2017

# Guidance for Floating Liquefied Gas Units

GC-13-E

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# APPLICATION OF
# "Guidance for Floating Liquefied Gas Units"

1. Unless expressly specified otherwise, the requirements in the Guidance apply to Floating Liquefied Gas Units for which contracts for construction are signed on or after 1 July 2017.
2. The amendments to the Rules for 2016 edition and their effective date are as follows;

**Effective Date 1 July 2017**

## CHAPTER 2 CLASSIFICATION AND SURVEYS

Section 2 Classification Survey

- 204. 2 (1) has been amended.

## CHAPTER 5 HULL CONSTRUCTION AND EQUIPMENT

Section 1 General

- 103. has been amended.

Section 2 Survival Capability and Location of Cargo Tanks

- 201. has been amended.

Section 3 Longitudinal Strength

- 301. 1 has been amended.
- 302. 1 has been amended.

Section 4 Structural Design and Analysis of the Hull

- 403. has been amended.

Section 8 Hull Arrangements

- 801. has been amended.

Section 10 Hull Equipment

- 1002. 2 has been amended.

## CHAPTER 6 POSITIONING SYSTEMS

Section 1 General

- 101. has been amended.

**CHAPTER 7 HAZARDOUS AREA**

Section 2 Ventilation

- 203. 1 (9) has been amended.

**CHAPTER 8 FIRE PROTECTION, MEANS OF ESCAPE AND FIRE EXTINCTION**

Section 1 General

- 101. has been amended.

Section 3 Suppression of Fire

- 304. has been amended.

**CHAPTER 9 MACHINERY INSTALLATIONS**

Section 1 General

- 101. 2 has been amended.

**CHAPTER 10 ELECTRICAL EQUIPMENT AND CONTROL SYSTEMS**

Section 1 Electrical Equipment

- 101. 1 (2) has been amended.

**CHAPTER 14 LOADING AND OFFLOADING SYSTEMS**

- has been totally amended.

# CONTENTS

# CHAPTER 1 GENERAL

## Section 1 General

### 101. Application

**1.** The requirements in the Guidance are to be applied to the surveys, hull construction, equipment and machinery of Floating liquefied gas units. Floating liquefied gas units(hereinafter referred to as "units" in the Guidance) as used herein mean units or ships, which are positioned at a specific site of the installation permanently or for long periods for storage and loading or offloading of liquefied gas and units are classified into floating liquefied gas production units(FLNG) and floating liquefied gas storage and regasification units(FSRU).

**2.** Attention is to be paid to plied to the International Conventions and National Regulations of the coastal state in which the unit is located during operation, and statutory requirements of the International Conventions and the National Authority may be stricter than requirements of this Guidance.

### 102. Types of units

#### 1. Ship Type Units

Ship type unit is a seagoing ship-shaped unit having a displacement type hull or hulls, of the single, catamaran or trimaran type, which have been designed or converted for operations in the floating condition. The unit of this type has propelling machinery.

#### 2. Barge Type Units

Barge type unit is a seagoing unit having a displacement type hull or hulls, which have been designed or converted for operations in the floating condition. The unit of this type has no propelling machinery.

**3.** Units other than those specified in **Par 1** to **Par 2** are to be in accordance with the relevant requirements in this guidance and are to be at the discretion of the Society.

### 103. Equivalence and novel features

**1.** The construction and equipment, etc. which are not in compliance with the requirements of the Guidance but are considered to be equivalent to those required in the Guidance will be accepted by the Society.

**2.** The Society may consider the classification of the construction and equipment based on or applying novel design principles or features, to which the Rules are not directly applicable, on the basis of experiments, calculations or other supporting information provided to the Society.

**3.** The risk evaluation of **104.** may be applicable for justification of equivalence or novel features.

### 104. Risk evaluation

**1.** A risk evaluation is be carried out to identify significant hazards and accident scenarios that may affect the installation or any part thereof, and consider the benefit of existing or potential risk control options.

**2.** The objective of the risk evaluation is to identify areas of the design that may require the implementation of risk control measures to reduce identified risks to an acceptable level. For this purpose, a systematic process is to be applied to identify situations where a combination or sequence of events could lead to undesirable consequences such as property damage, personnel safety and environmental damage at an acceptable frequency.

**3.** The risk assessment is to consider the following events as a minimum.

(1) Damage to the primary structure due to extreme weather, impact and collision, dropped objects, helicopter collision, exposure to unsuitably cold temperature, exposure to high radiant heat

(2) Fire and explosion
(3) Loss of primary liquid containment(for a duration to be determined based on an approved contingency plan)
(4) Leakage of liquefied gas
(5) Release of flammable or toxic gas
(6) Roll-over
(7) Loss of stability
(8) Loss of any single component in the station keeping and mooring system
(9) Loss of ability to offload liquefied gas or discharge gas ashore
(10) Loss of any one critical component in the process system
(11) Loss of electrical power

**4.** The identified risk control options(prevention and mitigation measures) deemed necessary to be implemented should be considered part of the design basis of the unit.

**5.** Approval process of Risk-based design is to comply with **Guidance for Approval of Risk-based Ship Design**.

### 105. Conversion of LNG carriers to units

LNG carriers may be converted and registered to units. The ship's existing systems and structures unaffected by the new application would be acceptable as is, however it should be assessed whether such are affected by issues such as different operational modes, modified maintenance schedules and differing accidental loads compared to the initial design. If the existing structure and systems onboard continuously, it should be assessed for the planned service life of the units.

## Section 2 Definitions

### 201. Application

**1.** The definitions of terms and symbols which appear in the Guidance are to be as specified in this Section, unless otherwise specified, and definitions of terms and symbols not specified in the Guidance are to be as specified in **Rules for Pt.7, Ch.5 of the Classification of Steel Ships** and **Guidance for Floating Production Units**.

### 202. Definitions

**1.** **Process system** is the system that treats and liquefies produced gas from the well and generally composed of the treatment equipment for acid gas(sulphur compounds, carbonic acid, etc.) removal, dehydration and mercury removal from raw gas and liquefaction equipment of treated gas.

**2.** **Regasification systems** is the system that convert the liquefied gas into vapor to transfer the gas ashore.

**3.** **Loading system** is the system that transfer the liquefied gas to the storage tanks of units and is considered to include the loading arms or cryogenic hoses and piping systems up to inlet flange on the storage tanks.

**4.** **Offloading system** is the system that transfer a liquefied gas from the storage tanks of units to liquefied gas ships and is considered to include cargo pumps, gas compressors, the piping system up to cargo manifold and loading arms or cryogenic hoses.

**5.** **Import system** is the riser that transfers the produced gas form well to the process systems in units and is considered to include connections to the pipe line end manifold and connection to the first flange in the unit.

**6.** **Export system** is the riser that transfers vaporized gas from units to shore and is considered to include the connectin to the last flange in the unit and the connection to the pipe line end manifold.

**7.** **Riser** is a subsea rigid or flexible pipe that connects the surface facilities with the sea floor and conveys produced gas or vaporized gas.

8. **Approval on risk-based design** refers to review and approve the units on which innovative novel design or risk-based design has been applied. Approval process may apply process defied in **Guidance for Approval of Risk-based Ship Design.** ⚓

# CHAPTER 2 CLASSIFICATION AND SURVEYS

## Section 1 General

### 101. General

**1.** The classification and surveys of units intended to be classed with the Society or classed with the Society are to be in accordance with the requirements specified in this Chapter.

**2.** In the case of items not specified in this Chapter, the requirements specified in **Pt 1** of **Rules for the Classification of Steel Ships** are to be applied.

## Section 2 Classification Survey

### 201. Classification

Units built and surveyed for the classification in accordance with this Guidance or in accordance with requirements deemed to be equivalent to this Guidance by the Society will be assigned a class and registered in the Register of structures.

### 202. Class notations

**1.** The class will be distinguished by the class notations and the class notations assigned to the unit classed with the Society are to be in accordance with the requirements specified in **Pt 1, Ch 1, 201. of Rules for the Classification of Steel Ships.** However ship type notation will be assigned according the purpose of unit as follows.

(1) Floating LNG Production, Storage and Offloading Unit
(2) Floating LNG Storage and Regasification Unit

**2.** Floating liquefied gas storage and regasification unit with a notation of **1** (2) is to have the Reagsification notation and the regasification system installed in the unit is to comply with **Ch 13**.

**3.** When an existing vessel is converted to an unit, and is classed with the Society according to the requirements of this Guidance, the notation (C) shall be assigned as special feature notation. If the existing vessel being converted is currently classed with the Society with ✠. symbol, then the ✠. symbol would be maintained for the converted unit.

**4.** At the request of the Owner, the special feature notations may be assigned as followings.

(1) For units fitted with the process systems, where the whole process systems are in compliance with **Ch 11**, the notation Process may be assigned additionally. However, for units fitted with the process systems, even if the process systems are not intended to be classed, the devices related to the safety of the process systems are to be comply with the requirements of **Ch 8** and **Ch 11**.
(2) Where the import system or export system are in compliance with the requirements of **Ch 15**, the notation Import or Export may be assigned additionally.
(3) For the units that has a propulsion system and a means of disengaging the unit from its mooring and riser systems, the notation Disconnectable may be assigned additionally.

### 203. Maintenance of classification

**1.** Units classed with the Society are to be subjected to the surveys to maintain the classification and are to be maintained in good condition in accordance with the requirements specified in this Chapter.

**2.** Plans and particulars of any proposed alterations to the approved scantlings or arrangements of hull, machinery or equipment are to be submitted for approval by the Society before the work is commenced and such alterations are to be surveyed by the Surveyor of the Society.

## 204. Classification Survey during Construction

### 1. General

At the Classification Survey during Construction, the hull, machinery and equipment are to be examined in detail in order to ascertain that they meet the relevant requirements of this Guidance.

### 2. Submission of plans and documents *(2017)*

(1) At the Classification Survey during Construction, where applicable, the following plans and documents are to be submitted to the Society for approval before the work is commenced.

(A) Hull and hull equipment

(a) Transverse section showing scantlings
(b) Longitudinal section showing scantlings
(c) Deck construction plan(including details of well and helicopter deck)
(d) Framing
(e) Shell expansion
(f) stability data
(g) Methods and locations for non-destructive testing
(h) Construction plan of watertight bulkheads and deep tanks indicating the highest position of tank and positions of tops of overflow pipes
(i) Construction of superstructures and deckhouses
(j) Details of arrangement and closing devices of watertight doors and hatchways, etc.
(k) Seatings of boilers, main engines, thrust blocks, plummer blocks, dynamos and other important auxiliary machinery
(l) Construction of machinery casings
(m) Construction of cargo handling appliances and its foundation
(n) Pumping arrangements
(o) Steering gear
(p) Construction of fire protection
(q) Means of escape
(r) Temporary mooring arrangements and towing arrangements
(s) Welding details and procedures
(t) Details of corrosion control arrangements
(u) Documents in respect of maintenance, corrosion control and inspection
(v) Sloshing analysis
(w) Other plans and/or documents considered necessary by the Society

(B) Cargo handling systems and cargo containment systems

For cargo handling systems(cargo piping systems, cargo pumps, venting systems, inert gas systems, etc.) and cargo containment systems, submission of plans and documents is to be in accordance with **Pt 7, Ch 5, Sec 1** of **the Classification of Steel Ships.**

(C) Machinery

(a) Plans and data relevant to machinery installation specified in **Pt 5, Ch 1, Sec 2** of **Rules for the Classification of Steel Ships**.
(b) Electrical installations specified in **Pt 6, Ch 1** of **Rules for the Classification of Steel Ships**, and automatic and remote control system specified in **Pt 6, Ch 2** of **Rules for the Classification of Steel Ships**.
(c) Fire extinguishing arrangements and inert gas system
(d) Other plans and/or documents considered necessary by the Society

(D) Site condition report

(a) Plans and data relevant to environmental condition of wave/wind/currents/tides/water depth/air, sea and ice temperature
(b) Report of seabed topography for design of anchoring systems, stablilty and pertinent geotechnical data
(c) Seismic condition report

(E) Regasification systems

Submission of plans and documents for the regasification system is to be in accordance with **Ch 12**.

(F) Process systems

For the unit with notation Process, submission of plans and documents for the Process system is to be in accordance with **Ch 13**.

(G) Loading and Offloading systems
Submission of plans and documents for the loading and offloading system is to be in accordance with **Ch 14**.
(H) Import and Export systems
For the unit with notation Import or Export, submission of plans and documents for the import and export system is to be in accordance with **Ch 15**.

(2) At the Classification Survey during Construction, the following plans and documents are to be submitted to the Society for reference.
(A) Specifications
(B) General arrangement
(C) Summary of distributions of fixed and variable weights
(D) Plan indicating design loadings for all decks
(E) Preliminary stability data
(F) Structural analysis and calculation for relevant loading conditions
(G) Resultant forces and moments from wind, waves, current, mooring and other environmental loadings taken into account in the structural analysis
(H) Calculations for significant operational loads from main equipment
(I) Lines or offsets
(J) Capacity plans and sounding tables of tanks
(K) Plans showing arrangement of watertight compartments, openings, their closing appliances, etc., necessary for calculation of stability
(L) Plans and data specified in **Pt 7, Ch 5, Sec 1** of **Rules for the Classification of Steel Ships**
(M) Other plans and/or documents considered necessary by the Society
Submitted calculations are to be suitably referenced. Results from relevant model tests or dynamic response calculations may be submitted as alternatives or as substantiation for the required calculations.

### 3. Presence of Surveyor

(1) At the Classification Survey during Construction, the presence of the Surveyor is required at the following stages of the work in relation to hull and equipment.
(A) When the tests of the materials specified in **Pt 2, Ch 1** of **Rules for the Classification of Steel Ships** and the equipment specified in **Pt 4** of **Rules for the Classification of Steel Ships** are carried out.
(B) When the tests of welding specified in **Pt 2, Ch 2** of **Rules for the Classification of Steel Ships** are carried out.
(C) When designated by the Society during shop work or sub-assembly.
(D) When each block is assembled and erected.
(E) When each part of the hull is completed.
(F) When structural tests, leak test, hose tests and non-destructive tests are carried out.
(G) When performance tests are carried out on closing appliances of openings, anchoring and mooring equipment, cargo handling appliances, fire detection systems, etc.
(H) When each part of the fire protection construction is completed.
(I) When measurement of principal dimensions, hull deflection, etc. are carried out.
(J) When a loading instrument is installed on board.
(K) When the load line mark is marked.
(L) When the onboard tests and stability experiments are carried out.
(M) When deemed necessary by the Society.

(2) At the Classification Survey during Construction, the presence of the Surveyor is required at the following stages of the work in relation to machinery.
(A) When the tests of materials of main parts of machinery specified in **Pt 2** of **Rules for the Classification of Steel Ships** are carried out.
(B) Main parts of machinery
(a) When the tests specified in either **Pt 5** or **Pt 6** of **Rules for the Classification of Steel Ships** according to the kind of machinery are carried out.
(b) When the materials are assembled for construction of the parts and the parts are assembled for installation on board.
(c) When machining of the main parts is finished and, if necessary, at appropriate stages during machining.

(d) In case of welded construction, before welding is commenced and when it is completed.
(e) When the shop trials are carried out.

(C) When main parts of machinery are installed on board.

(D) When performance tests/onboard tests are carried out on measurement instruments, remote control devices of closing appliances, remote control devices for machinery and gears, automatic control devices, steering gear, mooring equipment, fire extinguishing equipment, piping, etc.

(E) When deemed necessary by the Society.

### 4. Tests

(1) At the Classification Survey during Construction, hydrostatic tests, leak tests, hose tests and performance tests, etc are to be carried out in accordance with the relevant requirements of this Guidance.

(2) In the case of machinery and electrical installations related to regasification systems and the pipes and loses installed on units during off loading, hydrostatic tests, leak tests or airtight tests are to be carried out as specified in this Guidance corresponding to the kind of machinery and electrical installations.

(3) In case where regasification systems or positioning systems, etc. are installed on board units at works different from the shipbuilding yards where hull structures are constructed (including the sea areas of the site of operation), surveys necessary in order to tow the hull structures of units to their site of operation are to be carried out. In this cases, the tests, examinations or inspections for the support structures of installations are to be carried out at suitable places/occasions before the final inspection at the site of operation.

(4) Equipment which cannot be surveyed at the Classification Survey during Construction due to special reasons that are related to such equipment only being capable of functioning after start-up and commissioning are to be identified for verification at the next Annual Survey.

### 5. Survey for cargo handling systems and cargo containment systems

For cargo handling systems(cargo piping systems, cargo pumps, venting systems, inert gas systems, etc.) and cargo containment systems, tests and surveys are to be carried out in accordance with the requirements for the cargo systems specified in **Pt 7, Ch 5, Sec 4, 420. 3** and **Sec 5 503.** of **Rules for the Classification of Steel Ships** as applicable.

### 6. Survey for regasification Systems(if relevant notations are assigned)

Survey for regasification systems is to be in accordance with **Ch 12**.

### 7. Survey for process Systems(if relevant notations are assigned)

Survey for process systems is to be in accordance with **Ch 13**.

### 8. Survey for loading and offloading System

Survey for loading and offloading system is to be in accordance with **Ch 14**.

### 9. Survey for import and export system (if relevant notations are assigned)

Survey for loading and offloading system is to be in accordance with **Ch 15**.

### 10. Survey during the installation of units at their site of operation

In case of the survey during the installation of units at their site of operation is to be carried out in accordance with the requirements specified in **Ch2 Sec 2 204. 8** of **Guidance for Floating Production Units** as applicable.

### 11. Onboard tests and stability experiments

The onboard tests and stability experiments is to be in accordance with **Ch 2 Sec 2 204. 9** of **Guidance for Floating Production Units** as applicable.

### 205. Classification Survey after Construction

#### 1. General

At the Classification Survey after Construction, the examination of the hull, machinery and equipment are carried out as required for the Special Survey corresponding to the age, kind and purpose of the unit and the actual scantlings, etc. of the main parts of the unit are to be measured as necessary.

#### 2. Submission of plans and documents

At the Classification Survey after Construction, plans and documents as may be required for the Classification Survey during Construction are to be submitted. If plans and documents cannot be obtained, facilities are to be given for the Surveyor to take the necessary information from the unit.

#### 3. Onboard tests and stability experiments

At the Classification Survey after Construction, onboard tests and stability experiments are to be carried out in accordance with the requirements specified in **204. 11**. However, onboard tests and stability experiments may be dispensed with provided that sufficient information based on previous tests is available and neither alteration nor repair affecting onboard tests and stability experiments has been made after such previous tests.

## Section 3 Surveys

### 301. General

**1.** Units classed with the Society are to be subjected to the following surveys to maintain the classification.

(1) Special Surveys
(2) Intermediate Surveys
(3) Annual Surveys
(4) Docking Surveys
(5) Surveys of Propeller Shaft and Stern Tube Shaft, Etc.
(6) Boiler Surveys
(7) Continuous Surveys
(8) Alteration Survey
(9) Occasional Surveys

#### 2. Damage, failure and repair

(1) Examination
Damage, failure, deterioration or repair to the unit or its elements which affects or may affects classification is to be submitted by the Owners or their representatives for examination by the Surveyor.

(2) Repairs
Where repairs to the unit or its elements which may affect classification are planned in advance, a complete repair procedure, including the extent of the proposed repair and the need for the Surveyor's attendance, is to be submitted to and agreed upon by the Surveyor reasonably in advance. Failure to notify the Society in advance of the repairs may result in suspension of the unit's classification until such time as the repair is redone or evidence is submitted to satisfy the Surveyor that the repair was properly carried out.

Note : The above applies also to repairs during voyage or on site.

The above is not intended to include maintenance and overhaul to hull, machinery and equipment in accordance with manufacturer's recommended procedures and established marine practice and which does not require the approval of the Society. However, any repairs as a result of such maintenance and overhauls which affects or may affect classification is to be noted in the unit's log and submitted to the Surveyors for use in determining further survey requirements as required by (1) above. All repairs found necessary by the Surveyor are to be completed to the Surveyor's satisfaction.

### 3. Continuous Surveys

(1) At the request of the Owner and upon the Society's approval of the proposed arrangements, a system of Continuous Surveys may be undertaken whereby the Special Survey requirements are carried out in regular rotation to complete all of the requirements of the particular Special Survey within a 5-year period. Each part(item) surveyed becomes due again for survey approximately five(5) years from the date of survey. The due parts(items) are generally to be completed each year. Continuous items that are three(3) months or more overdue at the time of Annual Survey attendance will be basis for the Annual Survey not to be credited and for non-endorsement of the Certificate of Classification. Consideration may be given by the Society to an extension to complete survey items. If any defects are found during the survey, they are to be dealt with to the satisfaction of the Surveyor.

(2) Docking Survey or equivalent In-water Survey, as required by **304.**, may be performed at any time within the five-year Special Survey period, provided that all requirements of **305.** are met and thickness measurements are taken when the unit is surveyed.

### 4. Lay-up and reactivation

(1) The Society is to be notified by the Owner that a unit has been laid-up. The surveys falling due during lay-up may then be held in abeyance until the unit reactivates. Lay-up procedures and arrangements for maintenance of conditions during lay-up may be submitted to the Society for review and verification by survey.

(2) The requirements for surveys on reactivation are to be specially considered in each case, with due regard given to the status of surveys at the time of the commencement of the lay-up period, the length of the period and the conditions under which the unit has been maintained during that period.

(3) Units returning to active service, regardless of whether the Society has been informed previously that the unit has been in lay-up, will require a Reactivation Survey.

### 5. Survey Reports File

All survey reports and records of all abnormalities found are to be compiled into the Survey Report File that is to be kept onboard the unit at all times for reference during any survey. The records to be kept include, but are not limited to, the following:

(1) Approved Survey and Inspection Plan, as required by **204. 2.**
(2) The updated status records of all class surveys
(3) The records of all abnormalities found that are to include all videos and photographic records
(4) The records of all repairs performed on any abnormalities found and any further repetitive abnormalities found subsequent to the repairs
(5) Records of all corrosion prevention system maintenance, including records of all cathodic potential readings taken, records of depletion of all sacrificial anodes, impressed current maintenance records, such as voltage and current demands of the system, coating breaks and the monitoring records of the steel material wastage in way of the coating break areas
(6) All classification survey reports pertaining to the unit
(7) All records of any findings of abnormalities by the crew personnel onboard, including all leakages in bulkheads and piping
(8) Reports of thickness measurements of the unit
(9) Reports of all NDE performed

### 6. Surveys using risk-based techniques

A properly conducted Risk-Based Inspection Plan or Reliability Centered Maintenance Plan may be credited as satisfying requirements of surveys for maintenance of class for the corresponding unit. The application of this requirements does not cover any statutory survey requirements that may apply to the unit being considered. Although the Society is authorized to perform statutory surveys on behalf of some authorities, the Society is not in a position to alter or waive them. The Owner is to ensure that in developing the inspection plan or maintenance plan, due consideration is given to applicable requirements external to the Society.

## 302. Annual survey

### 1. Due range

Annual Survey is to be carried out within 3 months before or after each anniversary date.

### 2. Hull and equipment

(1) Ship and barge type units
For ship and barge type units, at each Annual Survey, the weather decks, hull plating and their closing appliances together with watertight penetrations are to be generally examined as far as practicable and placed in satisfactory condition. The following documents, as applicable, are to be available onboard during Annual Surveys:
(a) General Arrangement
(b) Capacity Plan
(c) Hazardous Area Classification Plans
(d) List of Electrical Equipment
(e) Operations Manual
(f) Construction Portfolio
(g) Survey Reports File, as required by **301. 5**

(2) Survey is to be in accordance with **Ch 2, 302. 2.** of **Guidance for Floating Production Units,** if applicable.

### 3. Fire protection and fire fighting systems

Fire protection and fire fighting systems is to be in accordance with **Ch 2, 302. 3. of Guidance for Floating Production Units**, if applicable.

### 4. Machinery and electrical equipment

(1) Annual Survey of machinery and electrical systems is mandatory for all types of units.
(2) Ship and barge type units
Survey for machinery and electrical equipment is to be in accordance with **Pt. 1, Ch 2, 203.** of **Rules for the Classification of Steel Ships**, if applicable.
(3) Non self propelled unit
Machinery items installed consistent with the services of the installation are subject to a general examination and are to be placed in satisfactory condition.
(4) Self propelled unit
(A) Surveys of self propelled installations is to comply with applicable requirements of **Pt 1, Ch 2, 203.** of **Rules for the Classification of Steel Ships**.
(B) Thruster surveys, where installed, are to comply with the requirements of **Pt 1, Annex 1-9** of **Guidance relating to the Rules for the Classification of Steel Ships**.
(5) Surveys of machinery that has been accepted for surveys based on preventative maintenance techniques are to comply with the requirements of **Pt 1, Annex 1-8** of **Guidance relating to the Rules for the Classification of Steel Ships**.
(6) Enclosed hazardous areas, including ventilation, electric lighting, electric fixtures and instrumentation is to be examined.
(7) The integrity of explosion-proof equipment is to be verified.
(8) Corrosion protection systems are to be examined.
(9) Remote shutdown arrangements for fuel and ventilation equipment are to be examined and tested.
(10) Emergency control stations are to be examined and tested.
(11) Safety relief valves are to be externally examined and tested.
(12) All machinery, pumps and pumping arrangements, including valves, cocks and pipes are to be externally examined during operation.
(13) Preventative maintenance records are to be examined.
(14) Structure, piping, electrical systems and machinery foundations are to be generally examined for damage or deterioration.

### 5. Dynamic positioning systems (if relevant notations are assigned)

Surveys of dynamic positioning systems are to comply with the requirements of **Pt 9, Ch 4** of **Rules for the Classification of Steel Ships**.

**6. Regasification systems**

Survey for regasification systems are to be in accordance with **Pt 1 Ch 2 Sec 2, 204.3** of **Rules for the Classification of Steel Ships** as applicable.

**7. Process systems(if relevant notation is assigned)**

Survey for process systems are to be in accordance with **Ch 2 302. 6** of **Guidance for Floating Production Units** as applicable.

**8. Loading and offloading system**

(1) A general examination is to be performed on all electrical system, cargo piping and valves, expansion joints and seals associated with loading and offloading system.
(2) All navigational aids are to be examined and functionally tested.

**9. Import system and export system (if relevant notation is assigned)**

Survey for Import system and export system are to be in accordance with **Ch 2 302. 7** of **Guidance for Floating Production Units** as applicable.

**10. Additional survey items**

Survey is to be in accordance with **Pt 1, Ch 2, 204. 3.** of **Rules for the Classification of Steel Ships, if applicable**.

## 303. Intermediate Surveys

**1. Due range**

Intermediate Surveys are to be carried out either at the second or third Annual Survey or between these surveys.

**2. Hull and equipment**

(1) Ship and barge type units
Survey is to be in accordance with **Ch 2, 303. 2.** of **Guidance for Floating Production Units**, if applicable. At the approval for registration survey if documents for repairs, corrosion protection and survey method are submitted and approved by classification society, relevant surveys should be required.

**3. Fire protection and fire fighting systems**

At each Intermediate Survey, all the requirements of Annual Survey are to be complied with.

**4. Machinery and electrical equipment**

At each Intermediate Survey, all the requirements of Annual Survey are to be complied with.

**5. Regasification systems**

Survey for regasification systems are to be in accordance with **Pt 1, Ch 2, 304. 3.** of **Rules for the Classification of Steel Ships** as applicable.

**6. Process system(if relevant notations are assigned)**

At each Intermediate Survey, all the requirements of Annual Survey are to be complied with.

**7. Loading and offloading system**

At each Intermediate Survey, all the requirements of Annual Survey are to be complied with.

**8. Import system and export system(if relevant notations are assigned)**

At each Intermediate Survey, all the requirements of Annual Survey are to be complied with.

**9. Additional survey items**

Survey is to be in accordance with **Pt 1, Ch 2, 304. 3.** of **Rules for the Classification of Steel Ships, if applicable**.

## 304. Special Surveys

### 1. Due range

(1) A Special Survey is to be completed within five(5) years after the date of build or after the crediting date of the previous Special Survey. The fifth Annual Survey must be credited as a requirement of the Special Survey. The interval between Special Survey may be reduced by the Society if it considered necessary.

(2) Special Survey may be commenced at the fourth Annual Survey and be continued with completion by the fifth anniversary date. Where the Special Survey is commenced prematurely, the entire survey is normally to be completed within 15 months if such work is to be credited to the Special Survey.

(3) Special consideration may be given to Special Survey requirements in the case of units of unusual design, in lay-up or in unusual circumstances. Consideration may be given for extensions of rule-required Special Surveys under exceptional circumstances.

### 2. Hull and equipment

Special Survey is to be in accordance with **Ch 2, 304. 2.** of **Guidance for Floating Production Units,** if applicable. However "(13) Thickness measurement" and "(14) Tank testing" of **Pt 1, Ch 2, 403. 1. of Rules for the Classification of Steel Ships** are to be applied instead of "(I) Close-up Survey requirements", "(J) Thickness measurements requirements" and "(K) Tank testing" of **Ch 2, 304. 2.** of **Guidance for Floating Production Units**.

### 3. Fire protection and fire fighting systems

Special Survey is to include compliance with the Annual Survey requirements and to be in accordance with **Ch 2, 304. 3.** of **Guidance for Floating Production Units**, if applicable.

### 4. Machinery and electrical equipment

Special Survey is to include compliance with the Annual Survey requirements and to be in accordance with **Ch 2, 304. 4.** of **Guidance for Floating Production Units**, if applicable.

### 5. Inert Gas Systems

Surveys of inert gas systems are to comply with the requirements of **Pt 1, Ch 2, Sec 5-2, Par 1** of **Rules for the Classification of Steel Ships**.

### 6. Dynamic positioning systems

Surveys of dynamic positioning systems are to comply with the requirements of **Pt 9, Ch 4** of **Rules for the Classification of Steel Ships**.

### 7. Regasification systems

Survey for regasification systems are to be in accordance with **Pt 1, Ch 2, Sec 5-2, Par 3** of **Rules for the Classification of Steel Ships** as applicable.

### 8. Process system(if relevant notations are assigned)

Surveys for process systems are to be in accordance with **Ch 2, 304. 7** of **Guidance for Floating Production Units** as applicable.

### 9. Loading and offloading system

At each Special Survey, all the requirements of Annual Survey are to be complied with.

### 10. Import system and export system(if relevant notations are assigned)

Surveys for import systems and export systems are to be in accordance with **Ch 2, 304. 8** of **Guidance for Floating Production Units** as applicable.

### 11. Additional survey items

Survey is to be in accordance with **Pt 1, Ch 2, Sec 5-2, Par 3** of **Rules for the Classification of Steel Ships, if applicable**.

## 305. Docking Survey

The underwater parts of a unit are to be examined at certain intervals. This examination may be conducted by In-water Survey in lieu of drydocking or, if necessary, a survey on drydock. During this survey, the Surveyors are to survey the unit, its structural condition, corrosion protection system, mooring system and(if classed) the loading and export systems.

### 1. Due range

(1) There is to be a minimum of two Docking Survey during each five-year Special Survey period. One such Docking Survey is to be carried out in conjunction with the Special Survey. In all cases the interval between any two such Docking Surveys is not to exceed 36 months.

(2) Consideration may be given for extensions of rule-required Docking Survey under exceptional circumstances. An In-water Survey may be required for such extensions.

### 2. Requirements of survey

(1) For ship type and barge type units, the following items are to be examined, as applicable:
The keel, stem, stern frame, rudder, propeller, and outside of side and bottom plating are to be cleaned as necessary and examined, together with bilge keels, thrusters, exposed parts of the stern bearing and seal assembly, sea chest, rudder pintles and gudgeons, together with their respective securing arrangements. All sea connections and overboard discharge valves and cocks, including their attachments to the hull or sea chests, are to be externally examined. All non-metallic expansion pieces in the sea-water cooling and circulating systems are to be examined both externally and internally. The stern bearing clearance or weardown and rudder bearing clearances are to be ascertained and reported on.

(2) Corrosion prevention system - underwater body
In addition to the above (1) requirements, the following are to be to be performed during all of the Docking Surveys(or equivalent In-water Surveys):
(A) Cathodic potential readings are to be taken from representative positions on the entire underwater body and evaluated to confirm that the cathodic protection system is operating within design limits.
(B) Sacrificial anodes are to be examined for depletion and placed in satisfactory condition, as considered necessary.
(C) Impressed current system anodes and cathodes are to be checked for damage, fouling by marine growth and carbonate deposits. The current and voltage demands of the system are to also be checked to ensure the system is functioning properly.
(D) Additional examinations are to be performed on the wind and water areas of the structures where coating breaks are evident. Thickness measurements in these areas may be required if found necessary by the attending Surveyor.

(3) Mooring system
For mooring systems, the following are to be cleaned and examined, where applicable:
(A) The mooring anchor chain or cable tensions are to be measured and the end connections of these components are to be examined. All mooring chains are to be generally examined for their entire lengths.
(B) Anchors, cables and their respective handling means are to be examined.
(C) The buoyancy tanks are to be cleaned and examined, if applicable.
(D) Chain and stopper assemblies are to be cleaned, examined and NDE performed, as considered necessary by the Surveyor.
(E) Areas of high stress or low fatigue life are to be preselected, cleaned and NDE performed, if considered necessary.
(F) Scour in way of anchors or anchor piles is to be examined.
(G) Cathodic potential readings are to be taken from representative positions on the entire underwater structure of the mooring system to confirm that the cathodic protection system is operating within design limits.
(H) Highly stressed, high wear and tear areas of the mooring chain are to be closely examined and nondestructively tested, if considered necessary by the Surveyor. These include areas in way of the stoppers and sea bed touchdown areas.

(4) Import and export systems (if relevant notations are assigned)
For import systems, the following are to be cleaned and examined, where applicable:
(A) The entire riser system
(B) The arch buoyancy tanks including their structures and clamping devices.

(C) The flexible riser, including all end flanges and bolting arrangements and spreader bars, if applicable.
(D) The entire export flexible system is to be examined for damage due to chafing and fatigue fractures.
(E) Hoses designed and manufactured based on OCIMF standards are to be tested in accordance with the "OCIMF Guide for the Handling, Storage, Inspection, and Testing of Hoses in the Field".

### 3. In-water Survey

(1) For units with IWS notation in accordance with relevant requirements specified in **Pt 1, Ch 2, 604.** of **Rule for the Classification of Steel Ships**, an approved In-water Survey by a diver may be considered equivalent to a Docking Survey, up to and including Special Survey No. 4. The In-water Survey Procedures in accordance with **Ch 2, Sec 3, 309.** of **Rules for Classification of Mobile Offshore Drilling Units** are to be submitted for review and approval in advance of the survey.
This approved procedure is to be made available onboard. In addition, the inspection procedures are to also consist of the following:
(A) Scope of inspection
(B) Procedure for divers to identify the exact location at which they are conducting their inspection
(C) Procedure for cleaning the marine growth for inspection purposes that is to include the extent and location of the underwater cleaning
(D) Procedure and extent for measuring the cathodic potential readings in way of the structures
(E) Procedure and extent for taking thickness measurements of the structures and NDE of critical joints
(F) Qualifications of all divers conducting the inspection, NDE and thickness measurements
(G) The type of underwater video and photography, including means of communication, monitoring and recording
(H) For In-water Surveys in lieu of Docking Surveys associated with Special Survey, means are to be provided to permit the opening up of all sea valves and overboard discharges for internal examination. In addition, all Special Survey items related to the underwater portion of the hull or structure, including the thickness measurement requirements are to be dealt with during the In-water Survey.

(2) For each In-water Survey in lieu of Docking Survey after Special Survey No. 4, requests to conduct an In-water Survey are to be submitted for consideration well in advance of the proposed survey. Approvals to conduct the In-water Survey in lieu of Docking Survey after Special Survey No. 4 are to be made available onboard for the Surveyor's reference.

## 306. Tail Shaft and Tube Shaft Surveys

For Tail Shaft Surveys of self-propelled units, applicable requirements of **Pt 1, Ch 2, Sec 7** of **Rule for the Classification of Steel Ships** are to be complied with. However, due to low running hours on tail shafts of units, the interval between tail shaft surveys may be extended.

## 307. Boiler Surveys

Boiler Surveys are to comply with the requirements of **Pt 1, Ch 2, Sec 8** of **Rule for the Classification of Steel Ships**. ⚓

# CHAPTER 3 DESIGN CONDITION

## Section 1 General

### 101. General

**1.** The unit is to be designed to consider the design environmental condition and the design operating condition encountered during transit condition and site-specific conditions.

**2.** The environmental conditions based on design such as atmosphere, seawater temperature, tides and currents, swells, waves, ice and snow, wind, tsunami, submarine slide, abnormal mixture of air and seawater, humidity, salinity, pack ice, ice collapse etc, the limitation of structure operation and the design loads are specified in submitted drawings for approval.

**3.** The information in submitted drawings based on environmental conditions such as weather and sea condition in specific site, statistical distribution, forecasting approach, experimental data, data and analysis provided by qualified consultants or design criteria accepted by the society is submitted to the society for reference.

**4.** The operational limitations of a unit are to be specified by designers. In such cases, the capability of positioning systems, the operating conditions of regasification systems, the conditions of off-loading, etc. with the combination of winds, waves and currents based on meteorological and sea state data for the specified site of operation are to be taken into account.

## Section 2 Design Principles

### 201. Application

The Design principles are to comply with the requirements of **Ch 3, Sec 2** of **Guidance for Floating Production Units**.

## Section 3 Corrosion Control Means and Corrosion Margins

### 201. Application

The corrosion control and corrosion margins are to comply with the requirements of **Ch 3, Sec 3** of **Guidance for Floating Production Units.**

## Section 4 Design Loads

### 201. Application

The design loads of structure are to comply with the requirements of **Ch 3, Sec 4** of **Guidance for Floating Production Units.** ⚓

# CHAPTER 4 MATERIALS AND WELDING

## Section 1 General

### 101. Application

1. The materials used for important structural members are to be in accordance with **Pt 2, Ch 1** of **Rules for the Classification of Steel Ships**. The steel used for parts supporting heavy loads such as plant facilities, etc. and those parts under tensile loads in the direction across the plate thickness are to be in accordance with **Pt 2, Ch 1, 310.** of **Rules for the Classification of Steel Ships**.
2. The welding work of important structural members is to be in accordance with **Pt 2, Ch 2** of **Rules for the Classification of Steel Ships**.
3. Underdeck and hull interface plating or bracket structures attached to the deck or hull should have the same or compatible material grade as the deck or hull structure, respectively.
4. Weld joint design is to be in accordance with **Pt 12** of **Rules for the Classification of Steel Ships.**
5. Mooring system chains, chain parts, wire ropes, fiber ropes, and anchors as well as the windows provided for accommodation spaces are to be in accordance with **Pt 4** of **Rules for the Classification of Steel Ships**, or standards deemed appropriate by the Society. ⚓

# CHAPTER 5 HULL CONSTRUCTION AND EQUIPMENT

## Section 1 General

### 101. General

**1.** The design and construction of the hull, superstructure and deckhouses for units that are new builds or conversions are to be based on the applicable requirements of design considerations of this guide and not specified in this guide are to be in accordance with the Rules.

**2.** Design Considerations of this Guide reflects the different structural performance and demands expected for an installation transiting and being positioned at a particular site on a long-term basis compared to that of a vessel engaged in unrestricted seagoing service.

### 102. Load line

**1.** A mark designating the maximum allowable draught for loading is to be located in easily visible positions on units as deemed appropriate by the Society or in positions easily distinguishable by the person in charge of liquid transfer operations.

**2.** The designation of load lines is to comply with the requirements given in the "International Convention on Load Lines, 1996 and Protocol of 1988 relating to the International Convention on Load Lines, 1966", unless specified otherwise by the relevant flag states or coastal states.

### 103. Loading manual, intact stability information and instruction for operation *(2017)*

**1.** For the case of units, loading manual and loading instruments are to be installed are to be as specified in **Pt 3, Ch 3, Table 3.3.3** of **Rules for the Classification of Steel Ships** and **Rules for the Classification of Steel Barges**.

**2.** In order to avoid the occurrence of unacceptable stress in unit structures corresponding to all cargo and ballast loading conditions and topside modules arrangement and mass and to enable the master or the person-in-charge of loading operations to adjust the loading of cargo and ballast, units are to be provided with loading manuals approved by the Society. Such loading manuals are to at least include the following (1) to (4) items as well as relevant provisions given in **Pt 3, Ch 3** of **Rules for the Classification of Steel Ships**.

(1) The loading conditions on which the design of a unit has been based, including the permissible limits of longitudinal still water bending moments and still water shearing forces.

(2) The calculation results of longitudinal still water bending moments and still water shearing forces corresponding to the loading conditions.

**3.** In addition to **Par 2** above, a loading computer that is capable of readily computing longitudinal still water bending moments and still water shearing forces working on units corresponding to all oil and ballast loading conditions and the operation manual for such a computer is to be provided on board.

**4.** The capability of the loading computer specified in **Par 3** above to function as specified in the location where it is installed is to be confirmed.

**5.** A intact stability information booklet approved by the Society is to be provided on board in accordance with **Pt 1, Annex 1-2** of **Rules for the Classification of Steel Ships**. This booklet is to include the results of stability evaluations in representative operating conditions.

**6.** Instructions for the loading and unloading, and transfer and offloading operations of cargo and ballast are to be provided on board. In cases where mooring systems can be isolated, the procedures for isolating and re-mooring are also to be included.

**7.** The loading precautions such as maximum cargo loading weight on the deck and equipment loading weight in the operating condition, etc., is to be stated in appropriate documents such as loading manual or stability information.

## Section 2 Survival Capability and Location of Cargo Tanks

### 201. General *(2017)*

1. Damage stability criteria are to be in accordance with the requirements specified in **Pt 7, Ch 5, Sec 2** of **Rules for the Classification of Steel Ships**. under the environmental conditions specified in **Ch 3**.
2. The arrangements of watertight compartments, watertight bulkheads and closing devices are to be in accordance with the requirements specified in **Rules for the Classification of Steel Ships** and **Rules for the Classification of Steel Barges**. However, for units of restricted service or units of non propulsion machinery, the requirements may be applied appropriately mitigated.
3. For units of restricted service or units of non propulsion machinery, the requirements may be applied appropriately mitigated by the requirements of damage criteria for 2PG or 3G ship.
4. Damage stability criteria for units of restricted service or units of non propulsion machinery is to be applied to the damage assumptions in **Pt 7, Ch 5, Sec 2 of the Rules**, except for bottom damage.

## Section 3 Longitudinal Strength

### 301. General *(2017)*

1. The assessment of the longitudinal hull girder strength should be based on the following operational modes:
   (1) All transit conditions
   (2) All operating conditions, intact, at the design locations(s)
   (3) All inspection and repair conditions
2. Changes in the design conditions of a ship-shaped unit are usually accompanied by significant changes in draught, ballast, riser connections, mooring line tension, etc. Limited variation of some of these parameters may be contained within a specific design condition.
3. The suitability of a ship-shaped unit is dependent on the environmental conditions in the areas of the intended operation. A production unit may be planned to operate at a specific site.
4. Use of finite element methodology for strength analysis of hull and cargo tank structures is primarily in order to obtain a better and complete understanding of the stress response when subject to wave, motion-induced loads as well as other functional loads. In practice, the structural analysis can be performed using several levels of modeling methods. The level of modeling and associated structural idealization should be based on purpose of the analysis.

### 302. Longitudinal hull girder strength *(2017)*

1. Longitudinal strength of ship type unit is to be based on **Pt 3 and Pt 12 of Rules for the Classification of Steel Ships** basically. However, for barge type unit of 150 m or less, it is to be in accordance with the **Rules for the Classification of Steel Barges**. The total hull girder bending moment, $M_t$ is the sum of the maximum still water bending moment for operation on site or in transit combined with the corresponding wave-induced bending moment ($M_W$) expected on-site and during transit to the installation site.
2. In lieu of directly calculated wave-induced hull girder vertical bending moments and shear forces, recourse can be made to the use of the Environmental Severity Factor (ESF) approach described of this guide. The ESF approach can be applied to modify the Steel Vessel Rules wave-induced hull girder bending moment and shear force formulas. Depending on the value of the Environmental Severity Factor, $\beta_{vbm}$, for vertical wave-induced hull girder bending moment (see this Guide), the minimum hull girder section modulus, $Z_{\min}$ of unit may vary in accordance with the following.

**Table 5.1 Minimum hull girder section modulus**

| $\beta_{vbm}$ | $Z_{\min}$ |
|---|---|
| $\beta_{vbm} < 0.7$ | $0.85Z_{\min}$ |
| $0.7 < \beta_{vbm} < 1.0$ | Varies linearly between $0.85Z_{\min}$ and $Z_{\min}$ |
| $\beta_{vbm} > 1.0$ | $Z_{\min}$ |
| Where $Z_{\min}$ = minimum hull girder section modulus as required in **Pt 3,Ch 3, 203. of Rules for the Classification of Steel Ships** | |

## 3. Environmental Severity Factor

Environmental Severity Factors are adjustment factors for the dynamic components of loads and the expected fatigue damage that account for site-specific conditions as compared to North Atlantic unrestricted service conditions.

(1) ESFs of the Beta ($\beta$) Type

This type of ESF is used to introduce a comparison of the severity between the intended environment and a base environment, which is the North Atlantic unrestricted service environment. In the modified formulations, the $\beta$ factors apply only to the dynamic portions of the load components, and the load components that are considered "static" are not affected by the introduction of the $\beta$ factors.

$$\beta = \frac{E_s}{E_u}$$

where

$E_s$ : most probable extreme value based on the intended site (100 years return period), transit (10 years return period), and repair/inspection (1 year return period) environments for the dynamic load parameters specified in **Table 5.2.**

$E_u$ : most probable extreme value base on the North Atlantic environment for the dynamic load parameters specified in **Table 5.2.**

A $\beta$ of 1.0 corresponds to the unrestricted service condition of a seagoing vessel. A value of $\beta$ less than 1.0 indicates a less severe environment than the unrestricted case.

**Table 5.2 Dynamic Load Parameters**

| | |
|---|---|
| VBM | Vertical Bending Moment |
| HBM | Horizontal Bending Moment |
| TM | Torsional Moment |
| EPP | External Pressure Port |
| EPS | External Pressure Starboard |
| VAC | Vertical Acceleration |
| TAC | Transverse Acceleration |
| LAC | Longitudinal Acceleration |
| PMO | Pitch Motion |
| RMO | Roll Motion |
| RVM | Relative Vertical Motion at Forepeak |
| WHT | Wave Height |
| VSF | Vertical Shear Force |
| HSF | Horizontal Shear Force |

(2) ESFs of the Alpha ($\alpha$) Type

This type of ESF compares the fatigue damage between the specified environment and a base environment, which is the North Atlantic environment. This type of ESF is used to adjust the expected fatigue damage induced from the dynamic components due to environmental loadings at the installation's site. It can be used to assess the fatigue damage accumulated during the histor-

ical service either as a trading vessel or as a unit, including both the historical site(s) and historical transit routes.

$$\alpha = \left( \frac{D_u}{D_s} \right)^{0.65}$$

where
$D_u$ : annual fatigue damage based on the North Atlantic environment (unrestricted service) at the details of the hull structure
$D_s$ : annual fatigue damage based on a specified environment, for historical routes, historical sites, transit and intended site, at the details of the hull structure

## 303. Hull girder ultimate strength

**1.** The hull girder ultimate longitudinal bending capacities are to be evaluated in accordance with **Pt 12** of **Rules for the Classification of Steel Ships**.

**2.** The vertical hull girder ultimate strength for the unit design environmental condition (DEC) is to satisfy the limit state as specified below. It need only be applied within the 0.4L amidship region.

$$\gamma_S M_{sw} + \gamma_W \beta_{VBM} M_{wv-sag} \leq \frac{M_U}{\gamma_R}$$

$M_{sw}$ : permissible still-water bending moment, in kNm
$M_{wv-sag}$ : sagging vertical wave bending moment, in kNm, to be taken as the midship sagging value defined in **Pt 12, Sec 7/3.4.1.1** of **Rules for the Classification of Steel Ships**.
$M_U$ : sagging vertical hull girder ultimate bending capacity, in kNm, as defined in **Pt 12, Appendix A/1.1.1** of **Rules for the Classification of Steel Ships**.
$\beta_{VBM}$ : ESF for vertical wave-induced bending moment for DEC
$\gamma_S$ : load factor for the maximum permissible still-water bending moment, but not to be taken as less than 1.0
$\gamma_W$ : load factor for the wave-induced bending moment, but not to be taken as less than below for the given limits
= 1.3 $(M_{sw} < 0.2M_t$ 또는 $M_{sw} > 0.5M_t)$
= 1.2 $(0.2M_t \leq M_{sw} \leq 0.5M_t)$
$M_t$ : total bending moment, in kNm
= $M_{sw} + \beta_{VBM} M_{wv-sag}$
$\gamma_R$ : safety factor for the vertical hull girder bending capacity, but not to be taken as less than 1.15

## 304. Additional Application

Other various matters on the longitudinal strength are to be as specified in **Pt 5, Ch3, of Rules for the Guidance for Floating Production Units.**

# Section 4 Structural Design and Analysis of the Hull

## 401. General

**1.** Design of ship type unit may generally follow the principles of design of steel ships. The design will have to account for characteristics in operation and loading of floating offshore gas installations.

**2.** The offshore installation design will include:

(1) Environmental loading regime for a fixed installation location
(2) Inability to avoid severe weather
(3) Fatigue design and details for service life
(4) Partial filling and sloshing loads
(5) Continuous operation and limited availability and access for inspection and repair
(6) Increased potential for cryogenic leakage
(7) Loading in exposed locations
(8) Scaling up of existing designs
(9) Increased corrosion considerations
(10) Increased hazard due to location of gas handling, liquefaction or regasification plant
(11) Provision of a position mooring system
(12) Project-specific Design Accidental Loads
(13) Different regulatory requirements

## 402. Design Criteria

**1.** Offshore operation will typically impose different requirements than those applicable for traditional LNG carrier designs. Some of the requirements will be related to safety while others will arise for reasons of operational optimization. The design is based on field-specific operation, usually involving permanently stationed installations and is governed by national regulation and site specific criteria. Offshore operation will normally imply that the unit is permanently position-moored. A turret mooring arrangement or a spread mooring arrangement may be used. The unit will impose additional structural loads arising from topsides loads, sloshing in storage tanks, loads from ship to ship mooring during LNG transfer, and additional design accidental loads arising from activities on board. Continuous operation offshore, typically without dry-docking, for the life of the gas field will impose the need for increased initial quality in order to avoid the need for in-service repair or replacement. This is particularly relevant for fatigue and corrosion considerations. To minimize fatigue damage occurring during service, the design fatigue factors for an offshore vessel not intending to dry-dock, will be stricter than for a trading carrier. The unit in benign areas with high ambient temperature has shown that there may be a high corrosion rate compared to oil carriers. The corrosion protection system may therefore need to meet a higher standard. Regulatory requirements applicable to unit may also impose some additional structural considerations.

**2.** There are a number of important key factors for a design suitable for an offshore application.

(1) Design for the intended site of operation
(2) Design life which is variable: 10-40 years usually depending on field life
(3) Design based on limit states with the specified probability levels for environmental loads
(4) 100 year return period for Ultimate Limit States, ULS
(5) Fatigue design for design life with increased design fatigue life
(6) Limited inspection and repair possibilities
(7) Increased corrosion protection
(8) Tank access and gas freeing for inspection
(9) Additional loads from: topsides, flare, mooring system, risers, cranes, helideck
(10) Continuous partial filling operation of the cargo tanks
(11) Different onloading and offloading pattern and berthing loads
(12) Additional accidental load scenarios to be defined and checked in addition to prescriptive requirements
(13) Additional requirements of regulatory schemes

## 403. Structural design of the hull *(2017)*

Design of the hull is to be based on this guide **401, 402.**, general hull structures are to be in accordance with the requirements of **Pt 3** and **Pt 12** of **Rules for the Classification of Steel Ships**. However, the general structure of hull, superstructure and deckhouse of barge type unit of 150 m or less operated and installed in the coastal service is to be in accordance with the **Rules for the Classification of Steel Barges** with regard to **401.**

### 1. Hull design for additional loads and load effects

The loads addressed in this Subsection are those required in the design of an installation depending on the length of the installation. Specifically, these loads are those arising from liquid sloshing in hydrocarbon storage or ballast tanks, green water on deck, bow impact due to wave group action above the waterline, bow flare slamming during vertical entry of the bow structure into the water, bottom slamming and deck loads due to on-deck production facilities. All of these can be treated directly by reference to unit. However, when it is permitted to design for these loads and load effects on a site-specific basis, reflect the introduction of the Environmental Severity Factors (ESFs-Beta-type) into the Rule criteria.

### 2. Superstructures and deckhouses

The designs of superstructures and deckhouses are to comply with the requirements of **Pt 12** of **Rules for the Classification of Steel Ships**. The structural arrangements of **Pt 12** of **Rules for the Classification of Steel Ships** for forecastle decks are to be satisfied.

### 3. Helicopter decks

The design of the helicopter deck structure is to comply with the requirements of **Rules for Classification of Mobile Offshore Drilling Units**. In addition to the required loadings defined in **Rules for Classification of Mobile Offshore Drilling Units**, the structural strength of the helicopter deck and its supporting structures are to be evaluated considering the DOC and DEC environments, if applicable.

### 4. Protection of deck openings

The machinery casings, all deck openings, hatch covers and companionway sills are to comply with the requirements of **Pt 12** of **Rules for the Classification of Steel Ships**.

### 5. Bulwarks, rails, freeing ports, ventilators and portlights

Bulwarks, rails, freeing ports, portlights and ventilators are to comply with the requirements of **Pt 12** of **Rules for the Classification of Steel Ships**.

### 6. Machinery and equipment foundations

Foundations for equipment subjected to high cyclic loading, such as mooring winches, chain stoppers and foundations for rotating process equipment, are to be analyzed to verify they provide satisfactory strength and fatigue resistance. Calculations and drawings showing weld details are to be submitted to the Bureau for review.

### 7. Bilge keels

The requirements of bilge keels are to comply with the requirements of **Pt 12** of **Rules for the Classification of Steel Ships**.

### 8. Sea chests

The requirements of Sea Chests are to comply with the requirements of **Pt 12** of **Rules for the Classification of Steel Ships**.

## 404. Engineering analyses of the hull structure

### 1. General

The criteria in this Subsection relate to the analyses required to verify the scantlings selected in the hull design in **403.**. Depending on the specific features of the offshore installation, additional analyses to verify and help design other portions of the hull structure will be required. Such additional analyses include those for the deck structural components supporting deck-mounted equipment and the hull structure interface with the position mooring system. Analysis criteria for these two situations are given in **Section 5**.

### 2. Strength analysis of the hull structure

For installations of 150 m in length and above, two approaches in performing the required strength assessment of the hull structure are acceptable. One approach is based on a three cargo tank length finite element model amidships where the strength assessment is focused on the results obtained from structures in the middle tank. As an alternative, a complete hull length or full cargo block length finite element model can be used in lieu of the three cargo tank length model. Details of the required Finite Element Method (FEM) strength analysis are in accordance with **Pt 12** of **Rules for the Classification of Steel Ships.**

When mooring and riser structures are located within the extent of the FE model, the static mass of the mooring lines and risers may be represented by a mass for which gravity and dynamic accelerations can be calculated and added to the FEM model. The resulting dynamic loads shall be compared to the mooring and riser analysis results to ensure that the dynamic effects are conservatively assessed in the hull FE analysis.

Generally, the strength analysis is performed to determine the stress distribution in the structure. To determine the local stress distribution in major supporting structures, particularly at intersections of two or more members, fine mesh FEM models are to be analyzed using the boundary displacements and load from the 3D FEM model. To examine stress concentrations, such as at intersections of longitudinal stiffeners with transverses and at cutouts, fine mesh 3D FEM models are to be analyzed. The accidental load condition, where a cargo tank is flooded, is to be assessed for longitudinal strength of the hull girder consistent with load cases used in damage stability calculations.

## 405. Additional Application

Other various matters on the Structural Design and Analysis of the Hull are to be as specified in **Pt 5, Ch4, of Rules for the Guidance for Floating Production Units.**

# Section 5 Design and Analysis of Other Major Hull Structural Features

## 501. General

The design and analysis criteria to be applied to the other pertinent features of the hull structural design are to conform to this **Guidance** or **Rules for the Classification of Steel Ships.** For ship-type unit, the hull design will need to consider the interface between the position mooring system and the hull structure or the effects of structural support reactions from deck-mounted (or above-deck) equipment modules, or both. The interface structure is defined as the attachment zone of load transmission between the main hull structure and hull mounted equipment, such as topside module stools, crane pedestals and foundations, riser porches, flare boom foundation, gantry foundation, mooring and offloading, etc. The zone includes components of the hull underdeck structures in way of module support stools and foundations, such as deck transverse web frames, deck longitudinals and upper parts of longitudinal and transverse bulkhead structures, as well as foundations of the hull-mounted equipment. These components of the interface structure should comply with the criteria indicated in **504.**.

## 502. Hull interface structure

The basic scantlings in way of the hull interface structure is to be designed based on the first principle approach and meet the requirements of strength criteria in **Rules for Classification of Mobile Offshore Drilling Units** or equivalent national industry standards recognized and accepted, such as API Standards. Welding design of hull interface structure connections is to be developed based on **Pt 12, Ch 6, Sec 5** of **Rules for the Classification of Steel Ships** or a direct calculation approach. Material grades for the above deck interface structure are to be selected as per **Rules for Classification of Mobile Offshore Drilling Units**. The material grades for the hull structure components, such as deck and frame structures, are to be selected as per **Pt 3** of **Rules for the Classification of Steel Ships**. The verification of the hull interface structure as defined above is to be performed using direct calculation of local 3-D hull interface finite element models, developed using gross scantlings and analyzed with load conditions and load cases described in the following sections.

**1. Position mooring/hull interface modeling**

A FEM analysis is to be performed and submitted for review.
(1) Turret or SPM Type Mooring System, External to the Installation's Hull
(2) Mooring system internal to the Installation Hull (Turret Moored)
(3) Spread Moored Installations

**2. Hull mounted equipment interface modeling**

(1) Topside Module Support Stools and Hull Underdeck Structures
(2) Other Hull Mounted Equipment Foundation Structures

### 503. Loads

For all conditions, the primary hull girder load effects are to be considered, where applicable.

The DLP values are to be selected for the most unfavorable structural response. Maximum accelerations are to be calculated at the center of gravity of the most forward and aft and midship topside production facility modules.

The load cases are to be selected to maximize each of the following DLPs together with other associated DLP values.

- Max. Vertical Bending Moment
- Max. Shear Force
- Max. Vertical Acceleration
- Max. Lateral Acceleration
- Max Roll

Alternatively, the number of load cases can be reduced by assuming that all maximum DLP values occur simultaneously, which is a conservative assumption.

As a minimum, the following two hull girder load cases are to be analyzed:

- Maximum hull girder sagging moment (i.e., generally full load condition)
- Maximum hull girder hogging moment (i.e., generally ballast, tank inspection or partial loading condition)

### 504. Additional Application

Other various matters on the Design and Analysis of Other Major Hull Structural Features are to be as specified in **Pt 5, Ch5, of Rules for the Guidance for Floating Production Units**.

## Section 6 Direct Strength Assessment

### 601. General

This Guidance deals with procedure of direct structural analysis that is composed of structural modeling, stress calculating, yielding check and buckling check for the primary supporting members of hull.

### 602. Direct Global Structural Analysis

**1.** General

(1)Application

(A) This Guidance provides overall procedures to be used in the global structural analysis with direct transfer of loads from hydrodynamic and stochastic analysis for the purpose of structural safety assurance.

(B) The design of the structure is to be in accordance with **Pt 3, Ch 3** of **Rules for the Classification of Steel Ships** regardless of the structural analysis according to this guidance, and the results of the direct global structural analyses cannot be used to reduce the basic scantlings based on the Rules.

(C)It is recommended to use the probability level equivalent to a return period of at least 100 years in intended site for design loads.

(D) The seakeeping and hydrodynamic load analysis is to be carried out using computer program recognized by the Society based on linear 2D Strip method or linear 3D panel method. The non-linear effects should be considered if these effects are regarded to be important after initial evaluation of the hull shape.

(E) The structural analysis is to be carried out using computer program which can consider the effects of bending deformation, shear deformation, axial deformation and torsional deformation.

(2) Documentation

The reports including drawings, structural and hydrodynamic model, mass model, assumption and theory used in analysis, results of loads calculation, results of structural analysis etc. should be presented to the Society for approval of the direct global structural analysis in accordance with this Guidance.

(3) The flow chart of the direct global structural analysis is shown in **Fig 5.1.**

**2.** Structural analysis and acceptance criteria

(1) Structural analysis

(A) The structural analysis is to be carried out with the Finite Element Method.

(B) An approved analysis program having adequate accuracy should be used. If deemed necessary, documents related to systems used in the analysis and documents for confirming the accuracy may be required to be submitted to the Society.

(2) Acceptance criteria

The results of global structural analysis is to be assessed for the failure mode of yielding according to the allowable stress as specified in **Pt 5, Ch5, of Rules for the Guidance for Floating Production Units**.

### 603. Additional Application

Other various matters on the major element modeling, stress calculations, yield strength, buckling strength assessment and evaluation process of hull structure are to be as specified in **Pt 3** of **Rules for the Classification of steel ships**.

## Section 7 Fatigue Strength Assessment

### 701. General

**1.** Fatigue failures are one of the most important structural defects that need to be assessed in the design. Such failures may be a more significant problem in an offshore vessel compared to a trading carrier. The fatigue evaluation should include.

(1) Evaluation of critical areas: both from experience and fatigue screening
(2) Assessment of the loads at the intended site of operation
(3) Calculations of the structural response based on the actual loads
(4) Accounting for the design life in the calculations
(5) Fatigue design for design life with increased design fatigue factors
(6) Internal structure directly welded to submerged part
(7) External structure not accessible for inspection and repair in dry and clean condition
(8) Non-accessible areas inside the vessel
(9) Very limited repair possibilities
(10) Critical areas in the hull structures will typically include.

(A) Topside supports, riser connections, flare tower supports etc.

(B) structure typical details such as longitudinal end connections, deck attachments

(C) LNG containment system specific details

**2.** Fatigue calculations are performed using as input environmental action of the waves and wind. Wave actions will induce dynamic loads in the hull. For slender structures in the topsides, vortex shedding from wind loads may also be a fatigue load of importance. The wave scatter diagram is used as input to the hydrodynamic analysis which will then give the motion and load response of the vessel in the waves. Modeling of the structure will typically be refined modelling with a fine mesh at the critical locations. These include:

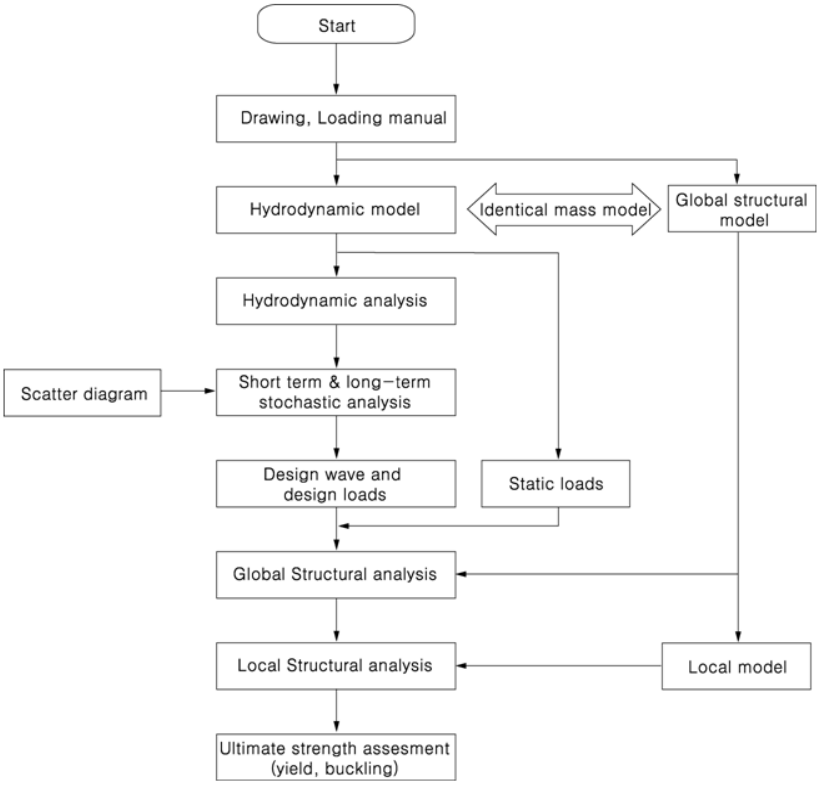


**Fig 5.1 Flow chart of the direct global structural analysis**

(1) Moonpool areas
(2) Topside support structures
(3) Cargo tank supports
(4) Support of spherical tank skirt and tank cover
(5) Hull adjacent to membrane tank

## 702. Fatigue Analysis Process

**1.** This guidance provides a guideline for a simplified fatigue analysis method and a direct fatigue analysis method (See **Fig 5.2**)

**2.** In case of requiring more precise fatigue strength assessment, the direct fatigue analysis method is to be applied to assess the fatigue strength. A spectral fatigue analysis method or a transfer function method may apply to the direct fatigue analysis.

**3.** Other equivalent methods may be applied to assess the fatigue strength when deemed appropriate by the Society.

## 703. Additional Application

Other various matters on major element in the evaluation process of hull fatigue strength are to be as specified in **Pt 3** of **Rules for the Classification of steel ships**.

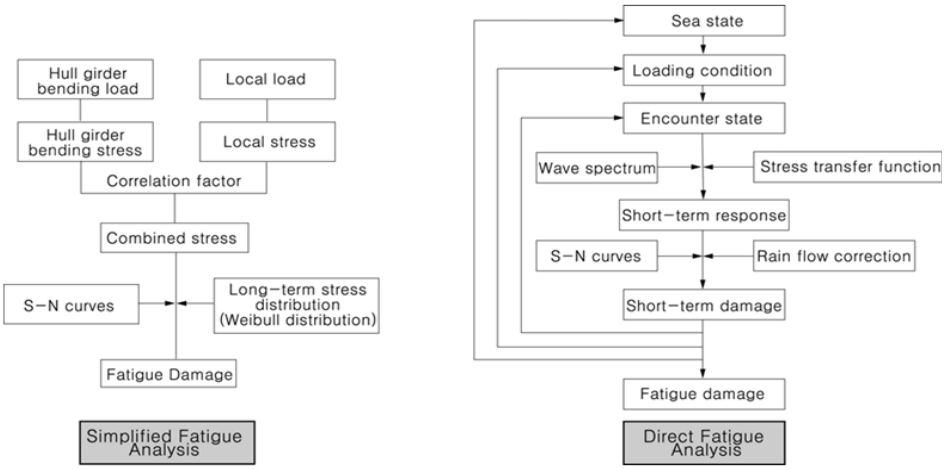


**Fig 5.2 Fatigue analysis method**

## Section 8 Hull Arrangements

### 801. Application *(2017)*

The applicable requirements for hull arrangements is to be in accordance with **Pt 7, Ch 5, Sec 3** of **Rules for the Classification of Steel Ships**. However, for units not engaged in voyage, the requirements in **Pt 7, Ch 5, 301. 1** (2) of **Rules for the Classification of Steel Ships** may not be applied.

## Section 9 Cargo Containment

### 901. Application

The applicable requirements for cargo containment is to be in accordance with **Pt 7, Ch 5, Sec 4** of **Rules for the Classification of Steel Ships**.

## Section 10 Hull Equipment

### 1001. Mooring systems for temporary mooring

**1.** The mooring systems for temporary mooring specified in **Rules for Classification of Mobile Offshore Drilling Units** need not be fitted. In cases where the Society deems such necessary in consideration of the form of unit operations, the mooring systems for temporary mooring specified in **Rules for Classification of Mobile Offshore Drilling Units** are required.

**2.** In the case of single-point mooring systems to moor shuttle tankers, the chafing chain used ends for mooring lines are to be fitted and are to comply with the following:

(1) The chafing chain is to be the offshore chain specified in **Pt 4** of **Rules for the Classification of Steel Ship**s, and the chain standard is short lengths (approximately 8 m) of 76 mm diameter.

(2) The arrangement of the end connections of chafing chains is to comply with any standards deemed appropriate by the Society.

(3) Documented evidence of satisfactory tests of similar diameter mooring chains in the prior six month period may be used in lieu of breaking tests subject to agreement with the Society.

3. Equipment used in mooring systems to moor at jetty etc. in order to install plant or mooring equipment for the mooring support ships and shuttle tankers, except for the equipment specified in **Par 2** above, is to be as deemed appropriate by the Society.

## 1002. Guardrails *(2017)*

1. The guardrails or bulwarks specified in **Pt 4** of **Rules for the Classification of Steel Ships** are to be provided on weather decks. In cases where guardrails will become hindrances to the taking-off and landing of helicopters, means to prevent falling such as wire nets, etc. are to be provided.
2. Freeing arrangements, cargo ports and other similar openings, side scuttles, rectangular windows, ventilators and gangways are to be in accordance with the requirements specified in **Rules for the Classification of Steel Ships** and **Rules for the Classification of Steel Barges**, unless specified otherwise by the relevant flag states or coastal states.
3. Ladders, steps, etc. are to be provided inside compartments for safety examinations as deemed appropriate by the Society.

## 1003. Fenders

1. Suitable fenders fore contact with the gunwales of other ships such as support ships, tug boats, shuttle tankers, etc. are to be provided.
2. The most common fender used for side-by-side transfer operations is the high pressure pneumatic type. These fenders are generally favoured for their robustness and longevity. The low pressure pneumatic type have been found useful for emergency situations where ease of transport is a first priority. However, they can have the disadvantage of much shorter life in service. Foam filled fenders are not commonly used but owing to lighter construction they can have advantages when used as secondary fenders.
3. Fender size will also be dictated by the freeboard of the ships, and the diameter of each floating fender should be no more than half the minimum freeboard of the smaller ship.
4. Fenders used in side-by-side transfer operations offshore are divided into two categories:
   (1) Primary fenders which are positioned along the parallel body of the ship to afford the maximum possible protection during mooring and unmooring.
   (2) Secondary fenders which may be used to protect bow and stern plating from inadvertent contact during mooring and unmooring.
5. For the details, Ship to Ship Transfer Guide(Liquefied Gases) issued by OCIMF is to be referred. ⚓

# CHAPTER 6 POSITIONING SYSTEMS *(2017)*

## Section 1 General

### 101. Application

**1.** Positioning systems are to be in accordance with **Ch 6** of **Guidance for Floating Production Units.** However, the mooring force can be calculated in consideration of the following safety factor and environmental loads according to the **Guidance for Floating structure** for the positioning systems of the units moored to the quay during operation.

(1) Safety factor

| Condition | Safety factor |
|---|---|
| Normal | 4 times of the breaking load of the mooring line |
| Storm | 2.5 times of the breaking load of the mooring line |
| Any one broken mooring line (storm) | 2 times of the breaking load of the mooring line |

(2) Design wind speed is not less than 15 m/s for normal condition and 44 m/s for storm condition. However, maximum wind speed of the data from Meteorological Administration may be used.

(3) The direction of the wind is to be considered as a maximum of 15 degrees in all directions. In this case, the condition that the wind acts as the same current direction is to be considered. ⚓

# CHAPTER 7 HAZARDOUS AREA

## Section 1 General

### 101. Application

**1.** The requirements which not specified in this Chapter, it is to be in accordance with **Ch 7** of **Guidance for Floating Production Units**. For cargo area are to be in accordance with **Pt 7, Ch 5** of **Rules for the Classification of Steel Ships**.

**2.** For the purpose of this Chapter :

(1) An enclosed space is considered to be a space bounded by bulkheads and decks which may have doors, windows, of other similar openings.

(2) A semi-enclosed location is considered to be a location where natural conditions of ventilation are notably different from those on open decks due to the presence of structure such as roofs, windbreaks and bulkheads and which are so arranged that the dispersion of gas may not occur.

### 102. Definition of hazardous area

**1.** Hazardous areas are all those areas where, due to the possible presence of a flammable atmosphere arising from the drilling operations, the use without proper consideration of machinery or electrical equipment may lead to fire hazard or explosion.

**2.** Hazardous areas are divided into zones as follows;

Zone 0: an area in which an explosive gas-air mixture is continuously present or present for long periods.

Zone 1: an area in which an explosive gas-air mixture is likely to occur in normal operating conditions.

Zone 2: an area in which an explosive gas-air mixture is not likely to occur, and if it occurs, it will only exist for a short time.

### 103. Definition of Gas-dangerous space or zone

**1.** The Gas-dangerous space as specified may be extended or reduced depending on the actual arrangements in each case, by use of windshields, special ventilation arrangements, structural arrangements, etc.

**2.** "**Gas-dangerous space or zone**" is:

(1) a space in the cargo area which is not arranged or equipped in an approved manner to ensure that its atmosphere is at all times maintained in a gas-safe condition;

(2) an enclosed space outside the cargo area through which any piping containing liquid or gaseous products passes, or within which such piping terminates, unless approved arrangements are installed to prevent any escape of product vapour into the atmosphere of that space;

(3) a cargo containment system and cargo piping;

(4) (a) a hold space where cargo is carried in a cargo containment system requiring a secondary barrier;

(b) a hold space where cargo is carried in a cargo containment system not requiring a secondary barrier;

(5) a space separated from a hold space described in (4) (a) by a single gastight steel boundary;

(6) a cargo pump room and cargo compressor room;

(7) a zone on the open deck, or semi-enclosed space on the open deck, within 3 m of any cargo tank outlet, gas or vapour outlet, cargo pipe flange or cargo valve or of entrances and ventilation openings to cargo pump rooms and cargo compressor rooms;

(8) the open deck over the cargo area and 3 m forward and aft of the cargo area on the open deck up to a height of 2.4 m above the weather deck;

(9) a zone within 2.4 m of the outer surface of a cargo containment system where such surface is exposed to the weather;

(10) an enclosed or semi-enclosed space in which pipes containing products are located. A space which contains gas detection equipment complying with **Pt 7, Ch 5, 1306. 11** of **Rules for the Classification of Steel Ships** and a space utilizing boil-off gas as fuel and complying with **Pt 7, Ch 5, Sec 16** of **Rules for the Classification of Steel Ships** are not considered gas-dangerous spaces in this context;
(11) a compartment for cargo hoses; or
(12) an enclosed or semi-enclosed space having a direct opening into any gas-dangerous space or zone.

## Section 2 Ventilation

### 201. General

**1.** Attention is to be given to ventilation inlet and outlet location and airflow in order to minimize the possibility of cross contamination.

**2.** Inlets are to be located in non-hazardous areas as high and as far away from any hazardous area as practicable.

**3.** Each air outlet is to be located in an outdoor area which, in the absence of the considered outlet, is of the same or lesser hazard than the ventilated space.

**4.** Ventilation for hazardous areas is to be completely separate from that used for non-hazardous areas.

### 202. Ventilation of hazardous areas

**1.** Where the ventilation duct passes through a hazardous area of a higher level, the ventilation duct should have overpressure in relation to this area and where the ventilation duct passes through a hazardous area of a lower level, the ventilation duct should have under-pressure in relation to this area.

**2.** The arrangement of ventilation inlet and outlet openings in the space is to be such that the entire space is efficiently ventilated, giving special consideration to location of equipment which may release gas, and to spaces where gas may accumulate.

**3.** The outlet air from Zone 1 and Zone 2 spaces is to be led in separate ducts to outdoor locations. The internal spaces of such ducts belong to the same Zone as the inlet space.

**4.** Air inlet ducts designed for constant relative under-pressures are to be rigidly constructed to avoid air leaks.

**5.** Fans are to be designed so as to reduce the risk that sparks may occur.

**6.** All areas are to be adequately ventilated. Hazardous enclosed spaces are to be ventilated with under-pressure in relation to adjacent non-hazardous locations and non-hazardous enclosed spaces are maintained in overpressure in relation to adjacent hazardous locations. To ensure that a negative pressure condition exists in any enclosed Zone 1 and Zone 2, supply and exhaust fans are to be interlocked so that supply fans cannot be activated without first engaging exhaust fans.

**7.** Means are to be provided for shutdown of ventilation fans and closing external openings from outside the spaces served, in the event of fire or detection of combustible or hydrogen or hydrogen sulfide gas.

### 203. Mechanical Ventilation in the Cargo Area

The requirements of this Section should be substituted for **SOLAS regulations II-2/4.5.2.6** and II-2/4.5.4.

**1.** Spaces required to be entered during normal cargo handling operations

(1) Electric motor rooms, cargo compressor and pump rooms, other enclosed spaces which contain cargo handling equipment and similar spaces in which cargo handling operations are performed should be fitted with mechanical ventilation systems capable of being controlled from outside such spaces. Provision should be made to ventilate such spaces prior to entering the compart-

ment and operating the equipment and a warning notice requiring the use of such ventilation should be placed outside the compartment.

(2) Mechanical ventilation inlets and outlets should be arranged to ensure sufficient air movement through the space to avoid the accumulation of flammable or toxic vapours and to ensure a safe working environment, but in no case should the ventilation system have a capacity of less than 30 changes of air per hour based upon the total volume of the space. As an exception, gas-safe cargo control rooms may have eight changes of air per hour.

(3) Ventilation systems should be fixed and, if of the negative pressure type, permit extraction from either the upper or the lower parts of the spaces, or from both the upper and the lower parts, depending on the density of the vapours of the products carried.

(4) In rooms housing electric motors driving cargo compressors or pumps, spaces except machinery spaces containing inert gas generators, cargo control rooms if considered as gas-safe spaces and other gas-safe spaces within the cargo area, the ventilation should be of the positive pressure type.

(5) In cargo compressor and pump rooms and in cargo control rooms if considered gas-dangerous, the ventilation should be of the negative pressure type.

(6) Ventilation exhaust ducts from gas-dangerous spaces should discharge upwards in locations at least 10 m in the horizontal direction from ventilation intakes and openings to accommodation spaces, service spaces and control stations and other gas-safe spaces.

(7) Ventilation intakes should be so arranged as to minimize the possibility of re-cycling hazardous vapours from any ventilation discharge opening.

(8) Ventilation ducts from gas-dangerous spaces should not be led through accommodation, service and machinery spaces or control stations, except as allowed in **Pt 7, Ch 5, Sec 16** of **Rules for the Classification of Steel Ships.**

(9) Electric motors driving fans other than certified safe type should be placed outside the ventilation ducts if the carriage of flammable products is intended. Ventilation fans should not produce a source of vapour ignition in either the ventilated space or the ventilation system associated with the space. Ventilation fans and fan ducts, in way of fans only, for gas-dangerous spaces should be of non sparking construction defined as: *(2017)*

(A) impellers or housing of nonmetallic construction, due regard being paid to the elimination of static electricity;

(B) impellers and housing of nonferrous materials;

(C) impellers and housing of austenitic stainless steel; and

(D) ferrous impellers and housing with not less than 13 mm design tip clearance.

Any combination or an aluminium or magnesium alloy fixed or rotating component and a ferrous fixed or rotating component, regardless of tip clearance, is considered a sparking hazard and should not be used in these places.

(10) Spare parts should be carried for each type of fan on board referred to in this Section.

(11) Protection screens of not more than 13 mm square mesh should be fitted in outside openings of ventilation ducts.

**2.** Spaces not normally entered

Hold spaces, interbarrier spaces, void spaces, cofferdams, spaces containing cargo piping and other spaces where cargo vapour may accumulate, should be capable of being ventilated to ensure a safe environment when entry into the spaces is necessary. Where a permanent ventilation system is not provided for such spaces, approved means of portable mechanical ventilation should be provided. Where necessary owing to the arrangement of spaces, such as hold spaces and interbarrier spaces, essential ducting for such ventilation should be permanently installed. Fans or blowers should be clear of personnel access openings, and should comply with **Pt 7, Ch 5, 1201. 7** of **Rules for the Classification of Steel Ships.** ⚓

# CHAPTER 8 FIRE PROTECTION, MEANS OF ESCAPE AND FIRE EXTINCTION

## Section 1 General

### 101. Application *(2017)*

**1.** The requirements not specified in this Guidance are to be in accordance with **Pt 7, Ch 5, Sec 11, Sec 12, Sec 13, Sec 14** of **Rules for the Classification of Steel Ships**. However, the floating LNG storage and regasification units(FSRU) which operates at berth and can be supported form the shore may be loosened as follows.

(1) In application to **Pt 7, Ch 5, 1106. 1** of **Rules for the Classification of Steel Ships**, two sets of fire-fighter's outfits may be accepted.

(2) In application to **Pt 8, Ch 8, 101. 3** (1) (B) of **Rules for the Classification of Steel Ships**, emergency fire pump may be omitted where fire water from the shore is connected to onboard shore connection and is continuously provided onboard.

(3) In application to **Sec. 3**, "H-60" may be reduced to "A-60"

### 102. Definition

1. **"H" class divisions** are those divisions formed by bulkheads and decks which comply with the following criteria:

(1) they are constructed of steel or other equivalent material;

(2) they are suitably stiffened;

(3) they are insulated with approved non-combustible materials such that the average temperature of unexposed sides will not rise more than 140 ℃ above the original temperature, nor will the temperature, at any one point, including any joint, rise more than 180 ℃ above the original temperature, within the time listed below during 120-minute hydrocarbon fire tests:

class "H-120" 120 min

class "H-60" 60 min

class "H-0" 0 min

(4) they are constructed as to be capable of withstanding and preventing the passage of smoke and flame to the end of the one-hour standard fire test; and

(5) they are ensured by through tests of prototype bulkheads or decks that the specimen is subjected to the temperature corresponding to the curve of hydrocarbon fire time versus temperature described in Interim Hydrocarbon Fire Resistance Test for Elements of Construction for Offshore Installations given by U.K. Department of Energy or Norwegian Petroleum Directorate to ensure that it meets the above requirements for integrity and temperature rise, and to be approved by the Society or organizations deemed appropriate by the Society.

**2.** **"A class divisions"** are those divisions formed by bulkheads and decks which comply with the following criteria:

(1) they are constructed of steel or other equivalent material;

(2) they are suitably stiffened;

(3) they are insulated with approved non-combustible materials such that the average temperature of the unexposed side will not rise more than 140 ℃ above the original temperature, nor will the temperature, at any one point, including any joint, rise more than 180 ℃ above the original temperature, within the time listed below:

class "A-60" 60 min

class "A-30" 30 min

class "A-15" 15 min

class "A-0" 0 min

(4) they are constructed as to be capable of preventing the passage of smoke and flame to the end of the one-hour standard fire test; and

(5) the Society has required a test of a prototype bulkhead or deck in accordance with the Fire

Test Procedures Code to ensure that it meets the requirements above for integrity and temperature rise.

## Section 2 Prevention of Fire and Explosion

### 201. Location and separation of spaces

#### 1. General

(1) Machinery and equipment are to be arranged in accordance with API RP 14J.

(2) Equipment items that could become fuel sources in the event of a fire are to be separated from potential ignition sources by space separation, firewalls or protective walls. The following may be referred for fuel sources and ignition sources.

| Ignition source | Fuel source |
|---|---|
| Fired vessels, Electrical equipment, Combustion engines, gas turbines, Waste heat recovery equipment, Living quarters, Mobile phones, Flares, Lighting, Welding machines, Spark producing hand tools, Grinding machines, Portable computer, Cutting machinery or torches, Static electricity, Cameras, Non-Intrinsically Safe Flashlights | Gas inlet and swivel, Liquefied gas manifold or loading arm, Process piping and hydrocarbon refrigerant piping, Separators and scrubbers, Riser and pipelines, Coalescer, Vent, Gas compressor, Pig launcher and receiver, Liquefied hydrocarbon pumps, Drains, Heat exchangers, Fuel tank, Hydrocarbon refrigerant storage tanks, Chemical storage tanks, Gas metering equipment, Gas sample containers, Oil purifiers, etc. |

(3) For the overall safety of personnel and unit, the followings are to be considered in design:
- (A) Separation of non-hazardous areas from those classified as hazardous areas
- (B) Minimizing the likelihood of uncontrollable releases of hydrocarbon to the environment
- (C) Minimizing the spread of flammable liquids and gases which may result in a hazardous event and facilitating rapid removal of any accumulations
- (D) Minimizing the probability of ignition
- (E) Minimizing the consequences of fire and explosions
- (F) Preventing fire escalation and equipment damage
- (G) Providing for adequate arrangements for escape and evacuation
- (H) Effective emergency response
- (I) Protection of safety systems, critical systems from damage
- (J) Equipment arrangements are to provide access for inspection and servicing and safe means of egress from all machinery spaces.

(4) In case of a fire onboard the unit, the means of escape is to permit the safe evacuation of all occupants to a safe area, even when the structure they occupy can be considered lost in a conflagration.

**2.** No accommodation spaces are to be located within the cargo area and not to be located above or below the liquefied gas storage tank, condensate storage tank and process areas.

**3.** No control stations are to be located within the cargo area.

**4.** Process systems are to be as follows.

(1) The raw gas inlet and vaporized gas outlet device including swivel are to be separated from sources of ignition and protected from mechanical damage.

(2) "A-0" firewalls around the raw gas inlet area are to be used to provide protection from potential uncontrolled flow from wellheads with shut-in pressures exceeding 42 kg/cm2.

(3) Flare and vent systems are to be in accordance with the API Std. 521 deemed appropriate by the Society. The radiant heat intensities or emissions from flares and vents are not to exceed the following limits:
- (A) In areas where emergency action lasting up to 1 minute may be required by personnel without shielding, but with appropriate clothing: 6.3 kW m
- (B) In areas where emergency action lasting several minutes may be required by personnel without shielding, but with appropriate closing: 4.7 kW m

(C) At any location where personnel are continuously exposed: 1.6 kW m
(D) Temperature rating of electrical and mechanical equipment
(E) At any point on the unit where the gas plumes from vents could be ignited or personnel could come into contact with such gas: 60% LEL

(4) Fired vessels(glycol reboilers, etc.) are to be installed away from wellheads and other hydrocarbon processing and storage equipment. If it is not be possible to comply to the above requirement, particularly when the space of the process area is limited, causing fired vessels to be located in the unfired process areas, then the fired vessel is to be surrounded on all sides by a minimum of "A-0" class firewall.

**5.** Stations for activation of the emergency shutdown system for complete platform shutdown are to be located as follows:

(1) Helicopter decks
(2) Exit stairway landings at each deck level
(3) Boat landings
(4) Emergency evacuation stations
(5) Near the main exits of living quarters
(6) Emergency control station
(7) Process control station

## Section 3 SUPPRESSION OF FIRE

### 301. Containment of fire

**1.** Exterior boundaries of superstructures and deckhouses enclosing accommodation and including any overhanging decks which support such accommodation, are to be constructed of steel and insulated to "H-60" class for the whole of the portions which face the cargo area and the process area and on the outward sides for a distance of 3 m from the end boundary facing the cargo area and process area. In cases where there is a minimum of 33 separation from the cargo area and process area, however, the results of risk assessment or fire load evaluation are satisfactory, "A-0" class may be used instead of the "H-0".

**2.** Fire integrity of bulkheads and decks

(1) The minimum fire integrity of bulkheads and decks shall be as prescribed in **Tables 8.1** and **8.2**.

(2) For determining the appropriate fire integrity standards to be applied to divisions between adjacent spaces, such spaces are classified according to their fire risk as shown in categories ① to ⑫ below. The title of each category is intended to be typical rather than restrictive.

① Control stations
spaces as defined in **Ch 1, 211.** of **Guidance for Mobile Offshore Drilling Unit** (A station where the emergency power source is located is not considered.)

② Corridors
corridors and lobbies.

③ Accommodation spaces
Spaces used for public spaces, cabins, offices, hospitals, cinemas, games and hobby rooms and similar spaces, excluding corridors, lavatories and pantries containing no cooking appliances.

④ Stairways
Interior stairways, lifts and escalators (other than those wholly contained within the machinery spaces) and enclosures thereto. In this connection a stairway which is enclosed only at one level is to be regarded as part of the space from which it is not separated by a fire door.

⑤ Service spaces (low risk)
Lockers, store-rooms and working spaces in which flammable materials are not stored, drying rooms and laundries.

⑥ Machinery spaces of category A
Spaces as defined in **Pt 8, Ch 1, 103. 31** of **Rules for the Classification of Steel Ships**.

⑦ Other machinery spaces
All other machinery spaces than machinery spaces of Category A, containing propelling machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilating and air-conditioning machinery and similar spaces, including trunks to such spaces.

⑧ Process areas, Cargo areas
Areas as defined in **Ch 1 202. 1** and **2** and **Pt 7, Ch 5, 105. 6** of **Rules for the Classification of Steel Ships**.

⑨ Hazardous areas
Areas as defined in **Ch 7, 102.**

⑩ Service spaces (high risk)
Lockers, store-rooms and working spaces in which flammable materials are stored, galleys, pantries containing cooking appliances, paint rooms and workshops other than those forming part of the machinery space.

⑪ Open decks
Open deck spaces and enclosed promenades having little or no fire risk.
Air spaces (the space outside superstructures and deckhouses).

⑫ Sanitary and Similar Spaces
Communal sanitary facilities such as showers, bath, lavatories, etc., and isolated pantries containing no cooking appliances.

**Table 8.1 Fire integrity of bulkheads separating adjacent spaces**

| Spaces | | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | ⑩ | ⑪ | ⑫ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Control stations | ① | A-0[(d)] | A-0 | A-60 | A-0 | A-15 | A-60 | A-15 | H-60[(e)] | A-60 | A-60 | * | A-0 |
| Corridors | ② | | C | B-0 | B-0<br>A-0[(b)] | B-0 | A-60 | A-0 | H-60[(e)] | A-0 | A-0 | * | B-0 |
| Accommodation spaces | ③ | | | C | B-0<br>A-0[(b)] | B-0 | A-60 | A-0 | H-60[(e)] | A-0 | A-0 | * | C |
| Stairways | ④ | | | | B-0<br>A-0[(b)] | B-0<br>A-0[(b)] | A-60 | A-0 | H-60[(e)] | A-0 | A-0 | * | B-0<br>A-0[(b)] |
| Service spaces (low risk) | ⑤ | | | | | C | A-60 | A-0 | H-60[(e)] | A-0 | A-0 | * | B-0 |
| Machinery spaces of category A | ⑥ | | | | | | *[(a)] | A-0[(a)] | H-60[(e)] | A-60 | A-60 | * | A-0 |
| Other machinery spaces | ⑦ | | | | | | | A-0[(a)(c)] | H-0[(e)] | A-0 | A-0 | * | A-0 |
| Process areas, Cargo areas | ⑧ | | | | | | | | - | H-60[(e)] | H-60[(e)] | * | H-60[(e)] |
| Hazardous areas | ⑨ | | | | | | | | | - | A-0 | * | A-0 |
| Service spaces (high risk) | ⑩ | | | | | | | | | | A-0[(c)] | * | A-0 |
| Open decks | ⑪ | | | | | | | | | | | - | * |
| Sanitary and Similar Spaces | ⑫ | | | | | | | | | | | | C |

**Table 8.2 Fire integrity of decks separating adjacent space**

| Spaces below ↓ Space above → | | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | ⑩ | ⑪ | ⑫ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Control stations | ① | A-0 | A-0 | A-0 | A-0 | A-0 | A-60 | A-0 | H-60[(e)] | A-0 | A-0 | * | A-0 |
| Corridors | ② | A-0 | * | * | A-0 | * | A-60 | A-0 | H-60[(e)] | A-0 | A-0 | * | * |
| Accommodation spaces | ③ | A-60 | A-0 | * | A-0 | * | A-60 | A-0 | X | A-0 | A-0 | * | * |
| Stairways | ④ | A-0 | A-0 | A-0 | * | A-0 | A-60 | A-0 | H-60[(e)] | A-0 | A-0 | * | A-0 |
| Service spaces (low risk) | ⑤ | A-15 | A-0 | A-0 | A-0 | * | A-60 | A-0 | H-60[(e)] | A-0 | A-0 | * | A-0 |
| Machinery spaces of category A | ⑥ | A-60 | A-60 | A-60 | A-60 | A-60 | *[(a)] | A-60 | H-60[(e)] | A-60 | A-60 | * | A-0 |
| Other machinery spaces | ⑦ | A-15 | A-0 | A-0 | A-0 | A-0 | A-0[(a)] | *[(a)] | H-0[(e)] | A-0 | A-0 | * | A-0 |
| Process areas, Cargo areas | ⑧ | H-60[(e)] | H-60[(e)] | X | H-60[(e)] | H-60[(e)] | H-60[(e)] | H-60[(e)] | - | - | H-60[(e)] | - | H-60[(e)] |
| Hazardous areas | ⑨ | A-60 | A-0 | A-0 | A-0 | A-0 | A-60 | A-0 | - | - | A-0 | - | A-0 |
| Service spaces (high risk) | ⑩ | A-60 | A-0 | A-0 | A-0 | A-0 | A-0 | A-0 | H-60[(e)] | A-0 | A-0[(c)] | * | A-0 |
| Open decks | ⑪ | * | * | * | * | * | * | * | - | - | * | - | * |
| Sanitary and Similar Spaces | ⑫ | A-0 | A-0 | * | A-0 | * | A-0 | A-0 | H-60[(e)] | A-0 | * | | * |

Note: To be applied to **Tables 8.1** and **8.2** as appropriate.

(a) Where the space contains an emergency power source or components of an emergency power source adjoining a space containing a unit's service generator or the components of a unit's service generator, the boundary bulkhead or deck between those spaces is to be an "A-60" class division.

(b) Either of the divisions indicated above or below is to be provided in consideration of **Ch 10, 201. 9 (3)** and **(5)** of **Guidance for the Mobile Offshore Drilling Units**.

(c) Where spaces are of the same numerical category and superscript (c) appears, a bulkhead or deck of rating shown in the table is only required when the adjacent spaces are for a different purpose, e.g. in category ⑩. A galley next to a galley does not require a bulkhead but a galley next to a paint room requires an "A-0" bulkhead.

(d) Bulkheads separating the navigating bridge, chartroom and radio room from each other may be an "B-0" rating.

(e) If the results of a Risk Analysis or Fire Load Analysis (reviewed and accepted by the Society) justify such, an "A-60" fire division may be used in lieu of an "H-60" bulkhead. An "A-0" wall used in conjunction with a water curtain system designed to provide a density of at least 6.1 $\ell/m^2$-min of exposed surface area may be used as an equivalent means of meeting the "A-60" class division.

* Where an asterisk appears in the tables, the division is required to be of steel or other equivalent material but is not required to be of "A" class standard. However, where a deck, except an open deck, is penetrated for the passage of electric cables, pipes and vent ducts, such penetrations should be made tight to prevent the passage of flame and smoke.

\- Where "-" appears in the table, the division need not be of "A", "B" nor "C" class divisions.

X Where an "X" appears in the table, the configuration is not allowed.

## 302. Fire fighting system

**1.** Fire water main equipment, water spray system and dry chemical powder fire-extinguishing systems are to comply with applicable requirements of **Pt 7, Ch 5, Sec 11.** of **Rules for the Classification of Steel Ships** except as otherwise provided in **Par 2** and **Par 3**.

### 2. Water spray system

(1) A water spray system is to cover the following equipment in addition to areas specified in **Pt 7, Ch 5, 1103. 1** (1) to (8) of **Rules for the Classification of Steel Ships**.
  (A) Process equipment
  (B) Connection for risers and turret areas

(2) In application to **Pt 7, Ch 5, 1103. 7** of **Rules for the Classification of Steel Ships**, remote starting of pumps supplying the water spray system and remote operation of any normally

closed valves in the system are to be arranged in suitable locations outside the cargo area and process area, adjacent to the accommodation spaces and readily accessible and operable in the event of fire in the areas protected.

**3. Dry chemical powder fire-extinguishing systems**

(1) In application to **Pt 7, Ch 5, 1104. 1** of **Rules for the Classification of Steel Ships**, a dry chemical powder fire-extinguishing system is to cover process areas.

(2) The capacity of the system is be determined by the fire and explosion analysis. However, the capacity is not be not less than required amount specified in **Pt 7, Ch 5, 1104.** of **Rules for the Classification of Steel Ships.**

**4.** Fire fighting systems of helicopter facilities are to comply with **Ch 10, Sec 4** of **Rules for the Classification of the Mobile Offshore Drilling Units**.

**5.** Quantities and locations of portable fire extinguishers are to comply with **Ch 8, 302. 8** of Guidance **for the Classification Floating Production Units.**

## 303. Fire detection and alarm systems

**1.** An automatic fire detection system is to be installed in machinery spaces, service spaces, accommodation spaces, process areas and in any space containing equipment in which hydrocarbons or any other flammable substance is stored, conveyed, processed or consumed.

**2.** When a fire is detected in the process area, the process is to be automatically stopped and the venting system is to be shut off.

**3.** Automatic shutdown of ventilation is to take place upon:

(1) detection of fire in enclosed spaces, unless this is in conflict with overall smoke control strategy.

(2) smoke detection in ventilation air inlets.

**4.** Detected fire in wellhead, turret, process plant, storage tank area or offloading area is to initiate automatic shutdown of wellhead valves and process facilities.

## 304. Gas detecting and alarm devices *(2017)*

**1.** A permanently installed system of gas detection is to be installed in accordance with **Pt 7, Ch 5, 1306. 2** of **Rules for the Classification of Steel Ships**.

**2.** Automatic shutdown of all hydrocarbon flow is to take place when gas is detected.

**3.** Automatic shutdown of ventilation is to take place upon confirmed detected gas in the air inlets to nonhazardous areas. Shutdown of ventilation is to ensure that the detected gas is isolated from ignition sources in the ventilated space.

**4.** Upon detection of hydrocarbon gas in the area of wellhead, turret, production facilities and storage tanks, the wellhead valves and production facilities are to be automatically shut down.

## 305. Fireman's Outfits

**1.** Fire-fighter's outfits are to comply with the Fire Safety Systems Code.

**2.** Fire-fighter's outfits are to comply with **Pt 7, Ch 5, 1106.** of **Rules for the Classification of Steel Ships**.

**3.** The fireman's outfits or sets of personal equipment are to be stored as to be easily accessible and ready for use, and where more than one fireman's outfit or more than one set of personal equipment is carried, they are to be stored in widely separated positions.

**4.** One of the outfits is to be readily accessible from the helicopter deck.

# Section 4 Means of Escape

## 401. Fireman's Outfits

### 1. General

All units are to have a designated muster stations where personnel can gather prior to entering the lifeboats.

### 2. Materials

All materials that comprise the muster stations routes are to be of steel or equivalent material.

### 3. Muster stations

(1) The muster station is to be of sufficient area to accommodate the number of personnel to be gathered.
(2) The muster station is to be located in a safe location with respect to the processing equipment.
(3) The muster station may be a meeting room inside the accommodations or may be part of the lifeboat embarkation station.

## 402. Escape route

### 1. Materials

All materials that comprise the escape routes are to be of steel or equivalent material.

### 2. Escape route

(1) At least two means of escape are to be provided for all continuously manned areas, and areas that are used on a regular working basis.
(2) The two means of escape are to be through routes that minimize the possibility of having both routes blocked in an emergency situation.
(3) Escape routes are to have a minimum width of 700 mm.
(4) Dead-end corridors exceeding 7 m in length are not permitted.
(5) Dead-end corridors are defined as a pathway which (when used during an escape) has no exit.

### 3. Marking and lighting of escape routes

Escape route paths are to be properly identified and provided with adequate lighting.

### 4. Escape route plan

(1) An escape route plan is to be prominently displayed at various points in the unit.
(2) Alternatively, this information may be included in the fire control plan.

## 403. Breathing Apparatus

**1.** A self-contained breathing apparatus of an approved type for escape purposes is to be provided for each person in working areas where hydrogen sulphide may be encountered.

**2.** The breathing apparatus for maintenance personnel is to have a minimum of 30 minutes air supply.

**3.** A designated safe area with proper supply of air is also to be provided and shown on the fire control plan.

## 404. Means of Embarkation

**1.** A unit is to have means of embarkation to allow personnel to leave the unit in an emergency.

**2.** The means of embarkation are to consist of at least two fixed ladders or stairways, widely separated, and extending from the main decks to the water line.

**3.** The ladders or stairways will preferably be located near lifeboat-launching stations.

**4.** Ladder construction is to be in accordance with the appropriate governmental authority, or other recognized standard. ⚓

# CHAPTER 9 MACHINERY INSTALLATIONS

## Section 1 General

### 101. Application

1. The requirements of this Chapter do not apply to the machinery installations used solely for process operation.
2. In the case of items not specified in this Chapter, the requirements specified in **Pt 5, Pt 7, Pt 8, Pt 9** of **Rules for mobile offshore drilling units** and **Pt 7, Ch 5** of **Rules for the Classification of Steel Ships** are to be applied. However, units not engaged in voyage are to comply with the followings. *(2017)*
   (1) The requirements in **Pt 5, Ch 6, 107. 1** and **9** of **Rules for the Classification of Steel Ships** may not be applied.
   (2) Units which also operates at berth are to comply with the followings.
      (A) The requirements in **Pt 5, Ch 6, 201. 1** (5) of **Rules for the Classification of Steel Ships** may not be applied.
      (B) The requirements in **Pt 5, Ch 6, 901. 13** of **Rules for the Classification of Steel Ships** may not be applied.
      (C) The water detection requirements in **Ch 5, 203. 5** (1) of **Rules for mobile offshore drilling units** may not be applied.
      (D) The water detection requirements in **Ch 5, 203. 7** (1) of **Rules for mobile offshore drilling units** may not be applied.

## Section 2 Piping Systems for Cargo Tanks

### 201. Pressure Vessels and Liquid, Vapour and Pressure Piping Systems for Cargo

Pressure vessels and liquid, vapour and pressure piping systems for cargo are to be in accordance with **Pt 7, Ch 5, Sec 5** of **Rules for the Classification of Steel Ships**.

### 202. Cargo tank perging and Inert gas system

1. On units equipped for storage of liquid hydrocarbons, a permanently installed inert gas system is to be provided for tank purging and inerting.
2. Inert gas systems are to be comply with **Pt 8, Annex 8-5** of **Rules for the Classification of Steel Ships**.

### 203. Cargo tanks venting system

1. Where pressure/vacuum relief valves are fitted on crude oil tanks, pressure relief lines are to be connected to the low-pressure flare header, or vented to a safe location.
2. The crude oil tanks venting system is to be designed and constructed in accordance with **Pt 7, Ch 5, Sec 8** of **Rules for the Classification of Steel Ships**.

### 204. Environmental Control of Cargo tanks and Piping Systems

Environmental control of cargo tanks and piping systems are to be in accordance with **Pt 7, Ch 5, Sec 9** of **Rules for the Classification of Steel Ships**.

# Section 3 Use of Natural Gas as Fuel

## 301. General

Boilers, gas turbines and internal combustion engine using produce gas as fuel are to comply with the requirements given in **Pt 7, Ch 5, Sec 16** of **Rules for the Classification of Steel Ships** in addition to requirements given in this Chapter.

## 302. Ventilation systems

1. The ventilation of boiler and engine rooms is to be carried out at pressures which exceed atmospheric pressure. Main ventilation systems are to be independent of all other ventilation systems. The number of pressure fans for boiler and engine rooms are to be such that capacity is not reduced by more than 50%, if one fan is out of operation.
2. Ventilation systems are to ensure good air circulation in all spaces, and in particular, ensure that there is no possibility of the formation of gas pockets in any space.

## 303. Gas fuel supply systems

Gas processing systems including storage vessels, compressors, separators, filters, pressure control valves, etc., are to be located in hazardous areas and separated from boiler and engine rooms by gas-tight bulkheads.

## 304. Enclosed spaces above decks having boilers and engines

1. Enclosed spaces above decks having boilers and engines using produced gas as fuel, are to have ventilation systems providing at least 30 air changes per hour.
2. These spaces are to be fitted with gas detection systems to alarm at 20% L.E.L., and to activate automatic shutdown of the gas supply at 60% L.E.L.
3. The automatic shutdown valve is to be located outside the space. This valve is also to be activated upon loss of the required ventilation in the enclosed space, and upon detection of abnormal pressure in the gas supply line.

## 305. Gas containing hydrogen sulfide($H_2S$)

1. For produced gas containing hydrogen sulfide($H_2S$), provisions are to be made for gas sweetening, unless the equipment manufacturer has certified the suitability of the equipment for sour gas application, and the equipment is located in a freely ventilated open space.
2. To bring fuel gas containing $H_2S$ to the equipment located in an enclosed machinery space, the sour gas is to be sweetened. Additionally, the machinery space is to be equipped with $H_2S$ gas detectors. The detectors are to be set to alarm at 10 ppm and to activate the shutdown valve at 50 ppm. ⚓

# CHAPTER 10 ELECTRICAL EQUIPMENT AND CONTROL SYSTEMS

## Section 1 Electrical Equipment

### 101. General

#### 1. Application

(1) The requirements of this Section apply to the electrical equipment installed in the unit.

(2) The electrical equipment is to comply with relevant requirements in **Pt 7, Ch 5** of **Rules for the Classification of Steel Ships** and **Pt 10, Ch 1** of **Guidance for Floating Production Units.** However, in application to **Ch 10, 108. 1** (3) of **Guidance for Floating Production Units**, restricted service units are to comply with the followings. *(2017)*

(A) One set of the main sources of electrical power may be acceptable.

(B) Electrical power supplied from shore may be used as main source of power at the discretion of the Society. However, the units having lighting systems such as the navigation lights, signal lights etc. are to be so designed as to be capable of operating these lighting systems without supplying electric power from the shore except that two or more sets of electric power sources are provided at this supplier.

#### 2. Codes and standards

In the case of items not specified in this Chapter, API RP 14FZ or equivalent recognised standards such IEC.

## Section 2 Control Systems

### 201. General

#### 1. Application

(1) Requirements in this Section apply to the instrumentation and control systems for offshore facilities.

(2) The control system is to comply with relevant requirements in **Pt 10, Ch 2** of **Guidance for Floating Production Units**.

#### 2. Codes and standards

In the case of items not specified in this Chapter, API RP 14C or equivalent recognised standards such IEC. ⚓

# CHAPTER 11 PERSONNEL PROTECTION

The personnel protection is to comply with requirements in **Pt 7, Ch 5, Sec 14** of **Rules for the Classification of Steel Ships**. ⚓

# CHAPTER 12 REGASIFICATION SYSTEMS

## Section 1 General

### 101. Application

**1.** The requirements in this Chapter apply to regasification system installed in the unit with Regasification notation specified in **Ch 2**. For the regasification system installed in the unit without Regasification notation, safety related requirements of this Chapter including facility layout, safety system, process shutdown systems shall be applied.

**2.** In this Chapter, the boundary between regasification systems and other onboard systems are as the following.

(1) from the flange connected to the outlet flange of the storage tank for liquefied gas piping
(2) to the last outlet flange in the unit connected to the vaporized gas export system

**3.** The requirements not specified in this Guidance are to be in accordance with relevant requirements in **Ch 8, Ch 9, Ch 10**.

### 102. General

**1.** Regasification system and associated equipment are to be designed to minimize the risk of hazards to personnel and property caused by potential threats to safety, with considering the followings:

(1) Prevent an abnormal condition from causing an upset condition
(2) Prevent an upset condition from causing a release of hydrocarbons
(3) Safely collect and dispose of hydrocarbon gasses and vapors released
(4) Prevent formation of explosive mixtures
(5) Prevent ignition of flammable liquids or gases and vapors released
(6) Limit exposure of personnel to fire hazards

**2.** Structure that supports regasification systems or forms an integral part of the equipment is to be designed to a recognized standard. Plans and calculations are to be submitted for the Society review. Process liquid weights and dynamic loads due to installation motions and other loads, such as wind imposed loads, are to be considered.

### 103. Codes and standards

**1.** The requirements not specified in this Guidance are to be in accordance with recognized national or international standards.

**2.** The following standards may be adequately referred as recognized national or international standards.

| Standard No. | Standard Title |
|---|---|
| API RP 520 | Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries: Part I - Sizing and Selection |
| API RP 521 | Guide for Pressure-Relieving and Depressuring Systems |
| ASME B31.3 | Process Piping |
| API RP 14E | Recommended Practice for Design and Installation of Offshore Production Platform Piping Systems |
| API RP 14C | Recommended Practice for Analysis, Design, Installation and Testing of Basic Surface Safety Systems on Offshore Production Platforms |
| ISO 10418 | Petroleum and natural gas industries -- Offshore production installations -- Analysis, design, installation and testing of basic surface process safety systems |

## 104. Definition

1. **Blow down system** is to system to maintain safety of facility by removing process gas.
2. **Suction Drum** is the drum to supply LNG stable to HP LNG Pump of liquefied natural gas re-gasification and boil-off gas recovery that occurs during evaporation to return back to the cargo tank acts.
3. **Booster Pump** the pump to pressurize LNG from suction drum to high pressure and transfer it to vaporizer.
4. **LNG Vaporizer** is the equipment to vaporize LNG supplied from HP LNG pump to NG.

## 105. Design conditions

The Regasification systems are to be designed to account for all applicable environmental, operational, and test loads, or combination thereof. These include the following:

1. Environmental Conditions
   (1) Earthquake
   (2) Wind Ice
   (3) Ice
   (4) Temperature
   (5) Current, waves
   (6) 1, 10, 50, 100 year storm event, as applicable
2. Operational Condition
   (1) Static pressure
   (2) Vibration
   (3) Transient pressure excursion
   (4) Acceleration loads due to movement of installation
   (5) Temperature excursion
   (6) Fluid static head and properties
   (7) Tension
   (8) Bending
3. Transportation
4. Installation
5. Commissioning
6. Storage and maintenance
7. Test loads

## 106. Classification survey during construction

### 1. Plans and data to be submitted

(1) Plans and data for approval
   (A) General arrangement of regasification systems
   (B) Hazardous area classification plans and ventilation arrangement
   (C) Piping and instrument diagrams (P&ID)
   (D) Pressure relief and depressurization vent systems arrangement
   (E) Flare/gas release systems arrangements
   (F) Spill containment, closed and open drain systems arrangements
   (G) Major equipment documentation of regasification systems

(2) Plans and data for reference
   (A) Process flow sheets showing major process equipment components, process piping, material balance, normal pressures and temperatures at the inlet and outlet of each major component
   (B) Safety Analysis Function Evaluation Chart
   (C) Philosophy of emergency shut down system and process shut down system
   (D) Document for stress analysis of the high-pressure pipes, the impact analysis in accordance with the immediate loss of the heating medium, stress analysis according to the piping leakage and piping vibration analysis, etc.

**2. Certification of equipment**

(1) The manufactured equipment and components are to be verified for satisfactory compliance with the requirements of this Chapter and the requirements of applicable **Rules for the Classification of Steel Ships**.

(2) The tests and surveys for pressure vessels, heat exchangers, pumps, compressors, valves and piping of regasification system are to comply with **Pt 7, Ch 5, Sec 5** of **Rules for Classification of Steel Ships**. However, regarding the devices for refrigerants which are not in direct contact with the cargo are to comply with other appliable **Rules for the classification of steel ships**.

**3. Onboard test**

(1) Onboard installation tests of all regasification systems are to be verified by the Surveyor and are to be in accordance with the Society agreed test procedures.

(2) Onboard tests and Surveys of regasification systems are to comply with **Pt 7, Ch 5, Sec 5** of **Rules for Classification of Steel Ships**. However, regarding the devices for refrigerants which are not in direct contact with the cargo are to comply with other appliable **Rules for the classification of steel ships**.

## Section 2 Design of Regasification Systems

### 201. General

**1.** Regasification systems are to be arranged so that one single maloperation or malfunction will not lead to critical situations for personnel or the unit.

**2.** The requirements not specified in this Guidance are to be in accordance with **Pt 7, Ch 5, Sec 5. of Rules for the Classification of Steel Ships**.

### 202. Heating system for vaporizer of regasification system

**1.** Heating device of the vaporizer may be composed of the following systems.

(1) Closed Loop System is that heat and reuse the part of seawater by seawater heater as re-circulate seawater from vaporizer outlet without suction of new seawater when the seawater temperature is 7.2 ℃ and below.

(2) Combined Loop System is that vaporize LNG maintaining the temperature of vaporizer inlet not less than 14.7 ℃ by heating seawater using seater heater when the seawater temperature is 7.2 ℃ to 14.7 ℃.

(3) Open Loop System is that heaters of direct combustion method is used, and generally used in suitable temperature of seawater is available and the site permitted disposal of cold seawater.

**2.** Heating medium should not exceed 220 ℃.

**3.** Heating systems are to require the device that detecting leakages of high pressure LNG or NG be able to flow to heating medium, and prevent from the over pressure.

**4.** Means for protecting the vaporizer from freezing of the heating medium is to be provided.

### 203. Process shutdown system

**1.** Process shutdown system should be provided for the regasification system. Process shutdown system is to be operated manually and remotely in accordance with **210. Table 12.1**

**2.** In operation of process shutdown system, the booster pump should be stopped and be closed the shutoff valves installed on the relevant regasification equipment.

### 204. Emergency shutdown system

**1.** The ESD system for regasification systems is to be in accordance with **Pt 7, Ch 5, 1810. 3** (1) & (2) of **Rules for classification of Steel Ships.**

2. Activation of the ESD is to stop in-tank transfer pumps and close gas export valves.

3. The ESD system is to be activated by manual call points and by fusible elements and fire detectors located in way of the regasification units in addition as addressed in **Pt 7, Ch 5, 1810. 3** (1) & (2) of **Rules for Classification of Steel Ships**.

## 205. Depressurization system and blow down system

1. The depressurization system is to ensure safe collection and disposal of hydrocarbon during the normal operation and during emergency condition.

2. The depressurization system is to be simple as possible and be designed in accordance with the fail safe principle.

3. Systems that contain significant energy are to be depressurised during an emergency situation. The rate of depressurising is to be sufficient to ensure that rupture will not occur in case of external heat input from a fire.

4. It shall be possible to activate the depressurising system manually from the control station, in addition to automatic actions initiated through the fire detection system based on voting.

5. During an dimensioning accidental event, the integrity and functionality of depressurising piping and valves is to be maintained for the required period of time in order to ensure that successful depressurization can be performed.

6. Blow down system of regasification system is to be arranged to vent from all parts containing more than 400kg of hydrocarbon inventory to vent system.

## 206. Pressure relieving systems

1. Where the suction drum installed to supply the liquefied gas to the booster pump, it shall be provided with a relief valve. The pressure relief valve is to be of adequate capacity for the case where the suction drum is exposed to fire or the outlet of the booster pump is blocked.

2. All pipelines or components which may be isolated in a liquid fill condition should be provided with relief valves.

3. In case of relief to cargo tanks, the effect of routing high pressure LNG/NG to the cargo tank is to be documented.

## 207. Vent system

Special consideration is be given with respect to release rate and the potential for liquid flow through the vent mast. In general, knock-out drum with a high level alarm device is considered to be installed between relief valve and vent mast. As an alternative, a calculation showing sufficient capacity of the vent mast to avoid any liquid release through the mast is to be carried out.

## 208. Alarm and safety system

Alarm and safety system to be provided in accordance with **Table 12.1**.

**Table 12.1 Monitoring of regasification system**

| Parameter (H=High L=Low HH=HighHigh LL=LowLow O=Abnormal condition) | | Alarm | Shut down | Remark |
|---|---|---|---|---|
| Suction drum Pressure | H/L | ● | | |
| Suction drum level | L<br>LL | ● | <br>● | |
| Vaporizer, heating medium inlet temperature | L<br>LL | ● | <br>● | |
| Vaporizer, heating medium inlet pressure | L<br>LL | ● | <br>● | |
| Vaporizer, heating medium outlet temperature | L<br>LL | ● | <br>● | |
| Vaporizer, liquefied gas inlet pressure | H/L | | | |
| Vaporizer, liquefied gas outlet temperature | L<br>LL | ● | <br>● | |
| Vaporizer, vaporized gas outlet pressure | H/L | ● | | |
| Heat exchanger, Steam supply pressure | L | ● | | Steam is not a direct heating medium |
| Heat exchanger, Condensate return temperature | H/L | ● | | Steam is not a direct heating medium |
| Overflow of the glycol heater/ Expansion tank | H<br>HH | ● | <br>● | If a glycol heating circuit is arranged |
| Liquid collector | H/L | ● | | If propane heating circuit is arranged |
| Gas flowmeter of export system | O | ● | | |
| Loss of power supply to control and monitoring system | O | ● | ● | |
| Instrument air, pressure | L<br>LL | ● | <br>● | |
| Natural Gas to export, pressure | H/L<br>LL | ● | <br>● | |
| Natural Gas to export, temperature | L<br>LL | ● | <br>● | |
| Damages on pipe lines for export | O | ● | | |
| Activation of unit's ESD system | O | | ● | |
| Gas leak detection of regasification system | O | ● | | |
| Fire detection in regasification areas | O | ● | ● | Activation of ESD and blow down system |

# Section 3 Regasification System Equipment

## 301. General

This Section provides requirements for regasification equipment that are typically utilized in the unit.

## 302. Definition

1. **Suction Drum** is to supply LNG stable to HP LNG Pump of liquefied natural gas regasification and gas recovery that occurs during evaporation to return back to the cargo tank acts.
2. **In-tank Pump/LP Pump** is to supply LNG from cargo tank to suction drum.
3. **Booster Pump/ HP Pump** is to pressurize over 1450 psi LNG from suction drum and transfer to vaporizer.
4. **LNG Vaporizer** is to vaporize LNG supplied from HP LNG pump to NG.
   (1) **Open Rack Vaporizer** is the method that provide heat loads to LNG inside plate exchanger equivalent to heat tranfer from seawater outside plate exchanger.
   (2) **Submerged Combustion Vaporizer** is the method that is heated by high temperature combustion gas generated from burning fuel gas and air inside of burner submerged in water while the heat exchanger is immersed in water.
5. **Heating system for LNG Vaporizer** is consist of the intermittent medium of glycol and propane gas based on normally seawater or steam.
6. **Boil-off Gas Handling System** is consist of gas compressors and gas condensers, and vaporized gas is normally recycled to structures or used as a fuel gas or condensated in gas condenser or exported through gas compressor or burned by flare system.
7. **Nitrogen System** is required for purging or maintenance of steam generated from equipment and pipes.

## 303. Heating system for vaporizer

1. Closed Loop System is that heat and reuse the part of seawater by seawater heater as recirculate seawater from vaporizer outlet without suction of new seawater when the seawater temperature is 7.2 ℃ and below.
2. Combined Loop System is that vaporize LNG maintaining the temperature of vaporizer inlet not less than 14.7 ℃ by heating seawater using seater heater when the seawater temperature is 7.2 ℃ ~ 14.7 ℃.
3. Open Loop System is that heaters of direct combustion method is used, and generally used in suitable temperature of seawater is available and the site permitted disposal of cold seawater.
4. Heating systems should require the device that detecting leakages of high pressure LNG or NG be able to flow to heating medium, and prevent from the over pressure and the damage of vaporizer by freezing of heating medium.

## 304. Heat exchangers

1. Tubular heat exchangers are to comply with applicable sections of ASME Boiler and Pressure Vessel Code Section VIII, Division 1 or Division 2, TEMA Standards or API Std. 660.
2. Plate and frame exchangers may be employed for handling flammable liquid, with the following restrictions:
   (1) Safety or protective devices are to be provided as required in accordance with of API RP 14C, Appendix A, A10.
   (2) Each exchanger is to be provided with an exchanger enclosure, protective wall, shield or similar barrier, capable of containing spray in case of gasket leakage during operation.
   (3) Each exchanger is to be provided with spill containment and drain capable of handling a liquid release of at least 10% of the maximum flammable stream flowrates.
3. Air-cooled heat exchangers are to comply with API Std. 661. ⚓

# CHAPTER 13 PROCESS SYSTEMS

## Section 1 General

### 101. Application

**1.** The requirements in this Chapter apply to the process systems installed in the unit with Process notation specified in **Ch 2**. For the process systems installed in the unit without process notation, safety related requirements of this Chapter including facility layout, safety system, process shutdown systems apply.

**2.** The requirements in this Chapter apply to facilities which are only installed on the unit and the boundary between process systems and other onboard systems are as the following:

(1) from the first inlet flange of the well fluid flow line above the water level inboard for import systems

(2) to the flange connected with the inlet flange of the storage tank.

**3.** The process system consists of the following equipment.

(1) Gas treatment systems for removal of the acid gases(hydrogen sulfide, carbon dioxide, etc.), dehydration and removal of mercury from raw gas prior to liquefaction

(3) Liquefaction systems for liquefying the treated gas

### 102. General

**1.** In general, the design of process systems and equipment are to comply with the requirement specified in **Ch 11, Sec 2** and **Sec 3** of **Guidance for Floating Production Units**. In addition, for the items which are not specified in this Chapter, systems which are in direct contact with liquefied gas or liquefied gas vapor are to be designed for compliance with the requirements of **Pt 7, Ch 5, Sec 5** of **Rules for Classification of Steel Ships**.

**2.** Hydrocarbon processing systems and associated equipment are to be designed to minimize the risk of hazards to personnel and property caused by potential threats to safety, with considering the followings:

(1) Prevent an abnormal condition from causing an upset condition

(2) Prevent an upset condition from causing a release of hydrocarbons

(3) Safely collect and dispose of hydrocarbon gasses and vapors released

(4) Prevent formation of explosive mixtures

(5) Prevent ignition of flammable liquids or gases and vapors released

(6) Limit exposure of personnel to fire hazards

**3.** Structure that supports process facilities or forms an integral part of the equipment is to be designed to a recognized standard. Plans and calculations are to be submitted for the Society review. Process liquid weights and dynamic loads due to installation motions and other loads, such as wind imposed loads, are to be considered.

### 102. Codes and standards

**1.** The requirements not specified in this Chapter are to be in accordance with recognized national or international standards.

**2.** The following standards may be adequately referred as recognized national or international standards.

| Standard No. | Standard Title |
|---|---|
| NFPA 59A | Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG) |
| EN 1473 | Installation and Equipment for Liquefied natural Gas : Design of onshore installations |
| API RP 14C | Recommended Practice for Analysis, Design, Installation and Testing of Basic Surface Safety Systems on Offshore Production Platforms |
| TEMA | Standard for Heat Exchanger |
| ASME | Boiler and Pressure Vessel Code, Section VIII |
| API RP 520 | Sizing, Selection and Installation of Pressure Relieving Devices in Refineries |
| API RP 521 | Guide for Pressure Relieving and Depressurising Systems |
| API Std 610 | Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries |
| API Std 617 | Axial and Centrifugal Compressors and Expander Compressors for Petroleum, Chemical and Gas Industry Services |
| API Std 618 | Reciprocating Compressors for Petroleum, Chemical and Gas Industry Services |
| API Std 619 | Rotary Type Positive Displacement Compressors for Petroleum, Chemical and Gas Industry Services |
| ASME B31.3 | Process Piping |

## 104. Definition

1. **Gas treatment** is a process in which impurities is removed from the produced raw gas from the well.
2. **Fractionation** is a separation process in which a mixture of treated gas is divided into LNG, LPG, condensate, etc.

## 105. Design conditions

The process systems are to be designed to account for all applicable environmental, operational, and test loads, or combination thereof. These include the following:

1. Environmental Conditions
   (1) Earthquake
   (2) Wind Ice
   (3) Ice
   (4) Temperature
   (5) Current, waves
   (6) 1, 10, 50, 100 year storm event, as applicable
2. Operational
   (1) Static pressure
   (2) Vibration
   (3) Transient pressure excursion
   (4) Acceleration loads due to movement of installation
   (5) Temperature excursion
   (6) Fluid static head and properties
   (7) Tension
   (8) Bending
3. Transportation
4. Installation
5. Commissioning
6. Test loads

## 106. Classification survey during construction

### 1. Submission of plans and documents

(1) The following plans and documents are to be submitted for the approval of the Society at classification survey during construction before the work is commenced.
  (A) General arrangement of process systems
  (B) Hazardous area classification plans and ventilation arrangement
  (C) Piping & instruments diagrams
  (D) Pressure relief and depressurization vent systems arrangement
  (E) Flare/gas release systems arrangements
  (F) Spill containment, closed and open drain systems arrangements
  (G) Major equipment documentation of process systems

(2) The following plans and documents are to be submitted for the reference of the Society at classification survey during construction.
  (A) Process flow sheets showing major process equipment components, process piping, material balance, normal pressures and temperatures at the inlet and outlet of each major component
  (B) Safety Analysis Function Evaluation Chart
  (C) Philosophy of emergency shut down system and process shut down system
  (D) Document for stress analysis of the high-pressure pipes, the impact analysis in accordance with the immediate loss of the heating medium, stress analysis according to the piping leakage and piping vibration analysis, etc.
  (E) Installation, hook-up and commissioning procedures of process system

### 2. Certification of equipment

(1) The manufactured equipment and components are to be verified for satisfactory compliance with the requirements of this Chapter and the requirements of applicable **Rules for the Classification of Steel Ships**.

(2) Certification of equipment and systems of process systems is to comply with **Ch 11, 106. 2** of **Guidance for Floating Production Units**. In addition, systems that are in direct contact with liquefied gas or liquefied gas vapor are to comply with **Pt 7, Ch 5, Sec 5** of **Rules for Classification of Steel Ships**.

### 3. Onboard test

(1) Onboard installation tests of all process systems are to be verified by the Surveyor and are to be in accordance with the Society agreed test procedures.

(2) Onboard tests and Surveys of process systems are to comply with **Ch 11, 106. 3** of **Guidance for Floating Production Units**. In addition, systems that are in direct contact with liquefied gas or liquefied gas vapor are to comply with **Pt 7, Ch 5, Sec 5** of **Rules for Classification of Steel Ships**.

## Section 2 Design of Process Systems

### 201. General

**1.** The items not specified in this Guidance are to be in accordance with **Ch 11** of **Guidance for Floating Production Units**.

### 202. Gas treatment systems

**1.** The produced raw gas from the well is to be removed the acid gas, water and mercury by the gas treatment systems prior to the liquefaction process.

**2.** Any constituents that may become a solid at the temperatures is to be removed to avoid clogging in the path which the feed gas flowing to the liquefaction systems

### 203. Liquefaction systems

**1.** The liquefaction system consists of a pre-cooler, fractionation device and cryogenic cooling device.

**2.** Leakage from the cryogenic cooling devices are to be isolated and drained. The parts where have the potential to contact with leaked cryogenic fluid to be designed to withstand the low temperature, or protected with a shield.

**3.** All equipment must be designed to operate safely for the unit's motion. The design, support and location of high structure such as a fractionation tower is to be specially considered.

**4.** The design is to ensure to prevent contamination of the gas by the refrigerant.

### 204. Electrical Equipment

For the electrical equipment, requirements of **Ch 10, Sec 1** of this Guidance and **Pt 7, Ch 5, Sec 10** of **Rules for the Classification of Steel Ships** are to be complied with.

### 205. Control systems

1. Control systems are to comply with **Ch 10, Sec 2** in addition to requirements in this Article.
2. Control systems for storage of the liquefied gas and transfer of liquefied gas and vaporized gas are to comply with **Pt 7, Ch 5, Sec 13** of **Rules for the Classification of Steel Ships**.

### 206. Emergency shutdown system

**1.** An emergency shutdown(ESD) system with manual stations is to be provided to shutdown the flow of hydrocarbon, and to terminate all gas process and liquefaction process on the unit.

**2.** Loading, offloading and storage system of liquefied gas should be provided with emergency shutoff valves in accordance with **Pt 7, Ch 5, 1810.** of **Rules for the classification of steel ships**.

**3.** The emergency shutdown system is to be automatically activated by:

(1) The detection of an abnormal operating condition by flowline pressure sensors and sensors on any downstream component through which the pipeline fluids flow;
(2) The detection of fire in the wellhead and process areas;
(3) The detection of combustible gas at a 60% level of the lower explosive limit (LEL)
(4) The detection of hydrogen sulfide (H2S) gas at a level of 50 ppm.

**4.** Emergency shutdown stations are to be identified by shutdown function, and shutdown position is to be clearly indicated.

**5.** Emergency stopping devices are to function independently and be able to operate after the loss of main power.

**6.** In cases where emergency stopping devices are put into action and the operation of production system components are stopped, such components are not to automatically restart before manual reset is made.

## Section 3 Process System Equipment

### 301. General

Process System Equipment is to comply with the requirements in **Ch 11, Sec 3 of Guidance for Floating Production Units**. However the selection of material of components handling liquefied gases is to comply with **Pt 7**, **Ch 5, Sec 4** of **Rule for the Classification of Steel Ships**.

## Section 4 Process Support Systems

### 401. General

The design and equipments of process support systems is to comply with the requirements in **Ch 11, Sec 4** of **Guidance for Floating Production Units**. ⚓

# CHAPTER 14 LOADING AND OFFLOADING SYSTEMS *(2017)*

## Section 1 General

### 101. Application

**1.** The requirements of this Chapter apply to the followings:

(1) The Loading Systems on the floating LNG storage and regasification units(FSRU) for transporting liquefied gas to storage tank

(2) The Offloading Systems on floating liquefied gas production units(FLNG) for transporting liquefied gas from storage tank to LNG carriers.

**2.** The definitions and boundary of loading system and offloading system are to comply with **Ch 1, 202. 3.** and **4.**

### 102. General

**1.** Transfer system is to have sufficient integrity to withstand operational and environmental loading throughout the system lifecycle.

**2.** Transfer system is to be designed with suitable functionality for prevention, detection, control and mitigation of foreseeable accident events affecting safety of the installation

**3.** Operational limitations for the transfer operation are to be set with respect to parameters such as :

(1) Sea conditions for safe approach, berthing and departure of the LNG carrier

(2) Operational envelope of the loading arms for relative motion and accelerations

(3) Loads in the mooring lines and fenders between the unit and the carrier

**4.** The transfer system is to be fitted with a Quick Connect Disconnect Coupling to be used in normal operation of the transfer system.

**5.** The QCDC system is to be fitted with an interlock to prevent inadvertent disconnection while transfer is underway or the lines are under pressure.

**6.** The transfer system is to be fitted with an Emergency Release System, which will permit rapid disconnection in the event of an emergency.

**7.** The control of the Emergency Release System is to be arranged to prevent inadvertent operation of the system. Testing of the Emergency Release System function should be possible without releasing the coupling.

**8.** The Emergency Release system is to be fitted with means to minimize any leakage in the event of operation of the system. This may typically involve installation of valves on each side of the separated connection.

**9.** The transfer system is to be designed to accommodate any LNG remaining in the transfer system either following normal disconnection or emergency disconnection.

**10.** Any structural elements which might be exposed to spillage of cryogenic fluid are to be either designed for such exposure or protected against exposure by shielding.

**11.** Effects of possible leakage of LNG on to water between the terminal and the carrier is to be documented (i.e. rapid phase transition scenario).

**12.** The transfer control system is to be linked to the ESD system, communication system, and carrier berthing system (line tension and release systems) to permit a safe disconnect in the event of an emergency.

### 103. Definitions

**1. Emergency shut down(ESD) system** is a system that safely and effectively stops the transfer of LNG and vapour between the LNG carrier and the unit.

**2. Emergency release system(ERS)** is a system that provides a positive means of quick release of

transfer system and safe isolation of LNG carrier and transfer system. An ERS normally contain one or several emergency release couplings

3. **Quick connect disconnect coupling(QCDC)** is a manual or hydraulic mechanical device used to clamp the loading arm or the transfer hose to connection of LNG carrier without use of bolted connections

## 104. Codes and standards

1. The requirements not specified in this Guidance are to be in accordance with recognized national or international standards.

2. The following standards may be adequately referred as recognized national or international standards.

| Standard No. | Standard Title |
|---|---|
| OCIMF/SIGTTO | Ship to Ship Transfer Guide(Liquefied Gases) |
| OCIMF/SIGTTO | Manifold Recommendations for Liquefied Gas Carriers |
| EN 1474-1 | Installation and equipment for liquefied natural gas - Design and testing of marine transfer systems - Design and testing of transfer arms |
| EN 1474-2 | Installation and equipment for liquefied natural gas. Design and testing of marine transfer systems. Design and testing of transfer hoses |
| EN 1474-3 | Installation and equipment for liquefied natural gas - Design and testing of marine transfer systems - Offshore transfer systems |

## 105. Classification survey during construction

### 1. Plans and data to be submitted

(1) The following plans and documents are to be submitted for the approval of the Society at classification survey during construction before the work is commenced.
  (A) Strength analysis of Supporting structures and foundations for transfer arm
  (B) drawing of control and monitoring system for transfer systems
  (C) Arrangement plan of bunker manifold including protection against low-temperature cargo leaks

(2) The following plans and documents are to be submitted for the reference of the Society at classification survey during construction.
  (A) Arrangement plan of transfer arms or transfer hoses
  (B) Working envelope for the transfer arms
  (C) Specification of transfer arms or transfer hoses
  (D) Cargo transfer operation manuals
  (E) Specification of emergency release coupling, emergency release system and quick connect disconnect coupling

### 2. Tests of equipment

(1) Transfer arms and their components are to be type approvedl and tested for each production in accordance with **EN1474-2.**

(2) Transfer hoses are to be type approved and tested for each production in accordance with **EN1474-1.**

### 3. Onboard test

(1) Correct operation of emergency shut down systems and emergency release systems is to be function-tested. and their sequence of operation required by **502.** and **503.** is to be confirmed.

(2) Alarms and safety systems related to the transfer systems are be function-tested.

## Section 2 Cargo Transfer Connection

### 201. General

1. The connections for LNG transfer and vapor return are to be fitted with manually operated stop valve and a remotely/automatically operated valve fitted in series.
2. The manifold is to be designed to withstand the external loads during cargo transfer. Safe working load of the manifold is to meet the **Manifold recommendations for liquefied gas carriers(OCIMF)**.
3. Information about maximum safe working load of the manifold is to be posted at the manifold area.

## Section 3 Transfer Arms

### 301. General

1. The length and the configuration of the transfer arms are to allow for the connection of the unit's manifold to the ship's cargo manifold. The connection is to allow for free movement within the operating envelope.
2. Provision are to be made to protect the piping from excessive stresses due to thermal movement and from movements of hull structure.
3. All piping supports are to be adequately designed so that stresses in the piping and the structure are within allowable limits for all attitudes and positions.
4. Transfer arms are to be designed considering the followings.
   (1) Acceleration forces acting on the transfer arm
   (2) Permissible manifold loads
   (3) Arm working envelope
   (4) Transfer arm support arrangements in operational and stowed positions
   (5) Effect of the hull vibration on the transfer arm
   (6) Vertical and horizontal vessel movement
   (7) Allowable flow velocity and pressure loss

### 302. Design

1. **EN1474-1** is to be applied for design and construction of transfer arms.

## Section 4 Transfer Hoses

### 401. General

1. Transfer hoses are to be compatible with the cargo and suitable for the cargo temperature.
2. Transfer hoses are to be designed for a bursting pressure not less than five times the maximum working pressure.
3. The transfer hose length is to be sufficient to meet obth storage and operational condition.
4. Length and size of the transfer hose are to be determined considering the followings.
   (1) Minimum allowable bend radius of the hose
   (2) Horizontal distance between the unit and the vessel
   (3) Distance between the mnifold and unit's side
   (4) Vertical and horizontal movement of the unit and the vessel
   (5) Relative change in freeboard between the unit and vessel
   (6) Allowable flow velocity and pressure drop

### 402. Design

1. **EN1474-2** is to be applied for design and construction of transfer hoses.

## Section 5 Safety Systems

### 501. General

1. Cargo transfer is to be stopped in the event of a cargo leak on either the unit of the vessel and is not to be resumed until the source of the leak is identified and repaired.
2. Safety systems of transfer systems are to be provided with two stage of protection. The first stage is emergency shutdown system that stops the transfer of cargo and the second stage is emergency release system that releases transfer system form the carrier.
3. The ship and unit monitoring and activation systems are to be linked to ensure the co-ordinated operation of both emergency shutdown system and emergency release system functions on ship and unit.

### 502. Emergency shutdown system

1. Emergency shutdown system is to safely stop and isolate the cargo transfer between ship and shore in the following cases:
   (1) fire or gas detection
   (2) tank high level or abnormal pressure
   (3) ship's drift
   (4) manual signal
   (5) Activation of emergency release system
2. Activation of emergency shutdown system is to initiates the following:
   (1) cargo transfer pump and vapour return compressor shut-down
   (2) Emergency shutdown valves are to be closed and closing time is selected to reduce hydraulic surge in the transfer lines to acceptable limits.

### 503. Emergency release system

1. The function of the emergency release system is to protect the transfer arms and transfer hoses by disconnecting them so that the ship drifts out of their operating envelope.
2. The emergency release system consists of emergency release coupler and two isolating valves, and each isolating valve is to be fitted at each side of emergency release coupler to minimise loss of cargo when the emergency release coupler parts,
3. Initiation of the emergency release system is to result in the simultaneous closing of interlocking isolating valves of emergency release system, followed by the emergency release coupler separation and the transfer arms withdrawing clear of the ship’s structure and adjacent arms; thus preventing the arms being damaged or spillage of LNG.
4. The disconnected arms are to retract behind the berthing line and shall lock hydraulically.
5. The emergency release system is not to be activated if the emergency shutdown system has not started.

### 504. Monitoring and alarm systems

1. A system of constant monitoring of the position of arms is to installed to provide real time information to the operator and ship.
2. Visible and audible arm positioning alarm system is to be installed on each arm for luffing and slewing in all three dimensions in order to detect the excessive drift of the LNG carrier and to initiate the emergency shutdown system and emergency release system.

3. Visual and audible alarms are to be initiated in the following cases:
   (1) low pressure in hydraulic accumulators
   (2) abnormal pressure in actuators chambers
   (3) low oil level in tank
   (4) low nitrogen pressure in accumulators
4. In addition to 2 and 3 above, alarm system and safety system are to be activated in the following cases:
   (1) low pressure in the supply tank
   (2) sudden pressure drop at the transfer pump discharge
   (3) high level or high pressure in the receiving tank
   (4) LNG leakage in manifold area
   (5) gas detection in the ducting around the bunkering lines
   (6) manual activation of emergency shutdown system
   (7) manual activation of the emergency release system
   (8) fire detection
   (9) electrical power failure

## Section 6 Communication Systems

### 601. General

1. Units are to be equipped with communication means for communication between the unit and LNG carrier.
2. The components of the communication system located in hazardous area are to be of certified safe type.
3. Where portable radios are used for communication with LNG carrier, they are to be of certified safe type for hazardous area.

## Section 7 Mooring equipment

### 601. General

1. Units are to be equipped with sufficient number of closed type fairleads for safe mooring to LNG carrier.
2. Reference is made to **OCIMF Mooring equipment guidelines**. ⚓

# CHAPTER 15 IMPORT AND EXPORT SYSTEM

## Section 1 General

### 101. Application

1. The requirements of this Chapter is applied to units with the Import or Export notation defined in **Ch 2**.
2. Import and export system is to comply with **Ch 12** of **Guidance for Floating Production Units**. ⚓

# GUIDANCE FOR FLOATING LIQUEFIED GAS UNITS

Published by
**KR**
36, Myeongji ocean city 9-ro, Gangseo-gu,
BUSAN, KOREA
TEL : +82 70 8799 7114
FAX : +82 70 8799 8999
Website : http://www.krs.co.kr