BUREAU VERITAS MARINE & OFFSHORE

RULES FOR CLASSIFICATION

RULES FOR THE CLASSIFICATION OF **FLOATING STORAGE REGASIFICATION UNITS** AND **FLOATING STORAGE UNITS**

NR645 R03

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RULE FOR CLASSIFICATION

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Unless otherwise specified, these rules apply to units which are contracted for construction on or after 1 December 2025. The Society may refer to the contents hereof before 1 December 2025, as and when deemed necessary or appropriate.

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These rules are provided within the scope of the Bureau Veritas Marine & Offshore General Conditions, enclosed at the end of Part A of NR467, Rules for the Classification of Steel Ships. The latest version of these General Conditions is available on the Bureau Veritas Marine & Offshore website.

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Rules for Classification
NR645

RULES FOR THE CLASSIFICATION OF FLOATING STORAGE REGASIFICATION UNITS AND FLOATING STORAGE UNITS

December 2025

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Section 1 General Principle of Classification

1 Purpose of the Rules

1.1 General

1.1.1 The requirements of these Rules apply specifically to Floating Storage Regasification Units (FSRUs) defined as floating units fitted with equipment for storage and regasification of liquefied natural gas (LNG) as defined in Sec 2, [1.1.1].

The requirements of these Rules apply also to Floating Storage Units (FSUs) defined as floating units fitted with equipment for storage of liquefied natural gas (LNG) as defined in Sec 2, [1.1.1].

Note 1: These Rules do not apply to:

- floating units designed for gas production for which reference is made to NR542
- pure gas carrier designed for LNG trading only or for bunkering operation for which reference is made to NR467, Part D, Chapter 9 and NR620, respectively.

2 Classification principles

2.1 General

2.1.1 In general, principles of classification set out in NR467, Pt A, Ch 1, Sec 1 and NR445, Pt A, Ch 1, Sec 1 apply.

2.2 Purpose of the classification notations

2.2.1 The classification notations give the scope according to which the class of the unit has been based and refer to the specific rule requirements, which are to be complied with for their assignment. In particular, the classification notations are assigned according to the type, service and navigation of the unit and other criteria which have been provided by the Interested Party, when applying for classification.

The Society may change the classification notations at any time, when the information available shows that the requested or already assigned notations are not suitable for the intended service, navigation and any other criteria taken into account for classification.

Note 1: Reference should be made to NR467, Pt A, Ch 1, Sec 1, [1.3] on the limits of classification and its meaning.

2.2.2 The classification notations assigned to a unit are indicated on the certificate of classification, as well as in the Register published by the Society.

2.2.3 The classification notations applicable to existing units conform to the Rules of the Society in force at the date of assignment of class. However, the classification notations of existing units may be updated according to the current Rules, as far as applicable.

2.3 Types of notations assigned

2.3.1 The types of classification notations assigned to a unit are the following:

a) class symbol

b) construction marks

c) service notations with additional service features, as applicable

d) navigation notations (may be optional)

e) site notation (may be optional)

f) transit notation (may be optional)

g) additional class notations (may be optional).

The different classification notations and their conditions of assignment are listed in Articles [3], [4], [5], [6] and Sec 2, [2] according to their types.

3 Class symbol

3.1 General

3.1.1 The class symbol expresses the degree of compliance of the ship with the rule requirements as regards its construction and maintenance. There is one class symbol, which is compulsory for every classed unit.

3.1.2 The class symbol **I** is assigned to units built in accordance with the requirements of the Rules or other rules recognised as equivalent, and maintained in a condition considered satisfactory by the Society.

The period of class (or interval between class renewal surveys) assigned to class symbol **I** units is maximum 5 years, see NR467, Pt A, Ch 2, Sec 2, [4].

Note 1: The class symbol **I** is to be understood as being the highest class symbol assigned by the Society.

3.1.3 The class symbol **II** is assigned to units which do not meet all requirements for class symbol **I**, but are deemed acceptable to be entered into the register of ships.

The period of class assigned to class symbol **II** ships is maximum 3 years, see NR467, Pt A, Ch 2, Sec 2, [4].

3.1.4 Except for special cases, class is assigned to a unit only when the hull, propulsion and auxiliary machinery installations, and equipment providing essential services have all been reviewed in relation to the requirements of the Rules.

4 Construction marks

4.1 General

4.1.1 The construction mark identifies the procedure under which the unit and its main equipment or arrangements have been surveyed for initial assignment of the class. The procedures under which the ship is assigned one of the construction marks are detailed in NR467, Pt A, Ch 2, Sec 1.

4.1.2 One of the construction marks defined below is assigned separately to the hull of the unit and its appendages, to the machinery installation, and to some installations for which an additional classification notation (see Sec 2, [2]) is assigned.

The construction mark is placed before the symbol **HULL** for the hull, before the symbol **MACH** for the machinery installations, and before the additional class notation assigned, when such a notation is eligible for a construction mark.

If the unit has no machinery installations covered by classification, the symbol **MACH** is not assigned and the construction mark will be only placed before the symbol **HULL**.

4.1.3 The construction marks refer to the original condition of the unit. However, the Society may change the construction mark where the unit is subjected to repairs, conversion or alterations.

4.2 List of construction marks

4.2.1 The mark ✠ is assigned to the relevant part of the unit, when it has been surveyed by the Society during its construction in compliance with the new building procedure detailed in NR467, Pt A, Ch 2, Sec 1, [2.1], or when it is changing class from an IACS Society at ship's delivery or when class is being added to an IACS Society's class at unit's delivery in accordance with specific procedures.

4.2.2 The mark ✠ is assigned to the relevant part of the ship, when the latter is classed after construction in compliance with the procedure detailed in NR467, Pt A, Ch 2, Sec 1, [3.2] and it is changing class from an IACS Society at the time of the admission to class.

4.2.3 The mark • is assigned to the relevant part of the unit, where the procedure for the assignment of classification is other than those detailed in [4.2.1] and [4.2.2], but however deemed acceptable.

5 Service notations and corresponding additional service features

5.1 General

5.1.1 The service notations define the type and/or service of the unit which have been considered for its classification, according to the request for classification signed by the interested party. At least one service notation is to be assigned to every classed unit.

Note 1: The service notations applicable to existing units conform to the Rules of the Society in force at the date of assignment of class. However, the service notations of existing units may be updated according to the current Rules, as far as applicable, at the request of the Interested Party.

A service notation may be completed by one or more additional service features, giving further precision regarding the type of service of the unit, for which specific rule requirements are applied.

The different service notations which may be assigned to a unit and the different additional service features are listed in Sec 2, [2].

6 Additional class notations

6.1 General

6.1.1 An additional class notation expresses the classification of additional equipment or specific arrangement, which has been requested by the Interested Party.

The assignment of such an additional class notation is subject to the compliance with additional rule requirements, which are detailed in NR467, Part A or NR445, Part A.

Some additional class notations are assigned a construction mark, according to the principles given in [4.1.2]. This is indicated in the definition of the relevant additional class notations.

The different additional class notations which may be assigned to a unit are listed in Sec 2, [2].

7 Assignment of class

7.1 General

7.1.1 In general, assignment of class set out in NR467, Pt A, Ch 2, Sec 1 or NR445, Pt A, Ch 1, Sec 3 applies.

8 Site conditions and related operating procedures

8.1 Design criteria statement on-site

8.1.1 General

Classification is based upon the design data or assumptions specified by the party applying for classification.

A design criteria statement is to list the service(s) performed by the unit and the design conditions and other assumptions on the basis of which class is assigned to the unit.

The design criteria statement is issued by the Society, based on information provided by the party applying for classification.

The design criteria statement is to be referred to in a memorandum on the class certificate.

The design criteria statement is to be incorporated in the operating manual as prescribed in [8.2].

8.1.2 Unit’s activities

The design criteria statement is to list the main services for which the unit is designed, the service notation and other notations assigned to the unit.

The nature of the unit's activity is to be duly accounted for in the application of the present Rules, as far as classification is concerned.

The design criteria statement is to mention when the unit is a permanent unit, and to make reference to the applicable site data.

8.1.3 Structural design criteria

The design criteria statement is to list the necessary data pertaining to the structural design of the unit for the different conditions of operation on-site of the unit, according to the provisions of Sec 5, as applicable.

Note 1: Transit of non self-propelled units is covered by classification as regards only the unit's structural overall and local strength as well as stability. All other aspects relating to towing are reviewed only on special request for a towage survey.

Note 2: As regards design of the foundations of equipment, classification is based upon the data submitted by the party applying for classification, under the format called for by the Rules.

8.1.4 Machinery, electrical and other system design conditions

The Party applying for classification is to submit the necessary description, diagrammatic plans, design data of all systems, including those used solely for the service performed by the unit on-site and, where applicable, their cross connections with other systems. The submitted data are to incorporate all information necessary to the assessment of the unit for the purpose of the assignment of class or for the assignment of additional class notations.

In accordance with [8.1.1] the party applying for classification is to give an estimation of electric balance for the different conditions of operation on-site of the unit. The specifications are to list all important equipment and apparatus, their rating and the power factors as applicable.

8.2 Operating manual on-site

8.2.1 An operating manual, which includes instructions regarding the safe operation of the unit and of the systems and equipment fitted on the unit, is to be placed onboard the unit.

The operating manual is to incorporate a dedicated section containing all information relating to classification, particularly environmental, loading and other design criteria as well as classification restrictions. The operating manual is to be, at all times, placed on board the unit and made available to all concerned. A copy of the operating manual is to be retained ashore by the Owners of the unit or their representatives.

It is the responsibility of the Interested party to prepare the contents of the operating manual.

9 Statutory requirements

9.1 General

9.1.1 Project specification

Prior to commencement of the review of drawings, the complete list of regulations, codes and statutory requirements to be complied with is to be submitted for information:

- international regulations
- flag state requirements
- coastal state requirements.

The project specification is also to specify the list of statutory certificates requested by the Owner.

9.1.2 Conflict of rules

In case of conflict between the present Rules and any statutory requirements as given by flag state or coastal state, most stringent requirements are to be applied.

Section 2 Classification of FSRUs and FSUs

1 General

1.1 Application

1.1.1 FSRUs (as defined in Sec 1, [1.1.1]) complying with these Rules are assigned one of the service notation **liquefied gas carrier - FSRU** or **FSRU** as defined in [2.1.1].

1.1.2 FSUs (as defined in Sec 1, [1.1.1]) complying with these Rules are assigned one of the service notation **liquefied gas carrier - FSU** or **FSU-LNG**.

1.1.3 Units intended to be assigned one of the service notation defined in [2.1.1], are to comply with the requirements of IGC Code, except where otherwise specified in these Rule. These Rules provide additional requirements and interpretations of IGC Code to be considered for the purpose of classification. The Society may refer to IGC Code, as defined in [3.2.1], when deemed necessary.

1.1.4 In general, units with the service notation **liquefied gas carrier - FSRU** or **liquefied gas carrier - FSU** are to comply with the requirements indicated in Tab 1.

1.1.5 In general, units with the service notation **FSRU** or **FSU** are to comply with the requirements indicated in Tab 1, as relevant, unless where indicated otherwise in these Rules.

1.2 Exclusion

1.2.1 These Rules do not cover the emergency escape mode due to harsh weather or accidental cases (for instance fire, explosion). This emergency escape mode is considered beyond the scope of classification, unless specific demand has been received from the party applying for classification.

Note 1: Emergency escape mode correspond to the possibility for the unit to leave the jetty and navigate at low speed for a short voyage during an emergency.

Table 1 : Applicable requirements

Item	Service notations **liquefied gas carrier - FSRU** or **liquefied gas carrier- FSU**	Service notations **FSRU** or **FSU-LNG**
General arrangement	Sec 8 NR467, Part B NR467, Part D, Chapter 9	Sec 8 **(1)** NR467, Part B **(1)** NR467, Part D, Chapter 9 **(1)**
Hull and cargo containment	Sec 3 **(1)** Sec 4 **(1)** Sec 5 **(1)** Sec 6 **(1)** Sec 7 Sec 8 NR467, Part B NR467, Part D, Chapter 9	Sec 3 Sec 4 Sec 5 Sec 6 Sec 7 Sec 8 NR467, Part B **(1)** NR467, Part D, Chapter 9 **(1)**
Materials and welding	Sec 6 NR467, Part D, Chapter 9 NR216	Sec 6 NR467, Pt D, Ch 9 NR216
Stability	Sec 3 NR467, Part B NR467, Part D, Chapter 9	Sec 3 NR467, Part B **(1)** NR467, Part D, Chapter 9 **(1)**

(1) When relevant
(2) Not applicable for units with the service notation **liquefied gas carrier - FSU** or **FSU-LNG**
(3) For units assigned the additional class notation **ASP**
Note 1:
NR467: Rules for the Classification of Steel Ships
NR216: Rules on Materials and Welding for the Classification of Marine Units.

Item	Service notations **liquefied gas carrier - FSRU** or **liquefied gas carrier- FSU**	Service notations **FSRU** or **FSU-LNG**
Machinery, cargo systems and safety features	Sec 10 **(2)** Sec 12 Sec 13 NR467, Part C NR467, Part D, Chapter 9	Sec 10 **(2)** Sec 12 **(1)** Sec 13 NR467, Part C **(1)** NR467, Part D, Chapter 9 **(1)**
Electrical installations and automation	Sec 11 Sec 12 NR467, Part C NR467, Part D, Chapter 9	Sec 11 Sec 12 NR467, Part C **(1)** NR467, Part D, Chapter 9 **(1)**
Design requirements for surveys on site	Sec 14	Sec 14
In-service survey	Sec 15 App 1 **(3)**	Sec 15 App 1 **(3)**

(1) When relevant
(2) Not applicable for units with the service notation **liquefied gas carrier - FSU** or **FSU-LNG**
(3) For units assigned the additional class notation **ASP**
Note 1:
NR467: Rules for the Classification of Steel Ships
NR216: Rules on Materials and Welding for the Classification of Marine Units.

2 Classification

2.1 Classification notations

2.1.1 Service notations

Units complying with these Rules are assigned one of the following notations:

- **liquefied gas carrier - FSRU**, when the floating unit is designed to operate as a regasification unit with the possibility of trading LNG in a navigation mode
- **liquefied gas carrier - FSU**, when the floating unit is designed to operate as a storage unit with the possibility of trading LNG in a navigation mode
- **FSRU**, when the floating unit is designed to operate as a regasification unit permanently moored without trading LNG
- **FSU-LNG**, when the floating unit is designed to operate as a storage unit permanently moored without trading LNG.

These service notations are to be completed by the additional service feature **([cargo type], [ship type], [cargo containment system type], [P_{design}], [T_{min}])** indicating the cargo type, the IMO code ship type, the cargo containment system type, the cargo tank design pressure P_{design} and minimum temperature T_{min}, as defined in NR467, Pt A, Ch 1, Sec 2, [4.4.5].

2.1.2 Additional service feature REGAS

The additional service feature **REGAS** is to be assigned to units with the service notation **liquefied gas carrier - FSRU** or **FSRU**.

The requirements for the regasification systems fitted to these units and for the assignment of these additional service feature are defined in Sec 10.

2.1.3 Additional class notation REGAS

On a voluntary application from interested parties, units other than those covered by the scope defined in [2.1.2] may be assigned the additional class notation **REGAS**, provided that requirements of the present Rules are complied with. In that case, the applicability of **REGAS** notation is to be considered on case by case basis.

2.1.4 Other additional service features

The following additional service features defined in NR445, Pt A, Ch 1, Sec 2 may be assigned to units covered by the present Rules when relevant:

- **SLOSHING** - mandatory for units using membrane tanks for cargo containment

Note 1: **SLOSHING** may also be requested by the Society on a case-by-case basis for containment systems other than membrane type, if deemed necessary considering the specific design of the containment system.

- for units considered as permanent installations, as defined in [4.2.8]:
  - moored at a jetty: **POSA JETTY** - recommended
  - moored at sea: **POSA** - mandatory.

2.1.5 Additional class notation ASP

The additional class notation **ASP** is assigned to units for which an alternative survey programme is implemented in accordance with the requirements given in App 1

2.1.6 Other additional class notations

The following additional class notations are mandatory for units covered by the present Rules:

- **INWATERSURVEY**, as defined in NR467, Pt A, Ch 1, Sec 2, [6.27.1]
- **MON-SHAFT**, as defined in NR467, Pt A, Ch 1, Sec 2, [6.6.3], if the unit is self-propelled.

2.1.7 Typical classification notations

As an example, the typical classification notations assigned to a unit with the service notation **FSRU** is given in Tab 2 and the typical classification notations assigned to a unit with the service notation **liquefied gas carrier - FSRU** is given in Tab 3.

Note 1: The kind of notation shown in brackets does not form part of the classification notation indicated in the Register of Ships and on the Certificate of Classification.

Table 2 : Typical classification notations for unit with the service notation FSRU

Classification notations		Reference
Class symbol	**I** or **II**	Sec 1, [3]
Construction mark	✠, ✠ or • to be separately assigned before: - **HULL** notation - **MACH** notation	Sec 1, [4]
Service notations	**FSRU** to be completed by he additional service feature **([cargo type], [ship type], [cargo containment system type], [P_{design}], [T_{min}])** indicating the cargo type, the IMO code ship type, the cargo containment system type, the cargo tank design pressure (P_{design}) and minimum temperature (T_{min})	[2.1.1]
Additional service features	**REGAS** **POSA** or **POSA jetty** **SLOSHING**	[2.1.2] [2.1.4] [2.1.4]
Site notation	- name of site - geographical area of operation - most unfavorable sea conditions	[2.2]
Transit notation	**transit - specific criteria (2)**	[2.2]
Additional class notations	**INWATERSURVEY**	NR467, Pt A, Ch 1, Sec 2
	MON-SHAFT (3)	NR467, Pt A, Ch 1, Sec 2
	Veristar Hull CM FAT xx years (FEM and fatigue analysis of ship's hull structure (xx years) and construction monitoring) **(1) (2)**	NR467, Pt A, Ch 1, Sec 2
	AUTO (automation) **(2)** **AUT-UMS** (automation) **(2) (4)**	NR445, Pt A, Ch 1, Sec 2
	IATP (Increased allowable tank design pressure) **(2)**	NR467, Pt A, Ch 1, Sec 2
	ALM (lifting appliances) **(2)**	NR467, Pt A, Ch 1, Sec 2
	liquefied gas transfer (LNG transfer system) **(2)**	NR542
	LSA (Life saving appliances) **(2)**	NR445, Pt A, Ch 1, Sec 2
	ERS-S (Emergency response service) **(2)**	NR467, Pt A, Ch 1, Sec 2
	CLEANSHIP (prevention of pollution) **(2)**	NR467, Pt A, Ch 1, Sec 2
	CPS (WBT) (coating performance standard) **(2)**	NR467, Pt A, Ch 1, Sec 2
	GREEN PASSPORT (unit recycling) **(2)**	NR467, Pt A, Ch 1, Sec 2
	OHS (handling systems and associated equipment) **(2)**	NR595
	STAR-REGAS (maintenance plan of regasification installation) **(2)**	NR467, Pt A, Ch 1, Sec 2
	ASP (alternative survey programme) **(2)**	App 1

(1) With $25 \leq xx \leq 40$
(2) Optional
(3) When relevant
(4) For self propelled FSRU

Table 3 : Typical classification notations for unit with the service notation liquefied gas carrier - FSRU

Classification notations		Reference
Class symbol	**I** or **II**	Sec 1, [3]
Construction mark	✠, ✠ or • to be separately assigned before: - **HULL** notation - **MACH** notation	Sec 1, [4]
Service notations	**liquefied gas carrier - FSRU** to be completed by he additional service feature **([cargo type], [ship type], [cargo containment system type], [P_{design}], [T_{min}])** indicating the cargo type, the IMO code ship type, the cargo containment system type, the cargo tank design pressure (P_{design}) and minimum temperature (T_{min})	[2.1.1]
Other additional service features	**REGAS** **POSA** or **POSA jetty** **SLOSHING**	[2.1.2] [2.1.4] [2.1.4]
Navigation notation	**unrestricted navigation** **summer zone** **tropical zone** **coastal area** **sheltered area**	[2.3]
Additional class notations	**INWATERSURVEY**	NR467, Pt A, Ch 1, Sec 2
	MON-SHAFT	NR467, Pt A, Ch 1, Sec 2
	Veristar Hull CM FAT xx years (FEM and fatigue analysis of ship's hull structure (xx years) and Construction monitoring) **(1) (2)**	NR467, Pt A, Ch 1, Sec 2
	AUT-UMS (automation) **(2)** **AUT-PORT** (automation) **(2)**	NR467, Pt A, Ch 1, Sec 2
	IATP (Increased allowable tank design pressure)	NR467, Pt A, Ch 1, Sec 2
	ALM (lifting appliances) **(2)**	NR467, Pt A, Ch 1, Sec 2
	liquefied gas transfer (LNG transfer system) **(2)**	NR542
	ERS-S (Emergency response service) **(2)**	NR467, Pt A, Ch 1, Sec 2
	CLEANSHIP (prevention of pollution) **(2)**	NR467, Pt A, Ch 1, Sec 2
	CPS (WBT) (coating performance standard) **(2)**	NR467, Pt A, Ch 1, Sec 2
	GREEN PASSPORT (unit recycling) **(2)**	NR467, Pt A, Ch 1, Sec 2
	STAR-REGAS (maintenance plan of regasification installation) **(2)**	NR467, Pt A, Ch 1, Sec 2
	ASP (alternative survey programme) **(2)**	App 1
(1) With $25 \leq xx \leq 40$ **(2)** Optional		

2.2 Site and transit notation

2.2.1 Site notation

Units with the service notation **FSRU** or **FSU-LNG** are to be assigned a site notation, consisting in the name of field and/or geographical area and/or the most unfavorable sea conditions where the unit is intended to operate.

For units with the notation **liquefied gas carrier - FSRU** or **liquefied gas carrier - FSU**, the site notation is not mandatory.

In both cases, the data, limitations and assumptions used for the assessment of the unit on site are stated in the Design Criteria Statement, as defined in Sec 1, [8.1], which is referred on a memorandum on the class certificate.

2.2.2 Transit notation

Units with the service notation **FSRU** or **FSU-LNG** involved in towing or transit by means of its own propulsion system between construction shipyard and the intended site, or between different operation sites, are to be assigned the notation **transit**.

The notation transit is to be completed as follows:

- **transit - specific criteria**, when the criteria for the assessment in towing/transit phase are based on data and assumptions specified by the party applying for classification. These criteria are to be stated in the Design Criteria Statement, as defined in Sec 1, [8.1], which is referred to on a memorandum on the class certificate

- for unit with the service notation **FSRU** or **FSU-LNG**, the notation **transit** may be completed by one of the navigation notations given in [2.3].

  Example: **transit - unrestricted navigation**.

Units with the service notation **liquefied gas carrier - FSRU** or **liquefied gas carrier - FSU**, need not be assigned the notation **transit**.

2.3 Navigation notation

2.3.1 Units with the service notation **liquefied gas carrier - FSRU** or **liquefied gas carrier - FSU**, are to be assigned one of the followings navigation notations:

- the navigation notation **unrestricted navigation** is assigned to units intended to operate in any area and any period of the year
- the navigation notation **summer zone** is assigned to units intended to operate only within the geographical limits as defined in ILLC 1966 for the Summer zones
- the navigation notation **tropical zone** is assigned to units intended to operate only within the geographical limits as defined in ILLC 1966 for the Tropical zones
- the navigation notation **coastal area** is assigned to units intended to operate only within 20 nautical miles from the shore and with a maximum sailing time of six hours from a port of refuge or safe sheltered anchorage
- the navigation notation **sheltered area** is assigned to units intended to operate in sheltered waters, i.e. harbours, estuaries, roadsteads, bays, lagoons and generally calm stretches of water and when the wind force does not exceed 6 Beaufort scale.

2.3.2 Navigation notations listed in [2.3.1] may complete the site notation and/or transit notation of the unit, as described in [2.2].

2.3.3 The assignment of a navigation notation, including the reduction of scantlings or specific arrangements for restricted navigation notations, is subject to compliance with the requirements laid down in NR467, Part B; NR467, Part C and NR467, Part D.

2.3.4 The assignment of a navigation notation does not absolve the Interested Party from compliance with any international and national regulations established by the Administrations for a unit operating in national waters, or a specific area, or a navigation zone. Neither does it waive the requirements in NR467, Pt A, Ch 1, Sec 1, [3.3.1].

3 Reference documents

3.1 Society's documents

3.1.1 Rules for classification, Rule Notes and Guidance Notes

- NR467 Rules for the classification of steel ships
- NR445 Rules for the classification of offshore units
- NR216 Rules on materials and welding for the classification of marine units
- NR266 Requirements for survey of materials and equipment for the classification of ships and offshore units
- NR320 Certification scheme of materials and equipment for the classification of marine units
- NR493 Classification of mooring systems for permanent and mobile offshore units
- NR542 Classification of floating gas units
- NI554 Design sloshing loads for LNG membrane tanks
- NR595 Classification of offshore handling systems (OHS)
- NR620 Bunkering ships

3.2 IMO documents

3.2.1 IGC Code

IGC Code means the International Code for the Construction and Equipment of Ships Carrying liquefied Gases in Bulk, as amended.

Where requirements of IGC Code are quoted as excerpts, they are printed in italic type.

4 Symbols and definitions

4.1 General

4.1.1 Unless otherwise specified in [4.2] the units, symbols, definitions and reference co-ordinate system given in NR467, Pt B, Ch 1, Sec 3 remain applicable.

4.2 Definitions

4.2.1 Cargo

Cargo means liquefied gas stored and processed by units subject to the present Rules. The list of products to be considered as cargo is given in NR467, Pt D, Ch 9, Sec 19.

4.2.2 Cargo containment system

Cargo containment system is the arrangement for containment of cargo, including, where fitted, a primary and secondary barrier, associated insulation and any intervening spaces, and adjacent structure if necessary for the support of these elements. If the secondary barrier is part of the hull structure, it may be a boundary of the hold space.

4.2.3 Fore and aft parts

For units with the service notation **FSRU** or **FSU-LNG**, the fore part and aft part are determined on a case-by-case basis, according to the main wave heading.

For units articulated around a single point mooring, the fore part is the part where the single point mooring is fitted.

During transit, the fore part is the one orientated in the direction of towage.

4.2.4 Hull and superstructures

The hull is a floating structure with overall dimensions in accordance with NR467, Pt B, Ch 1, Sec 3. The purpose is to store cargo, ballast and production liquids. In addition, there are dedicated machinery spaces provided for essential generators, etc.

The definition of the hull includes the living quarters, which are to be designed and built in accordance with the relevant requirements for superstructures, as given by NR467.

4.2.5 Independent tank

Independent tanks are self-supporting tanks; they do not form part of the unit's hull and are not essential to the hull strength. There are three types of independent tanks:

- type A
- type B
- type C,

as defined in IGC Code.

4.2.6 Membrane tanks

Membrane tanks are non-self-supporting tanks which consist of a thin layer (membrane) supported through insulation by the adjacent hull structure. The membrane is designed in such a way that the thermal and other expansion or contraction is compensated for without undue stressing of the membrane.

4.2.7 Navigation condition

The navigation condition represents, for units assigned the notation **liquefied gas carrier-FSRU**, the operation phase under sailing conditions and the associated loads taking into account the assigned navigation notation.

4.2.8 Permanent installation

Units are considered as permanent installations when performing their service either:

- at a single location, or
- on a single site for a duration not less than, typically, 5 years.

Two types of permanent installations are to be considered:

- disconnectable, when the unit has a means of disengaging from its mooring and riser systems in extreme environmental or emergency conditions
- non-disconnectable.

A permanent installation is assigned a site notation consisting in the name of the unit operation field.

4.2.9 Primary barrier

Primary barrier is the inner element designed to contain the cargo when the cargo containment system includes two boundaries.

4.2.10 Regasification area

Regasification area includes:

- regasification skid
- process equipment for regasification
- foundations for the support of regasification skid.

4.2.11 Rule length L

For a unit with propulsion system, the rule length L is determined similarly to seagoing ships (see NR467, Pt B, Ch 1, Sec 3). In case of units without rudder shaft, the rule length L is to be taken equal to 97% of the extreme length at the maximum draught.

The extreme length at the maximum draught is not to include external turret system or boat landing platforms possibly attached to the extreme ends.

4.2.12 Secondary barrier

Secondary barrier is the liquid resistant outer element of a cargo containment system designed to afford temporary containment of any envisaged leakage of liquid cargo through the primary barrier and to prevent the lowering of the temperature of the unit's structure to an unsafe level.

4.2.13 Site condition

For the service notations defined in [2.1.1], the site condition represents the operation phase under regasification mode on site and the associated loads taking into account the assigned site notation.

4.2.14 Site draughts

The draught is the distance, in m, from the base line to the waterline, measured amidships.

The maximum site draught T_{maxi} is the deepest draught able to be observed during operation.

The minimum site draught T_{mini} is the lightest draught able to be observed during operation.

4.2.15 Transit draughts

For any transit phase, a maximum draught and a minimum draught are to be determined by the designer, and reflected in the associated loading conditions.

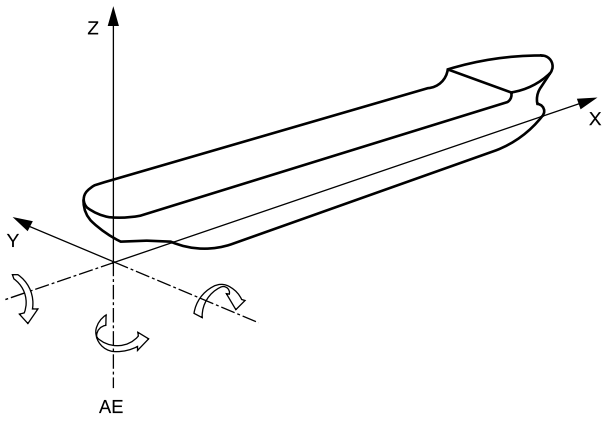
4.3 Reference co-ordinate system

4.3.1 The unit's geometry, motions, accelerations and loads are defined with respect to the following right-hand co-ordinate system (see Fig 1):

- Origin : At the intersection between the longitudinal plane of symmetry of the unit, the aft end of L and the baseline
- X axis : Longitudinal axis, positive forwards
- Y axis : Transverse axis, positive towards portside
- Z axis : Vertical axis, positive upwards.

Positive rotations are oriented in anti-clockwise direction about the X, Y and Z axes.

Figure 1 : Reference co-ordinate system



5 Unit with service notation FSRU or FSU-LNG

5.1 Classification and towing/transit

5.1.1 The towing or transit by means of own propulsion system, between the construction shipyard and the intended site, is covered by classification requirements.

To flag the unit is:

- recommended for the towing
- mandatory in international waters and when people is onboard. Attention is to be paid to the compliance with international codes and standards as required by National Authorities.

The Society issues a provisional certificate upon completion of the hull, with design criteria for towing/transit condition clearly identified.

5.1.2 Temporary conditions

In accordance with the provisions of classification, any temporary conditions during fabrication and load out, any intermediate towing between two construction sites before complete finalisation of the unit and final load out of topside modules are considered beyond the scope of classification, unless a specific demand has been received from the party applying for classification.

Corrosion protection systems are to be arranged for the hull during the outfitting phase. The documentation is to be submitted to the Society for information. The Society may require thickness measurements to be carried out prior to the hull leaving the yard.

5.1.3 Environmental conditions for towing/transit

The Society may require:

- detailed documentation for the intended route between the construction shipyard and the intended site, and
- further investigation of slamming loads, green waters, bow impact and ice loads, if any, depending on the severity of the intended route, the planned period of the year and duration for the towing.

Extreme loads for towing/transit are to be taken by default for a return period of 10 years (typically referred to as a probability level of $10^{-7.7}$). Different values may be considered if specified by the party applying for classification.

Limitations on sea heading (for avoidance of beam seas) including possible seasonal limitations are to be defined by the Owner and/or the party applying for classification.

5.1.4 Fatigue strength during towing/transit

The Society reserves the right to require, for structural members, a direct fatigue analysis resulting from the towing/transit. Such fatigue analysis is to be combined with the overall fatigue verification of the unit in operation at intended site.

5.1.5 Temporary mooring during towing/transit

The unit is to be equipped with temporary mooring (anchoring) equipment during the towing/transit operation. This equipment may be removed when the unit is permanently moored at the operation site.

6 Documents to be submitted

6.1 General

6.1.1 The documentation to be submitted is to include the following information, in addition to the documentation required in NR467, Pt D, Chapter 9 and required in the other sections of these Rules:

a) design criteria and data, as defined in Sec 1, [8.1]

b) data for hydrodynamic analysis:
   - lines plan and appendices on hull
   - environmental data as required in NR445, Pt B, Ch 2, Sec 2
   - properties of the unit related to the assessment of wind and current loads (areas, coefficients), when a heading analysis is performed (see Sec 4)
   - properties of mooring system and relevant information
   - loading manual with description of each loading condition.

c) others:
   - documents relevant to the contemplated additional class notations.

Section 3 Stability and Subdivision

1 General

1.1 Application

1.1.1 The requirements related to stability and subdivision specified in NR467, Pt D, Chapter 9 and NR467, Pt B are applicable, except where specifically indicated otherwise in this Section.

2 Stability

2.1 Stability calculations

2.1.1 Free surface effects

The free surface effects of partially filled tanks are to be taken into account in the stability calculations. Filling restrictions entered in the operating manual are to be given special consideration by the Society.

Free surface effects are to be considered whenever the filling level in a tank is less than 98% of full condition. Free surface effects need not be considered where a tank is nominally full, i.e. filling level is 98% or above.

Nominally full cargo tanks are to be corrected for free surface effects at 98% filling level. In doing so, the correction to initial metacentric height should be based on the inertia moment of liquid surface at 5° of the heeling angle divided by displacement, and the correction to righting lever is suggested to be on the basis of real shifting moment of cargo liquids.

In calculating the free surfaces effect in tanks containing consumable liquids, it is to be assumed that for each type of liquid at least one transverse pair or a single centreline tank has a free surface and the tank or combination of tanks taken into account are to be those where the effect of free surface is the greatest.

2.2 Standard loading conditions on-site

2.2.1 Standard loading conditions on-site

The following standard loading conditions are to be included in the trim and stability booklet:

- lightweight condition
- normal operation conditions with maximum deck loads and equipment in the most unfavourable positions, if relevant
- inspection conditions consistent with the operational procedures
- loading condition for inspection of cargo tanks, where one cargo tank or two consecutive cargo tanks is/are empty (to be considered in accordance with operational procedures)
- selected operational conditions covering foreseen fillings of cargo tanks. One of the conditions is to correspond to the maximum draught. The selection is to include loading and off-loading conditions.

  For the assignment of a tropical freeboard, the corresponding loading condition is also to be submitted.

3 Stability and subdivision for units with service notation FSRU or FSU-LNG

3.1 General

3.1.1 Application

For units with service notation **FSRU** or **FSU-LNG**, additional requirements and relaxation are given in this Article.

3.2 Standard loading conditions

3.2.1 Standard loading conditions

The following standard loading conditions are to be included in the trim and stability booklet, in addition to the loading conditions defined in [2.2]:

- transit/towing condition, if relevant.

3.3 Stability calculations

3.3.1 Ice and snow conditions

For units with the service notation **FSRU** or **FSU-LNG** and liable to operate in areas of snow and glazed frost, the verification of the intact and damage stability is to be performed, taking into account the possible overloads due to ice and snow accumulation.

The requirements given in NR445, Pt B, Ch 1, Sec 2, [2] are to be complied with.

3.4 Damage stability

3.4.1 Extent of damage

The extent of damage on the bottom need not to be considered.

The assumed maximum extent of damage on the side shell is to be as follows:

- longitudinal extent ℓ_c:

  $\ell_c = 1/3\ L_{LL}^{2/3}$ or 14,5 m whichever is the lesser

- transverse extent t_c measured inboard from the side shell plating, at right angle to the centreline, at the level of summer load line:

  $t_c = B/5$ or 11,5 m whichever is the lesser

- vertical extent v_c, from the moulded line of the bottom shell plating at centreline: upwards without limits.

If any damage of a lesser extent than the maximum damage specified above would result in a more severe condition, such damage is to be considered.

Local side damage anywhere in the extending inboard distance "d" as defined in NR467, Pt D, Ch 9, Sec 2, [4.1.1], measured normal to the moulded line of the outer shell is to be considered. Bulkheads are to be assumed damaged when the relevant paragraph of [3.4.2] apply. If a damage of a lesser extent "d" would result in a more severe condition, such damage is to be considered.

3.4.2 Standard of damage

Units covered by these Rules are to sustain the damage indicated in [3.4.1] to the extent determined by the unit's type according to the following standards:

a) a type 1G should be assumed to sustain damage anywhere in its length

b) a type 2G of more than 150 m in length should be assumed to sustain damage anywhere in its length

c) a type 2G of 150 m in length or less should be assumed to sustain damage anywhere in its length except involving either of the bulkheads bounding a machinery space located aft

d) a type 2PG should be assumed to sustain damage anywhere in its length except involving transverse bulkheads spaced further apart than the longitudinal extent of damage as specified in [3.4.1].

Note 1: Definition of unit's type are given in NR467, Pt D, Ch 9, Sec 2, [1.1.2].

3.5 General arrangement

3.5.1 Cargo tanks location

Cargo tanks of units assigned the service notation **FSRU** or **FSU-LNG** are to be located as required in NR467, Pt D, Ch 9, Sec 2, [4], taking into account the extent of damage defined in [3.4.1].

3.5.2 Collision bulkhead

A collision bulkhead is to be provided to prevent flooding during transit and/or site conditions.

The collision bulkhead is to comply with NR467, Part B, Chapter 2.

Subject to the agreement of the flag Administration, if any, the Society may accept an exemption from having a collision bulkhead when the risk of collision is mitigated and duly justified (collision analysis, external turret, damage stability...).

Subject to the agreement of the flag Administration, if any, the Society may, on a case by case basis, accept a distance from the collision bulkhead to the forward perpendicular FPLL greater than the maximum specified in NR467, provided that subdivision and stability calculations show that, when the unit is in upright condition on full load draft, flooding of the space forward of the collision bulkhead will not result in any part of the freeboard deck becoming submerged, or in any unacceptable loss of stability.

3.5.3 Aft peak bulkhead

As a rule, units are to be provided with an aft peak bulkhead in accordance with the NR467, except when the risk of collision is mitigated and duly justified (collision analysis, external turret, damage stability...).

Section 4 Hydrodynamic Analysis

1 General

1.1 Application

1.1.1 Hydrodynamic analysis is to be performed for both site conditions and towing/transit phases in accordance with the requirements of NR445, Pt D, Ch 1, Sec 4.

2 Units with service notation liquefied gas carrier - FSRU or liquefied gas carrier - FSU

2.1 General

2.1.1 Hydrodynamic analysis is not mandatory for unit assigned the service notation **liquefied gas carrier - FSRU** or **liquefied gas carrier - FSU**, except if the site condition is more severe than the condition given by the navigation condition, but justification is to be provided to the Society.

When the navigation condition covers the site condition, Sec 5 and Sec 7 are not applicable except the requirements Sec 7, [1.1.1] and Sec 7, [4.3].

Section 5 Design Loads on Site

1 General

1.1 Principles

1.1.1 Application

The design loads on site are to be determined in accordance with this Section and are to consider the relevant loading conditions and associated loads including:

- still water conditions
- extreme environmental conditions during unit's operation (100 years return period)
- loading and off-loading conditions, taking into account side-by-side or tandem configuration, as relevant
- limiting conditions before the disconnection from single point mooring, if relevant
- conditions during maintenance or inspection operations
- transit/towing conditions, from the construction/conversion location to offshore site and between constructing shipyards, if more than one
- loads induced by process and other equipment, in above conditions, as relevant
- damaged conditions, taking into account the provisions and damage assumptions as given in Sec 3.

In case of units with the service notation **liquefied gas carrier - FSRU** or **liquefied gas carrier - FSU** and if the site condition is less severe than the navigation condition, it is not necessary to apply this Section.

1.1.2 Site conditions

The design loads for site conditions are to be determined as stated in this Section, taking into account the results of hydrodynamic analysis (see Sec 4). Two situations may be considered:

- when a navigation notation completes the site notation of the unit, the rule values of wave loads for this navigation notation are to be superimposed with the values obtained from hydrodynamic analysis as defined in Sec 4
- when no navigation notation is assigned to the unit for on-site conditions, the wave loads obtained from hydrodynamic analysis are to be superimposed with the rule values calculated for sheltered area, as defined in Article [3].

1.1.3 Towing/transit conditions

The design loads for towing/transit conditions are to be determined as stated in this Section, taking into account the results of hydrodynamic analysis. Two situations may be considered:

- when a navigation notation completes the transit notation of the unit, the rule values of wave loads for this navigation notation are to be superimposed with the values obtained from hydrodynamic analysis, as defined in [3.2]
- when no navigation notation is assigned to the unit for towing/transit conditions, the wave loads obtained from hydrodynamic analysis are to be used, as defined in [3.2].

1.2 Design loads

1.2.1 Hull girder loads

The wave and dynamic hull girder loads are to be used for the determination of:

- the hull girder strength, according to the requirements of Sec 7
- the structural scantling of platings, ordinary stiffeners and primary supporting members contributing to the hull girder strength, in combination with the local loads given in Articles [5] and [6], according to the requirements of Sec 7.

1.2.2 Load cases

The local loads defined in Articles [5] and [6] for the towing/transit and site conditions are to be calculated in each of the mutually exclusive load cases described in Article [4].

1.2.3 Unit motions and global accelerations

The wave local loads are to be calculated on the basis of the reference values of unit motions and global accelerations specified in [3.4].

1.2.4 Calculation and application of local loads

The criteria for the calculation of:

- still water local loads
- wave local loads on the basis of the reference values of unit motions and global accelerations

are specified in Articles [5] and [6].

1.2.5 Flooding conditions

The still water and wave pressures in flooding conditions are specified in [6.3.4].

1.2.6 Accidental loading cases

Following the HAZID & HAZOP outcomes results, the design of the floating unit is to consider the possibility of accidental loads as may result from collisions, fire or explosions.

Accidental loading cases are required for the towing/transit and site phases.

In accidental conditions, environmental loads are to be evaluated taking into account the circumstances in which the considered situation may realistically occur, and the time needed for evacuation or other remedial action. The return period of such environmental loads is generally taken as 1 year.

1.2.7 Load definition criteria to be adopted in structural analyses of plates and secondary stiffeners

a) Application

This requirement applies for the definition of local loads to be used in the scantling checks of plating and ordinary stiffeners according to Sec 7.

b) Load model

1) when calculating the local loads for the structural scantling of an element which separates two adjacent compartments, the latter may not be considered simultaneously loaded. The local loads to be used are those obtained considering the two compartments individually loaded.

2) for elements of the outer shell, the local loads are to be calculated considering separately:

- the still water and wave external sea pressures, considered as acting alone without any counteraction from the unit internal compartments. This calculation is to be done considering the maximum draught
- the still water and wave differential pressures (internal minus external sea pressures) considering the compartment adjacent to the outer shell as being loaded. This calculation is to be made considering the minimum draught T_{mini} defined in Sec 2, [4.2.14].

Note 1: The external wave pressure in case “b” is to be taken equal to 0.

In the absence of more precise information, the unit minimum draught at site, in m, is to be obtained from the following formula:

T_{mini} = 0,03 L, without being greater than 7,5 m

where:

L : Rule length, in m as defined in Sec 2, [4.2.11].

1.2.8 Load definition criteria to be adopted in structural analyses of primary supporting members

This requirement applies for the definition of local loads to be used in the scantling checks of primary supporting members.

The most severe loading conditions and associated draught for the structural elements under investigation are specified in Sec 7.

For primary supporting members, a three-dimensional structural model is required.

2 Still water loads

2.1 Hull girder still water loads

2.1.1 Towing/transit and site loads

The hull girder still water loads as per [2.1.2] and [2.1.3] are to be defined for both towing/transit and on-site conditions. For this purpose, two distinct sets of still water bending moments and shear forces are to be specified.

2.1.2 Still water bending moment distribution

Design or allowable still water bending moment distribution is to be presented in a diagram or a table indicating the bending moment values at the longitudinal location of each compartment centre and at each transverse bulkhead.

2.1.3 Still water shear force distribution

Design or allowable still water shear force distribution is to be presented in a diagram or a table indicating the shear force values at each transverse bulkhead.

3 Wave loads

3.1 Towing/transit and site conditions

3.1.1 Wave loads defined in Article [3] are to be processed for both towing/transit and on-site conditions. For this purpose, two distinct sets of design wave loads are to be considered.

3.2 Design wave loads

3.2.1 Definitions

The following terms are used to describe the wave loads:

- wave load values:
  wave load parameters constant along the length of the unit (unit motions and accelerations).
- wave load distributions:
  wave load parameters varying along the length of the unit (hull girder wave loads, relative wave elevation).

3.2.2 Determination of the design wave loads

The design values and distributions of wave loads are to be determined as per NR445, Pt D, Ch 1, Sec 5, [3.2].

3.3 Hull girder wave loads

3.3.1 Vertical wave bending moment

The vertical wave bending moment at any hull transverse section in upright ship condition is to be obtained as required in NR445, Pt D, Ch 1, Sec 5, [3.3.1].

3.3.2 Horizontal wave bending moment

The horizontal wave bending moment at any hull transverse section is to be obtained as required in NR445, Pt D, Ch 1, Sec 5, [3.3.2].

3.3.3 Vertical wave shear force

The vertical wave shear force at any hull transverse section is to be obtained as required in NR445, Pt D, Ch 1, Sec 5, [3.3.3].

3.4 Unit motions and accelerations

3.4.1 Absolute motions and global accelerations

Rule values of the unit absolute motions and global accelerations are to be determined according to NR445, Pt D, Ch 1, Sec 5, [3.4] taking into account the following values for GM, when not know from loading manual or Trim and Stability Booklet:

- 0,07 B for full loading condition
- 0,18 B for the other loading conditions.

3.4.2 Local accelerations

The design values of total longitudinal, transverse and vertical accelerations at any point are obtained from NR445, Pt D, Ch 1, Sec 5, [3.6.1], for upright and inclined ship conditions and based on the design unit absolute motions and global accelerations.

Note 1: As an alternative, the local accelerations directly calculated by hydrodynamic analysis may be specially considered by the Society.

3.5 Relative wave elevation

3.5.1 Design distributions

The design distributions of the relative wave elevation in upright and inclined ship conditions are obtained from NR445, Pt D, Ch 1, Sec 5, [3.5].

4 Load cases

4.1 Towing/transit and site conditions

4.1.1 Load cases defined in [4.2] are to be processed for both towing/transit and on-site conditions.

4.2 Load cases for structural analyses

4.2.1 Load cases to be considered are to be in accordance with NR445, Pt D, Ch 1, Sec 5, [4].

5 Sea pressures

5.1 General

5.1.1 The sea pressures to be taken into account are those given in this Article [5].

However the Society may accept calculations based on pressures coming directly from hydrodynamic calculation, if duly justified.

5.2 Towing/transit and site conditions

5.2.1 Sea pressures defined are to be processed for both towing/transit and on-site conditions. For this purpose, two distinct sets of sea pressures are to be calculated.

5.3 Still water pressure

5.3.1 Still water pressure on sides and bottom, and pressure on exposed decks are to be calculated according to NR467, Pt D, Ch 5, Sec 5, [3].

5.4 Wave pressure

5.4.1 Upright ship conditions

The wave pressure on sides, bottom and exposed decks in upright ship conditions at any point of the hull is to be calculated as required in NR445, Pt D, Ch 1, Sec 5, [5.4].

5.4.2 Inclined ship conditions

The wave pressure on sides, bottom and exposed decks in inclined ship conditions at any point of the hull is to be calculated as required in NR445, Pt D, Ch 1, Sec 5, [5.5].

6 Internal pressures

6.1 Towing/transit and site conditions

6.1.1 Internal pressures defined in [6] are to be processed for both towing/transit and on-site conditions. For this purpose, two distinct sets of internal pressures are to be calculated.

6.2 Mass densities

6.2.1 Cargo mass density

The maximum mass density of each product stored and processed by the unit is to be indicated on drawings or in the loading manual.

Where the maximum mass density of the liquid carried is not given, the following values, in t/m^3, are to be considered:

- $\rho_L = 0,50\ t/m^3$ for methane
- ρ_L according to NR467, Pt D, Ch 9, Sec 19, Tab 2 for the other products.

6.2.2 Sea water mass density

A sea water mass density of $1,025\ t/m^3$ is to be considered.

6.3 Calculations

6.3.1 Internal pressures

The internal still water pressure and the internal inertial pressure for all types of tanks and at any point are to be defined in accordance with NR445, Pt D, Ch 1, Sec 5, [6.3.1] and NR445, Pt D, Ch 1, Sec 5, [6.3.2].

6.3.2 Partly filled tanks

For units assigned the additional service feature **SLOSHING**, as defined in Sec 2, [2.1.4], all cargo tanks are to be checked for several relevant partial filling levels. A direct sloshing calculation is to be submitted to the Society, as required in Sec 10, Tab 1.

Note 1: Guidelines for sloshing calculations are given in NI554, Design Sloshing Loads for LNG Membrane Tanks.

Note 2: Subject to the agreement of the Society, direct sloshing calculation need not be performed for site areas where the extreme 100 years return period significant wave height is less than 1,5m.

6.3.3 Accommodations

The still water and inertial pressures transmitted to the deck structures are to be defined in accordance with NR445, Pt D, Ch 1, Sec 5, [6.5].

6.3.4 Flooding

The flooding pressure are to be defined in accordance with NR445, Pt D, Ch 1, Sec 5, [6.6].

6.3.5 Testing

Testing still water and inertial pressures are to be defined in accordance with NR445,Pt D, Ch 1, Sec 5, [6.7].

Section 6 Structure Design Principles

1 Structural principles

1.1 General

1.1.1 Units assigned the service notation **liquefied gas carrier - FSRU** or **liquefied gas carrier - FSU** as are to comply with the requirements of NR467, Part B, Chapter 4.

1.1.2 Units assigned the service notation **FSRU** or **FSU** as are to comply with the requirements of NR445, Pt D, Ch 1, Sec 3.

1.2 Typical arrangement

1.2.1 Large openings in web frames and stringers should be verified and necessary documentation/calculation notes are to be submitted to the Society.

2 Materials for construction

2.1 General

2.1.1 Materials for construction are to comply with the requirements given in NR467, Pt D, Ch 9, Sec 6 and NR467, Pt B, Ch 4, Sec 1.

3 Welding and weld connections

3.1 General

3.1.1 Welding and weld connections are to comply with the requirements given in NR467, Pt D, Ch 9, Sec 6 and NR467, Pt B, Ch 13, Sec 2.

4 Reinforcements in way of supporting structures for hull attachments

4.1 Local arrangement

4.1.1 Generally, the supports for attachments and appurtenances are to be fitted in way of longitudinal and transverse bulkheads or in way of deck beams. Other supports are to be fitted in way of large primary supporting members.

The main structure may be locally reinforced by means of insert plates.

When the supports are only located on transverse web beams, the longitudinal structure is to be adequately reinforced.

The cut-outs in the deck transverses for the passage of ordinary stiffeners are to be closed in way of supports.

Particular attention is to be paid to buckling below supports.

5 Access

5.1 Access manual

5.1.1 An access manual is to be incorporated in the operating manual of the unit. The access manual is to describe unit's means of access to carry out overall and close-up inspections and thickness measurements.

5.1.2 The access manual is to be updated as necessary, and an up-dated copy is to be maintained onboard.

5.1.3 The access manual is to include, for each space, the following information:

- plans showing the means of access to the space, with appropriate technical specifications and dimensions
- plans showing the means of access within each space to enable an overall inspection to be carried out, with appropriate technical specifications and dimensions; the plans are to indicate from where each area in the space can be inspected
- plans showing the means of access within each space to enable close-up inspection to be carried out, with appropriate technical specifications and dimensions; the plans are to indicate the position of structural critical areas, whether the means of access are permanent or portable and from where each area can be inspected.

Note 1: Critical structural areas are locations identified from calculations to require monitoring, or, from the service history of similar or sister units, to be sensitive to cracking, buckling, deformation or corrosion which would impair the structural integrity of the unit.

- instructions for inspecting and maintaining the structural strength of all means of access and means of attachment, taking into account any corrosive atmosphere that may be within the space
- instructions for safety guidance when rafting is used for close-up inspections and thickness measurements
- instructions for the rigging and use of any portable means of access in a safe manner
- an inventory of all portable means of access
- records of periodical inspections and maintenance of the unit's means of access.

Section 7 Structure Strength

1 Application

1.1 Units with the service notation liquefied gas carrier - FSRU or liquefied gas carrier - FSU

1.1.1 The structural strength under navigation condition is to comply with NR467, Part B, Chapter 6, NR467, Part B, Chapter 7 and NR467, Part D, Ch 9, Sec 4 taking into account the design loads defined in NR467, Part B, Chapter 5.

1.1.2 When the navigation condition covers the site conditions it is not necessary to evaluate the structural strength on-site and Articles [2] and [3] are not applicable.

Otherwise, if the site condition is more severe than the navigation conditions, the hull girder strength and the hull scantlings are to be evaluated, as defined in Articles [2] and [3] with the design loads defined in Sec 5, in addition to the requirement [1.1.1].

1.1.3 The fatigue assessment is to comply with the requirements given in Article [4].

1.2 Units with the service notation FSRU or FSU-LNG

1.2.1 For on-site conditions, the structural strength is to comply with the requirements given in Articles [2] and [3] with the design loads defined in Sec 5.

1.2.2 The structural strength is to be evaluated independently for the towing/transit phases covered by classification and the on-site conditions, with the design loads defined in Sec 5.

1.2.3 The fatigue assessment is to comply with the requirements given in Article [4].

2 Hull girder strength on-site

2.1 Application

2.1.1 In case of units with the service notation **liquefied gas carrier - FSRU** or **liquefied gas carrier - FSU**, this Article need not be applied in case the navigation condition covers the site condition, as defined in [1.1.2].

2.1.2 The hull girder transverse sections are to comply with NR467, Pt B, Ch 6, Sec 1 taking into account the requirements of the present Article and the design loads defined in Sec 5.

2.2 Strength characteristics of the hull girder transverse sections

2.2.1 The strength characteristics of the hull girder transverse sections are to comply with NR445, Pt D, Ch 1, Sec 6, [2] taking into account the design loads defined in Sec 5.

2.3 Yielding checks

2.3.1 The yielding strength are to comply with NR445, Pt D, Ch 1, Sec 6, [3] taking into account the design loads defined in Sec 5.

2.4 Ultimate strength Check

2.4.1 The ultimate strength of the hull girder is to be checked according to NR445, Pt D, Ch 1, Sec 6, [4] taking into account the partial safety factors defined in Tab 1 and the design loads defined in Sec 5.

Table 1 : Partial safety factors

Partial safety factor covering uncertainties on:	Symbol	On-site condition value	Transit condition value
Still water hull girder loads	γ_{S1}	1,00	1,00
Wave induced hull girder loads	γ_{W1}	1,25 **(1)**	1,10
Material	γ_m	1,02	1,02
Resistance	γ_R	1,10	1,03
(1) If the vertical wave bending moment M_{WV} considered is derived from hydrodynamic calculations with a 10 000 years return period, the partial safety factor γ_W may be reduced to 1,00. In this case, the product $\gamma_{W1} \times M_{WV}$ defined above with 10 000 years RP is not to be less than 1,25 M_{WV} derived with 100 years RP.			

3 Hull Scantlings on-site

3.1 General

3.1.1 In case of units with the service notation **liquefied gas carrier - FSRU** or **liquefied gas carrier - FSU**, this Article need not be applied in case the navigation condition covers the site condition, as defined in [1.1.2].

3.1.2 The hull scantlings are to comply with the provision of Sec 6taking into account the requirements of the present Article and the design loads defined in Sec 5.

3.2 Plating

3.2.1 General

Plating are to be in accordance with the provision of NR542, Sec 6, [2].

3.3 Ordinary stiffeners

3.3.1 General

Ordinary stiffeners are to be in accordance with the provision of NR542, Sec 6, [3].

3.4 Primary supporting members

3.4.1 General

Primary supporting members are to be in accordance with the provision of NR542, Sec 6, [4] taking into account loads from Sec 5.

4 Fatigue check of structural details

4.1 General

4.1.1 The design fatigue life of the unit is to be specified by the party applying for classification, and to be indicated on the midship section drawing.

By default the design fatigue life is to be no less than 20 years.

4.2 Structural details

4.2.1 The structural details to be checked are those defined in NR467, Pt B, Ch 13, Sec 5, [2.4].

4.2.2 In addition, the following structural details are to be checked:

- regasification plant connection with the main deck
- crane pedestal, if relevant
- mooring integration structure with hull in case of unusual structural arrangement (turret, buoy, quick release hook fondations)

Note 1: The long term distribution of forces is to be submitted by the turret designer.

4.3 Units with service notation liquefied gas carrier - FSRU or liquefied gas carrier - FSU

4.3.1 For units with the service notation **liquefied gas carrier - FSRU** or **liquefied gas carrier - FSU**, the fatigue damage is a combination between the fatigue damage on navigation condition, as defined in [4.3.2], and the fatigue damage on-site condition, as defined in [4.3.3].

Hypothesis for the fraction of time for each condition is to be specified by the party applying for classification.

The damage combination is to be calculated using the following formulae:

$D_{tot} = \alpha_{nav} \times D_{nav} + (1 - \alpha_{nav}) \times D_{site}$

Where:

α_{nav} : Fraction of time for the navigation condition

D_{nav} : Fatigue damage in navigation condition, as defined in [4.3.2]

D_{site} : Fatigue damage on site condition, as defined in [4.3.3].

4.3.2 For navigation condition, the fatigue damage is to be performed in accordance with the provisions of NR467, Pt D, Ch 9, Sec 4 and NR467, Pt B, Ch 10, Sec 1, taking into account [4.1] and [4.2].

4.3.3 For on-site condition, the fatigue damage is to be performed in accordance with the provisions of NR445, Pt D, Ch 1, Sec 10 taking into account the loading/unloading cycles.

4.4 Units with service notation FSRU or FSU-LNG

4.4.1 The fatigue assessment is to be performed in accordance with the provisions of NR445, Pt D, Ch 1, Sec 10 taking into account [4.1], [4.2] and the loading/unloading cycles.

5 Loading manual and loading instrument

5.1 Loading manual

5.1.1 A loading manual is to be submitted for approval.

The loading manual is to comply with the applicable requirements of NR467, Pt B, Ch 1, Sec 5, [1] and NR467, Pt B, Ch 1, Sec 5, [2].

In addition, the requirements given in NR445, Pt D, Ch 1, Sec 5, [2.1.2] to NR445, Pt D, Ch 1, Sec 5, [2.1.8] are to be complied with.

5.2 Loading instrument

5.2.1 The loading instrument is to be in accordance with the requirements of NR467, Pt B, Ch 1, Sec 5, [3]. Units covered by these Rules are to be considered as belonging to “Category I ships” as defined in NR467, Pt B, Ch 1, Sec 5, [1].

5.2.2 The loading instrument is also to perform stability calculations according to the procedures indicated in NR467 as referenced above.

Section 8 Unit Arrangement

1 General

1.1 Application

1.1.1 For units with the service notation **liquefied gas carrier - FSRU** or **liquefied gas carrier - FSU**, unit arrangement is to comply with NR467, Part B and NR467, Part D, Chapter 9.

In addition, units with the service notation **liquefied gas carrier- FSRU** are to comply with requirements given in Sec 10.

1.1.2 In general, units with the service notation **FSRU** or **FSU-LNG** are to comply with the requirements [1.1.1], as relevant.

Section 9 Cargo Containment

1 General

1.1 Application

1.1.1 The requirements related to cargo containment specified in NR467, Pt D, Ch 9, Sec 4 are applicable for units covered by the present Rules.

2 Sloshing on-site

2.1 Partly filled tanks on-site

2.1.1 For units intended to be assigned the additional service feature **SLOSHING**, as defined in Sec 2, [2.1.4], all cargo tanks are to be checked for several relevant partial filling levels. CFD calculation or test campaigns is to be carried out for verification of sloshing pressure to no filling limitation, when the FSRU or the FSU is on operation site.

A direct sloshing calculation is to be submitted to the Society, as required in Sec 10, Tab 1.

Note 1: Guidelines for sloshing calculations are given in NI554, Design Sloshing Loads for LNG Membrane Tanks.

Note 2: Subject to the agreement of the Society, direct sloshing calculation need not be performed for site areas where the extreme 100 years return period significant wave height is less than 1.5m.

3 Units with service notation liquefied gas carrier - FSRU or liquefied gas carrier - FSU

3.1 Sloshing

3.1.1 In addition to the requirement given in Article [2], the sloshing loads on cargo containment system and internal components are to be evaluated, as defined in NR467, Pt D, Ch 9, Sec 4, [3.4.4].

This evaluation is to be based on the standard filling levels for the navigation condition (full load condition and ballast condition).

Section 10 Regasification Plant (REGAS)

1 General

1.1 Application

1.1.1 Additional service feature REGAS

Additional service feature **REGAS** is to be assigned to units with the service notation **liquefied gas carrier - FSRU** or **FSRU** provided that requirements of the present section are fulfilled.

1.1.2 Additional class notation REGAS

On a voluntary application from interested parties, units other than those covered by the scope defined in Sec 2, [2.1.4] may be assigned the additional class notation **REGAS**, when the design, construction and testing of regasification plant are in compliance with the requirements of this Section.

1.2 Principal

1.2.1 Regasification plant might include the following main components but not limited to:

- low pressure liquefied natural gas transfer pump (See Note 1)
- boil off Gas compressor (see Note 1)
- boil off recondenser tank or suction drum (see Note 1)
- high pressure liquefied natural gas pump or send out pump
- liquefied natural gas heat exchanger or vaporizer
- gas metering and analyzer skid
- associated liquefied natural gas and gas pipes and fittings including main send out gas manifold
- gas off-loading system
- associated automation systems
- utilities, heating medium systems (water glycol, refrigerant, steam or sea water)
- steel structure.

Note 1: Components might not be included on regasification plant when already fitted on liquefied gas carrier system.

1.3 Documents to be submitted

1.3.1 Documents to be submitted for the assignment of the notation **REGAS** are listed in Tab 1.

Table 1 : Documents to be submitted

No.	A/I	Documents
1	I	Regasification operational philosophy (includes process and safety)
2	I	General arrangement of regasification plant
3	I	General arrangement of Unit including regasification plant layout
4	A	Regasification plant steel structure drawings and details
5	I	Sloshing calculation, study for containment system, transfer pump mast and tower support
6	I	Process flow diagrams (PFD)
7	A	Piping and instrument diagrams
8	A	Single lines diagram and detailed diagrams of the electrical installations
9	I	REGAS Operating manual **(1)**
10	I	List of local authority requirement (if any)
11	A	Hazardous area plans
12	I	Risks assessment and analysis study reports

Note 1: A = to be submitted for approval; I = to be submitted for information

Note 2: The Society may require additional documents and plans based on project scenario and operational philosophy.

Note 3: No additional or duplication of documents are required to be submitted when above technical contents are already presented and included in typical standard unit's drawing.

(1) REGAS operating manual may be included in the cargo operating manual

No.	A/I	Documents
13	A	Fire and gas detection and alarm systems
14	A	Safety cause and effect diagram and chart
15	A	Passive and active fire protection systems (including Hull deck and regasification plant)
16	A	Escape route and evacuation plan
17	A	Arrangement and layout for protection against cryogenic leakage
18	A	Complete stress analysis of the piping system
19	A	Description of the automation systems
20	A	Architecture diagram of the automation systems
21	A	Regasification workshops (FAT) and onboard operational test procedures
22	I	ESD philosophy arrangement

Note 1: A = to be submitted for approval; I = to be submitted for information

Note 2: The Society may require additional documents and plans based on project scenario and operational philosophy.

Note 3: No additional or duplication of documents are required to be submitted when above technical contents are already presented and included in typical standard unit's drawing.

(1) REGAS operating manual may be included in the cargo operating manual

1.4 Identified risk and hazards

1.4.1 In addition to typical HAZID and HAZOP study for liquefied natural gas storage unit, relevant hazard and risks scenarios with respect to regasification operation are to be identified (which might not be addressed by recognized Code and Rules).

Such risks might include but not limited to:

- fire and explosion
- evacuation
- extension of hazardous areas
- pressurized gas discharge to shore
- process upset conditions
- high pressure gas venting
- storage and handling of flammable refrigerants, as relevant
- continuous presence of liquefied and vapour cargo outside the cargo containment system
- tank over-pressure and under pressure
- cryogenic liquid spillage
- collision risk during berthing manoeuvres

According to the results of the HAZID and HAZOP study, specific risks analyses are to be carried out, if they are relevant.

Corresponding mitigation measures and provisions are to be taken and addressed and implemented accordingly on design (as defined in Sec 5, [1.2.6]), construction and testing.

Outcomes, provisions of risk assessment and studies are to be submitted to the Society and to be implemented on the design and drawings which are listed on Sec 2, [6].

Note 1: Risk analysis reports are considered for information only, to ensure that findings and conclusions of the risk analysis are properly taken into account for the design of the unit.

1.5 Layout

1.5.1 The layout of regasification plant or installation is to be designed giving due consideration to safety of personnel, prevention potential pollution, environment impact and protection of floating unit.

1.5.2 The installation is to be so arranged as to minimize the risk of occurrence of accident, risk of escalation, to protect manned spaces from consequences of accidents affecting other areas, ensure integrity of LNG storage and allow a safe evacuation when necessary.

1.5.3 Adequate provisions and arrangement should be made to facilitate safe access to control, cleaning and inspection on various places on regular basis during normal operation of regasification plant.

Arrangement should be made such that there is safe access at all times to valves that may need to be handled in normal operation.

1.5.4 Arrangement is to be made to have adequate lighting and ventilation when deemed necessary.

1.6 Structure

1.6.1 The steel structure of regasification plant is to be so designed and strengthened to support component weight and relevant forces including weather and sea dynamic motions in accordance with Sec 6 and Sec 7.

The local strength of the structure is to be assessed according to methods, codes or standards recognised to the satisfaction of the Society. Strength of plating under pressure loads is to be separately evaluated, using recognised codes or standards to the satisfaction of the Society.

Strength of lattice type structures is to be assessed using codes or standards recognised by the Society, such as American Institute of Steel Construction - Specification for Structural Steel for Buildings (AISC).

1.6.2 The regasification plant is to be protected from external forces and impact such as green sea water forces as relevant according to outcome of risk analysis required in [1.4.1].

1.6.3 The hull structure of the unit is to be protected against cryogenic release due to regasification plant operation. Relevant arrangement and plan based on location of sources of release is to be submitted.

1.6.4 Based on fire explosion risk analysis and study findings outcome according to [1.4.1] mitigation of risk of explosion to other places might require fitting of an insulated fire rated steel bulkhead.

1.7 Piping process safety features, mechanical integrity

1.7.1 Design pressure and design temperature are to be defined as stated in NR467, Pt C, Ch 1, Sec 10.

1.7.2 Piping systems are to be protected against over pressure and over undesired temperature.

1.7.3 Fitting material of piping are to be in accordance with requirements of NR467, Part D, Chapter 9.

1.7.4 Certification scheme of pipes and material is to be in accordance with [1.10].

1.7.5 Heating medium piping system is to comply with the requirements of NR467, Pt C, Ch 1, Sec 10.

1.7.6 Process cause and effect chart is to meet minimum requirement of rule monitoring and control system including process shut down and emergency shutdown philosophy as per Tab 2.

1.7.7 Depressurizing manual and philosophy is to be submitted and to ensure safe operation of depressurizing while regasification plant is in normal operation, in process upset or shutdown mode.

1.7.8 Pumps and vaporizers or regas trains are to be fitted with isolating valves at the inlets and outlets.

Note 1: Alternative isolation philosophy and arrangement might accepted by Society in case base case basis providing Operator agreement.

1.7.9 As practicable as possible, cryogenic pipes and pieces of equipment are to be located at the lowest level of plant.

1.8 Monitoring and control

1.8.1 The monitoring, controls, alarms and safeguards are to be provided in accordance with Tab 2.

Table 2 : Monitoring and control

Symbol Convention H = High, HH = High high, L = Low, LL = Low low, R = Remote, X = Function is required	Monitoring		Automatic Control			
			System		Auxiliary	
Identification of system parameter	Alarm	Indication	Shut-down	Control	Standby Start	Stop
LP Transfer Pump pressure	L	Local + R				
Recondenser tank or suction drum level	L + H	Local + R				
	LL		X			
Recondenser tank or suction drum pressure	L + H	Local + R				
BOG condenser liquid pressure	L + H	Local + R				
	HH		X			
HP send out pump pressure	L + H	Local + R		X		
	HH		X			
Vaporizer outlet gas pressure	L + H	Local + R		X		
Vaporizer outlet gas temperature	L + H	Local + R		X		
	LL		X			
Manifold/header pressure		Local + R				
Note 1: Alarm and shut down control requirements might be modified based on HAZID/HAZOP recommendations and findings.						

Symbol Convention H = High, HH = High high, L = Low, LL = Low low, R = Remote, X = Function is required	Monitoring		Automatic Control			
			System		Auxiliary	
Identification of system parameter	Alarm	Indication	Shut-down	Control	Standby Start	Stop
Depressurizing mode	X					
Cryogenic spill detection	X					
Heating medium contaminated (LNG-Gas) detection	X					
Vaporizer heating medium inlet pressure	L + H	Local + R				
	LL		X			
Vaporizer heating medium inlet temperature	L	Local + R				
Vaporizer heating medium inlet flow	L		X			
Instrumentation supply failure	X		X			
Emergency shut down	X		X			
Gas detection system	X					
Fire detection system	X		X			
Note 1: Alarm and shut down control requirements might be modified based on HAZID/HAZOP recommendations and findings.						

1.9 Fire Safety features

1.9.1 General

When relevant, findings of risk assessment study required in [1.4.1] are to be considered and implemented on design and drawings which are listed on Tab 1.

1.9.2 Hazardous area

Extensions of hazardous area with respect to regasification plant configuration is to comply with requirements of Sec 12.

Alternative arrangement may however be accepted for process parts of regasification plant, but justifications are to be provided.

1.9.3 Access arrangement and ventilation

In case of regasification plant installed on semi enclosed space, access arrangement and ventilation are to be in accordance with requirements of NR467, Part D, Chapter 9.

If plant fitted on the open deck, then arrangement with adjacent space is to be agreed by society on case by case basis.

1.9.4 Fire passive protection system

Arrangement of fire passive protection and material documents are to be submitted.

1.9.5 Fire and Gas detection

The arrangement and layout of fire and gas detections are to be designed to cover regasification plant with respect to probability of presence of gas and fire risk. Such arrangement is subject to society approval.

1.9.6 Safety fire active system

Arrangement of fire fighting systems (fire main and hydrants, water spray systems and dry chemical powder) is to comply with the requirements of NR467, Part D, Chapter 9.

1.9.7 Escape routes

At least two different escape routes are to be provided from the regasification plant.

Main escape routes are to be protected from green water effect.

Escape routes are to be protected against fire and sources of excessive heat.

1.10 Certification scheme

1.10.1 The requirement for survey of material and equipment covered by classification is given in Tab 3.

1.10.2 The certification scheme of materials and equipment covered by the Class, not list in Tab 3 is given in NR320, Certification Scheme of Materials and Equipment for the Classification of Marine Units.

Table 3 : Regasification components certification scheme

No	Item	Design assessment / Approval	Raw material certificate	Examination and test	Product certificate
1	Steel plates, profiles, bars & pipes for main structure	-	C	-	C
2	Pipes and fittings	-	C	X	C
3	Expansion joint	TA	C	X	C
4	Flexible and loading/off-loading hoses	TA	C	X	C
5	Safety valves	TA	C	X	C
6	Cryogenic & Gas valves	TA	C	X	C
7	LP Transfer & HP send out pumps	DA	C	X	C
8	Heat exchanges, vaporizers	DA	C	X	C
9	Pressure vessels, suction drum	DA	C	X	C
10	Compressors	DA	C	X	C
11	Fire passive system and materials	TA	-	-	C/W
12	Fire active system	TA/DA	C/W	X	C
13	Gas detection system	TA	-	X	C
14	Cryogenic protection material	TA/DA	-	X	C
15	Electro motors	TA/DA	C/W	X	C
16	Automation systems	TA	-	X	C/W
17	Sensors, transmitters, flow meters, circuit breaker, electrical cable	TA	-	X	C/W
18	Heating media pump	TA/DA	W	X	C
19	Heating media pipes and fittings Class I & II Class III	- - -	- C W	- X -	- C W
20	Insulation material	TA	-	X	C/W
21	Gas metering/analyzer skid	DA	C	X	C
22	Boiler with associated components	TA/DA	C	X	C

Note 1: Abbreviations:
W : Work/manufacturer certificates
TA : Type Approval certificate (or MED Certificate) is required
DA : Design assessment is required
C : Class certificate is required
X : Classification intervention is required.
Note 2: In case a material or equipment is not listed, the requirement for survey as per NR266 is applicable.

1.11 Tests after installation onboard

1.11.1 This sub-article covers the tests to be carried out on board after installation of regasification plant. Onboard tests are intended to demonstrate that the plant with associated safety features is functioning properly in compliance with the Rules criteria. The tests are to be witnessed by a Surveyor.

1.11.2 Prior to commissioning of regasification plant, complete workshop tests and component certificates, pre-commissioning dossier is to be verified by surveyor to ensured compliance with rule requirement and punch lists are closed.

1.11.3 The fire safety features of the regasification plant are to be operationally tested in the presence of surveyor.

1.11.4 Regasification process safety features are to be tested, including process upset simulation and emergency shut down functioning, according to approved test procedure, in the presence of a surveyor.

1.11.5 Upon completion of above satisfactory tests result, regasification operational test (including ESD functioning) is to be carried out in the presence of a surveyor.

1.12 References and codes

1.12.1 As reference only, a list of recognized regulations and standards relevant for regasification plant and components is given in Tab 4.

Table 4 : List of references and standards

Reference	Title
ASME Code Section VIII	Boiler and pressure vessel code
TEMA	Tubular exchanger manufacturer association
ASME B31.3	Process piping code
API 14C	Recommended practice for analysis, design, installation, and testing of basic surface safety systems for offshore production platforms
API 520 and API 521	Pressure relieving devices and depressurizing system
API 610	Centrifugal pumps for petroleum, heavy duty chemical and gas industry service
API 617	Axial and centrifugal compressors and expander compressors for petroleum compressors for petroleum, chemical and gas industry services
API 618	Reciprocating compressors for petroleum, chemical and gas industry services
API 619	Rotary type positive displacement compressors for petroleum, chemical and gas industry services
IEC 60092-502	Tankers - Special features
IEC 61285	Process control safety of analyser houses
EN 1474	Installation and equipment for liquefied natural gas, design and testing of marine transfer systems.
EN 1626	Valve for cryogenic service
EN 12434	Cryogenic flexible hose
EN 13275	Pumps for cryogenic service
IEC 60034	Rotating electrical machines
IEC 61892 series	Mobile and fixed offshore-electrical installation
IEC 60079-10	Classification of hazardous areas
Note 1: The latest version of reference and codes are to be addressed during design, construction, testing. Alternative international code and standards might replace upon society agreement in case by case basis.	

Section 11 Electrical Installations

1 General

1.1 Application

1.1.1 The requirements related to electrical installations specified in NR467, Pt D, Ch 9, Sec 10 and NR467, Part C, Chapter 2 are applicable, except where specifically indicated otherwise in this Section.

2 Hazardous locations and types of equipment

2.1 Electrical equipment permitted in gas-dangerous spaces and zones

2.1.1 In order to facilitate the selection of appropriate electrical apparatus and the design of suitable electrical installations, hazardous areas are divided into zones (0, 1 and 2) according to the definitions given in Sec 12, [1.3.4]. The different spaces are to be classified according to Sec 12, Tab 1.

The types of electrical equipment permitted, depending on the zone where they are installed, are specified in NR467, Pt C, Ch 2, Sec 3.

3 Units with service notation FSRU or FSU-LNG

3.1 General

3.1.1 For units with the service notation **FSRU** or **FSU-LNG**, provisions of Article [3] may be applied as an alternative to the requirements for supply systems from NR467, Pt D, Ch 9, Sec 10.

3.2 Supply systems

3.2.1 The following parallel distribution systems with constant voltage may be used:

a) on d.c. installations:
- two-wire insulated (IT system)
- two-wire with one pole earthed (TN system)
- three-wire with middle wire earthed (TN system).

b) on a.c. installations (primary distribution systems):
- three-phase three-wire with insulated or impedance earthed (IT system)
- three-phase four-wire with neutral directly earthed (TN system).

c) on a.c. installations (secondary distribution systems):
- three-phase three-wire with insulated or impedance earthed (IT system)
- three-phase four-wire with neutral directly earthed (TN system)
- single-phase two-wire insulated (IT system)
- single-phase two-wire with one pole earthed (TN system)
- single-phase two-wire with mid-point of system earthed for supplying lighting and socket outlets (TN system)
- single-phase three-wire with mid-point earthed (TN system).

3.2.2 Where phase to neutral loads are to be served, systems are to be directly earthed (TN system).

Note 1: The neutral is defined for a polyphase only.

3.3 Impedance earthed distribution system

3.3.1 In the case of impedance earthing, the impedance is to be such that the earth fault current is slightly higher than the capacitive current of system. The maximum earth fault is however to be limited to:

- 100 A per generator
- 100 A per transformer.

3.3.2 Earth leakage monitoring and an alarm or automatic disconnection via earth leakage protection devices are to be provided.

3.4 Distribution systems in hazardous areas

3.4.1 If a power system with directly earthed neutral is used, it is to be of type TN-S with separate neutral and protective conductor. The neutral and the protective conductor are not to be connected together, or combined in a single conductor in a hazardous area.

Power system of type TN-C, having combined neutral and protective functions in a single conductor throughout the system, is not allowed in hazardous areas.

3.4.2 The electrical circuits and apparatus in hazardous areas, except intrinsically safe circuits and apparatus, are to be provided with means to ensure disconnection in the shortest practical time in the event of overload or short-circuit.

3.4.3 The electrical systems located in hazardous areas are to be further protected against earth fault as follows:

a) IT system: alarm or automatic disconnection

b) IT system with impedance earthed neutral: automatic disconnection in the shortest practical time

c) TN-S system: automatic disconnection in the shortest practical time.

3.4.4 For installation in Zone 0, the following precautions are to be considered:

a) earth fault currents in magnitude and duration is to be limited

b) installation is to be disconnected instantaneously in case of the first fault, either by the insulation monitoring device or by a residual current device.

3.4.5 In insulated distribution systems, no current carrying part is to be earthed, other than:

a) through an insulation level monitoring device

b) through components used for the suppression of interference in radio circuits.

3.5 High voltage installations

3.5.1 Directly earthed neutral system is not to be used for high voltage installations.

3.5.2 Earthed neutral systems are admitted provided that the earth fault current is limited to an acceptable level, either by inserting an impedance in the neutral connection to earth or by an earthing transformer.

3.5.3 The earthing impedance is to be designed in order that:

a) the resistive current is higher than the network capacitive current in the event of an earth fault, and

b) the maximum earth fault current is limited to a value that the generators and transformers can withstand for a prolonged time without damage to the core (see Note 1), and

c) the prospective earth fault current is at least three times the values of current required to operate any earth fault protective devices.

Note 1: The maximum earthing current is to be discussed with the equipment manufacturer. In the absence of precise values, the values specified in Tab 1 may be taken for guidance.

Table 1 : Recommended maximum earth fault currents

Rated voltage	Generator	Transformer
6,6 kV	20 A per generator	20 A per transformer
11,0 kV	20 A per generator	20 A per transformer

3.5.4 Efficient means are to be provided for detecting defects in the insulation of the system. For systems where the earth fault current exceeds 5 A, automatic tripping devices are to be provided. Where the earth fault current does not exceed 5 A, an indicator may be provided as an alternative to an automatic tripping.

3.5.5 In insulated earth system, any earth fault in the system is to be indicated by means of a visual and audible alarm.

3.5.6 In installations where outgoing feeders are not disconnected in case of an earth fault, the insulation of the equipment is to be designed for the phase-to-phase voltage.

Section 12 Hazardous Areas

1 General

1.1 General

1.1.1 This Section is applicable to hazardous areas due to cargo storage, LNG loading/off-loading and regasification plant.

1.1.2 All the requirements of this Section may be adapted, based on the finding and conclusions of the risk analysis report, defined in Sec 10, [1.4], which is to be submitted to the Society for information.

Detailed follow-up report of actions and mitigation measures taken in response to risk analysis findings is to be submitted to the Society for information.

1.2 General requirements

1.2.1 Where electrical equipment is installed in hazardous areas, it is to be selected, installed and maintained in accordance with standards not inferior to those acceptable to the Society. The types of electrical equipment admitted, depending on the zone where they are installed, are specified in NR467, Pt C, Ch 2, Sec 3, [10]. Equipment for hazardous areas is to be type approved by the Society. Automatic isolation of non-certified equipment on detection of a flammable gas is not to be accepted as an alternative to the use of certified equipment.

1.3 Definitions

1.3.1 Cargo area

The cargo area is that part of the unit which contains the cargo containment system, cargo pump room, compressor room, and includes deck areas above these spaces. Where fitted, the cofferdams, ballast or void spaces at the after end of the aftermost hold space or at the forward end of the forwardmost hold space are excluded from the cargo area.

1.3.2 Cargo control room

A cargo control room is a space used for the control of cargo handling operations.

1.3.3 Hold space

An hold space is a space enclosed by the unit structure in which a cargo containment system is located.

1.3.4 Hazardous areas, gas-dangerous spaces

Hazardous areas or gas-dangerous spaces are areas in which an explosive gas atmosphere is, or may be expected to be, present in quantities such as to require special precautions for the construction, installation and use of electrical apparatus.

Based upon the frequency and the duration of the occurrence of explosive atmosphere, hazardous areas are classified into the following zones:

- Zone 0:

  an area where gas (or cargo) is present continuously or in which an explosive gas atmosphere is present continuously or is present for long periods.
- Zone 1:

  an area in which an explosive gas atmosphere is likely to occur in normal operation.
- Zone 2:

  an area in which an explosive gas atmosphere is not likely to occur in normal operations and, if it does, is likely to occur infrequently only and will exist for a short period only.

1.3.5 Explosive gas atmosphere

An explosive gas atmosphere is a mixture with air, under atmospheric conditions, of flammable substances in the form of gas, vapour or mist, in which, after ignition, combustion spreads throughout the unconsumed mixture.

2 Hazardous areas

2.1 Classification of hazardous areas due to storage, off-loading and regasification plant

2.1.1 For the purpose of machinery and electrical installations, hazardous areas are classified as indicated in Tab 1.

2.1.2 Alternative classification of hazardous area may be considered with justifications, based on IEC 60079-10 or equivalent to ensure that in case of leakage, the presence of an explosive gas atmosphere can be present only for a short period. This study shall cover all low and high pressure parts, liquid and vapour phases and is to be agreed by Society on case by case basis.

Table 1 : Description of spaces and hazardous area zones

No.	Space description	Hazardous area zone
1	The interior of cargo tanks, any pipework of pressure-relief or other venting systems for cargo, pipes and equipment containing the cargo or developing flammable gases and vapours	Zone 0
2	Interbarrier spaces, hold spaces where cargo is carried in a cargo containment system requiring a secondary barrier	Zone 0
3	Hold spaces where cargo is carried in a cargo containment system not requiring a secondary barrier	Zone 1
4	Cofferdams and permanent (for example, segregated) ballast tanks adjacent to cargo tanks	Zone 1
5	Cargo pump rooms and cargo compressor rooms	Zone 1
6	Enclosed or semi-enclosed spaces, immediately above cargo tanks (for example, between decks) or having bulkheads above and in line with cargo tank bulkheads, unless protected by a diagonal plate acceptable to the Society	Zone 1
7	Spaces, other than cofferdams, adjacent to, and below, the top of a cargo tank (for example, trunks, passageways and holds)	Zone 1
8	Areas on open deck, or semi-enclosed spaces on open deck above and in the vicinity of any cargo gas outlet intended for the passage of large volumes of gas or vapour mixture during cargo loading and ballasting or during discharging, within a vertical cylinder of unlimited height and 6 m radius centred upon the centre of the outlet, and within a hemisphere of 6 m radius below the outlet	Zone 1
9	Areas on open deck, or semi-enclosed spaces on open deck, within 1,5 m of cargo pump room entrances, cargo pump room ventilation inlet, openings into cofferdams, cargo compressor room entrances, cargo compressor room ventilation inlets or other zone 1 spaces	Zone 1
10	Areas on open deck within spillage coamings surrounding cargo manifold valves and 3 m beyond these ones, up to a height of 2,4 m above the deck	Zone 1
11	Areas on open deck over the cargo area where structures are restricting the natural ventilation and over the full breadth of the unit plus 3 m fore and aft of the forwardmost and aftermost cargo tank bulkheads, up to a height of 2,4 m above the deck	Zone 1
12	Compartments for cargo hoses	Zone 1
13	Spaces separated from a hold space, where cargo is stored in a cargo tank requiring a secondary barrier, by a single gastight boundary	Zone 1
14	Enclosed or semi-enclosed spaces in which pipes containing cargo products for boil-off gas fuel burning systems are located, unless special precautions approved by the Society are provided to prevent product gas escaping into such spaces	Zone 1
15	Cargo areas on open deck, or semi-enclosed spaces on open deck, within 3 m of any cargo tank outlet, gas or vapour outlet, cargo manifold valve, cargo valve, cargo pipe flange, cargo pump room ventilation outlets, cargo compressor room ventilation outlets and cargo tank openings for pressure release provided to permit the flow of small volumes of gas or vapour mixtures caused by thermal variations	Zone 1
16	Regasification areas on enclosed or semi-enclosed spaces, within 3 m of any gas or vapour outlet, valve, pipe flange, pump room ventilation outlets and compressor room ventilation outlets	Zone 1
17	Regasification areas on open deck, within 3 m of any gas or vapour outlet, valve, pipe flange, pump room ventilation outlets and compressor room ventilation outlets	Zone 1
18	Enclosed or semi-enclosed spaces in which pipes containing cargoes are located	Zone 1
19	Spaces 4 m beyond the cylinder and 4 m beyond the sphere defined in No. 8	Zone 2
20	Spaces forming an air lock as defined in NR467, Pt D, Ch 9, Sec 3, [1.6]	Zone 2
21	Areas on open deck extending to the coamings fitted to keep any spills on deck and away from the accommodation and service areas and 3 m beyond them up to a height of 2,4 m above the deck	Zone 2
22	Areas on open deck over the cargo area where unrestricted natural ventilation is guaranteed and over the full breadth of the unit plus 3 m fore and aft of the forwardmost and aftermost cargo tank bulkheads, up to a height of 2,4 m above the deck surrounding open or semi-enclosed spaces of zone 1	Zone 2
23	Spaces forward of the open deck areas referred to in 13 and 21, located below the level of the main deck and having an opening onto the main deck or at a level less than 0,5 m above the main deck, unless: • the doors and all openings are in non-hazardous area; and • the spaces are mechanically ventilated	Zone 2
24	Areas within 2,4 m of the outer surface of a cargo tank where such a surface is exposed to the weather	Zone 2
25	Regasification areas on open deck, except areas defined in No 17, up to a height of 2,4 m above the upper skids level	Zone 2
26	Areas of 1,5 m surrounding a space of zone 1 defined in No. 15, No. 16 and No. 18	Zone 2

Section 13 Machinery, Automation and Fire Protection

1 General

1.1 Application

1.1.1 For machinery, automation systems and fire protection, units with the service notation **liquefied gas carrier - FSRU or liquefied gas carrier - FSU** are to comply with NR467, Part C and NR467, Part D, Chapter 9.

1.1.2 In general, units with the service notation **FSRU** or **FSU-LNG** are to comply with the requirements [1.1.1], as relevant.

Section 14 Design Requirements for Survey on Site

1 General

1.1 Application

1.1.1 This Section is applicable only when unit is intended to have the intermediate and/or renewal survey performed while the unit is in continuous operation.

1.1.2 Where in-service inspection programme as per requirement Sec 15, [1.1.3] is approved then surveys and inspections according to this program are to be complied with.

2 Design requirements for survey

2.1 General

2.1.1 The unit is to be adequatedly prepared to allow the relevant surveys and tests to be safely undertaken to the required extent, paying particular attention to safety valves, cargo pumps, regasification plant, electrical equipment in hazardous areas and inert gas system as defined in [2.2] to [2.4].

2.2 Sea water system

2.2.1 When sea water intakes are located in the hull and below the maximum draft water line, they are to be modified by adding mechanical fasteners welded to the outside of the hull in order to block the sea chest from the outside whenever required for inspection and maintenance.

The isolation is to guarantee the tightness of the sea chest for the safe removal of a sea water intake valve and/or other component downstream of it, without risking the ingress of water from the outside of the unit. Such system is to be approved by the Society on a case-by-case basis.

2.3 Cargo tanks inspection

2.3.1 Arrangements are to be set out to allow safe inspection of a single or more cargo tanks with the unit in operation. Double shut off arrangement for all interconnections between tanks and equipment and piping to be fitted.

2.4 Cargo handling equipment

2.4.1 General

When inspection is required during the renewal survey, arrangements are to be made during the design stage to allow this testing when the plant is in operation.

2.4.2 Cargo pumps

Cargo pumps are to be dismounted for inspection during renewal survey. Arrangements are to be made during the design stage to allow this testing when the plant is in operation.

2.4.3 Safety valve

As required in NR467 Pt A, Ch 4, Sec 5, [6.7.13], safety valve are to be tested every 5 years, arrangements are to be made during the design stage to allow this testing when the plant is in operation.

2.4.4 Regasification plant

Internal and external inspection of equipments (such as suction drum) are to be planned when the plant is in operation.

2.4.5 Electrical equipment

For each renewal survey, the electrical resistance of electrical equipment circuits are to be measured, while the cargo handling system is in operation.

Tests, exams and possible calibration of the different instrumentation and safety devices is to be foreseen.

2.4.6 Inert gas system

This system is to be overhauled and serviced during the renewal surveys, but precautions will be required during this period, in case a supply of inert gas is needed while the plant is shut down.

Section 15 In-Service survey

1 General

1.1 Application

1.1.1 In general, units with the service notation **liquefied gas carrier - FSRU** or **liquefied gas carrier - FSU** are surveyed in accordance with NR467 Part A, Chapter 3 and NR467, Pt A, Ch 4, Sec 5.

1.1.2 In general, units with the service notation **FSRU** or **FSU-LNG** are surveyed in accordance with NR445, Part A, Chapter 2.

1.1.3 The cargo containment system, pump transfer mast and support tower and selected cargo machinery and equipment such as cargo pumps may be subject to alternative survey programme when the additional class notation **ASP** is assigned in accordance with App 1.

2 Bottom surveys

2.1 General

2.1.1 For permanent installations and for other units where drydocking is impracticable, the examination of the outside of the unit's underwater parts and related items may be carried out during an in-water survey, subject to the notation **INWATERSURVEY** having been assigned and subject to the agreement of the Society and as authorised by Flag Administration and, when relevant, by the coastal state.

2.1.2 In principle, no outstanding recommendations are to exist requiring repair work to be carried out to the underwater part of the shell plating, the rudder, the propeller or the propeller shaft, unless the Society is satisfied that such repairs may be carried out while the ship is afloat.

2.1.3 Proposals for in-water survey are to be submitted in advance of the entry in service and the mandatory following surveys by the Owner so that satisfactory arrangements can be agreed with the Society and the Flag Administration.

The in-water survey is to be carried out with the ship in calm water and preferably with weak tidal streams and currents. The in-water visibility and the cleanliness of the hull below the waterline are to be clear enough to permit a meaningful examination allowing the Surveyor and the diver to determine the condition of the plating, the appendages and the welding.

The equipment, procedure for observing and reporting the survey are to be discussed with the parties involved prior to the in-water survey, and suitable time is to be allowed to permit the diving company to test all equipment beforehand.

2.1.4 The in-water survey is to be carried out, under surveillance of a Surveyor, by divers or by suitably equipped remotely operated vehicles (ROV's). The divers are to be employed by a firm approved as service supplier by the Society.

The in-water survey scope of work maybe mergeable over a three months period (weather condition, in-water visibility, diver's safety...). The overlap and the sequence of inspection shall be provided at satisfaction of the surveyor.

The Surveyor is to be satisfied with the methods of orientation of the diver(s) on the plating, which should make use where necessary of permanent markings on the plating at selected points and with the method of pictorial representation. An efficient two-way communication between the Surveyor and the diver(s) is to be provided.

2.1.5 The in-water survey is to provide the information normally obtained from a bottom survey in dry condition. Special consideration shall be given to ascertaining rudder bearing clearances and stern bush clearances of oil stern bearings based on a review of the operating history, on board testing and stern oil sample reports. These considerations are to be included in the proposals for in-water survey as required in [2.1.3].

During in-water survey, cathodic protection potential readings are to be taken. The amount of readings is to be representative of the whole immersed part of the structure of the unit.

Upon completion of the survey, the approved diving firm is to submit to the attending Society Surveyor a detailed report including video tapes, as well as a photographic documentation of the main parts inspected.

2.1.6 If the in-water survey reveals damage or deterioration that requires immediate attention, the Surveyor may require that the ship be drydocked in order that a detailed survey can be undertaken and the necessary repairs carried out.

2.1.7 A memoranda is to be entered in ship status.

2.1.8 On completion of the on-site FRSU assignment when the unit has been for five years or more, or has performed its latest renewal survey on site without drydocking and before re-location or to resume trading, a bottom survey in drydock is to be performed.

Note 1: Attention is also drawn to the relevant requirements concerning the application of national and international regulations.

3 Tailshaft surveys

3.1 General

3.1.1 Tailshafts surveys are done as per NR467, Pt A, Ch 3, Sec 5. Special consideration may be given by the Society when the shaft is fitted with keyed propeller coupling.

4 Mooring system

4.1 General

4.1.1 For units intended to be assigned the additional service feature **POSA** or **POSA JETTY**, surveys of the permanent mooring system are to be done as per NR493, Classification of Mooring Systems for Permanent Offshore Units.

4.1.2 Surveys of the temporary mooring equipment, if any, are to be done as per NR445, Pt A, Ch 2, Sec 8.

Appendix 1 Alternative Survey Programme (ASP)

1 General

1.1 Application

1.1.1 This Appendix is applicable to unit designed with cargo containment system of membrane type or type B spherical tank.

1.1.2 The additional class notation **ASP** may be assigned to units complying with the requirements of this Appendix and having one of the following service notations while not trading LNG in a navigation mode:

liquefied gas carrier - FSRU

liquefied gas carrier - FSU

FSRU

FSU-LNG

1.2 Scope

1.2.1 This Appendix provides the requirements for implementing an Alternative Survey Programme (ASP) for the cargo containment system, pump transfer mast and support tower and selected cargo machinery and equipment such as cargo pumps, cargo valves, or any other equipment deemed necessary by the Society.

1.2.2 The Alternative Survey Programme (ASP) aims at providing a structured approach for extending the interval of the examination of cargo containment system, including pump transfer mast, support tower, and other selected cargo machinery and equipment, beyond the 5 years prescriptive period.

1.3 Alternative Survey Programme (ASP)

1.3.1 General Requirements

Alternative Survey Programme (ASP) will be considered, on the basis of the following:

a) Location:

The unit is to be operated in a fixed predefined location, with reference site conditions, as defined in Sec 2, [4.2.13], authorized filling levels, and associated environmental loads, used to establish acceptable sloshing loads as per the recommendations of the cargo containment system, and pump transfer mast and pump support designer.

Note 1: Environmental loads are to include site particularities such as break waves or jetty.

b) Reference:

The Alternative Survey Programme is to be described in the ASP plan as defined in [2.3] to be submitted to the Society for approval.

c) Interval for examination of items covered under ASP:

The interval for tank's internal examination as well as any additional items covered under ASP will be defined based on engineering studies, mitigation measures, an inspection strategy approved by the Society. The ASP plan may be approved with extended interval for the examination of cargo containment system, selected cargo machinery and equipment, from 5 years up to the number of years related to the expected operation at that specific location:

- The survey interval of the items covered under ASP is the results of the ASP analysis which includes an ASP workshop and the continuous monitoring. The maximum survey interval will be re- assessed by the society every year during the annual and renewal ASP review. Internal inspection may be requested if the permissible limits of monitored parameters, as defined in the ASP plan, are exceeded.
- The ASP plan is to cover all equipment inside the cargo containment system, including pump transfer mast, support tower, selected cargo machinery and equipment.
- The sloshing effects on the containment system (primary barrier and subsequent systems) and the pump tower, are to be taken into account depending on the site conditions. The cumulated probability of failures and fatigue for the containment system and pump tower, for the expected period of operation at the specific location, is not to exceed the expected probability of failure and cumulated fatigue damage of same components on a liquefied gas carrier trading for 5 years in the following environment:
  - in general: North Atlantic
  - for units designed for environment other than North Atlantic: conditions corresponding to the design environment.

  The sloshing study including direct sloshing calculation is to be submitted to the Society (see Sec 10, Tab 1).

Note 2: When statutory certification as per IGC Code is applicable, the implementation of the ASP plan is subject to the acceptance from the Flag Administration and, when relevant, by the coastal state.

d) Application to ASP for units in-service

The application to ASP is to be made in conjunction with a class renewal survey in order to confirm the tank condition prior implementation of ASP.

For units with independent tanks of type B, non-destructive test covering all tanks is to be performed

When the application to ASP is made between two class renewal surveys, the ASP will be subject to the review of the operating history since the last renewal survey and the review of the report of the last tank internal report.

Where the significant wave height is less than 1.5m, the society may accept to omit this report provided that historical evidence of the environmental conditions has been provided. This will be recorded in the ASP plan.

1.3.2 Environmental conditions

The environmental conditions (Hs, Tp) on the site area are to be recorded along the time (every 3 hours) with the corresponding operation parameters (draft, filling level) and are to be submitted to the Society for their review as part of the annual ASP report.

Where the significant wave height is less than 1,5m, the Society may accept to omit this report provided that historical evidence of the environmental conditions has been provided. This will be recorded in the ASP plan.

1.3.3 Design requirements

a) A motion reference unit (MRU) or other sloshing monitoring system are to be arranged onboard for the monitoring of the sloshing effect when the site area significant wave height is higher than 1,5 m, as defined in Sec 5, [6.3.2]. In such case, the sampling frequency of the MRU is to be at least 10 Hz.

b) All loose equipment (bolts, cable trays, covers ..) in the cargo tank are to be properly secured (e.g. tack welded, locking pin).

c) Provisions are to be provided onboard to record and save parameters and alarms of the instrumentation and safety devices for each cargo tank. The final list of required parameters and permissible limits is to be defined during ASP workshop based on the type of containment system. Below is on-exhaustive indicative list of monitored parameters:

- pressure
- temperature
- gas detection
- leakage detection
- tank liquid level
- manual and automatic shut-down system of storage pumps and compressors
- environmental conditions (H_S, T_p)
- ship motions from the MRU, if applicable.

d) For disconnectable permanent units, the parameters monitored in accordance with item c) are to be recorded during the following periods:

- period on site
- period when the unit is disconnected (when the unit is not on site).

e) The data acquisition system for monitoring the necessary parameters for the ASP plan is to ensure reliable data collection, transmission, storage, control, sharing and availability in accordance with the requirements for assignment of the additional class notation **DATA-INFRA** or any other standard recognized by the Society.

1.3.4 Review of the monitored parameters and class surveys

Prior to the class annual and renewal surveys, the reporting of the monitored parameters is reviewed by the Society during the annual and renewal ASP review. Then annual and renewal surveys are performed on-site as per the requirements of Article [3], during continuous operations, supported by an ASP plan approved by the Society and implemented by the Owner or Operator.

1.3.5 Approval of monitoring technologies and data acquisition systems

Any new or modified equipment or technology utilized as part of the ASP is to be agreed by the Society. Additionally, the number or design of these equipment or technologies are to be such that sufficient redundancy is ensured.

Note 1: When a digital solution for monitoring the LNG cargo containment system is installed onboard or a remote sloshing activity monitoring system is provided by an expert in-the-loop company, the notation **SMART(Xx)** may be assigned to the unit when complying to the requirements given in NR675 Sec 1 and NR675, Sec 7.

The notation **Xx** is to be replaced by the name of the smart function and the smart group covered by the additional class notation (Examples: **SMART(LNGTANK-MON1)**, **SMART(LNGTANK-MON2)**, **SMART(LNGTANK-MON1, SLOSHING3)**).

1.3.6 Resuming trading activities

Prior resuming trading activities, all cargo tanks are to be internally inspected, except where internal inspection of all cargo tanks has been completed within the last 5 years. In such cases the additional class notation **ASP** is to be withdrawn.

1.3.7 Relocation

The maintenance of the additional class notation **ASP** is considered on a case-by-case basis when the unit is redeployed to another location.

1.3.8 Emergency departure

After an emergency departure, the period during which the unit is not in its site area is to be recorded. The review of these monitored parameters will be carried out during the annual ASP review

1.4 Documentation to be submitted

1.4.1 The documentation to be submitted to the Society for the assignment of the additional class notation **ASP** is listed in:

- Tab 1 for the documentation to be submitted before the ASP workshop
- Tab 2 for the documentation to be submitted after the ASP workshop.

1.4.2 The documentation to be submitted to the Society for the maintenance of the additional class notation **ASP** is listed in:

- Tab 3 for the documentation to be submitted for the annual ASP review
- Tab 4 for the documentation to be submitted for the renewal ASP review.

1.4.3 The Society reserves the right to require additional documents as deemed necessary.

Table 1 : Before the ASP Workshop - List of documents to be submitted for the assignment of the additional class notation ASP

No.	A/I **(1)**	Documentation to be submitted
1	I	For all units: Unit general particulars and all relevant structural and non-structural drawings pertaining to the items of the scope of ASP including: • General arrangement • Details of ladders, fittings and towers in tanks and relative stress analysis, if any • Details of tank domes and deck sealings • Plans, arrangement and calculations of safety relief valves • Details of cargo handling and vapour system, including arrangements and details of piping and fitting • Details of cargo pumps and cargo compressors • Details of process pressure vessels and relative valving arrangement • Interbarrier space drainage, inerting and pressurisation systems • Hull structure heating system • Refrigeration and reliquefaction plant system diagram, if any • Gas detection system • Cargo tank instrumentation, including cargo and hull temperature monitoring system • Loading and unloading operation description, including cargo tank filling limits • Cargo operating manual • Cargo tank testing and inspection procedures for in-service inspection as defined in NR467, Pt D, Ch 9, Sec 4, [2.1.6] • For independent tanks of type B, non destructive testing program specially prepared for the cargo tank design • Design criteria statement as defined in Sec 1, [8.1]
2	I	Additional documentation for existing units: • Unit operational history and survey reports • Thickness measurement reports • Containment system inspection reports (including primary and secondary barriers repairs history) • For independent tanks of type B, last non-destructive testing report in line with the program specially prepared for the cargo tank design
(1) A: to be submitted for approval, I: to be submitted for information		

Table 2 : After the ASP workshop - List of documents to be submitted for the assignment of the additional class notation ASP

No.	A/I **(1)**	Documentation to be submitted
1	A	ASP plan as defined in [2.3]
(1) A: to be submitted for approval, I: to be submitted for information		

Table 3 : Annual ASP review - List of documents to be submitted for the maintenance of the additional class notation ASP

No.	A/I **(1)**	Documentation to be submitted
1	A	Annual ASP report as defined in the ASP plan
(1) A: to be submitted for approval, I: to be submitted for information		

Table 4 : Renewal ASP review - List of documents to be submitted for the maintenance of the additional class notation ASP

No.	A/I **(1)**	Documentation to be submitted
1	A	Renewal ASP report as defined in the ASP plan
(1) A: to be submitted for approval, I: to be submitted for information		

2 Assignment of the ASP notation

2.1 General

2.1.1 The additional class notation **ASP** is assigned upon completion of the process described in [2.1.2] to [2.1.6].

2.1.2 ASP workshop

An ASP workshop is to be organized involving the Owner, the Society and other necessary stakeholders (e.g. designers/makers of cargo containment system and equipment).

2.1.3 ASP plan submission

The Owner submits the ASP plan as per the requirements of [2.3] on the basis of the ASP workshop results, along with the documentation listed in [1.4.1].

2.1.4 Review and approval

The Society approves the ASP plan.

2.1.5 Implementation

The approved ASP plan is to be implemented by the Owner.

2.1.6 Initial survey

The implementation of the ASP is subject to an initial survey according to [2.5]. The additional class notation **ASP** is assigned upon satisfactory results of the initial survey.

2.2 ASP workshop and risk assessment

2.2.1 An ASP workshop is to take place with the objective to facilitate the completion of the various tasks of the ASP analysis and to facilitate the understanding of the Society.

2.2.2 The ASP workshop and the risk assessment are to be organized by the Owner.

2.2.3 The ASP workshop consists of evaluating the alternative survey means and methodologies as an equivalent means of performing class renewal surveys as required by the Harmonized System of Survey and Certification (HSSC) and the requirements given in NR445, Part A, Chapter 2 or NR467, Part A, Chapter 3 and NR467, Pt A, Ch 4, Sec 5, in the context of an extended survey interval beyond 5 years.

For items which cannot be examined without entering the cargo tank or without interrupting the operations, such as the supply of gas to a consumer, an alternative solution is to be proposed and is to be justified as equivalent to the prescriptive class requirements.

2.2.4 A risk assessment is to be carried out to evaluate and address the risk of the alternative means of inspection as identified during the ASP workshop. The risk assessment can be part of the ASP workshop or conducted afterwards. The risk assessment is to account for the following aspects:

a) hazards associated with the extended survey interval defined based on engineering studies, mitigation measures, a defined inspection strategy and continuous monitoring activities.

b) the Harmonized System of Survey and Certification (HSSC) and the requirements given in NR467, Part A, Chapter 3 and NR467, Pt A, Ch 4, Sec 5.

c) all equipment inside the cargo tanks, including pumps, ancillaries and their supports, selected cargo machinery and equipment.

d) additional safeguards and monitoring solutions

e) alternative solutions for any items which cannot be surveyed during the class renewal interval.

2.2.5 Recommended risk assessment techniques and other guidance are listed below but are not limited to:

a) FMECA, HAZID

b) ISO 31010:2009 - Risk Assessment Techniques.

2.2.6 The risk assessment is to ensure that the additional safeguards and monitoring systems provide mitigation measures to the hazards related to the extended interval examination of items defined in [1.1.2]. A non-exhaustive list of hazards associated with cargo tanks, cargo pumps, supports and other related machinery equipment is given as follows:

a) loose objects and/or foreign objects in the tank

b) cargo tank damage due to sloshing

c) cargo tank fatigue damage

d) pump and ancillaries supports damage

e) corrosion

f) deformation due to expansion-contraction

g) insulation damage.

2.2.7 The outcome of the ASP workshop and the risk assessment are to serve as the basis for establishing the ASP plan and is to be included in the ASP plan.

2.3 ASP plan

2.3.1 The ASP plan is to contain the following information:

a) Description of the unit and the operations.

b) List of class items (cargo containment system, including pump transfer mast, support tower, selected cargo machinery and equipment) covered under the ASP.

c) Description of the alternative methods of inspection for all equipment under ASP related to the cargo containment system, selected cargo machinery (such as pumps, compressors, etc.) and equipment (such as valves, sensors, cargo containment system pressure relief, pressure vessels vaporizers, mist separators, etc.).

d) Description of the sloshing monitoring system technology, if fitted, as per [1.3.3], item a), and approval references.

Note 1: Sloshing monitoring system technology does not replace the operational limitation derived from the sloshing study as per the requirement in Sec 10, Tab 1.

This system is to be validated by the Society. It is to be demonstrated that this system can safely evaluate the sloshing activity.

e) ASP workshop outcome including risk assessment.

f) Methodology of recording, storing, analysing necessary operational data, including contingency measures if deemed necessary. Operational data are to include containment system temperature, primary and secondary pressure, cargo pressure, nitrogen consumption, gas detection records and alarms, filling conditions of the cargo tanks, as well as any other necessary data identified during the ASP workshop.

g) ASP Plan Management Policy defining responsibility of implementation and management of all procedures related to the ASP plan including reporting requirements.

h) Monitoring permissible limits which, when exceeded, may lead the Society to require an internal inspection, and references of the corresponding inspection procedure.

i) Description of the data to be included in the annual and renewal ASP reports with as a minimum, the assessment of the monitored parameters covering the period starting from the last inspection until the end of the annual survey or renewal survey window, as applicable.

2.4 ASP implementation

2.4.1 Upon approval of the ASP plan, the Owner is to implement all measures defined in the approved ASP plan.

2.5 ASP initial survey

2.5.1 The ASP initial survey is to be carried out on board when the unit is operated on site after implementation of the ASP plan. The following items are to be checked:

a) The survey is to include the survey requirements listed in NR445, Pt A, Ch 2, Sec 7, [3.2].

b) Confirmation that the personnel in charge of the ASP plan management policy are familiar with the ASP plan.

c) Confirmation that each parameter listed in [1.3.3], item c) and alarm of the instrumentation and safety devices as defined in the approved ASP plan are within the permissible limits.

d) Confirmation that the ASP plan is implemented in the Owner procedures and is followed by the personnels on board.

e) Visual check of the sloshing monitoring system (main and secondary system if applicable).

f) Confirmation that the sloshing monitoring system or MRU, if fitted, is recording the data along the time and the system has been tested and calibrated.

3 Maintenance of the additional class notation ASP

3.1 Application

3.1.1 The requirements of this Article apply to the maintenance of the additional class notation **ASP**.

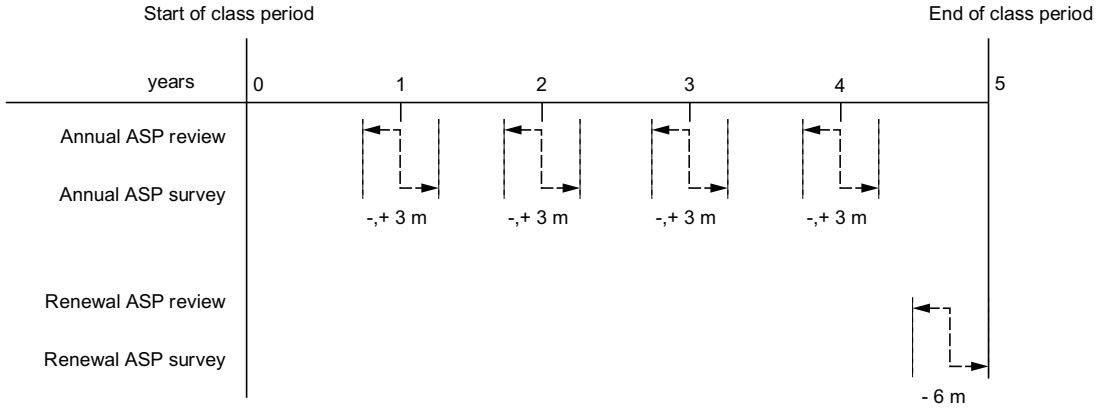
3.1.2 The maintenance of the notation is subject to annual and renewal ASP reviews and ASP surveys.

3.1.3 During the annual and renewal ASP review, cargo tanks and containment systems monitoring data are to be verified according to the limitations from the cargo containment system designer and equipment manufacturer to check that the Alternative Survey Programme (ASP) remains applicable.

3.1.4 The Owner is to inform the Society of any changes which may affect the approved ASP plan.

3.1.5 Fig 1 provides, for a 5-year class period, the link between ASP reviews dates and ASP surveys windows used for the cargo containment system, pump transfer mast and support tower and selected cargo machinery and equipment for maintaining the notation **ASP**.

Figure 1 : Links between survey dates and ASP review dates



3.2 Annual ASP review

3.2.1 The annual ASP report, as defined in the ASP plan, is to be submitted by the Owner to the Society for approval prior the annual ASP survey.

3.2.2 The annual ASP report is to cover the period since the latest reviewed ASP report (initial, annual or renewal).

3.2.3 After completion of the ASP review, the annual ASP survey may be carried out as per [3.3].

3.2.4 Any emergency departure is to be recorded in the annual ASP report.

3.2.5 The survey interval for the next class survey is to be confirmed by the Society.

3.2.6 Additional inspection may be required by the Society if the monitoring data exceed the permissible limits reported in the ASP plan.

3.3 Annual ASP survey

3.3.1 In addition to the annual survey requirements from the NR445, Pt A, Ch 2, Sec 7, [2] and [3], the following items are to be checked:

a) Confirmation that the annual ASP report has been approved by the Society and is available on board.

b) Confirmation that no changes have occurred from the previous annual ASP review with regards to the following:
   - operational conditions
   - design environmental conditions
   - Owner ASP plan management policy and corresponding internal procedures.

c) Confirmation that the operating personnels in charge of the ASP Plan Management Policy are familiar with the ASP plan.

d) Confirmation that the ASP plan is implemented in the Owner procedures and is followed by the personnels on board.

e) Confirmation that each parameter listed in [1.3.3], item c) and alarm of the instrumentation and safety devices as defined in the approved ASP plan are within the permissible limits.

f) Visual check of the sloshing monitoring system (main and secondary system if applicable)

g) Confirmation that the sloshing monitoring system is recording the data along the time and the system has been tested and calibrated.

3.4 Renewal ASP review

3.4.1 The renewal ASP report, as defined in the ASP plan, is to be submitted by the Owner to the Society for approval prior to the renewal ASP survey.

3.4.2 The renewal ASP report is to cover the period since the latest reviewed ASP report (initial, annual or renewal).

3.4.3 After completion of the ASP review, the renewal ASP survey may be carried out as per [3.5].

3.4.4 The survey interval for the next class survey is to be confirmed by the Society.

3.4.5 Additional inspection may be required by the Society if the monitoring data exceed the permissible limits reported in the ASP plan.

3.5 Renewal ASP survey

3.5.1 In addition to the survey requirements of the annual ASP survey as detailed in [3.3], the following items are to be checked:

a) Confirmation that the renewal ASP report as per [3.4] is on board and has been approved by the Society.

b) Tightness test of the primary and secondary barrier, as applicable depending on the type of the containment system, is to be carried out and demonstrated in accordance with the procedures of the cargo containment system designer, and acceptance criteria.

c) The pressure/vacuum valves, rupture disc and/or any other pressure relief devices fitted for interbarrier spaces and hold spaces are to be opened for examination, function tested and adjusted as necessary depending on their design.

d) The pressure relief valves for the cargo tanks are to be opened for examination, adjusted, function tested, and sealed.

e) The pressure relief valves on cargo piping are to be function tested. A random selection of valves is to be opened for examination and adjusted.

The renewal ASP survey may also include additional requirements for items other than those listed above but identified during the ASP workshop and included in the ASP plan.

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