) environmental aspects with beneficial impact;

- b) monitoring of environmental impacts:

Environmental impacts can occur at local, regional and global scales, while they can also be direct, indirect or cumulative.

The relationship between environmental aspects and environmental impacts is one of cause and effect.

Within the scope of this document, the environment includes all relevant physical, chemical and biological components of the sea, atmosphere and land, where the latter is potentially impacted by an offshore development. When an organization determines the scope of its environmental impact, the need to protect the following attributes is considered:

- human beings and cultural heritage;
- fauna and flora;
- soil, water, air and climate;
- material assets (such as existing pipelines and cables, shipping routes, seabed resources and resource extraction facilities).

There are no existing internationally agreed standards for environmental monitoring; neither are there such standards for marine environmental monitoring although there is a considerable body of guidance documents.

This document presents sufficient information to guide organizations towards relevant monitoring methods for use in the Arctic.

The special conditions of the Arctic will require organizations to modify their monitoring methods to suit the conditions encountered.

General marine monitoring methods can be adapted by the oil and gas sector to meet the needs of its Arctic maritime locations, its development phases, facility types and operations, their environmental aspects and their impacts upon the marine environment.

Relationship of this document to ISO 14001, ISO 9001 and other standards

The organizations that have implemented ISO 14001 or ISO 9001 already apply the elements of monitoring, measurement, analysis and improvement to their (environmental) monitoring processes.

Additional standards that apply to environmental monitoring include laboratory standards, specific guides on sediment, water and air quality monitoring, and recommended practices for species identification; the use of agreed statistical methods is essential.

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Petroleum and natural gas industries — Arctic operations — Environmental monitoring

1 Scope

This document gives requirements, specifications and guidelines to ensure that environmental monitoring in the offshore Arctic region is fit for purpose. The Arctic region includes the territory lying to the North of the Arctic Circle (Latitude 66°33'45.8"). This document can be applied to sub-Arctic locations which experience Arctic-like conditions and contain relevant components of a cold-climate ecosystem.

This document is applicable to all Arctic oil and gas operations from licence block acquisition through exploration, engineering design, construction, commissioning, operation, decommissioning and restoration. It covers the offshore or maritime environment, including for the purposes of this document, the fully marine and estuarine waters of the Arctic, whether frozen or ice-free. The environment includes all relevant physical, chemical and biological components. Monitoring methods for onshore (terrestrial) environments are not covered in this document, although onshore environments are included where monitoring is required at onshore locations in relation to an offshore development.

This document covers both monitoring of environmental aspects for normal, abnormal and emergency conditions, and monitoring of environmental impacts. It includes monitoring in near-field, far-field, transboundary and regional scales, but does not include global environmental monitoring.

2 Normative references

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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/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ISO/TS 20281, *Water quality — Guidance on statistical interpretation of ecotoxicity data*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 Risk

3.1.1 accident

unplanned event that resulted in injury or ill health of people, or damage or loss to property, plant, materials or the environment or a loss of business opportunity

3.1.2

emergency

unplanned event that has caused injury, loss or damage or that is an actual or potential threat to human life, the environment or the installation and has made it necessary to deviate from the planned operation or suspend the use of standard operating procedures

3.1.3

hazard

physical situation with a potential for causing human injury, damage to property, negative effects on the environment or a combination of these

3.1.4

hazard identification

process of recognizing that a *hazard* ([3.1.3](#)) exists or has the potential to exist and defining its characteristics

3.1.5

incident

event or chain of events which has caused or could have caused injury, illness, and/or damage (loss) to assets, the environment or third parties

[SOURCE: OGP Glossary of HSE Terms]

3.1.6

risk

product of the chance that a specified undesired event will occur and the severity of the consequences of this event

Note 1 to entry: Also defined as the measure of the likelihood of occurrence of an undesirable event and of the potentially adverse consequences which this event can have upon people, the environment or economic resources.

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[SOURCE: OGP Glossary of HSE Terms] [s.iteh.ai/catalog/standards/sist/98cfe368-b3fb-4a83-9e5a-dd7d0387b7c9/iso-35103-2017](https://www.iso.org/standards/catalog/standards/sist/98cfe368-b3fb-4a83-9e5a-dd7d0387b7c9/iso-35103-2017)

3.1.7

risk assessment

whole process of *risk* ([3.1.6](#)) analysis and the evaluation of the results of the risk analysis against technological and/or economic, social and political criteria

[SOURCE: OGP Glossary of HSE Terms]

3.2 Geography

3.2.1

Arctic

territory lying to the North of the Arctic Circle (Latitude 66°33'45.8")

3.2.2

region

delimited area of the continental shelf defined by geographical coordinates

3.3 Survey

3.3.1

baseline survey

environmental survey of an area or locality to obtain information on its physical, chemical and/or biological status before a new activity starts

3.3.2**grid**

design used to determine locations for the sampling stations if the position of the oil/gas field has not yet been established or if obstacles on the seabed make it impossible to use a *radial transect* (3.3.4) design

[SOURCE: Norwegian Environment Agency. Environmental monitoring of petroleum activities on the Norwegian continental shelf. M408, 2015]

3.3.3**transect**

straight line through a natural feature along which observations are made or measurements taken

3.3.4**radial transect**

design consisting of two axes placed perpendicular to one another with an offshore installation at the origin and the main axis in the prevailing direction of current flow

3.3.5**remotely operated vehicle**

remotely controlled underwater vehicle carrying a video camera, which is often equipped with sonar, sensors, a manipulator and sampling devices

3.3.6**water column**

marine environment from the water surface to the surface of the sediment

3.3.7**pelagic**

relating to the marine *water column* (3.3.6)

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3.4 Biology

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<https://standards.iteh.ai/catalog/standards/sist/98cfe368-b3fb-4a83-9e5a-dd7d0387b7c9/iso-35103-2017>

3.4.1**benthic**

relating to the marine zone on, within or near the seabed

3.4.2**biota**

living organisms in a given location

3.4.3**epifauna**

animals that live on a surface, such as the sea floor, other organisms, or objects, or an ice surface

3.4.4**epiflora**

plants that live on a surface, such as the sea floor, other organisms, or object, or an ice surface

3.4.5**macrofauna**

organisms larger than 1,0 mm (i.e. that are retained on a 1,0 mm sieve)

3.4.6**meiofauna**

organisms smaller than *macrofauna* (3.4.5), but larger than *microfauna* (3.4.7)

Note 1 to entry: Meiofauna generally refers to specific groups of organisms (foraminifera, nematodes, harpacticoid copepods, etc.).

3.4.7

microfauna

microscopic animals

3.4.8

plankton

organisms that spend all or part of their life cycle floating or drifting in the water and that have little or no independent mobility

Note 1 to entry: Plankton comprises plants (phytoplankton) and animals (zooplankton), and includes seasonally the juvenile stages of larger marine animals.

3.5 Oil and gas

3.5.1

drill cutting

rock piece dislodged during drilling

Note 1 to entry: Drill cuttings from offshore wells contaminated with adhering residual drilling fluid are often discharged to sea. Drilling fluid is a mixture of liquids and solids pumped into a borehole during drilling for the purpose of cooling and lubricating the drill string, transporting drill cuttings to surface, maintaining borehole stability and preventing hydrocarbon influx.

3.5.2

produced water

water (generally brine) brought up from the hydrocarbon-bearing strata during the extraction of oil and gas, including formation water, injection water, and any chemicals added downhole or during the oil/water separation process

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[SOURCE: IOGP Environmental Performance Indicators — 2014 data]

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3.6 Environment

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3.6.1

background level

concentration of selected parameters (hydrocarbons, metals, radioactive substances, etc.) that provide a level as close as possible to the natural concentrations in the area and to determine natural conditions and a level prior to project activities

Note 1 to entry: Background level can include existing anthropogenic contamination.

[SOURCE: Fishery Harbour Manual on the Prevention of Pollution — Bay of Bengal Programme, Food and Agriculture Organization of the United Nations (FAO), Fisheries & Aquacultures Department, 1999]

3.6.2

environmental aspect

element of an organization's activities or products or services that interacts or can interact with the environment

[SOURCE: ISO 14001:2015, 3.2.2, modified – notes to entry have been omitted.]

3.6.3

environmental impact

change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's *environmental aspects* ([3.6.2](#))

[SOURCE: ISO 14001:2015, 3.2.4]

3.6.4

environmental impact assessment

tool used to identify the *environmental impacts* ([3.6.3](#)) of a project prior to decision-making