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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 9, Liquefied natural gas installations and equipment.

A list of all parts in the ISO 20257 series can be found on the ISO website.

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

This document addresses specific issues related to floating LNG storage and regasification units (FSRU) and supplements the general requirements for floating LNG installations as provided in ISO 20257-1.
Installation and equipment for liquefied natural gas - Design of floating LNG installations —

Part 2: Specific FSRU issues

1 Scope

This document provides specific requirements and guidance for the design and operation of floating LNG storage and regasification unit (FSRU) as described in ISO 20257-1.

This document is applicable to offshore, near-shore or docked FSRU and applies to both new-built and converted FSRU.

This document includes jetty in the case of mooring to of an FSRU.

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.


AGA 9, Measurement of Gas by Multipath Ultrasonic Meters

AGA 10, Speed of Sound in Natural Gas and Other Related Hydrocarbon Gases

EN 1776, Gas infrastructure — Gas measuring systems — Functional requirements

EN 12186, Gas infrastructure — Gas pressure regulating stations for transmission and distribution - Functional requirements

EN 14382, Safety devices for gas pressure regulating stations and installations — Gas safety shut-off devices for inlet pressures up to 100 bar

IEC 61508 (all parts), Functional safety of electrical/electronic/programmable electronic safety-related systems

IEC 61511 (all parts), Functional safety — Safety instrumented systems for the process industry sector

ISO 5168, Measurement of fluid flow — Procedures for the evaluation of uncertainties

ISO 6976, Natural gas — Calculation of calorific values, density, relative density and Wobbe indices from composition

ISO 8943, Refrigerated light hydrocarbon fluids — Sampling of liquefied natural gas — Continuous and intermittent methods


ISO 12213-2, Natural gas — Calculation of compression factor — Part 2: Calculation using molar-composition analysis
3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 20257-1:2020 and the following 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

3.1.1 fiscal metering
metering aimed to define the quantity and financial value of hydrocarbon product transaction

3.1.2 custody transfer
physical transfer of hydrocarbon product which results in change in ownership and/or a change in responsibility

3.2 Abbreviated terms

ALARP as low as reasonably practicable
BOG boil-off gas
CLV closed loop vaporizer
CW cold water
DFDE dual fuel diesel engine
EDS emergency disconnection system
ERC emergency release coupling
ESD emergency shut down
FSRU floating storage and regasification unit
GCU gas combustion unit
HAZOP hazard and operability (study)
ISO/DIS 20257-2:2020(E)

HD  
HIPPS  
HP  
HVAC  
HW  
IFV  
IR  
LD  
LNG  
LP  
MAC  
MOP  
MSO  
NG  
NPSH  
OEM  
OLV  
ORV  
QRA  
RAM  
SCV  
SIL  
SIS  
SW  
UV

high duty
high integrity pressure protection system
high pressure
heating, ventilation and air conditioning
hot water
intermediate fluid vaporizer
infrared
low duty
liquefied natural gas
low pressure
manual alarm call
maximum operating pressure
minimum send out
natural gas
net positive suction head
original equipment manufacturer
open loop (direct contact) vaporizer
open rack vaporizer
quantitative risk analysis
reliability, availability, maintainability
submerged combustion vaporizer
safety integrity level
safety instrumented system
sea water
ultraviolet

4  Basis of design

4.1  General description of FSRU

Figure 1 illustrates a typical arrangement of FSRU facilities, showing an FSRU berthed to a single jetty. The arrangement may slightly differ in case of other mooring type.
For safe loading, storage and regasification of LNG and discharging NG through HP manifolds to the shore, an FSRU is typically equipped with integrated systems for:

a) cargo handling;

b) cargo containment;

c) regasification.

Associated systems and equipment for cargo, such as BOG management systems, cargo tank spray systems, inert gas system, nitrogen system, venting system, auxiliary system, are provided in accordance with project and classification society requirements.

Figure 2 illustrates terminology typically used in descriptions of the regasification system.

4.2 Main design criteria for process facilities

The process facilities of FSRU shall be designed considering the following conditions:

a) NG send-out capacity, which may be minimum, nominal, peak and zero;

b) redundancy, holding period and turn-down requirements of process facilities;

c) regasification type (e.g. open loop, combined or closed loop);

d) regasification operation (e.g. metocean and site conditions during regasification operation);

e) maximum operating and design send-out pressure at HP manifold;

f) minimum and maximum send-out temperature at HP manifold;
g) design range of seawater temperature and flowrate for regasification;

h) LNG loading rate concurrent with regasification (minimum send-out capacity to be considered);

i) LNG quality and chemical composition;

j) odorization, if required;

k) discharge seawater temperature (i.e. seawater used for regasification process);

l) BOG management (e.g. venting and flaring philosophy required);

m) dual operation FSRU and LNG carrier requirements.

### 4.3 Reliability, availability and maintainability of LNG floating installation

A RAM analysis should be performed to determine the availability of gas export from FSRU given a certain demand profile. Availability curves should be prepared for various demand scenarios.

Metocean conditions shall be considered while operating regasification facilities to define availability.

The design should consider N+1 configurations for all key equipment to ensure a high availability of gas export. Typically, the HD compressor and HP compressors are not subject to the N+1 philosophy.

### 4.4 Specific requirements for FSRU operating as LNG carrier

When an FSRU is operating as LNG carrier (part-time or after extended stay on location) provisions shall be taken to:

a) shutdown and isolate the regasification facilities;

b) fasten potential transfer systems.

After extended stay on location, revision of drydock plan before starting operation as LNG carrier can be required by flag and/or class requirements.

### 4.5 Specific FSRU studies

#### 4.5.1 General

All studies mentioned in Clause 4 of ISO 20257-1:2020 shall be performed. In addition, the process and environmental aspects described in the following subclauses shall be addressed.

#### 4.5.2 Environmental impact of seawater intake and discharge study

Specific studies related to environmental impact of seawater intake and discharge shall be performed in accordance with 5.2. Local requirements can have an impact on the regasification type selection.

#### 4.5.3 Recirculation study

During the regasification process, an FSRU takes in seawater, extracts heat from it for regasification of LNG, and discharges the seawater at a lower temperature. The recirculation pattern of the discharged effluent towards the intake point can lead to lower intake temperature and reduce the unit’s efficiency.

The aim of a recirculation study is to assess the risk on recirculation of the cold water effluent based on the discharge characteristics during FSRU operations and the ambient characteristics of the receiving water body. A recirculation study can also assist the FSRU owner and builder by optimizing the intake and outlet locations in the design.