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**Petroleum and natural gas  
industries — Arctic operations —  
Working environment**

*Industries du pétrole et du gaz naturel — Opérations en Arctique —  
Environnement de travail*

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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](http://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](http://www.iso.org/patents)).

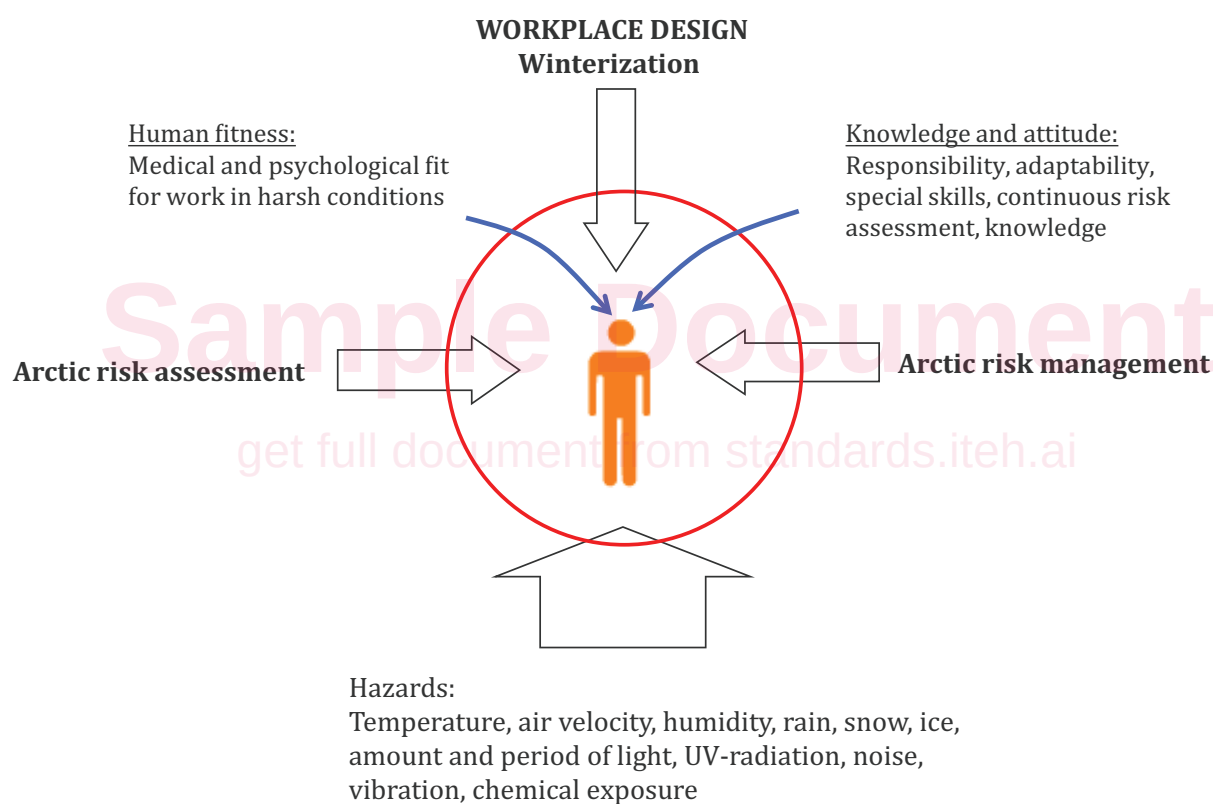
Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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](http://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

Workers in the petroleum and natural gas industries face a number of stressors from the physical and psychosocial environment when working in the Arctic. These include prolonged periods of darkness (polar winter) and light (polar summer), remoteness, noise and vibration, low humidity and cold climate. The combination of different working environment factors can affect people's health and safety. Cold-climate locations, low temperatures and wind can directly affect both equipment (e.g. operability, reliability and integrity) and people (e.g. frostbite, hypothermia and performance decrement). In turn, affected equipment can affect the health and safety of personnel, and poor personnel performance can likewise have a detrimental effect on equipment. It is important to consider and assess all these relationships in order to have confidence in production and health, safety and environmental (HSE) risks at facilities in cold climates. This is illustrated in [Figure 1](#). Based on the outcome of the assessment, approaches for cold-climate risk management should address all aspects of winterization, from prevention through facility design and specification through to working procedures. In addition to this, personal protective equipment (including clothing) may be necessary.



**Figure 1 — Hazards and preventive measures to protect people in Arctic environment**

# Petroleum and natural gas industries — Arctic operations — Working environment

## 1 Scope

This document describes the working environment that can be expected when operating oil and gas facilities in Arctic environments/climate. This document provides principles and generic guidelines for the design and operation of fixed and floating oil and gas facilities both onshore and offshore.

The aim of this document is to ensure optimal health, safety, human performance and decision-making conditions for people working on oil and gas facilities in Arctic conditions.

This document applies to the design and operation of new facilities and structures, and to modification of existing facilities for operation in the Arctic environment. This also includes offshore and onshore exploration and accommodation units for such activities.

This document is divided into three main parts.

- The first part ([Clause 5](#)) describes the general principles and guidelines for risk management.
- The second part ([Clause 6](#)) describes the general working environment (working environment hazards found in many workplaces and provides some threshold limit values (TLVs) and design references that can be especially challenging in Arctic conditions).
- The third part ([Clause 7](#) to [Clause 9](#)) addresses the climatic conditions expected in the Arctic. [Clause 8](#) describes working environment design and technical solutions, while [Clause 9](#) describes working environment operational requirements for prevention and management of cold-related problems.

## 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 Guide 73, *Risk management — Vocabulary*

ISO 5349-1, *Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration — Part 1: General requirements*

ISO 5349-2, *Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration — Part 2: Practical guidance for measurement at the workplace*

ISO 11064-6, *Ergonomic design of control centres — Part 6: Environmental requirements for control centres*

ISO 11079:2007, *Ergonomics of the thermal environment — Determination and interpretation of cold stress when using required clothing insulation (IREQ) and local cooling effects*

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

ISO 19906:2010, *Petroleum and natural gas industries — Arctic offshore structures*

ISO 31000, *Risk management — Principles and guidelines*

IMO MSC/Circ. 982, *Guidelines on ergonomic criteria for bridge equipment and layout*

EN 12464-1, *Light and lighting — Lighting of work places — Part 1: Indoor work places*

EN 12464-2, *Light and lighting — Lighting of work places — Part 2: Outdoor work places*

EN 12665, *Light and lighting — Basic terms and criteria for specifying lighting requirements*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions in ISO Guide 73 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 anti-icing

measures to prevent ice from forming on surfaces, *structures* (3.15) or equipment

Note 1 to entry: The intent of anti-icing is to make the surfaces, structures or equipment immediately available for use.

#### 3.2 Arctic

area characterized by low ambient temperatures and the presence or possibility of sea ice, icebergs, icing conditions, persistent snow cover, and/or permafrost

Note 1 to entry: Area does not only include the Arctic, but also other areas that meet this characterization.

#### 3.3 comfort

state of physical ease and freedom from pain or constraint

#### 3.4 company

owner, operator, or license or duty holder of the authorized work

#### 3.5 cold-climate conditions

potential presence of combinations of low air temperatures, low seawater temperatures, wind, snow, ice, freezing fog, etc.

#### 3.6 de-icing

measures to remove snow and ice accumulations from surfaces, *structures* (3.15) or equipment

Note 1 to entry: The intent of de-icing is to make the surfaces, structures or equipment functionally available within a reasonable period of time.

#### 3.7 facility

plant, rig, or *platform* (3.12), fixed or floating, stationary or mobile, on- or offshore, for use in oil and gas exploration, production or support.

#### 3.8 functional requirement

requirement that provides the fundamental rationale behind a particular rule and which needs to be satisfied

**3.9****hazard**

source of potential harm

Note 1 to entry: Hazard can be a risk source.

**3.10****heat tracing**

method used to raise or maintain the temperature of pipes and surfaces

Note 1 to entry: Heat tracing is based on the principle that objects of unequal temperatures in a thermal system tend toward thermal equilibrium. Heat tracing cables consist of a heating element (a resistor) in either series or parallel configuration which produces heat when voltage is applied to it.

**3.11****open work area**

*work area* (3.18) with no substantial obstacles to the open air and completely exposed to ambient conditions

**3.12****platform**

complete assembly of structural and non-structural systems for the purpose of development and production of petroleum and natural gas fields

Note 1 to entry: The platform includes *structure* (3.15) and non-structural systems such as topsides equipment, piping and accommodation.

Note 2 to entry: The platform does not include soils.

**3.13****safety system**

system, including required utilities, which is intended to prevent, detect/warn of an accidental event/abnormal conditions, and/or to mitigate its effects

**3.14****semi-open work area**

*work area* (3.18) that is weather-protected (e.g. with weather louvers) and partially exposed to the open air

**3.15****structure**

organized combination of connected components and subsystems designed to withstand actions and provide adequate rigidity and stability

EXAMPLE 1 Examples of components include columns, beams, stiffened plates, tubular members and joints, mooring lines and tendons, foundation anchors and piles, but not the soil.

EXAMPLE 2 Examples of subsystems include structural integrity management (SIM) systems, stationkeeping thrusters and their control and power systems.

**3.16****vendor**

one who sells and/or delivers equipment and/or engineering services

**3.17****weather protection**

measures taken to prepare *work areas* (3.18) on the *facility* (3.7) for harsh weather (rain, sea-spray, wind, cold, snow)

EXAMPLE Wind walls, roof, partial or total enclosure.

**3.18**

**work area**

area of the *facility* (3.7) where personnel normally stay or move in connection with work, excluding void hull areas

**3.19**

**workplace**

space within a *work area* (3.18) allocated to one or more persons to complete work tasks related to operations, production, inspection or maintenance

**3.20**

**work system**

combination of people and work equipment, acting together in the work process, at the workplace, in the work environment, and under the conditions imposed by the work task

**3.21**

**working environment**

totality of all physical, chemical, biological and psychological factors at work that can affect the employees' health and well-being

**3.22**

**winterization**

measures taken in the design and preparation of a *facility* (3.7) for operations in cold climates

Note 1 to entry: Winterization is primarily focused on the adverse effects and control of freezing, icing, wind chill, snow, falling ice and material properties in cold temperatures.

## 4 Abbreviated terms

ACGIH American Conference of Governmental Industrial Hygienists

ALARP as low as reasonably practicable

CFD computational fluid dynamic

EER escape, evacuation and rescue

FEED front-end engineering design

HAV hand-arm vibration

HSE health, safety and environment

IREQ required clothing insulation

JHA job hazard analysis (equivalent to job safety analysis)

JTA job task analysis

PPE personal protective equipment

SAR search and rescue

TLV threshold limit value

WCT wind chill temperature

## 5 Risk management

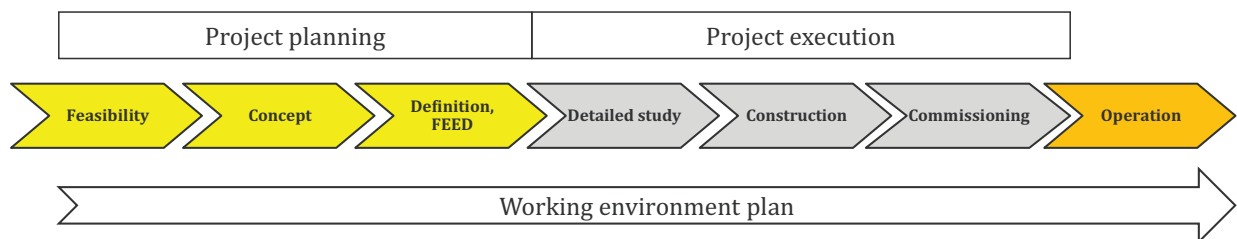
### 5.1 General

The working environment shall be managed so that the working environment risks are controlled. These risks shall be managed according to the principles in ISO 31000.

Risk assessment shall include risk identification, risk analysis and risk evaluation. Mitigating measures shall be applied to eliminate or reduce the identified risks.

### 5.2 Management of working environment risks in the design process

[Figure 2](#) shows the typical project phases in a design process that are also applicable to managing of working environment risks.



**Figure 2 — Typical project phases in a design process**

The operating circumstances (geographical site, environment, type of facility, manning, operating philosophy, etc.) shall be established in the concept and be updated throughout the design process.

A list of generic working environment hazards and risks connected is presented in [Clause 6](#). The list is not complete and should be used only as a guide for risk identification.

All working environment risks shall be identified and assessed and form the basis for prioritized risk reducing actions. This process shall start in the concept phase and give input to the design basis. The process shall be updated throughout the planning and execution.

It is recommended to use a workshop method with participants from line management, technical disciplines, HSE experts and with employee involvement.

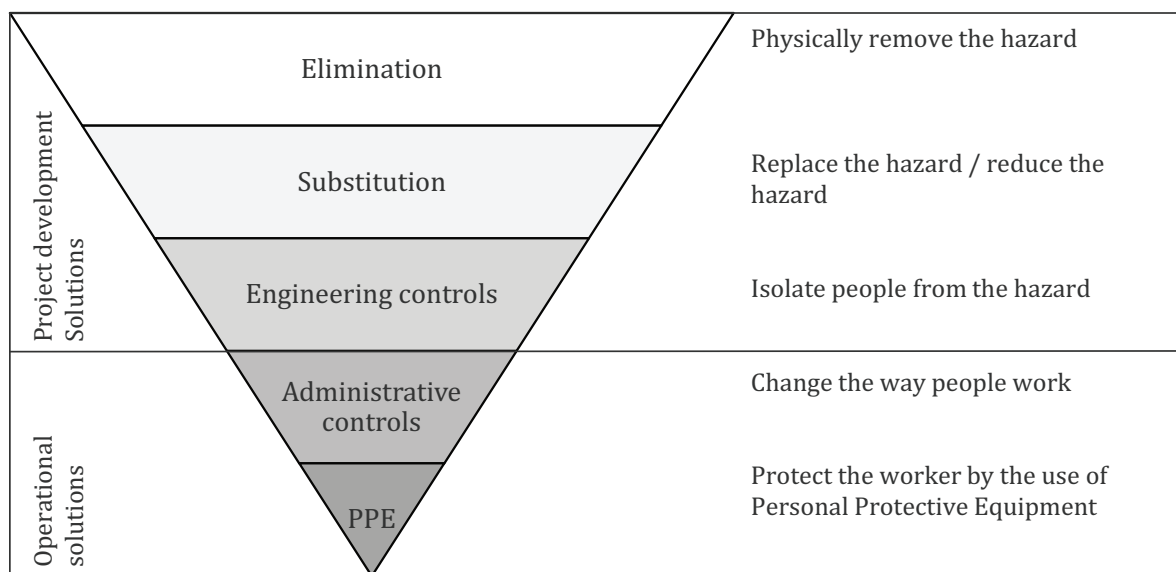
Relevant elements for risk management of the working environment include:

- the geographical position, climate, type of facility;
- existing information (literature, experience transfer from similar projects);
- the manning level, operational conditions, operation and maintenance strategies;
- personnel competence, health, etc.;
- calculation of local wind chill, snow and ice conditions.

### 5.3 Mitigating measures — Risk reduction principles

#### 5.3.1 Hierarchy of controls

The risk treatment shall describe solutions to eliminate, reduce and control the working environment risks. The method to control the risk should be considered in the order presented in [Figure 3](#).



**Figure 3 — Hierarchy of controls to mitigate working environment risks**

### 5.3.2 ALARP

The working environment risk shall be kept as low as reasonably practicable (ALARP). For a risk to be ALARP, it shall be possible to demonstrate that the cost involved in reducing the risk further would be grossly disproportionate to the benefit gained.

## 5.4 Special assessment in Arctic environment

### 5.4.1 Input to design specification

The process to secure a safe and healthy workplace in the Arctic starts by assessing the concept, the area of operation, the climate preconditions and the operation philosophy.

[Figure 4](#) illustrates the assessments, possible solutions and the importance of making quality assessments to decide the right type of risk reducing measure in the design, especially the need for weather protection.

Design solutions and operational measures in combination give the protection level. The level of design solution should be according to risk assessment and ALARP analysis. See [Clauses 5](#) and [8](#).

Operational solutions: Operations/work task performed in outdoor areas that are not adequately weather protected shall be risk assessed and treated as described in [Clause 9](#).

**NOTE** Availability (i.e. high, medium, low) means how important it is that the outdoor area can be entered and used as a workplace independent of the weather conditions.