



RULES FOR BUILDING AND CLASSING

FLOATING PRODUCTION INSTALLATIONS 2018

**American Bureau of Shipping
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Foreword

These Rules specify the ABS requirements for building and classing Floating Production Installations (FPIs) that should be used by designers, builders, Owners and Operators in the offshore industry. The requirements contained in these Rules are for design, construction, and survey after construction of the floating installation (including hull structure, equipment and marine machinery), the position mooring system and the hydrocarbon production facilities. Floating installations of the ship-type, column-stabilized-type, tension leg platforms and spar installations are included, as well as existing vessels converted to FPIs. The requirements for optional notations for disconnectable floating installations, dynamic positioning systems and import/export systems are also provided. These Rules are to be used in conjunction with other ABS Rules and Guides, as specified herein.

The effective date of these Rules is 1 January 2018. In general, until the effective date, plan approval for designs will follow prior practice unless review under these Rules is specifically requested by the party signatory to the application for classification.

Changes to Conditions of Classification (1 January 2008)

For the 2008 edition, Part 1, Chapter 1, “Scope and Conditions of Classification” was consolidated into a generic booklet, entitled *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)* for all units, installations, vessels or systems in offshore service. The purpose of this consolidation was to emphasize the common applicability of the classification requirements in “Part 1, Chapter 1” to ABS-classed offshore units, pipelines, risers, and other offshore structures, and thereby make “Conditions of Classification” more readily a common Rule of the various ABS Rules and Guides, as appropriate.

Thus, Part 1, Chapter 1 of these Rules specifies only the unique requirements applicable to floating production installations. These supplemental requirements are always to be used with the aforementioned *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*.



RULES FOR BUILDING AND CLASSING

FLOATING PRODUCTION INSTALLATIONS

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Notices and General Information

Introduction

1. The 2018 edition of the *Rules for Building and Classing Floating Production Installations* consists of the seven (7) Parts as shown in Table 1. In general these seven Parts subdivide these Rules into parts that are more consistent with other ABS Rules. With regard to two Parts, Part 1, and Part 2:
 - a) The purpose of the generic title *ABS Rules for Conditions of Classification – Offshore Units and Structures (Part 1)* is to reflect the expanded contents of PART 1, as a result of including consolidated requirements for “Classification” applicable to all types of and sizes of units, installations, vessels or systems in offshore service, etc., as specified in the Foreword to Part 1. Additional specific requirements are contained in Part 1 of these *Rules for Building and Classing Floating Production Installations*.
 - b) The purpose of the generic title *ABS Rules for Materials and Welding* of PART 2 is to emphasize the common applicability of the requirements to ABS-classed vessels, other marine structures and their associated machinery, and thereby make PART 2 more readily a common “PART” of various ABS Rules and Guides, as appropriate.
2. The numbering system applied in the Rules is shown in Table 2.
3. The primary changes from the 2017 Rules are identified and listed in Table 3. The effective date of the indicated Rule Changes is 1 January 2018, unless specifically indicated otherwise.
4. The effective date of each technical change since 1993 is shown in parenthesis at the end of the subsection/paragraph titles within the text of each Part. Unless a particular date and month are shown, the years in parentheses refer to the following effective dates:

(2000) and after	1 January 2000 (and subsequent years)	(1996)	9 May 1996
(1999)	12 May 1999	(1995)	15 May 1995
(1998)	13 May 1998	(1994)	9 May 1994
(1997)	19 May 1997	(1993)	11 May 1993

For certain changes that have a major impact on shipyards, designers and vendors, ABS has instituted a two-year Rule cycle to give the industry more time to prepare for these changes. The text of these changes will appear in a box along with the effective date just under the existing Rule requirement.

5. Until the next edition of the *Rules for Building and Classing Floating Production Installations* is published, Notices and/or Corrigenda, as necessary, will be published on the ABS website – www.eagle.org – only, and will be available free for downloading. It is not intended to publish hard copies of future Notices and/or Corrigenda to existing Rules or Guides. The consolidated edition of the *Rules for Building and Classing Floating Production Installations*, which includes Notices and/or Corrigenda using different colors for easy recognition, will be published on the ABS website only when Notices and/or Corrigenda are issued.
6. The listing of CLASSIFICATION SYMBOLS AND NOTATIONS is available from the ABS website www.eagle.org for download.

TABLE 1
Applicable Editions of Parts Comprising 2018 Rules

Rules for Building and Classing Floating Production Installations		
Notices and General Information		2018
Part 1:	Conditions of Classification (Supplement to the ABS Rules for Condition of Classification – Offshore Units and Structures) ⁽¹⁾	2018
Part 3:	Installation Types, Functions, Features and General Requirements	2018
Part 4:	Units Systems (Process and Import/Export)	2018
Part 5A:	Ship-Type Installations	2018
Part 5B:	Other Installation Types	2018
Part 6:	Mooring Systems	2018
Part 7:	Surveys After Construction	2018
Rules for Conditions of Classification – Offshore Units and Structures – not included ^(1,2)		
Part 1:	Rules for Conditions of Classification – Offshore Units and Structures	2018
Rules for Materials and Welding – not included ⁽²⁾		
Part 2:	Rules for Materials and Welding	2018

Notes:

- 1 The requirements for conditions of classification are contained in the separate, generic ABS *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*. Additional specific requirements are contained in Part 1 of these Rules.
- 2 The latest edition of these Rules is to be referred to. These Rules may be downloaded from the ABS website at www.eagle.org, Rules and Guides, Downloads or may be ordered separately from the ABS Publications online catalog at www.eagle.org, Rules and Guides, Catalog.

TABLE 2
Division and Numbering of Rules

<i>Division</i>	<i>Number</i>
Part	Part 1
Chapter	Part 1, Chapter 1
Section	Section 1-1-1
Subsection (see Note 1)	1-1-1/1
Paragraph (see Note 1)	1-1-1/1.1
Subparagraph	1-1-1/1.1.1
Item	1-1-1/1.1.1(a)
Subitem	1-1-1/1.1.1(a)i
Appendix	Appendix 1-1-A1 or Appendix 1-A1-1

Note:

- 1 An odd number (1, 3, 5, etc.) numbering system is used for the Rules. The purpose is to permit future insertions of even-numbered paragraphs (2, 4, 6, etc.) of text and to avoid the necessity of having to renumber the existing text and associated cross-references, as applicable, within the Rules and associated process instructions, check sheets, etc.

Rule Change Notice (2018)

TABLE 3
Summary of Changes from the 2017 Rules

Notice No. 1 (effective on 1 July 2017) to the 2017 Rules, which is incorporated into the 2018 Rules, is summarized below.

EFFECTIVE DATE 1 July 2017 – shown as (1 July 2017)
(based on the contract date for new construction between builder and Owner)

<i>Part/Para. No.</i>	<i>Title/Subject</i>	<i>Status/Remarks</i>
PART 1	Conditions of Classification (Supplement to the ABS Rules for Condition of Classification – Offshore Units and Structures)	
1-1-2/5.9.3	Relocation of FPI	To specify the applicable rules for relocation. (Incorporates Notice No. 1)
1-1-2/5.11.5	Life Extension of FPI on the Same Site	To specify the applicable rules for relocation and to introduce the LE notation for life extension up to 5 years. (Incorporates Notice No. 1)
1-1-4/1xxv) (New)	<No Title>	To specify that the SCIP section of the ISIP plan must be reviewed and approved by ABS. (Incorporates Notice No. 1)
1-1-4/11.3	Procedures	To specify that for FPI, FOI and FPSO classed by ABS, or for ABS class surveys, an ISIP plan is to be reviewed and approved by ABS Engineering and Surveyor. (Incorporates Notice No. 1)
PART 5A	Ship-Type Installations	
5A-2-1/9.1.3	Modifications	To specify the requirements for coatings of ballast tanks and void tanks. (Incorporates Notice No. 1)
5A-3-3/3.1.1	Hull Girder Section Modulus Amidships	To clarify that the hull girder ultimate strength calculation is based on the “gross” ship approach. (Incorporates Notice No. 1)
PART 5B	Other Installation Types	
5B-1-2/1	Structural Design	To specify that the LRFD structural design criteria in the <i>Guide for Load and Resistance Factor Design (LRFD) Criteria for Offshore Structures</i> can be used as an alternative to those affected criteria in Part 3 of the <i>MODU Rules</i> and Part 5B of the <i>FPI Rules</i> . (Incorporates Notice No. 1)
5B-3-3/1	Structural Design	To specify that the LRFD structural design criteria in the <i>Guide for Load and Resistance Factor Design (LRFD) Criteria for Offshore Structures</i> can be used as an alternative to those affected criteria in Part 3 of the <i>MODU Rules</i> and Part 5B of the <i>FPI Rules</i> . (Incorporates Notice No. 1)
PART 7	Surveys	
7-2-2/1	In-Service Inspection Program (ISIP)	To specify that the In-Service Inspection Program is applicable to all installations. (Incorporates Notice No. 1)
7-2-3/1.3	In-Service Inspection Program (ISIP)	To specify that the In-Service Inspection Program is applicable to all installations. (Incorporates Notice No. 1)
7-2-3/3	In-Service Inspection Program (ISIP)	To specify that the In-Service Inspection Program is applicable to all installations. (Incorporates Notice No. 1)
7-2-3/3.3.2iv)e)	<No Title>	To require a record of repairs, which will enable the Surveyor to carry out surveys with more detail. (Incorporates Notice No. 1)

EFFECTIVE DATE 1 January 2018 – shown as (2018)
(based on the contract date for new construction between builder and Owner)

<i>Part/Para. No.</i>	<i>Title/Subject</i>	<i>Status/Remarks</i>
PART 3	Installation Types, Functions, Features and General Requirements	
3-4-4	Surveys During Installation, Hook-up and Commissioning	To provide a list of items that the Surveyor is to witness
3-4-5 (Deleted)	Surveys During Installation of the Import/Export System	To remove redundant requirements already included in Part 7.
3-4-6 (Deleted)	Surveys During Hook-up	To remove redundant requirements already included in Part 7.
3-4-7 (Deleted)	Demonstration of the Disconnectable Mooring System	To remove redundant requirements already included in Part 7.
3-4-8 (Deleted)	Surveys During Start-Up and Commissioning	To remove redundant requirements already included in Part 7.
PART 5A	Ship-Type Installations	
5A-3-2/Table 1A	Combined Load Cases	To align with the ABS SafeHull requirements for tankers and containerships.
5A-3-2/Table 3	Design Pressure for Local and Supporting Members	To align with the changes to 5A-3-2/Table 1A.
5A-3-A2/17.5.1	Elastic Hot Spot Stress Range Calculation	To permit the use of the actual number of offloading for calculating Low cycle fatigue in FPSO phase in the previous site (historical site), since such data can be provided.
5A-3-A2/17.5.3	Low Cycle S-N Curve and Damage Calculation	To permit the use of the actual number of offloading for calculating Low cycle fatigue in FPSO phase in the previous site (historical site), since such data can be provided.
PART 5B	Other Installation Types	
5B-1-1/3	Definitions	To replace “Topside Deck Structure” with “Integrated Deck”, “Column Top Frame”, and “Non-integrated Deck” as applicable.
5B-1-2/5.1.1	General	To clarify the difference between “Integrated Deck” with “Column Top Frame” and “Non-integrated Deck”.
5B-1-2/5.1.2	Global Strength Analysis	To clarify the difference between “Integrated Deck” with “Column Top Frame” and “Non-integrated Deck”.
5B-1-2/5.1.5	Structural Redundancy Analysis	To clarify the difference between “Integrated Deck” with “Column Top Frame” and “Non-integrated Deck”.
5B-1-2/5.1.6	Acceptance Criteria	To clarify the difference between “Integrated Deck” with “Column Top Frame” and “Non-integrated Deck”.
5B-1-2/5.3 (New)	Non-Integrated Deck	To address design requirements for “non-integrated” deck, which doesn’t contribute global strength.
5B-2-3/5.1.6(b)	Buckling and Ultimate Strength	To specify the ABS <i>Guide for Buckling and Ultimate Strength Assessment for Offshore Structures</i> as an alternative to the required API 2U, 2V.
5B-3-3/5.1.6(b)	Buckling and Ultimate Strength	To specify the ABS <i>Guide for Buckling and Ultimate Strength Assessment for Offshore Structures</i> as an alternative to the required API 2U, 2V.
PART 6	Mooring Systems	
6-1-2/1	Drag Anchor	To align the requirements with the design method and recommendations to derive the tension force and load angle at anchor padeye/shackle included in the ABS <i>Guidance Notes on Design and Installation of Drag Embedment Anchor and Plate Anchor</i> and the ABS <i>Guidance Notes on Design and Installation of Dynamically Installed Piles</i> .
6-1-2/9	Factor of Safety	To align the requirements with the design method and recommendations to derive the tension force and load angle at anchor padeye/shackle included in the ABS <i>Guidance Notes on Design and Installation of Drag Embedment Anchor and Plate Anchor</i> and the ABS <i>Guidance Notes on Design and Installation of Dynamically Installed Piles</i> .

Notices and General Information

<i>Part/Para. No.</i>	<i>Title/Subject</i>	<i>Status/Remarks</i>
6-1-2/11 (New)	Allowable Yielding Stresses	To specify the design factor of the allowable yielding stress of anchor, in line with API-RP-2SK.
6-1-3 (Deleted)	Field Test	To relocate survey-related requirements to Part 7, "Surveys".
6-3-1 (Deleted)	Surveys During Construction	To relocate survey-related requirements to Part 7, "Surveys".
PART 7	Surveys	
7-1-1	General	To clarify the requirements and include a description of which Rules the Surveyor should use.
7-1-2/3	Piping Systems	To align the requirements with the ABS <i>MODU Rules</i> .
7-1-3/1	General	To provide reference to the installation procedures.
7-1-3/7.3.2 (New)	Fiber Rope Mooring Lines	To include installation requirements for fiber rope mooring lines.
7-1-3/9 (New)	Field Test	To relocate survey-related requirements to Part 7, "Surveys".
7-1-3/11 (New)	Post Installation Survey	To include Post Installation Survey requirements from ABS <i>Fiber Rope Guidance Notes</i> .
7-2-1/1	General	To specify that current survey Rules are applied to vessels after construction.
7-2-1/7.9	Prompt and Thorough Repairs	To provide the Surveyors more guidance on how to deal with structural repairs.

PART

1

Conditions of Classification

(Supplement to the ABS Rules for Conditions of Classification – Offshore Units and Structures)

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CHAPTER 1 Scope and Conditions of Classification

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PART

1

CHAPTER 1 Scope and Conditions of Classification

SECTION 1 Classification (*1 January 2008*)

The requirements for conditions of classification are contained in the separate, generic *ABS Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*.

Additional requirements specific to floating production installations are contained in the following Sections.

PART

1

CHAPTER 1 Scope and Conditions of Classification

SECTION 2 System Classification, Symbols and Notations (1 January 2008)

A listing of Classification Symbols and Notations available to the Owners of vessels, offshore drilling and production units and other marine structures and systems, "List of ABS Notations and Symbols" is available from the ABS website "<http://www.eagle.org>".

The following classification boundaries, symbols and notations are specific to floating production installations.

1 Classification Boundaries (1 July 2012)

The classification of a Floating Production Installation (FPI) includes three major items: the installation, its position mooring system, and its production facilities.

Classification of additional equipment and systems may be offered if requested by the Owner. (See 3-1-1/3.)

Where Import and or Export Risers provide substantial mooring restraint, the design, construction and classification of the Riser(s) providing restraint and their connection to the seabed will require special consideration.

3 Classification Symbols and Notations (1 July 2012)

The Maltese Cross, ☒, symbol is assigned to Floating Production Installations for which the hull construction and/or the manufacture and installation of its machinery and components and any associated required testing, as applicable, and the on-site installation (for site specific FPIs) and commissioning tests and trials of the FPI is carried out under ABS survey. For FPIs constructed under survey of another recognized Classification Society or Authority, the Maltese Cross, ☒, symbol will be omitted from the applicable classification notations.

A1 is a classification symbol that, together with the Maltese Cross ☒ symbol, indicates compliance with the hull requirements of the ABS Rules, Guides, or their equivalent for service and survey by ABS during construction of the vessel. The symbols ☒ **A1** may be followed by appropriate FPI type notation such as the notations shown in 1-1-2/3.1 of these Rules.

3.1 New Construction

Systems that have been built, installed and commissioned to the requirements of the Rules and to the satisfaction of the ABS Surveyors, where approved by ABS for service for the specified design environmental conditions, are to be classed and distinguished in the *ABS Record* by the symbol ☒ **A1**, followed by the appropriate notation for the intended service and hull type given below:

Floating Production, Storage and Offloading System (hull type)

Floating Production (and Offloading) System (hull type)

Floating Storage and Offloading System (hull type)

The above class notations cover the following components:

- i) *Floating Production Installation*, including its hull structure, applicable marine systems and associated equipment and machinery, safety systems and associated equipment, life saving appliances machinery under one of the above notations, subject to the requirements of these Rules.

- ii) *Position Mooring System* according to the requirements of these Rules.
- iii) *Topside Production Facilities* according to the requirements of the *ABS Rules for Building and Classing Facilities on Offshore Installations (Facilities Rules)* and these Rules.

The service notation will be appended by one of the following **(Ship-Type)**, **(Column-Stabilized)**, **(TLP)**, or **(Spar)** to indicate the hull type. The hull structural configurations of these installations are described in Section 3-1-2.

Examples of notations for installations are:

Floating Production, Storage and Offloading System (Ship-Type)

Floating Production (and Offloading) System (Ship-Type)

Floating Offshore Installation (Spar)

Floating Production (and Offloading) System (TLP)

Floating Offshore Installation (Column Stabilized)

3.3 Conversion to FPI

3.3.1 Conversion of Existing Vessel

An existing vessel is a vessel that has been issued a Certificate of Classification. When an existing vessel is converted to an FPI, and is classed under the provisions of Section 5A-2-1, it will be distinguished in the *ABS Record* by the symbol **A1**, followed by the appropriate notation for the intended service, the notation **(Ship-Type)** and the qualifier **(CI)**. If the existing vessel being converted is currently in ABS class with **✕**, then the **✕** would be maintained for the converted FPI. Examples of notations are:

✕ Floating Production, Storage and Offloading System (Ship-Type) (CI)

✕ Floating Offshore Installation (Ship-Type) (CI)

3.3.2 Conversion of Vessel Design or Vessel Under Construction

3.3.2(a) A vessel's design that has been approved by ABS or another IACS member and is to be converted to an FPI, can either be classed under the provisions of 1-1-2/3.3.1 and Section 5A-2-1 as an FPI conversion, or it can be classed as a new build FPI under the provisions of 1-1-2/3.1.

3.3.2(b) A vessel under construction that has not been issued a Certificate of Classification, and its design has been approved by ABS or another IACS member, can either be classed under the provisions of 1-1-2/3.3.1 and Section 5A-2-1 as an FPI conversion, or it can be classed as a new build FPI under the provisions of 1-1-2/3.1.

3.5 Floating Offshore Installation

Where an installation is fitted with production facilities, but the optional classification of the topside production facilities is not requested, the installation will be classed and distinguished in the *ABS Record* by the symbol **✕ A1**, followed by the notation **Floating Offshore Installation (hull type)**, provided the installation and its position mooring system comply with the applicable requirements. On a Floating Offshore Installation (FOI), certain systems and equipment for the production facilities are to be in compliance with 4-1-1/3 of these Rules.

Where an installation is fitted with production facilities, but the optional classification of the topside production facilities is not requested, but the essential safety features of the production facilities in compliance with 4-1-1/5 are approved by ABS, the installation will be classed and distinguished in the *ABS Record* by the symbol **✕ A1**, followed by the notation **Floating Offshore Installation (hull type)**. "Production Facilities" will be indicated in the *Record*. Compliance with the applicable requirements for the installation and position mooring system is required.

In either case, the scope of classification for an FOI includes the shipboard systems, including the electrical system circuit protection for the production facilities and production fire fighting equipment. In addition, topside structures and modules are to comply with Section 5A-1-5, 5B-1-2/1.3, 5B-3-3/5.3, 5B-2-3/5.1 or 5B 2 3/5.3 as appropriate.

5 Additional Class Notations

5.1 Disconnectable System

A floating installation system that has a propulsion system and a means of disengaging the installation from its mooring and riser systems to allow the installation to ride out severe weather or seek refuge under its own power for a specified design environmental condition will be classed with the above designations and with notations **(Disconnectable)** ✕ **AMS** at the end. One example of such class designation is:

**✕ A1 Floating Production, Storage and Offloading System (Ship-Type)
(Disconnectable), ✕ AMS**

See 1-1-2/7 of these Rules for ✕ **AMS** notation.

5.3 Classification of Dynamic Positioning Systems (1 July 2012)

Dynamic positioning systems installed for station keeping purposes, will be denoted by the notation **DPS** (see the *ABS Guide for Dynamic Positioning Systems*).

5.5 Classification of Additional Equipment and Systems (1 July 2012)

Additional equipment and systems, such as the subsea template, Import (or Export) PLEMs and the Import (or Export) system may be considered at the Owner's request. Where the import and export systems are built in full compliance with the requirements of Part 4, Chapter 2 of these Rules, the installation will be classed and distinguished in the *Record* by the notation **IMP-EXP**. The notations **IMP** or **EXP** will be applied to the installation when only the import system or the export system, respectively, is built in full compliance with the requirements of Part 4, Chapter 2 of these Rules. These notations for import and export systems are optional.

5.7 Dynamic Loading Approach (DLA) (2017)

Where the system's hull structure has been built to plans reviewed in accordance with the procedure and criteria in the *ABS Guide for "Dynamic Loading Approach" for Floating Production, Storage and Offloading (FPSO) Systems* for calculating and evaluating the behavior of hull structures under dynamic loading conditions, in addition to compliance with other requirements of the Rules, the installation will be classed and distinguished in the *Record* by the notation **DLA**. The **DLA** notation will be placed after the appropriate hull classification notation. The application of the dynamic loading approach is optional except for the installation over 350 meters (1148 feet) in length as indicated in 5A-1-1/1.

The dynamic load components considered in the evaluation of the hull structure are to include the external hydrodynamic pressure loads, internal dynamic loads (fluids stored onboard, ballast, major equipment items, etc.) and inertial loads of the hull structure. The magnitude of the load components and their combinations are to be determined from appropriate ship motion response calculations for loading conditions that represent the envelope of maximum dynamically-induced stresses in the installation. The adequacy of the hull structure for all combinations of the dynamic loadings is to be evaluated using an acceptable finite element analysis method. In no case are the structural scantlings to be less than those obtained from other requirements in these Rules.

The basic notation **DLA** is applied when the hydrodynamic loads have been determined using the wave environment of the North Atlantic as if the installation is a trading vessel with a 20- to 25-year service life. If the wave environment of the intended site is used during the analysis, the notation will include an **S** qualifier, followed by the design return period at the defined site. For example, if the 100-year return period was used, the following may apply: **DLA (S100)**. Transit conditions to the intended site are also to be included in the DLA evaluation.

5.9 Strength Criteria for Ship-Type Installations (1 July 2012)

Ship-type installations of 150 meters (492 feet) or more in length that are designed and built to the requirements of Part 5A of these Rules and Section 5C-1-7 of the *Steel Vessel Rules* will be identified in the *Record* by the notation as given in 1-1-2/3 of these Rules.

The basic notation of 1-1-2/3 of these Rules is applied when the dynamic loads have been determined using the wave environment representative of unrestricted service, i.e., for North Atlantic exposure as if the installation is a trading vessel with a 20- to 25-year service life. There are several additional qualifiers, described in the following sub sections, covering site-specific wave environment, definition of the site and whether the installation has been converted from an existing vessel.

5.9.1 New Construction

For new-build ship-type installations where transit condition and site-specific environmental data have been used per these Rules in lieu of North Atlantic data, the basic notation is to be followed by the **(S)** qualifier. This qualifier will then be followed by the definition of the site. For example, **(S) Brazil Santos Basin**.

5.9.2 Conversion of Existing Vessel to FPI

For a converted installation where the trading vessel and site-specific environmental data have been used per these Rules, the basic notation is followed by the qualifier **(CI)**. The **(CI)** qualifier will be followed by the definition of the site. For example, **(CI) Brazil Santos Basin**.

5.9.3 Relocation of FPI (1 July 2017)

As site specific units, FPIs are designed and classed taking into consideration the location where they will operate and the intended period of operation. When the FPI is relocated to a new site, either within the same field or in a different operating area, or when the intended period of operation is extended, the strength of the unit is to be reassessed to satisfy that the unit will remain in compliance with applicable requirements as described below.

5.9.3(a) Relocation within the Same Field. When an FPI is relocated within the same field or the same operating area, the environmental conditions are expected to remain identical to those considered during the original classification process for the current site.

If the environmental conditions for the field or operating area have been revised since the original approval due to new environmental data or changing environmental conditions (e.g., new environmental data in the Gulf of Mexico after hurricanes Rita and Katrina), the Coastal State may require the use of new environmental conditions for the relocation, in which case the same requirements as relocation to a different operating area will apply.

The expected operating life in the new location may be within the originally considered design life or otherwise, it may extend beyond the original design life period. In the latter case, in addition to the requirements for relocation, the requirements for life extension will apply.

It is expected that relocation within the same field will require at least a new position mooring and anchoring system for the new site and probably, modifications to the process facilities.

For the relocation within the same field, without exceeding the original design life of the unit, the following actions will to be required:

- Design review and surveys related to the new position mooring system and anchoring.
- Design review and surveys related to the modifications to the process facilities, if applicable.
- Design review and surveys related to any other modifications affecting class items.
- Drydocking survey, including gauging, with steel renewals as necessary to bring the unit to a satisfactory condition to complete the remaining design life at the specific site.

Structural strength analysis and fatigue life re-evaluation for the hull structure, turret, module structures, etc., will not to be required, unless structural modifications are performed or current environmental conditions are harsher than the environmental conditions considered in the original design.

For structures, systems or equipment not modified and maintained per original design, design review is to be based on the design codes used in the original design with current environmental data.

For added or modified structures, systems or equipment, design review is to be based on the design codes at the time of the contract for the relocation with current environmental data.

Surveys are to be based on the current rule requirements, see Part 7 of these Rules.

5.9.3(b) Relocation to a Different Operating Area. When an FPI is relocated to an operating area where the environmental conditions are different than those at the original site, the structural strength and fatigue life of the unit will need to be reassessed for the new conditions. However, if the new location has milder environmental conditions than the current site, the reassessment may not need to be performed provided that the unit is kept under the same structural condition as in the original site and the design fatigue life of the unit is not extended.

Relocation to a different operating area will require a new position mooring and anchoring system for the new site and most probably, extensive modifications to the process facilities.

For the relocation to a different operating area, the following actions will be required:

- Structural strength analysis and fatigue life re-evaluation for the hull structure, turret, module structures, etc. (except as noted above).
- Design review and surveys related to the new position mooring system and anchoring.
- Design review and surveys related to the modifications to the process facilities.
- Design review and surveys related to any other modifications affecting class items.
- Drydocking survey, including gauging, with steel renewals as necessary to bring the unit to a satisfactory condition to complete the remaining design life at the specific site.

For structures, systems or equipment not modified and maintained per original design, design review is to be based on the design codes used in the original design with current environmental data.

For added or modified structures, systems or equipment, design review is to be based on the design codes at the time of the contract for the relocation with current environmental data.

Surveys are to be based on the current rule requirements, see Part 7 of these Rules.

5.10 Strength Criteria for Other Installation Types (1 July 2012)

Installations (other than ship-type, see 1-1-2/5.9 above) that are designed and built to the requirements of Part 5B of these Rules will be identified in the *Record* by the notation as given in 1-1-2/3 of these Rules followed by additional qualifiers, described in the following Subparagraphs, covering site-specific wave environment and definition of the site.

5.10.1 New Construction

Site-specific environmental data will be indicated by the **(S)** qualifier following the basic notation of 1-1-2/3. This qualifier will then to be followed by the definition of the site. For example, **✕ A1 Floating Offshore Installation (Spar) (S) in Mississippi Canyon Block 779.**

5.10.2 Relocation of FPI

As site specific units, FPIs are designed and classed taking into consideration the location where they will be operated and the intended period of operation. When the FPI is relocated to a new site, either within the same field or in a different operating area, or when the intended period of operation is extended, the strength of the unit is to be reassessed to satisfy that the unit will remain in compliance with applicable requirements.

5.11 Design Life and Design Fatigue Life (1 July 2012)

5.11.1 Design Life – New Construction

Floating installations designed and built to the requirements in these Rules and maintained in accordance with the applicable ABS requirements are intended to have a structural design life of not less than 20 years for a new build hull structure. Where the structural design life is greater than 20 years and the floating installation is designed for uninterrupted operation on-site without any drydocking, the nominal design corrosion values (NDCV) of the hull structure are to be increased in accordance with 5A-3-1/1.7 for ship-type installations or an acceptable equivalent criteria for non-ship-type installations. When the design life is greater than 20 years (in 5-year increments) the increased life will be identified in the *Record* by the notation **HL(number of years)**. The **(number of years)** refers to a design life different than 20 years.

5.11.2 Design Fatigue Life – New Construction

Where a floating installation's design calls for a minimum design fatigue life of 20 years or in excess of the minimum design life of 20 years, the design fatigue life is to be verified to be in compliance with the fatigue criteria in these Rules. The "design fatigue life" refers to the target value set by the owner or designer, not the value calculated in the analysis.

The required fatigue strength analysis of critical details and welded joints in floating installations is to be in accordance with the criteria in Appendix 5A-3-A2 of these Rules for ship-type installations or an acceptable equivalent criteria for non-ship-type installations.

Only one design fatigue life value notation is to be assigned and published in the *Record* for the hull, hull interface structure, position mooring system and components. The hull interface structural requirements for ship-type installations are described in 5A-1-4 of these Rules and the position mooring system requirements in Part 6 of these Rules. When only the required fatigue analysis of Appendix 5A-3-A2 for ship-type installations or 5B-1-2/5, 5B-2-3/5 or 5B-3-3/5 for non-ship-type installations is performed for either unrestricted service wave environment or the transit and site specific wave environment, the class notation **FL(number of years)** and the **Year** of maturation of fatigue life in the defined site location is assigned. The fatigue life will be identified in the *Record* by the notation **FL(number of years),Year**; for example, **FL(30), 2041** for an FPI built in 2011 if the minimum design fatigue life specified is 30 years.

If in addition, spectral fatigue analysis (see 1-1-2/5.11) is requested by the owner or designer, only the design fatigue life notation, **SFA(number of years),Year** will be assigned and published in the *Record* for the hull and hull interface structural system. Although only the **SFA** notation is assigned, and not the **FL** notation for ship-type installations, the required fatigue analysis of Appendix 5A-3-A2 is to be performed and the calculated fatigue life is to satisfy the design fatigue life.

The **(number of years)** refers to the design fatigue life equal to 20 years or more (in 5-year increments), as specified by the applicant. Where different design fatigue life values are specified for different structural elements within the installation, such as hull structure components, hull interface structures and position mooring system components, the **(number of years)** refers to the least of the target values. In the case when spectral fatigue analysis is also applied the least of the fatigue life values calculated by the required fatigue strength analysis for the **FL** notation and the spectral fatigue analysis must satisfy the design fatigue life. The "design fatigue life" refers to the target value set by the applicant, not the value calculated in the analysis.

For example if the design fatigue life is specified as 25 years, the fatigue calculations of hull structural components must satisfy a fatigue life of 25 years. The fatigue calculations of the position mooring hull interface structures and hull mounted equipment interface structures, and position mooring system must also satisfy fatigue lives of $(25 \times \text{FDF})$ years, where FDF are the fatigue safety factors specified in 5A-1-4/Table 1, 5B-1-2/Table 2, 5B-2-3/Table 2 or 5B-3-3/Table 2, as applicable, for hull interface structures and in 6-1-1/Table 1 for mooring lines.

5.11.3 Conversion of Existing Vessel to FPSO, FPS or FSO (2016)

When an existing vessel is converted to an FPSO, FPS or FSO in the process referred to as an FPI vessel conversion, and the ship-shaped FPSO, FPS or FSO is classed under the provisions of Section 5A-2-1, the expected minimum remaining fatigue life of the structure is to be assessed according to Section 5A-2-3 and documented by recording its value in the *Record*. The **RFL** notation will be followed by the value of the expected minimum remaining fatigue life in years, and the year of maturation of fatigue life in the defined site location in accordance with 1-1-2/5.9.2. For example, **RFL(15), 2018** indicates that the expected minimum remaining fatigue life of the structure is 15 years, which will be reached in the year 2018. The **RFL(number of years), Year** notation as applied to an FPI vessel conversion is mandatory.

When an existing vessel is converted to a FPSO, FPS or FSO and is intended to be used at marginal field and the unit will be drydocking every 5 years, the **RFL** notation may be omitted. A notation **MARGINAL FIELD (site)** will be added after **CI** to indicate the intended use for 5 years for the site. For a marginal field FPI without **RFL** notation, the following actions will be required:

- Verification of the existing vessel's original fatigue life. If the remaining fatigue life as unrestricted vessel is not less than 5 years and Alpha factors for the intended site is greater than 1, the fatigue analysis for the hull structure is not mandatory. However, the hull interface structures for process modules, flare tower, mooring structure, riser porch or balcony are to be evaluated for compliance with 5A-1-4/3, based on FEM models and including fatigue analysis. The analysis is to apply the most critical combination of topsides or mooring loads and hull girder loads.
- If the remaining fatigue life as unrestricted vessel is less than 5 years, or if the Alpha factors for the intended site is not greater than 1, the fatigue analysis for the hull is mandatory for a fatigue life of 10 years. The fatigue analysis of the hull structure is to comply with 5A-2-1/5.7. The hull interface structures for process modules, flare tower, mooring structure, riser porch or balcony are to be evaluated for compliance with 5A-1-4/3, based on FEM models and including fatigue analysis. The analysis is to apply the most critical combination of topsides or mooring loads and hull girder loads.
- Mooring system is to be designed for compliance with Part 6 for a fatigue life not less than 10 years.
- Survey of the FPI hull structure after conversion is to comply with Chapter 1 of the *ABS Rules for Survey After Construction (Part 7)* for an unrestricted vessel.
- If the FPI intends to be relocated to a new site or extend the life at current site after 5 years, the FPI is to be assessed in accordance with 1-1-2/5.11.4 and 1-1-2/5.11.5 with consideration of the above actions.

5.11.4 Relocation of FPI

When an FPI is relocated to a new site, either within the same field or in a different operating area, the fatigue life of the unit is to be reassessed to satisfy that the unit's remaining fatigue life for the new operating conditions is within the design fatigue life of the unit. The position mooring system including chain and other mooring components is also subject to reassessment if it is to be used at the new site.

5.11.5 Life Extension of FPI on the Same Site (1 July 2017)

When an FPI exceeds the design fatigue life specified in the **FL (number of years), Year** or **RFL (number of years), Year** notation for which it was classed, an evaluation is to be made and appropriate actions are to be taken to extend the fatigue life up to the new operating life of the unit under the site-specific environmental conditions.

For conversions, the design fatigue life will depend on the minimum remaining fatigue life expected from the time of the conversion. For conversions before October 2001, the remaining fatigue life is only documented in the original calculations submitted at the time of the conversion. For conversions on or after October 2001, the remaining fatigue life is indicated with the **FL** notation (before July 2003) or the **RFL** notation (on or after July 2003).

For both original build FPIs and conversions, the remaining fatigue life of the unit may be extended during the operating life of the FPI by renewals or modifications of those structural details with lower fatigue life.

For the life extension of the unit remaining in the same location, the following actions will be required:

- Verification from the original fatigue analysis that the actual fatigue values of all the structural elements of the unit are still higher than the proposed extended fatigue life; or
- New fatigue analysis covering all the structural elements (hull, turret, hull interfaces, position mooring system) in accordance with **SFA**, **FL** or **RFL** requirements, as applicable. Risers (if classed) are also to be analyzed for the extended fatigue life.
- Identification of structural elements or details with a fatigue life below the new intended design fatigue life of the unit and proposed actions to increase the fatigue life of those elements or details.
- Design review and surveys of structural modifications proposed as a consequence of the fatigue analysis.
- Enhanced survey program to monitor those structural elements or details with lower fatigue life which cannot be modified or renewed on site.
- Special survey, including Underwater Inspection, to determine the structural condition of the unit at the time of the life extension.

For structures, systems or equipment not modified and maintained per original design, the new fatigue analysis and related design review, when necessary, is to be based on the design codes used in the original design with current environmental data.

For added or modified structures, systems or equipment, the new fatigue analysis and related design review are to be based on the design codes at the time of the life extension with current environmental data.

Surveys are to be based on the current rule requirements, see Part 7 of these Rules.

Once the life extension is approved, the existing **SFA**, **FL** or **RFL** notation with year of maturation is to be updated accordingly.

When a fatigue notation is requested, and where none of the above notations was previously assigned to the unit, the most appropriate fatigue notation for the unit is to be assigned.

For the first life extension up to 5 years, upon agreement with operator/owner, a new notation **LE (number of years) year** can be granted instead of **RFL** or **FL** without performing new fatigue analysis as required in this section. To be granted the **LE** Notation, the following conditions are to be satisfied:

- Any modifications to the structure have class approval.
- Critical areas of the original design have been re-examined using NDT techniques and verified to be satisfactory by ABS Surveyor.
- Additional items to be determined on a case-by-case basis during the life extension process have been resolved.

5.12 Spectral Fatigue Analysis (2017)

5.12.1 Design Fatigue Life – New Construction

Where more extensive use of Spectral Fatigue Analysis is performed in accordance with criteria established in Part 5A, Chapter 1 of these Rules and the *ABS Guide for the Fatigue Assessment of Offshore Structures*, the installation is to be identified in the *Record* by the notation **SFA (number of years), Year**. The fatigue analysis is performed for either unrestricted service wave environment or the transit and site specific wave environment in accordance with 1-1-2/5.9. The **(number of years)** refers to the design fatigue life equal to 20 years or more (in 5-year increments), as specified by the applicant. The **Year** is the year of maturation of fatigue. For example, **SFA (30), 2041** if the design fatigue life specified is 30 years, and the FPI is built in 2011. Only one minimum

design fatigue life value is applied to the entire structural system. For a structural location required to have an additional factor applied to the minimum design fatigue life (say, due to safety critical function or relative difficulty of inspection, see for example, 6-2-1/13), the required minimum fatigue life for such a location is the minimum design fatigue life being applied in the project multiplied by the additional factor. The ‘design fatigue life’ refers to the target value set by the designer and not the value calculated in the analysis. The calculated values are usually much higher than the target value specified for design. The application of spectral fatigue analysis is optional except for the installation over 350 meters (1148 feet) in length as indicated in 5A-1-1/1.

5.12.2 Conversion of Existing Vessel to FPSO, FPS or FSO

When spectral fatigue analysis is applied to an existing vessel that is converted to an FPSO, FPS or FSO, the expected minimum remaining fatigue life of the structure is to be assessed according to Section 5A-2-3/3 and documented by recording its value in the *Record*. The **SFA** notation will be followed by the value of the expected minimum remaining fatigue life in years preceded by the letter **R**, and the year of maturation of fatigue life in the defined site location in accordance with 1-1-2/5.9.2. For example, **SFA (R15), 2018** indicates that the expected minimum remaining fatigue life of the structure is 15 years, which will be reached in the year 2018 at the defined site location. The application of spectral fatigue analysis for FPI conversions is optional except for the installation over 350 meters (1148 feet) in length as indicated in 5A-1-1/1.

5.13 Additional Corrosion Margin (1 March 2006)

Where the installation incorporates additional plate thicknesses above the required scantlings, the installation will be identified in the *Record* by the notation **AT**, followed by the description of the major hull girder component(s) that has the additional thickness. This notation will also include a number to indicate the magnitude of the additional thickness (rounded down to the nearest 0.5 mm) that has been applied, i.e., **AT(DK+0.5)**. In order to apply the notation **AT**, the additional thickness must be applied to the complete structural element throughout the tank area of the installation. This notation documents major areas of the structure that have an additional “as-built” margin on thickness to address areas subject to significant corrosion or areas where it may be desirable to increase normal corrosion margins to extend a structural member’s anticipated service life. This notation is optional and is only available to new construction FPIs.

The major structural components are defined as follows:

DK	Upper deck (including stringer plate)
BS	Bottom shell (including bilge)
IB	Inner-bottom
SS	Side shell (including shear strake)
IS	Inner skin (including “hopper” sloping plating)
LB	Longitudinal bulkheads other than the inner skin
TB	Transverse Bulkhead

5.15 Hull Construction Monitoring Program (1 July 2012)

Ship-type installations designed and reviewed to the *FPI Rules* are to comply with the requirements of the Offshore Hull Construction Monitoring Program in Appendix 5A-3-A5 of these Rules and have the notation **OHCM**.

7 ✖ AMS Notation (2017)

Machinery and boilers for self-propulsion which have been constructed and installed to the satisfaction of the Surveyors to ABS’s Rule requirements, when found satisfactory after trial and approved by ABS, will be classed and distinguished in the *Record* by the notation ✖ **AMS**. This notation is mandatory for classification of self-propelled floating production installations.

Where machinery and boilers are not satisfying the dynamic inclination requirements in 4-1-1/Table 1 of the *MODU Rules* and 4-1-1/Table 7 of the *Steel Vessel Rules*, assigning of the **AMS** notation for one voyage only to the installation site may be considered, provided the following conditions are satisfied:

- i) The maximum dynamic inclinations obtained from the seakeeping analysis for the routes taken during the transit voyage considering wind velocity and significant wave height of 10-year return period storm, are to satisfy the inclination requirements of the *MODU Rules* and *Steel Vessel Rules* for static inclination on surface units.
- ii) The voyage is to be planned using weather routing to avoid heavy seas.
- iii) Concurrence of the flag Administration is required.

9 Notations for Automatic or Remote Control and Monitoring Systems

9.1 ✕ ACC or ✕ ACCU Notations (October 2001)

For automatic or remote control and monitoring systems of the propulsion machinery, ABS will consider additional classifications with symbols ✕ **ACC** or ✕ **ACCU**, as appropriate, provided that the applicable requirements of Part 4, Chapter 9 of the *Steel Vessel Rules* are satisfied.

9.3 ✕ AMCC or ✕ AMCCU Notations (March 2003)

For automatic or remote control and monitoring systems of the machinery other than the propulsion machinery as referenced in Subsection 1/1 of the *ABS Guide for Remote Control and Monitoring for Auxiliary Machinery and Systems (other than Propulsion) on Offshore Installations*, ABS will consider additional classifications with symbols ✕ **AMCC** or ✕ **AMCCU**, as appropriate, provided that the applicable requirements of the *ABS Guide for Remote Control and Monitoring for Auxiliary Machinery and Systems (other than Propulsion) on Offshore Installations* are satisfied.

11 Temporary Mooring Equipment Symbol

The symbol  will be placed after the symbols of classification to signify that the equipment for temporary mooring of the floating installation complies with 3-4-1/3 of the *MODU Rules* or Part 3, Chapter 5 of the *Steel Vessel Rules*.

13 Conversion of Existing Vessels or Floating Structures

Modifications of existing vessels or floating structures intended for classification as Floating Installations are to be converted under ABS design review and survey.

15 Significant Change of Operating Conditions Affecting Safety of Unit or Personnel (1 July 2012)

In a few occasions, the operating conditions of the FPI initially considered during the classification of the unit change with time. For example, the composition of the oil coming from the well may turn sour (high concentration of hydrogen sulfide, H₂S). If these changes affect the safety of the unit or the personnel on board, the owner/operator needs to approach ABS as the changes may have an effect in the compliance with the applicable Rules and Guides and therefore, in the maintenance of class.

If it is confirmed that the changes are affecting the compliance with the applicable Rules and Guides, there are two options:

- To identify the Rule requirements that the unit has to comply with in order to maintain classification and to verify compliance by design review and survey, as applicable; or
- To perform a risk assessment with ABS participation in order to analyze the new hazards due to the changes and determine the mitigation actions required to bring the unit to an equivalent level of safety to the applicable Rules and Guides.

PART

1

CHAPTER 1 Scope and Conditions of Classification

SECTION 3 Rules and the Criteria Presented for Classification (*1 January 2008*)

1 Application

1.1 General (*1 July 2009*)

The criteria in this document are applicable to Floating Production, Storage and Offloading installations (FPSOs), as defined in Section 3-1-1 of these Rules. The criteria are also applicable to Floating Production Systems (FPSs), as defined in 3-1-1/3, Floating Storage and Offloading systems (FSOs), as defined in 3-1-1/3, or Floating Offshore Installation (FOI), as defined in 3-1-1/3, with corresponding classification notation, as indicated in Section 1-1-2 of these Rules.

The application of the criteria to systems other than the above will be considered on a case-by-case basis.

The criteria are applicable to those features that are permanent and can be verified by plan review, calculation, physical survey or other appropriate means. Any statement in the Rules and the criteria in this document regarding other features are to be considered as guidance to the designer, builder, Owner, et al.

1.3 Application (*1 July 2009*)

These Rules have an effective date of 1 July 2009. The application of these Rules is, in general, based on the contract date for construction or conversion between the shipbuilder and the prospective owner (e.g., Rules which became effective on 1 July 2009 are not applicable to a floating production installation for which the contract for construction was signed on 30 June 2009). See also 1-1-4/3 of the *ABS Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*.

In the case of conversions, structures other than hull structures (such as deckhouses), machinery equipment and/or marine systems which will remain unchanged or with minor modifications during the conversion will be considered on the basis of the original Rules used for the vessel construction as well as the safety features of the converted unit.

3 Reference Standards

Reference is made in these Rules to ABS Rules and other criteria issued by ABS and other organizations. Appendix 3-A1-2 contains a listing of such Reference Standards.

5 Risk Evaluations for Alternative Arrangements and Novel Features (*April 2004*)

Risk assessment techniques may be used to demonstrate that alternatives and novel features provide acceptable levels of safety in line with current offshore and marine industry practice. The *ABS Guide for Risk Evaluations for the Classification of Marine-Related Facilities* provides guidance to ABS clients on how to prepare a risk evaluation to demonstrate equivalency or acceptability for a proposed Floating Production Installation.

Risk evaluations for the justification of alternative arrangements or novel features may be applicable either to the installation as a whole, or to individual systems, subsystems or components. ABS will consider the application of risk evaluations for alternative arrangements and novel features in the design of the floating production installations, Verification Surveys during construction, and Surveys for Maintenance of Class.

Portions of the floating production installation or any of its components thereof not explicitly included in the risk evaluation submitted to ABS are to comply with any applicable part of the ABS Rules and Guides. If any proposed alternative arrangement or novel feature affects any applicable requirements of Flag and Coastal State, it is the responsibility of the Owner to discuss with the applicable authorities the acceptance of alternatives based on risk evaluations.

PART

1

CHAPTER 1 Scope and Conditions of Classification

SECTION 4 Submission of Plans, Data and Calculations

1 Design Plans and Data (*1 March 2006*)

Plans showing the scantlings, arrangements and details of the principal parts of the hull structure of each installation to be built under survey are to be submitted and approved before the work of construction has commenced. These plans are to clearly indicate the scantlings, joint details and welding, or other methods of connection. In general, plans are to be submitted that include the following, where applicable:

- i) General Arrangement
- ii) Body Plan, lines, offsets, curves of form, inboard and outboard profile
- iii) Wind heeling moment curves of equivalent data
- iv) (*1 July 2012*) Arrangement plan of watertight, firetight and gastight compartmentation
- v) Diagrams showing the extent to which the watertight and weathertight integrity is intended to be maintained, the location, type and disposition of watertight and weathertight closures
- vi) Capacity plan and tank sounding tables
- vii) Summary of distributions of weights (fixed, variable, ballast, etc.) for various conditions
- viii) Type, location and quantities of permanent ballast, if any
- ix) Loadings for all decks
- x) Transverse section showing scantlings
- xi) Longitudinal sections showing scantlings
- xii) Decks, including helicopter deck
- xiii) Framing, shell plating, watertight bulkheads and flats, structural bulkheads and flats, tank bulkheads and flats with location of overflows and air pipes
- xiv) Pillars, girders, diagonals and struts
- xv) Stability columns, intermediate columns, hulls, pontoons, superstructure and deck houses
- xvi) (*1 July 2012*) Arrangement and details of watertight and weathertight doors and hatches
- xvii) Foundations for anchoring equipment, industrial equipment, process, and process support modules, etc., where attached to hull structure, superstructures or deckhouses
- xviii) Mooring turrets and yoke arms, including mechanical details
- xix) Corrosion control arrangements
- xx) (*1 July 2012*) Methods and locations for nondestructive testing (submitted to attending Surveyor for review and agreement)
- xxi) The plans listed in 5B-1-4/11 for column-stabilized units
- xxii) (*1 March 2006*) Plans and calculations/analyses for the module structures to support production facilities
- xxiii) (*1 March 2006*) Plans and calculations/analyses for module support structures
- xxiv) (*1 July 2009*) Construction Monitoring Plan
- xxv) (*1 July 2017*) Structural critical inspection points (SCIPs) (see 7-2-1/3.27 & Section 7-2-3)

3 Position Mooring System Design Documentation

The design documentation for the mooring system is to include the following, when applicable:

- i) Mooring Arrangement or Pattern.
- ii) Details of winching equipment.
- iii) Details of anchoring system.
- iv) Details of mooring line segments.
- v) Connections at anchors and between mooring line segments.
- vi) Details of in-line (spring) buoys.
- vii) Details of buoy for CALM system.
- viii) Details of SALM structures, if appropriate.
- ix) Details of Turret System to show turret structure, swivel, turntable and disconnecting device.
- x) Details of yoke (hard or soft) connecting the installation and CALM/SALM structure.
- xi) Environmental Report.
- xii) Mooring Analysis describing method of load calculations and analysis of dynamic system to determine the mooring line design loads.
- xiii) Model Test report when the design loads are based on model tests in a wave basin.
- xiv) Thruster specifications and calculations of a system with dynamic positioning system for thruster forces and power to counteract environmental forces. (See Sections 3-2-3 and 3-2-4.)
- xv) (2016) Details of arrangements and procedures for the crew to periodically verify that mooring lines have not failed. (See 6-1-1/15)

5 Production Facilities and Production Support Facilities (1 July 2012)

The following design documentation of a floating production and installation is required to be submitted, as applicable, depending on the classification notation:

- i) General Arrangements showing arrangements and locations of storage tanks, machinery, equipment, living quarters, fire walls, emergency shutdown (ESD) stations, control stations, crude loading and discharge stations and the flare (see 4-1-7/3).
- ii) Hazardous Area Classification Plans, as defined in 3-1-3/7 herein.
- iii) Details of Storage Tank Venting and Inerting indicating arrangements for storage tank venting and inerting.
- iv) Arrangements for Use of Produced Gas as Fuel showing piping and control arrangements for use of produced gas as fuel showing details of double wall or ducting arrangements for the pipe runs in way of the safe space.
- v) A design specification that is to include design parameters (environmental conditions, geographical location of the unit, external loads, pressures, temperatures, etc.), standards and codes adopted throughout the design, construction and testing stages and the process description.
- vi) A description of the field development plan, including well fluid properties, production rates, gas oil ratios, processing scheme, well shut-in pressures.
- vii) Process flow sheets showing major process equipment components, process piping, material balance, normal pressures and temperatures at the inlet and outlet of each major component.
- viii) Piping and Instrumentation Diagrams (P&IDs) indicating location of all sensing and controlling elements on the process and production support systems, sizing and material specification of piping and the associated components, maximum design pressure and temperature ratings, piping strength and flow calculations.

- ix) List of electrical equipment located in hazardous areas together with the certificates issued by an independent testing laboratory to show suitability of their use in the intended location.
- x) Electrical one line diagram showing ratings of all generators, motors, transformers, type and size of wires and cables. Types and rating of circuit breakers with the setting, interrupting capacity of circuit breakers and fuses.
- xi) Short circuit current calculations and coordination data giving the maximum calculated short circuit current available at the main bus bars and at each point in the distribution system in order to determine the adequacy of the interrupting capacities of the protective device. A system coordination study is to be included.
- xii) Safety Analysis, including Safety Analysis Function Evaluation (S.A.F.E.) charts.
- xiii) Emergency shutdown system (ESD) relating to all sensing devices, shutdown valves, shutdown devices and emergency support system to their functions and showing ESD logic for the complete process and the subsea valves system.
- xiv) Emergency backup and uninterrupted power source, supply and the consumers.
- xv) Pressure vessel (fired and unfired) and heat exchangers, design dimensional drawings, design calculations, material specifications, pressure and temperature ratings, together with weld details and the details of their support.
- xvi) Pressure relief and depressurization vent systems showing arrangements sizing of the lines, capacities of the relief valve, materials, design capacity, calculations for the relief valves, knock out drums, anticipated noise levels and gas dispersion analyses.
- xvii) Complete details of flares, including pilots, igniters and water seal and design calculations, including stability and radiant heat analyses.
- xviii) Schematic plans for the production support systems, including the size, wall thicknesses, maximum design working pressure and temperature and materials for all pipes and the type, size and material of valves and fittings.
- xix) Compressors, pumps selection and control arrangements, including specification data sheet.
- xx) Fire and gas detection system showing the location and detailed description of all power sources, sensors, annunciation and indication, set point for the alarm system.
- xxi) Passive and active fire protection system indicating locations of fire walls, fire pumps and their capacities, main and backup power supply, fixed and portable fire extinguishing, and fire fighting systems and equipment. In this regard, supportive calculations are to be submitted to show the basis of capacities and quantities of fire extinguishing equipment.
- xxii) Escape route plan showing escape routes to abandonment stations and survival embarkation areas.
- xxiii) (1 July 2012) Startup and commissioning procedures detailing sequence of events for inspection, testing and startup and commissioning of equipment and system (submitted to attending Surveyor for review and agreement).
- xxiv) (1 July 2012) Installation, Hook-up and Commissioning Procedures (submitted to attending Surveyor for review and agreement, also See Part 3, Chapter 4.)

Above items i), ii), ix), xiii), xx), xxi), and xxii), are required to be submitted for any type of a floating production installation that is classed with or without its topsides production facilities.

7 Marine Systems and Machinery Plans (1 July 2012)

Plans showing marine piping systems, electrical systems, fire fighting systems and equipment, and machinery and equipment not associated with the process facilities are to be submitted (see Section 5A-1-6, 5B-1-4, 5B-2-6 or 5B-3-6 depending on the type of installation).

Where applicable, machinery plans listed in Part 4 of the *Steel Vessel Rules* or *MODU Rules* are to be submitted. Machinery general arrangements, installation and equipment plans, are also to be submitted and approved before proceeding with the work.

9 Additional Plans

Submission of additional plans and calculations may be required when additional classification designations or certifications are requested:

Additional classification designations under 1-1-2/5, 1-1-2/9, 1-1-2/11, 1-1-2/13 of these Rules or Part 4, Chapter 2. (See Section 4-2-2 for import/export system submission requirements.)

Certifications under 1-1-2/5, 1-1-2/9, 1-1-2/11 or 1-1-2/13 of these Rules or 1-1-5/3 or 1-1-5/5 of the ABS *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*.

11 Manuals and Procedures

11.1 Operations Manual

The Operations Manual is to be submitted, providing guidance information for operating personnel regarding the following, when applicable:

<i>Subject</i>	<i>References in these Rules</i>
Loading Manual	3-3-1/7, 5B-1-1/5
Trim and Stability	3-3-1/9, 3-3-1/11, 5B-1-3/1

11.3 Procedures (1 July 2017)

Procedures are to be submitted for the following:

<i>Subject</i>	<i>References in these Rules</i>
Disconnecting Procedure, if applicable	3-4-1/13
Drydocking Procedure*	Section 7-3-1
Hook Up Procedures	Section 3-4-2
Installation Procedures	Section 3-4-1
Installation Manual	3-4-1/11
Import/Export System	4-2-4/7, 3-4-1/11
Lay-up and Reactivation, if applicable*	7-2-1/21
Startup and Commissioning Procedures*	Section 3-4-3
In-Service Inspection Program (ISIP)	7-2-1/3.27 & Section 7-2-3
Procedure for periodic verification by the crew that mooring lines have not parted (See 6-1-1/15)	

* Submitted to attending Surveyor for review and agreement

PART

2

Materials and Welding

The independent booklet, *ABS Rules for Materials and Welding (Part 2)*, for steels, irons, bronzes, etc., is to be referred to. This booklet consists of the following Chapters:

Rules for Testing and Certification of Materials

CHAPTER 1 Materials for Hull Construction

CHAPTER 2 Equipment

CHAPTER 3 Materials for Machinery, Boilers, Pressure Vessels, and Piping

APPENDIX 1 List of Destructive and Nondestructive Tests Required for Materials and Responsibility for Verifying

APPENDIX 4 Procedure for the Approval of Manufacturers of Hull Structural Steel

APPENDIX 5 Procedure for the Approval of Manufacturers of Hull Structural Steels Intended for Welding with High Heat Input

APPENDIX 6 Nondestructive Examination of Marine Steel Castings

APPENDIX 7 Nondestructive Examination of Hull and Machinery Steel Forgings

APPENDIX 8 Additional Approval Procedure for Steel with Enhanced Corrosion Resistance Properties

Rules for Welding and Fabrication

CHAPTER 4 Welding and Fabrication

APPENDIX 2 Requirements for the Approval of Filler Metals

APPENDIX 3 Application of Filler Metals to ABS Steels

APPENDIX 9 Welding Procedure Qualification Tests of Steels for Hull Construction and Marine Structures

Installation Types, Functions, Features and General Requirements

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PART 3

CHAPTER 1 General Description

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PART

3

CHAPTER 1 General Description

SECTION 1 Basic Configurations

1 Purpose

A *Floating Installation* provides hydrocarbon processing and/or hydrocarbon storage and offloads hydrocarbons. Where discussion of the various component systems supporting hydrocarbon processing and/or storage may cause confusion with the total system, *Floating Installation* is used to generically identify the combination under discussion and refers to a site-specific installation.

The notations:

Floating Production, Storage and Offloading System

Floating Production (and Offloading) System

Floating Storage and Offloading System

Floating Offshore Installation

are based on accepted industry practice and were chosen to provide a clear description of the function of each configuration.

- **Floating Production, Storage and Offloading System** – This installation processes, stores and offloads hydrocarbons.
- **Floating Production (and Offloading) System** – This installation processes and offloads hydrocarbons without storage capacity.
- **Floating Storage and Offloading System** – This installation stores and offloads hydrocarbons without hydrocarbon processing facilities.
- **Floating Offshore Installation** – This installation may process and offload hydrocarbons and may or may not have storage capacity, but the production facilities are not classed.

3 Major Elements

A Floating Installation consists of several of the following major elements that are addressed in these Rules:

- i) Installation
- ii) Position mooring (or station keeping system)
- iii) Production processing facilities
- iv) Import/export system

Classification boundaries encompass the installation and position mooring system and may include the production facilities. Import/export systems may be classed, as well. (See Section 1-1-2 of these Rules.)

A Floating Installation classed as an **FPSO**, **FPS**, **FSO** or **FOI** includes the following elements:

	<i>Installation</i>	<i>Position Mooring System</i>	<i>Storage</i>	<i>Hydrocarbon Process System(s)</i>	<i>Import/Export System</i>
FPSO	✓	✓	✓	✓	Optional
FPS	✓	✓	---	✓	Optional
FSO	✓	✓	✓	---	Optional
FOI (Production Facilities not classed)	✓	✓	Safety Features Only See 4-1-1/3		Optional
FOI (with Production Facilities indicated in Column 5)	✓	✓	Safety Features Only See 4-1-1/5		Optional

PART

3

CHAPTER 1 General Description

SECTION 2 Installation

1 General

Installation, as used in these Rules, refers to a floating structure and the machinery, equipment and systems necessary for safety, propulsion (if fitted) and auxiliary services. The structural configurations of these installations may be ship-shaped or barge-shaped (with or without propulsion), column stabilized or any other configuration of a purpose-built floating installation.

3 Ship-Type Installations

Ship-type installations are single displacement hulls, either ship-shaped or barge-shaped, which have been designed or converted to a floating production and/or storage system. They may have propulsion machinery and/or station keeping systems.

5 Column-Stabilized Installations

Column-stabilized installations consist of surface piercing columns, submerged pontoons and a deck supported at column tops. Buoyancy is provided by the submerged pontoons, surface piercing columns and braces, if any.

7 Tension Leg Platform Installations (1 July 2009)

Tension leg platform (TLP) installations are vertically moored, buoyant structural systems wherein the excess buoyancy of the platform maintains tension in the mooring system. The TLPs consist of buoyant pontoons and columns, a column top frame or a topside deck and a tendon system with its seafloor foundations.

9 Spar Installations (1 July 2009)

Spar installations are deep draft, vertical floating structures, usually of cylindrical shape, supporting a topside deck and moored to the seafloor. The hull can be divided into upper hull, mid-section and lower hull.

11 Other Types (1 July 2009)

Purpose-built and new configurations belong to this category.

PART

3

CHAPTER 1 General Description

SECTION 3 Production Facilities

1 General (1 July 2009)

The production facilities typically consist of the processing, safety and control systems, production support systems and auxiliary equipment for processing hydrocarbon liquid and gas mixtures from wells or other sources. Generally, a production facility includes all elements located onboard the Floating Installation unit. These elements are located from (and including) the first inlet flange of the well fluid flow line above the water level inboard to (and including) the last onboard flange. Some important items related to production facilities are defined in the following paragraphs.

3 Production Support Systems

The production support systems include power generation and distribution, instrument and service air, potable water, fuel oil systems, HVAC, instrumentation, communication systems and firewater systems required to support hydrocarbon production and processing.

Production support systems may be in addition to or extensions of the normal marine utility systems found on MODUs, barges or ship-type installations. (See Part 4, Chapter 1 of these Rules and Chapter 3, Section 6 of the *Facilities Rules*.)

5 Manned Facility

A manned facility is one with permanent occupied living accommodations or one that requires the continuous presence of personnel for more than 12 hours in successive 24 hour periods.

7 Hazardous Areas: Classified Areas and Area Classification Plan

A classified area is an area in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. See 3-6/15 of the *Facilities Rules*.

An area classification plan is a set of drawings indicating extent, boundaries and classification of all classified areas.

9 Piping and Instrumentation Diagrams (P&IDs)

P&IDs show the size, design and operating conditions of each major process component, piping and valve designation and size, sensing and control instrumentation, shutdown and pressure relief devices with set points, signal circuits, set points for controllers, continuity of all line pipes and boundaries of skid units and process packages.

11 Safety Analysis Function Evaluation (S.A.F.E.) Charts

The S.A.F.E. charts list all process components and emergency support systems with their required sensing devices and the functions to be performed by each device and relate all sensing devices, shutdown valves, shutdown devices and emergency support systems to their functions.

PART

3

CHAPTER 1 General Description

SECTION 4 Position Mooring System

1 General

A Position Mooring System keeps the installation on station. The Position Mooring System includes mooring lines, connectors and hardware, winches, piles, anchors and thrusters. For a single point mooring system, the turret, turntable, disconnecting system, buoy, anchoring legs, etc., are also part of the system.

3 Spread Mooring

A spread mooring is a system with multiple catenary mooring lines anchored to piles or drag anchors at the sea bed. The other end of each line is individually attached to winches or stoppers on the installation through fairleads as necessary. A catenary mooring line may have one or more line segments, in-line buoy(s) (*spring buoy*) or sinker(s) (*clumped weight*) along the line.

5 Single Point Mooring (SPM)

A single point mooring allows the installation to weathervane. Three typical types of single point mooring systems that are commonly used are described below:

5.1 CALM (Catenary Anchor Leg Mooring)

A catenary anchor leg mooring system consists of a large buoy anchored by catenary mooring lines. The installation is moored to the buoy by soft hawser(s) or a rigid yoke structure.

5.3 SALM (Single Anchor Leg Mooring)

A single anchor leg mooring system consists of an anchoring structure with built-in buoyancy at or near the water surface and is itself anchored to the seabed by an articulated connection.

5.5 Turret Mooring

A turret mooring system consists of a number of mooring legs attached to a turret that is designed to act as part of the installation, allowing only angular relative movement of the installation to the turret, so that the installation may weathervane. The turret may be mounted internally within the installation or externally from the installation bow or stern. Typically, a spread mooring arrangement connects the turret to the seabed.

5.7 Yoke Arm

A yoke arm is a structure at the end of the installation that only allows angular relative movement between the installation and the mooring attachment to the seabed.

7 Dynamic Positioning and Thruster Assisted Systems

A dynamic positioning system is defined as all of the equipment necessary to provide a means of controlling the position and heading of a Floating Installation within predetermined limits by means of vectored thrust.

A thruster-assisted system provides controlled thrust to assist the main (usually static) mooring system and reduce component loading of the main mooring system.

PART

3

CHAPTER 1 General Description

SECTION 5 Subsea System

1 General

A subsea system is a flexible/articulated piping system providing a conduit for the hydrocarbons from the subsea pipeline to the surface components. It includes subsea pipelines, subsea well system and risers.

The definitions in this Section describe the various aspects of the classification procedure in these Rules.

3 Floating Hose

A floating hose is a floating conduit used to export hydrocarbons from a point of storage/production, either an SPM or installation's manifold to a receiving installation's manifold for transport.

5 On Bottom Flexible Flow Lines

These lines are conduit used to connect one subsea location to another subsea location prior to a vertical conveyance by the riser system to the surface.

7 Pipe Line End Manifold (PLEM)

A PLEM is the assemblage of valves and components or equipment performing the equivalent function connecting the production facilities to the pipeline carrying product to or from the shore, an offloading system or to another facility.

7.1 Import PLEM

Import PLEM is the equipment connecting to the Import Riser and the import supply line or wellhead. (In some configurations, the wellhead may provide the function of the Import PLEM.)

7.3 Export PLEM

Export PLEM is the equipment connection between the Export Riser and the product discharge line.

9 Riser

A riser is a subsea rigid and/or flexible pipe that connects the surface facilities with the sea floor and is thus the conduit for fulfilling the desired function of conveying fluids, gas, electrical power, etc.

11 Riser System

The riser system includes the entire assemblage of components, control systems, safety systems and tensioning devices that ensure the integrity of the riser throughout its operation. Riser classification boundaries are defined in Section 4-2-1 of these Rules.

13 Riser Support

Riser support comprises any structural attachments, including buoyancy devices that are used to give structural integrity to the riser or transfer load to the supporting structure.

15 Submerged Jumper Hoses

Jumper hoses are flexible lines used in conjunction with rigid risers to accommodate the relative motion between the Floating Installation and the submerged top of the riser. Jumper hoses may also be used to connect the subsea manifold to the wellhead.

PART 3

CHAPTER 2 Design Basis and Environmental Loading

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PART

3

CHAPTER 2 Design Basis and Environmental Loading

SECTION 1 General Design Basis

(1 July 2009) The design basis of a Floating Installation identifies, among other items, the production rate, storage capacity and loading capabilities. Since the system operation is site-specific, the environmental conditions of the site directly influence the design of such a system.

The effects of prevailing winds are to be considered to minimize the risk of vented or flared hydrocarbons to personnel, living quarters and evacuation means. Generally, atmospheric vents, flare systems and emergency gas release vents are to be arranged in such a way so that prevailing winds will carry heat and/or unburned gases away from potential ignition sources on the installation. See API RP 14J.

The design environmental conditions are to include those for the operation, installation and transit portions of the Floating Installation's design life. This Chapter specifically covers the environmental design criteria for:

- i) Position Mooring System.
- ii) Structural Strength and Fatigue Life Assessments.

PART

3

CHAPTER 2 Design Basis and Environmental Loading

SECTION 2 Design Documentation

The design documentation submitted is to include reports, calculations, plans and other documentation necessary to verify the structural strength of the installation itself and adequacy of the mooring system, production and other utility facilities and riser system (if included in the classification) for the intended operations.

PART

3

CHAPTER 2 Design Basis and Environmental Loading

SECTION 3 Design Conditions

The FPI is to be designed for load scenarios encountered during transit and site-specific conditions. Site-specific conditions are to include both the Design Environmental Condition and the Design Operating Condition.

1 Position Mooring System

The position mooring system of a Floating Installation is to be designed to survive in the Design Environmental Condition and operate in the Design Operating Condition. For a disconnectable mooring system, the limiting condition at which the mooring system is to be disconnected or reconnected is to be specified.

1.1 Design Environmental Condition (DEC) (2017)

The *Design Environmental Condition (DEC)* is defined as the extreme condition with a specific combination of wind, waves and current for which the system is to be designed.

The DEC is to be one of the following combinations that results in the most severe loading case:

- 100-year waves with associated wind and current.
- 100-year wind with associated waves and current.
- 100-year current with associated waves and wind.

In areas where the maximum mooring system responses are governed by squalls, 100-year squalls with the following combination are also to be included for the DEC.

- 100-year squalls with associated wave and current.

A squall event is defined as a wind with a rapid increase in speed of 8 m/s, sustained above 11 m/s for at least 1 minute.

In areas with high current, additional design environmental load cases may need to be considered.

The 100-year waves are normally characterized by a significant wave height with a spectral shape type and a range of associated peak wave periods.

A minimum return period of 100 years for the DEC is required for Floating Installations. A minimum return period of 50 years will be specially considered if it is accepted by the coastal state. Any environmental combinations with return periods shorter than that of the DEC which induce larger mooring load responses are also to be used in the design.

For a Floating Installation with a **Disconnectable** notation (see 1-1-2/5.1 of these Rules), the *DISconnecting Environmental Condition (DISEC)* of the mooring system is the limiting extreme environmental condition at which the installation is to be disconnected from the mooring system. The DISEC condition is not to be taken as less severe than the environmental condition based on 10-year return period. In tropical revolving storm areas, the 10-year “sudden” tropical cyclone (hurricane or typhoon) which may form near the site of the installation may be considered instead of a fully developed storm for this evaluation.

The permanent mooring system, i.e., the mooring system alone (without the installation), is to be designed to withstand an environmental condition based on a 100-year recurrence period. An acceptable monitoring system is to be provided for tracking environmental conditions or mooring line tensions in order to assist in the decision to disconnect the installation from the mooring system.

1.3 Design Operating Condition (DOC) (1 July 2009)

The *Design Operating Condition (DOC)* is defined as the limiting environmental condition that would require suspension of normal operations. The return period associated with the DOC shall be the larger of: a) the value as specified by the Operator, or b) one year.

1.5 Design Installation Condition (DIC)

The *Design Installation Condition (DIC)* is defined as the limiting environmental condition that would require suspension of installation operations. Specific limits on environmental conditions affecting safe operation during the installation phases described in Part 3, Chapter 4 are to be established and documented.

1.7 Angular Separation of Wind, Current and Waves (2017)

For single point mooring systems, which allow the installation to weathervane, both collinear and non-collinear directions among wind, current and waves are to be considered. Proper angular separation for the DEC of wind, current and waves is to be determined based on the site-specific environmental study. If this information is not available, the following two angular combinations for non-collinear environments can be considered as a minimum:

- i) Wind and current are collinear and both at 30 degrees to waves.
- ii) Wind at 30 degrees to waves and current at 90 degrees to waves. Alternatively, the following option may be considered provided the equivalent probability of the 100-yr DEC is maintained:
 - Angular separation between current and waves may be reduced from 90 degrees but no less than 45 degrees.

For spread mooring systems with limited change in installation heading angles (less than 20 degrees) under design environmental loads, the collinear environments of wind, current and waves, which are generally controlling, can be used in design.

For each design sea state, a long-crested sea without spectral energy spreading in direction is normally considered in the mooring analysis.

3 Structural Strength and Fatigue Life

3.1 Project Site (December 2008)

The site-specific environmental conditions, including both 100-year return period environmental events and wave scatter diagram data of wave height/period joint occurrence distribution, are to be considered for the installation's hull strength and fatigue life assessment. Fatigue life assessment is also to include the effects of on-site operational loading and unloading cycles. A minimum return period of 100 years for the design response should be used for the DEC criteria per API RP 2T. A minimum return period of 50 years for the structural response may be specially considered, provided that it is accepted by the Coastal State. Different environmental conditions may induce different worst responses on various parts of the hull structure. The wave-induced maximum motion responses and maximum structural load effects may result from different wave periods. Therefore, the following two environmental conditions are to be considered to derive the maximum motion responses and maximum structural load effects. The larger of the two values obtained from i) and ii) is to be considered the maximum response:

- i) 100-year return period waves characterized by a significant wave height with a range of associated peak wave periods. Both winter storms and tropical cyclones (hurricanes or typhoons), if any, need to be considered.
- ii) Wave scatter diagram data of wave height/period joint occurrence distribution. The length of time on which the data base for the wave scatter diagram data is constructed is long enough to be a reliable basis for design (preferably at least five years). The occurrence distribution is to be annualized with equal probability of occurrence for each data point. Each data point is to represent a sea state of approximately three hours in a continuous time duration of the database.

For both of the above environmental conditions the following are also to be considered:

- iii) Wave directions of head seas and other directions relative to the installation heading, including the effects of wind and current, with proper probability distribution are to be considered, irrespective of the type of mooring system utilized.
- iv) As appropriate, either long-crested seas or short-crested seas with spreading function are to be considered for various design issues.

3.3 Transit

The wind and wave conditions representing the environment for the transit route from the building or outfitting site (or the shipyard where the conversion modifications are made) to the project site and the time of the year are to be determined for the design of a floating installation. Except for floating installations that qualify for the **Disconnectable** classification notation, any other transit conditions occurring during the operational life of the floating installation are to be submitted for review. Prior to commencement of such a voyage, an ABS Surveyor is to attend and survey the installation to assess its condition.

As a minimum, the wind speed and significant wave height of 10-year return period are to be considered, unless a weather routing plan is to be implemented for the voyage. Seasonal effects on the design environments as appropriate for the proposed transit duration can be considered.

In addition to the check on the installation's hull strength during transit, special attention is to be paid to items such as the flare boom, crane pedestal and process equipment supports that will be subject to motion-induced loading and/or effects of green water. Motion-induced loads during transit are to be calculated and the superstructures and their supports, which are included in the scope of classification, shall be verified against these loads.

If fitted with an internal turret, special consideration is to be given to bottom slamming to preclude damage to the turret supports and bearings.

3.5 Disconnectable Installations (1 July 2012)

For disconnectable floating installations that are disconnected from its mooring and riser systems due to the occurrence of a limiting extreme environmental condition, the structural strength of the installation shall comply with unrestricted service (North Atlantic) conditions. However, if the disconnectable floating installation is restricted to a specific service area in proximity to its operating site location, reduced design load parameters may be applied with an appropriate limited area of disconnected service notation **Disconnectable-R (from site to designated port)** or **(from site to geographic area Lat. X1, Long. Y1; Lat. X2, Long. Y2; Lat. X3, Long. Y3; Lat. X4, Long. Y4)**, where permitted by local authorities or regulations.

3.7 Strength and Fatigue Life (December 2008)

Hull strength and fatigue life assessment are calculated according to Part 5A or 5B of these Rules for a given project site and transit route.

PART

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CHAPTER 2 Design Basis and Environmental Loading

SECTION 4 Environmental Conditions

1 General

The environmental conditions for various design conditions described in Section 3-2-3 are to be submitted with adequate data for the specific site of operation. Statistical data and mathematical models that describe the range of pertinent expected variations of environmental conditions are to be employed. All data used are to be fully documented with the sources and estimated reliability of data noted.

An *environmental report* describing methods employed in developing available data into design criteria is to be submitted in accordance with 1-1-4/3 of these Rules. Probabilistic methods for short-term, long-term and extreme-value prediction are to employ statistical distributions appropriate to the environmental phenomena being considered, as evidenced by relevant statistical tests, confidence limits and other measures of statistical significance. Hindcasting methods and models are to be fully documented.

Generally, data and analyses supplied by recognized consultants will be accepted as the basis of design. Published design standards and data, if available for the location of interest, may be cited as documentation.

Specifically, the following environmental data are normally to be provided:

- i) Extreme events of 100-, 10- and 1-year return period data for wind speed, significant wave height and current. A range of associated wave periods is to be considered for each specified significant wave height. Both winter storms and tropical cyclones (hurricanes or typhoons), if any, need be considered.
- ii) Directional data and angular separation for extreme values of wind, waves and current.
- iii) Wave spectral shape formulation.
- iv) Current speed and directional variation through the water depth.
- v) Wave height/period joint occurrence distribution (wave scatter diagram data with equal annual probability of occurrence for each data point).
- vi) Long-term wave statistics by direction.
- vii) Water depth and tidal variations, including wind and pressure effects of storms.
- viii) Air and sea temperature.
- ix) Ice, iceberg and snow, if any.
- x) (2017) Time series of squalls with wind speeds and wind directions in the areas where the maximum mooring system responses are governed by squalls (refer to 3-2-3/1.1 for DEC)

3 Environmental Loads

The design of a Floating Installation requires the establishment of environmental loads considering the following parameters:

Air and sea temperatures	Tides and storm surges
Currents	Waves
Ice and Snow	Wind

Other phenomena such as loop currents, tsunamis, submarine slides, seiche, abnormal composition of air and water, air humidity, salinity, ice drift and icebergs may require special considerations.

Wind tunnel and towing tank tests on the project-specific submerged hull and superstructures are preferred in determining current and wind loads. Alternatively, the following calculation procedures can also be applied.

5 Current

The current forces on the submerged hull, mooring lines, risers or any other submerged objects associated with the system are to be calculated using a current profile established in accordance with 3-2-3/1. In areas where relatively high velocity currents occur, load amplification due to vortex shedding is to be considered.

Current force, $F_{current}$, on the submerged part of any structure is calculated as the drag force by the following equation:

$$F_{current} = 1/2 \rho_{water} C_D A_{current} u_c |u_c| \quad \text{kN (lbf)}$$

where

- ρ_{water} = density of sea water, 1.025 tonnes/m³ (1.99 Slugs/ft³)
- C_D = drag coefficient, in steady flow (dimensionless)
- u_c = current velocity vector normal to the plane of projected area, in m/s (ft/s)
- $A_{current}$ = projected area exposed to current, in m² (ft²)

For a Floating Installation using a ship-type configuration (e.g., tankers), current forces may be calculated (as appropriate) by using coefficients based on model test data as presented in *Prediction of Wind and Current Loads on VLCCs*, published by Oil Companies International Marine Forum (OCIMF), 1994.

7 Wind

The wind conditions for various design conditions are to be established from collected wind data and should be consistent with other environmental parameters assumed to occur simultaneously. In general, the wind speed is to be based on a recurrence period of 100 years.

The environmental report is to present wind statistics for the site of installation. The statistics are to be based on the analysis and interpretation of wind data by a recognized consultant. The report is to include a wind rose or table showing the frequency distributions of wind velocity and direction and a table or graph showing the recurrence period of extreme winds. The percentage of time for which the operational phase limiting wind velocity is expected to be exceeded during a year and during the worst month or season is to be identified.

7.1 Wind Load

The wind loading can be considered either as a steady wind force or as a combination of steady and time-varying load, as described below:

- i) When wind force is considered as a constant (steady) force, the wind velocity based on the 1-minute average velocity is to be used in calculating the wind load.
- ii) Effect of the wind gust spectrum can be taken into account by considering wind loading as a combination of steady load and a time-varying component calculated from a suitable wind spectrum. For this approach, the wind velocity based on 1-hour average speed is to be used for steady wind load calculation. The first approach is preferred to this approach when the wind energy spectrum cannot be derived with confidence.

Wind pressure, p_{wind} , on a particular windage of a floating installation may be calculated as drag forces using the following equations:

$$\begin{aligned} P_{wind} &= 0.610 C_s C_h V_{ref}^2 \quad \text{N/m}^2 \quad V_{ref} \text{ in m/s} \\ &= 0.0623 C_s C_h V_{ref}^2 \quad \text{kgf/m}^2 \quad V_{ref} \text{ in m/s} \\ &= 0.00338 C_s C_h V_{ref}^2 \quad \text{lbf/ft}^2 \quad V_{ref} \text{ in knots} \end{aligned}$$

where

C_s = Shape Coefficient (dimensionless)

C_h = Height Coefficient (dimensionless)

The height coefficient, C_h , in the above formulation accounts for the wind velocity (V_{wind}) profile in the vertical plane. The height coefficient, C_h , is given by the following equation:

$$C_h = \left(\frac{V_z}{V_{ref}} \right)^2 \quad \text{or} \quad C_h = \left(\frac{z}{Z_{ref}} \right)^{2\beta}, \quad \text{but } C_h (\geq 1)$$

where the velocity of wind, V_z , at a height, z , is to be calculated as follows:

$$V_z = V_{ref} \left(\frac{z}{Z_{ref}} \right)^\beta$$

V_{ref} = velocity of wind at a reference elevation, Z_{ref} , of 10 m (33 feet)

β = 0.09 - 0.16 for 1-minute average wind
= 0.125 for 1-hour average wind.

The corresponding wind force, F_{wind} , on the windage is:

$$F_{wind} = p_{wind} A_{wind}$$

where

A_{wind} = projected area of windage on a plane normal to the direction of the wind, in m^2 (ft^2)

The total wind force is then obtained by summing up the wind forces on each windage.

Representative values of C_h are given in 3-2-4/Table 2 of these Rules. Wind profiles for the specific site of the Floating Installation should be used.

The shape coefficients for typical structural shapes are presented in 3-2-4/Table 1 of these Rules. To convert the wind velocity, V_p , at a reference of 10 m (33 feet) above sea level for a given time average, t , to velocity of another time average, the following relationship may be used:

$$V_t = f V_{(1 \text{ hr})}$$

Example values of the factor f , based on API RP 2A, for U.S. waters are listed in 3-2-4/Table 3 of these Rules. Values specific to the site of the Floating Installation are to be used.

Wind forces can be calculated for large ship-type installations with relatively small superstructure (e.g., tankers) using the coefficients presented in the document *Prediction of Wind and Current Loads on VLCCs*, OCIMF, 1994. Additional forces due to superstructures and equipment can be calculated by the above formula and added to these results.

Wind forces on Floating Installations other than ship-type are to be calculated by the summation of wind forces on individual areas using the above formulas.

If the 1-hour average wind speed is used, the wind's dynamic effect should be separately considered. The wind energy spectrum, as recommended in API RP 2A, may be used.