



SLOVENSKI STANDARD

kSIST-TS FprCEN ISO/TS 16901:2025

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Navodilo za oceno tveganja pri načrtovanju napeljav za utekočinjeni zemeljski plin na kopnem, vključno s povezavo med ladjo in kopnim (ISO/TS 16901:2022)

Guidance on performing risk assessment in the design of onshore LNG installations including the ship/shore interface (ISO/TS 16901:2022)

Leitfaden zur Durchführung von Risikobewertungen bei der Planung von LNG-Anlagen an Land, einschließlich der Schnittstelle zwischen Schiff und Land (ISO/TS 16901:2022)

Recommandations sur l'évaluation des risques dans la conception d'installations terrestres pour le GNL en incluant l'interface terre/navire (ISO/TS 16901:2022)

Ta slovenski standard je istoveten z: FprCEN ISO/TS 16901

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Guidance on performing risk assessment in the design of onshore LNG installations including the ship/ shore interface

*Recommandations sur l'évaluation des risques dans la conception
d'installations terrestres pour le GNL en incluant l'interface terre/
navire*

ITeH Standards

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 67, *Oil and gas industries including lower carbon energy*, Subcommittee SC 9, *Production, transport and storage facilities for cryogenic liquefied gases*.

This second edition cancels and replaces the first edition (ISO/TS 16901:2015), which has been technically revised.

The main changes are as follows:

- reference to IGF code added to the scope;
- references updated in [Clause 2](#) and the bibliography;
- definitions added for HSE critical activity and HSE critical element.

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.

Guidance on performing risk assessment in the design of onshore LNG installations including the ship/shore interface

1 Scope

This document provides a common approach and guidance to those undertaking assessment of the major safety hazards as part of the planning, design, and operation of LNG facilities onshore and at shoreline using risk-based methods and standards, to enable a safe design and operation of LNG facilities. The environmental risks associated with an LNG release are not addressed in this document.

This document is applicable both to export and import terminals but can be applicable to other facilities such as satellite and peak shaving plants.

This document is applicable to all facilities inside the perimeter of the terminal and all hazardous materials including LNG and associated products: LPG, pressurized natural gas, odorizers, and other flammable or hazardous products handled within the terminal.

The navigation risks and LNG tanker intrinsic operation risks are recognised, but they are not in the scope of this document. Hazards arising from interfaces between port and facility and ship are addressed and requirements are normally given by port authorities. It is assumed that LNG carriers are designed according to the IGC code, and that LNG fuelled vessels receiving bunker fuel are designed according to IGF code.

Border between port operation and LNG facility is when the ship/shore link (SSL) is established.

This document is not intended to specify acceptable levels of risk; however, examples of tolerable levels of risk are referenced.

See IEC 31010 and ISO 17776 with regard to general risk assessment methods, while this document focuses on the specific needs scenarios and practices within the LNG industry.

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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO Guide 73 and the following apply.

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

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

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3.1

as low as reasonably practicable

ALARP

reducing a *risk* (3.28) to a level that represents the point, objectively assessed, at which the time, trouble, difficulty, and cost of further reduction measures become unreasonably disproportionate to the additional risk reduction obtained

3.2

boiling liquid expanding vapour explosion

BLEVE

sudden release of the content of a vessel containing a pressurized flammable liquid followed by a fireball

Note 1 to entry: This hazard is not applicable to atmospheric LNG tanks, but to pressurized forms of hydrocarbon storage.

[SOURCE: ISO/TS 18683, 3.1.2, modified — Note to entry added.]

3.3

bow-tie

pictorial representation of how a hazard can be hypothetically released and further developed into a number of *consequences* (3.6)

Note 1 to entry: The left-hand side of the diagram is constructed from the fault tree (causal) analysis and involves those threats associated with the hazard, the controls associated with each threat, and any factors that escalate likelihood. The right-hand side of the diagram is constructed from the hazard event tree (consequence) analysis and involves escalation factors and recovery preparedness measures. The centre of the bow-tie is commonly referred to as the “top event”.

3.4

cost to avert a fatality

CAF

value calculated by dividing the costs to install and operate the protection/mitigation (3.20) by the reduction in *potential loss* (3.22) of life (PLL)

Note 1 to entry: It is a measure of effectiveness of the protection/mitigation.

3.5

computational fluid dynamics

CFD

numerical methods and algorithms to solve and analyse problems that involve fluid flows

3.6

consequence

outcome of an event

3.7

cost benefit analysis

CBA

means used to assess the relative cost and benefit of a number of *risk* (3.28) reduction alternatives

Note 1 to entry: The ranking of the risk reduction alternatives evaluated is usually shown graphically.

3.8

design accidental load

DAL

most severe accidental load that the function or system is able to withstand during a required period of time, in order to meet the defined *risk* (3.28) acceptance criteria

3.9**explosion barrier**

structural barrier installed to prevent explosion damage in adjacent areas

EXAMPLE A wall.

3.10**F/N curve****FN**

plot of cumulative frequency versus N or more persons that sustain a given level of harm from defined sources of hazards

3.11**failure mode and effect analysis****FMEA**

analytically derived identification of the conceivable equipment failure modes and the potential adverse effects of those modes on the system and mission

Note 1 to entry: It is primarily used as a design tool for review of critical components.

3.12**fatal accident rate****FAR**

number of fatalities per 100 million hours exposure for a certain activity

3.13**harm**

physical injury or damage to the health of people or damage to property or the environment

3.14**hazard**

potential source of *harm* (3.13)

3.15**hazard identification****HAZID**

brainstorming exercise using checklists the hazards in a project are identified and gathered in a *risk register* (3.39) for follow up in the project

3.16**hazard and operability study****HAZOP**

systematic approach by an interdisciplinary team to identify hazards and operability problems occurring as a result of deviations from the intended range of process conditions

Note 1 to entry: It consists of four steps: definition, preparation, documentation/follow up and examination to manage a hazard completely.

3.17**health, safety and environmental critical activity****HSE critical activity**

activity or task that provides or maintains barriers

3.18**health, safety and environmental critical element****HSE critical element**

component or system whose failure could cause or substantially contribute to the loss of integrity and safety of a system and whose purpose is to prevent or mitigate from the effects of hazards

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3.19

impact assessment

assessment of how *consequences* (3.6) (fires, explosions, etc.) do affect people, structures the environment, etc.

3.20

mitigation

limitation of any negative *consequence* (3.6) of a particular event

3.21

Monte Carlo simulation

simulation having many repeats, each time with a different starting value, to obtain distribution function

3.22

potential loss

product of frequency and *harm* (3.13) summed over all the outcomes of a number of top events

3.23

probability

extent to which an event is likely to occur

3.24

probit

inverse cumulative distribution function associated with the standard normal distribution

Note 1 to entry: Probit is used in QRA to describe the relation between exposure, e.g. to radiation or toxics, and fraction fatalities.

3.25

protective measure

means used to reduce risk

3.26

quantitative risk assessment

QRA

techniques that allow the *risk* (3.28) associated with a particular activity to be estimated in absolute quantitative terms rather than in relative terms such as high or low

Note 1 to entry: QRA may be used to determine all risk dimensions, including risk to personnel, risk to the environment, risk to the installation, and/or the assets and financial interests of the company. See ISO 17776:2016, B.12.

3.27

residual risk

risk (3.28) remaining after *protective measures* (3.25) have been taken

3.28

risk

combination of the *probability* (3.23) of occurrence of *harm* (3.13) and the severity of that harm

3.29

risk analysis

systematic use of information to identify sources and to estimate the *risk* (3.28)

3.30

risk assessment

overall process of *risk analysis* (3.29) and *risk evaluation* (3.33)

3.31
risk contour
RC

two-dimensional representation of *risk* (3.28) on a map

Note 1 to entry: Also called individual risk contours (IRC) or location-specific risk (LSR).

3.32
risk criteria

terms of reference by which the significance of *risk* (3.28) is assessed

3.33
risk evaluation

procedure based on the *risk analysis* (3.29) to determine whether the *tolerable risk* (3.47) has been achieved

3.34
risk management

coordinated activities to direct and control an organization with regard to *risk* (3.28)

3.35
risk management system

set of elements of an organization's management system concerned with managing *risk* (3.28)

3.36
risk matrix

matrix portraying *risk* (3.28) as the product of *probability* (3.23) and *consequence* (3.6), used as the basis for risk determination

Note 1 to entry: Considerations for the assessment of probability are shown on the horizontal axis. Considerations for the assessment of consequence are shown on the vertical axis. Multiple consequence categories are included: impact on people, environment, assets, and reputation. Plotting the intersection of the two considerations on the matrix provides an estimate of the risk.

3.37
risk perception

way in which a *stakeholder* (3.46) views a *risk* (3.28) based on a set of values or concerns

3.38
risk ranking

outcome of a qualitative *risk analysis* (3.29) with a numerical annotation of *risk* (3.28)

Note 1 to entry: It allows accident scenarios and their risk to be ranked numerically so that the most severe risks are evident and can be addressed.

3.39
risk register

hazard management communication document that demonstrates that hazards have been identified, assessed, are being properly controlled, and that recovery preparedness measures are in place in the event control is ever lost

3.40
risk transect
RT

representation of *risk* (3.28) as a function of distance from the hazard

3.41
rollover

sudden mixing of two layers in a tank resulting to a massive vapour generation

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3.42 rapid phase transition RPT

explosive change from liquid into vapour phase

Note 1 to entry: When two liquids at two different temperatures come into contact, explosive forces can occur, given certain circumstances. This phenomenon, called rapid phase transition (RPT), can occur when LNG and water come into contact. Although no combustion occurs, this phenomenon has all the other characteristics of an explosion. RPTs resulting from an LNG spill on water have been both rare and with relatively limited consequences (3.6).

3.43 safety

freedom from unacceptable *risk* (3.28)

3.44 SIMOPS

concatenation of simultaneous operations

Note 1 to entry: SIMOPS often refers to events such as maintenance or construction work in an existing plant when there are more personnel near a live operating plant and who are exposed to a higher level of *risk* (3.28) than normal.

3.45 showstopper

event or *consequence* (3.6) that produces an unacceptable level of *risk* (3.28) such that the project cannot proceed and where the level of risk cannot be mitigated to an acceptable level

3.46 stakeholder

individual, group, or organization that can affect, be affected by, or perceive itself to be affected by a *risk* (3.28)

3.47 tolerable risk

risk (3.28) that is accepted in a given context based on the current values of society

3.48 individual risk

probability of being killed (or harmed at certain level) on an annual basis from all *hazards* (3.13)

3.49 potential loss of life

expected value of the number of fatalities per year (or over the life time of a project)

4 Abbreviated terms

| | |
|-------|---|
| ALARP | as low as reasonably practicable |
| BLEVE | boiling liquid expanding vapour explosion |
| CAF | cost to avert a fatality |
| CFD | computational fluid dynamics |
| CBA | cost benefit analysis |
| DAL | design accidental load |
| EDP | emergency depressuring |