



BSI Standards Publication

Petroleum and natural gas industries — Arctic operations — Escape, evacuation and rescue from offshore installations

National foreword

This British Standard is the UK implementation of EN ISO 35102:2021. It is identical to ISO 35102:2020. It supersedes BS ISO 35102:2020, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PSE/17, Materials and equipment for petroleum, petrochemical and natural gas industries.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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English Version

**Petroleum and natural gas industries - Arctic operations -
Escape, evacuation and rescue from offshore installations
(ISO 35102:2020)**

Industries du pétrole et du gaz naturel - Opérations en
Arctique - Fuite, évacuation et sauvetage depuis les
installations en mer (ISO 35102:2020)

Erdöl- und Erdgasindustrie - Arktisbetrieb - Flucht,
Evakuierung und Rettung von Offshore-Anlagen (ISO
35102:2020)

This European Standard was approved by CEN on 5 December 2021.

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European foreword

The text of ISO 35102:2020 has been prepared by Technical Committee ISO/TC 67 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries" of the International Organization for Standardization (ISO) and has been taken over as EN ISO 35102:2021 by Technical Committee CEN/TC 12 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries" the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2022, and conflicting national standards shall be withdrawn at the latest by June 2022.

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Endorsement notice

The text of ISO 35102:2020 has been approved by CEN as EN ISO 35102:2021 without any modification.

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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).

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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*.

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

The International Standards on arctic operations (ISO 35101, ISO 35102, ISO 35103, ISO 35104, ISO/TS 35105 and ISO 35106) address design and operational requirements and provide guidance on their use by the petroleum and natural gas industries in offshore arctic and cold regions. These documents promote internationally agreed approaches for oil and gas operations in arctic and cold region offshore environments. They were developed in response to the offshore oil and gas industry's demand for a coherent and consistent definition of methodologies to design, analyze, assess and operate arctic and cold region offshore structures. Through their proper application, the intention is to help ensure the safety of life and to minimize damage to the arctic environment. These documents are intended to provide wide latitude in the selection of design and operational solutions without hindering innovation. Even so, sound engineering judgement is expected in the application of these documents.

Personnel working in petroleum and natural gas industries in the arctic offshore face a number of risks from the physical and work environments. These include prolonged periods of darkness (in the winter) and light (in the summer), remoteness, cold ambient air temperatures, wind chill, dense fog, cold water temperatures, sea ice in varying concentrations and thickness and potentially, icebergs. These environmental factors can affect worker safety, should the installation's integrity be compromised. Additionally, these harsh environmental factors can have a negative impact on equipment.

The escape, evacuation and rescue (EER) system facilitates the successful escape from an incident, subsequent precautionary or emergency evacuation from the installation, and the ultimate rescue of installation personnel. The EER provisions are the compensating measures mitigating risks which facilitate the safety of personnel working in arctic and cold region offshore environments.

This document specifies requirements and recommendations applicable to design and operational aspects of EER from oil and gas installations deployed in arctic and cold region offshore environments. Through their application, the intention is to achieve reliability levels appropriate for manned and normally unmanned offshore installations, regardless of the type of structure/facility and the nature or combination of the materials used and the severity of the environment to which the installation is subjected.

The EER provisions are largely performance-based stipulations which include verifiable attributes or benchmarks that provide qualitative levels or quantitative measures of performance. The key characteristic of a performance-based standard is that it is focused on what needs to be achieved rather than on how it should be done. One of the performance targets is that use of the EER minimizes the possibility of casualties in the process. The performance target is developed in the context of a design HSE case.

The main body of this document considers the overall EER system design and operational aspects. [Annex A](#) provides EER system design and operational background information and guidance intended to assist the user of this document in understanding the requirements and how they can be met. The clause numbering in [Annex A](#) is the same as in the main body text to facilitate cross-referencing. [Annex B](#) provides a risk analysis example and information pertaining to operational EER systems.

In this document, the following verbal forms are used:

- “shall” indicates a requirement;
- “should” indicates a recommendation;
- “may” indicates a permission;
- “can” indicates a possibility or a capability.

Users of this document are expected to be familiar with ISO 15544, ISO 17776 and ISO 31000.

Petroleum and natural gas industries — Arctic operations — Escape, evacuation and rescue from offshore installations

1 Scope

This document establishes the principles, specifies the requirements and provides guidance for the development and implementation of an escape, evacuation and rescue (EER) plan. It is applicable to offshore installation design, construction, transportation, installation, offshore production/exploration drilling operation service life inspection/repair, decommissioning and removal activities related to petroleum and natural gas industries in the 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.

This document contains requirements for the design, operation, maintenance, and service-life inspection or repair of new installations and structures, and to modification of existing installations for operation in the offshore Arctic and cold regions, where ice can be present for at least a portion of the year. This includes offshore exploration, production and accommodation units utilized for such activities. To a limited extent, this document also addresses the vessels that support ER, if part of the overall EER plan.

While this document does not apply specifically to mobile offshore drilling units (MODUs, see ISO 19905-1) many of the EER provisions contained herein are applicable to the assessment of such units in situations when the MODU is operated in arctic and cold regions.

The provisions of this document are intended to be used by stakeholders including designers, operators and duty holders. In some cases, floating platforms (as a type of offshore installations) can be classified as vessels (ships) by national law and the EER for these units are stipulated by international maritime law. However, many of the EER provisions contained in this document are applicable to such floating platforms.

This document applies to mechanical, process and electrical equipment or any specialized process equipment associated with offshore arctic and cold region operations that impacts the performance of the EER system. This includes periodic training and drills, EER system maintenance and precautionary down-manning as well as emergency situations.

EER associated with onshore arctic oil and gas facilities are not addressed in this document, except where relevant to an offshore development.

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 15544, *Petroleum and natural gas industries — Offshore production installations — Requirements and guidelines for emergency response*

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

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

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

ISO 31000, *Risk management — Guidelines*

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

ISO 35106, *Petroleum and natural gas industries — Arctic operations — Metocean, ice, and seabed data*

IMO International Convention for the Safety of Life at Sea (SOLAS), 1974

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 abandonment

act of personnel on-board leaving an installation in an emergency

3.2 accommodation

place where personnel on-board sleep and spend their off-duty time

Note 1 to entry: It can include dining rooms, recreation rooms, lavatories, cabins, offices, sickbay, living quarters, galley, pantries and similar permanently enclosed spaces.

3.3 annual risk tolerability criterion ARTC

value of the individual and collective *risks* (3.50) per year of a fatality for persons, considering the amount of time spent in the operation and considering all risk sources, including workplace accidents, other incidents and *EER* (3.18) risks

3.4 anti-icing

measures to prevent ice from forming on surfaces, structures or equipment

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

3.5 as low as reasonably practicable ALARP

implementation of *risk* (3.50) reducing measures until the cost (including time, capital costs or other resources/assets) of further risk reduction is grossly disproportional to the potential risk reducing effect achieved by implementing any additional measure

3.6 casualty

serious injury or fatality resulting from an accident that occurs during the *EER* (3.18) process

3.7**cold-climate conditions**

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

3.8**action**

measure to limit the extent and/or duration of a hazardous event to prevent *escalation* (3.16)

3.9**direct evacuation****dry evacuation**

movement of personnel from the installation directly to a *safe haven* (3.52) or to a vessel in the vicinity with the capability of safely reaching the platform without having to enter the sea or the ice cover

3.10**drills and exercises**

activities undertaken to ensure verification of performance criteria, targets or requirements

3.11**duty holder**

individual, legal entity or organization holding legal title to the equipment or process and accountable for the safety and welfare of all associated personnel

3.12**embarkation area**

place from which personnel abandon the installation during *evacuation* (3.20)

3.13**emergency breathing system****EBS****compressed air emergency breathing system****CA-EBS**

form of personal protective equipment that provides the user with a means to breathe underwater for at least one minute, overcoming the need to make a single breath last for the complete duration of an underwater *escape* (3.17) from a helicopter

Note 1 to entry: If used correctly, EBS can mitigate the *risk* (3.50) of drowning. EBSs are categorized as follows:

- Category A: capable of deployment in air and underwater within 12 s;
- Category B: capable of deployment in air within 20 s.

3.14**emergency**

hazardous event which cannot be handled by normal measures and requires immediate *action* (3.8) to limit its extent, duration or consequences

3.15**emergency response****ER**

action (3.8) taken by personnel on or off the installation to control or mitigate a hazardous event or initiate and execute *abandonment* (3.1)

3.16**escalation**

increase in the consequences of a hazardous event

3.17

escape

act of personnel moving away from a hazardous event to a place on the installation where its effects are reduced or removed

3.18

escape, evacuation and rescue

EER

range of possible *actions* ([3.8](#)) in an *emergency* ([3.14](#))

EXAMPLE *Escape* ([3.17](#)), *muster* ([3.38](#)), *refuge*, *emergency or precautionary evacuation* ([3.44](#)) and *rescue* ([3.48](#)).

3.19

escape route

normally available and unobstructed route from locations where personnel can be present on the installation to the *temporary refuge* ([3.61](#)) or alternative protected muster point

3.20

evacuation

planned method of abandoning the installation in an *emergency* ([3.14](#))

3.21

evacuation craft

survival craft

marine or amphibious craft used by installation personnel to evacuate to the sea or ice cover

Note 1 to entry: An evacuation or survival craft provides evacuees with protection from the incident and the physical environment.

Note 2 to entry: This is a generic term that can cover lifeboats, life rafts, personnel basket or similar.

3.22

immersion suit

protective suit made of materials which reduce loss of body heat of a person wearing it in cold water or on the ice

3.23

first-year ice

FYI

sea ice of not more than one winter's growth

3.24

floe

relatively flat piece of sea ice greater than 20 m across

Note 1 to entry: Typical subcategories are: small (20 m to 100 m across), medium (100 m to 500 m across), big (500 m to 2 000 m across), vast (2 km to 10 km across) and giant (greater than 10 km across).

3.25

freeboard

ice freeboard

vertical distance from the mean sea surface to the ice surface

3.26

hazard

potential source of harm

3.27

hazard zone

largest possible area within which personnel safety is at *risk* ([3.50](#)) due to the installation *hazard* ([3.26](#))

3.28**iceberg**

glacial or shelf ice of greater than 5 m *freeboard* (3.25) that has broken (calved) away from its source

Note 1 to entry: Icebergs can be freely floating or grounded, and their shapes are sometimes defined as tabular, dome, pinnacle, wedge or block. Smaller pieces of ice are called bergy bits or growlers

3.29**ice detection**

discrimination of ice features from the surrounding environment

3.30**ice island**

large tabular-shaped ice feature that has calved from an ice shelf or glacier

3.31**ice management**

active processes used to alter the ice environment with the intent of reducing the frequency, severity or uncertainty of ice actions

3.32**ice management plan**

detailed plan outlining the objectives, active procedures involved and individual responsibilities for the implementation of the ice management strategy

3.33**indirect evacuation**

movement of personnel from the installation to an intermediate *safe haven* (3.52) off the installation, such as an *evacuation* (3.20) craft

3.34**indirect evacuation system**

system by which evacuees move from the *temporary refuge* (3.61) or muster point on the installation to a location outside the *hazard zone* (3.27) if they are able to do so

3.35**landfast ice****fast ice**

ice that remains attached to a shoreline, island or a grounded ice feature

3.36**major incident**

major accident

event with potential for multiple personnel casualties, significant environmental damage, installation failure, or any combination of these consequences

3.37**multi-year ice**

sea ice that has survived at least one summer melt season

Note 1 to entry: When the term “multi-year ice” is used in conjunction with the term “second-year ice”, the former should be interpreted as ice that has survived at least two summer melt seasons.

3.38**muster**

movement of people to a designated area(s) so that the person in overall charge can account for all people and thereby facilitate *emergency response* (3.15) *actions* (3.8)

3.39

muster station

MS

muster area

assembly station

designated area(s) to which personnel report when required to do so in an *emergency* ([3.14](#))

3.40

offshore installation manager

OIM

person legally responsible for the installation and all operations on and around an offshore platform

3.41

pack ice

sea ice consisting of discrete *floes* ([3.24](#)) that are not *landfast ice* ([3.35](#))

3.42

performance-based standard

standard that specifies in qualitative and quantitative terms the requirements of safety-critical systems and their elements

3.43

personnel on board

POB

total number of personnel on board the installation

Note 1 to entry: This includes visitors, vessel crews, cross-shift personnel on the installation transferring to vessel, helicopter or other means, etc.

3.44

precautionary evacuation

controlled means of removing personnel from the installation prior to an uncontrolled or escalating incident that can otherwise dictate an emergency *evacuation* ([3.20](#))

3.45

preferred means of evacuation

method of choice for evacuating personnel based on the lowest *risk* ([3.50](#)) and on the familiarity, frequency of use, availability and suitability under prevailing conditions

Note 1 to entry: This is the method normally used to transfer personnel to and from the offshore location and could possibly not be available in an emergency.

3.46

primary means of evacuation

method of evacuating personnel that can be carried out in a controlled manner under the direction of the person in charge

Note 1 to entry: This is the *preferred means of evacuation* ([3.45](#)) of the installation in an emergency.

3.47

recovery

retrieval

transfer of evacuees to a rescue vessel, helicopter, safe installation or other *safe haven* ([3.52](#))

3.48

rescue

process by which those who have evacuated, survived until a *safe haven* ([3.52](#)) is available and are retrieved to a place where medical assistance is generally available

3.49
ridge
ice ridge

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

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

3.50
risk

probability that a specified undesirable event will occur combined with the severity of the consequences of that event

3.51
rubble field

region of broken ice blocks floating together as a continuous body

3.52
safe haven

area outside the *hazard zone* (3.27) in which personnel safety is no longer at *risk* (3.50) due to the installation *hazard* (3.26) or physical environmental risks, and where medical attention is normally available

EXAMPLE A safe haven can be a rescue helicopter or a *standby vessel* (3.58).

3.53
safety-critical element
SCE

item of equipment, procedure or structure whose failure can lead to a *major incident* (3.36) or whose purpose is to prevent or limit the consequences of a major incident

3.54
scenario risk tolerability criterion
SRTC

upper limit of the individual and collective *risk* (3.50) for any *EER* (3.18) scenario

3.55
secondary means of evacuation

method of evacuating personnel in an *emergency* (3.14) when the *primary means of evacuation* (3.46) cannot be used, which can be carried out in a fully controlled manner under the direction of the person in charge, independent of external support

Note 1 to entry: This means of *evacuation* (3.20) does not provide as much protection from *hazards* (3.26) and the elements as does the *primary means of evacuation* (3.46) but it can avoid immersion in the sea/ice.

3.56
second-year ice

sea ice that has survived one summer's melt season

Note 1 to entry: Second-year ice is sometimes referred to as *multi-year ice* (3.37).

3.57
stamukha

grounded ice feature composed of broken ice pieces or rubble

Note 1 to entry: The plural form of "stamukha" is "stamukhi".

3.58

standby vessel

SBV

vessel stationed near the installation at all times that provides *rescue* (3.48) assistance if needed within defined performance times and can accommodate installation *personnel on board* (3.43) and typically can offer medical assistance to survivors

3.59

standby ice management vessel

SIMV

icebreaker standby vessel

standby vessel (3.58) used during the ice season that is capable of clearing ice and ice rubble away from the installation to create a clear route in the event of an *emergency* (3.14)

3.60

station bill

posted list showing the duties and duty stations of designated personnel on the installation with *emergency response* (3.15) organization roles and responsibilities

3.61

success

conduct of an *EER* (3.18) operation with zero casualties

Note 1 to entry: See also definition of *casualty* (3.6).

3.62

temporary refuge

TR

place provided where personnel can take refuge for a predetermined period whilst investigations, *emergency response* (3.15) and *evacuation* (3.20) preparations are undertaken

Note 1 to entry: Where provided, a TR might not necessarily be useable under all incident scenarios.

Note 2 to entry: The specified period that a TR is deemed to provide a *safe haven* (3.52) is called the TR impairment time.

3.63

tertiary means of evacuation

method of evacuating personnel in an *emergency* (3.14) that relies heavily on an individual's own *actions* (3.8), is used when the primary and secondary means are not available, and that has an inherently higher *risk* (3.50)

3.64

training

activities undertaken to ensure that competence is increased or maintained on an individual and team level

3.65

winterization

measures taken in the design and preparation of a facility or installation to facilitate 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

CCR	central control room
ECP	emergency control point
ERO	emergency response organization
ERP	emergency response plan
HAZID	hazard identification
HSE	health, safety and environment
H ₂ S	hydrogen sulphide gas
HVAC	heating, ventilation and air conditioning
LSA	life-saving appliance
MOB	man overboard
PA	public address
PPE	personal protective equipment
QRA	quantitative risk analysis (assessment)
SAR	search and rescue
FEED	front-end engineering design
HEP	human error probability
PSV	platform supply vessel
PEERS	probabilistic EER simulator
P&ID	piping and instrumentation drawings
PLB	personal locator beacon
RPT	risk and performance tool
SOLAS	international convention for the Safety Of Life At Sea
SSIV	subsea isolation valve
TEMPSC	totally enclosed motor propelled survival craft

5 General requirements and conditions for EER systems

5.1 Fundamental requirements

The EER system shall:

- a) be designed:
 - with the safeguarding of human life as the top priority;

- to help ensure continuous protection for personnel engaged in EER activities in response to all credible hazards;
 - to be robust and adaptable with respect to changing conditions.
- b) establish and maintain installation personnel preparedness (competency);
- c) maintain year-round readiness of all its components (e.g. the TR, escape and evacuation routes, muster and embarkation areas, LSAs);
- d) provide space and means (e.g. first aid kits and other medical equipment) to accommodate and treat injured installation personnel in the TR(s), primary and secondary means of evacuation;
- e) provide medical support to evacuees who have been rescued.

5.2 Methods — Design

5.2.1 General

To the extent possible, data and lessons learned from the performance of previously deployed EER systems in arctic and cold regions shall be used to help verify new EER system designs. Appropriately scaled physical models and mathematical models can also be used to determine the response of EER systems to ice actions, in combination with current, wind and wave actions. If using such models, these shall be calibrated using data from full-scale measurements where available.

The EER system shall be functional in all applicable arctic physical environmental conditions in the region operated. The functionality can vary widely from location to location, both seasonally and annually.

Identification, investigation and determination of site-specific conditions for sea ice, icebergs, ice islands and other environmental factors and any possible combination thereof on EER system performance shall be made with due consideration of the phenomena and effects of their impact (see [Clause 7](#)).

The EER system, including all subsystems, shall be designed for operation in an environmentally sound manner during emergency scenario drills and when maintaining EER system hardware. Conditions that can influence the functional and operational requirements, particularly those associated with the arctic physical environment, shall be identified. It shall be demonstrated that the EER system performs as intended.

The evaluation of possible hazard scenarios shall include:

- potential occurrences of design-basis extreme ice features;
- the local consequences of impacts from such ice features; and
- arctic-specific geohazards that can negatively impact EER system performance.

The following aspects shall be considered in the EER system design or addressed periodically during operation of the offshore installation:

- a) the potential for changes in storm frequency and magnitude;
- b) ice and icing conditions;
- c) ocean circulation;
- d) air temperatures;
- e) permafrost;
- f) snowfall;

- g) wave heights and water levels during the design service life of the structure, including the decommissioning phase.

5.2.2 Structural configuration — Design

Structure configuration shall consider the layout of facilities and separation distances from hazards (as applicable) and environmental constraints as it impacts the EER system design.

The EER system design shall:

- a) Take into account the impact of different substructure geometries (shapes, orientations and profiles) as well as the topsides arrangement.
- b) Address the impacts of ice conditions during the offshore installation's design life, including the decommissioning phase. Such ice conditions shall include but not be limited to:
 - all relevant ice drift directions and velocities;
 - ice types and concentrations;
 - ice rubble build up locations, dimensions, and durations;
 all in the context of the installation's ice resistance and ice management provisions.
- c) Account for topsides arrangements with respect to the functional and operational requirements, such as resupply, offloading, flaring, and with respect to wind and ice encroachment.
- d) Consider winterization measures to help ensure the safe operation of EER systems and equipment during operations. Such measures shall help ensure that personnel can conduct the required tasks in an ergonomically sound way with respect to ambient temperature, wind, visibility and restrictions imposed by PPE and installation conditions.
- e) Be suitable for periods of installation transportation, e.g. during a manned tow, and installation, accounting for the ice and/or metocean conditions along the transportation route, which can be different than environmental/ice conditions at the set-down location, and during the installation design service life.
- f) Take into account any restrictions to system availability and/or performance associated with transportation and installation when the installation EER provisions are relied upon, e.g. during a manned tow.

5.3 Methods — Operations

5.3.1 General

The level of safety and performance with respect to the operational aspects of the EER system shall be established as part of the overall EER plan. These shall be consistent with goals and guidelines established in the EER design basis.

Where practical, rational operational EER methods based on recognized operational practices in open water seas during the open water season may be considered. If rational optional EER methods are considered, it shall be demonstrated that they are effective for periods when sea ice and/or icebergs are present and ice accretion is to be considered.

EER systems and subsystems shall be operated in an environmentally sound manner. Any condition that can potentially adversely influence the functional and operational capabilities of the EER subsystem shall be identified and mitigated.

Appropriate procedures for issues concerning health and safety in an arctic environment where they pertain to EER shall be established and maintained.

The operational plan shall include consideration for any changes in:

- storm frequency/magnitude;
- ice conditions;
- air temperatures;
- snowfall;
- wave heights and water levels that can occur during the design service life of the structure.

NOTE These aspects can negatively impact the performance of the EER system.

The operational plan shall be updated as necessary throughout the installation life cycle.

Inspection and maintenance procedures for any tanks, pipes or liquid transfer processes associated with the EER system, including temporary EER arrangements during tow, set-down and when ice is present, that can leak or spill under non-emergency situations shall be developed.

Means for the containment and clean-up of spills from the EER system shall be proven to function under the expected range of arctic physical environmental conditions.

5.3.2 Structural configuration — Operations

The impacts of structural configuration provisions, as applicable, on the operational aspects of the EER system, including the layout of facilities and separation distances from hazards and physical environment constraints, shall be assessed.

The operational impact on EER due to the orientation of the substructure from the perspective of the anticipated ice conditions, prevailing ice drift directions and ice rubble build-up shall be taken into account. Functional and operational impacts on the topsides with respect to resupply, offloading and flaring on the EER system performance, and wind and ice encroachment shall be considered.

Winterization measures shall be maintained during operations to help ensure the functionality of EER systems and equipment. The winterization measures shall enable personnel to conduct the required maintenance and repair tasks in an ergonomically sound way with respect to cold ambient outside air temperature, wind, visibility and restrictions imposed by PPE.

The EER system design shall be integrated into any offshore component of the operations, maintenance and repair process. The planning of operations, maintenance and repair activities shall include adequate consideration for periods of extremely low ambient temperatures. EER system materials and equipment shall be adequately protected where deemed necessary by the provision of heating, insulation, enclosures or other means.

EER system operation shall take into account any system restrictions on availability and/or performance associated with transportation and installation when the installation EER provisions are relied upon (e.g. during a manned tow).

The EER system shall be in place for periods of installation transportation and decommissioning. The EER system shall account for the ice and/or metocean conditions along the transportation route, which can differ from those at the set-down location, and during the commissioning, hook-up and decommissioning phases.

Marine operations associated with the transportation and installation of the structure shall be in accordance with ISO 19901-6. Marine operations shall be addressed in the EER plan.

6 Escape, evacuation and rescue strategy

6.1 General EER strategy

The EER system components consist of hardware, procedures, organization and personnel. The EER system components shall include the EER strategy physical environment in [Clause 7](#), the EER strategy reliability in ISO 19906 and continuous assessment in [Clause 9](#).

The EER system shall:

- a) be developed for the full suite of credible incident scenarios and under the design arctic physical environment and operating conditions;
- b) be regularly monitored, tested, maintained and improved or corrected to maintain optimal performance;
- c) be designed and operated based on the preservation of human life, minimizing casualties and minimizing potential adverse effects on the arctic environment;
- d) promote the successful escape from an incident and if necessary, the subsequent evacuation from the installation and the ultimate rescue of personnel in the arctic environment;
- e) be designed and activated during operations in response to an emergency or during training and drills, ensuring continuous protection for all installation personnel in the arctic environment from any credible incident.

The EER system design shall be:

- a) robust and capable of responding to changing conditions in an emergency;
- b) deployed without any significant degradation in performance due to the arctic physical environment.

Management of the EER system shall be kept under close management review on an ongoing basis.

6.2 Human and hardware performance in EER

When developing the EER design basis, the following shall be considered:

- a) hardware performance and integrity;
- b) human performance, including performance under the stressors of life-threatening conditions, harsh arctic environment.

Reliabilities of both EER hardware and human performance, under the design arctic environmental conditions and credible incident scenarios, shall be assessed and determined to be acceptable.

Performance-based provisions shall be specified, taking into account the arctic environment and remoteness. Verifiable attributes or benchmarks which provide qualitative levels or quantitative measures of performance shall be achieved. Performance targets shall be developed in the context of a design safety case. Performance targets shall be verified before start-up of operations.

7 Physical environment

7.1 General physical environment

An assessment shall be made of the physical environment's influence on the EER system through the stages of design, operations and decommissioning.

Metocean, ice and seabed data used to design and support operation of the EER system shall be in accordance with ISO 35106.

Where deemed applicable to the EER design basis, the following impacts shall be taken into account:

- a) physical environmental conditions on ice management in accordance with ISO 35104;
- b) environmental conditions on ice management and the forecasting and monitoring of physical environmental conditions in accordance with ISO 35104.

7.2 Physical environmental conditions — Design

The EER system shall be designed to achieve a consistent level of safety and effective operation throughout the complete range of physical environmental conditions (i.e. climatic, ocean and ice) expected for a given location over the design service life of the installation.

Physical environmental conditions studied shall include, but not be limited to, the following factors and any associated issues affecting the performance and reliability of the EER system:

- a) atmospheric parameters (e.g. daylight, visibility, precipitation, geomagnetic storms — potential impact on communications relied upon during EER);
- b) wind, including wind speed, direction and chill;
- c) air and sea water temperatures;
- d) water depth, tides, storm surge, including sea level and long-term sea level fluctuations, and currents (e.g. local residual wind-driven and tidal);
- e) sea state (e.g. wave height, wave period, wave direction, including ice-wave combinations);
- f) tsunami (e.g. seismic sea waves or waves resulting from glacier calving);
- g) snow and ice accretion (e.g. marine and atmospheric icing);
- h) ice parameters in accordance with ISO 35104;
- i) coastal and nearshore considerations as applicable.

Arctic environmental condition data used in the quantitative assessment of the EER system risk and reliability under applicable environmental conditions shall be evaluated for statistical variability. Appropriate measures of variability (e.g. standard deviation, mode, mean values) shall be incorporated in the EER risk calculations, to provide measures of the variability of the risk results.

Changes in climatic conditions (e.g. sea ice extent, thickness and drift) that could occur during the expected installation operating service life, including the decommissioning phase, and that could adversely impact performance and/or reliability of the EER system shall be taken into consideration.

7.3 Physical environmental conditions — Operations

The offshore installation operator shall have the means and competency for evaluating risk associated with the arctic physical environmental conditions on the operational performance and/or reliability of the EER system.

8 Escape, evacuation and rescue hazard identification and risk analysis — Design and operations

8.1 General

Risk assessments shall be performed in accordance with ISO 31000, ISO 17776 and ISO 15544, related to the processes of risk analysis, hazard identification and requirements for emergency response.

8.2 General HAZID and risk analysis

The EER system consists of the equipment and procedures for EER, including the entire hierarchy of preferred, primary, secondary and tertiary evacuations, and any other levels of systems. The HAZID, QRA and qualitative risk analyses shall be:

- a) performed in the context of EER for hardware, procedures and personnel;
- b) performed for the phases of the offshore operation during which time personnel can be exposed to hazards;
- c) fully documented, typically in a design HSE case, in an auditable decision record for the EER system.

The authority having jurisdiction might have specific requirements on the scope of the HAZID and risk analysis methodologies to use.

Operability criteria for the EER system choices with respect to escape routes, TR, muster locations, choice of evacuation systems and their locations and safe havens for different physical environmental and incident conditions, shall be documented. This documentation allows effective decisions to be taken as to which method to use in an emergency under the prevailing environmental conditions.

ARTC and SRTC shall:

- a) be set by the operator and/or installation owner prior to conducting the HAZID and risk analyses;
- b) apply to all phases of the operation and EER procedures that pose hazards to personnel;
- c) be maintained and updated periodically throughout the service life of the facility and whenever there are changes in the operation.

The owner shall ensure that EER system ARTC and SRTC, which are performance-based standards, are:

- a) established at the earliest stages of design for all phases of the installation design service life;
- b) coordinated with other interrelated ER performance-based standards; and
- c) appropriately implemented.

Documented conformity with EER standards shall be available to support ARTC ALARP. Each EER scenario shall be shown to conform to the SRTC demonstration as part of the installation HSE case prior to commencing operations.

The duty holder (owner) shall ensure that:

- a) the equipment provided for the purpose of protecting personnel during the EER process satisfies the SRTC performance-based standards and is maintained in a state of readiness;
- b) the implemented EER measures, associated design and procedure decision processes are documented for the examination (by a competent and independent organization) of the system, comprising:
 - escape (from workplace to the TR or MS);
 - evacuation from MS or TR off installation to beyond hazard zone; and

- rescue, i.e. survival outside the hazard zone off-installation (e.g. in an evacuation craft or on the ice) and recovery to a safe haven such as an SIMV or conventional SBV.

8.3 EER HAZID

HAZID study techniques shall be applied to each component (i.e. equipment and activity) of the EER system and to the system as a whole for all credible hazard scenarios.

EER HAZID studies shall:

- identify and record major incident hazards and their consequences, so far as they can influence the selection of EER system design, components, support services and procedures;
- determine environmental factors that can influence the selection of EER system design, component specifications and support services or affect related procedures;
- establish the safety-critical systems and their elements on which the EER system performance-based standards shall be based;
- establish for each scenario approximate risk levels (context of SRTC and ALARP) for application during ranking of various system design options to achieve or improve the targets;
- provide primary input to QRA which, when undertaken, shall demonstrate that risks to personnel during the EER process meet EER SRTC criteria and are ALARP.

8.4 EER risk analysis

EER risk analyses shall be undertaken to support ALARP demonstrations that are required for installation HSE cases and to demonstrate EER SRTC are met.

Each EER scenario shall be analyzed, considering relevant hazards, environmental conditions, failure mechanisms, controls and safeguards provided to satisfy the SRTC performance-based standards.

9 Continuous assessment

9.1 Continuous assessment — Design

The EER system and its various components shall be assessed at regular intervals throughout the design service life of the offshore installation, from the concept phase to preparation for operation.

To help ensure that EER system integrity is maintained, risk analyses shall be updated for changes impacting the HSE case and/or the assumed or actual external EER resources and their capabilities.

9.2 Continuous assessment — Operations

The EER system and its various components shall be assessed at regular intervals throughout the service life of the offshore installation during operations through to decommissioning.

The installation's EER system and ER organization shall be tested through the implementation of emergency scenario drills and exercises. All deficiencies shall be addressed and mitigated as soon as possible following their detection.

Detailed assessment of evacuation scenarios should include human factors issues relating to environmental conditions and expected emergency rescue time. This is important since it can govern the means of rescue chosen and how it is deployed. For example, it can be deemed necessary to maintain rescue facilities for some installations by using an appropriately equipped rescue vessel in standby mode. This can be the best way to meet a performance-based standard that specifies the emergency response time. The same vessel may be equipped with smaller rescue craft (e.g. fast rescue craft or daughter craft) capable of performing rescue in certain conditions. An adequate place of safety

would include the availability of specific human and physical resources to rescue evacuees and provide necessary medical treatment.

All POB on the installation shall be trained in escape procedures and the use of the evacuation means including any special training required for designated personnel to operate the equipment.

The operator shall ensure that all persons onboard or in transit to/from an installation:

- a) receive appropriate and approved instructions;
- b) are familiar with safety and evacuation procedures;
- c) are taught what their roles and responsibilities are during emergency response.

The impact of any identified deficiencies on the installation's ability to continue operations in a safe manner shall be assessed, as the non-availability of a particular EER system can require a precautionary down-manning of the facility, a restriction of activities or both (e.g. a lifeboat can become damaged or unavailable by the initial hazardous event). Risk assessments should help identify and evaluate credible hazards and put in place mitigating measures and protection strategies.

The operator shall:

- a) establish effective inspection, testing and maintenance operational procedures in accordance with ISO 15544, accounting for the arctic physical environment and remoteness, to help ensure that EER material and equipment are properly maintained;
- b) ensure that all communication methods, passive and active protective measures and personal survival equipment on board are fit for purpose and maintained;
- c) use established performance-based standards and an approved inspection and maintenance program.

The effects of human performance, snow, icing and ambient low temperatures shall be factored into the preventative maintenance procedures of evacuation means.

10 Escape, evacuation and rescue system capabilities

10.1 EER system capabilities — Design

The EER system shall:

- a) be available to all persons on board the installation;
- b) help ensure that, in the event of a potential or actual emergency, installation personnel are protected and can be moved to a safe haven.

The EER system design shall:

- a) be fully integrated within the overall ER system in accordance with the governing principles described in [Clause 6](#);
- b) take into account the assumption that under certain credible incident scenarios, personnel might potentially have to abandon the installation via direct evacuation to the sea/ice cover and possibly without the benefit of external support;
- c) account for the impact that substructure geometry can have on ice, wave and ice/wave combination conditions near the installation, and thus on the performance of evacuation and rescue systems;
- d) account for trap risks created by enclosed areas/winterized work places and impacts on safety exits, escape ways/routes at the very beginning of the design stage and for any modification or upgrade of the installation carried out during its service life.

- e) account for as appropriate:
- ice thickness and strength [e.g. impacts evacuation onto ice and capability required for standby icebreakers (if so equipped)];
 - ice concentration (e.g. impacts manoeuvrability of evacuation and rescue craft);
 - ice drift (e.g. impacts ice encroachment and ice rubble/stamukha generation on the substructure and potentially the evacuation craft landing area);
 - ice deformation (e.g. impacts personnel mobility while on ice);
 - any other ice properties/characteristics that could adversely impact evacuation and/or rescue.

NOTE ISO 35104 provides for full details on ice parameters.

- f) take into consideration winterization requirements;
- g) take into consideration the requirement for regular inspection, maintenance, repair and testing, including functionality readiness assessments.

Installation LSAs exposed to an arctic environment shall be protected from the effects of cold ambient air temperatures, snow accumulation and marine/atmospheric icing to ensure availability when needed.

The EER system on a given installation shall be installed, tested, maintained and operated based on the established performance-based standards.

Power supplies, including emergency power, shall be available to allow all safety-critical equipment to perform its emergency function for the required duration.

Rescue systems shall be compatible with the evacuation system design in the context of the arctic or cold region physical environment to facilitate the safe passage of personnel between the systems.

10.2 EER system capabilities — Operations

Integration of the EER system with the installation's overall ER system shall be regularly assessed.

The design assumptions that the installation's substructure geometry has on ice, wave and ice/wave combination conditions, and thus on the performance of evacuation and rescue systems, shall be verified during operations. In the event that the ice and/or wave environmental conditions are magnified by the substructure to the extent that they are worse than assumed in the design, an EER analysis shall be performed to identify appropriate mitigating actions and measures.

The functionality of EER hardware and appropriateness of procedures shall be assessed during operations. Mitigations shall be taken to address any significant deficiencies.

Inspections of LSAs exposed to arctic conditions shall be undertaken on a regular basis and more frequently in response to cold temperatures, icing events and snowstorms.

The operator shall ensure that all personnel on-board the installation, as well as those supporting the EER plan off the installation:

- a) are provided with appropriate training;
- b) are familiar in the use of the evacuation and rescue systems;
- c) are familiar with the emergency procedures under both precautionary and emergency incident scenarios.

11 Emergency response organization

11.1 ERO — Design

The ERO shall be developed based on the assessments, philosophy and design basis described in this document and in accordance with ISO 15544.

In the design stage, the installation ERO shall be documented and summarized (e.g. in a station bill) for posting at strategic locations throughout the installation.

The installation's ERO and associated command structure shall be dimensioned to meet the performance requirements for all credible hazard and incident scenarios.

The need for back-up ER personnel shall be assessed. If deemed necessary, a plan shall be developed that addresses the risk of fatigue during an emergency.

11.2 ERO — Operations

The installation's ERO and associated command structure shall meet the performance requirements under all credible incident scenarios.

The installation's ERO shall be tested in the implementation of emergency scenario drills as described in [16.2](#), [17.2](#) and [18.2](#). Deficiencies identified shall be addressed as soon as possible following their detection.

The ERO shall be updated as necessary throughout the installation life-cycle and current versions posted at strategic locations on board.

When developing the ERO, personnel fatigue shall be addressed, taking into account the planned organization, the tasks assigned and associated fatigue related to working in an arctic offshore environment.

If a person is expected to fill more than one ERO role, an assessment shall be performed to ensure that the assigned roles are not in conflict; i.e. the person does not have to simultaneously carry out multiple duties or be in two different locations at the same time.

Interfaces between the installation's ERO and external organizations/resources shall be:

- a) clear and unambiguous;
- b) understood by the organizations involved in providing ER support.

12 Competency assurance

12.1 Competency assurance — Design

The installation design shall provide for testing the EER system in a realistic manner through a year-round systematic programme of emergency scenario drills with specific pre-planned learning objectives. This helps to ensure that the installation tests and assesses EER performance in arctic conditions of cold weather, ice, snow and extended darkness. The risks associated with the drills should be assessed. Those risks that pose undue risks should be modified so that the drills do not pose undue risks.

The EER system shall be designed so that it does not pose hazards to the safety of personnel undertaking emergency scenario drills. Realistic scenarios shall be planned that adequately test individuals' competencies without exposing them to prolonged cold temperatures and/or other undue hazards.

12.2 Competency assurance — Operations

Individuals, including their deputies/back-ups, responsible for emergency duties shall undergo periodic qualification and competency assessments that apply their training, experience and knowledge to carry out the tasks for which they are responsible. Where practical, the assessment shall be carried out under realistic simulated conditions, either individually or with the appropriate EER team throughout the year (e.g. open water season, shoulder season and when ice is present, to account for the different cold-climate condition seasonal challenges).

Key persons in the ERO shall be proven competent to perform their emergency duties before they are appointed. These key persons shall have the necessary regulatory and company attestation, including pertinent knowledge of the arctic environment, to perform their roles before taking on that responsibility offshore.

For normally manned installations, sufficient competent personnel shall be present on the installation at all times to carry out the required emergency duties year-round, including the operation of equipment specifically provided for emergencies.

The required level of competence shall be assessed for:

- a) the general installation workforce;
- b) installation personnel having specific emergency duties;
- c) senior staff in the company's organization, including the person in charge overall;
- d) personnel on other installations or vessels (if part of the ERP) onshore who have an ER role;
- e) any personnel having a specialized role (e.g. ice forecaster), if applicable.

Individual competencies shall be periodically evaluated to determine whether further training and knowledge is required to allow them to effectively perform their ER duties associated with EER. The ERO relating to EER shall include the measures to be taken to maintain this competence by, for example, the conduct of emergency scenario drills and refresher training.

So far as practical, the ERO for EER shall reflect the organization used in normal operating conditions. In this way, EER is emphasized as a responsibility embodied in the normal management structure. In the case of non-routine activities, such as combined operations with a crane barge or flotel, an alternative organization for EER might be appropriate.

The training and competency assurance system shall help ensure redundancy of trained personnel (e.g. by means of a deputy system), demonstrating a level of competence equivalent to the primary person whom they need to replace.

The operator shall ensure that all installation POB:

- a) are adequately familiar with the operator's safety management system, including the emergency EER response plans and hardware systems;
- b) are adequately trained and competent in accordance with their safety and ER-related responsibilities and duties.

Personnel shall be given appropriate installation-specific EER training for arctic regions and/or drills (i.e. for the use of the LSAs and PPE carried aboard the installation). Competency of personnel shall be maintained and regularly tested. Installation-specific training shall take into account the open water, shoulder- and ice-season operating environments. Installation-based training shall include any specialist training required for designated personnel to operate the equipment.

A systematic programme of emergency scenario drills with specific pre-planned learning objectives shall be implemented in a realistic manner as described in [16.2](#), [17.2](#) and [18.2](#).

Operational reviews by qualified personnel shall be conducted to help ensure that the EER system does not pose hazards to the safety of personnel undertaking drills during any season of the year.

Competency assurance in the use of PPE shall be evaluated at regular intervals. This is especially with reference to cold weather clothing appropriate for the lowest temperatures likely to be encountered and the effects that wearing bulky clothing/mittens can have on the ability to operate equipment and permit ease of movement around the installation (e.g. during escape) and in evacuation craft. Where deficiencies are identified, a corrective action plan shall be developed and implemented.

If weapons or hazing devices are required as part of the EER plan for protection from wildlife when evacuating to the ice or while awaiting rescue, training in their safe use, storage and maintenance shall be provided. Designated user competency related to weapons or hazing devices shall be assessed.

13 Communications and alarms

13.1 Communications and alarms — Design

The communication and alarm system shall be designed to operate (within the operational network offshore, onshore, on SBV support if applicable, and on-board the installation) under all credible emergency scenarios, taking into account geography, distance from the shore base and the arctic physical environment. The communication system design shall include the capability to communicate from the TR/CCR with standby and service vessels, helicopters, shore base and nearby installations and any other location deemed necessary as identified in the EER plan.

PA announcements, visual and audible communications, including external communications (e.g. with standby/icebreaker/service vessels, helicopters, shore base, nearby installations and any other location deemed necessary as identified in the EER design basis) shall be operable from the TR/CCR and wherever identified as necessary.

The alarm system design shall include the capability to make PA announcements, visual and audible communications from the TR and any other location deemed necessary as identified in the EER plan.

Redundant communication and alarm systems that are capable of functioning in cold-climate conditions shall be available for use in the event that the primary communication system fails.

The need for intrinsically safe communication systems shall be assessed in the EER system design and verified in the EER analysis.

The number and location of visual and audio alarms specified in the design shall be verified in the EER analysis and revised as appropriate.

The plan for communication with personnel working in normally unmanned locations, including unheated spaces, shall be assessed and addressed.

EER system design shall allow for assessing off-installation environmental conditions (i.e. ice conditions, wave state, wind speed and direction) from the TR for those installations requiring the information as part of the EER plan.

The design shall allow for communication between the MS and incident responders following a general or abandonment alarm for the duration of the incident or until installation abandonment has been completed.

Emergency information, signage and auditory systems shall account for language/culture differences and be strategically located throughout the EER system.

Key components of the EER system (e.g. escape routes, evacuation boarding areas, TR) as determined by the EER analysis shall be illuminated for the required duration to facilitate carrying out EER functions regardless of the season.

Communication and alarm systems shall be operable with back-up emergency power systems in addition to the main installation power. The provision for battery back-up shall be assessed as part of the EER analysis. If battery back-up is deemed necessary, the impact of cold temperatures on communication and alarm systems' battery life shall be accounted for in the design.

The design shall account for powered, photoluminescent and retroreflective signs, as appropriate, located on open decks to function normally within the arctic design low temperature and anticipated snow and ice accumulation/accretion. If de-icing protection is not suitable, signs shall be equipped with anti-ice accretion protection to help ensure that they will not be damaged.

Audible alarm devices and loudspeakers and visible alarm devices located in open spaces and unheated compartments shall:

- a) function normally at the lowest design temperature;
- b) be equipped with anti-icing protection, if necessary, to help ensure that they will not be damaged or their functionality compromised due to icing and snow accumulation;
- c) be protected against mechanical damage caused by manual de-icing/snow removal measures, in cases where manual de-icing and snow removal is employed, including signage.

13.2 Communications and alarms — Operations

Regular inspections and testing of all auditory and visual, including illumination, communication systems required to support EER shall be carried out in accordance with the manufacturer's or owner's, whichever is more onerous, preventative maintenance and inspection schedule.

The inspection frequency shall take into account the impact of cold-climate conditions (i.e. cold temperature, icing and snow) on communications and alarm system functionality.

Necessary repairs and upgrades shall be effected in a timely manner regardless of the season, to help ensure that communications and alarm equipment is kept in good working order throughout the installation service life.

Functionality of the communication systems, including the emergency power supply required to support EER, shall be tested and validated during the conduct of emergency scenario drills carried out throughout the year as described in [16.2](#), [17.2](#) and [18.2](#).

Powered, photoluminescent and retroreflective signs located on open decks shall be kept free of snow and ice. The effectiveness of snow and ice removal preventative maintenance shall be assessed. Powered, photoluminescent and retroreflective signs shall be protected against mechanical damage caused by manual de-icing and snow removal.

In cases when communications and/or alarms are temporarily out of service for maintenance and/or repair, either measures shall be implemented to temporarily duplicate their functions or work activities shall be restricted until such time as repairs are effected and system functionality restored.

14 Personal protective equipment (PPE)

14.1 PPE — Design

The need for, the quantity, types and storage locations of PPE shall be determined in the EER analysis.

NOTE ISO 35101 provides general guidance on PPE.

PPE deployment locations shall include the living quarters, TR and other strategic areas.

Evacuee PPE shall include devices to facilitate evacuee movement from the sea to the ice (if required by the EER analysis).

If evacuation onto the ice is part of the EER design basis, the PPE shall include appropriate thermal protection and proper footwear with suitable traction to aid in the traverse over ice and snow to facilitate rescue.

Consideration shall be given to providing thermal protection for injured parties (i.e. stretcher cases) that might not be physically able to don an immersion suit.

Externally stored PPE shall be capable of withstanding the lowest design temperature as well as snow and ice accumulations. The requirement for heated storage areas shall be assessed.

PPE performance shall provide adequate protection under cold-climate conditions.

The need for weapons or hazing devices for protection against wildlife risks shall be assessed.

14.2 PPE — Operations

PPE shall be regularly inspected, maintained, upgraded as deemed necessary and donned during drills. Equipment whose expiry date has elapsed or which has been damaged, shall be replaced or refurbished and recertified at the first opportunity.

The condition of PPE stored on deck shall be assessed periodically to confirm its availability to support EER.

Immersion suits and lifejackets shall be stored in locations (e.g. heated storage lockers on exposed decks, inside heated spaces such as the TR/quarters/command centre), conducive to maintaining suit pliability when donning. Provisions to help ensure that immersion suits and lifejackets exposed to cold climate conditions maintain sufficient pliability shall be regularly assessed.

The MOB recovery ER crew shall have dedicated PPE specific to that task readily available for rapid donning in the event of an emergency requiring launch of the MOB recovery craft.

15 Man overboard recovery

15.1 MOB recovery — Design

The installation and/or SBV or SIMV shall have redundant means to recover a MOB, including injured personnel, under the anticipated incident and arctic physical environmental conditions. Redundant MOB boat systems also require redundant launching arrangements.

A performance-based standard that establishes a target recovery time shall be developed for the design that results in a high probability of successfully rescuing personnel from the sea/partial ice cover in the environmental conditions specified in the EER analysis.

Where utilized as part of the MOB plan, a rescue craft shall meet the LSA Code if applicable local regulations are less stringent.

15.2 MOB recovery — Operations

MOB drills shall be carried out periodically to validate the performance-based standard including responder competency, to verify that the target retrieval times are met and to validate the adequacy of hardware capabilities under the arctic physical environmental conditions anticipated.

Off-installation support (e.g. SIMV/SBV, shore base resources if relied upon) shall be considered as part of the MOB response plan when carrying out MOB drills.

16 Escape

16.1 Escape — Design

16.1.1 General escape — Design

Escape system design shall consider communications and alarms, escape routes, TR (if so equipped), MS and PPE locations and quantities and their integrated function in the escape process.

Escape system design shall:

- a) help ensure that all parts of the escape system are fully functional in the physical environmental conditions, including cold temperatures, darkness, icing, snow accumulations and remoteness or malfunction due to low ambient air conditions;
- b) be documented, specifying the types of equipment, their capacities and arrangements and how the design meets the associated performance-based standards.

Provisions for medical first-aid shall be available at TRs and MSs. First-aid provisions shall be protected from the effects of freezing, snow and marine/atmospheric icing.

16.1.2 Escape routes — Design

An escape route impairment analysis shall be performed as part of the EER analysis to help ensure that personnel can safely leave all normally manned work spaces in the case the incident causes a blockage of one of the routes. The impairment analysis shall take into account the aspects of escape route impairment from relevant incident scenarios, including arctic conditions that can hamper and delay the escape process (e.g. snow, ice, winds, darkness).

Escape routes design shall:

- a) account for impairment associated with hazards, to help ensure that personnel can safely move from any part of the installation via at least one safe route to the TR or MS under all credible incident, physical environmental and operational conditions;
- b) be obstruction free and reduce the risks of tripping and falling;
- c) provide sufficient width for the safe and unobstructed passage of the maximum estimated number of personnel expected to move through the escape route without creating bottlenecks, including the ability to manoeuvre injured personnel on stretchers;
- d) ensure that personnel traffic moves in one direction and does not allow personnel flow to join from the opposite direction, unless needed due to hazard avoidance.

Escape routes, stairways, ladders and landings shall be sized to take into account bulky cold-weather PPE and to maximize the flow of personnel in an emergency. Exit doors, stairways and ladders shall be appropriately designed, taking into account icing and/or snow accumulations and the direction of escape.

The escape system shall be implemented and maintained in accordance with the documented design.

Wind socks or other types of wind direction indicators (e.g. signs, PA announcements) shall be available to assist personnel in selecting the appropriate escape route.

Sealed/enclosed or semi-enclosed escape ways (e.g. stairways and tunnels) designed to protect against the outside environment shall minimize the potential for smoke and gas ingress in their design through properly dimensioned and purpose-made ventilation/dilution/sealing solutions.

Both visual signage and audio communications shall be provided to clearly designate all escape routes, including any turns, stairs, ladders or any other changes along each route. Escape routes shall be well marked and illuminated by emergency lighting leading to the TR, including signs or other visuals that clearly show the preferred direction of escape. Signs shall be designed to remain visible in the physical

environmental conditions, including extended darkness, icing, snow and dense fog and for situations where loss of central power can occur. Ice accretion and snow build-up shall be taken into account in the escape routes design.

Escape routes shall be designed:

- a) free of obstructions to reduce the risks of tripping and falling when visibility can be reduced due to congestion and flow of people;
- b) to minimize the accumulation of snow and icing, in which permanent engineered solutions is preferred over temporary operational or procedural solutions. In case the latter, the EER plan can include procedures to remove snow and ice along the escape route so that escape performance is not negatively impacted, in the case an incident occur;
- c) with sufficient drainage to remove melt and wash water. If deemed necessary, drainage systems shall be provided with anti-freezing protection to help ensure that they are not blocked or impaired by internal freezing.

The need for adding heat to walkways and hand rails shall be assessed in the design.

Door handles and means of quick release located outside the heated compartments shall be designed to function under the cold-climate conditions, particularly low temperatures, snow accumulation, atmospheric and sea spray icing. The need for ice removal protection provisions shall be assessed. Ice accretion protection measures shall not impose any additional ergonomic challenges for users.

Hand rails and other handholds located on outdoor spaces shall be fully functional in cold climate conditions at all times. If necessary, they shall be equipped with active ice build-up prevention protection. Ice build-up prevention protection measures shall not impose any additional ergonomic challenges.

The surface coating of decks, walkways, platforms, stairs, ladder rungs, etc. exposed to the arctic environment and/or operations shall remain non-slip under expected environmental and operational conditions.

When designing evacuation routes for floating installations requirements of the IMO International Convention for the Safety of Life at Sea, 1974 (SOLAS 74), Chapter II, Part D, Evacuation, Regulation 13, Evacuation routes, shall be used for design.

16.1.3 TR — Design

At least one TR shall be provided, except where the EER analysis or risk assessments demonstrate that none is required.

The TR shall act as a safe haven providing protection to installation personnel from any incident and physical environment effects for a time sufficient to allow control of the emergency or until a decision is made to abandon the installation.

The TR shall be located as far as reasonably practical from hazardous zones.

The length of time that a TR is rated to withstand the effects of any incident (i.e. the TR impairment time) shall be sufficient to allow muster and evacuation plus a safety margin. The TR impairment time shall take into account the possibility of longer evacuation times (e.g. due to challenging ice conditions).

A TR impairment analysis shall be performed as part of the EER analysis, taking into account:

- a) the aspects of impairment including ice and other physical environmental conditions that can delay evacuation;
- b) the time required to assess the incident;
- c) the time required to complete the evacuation process.

The TR shall have stored and available air supply sufficient for the maximum POB expected for the requisite time.

The TR design shall prevent or avoid impairment due to cold temperatures, icing, snow accumulation or other physical environmental conditions, to the extent possible.

The TR HVAC system inlet design shall account for the effects on functionality of marine and atmospheric icing and snow accumulation.

Power to the TR shall be supplied by the main source and backed up by the emergency power supply.

Passive fire protection materials, if used in the TR design, shall account for environmental and operational conditions (factors), including extreme low temperature, marine and atmospheric icing, snow accumulation and manual ice removal measures, if planned.

Where required by the EER analysis, the TR shall be a single location in which other structures provide protection from the drilling operation, process events, helicopter incidents and falling structures or large objects, as applicable.

The primary TR shall have sufficient capacity for the maximum permitted POB. If the main installation control point is not in the TR, then an ECP should be located in the TR. Similarly, if the main installation radio room is not part of the primary TR, there shall be an emergency radio point located within the TR.

The TR design shall:

- a) have minimal door openings, generally equipped to maintain positive pressure relative to the outside environment and have a back-up air supply;
- b) secure communications, command and control facilities;
- c) have sufficient space for assembling, donning arctic PPE and evacuating to the embarkation area.

Where a secondary TR is deemed necessary by the EER analysis, it shall be subordinate to the main TR. A secondary TR shall have an independent means of evacuation as determined by an EER analysis. Secondary TRs shall be able to accommodate all individuals potentially isolated from the primary TR, plus a contingency, as determined by the EER analysis. A means of communication between the two TRs shall be available.

16.1.4 MS — Design

As determined by the EER analysis, strategically located MS(s) shall be present, which:

- a) have dimensions that can accommodate the maximum anticipated POB;
- b) provide protection from the physical effects of the arctic environmental and incident conditions;
- c) provide sufficient space for bulky cold-climate condition clothing/immersion suits and other PPE that personnel will be wearing and/or will need to don at the MS.

When dimensioning MSs, consideration shall be given to accommodating injured personnel on stretchers, as well as extra personnel who have arrived by helicopter in the event the helicopter cannot depart, personnel on the installation from an SIMV or other vessel and visitors.

The MS shall be provided with emergency lighting sufficient for the entire period for which personnel might have to use the area.

Appropriate facilities for internal and external communication to cover emergency communication demands shall be provided in muster areas.

If deemed necessary by the EER analysis, alternative MSs shall provide protection from the effects of the incident and environment for a period of time sufficient to allow control of an emergency or until a decision is made to abandon the installation.