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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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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

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.

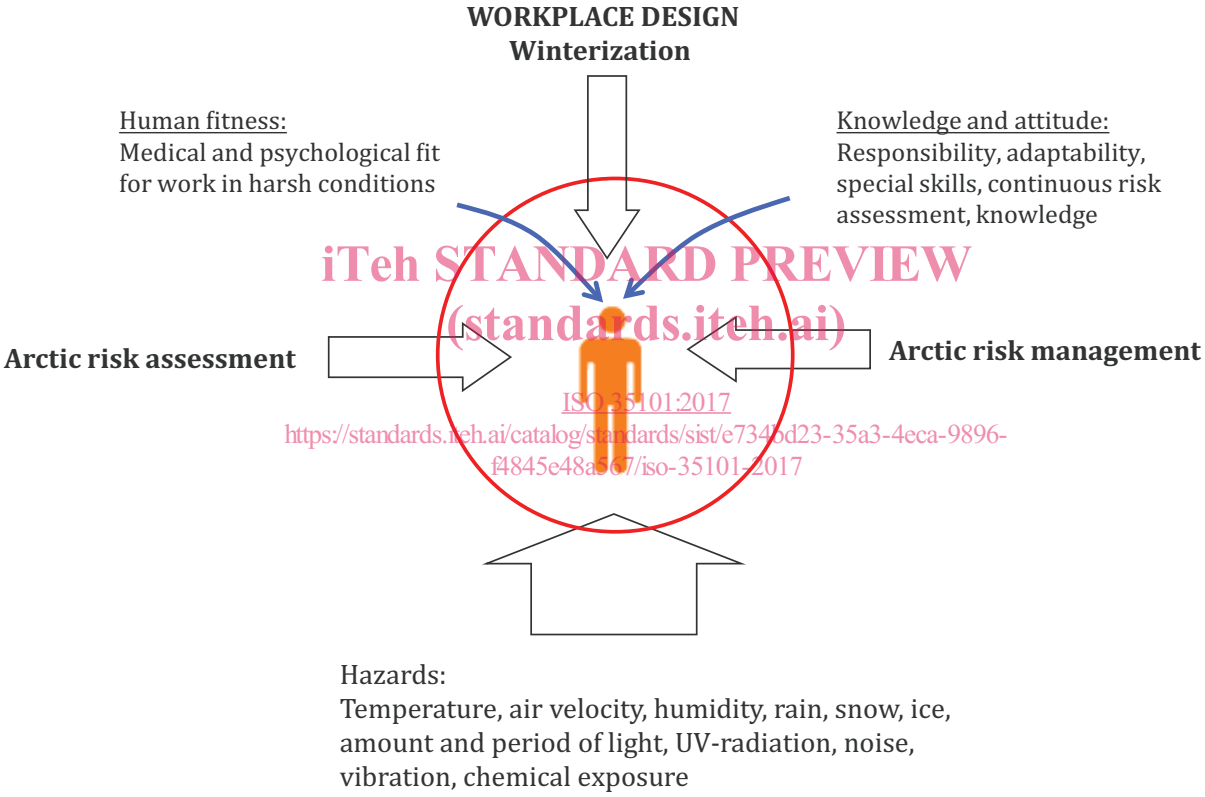

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Figure 1 — Hazards and preventive measures to protect people in Arctic environment

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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.

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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

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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

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

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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

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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.

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

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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

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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.

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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.

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4 Abbreviated terms

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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

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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.

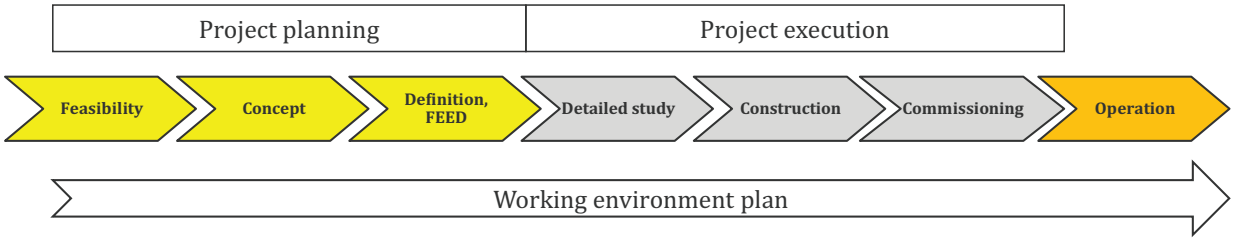

Figure 2 — Typical project phases in a design process

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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.

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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:

a) the geographical position, climate, type of facility;

b) existing information (literature, experience transfer from similar projects);

c) the manning level, operational conditions, operation and maintenance strategies;

d) personnel competence, health, etc.;

e) 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.

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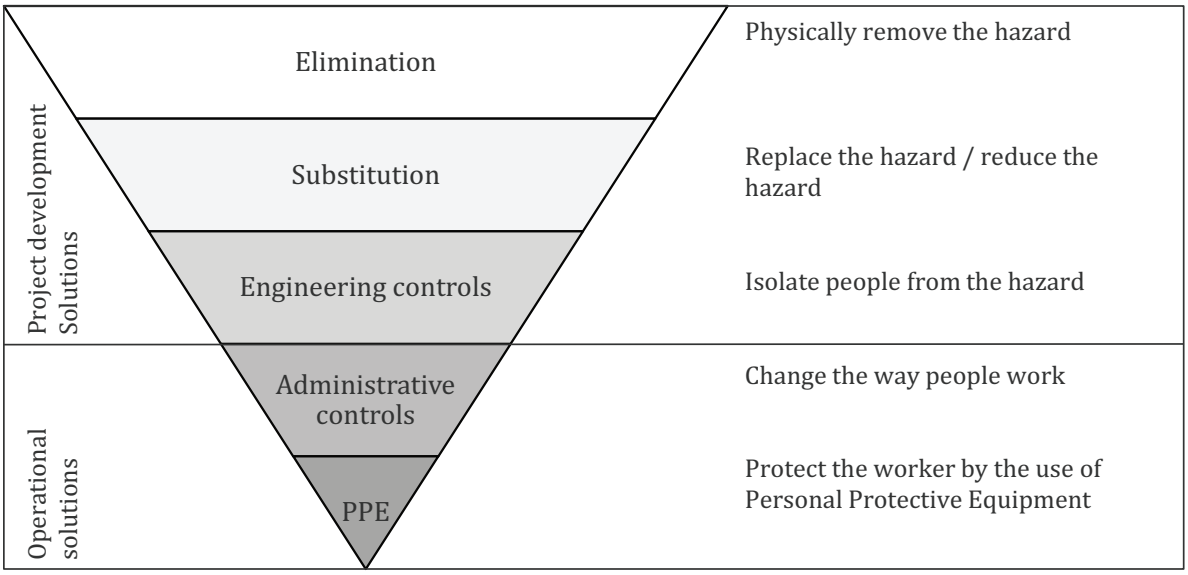

Figure 3 — Hierarchy of controls to mitigate working environment risks

5.3.2 ALARP

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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.

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5.4 Special assessment in Arctic environment

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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.

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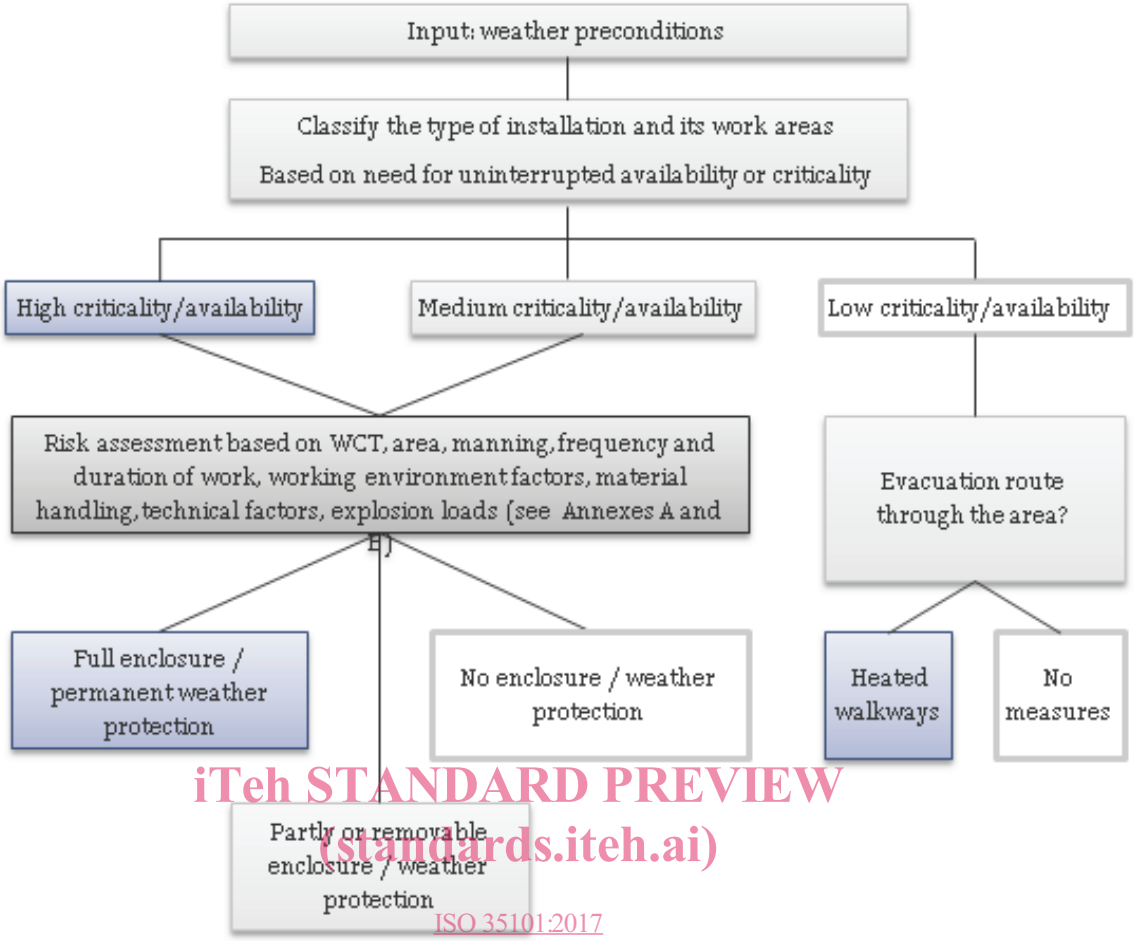

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Operational solutions: Operations / work task performed in outdoor areas that are not adequately weather protected shall be risk assessed and treated as described in Clause 9.

Figure 4 — Flowchart illustrating the steps to analyse and prioritize the need for weather protection in the design process

This document addresses these issues in more details by describing:

a) the general work environment hazards in Clause 6;

b) the assessment of need for weather protection and other design requirements in Clause 8 and Annex B;

c) the risk assessment of operation, operational restrictions, clothing, guidelines for work and health requirements in Clause 9;

d) the education, training and supervision needs in Clause 10.

The operational consequences of cold risks due to unsolved design solutions shall be analysed. Clause 9 provides detailed methods and Annex A gives additional information about working environment studies and deliverables in project development.

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