GUIDE FOR BUILDING AND CLASSING

FLOATING PRODUCTION INSTALLATIONS
JULY 2009

NOTICE NO. 1 – July 2012

The following Rule Changes were approved by the ABS Rules Committee on 31 May 2012 and become **EFFECTIVE AS OF 1 JULY 2012.**

(See http://www.eagle.org for the consolidated version of the Guide for Building and Classing Floating Production Installations 2009, with all Notices and Corrigenda incorporated.)

Notes - The date in the parentheses means the date that the Rule becomes effective for new construction based on the contract date for construction. (See 1-1-4/3.3 of the ABS Rules for Conditions of Classification – Offshore Units and Structures (Part 1).)

PART 1 **CONDITIONS OF CLASSIFICATION (SUPPLEMENT TO THE ABS RULES FOR CONDITIONS OF CLASSIFICATION – OFFSHORE UNITS AND STRUCTURES)**

CHAPTER 1 **SCOPE AND CONDITIONS OF CLASSIFICATION**

SECTION 2 **SYSTEM CLASSIFICATION, SYMBOLS AND NOTATIONS**

(Revise Subsection 1-1-2/1, as follows:)

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.

(Revise Subsection 1-1-2/3, as follows:)

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 this Guide.

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 this Guide.

ii) *Position Mooring System* according to the requirements of this Guide.

iii) *Topside Production Facilities* according to the requirements of the ABS *Guide for Building and Classing Facilities on Offshore Installations* (*Facilities Guide*) and this Guide.

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 this Guide.

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

(Revise Paragraphs 1-1-2/5.3 and 1-1-2/5.5, as follows:)

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 4-3-5/15 of the *Steel Vessel Rules*).

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 this Guide, 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 this Guide. These notations for import and export systems are optional.

(Revise Paragraphs 1-1-2/5.7, as follows:)

5.7 Dynamic Loading Approach (DLA) *(1 July 2012)*

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.

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 this Guide.

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.

(Revise Paragraph 1-1-2/5.9, as follows:)

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 this Guide 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 this Guide.

The basic notation of 1-1-2/3 of this Guide 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 this Guide 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 this Guide, 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

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.

Design review and surveys will be based on the current ABS requirements at the time of the contract for the relocation of the unit.

For minor modifications of structures, systems or equipment, special consideration may be made in a case-by-case basis for the use of the original ABS requirements applied to the unit, when the majority of the particular structure, system or equipment remains unchanged.

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.

Design review and surveys are to be based on the current ABS requirements at the time of the contract for the relocation of the unit.

For minor modifications of structures, systems or equipment, special consideration may be made in a case-by-case basis for the use of the original ABS requirements applied to the unit, when the majority of the particular structure, system or equipment remains unchanged.

(Add new Paragraph 1-1-2/5.10, as follows:)

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 this Guide will be identified in the *Record* by the notation as given in 1-1-2/3 of this Guide 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.

(Renumber existing Paragraph 1-1-2/5.10 as 1-1-2/5.11 and revise, as follows:)

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 this Guide 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 this Guide. 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 this Guide 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 this Guide and the position mooring system requirements in Part 6 of this Guide. 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 × 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

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.

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

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 Periodical survey, including Underwater Inspection, to determine the structural condition of the unit at the time of the life extension.

The new fatigue analysis and related design review and surveys, when necessary, will be based on the current ABS requirements at the time of the life extension.

For minor modifications of structures, systems or equipment, special consideration may be made in a case-by-case basis for the use of the original ABS requirements applied to the unit, when the majority of the particular structure, system or equipment remains unchanged.

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

(Renumber existing Paragraph 1-1-2/5.11 as 1-1-2/5.12 and revise, as follows:)

5.12 Spectral Fatigue Analysis *(1 July 2012)*

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 this Guide 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.

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 is to be reached in the year 2018 at the defined site location. The application of spectral fatigue analysis for FPI conversions is optional.

(Add new Paragraph 1-1-2/5.15, as follows:)

5.15 Hull Construction Monitoring Program *(1 July 2012)*

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

7 ✠ AMS Notation *(1 July 2012)*

(Revise Subsection 1-1-2/7, as follows:)

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.

(Delete Subsection 1-1-2/13 and renumber existing Subsection 1-1-2/15 as 1-1-2/13.)

(Add new Subsection 1-1-2/15, as follows:)

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, H_2S). 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 CONDITIONS OF CLASSIFICATION (SUPPLEMENT TO THE ABS RULES FOR CONDITIONS OF CLASSIFICATION – OFFSHORE UNITS AND STRUCTURES)

CHAPTER 1 SCOPE AND CONDITIONS OF CLASSIFICATION

SECTION 4 SUBMISSION OF PLANS, DATA AND CALCULATIONS

(Revise Items iv), xvi), and xx) of Subsection 1-1-4/1, as follows:)

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

(Revise first paragraph of Subsection 1-1-4/5, as follows:)

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:

(Revise Items xxiii) and xxiv) of Subsection 1-1-4/5 and add new last sentence, as follows:)

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.

(Revise Subsection 1-1-4/7, as follows:)

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.

11 Manuals and Procedures

(Revise Paragraph 1-1-4/11.3, as follows:)

11.3 Procedures *(1 July 2012)*

Procedures are to be submitted for the following:

Subject	*References in this Guide*
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*	7-1-1/15
Startup and Commissioning Procedures*	Section 3-4-3
Survey and Inspection Planning Document*	7-1-1/21

* Submitted to attending Surveyor for review and agreement

PART 3 INSTALLATION TYPES, FUNCTIONS, FEATURES AND GENERAL REQUIREMENTS

CHAPTER 2 DESIGN BASIS AND ENVIRONMENTAL LOADING

SECTION 3 DESIGN CONDITIONS

3 Structural Strength and Fatigue Life

(Revise Paragraph 3-2-3/3.5 as follows:)

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.

PART 3 INSTALLATION TYPES, FUNCTIONS, FEATURES AND GENERAL REQUIREMENTS

CHAPTER 3 GENERAL REQUIREMENTS

SECTION 1 ALL INSTALLATIONS

(Revise Subsection 3-3-1/3 as follows:)

3 Lightweight Data *(1 July 2012)*

The lightweight and center of gravity are to be determined for installations of all types. An inclining test will be required for the first floating installation of a series, when as near to completion as practical, to determine accurately the lightweight and position of center of gravity. An inclining test procedure is to be submitted for review prior to the test, which is to be witnessed by an ABS Surveyor. For specific requirements related to non-ship-type installations, refer to Section 5B-1-3, 5B-2-2, or 5B-3-2.

(Revise Subsection 3-3-1/5 as follows:)

5 Maximum Draft *(1 July 2012)*

Every installation is to have marks that designate the maximum permissible draft to which the installation may be loaded. Such markings are to be placed at suitable visible locations on the hull or structure to the satisfaction of ABS. On column-stabilized installations, where practical, these marks are to be visible to the person in charge of liquid transfer operations.

Where a Load Line certificate, issued in accordance with the International Convention of Load Lines, 1966, as amended by the 1988 Protocol, is not required, marks shall be affixed to the hull that clearly show the maximum draft permitted.

Maximum draft marks are to be established under the terms of the International Convention of Load Lines, 1966. Only the summer freeboard should be applied, unless other freeboards are necessary for disconnectable ship-type units. Where minimum freeboards cannot be computed by the normal methods laid down by the convention, such as in the case of a column stabilized installation, they are to be determined on the basis of compliance with strength and stability criteria in the Rules and applicable statutory regulations.

The installation's arrangements are to comply with all applicable regulations of the International Convention on Load Lines. Where alternative method of establishing the maximum draft has been based on strength and stability calculations as described above, arrangements are to be consistent with watertight and weathertight integrity assumptions in those calculations.

(Revise Subsection 3-3-1/11 as follows:)

11 Stability *(1 July 2012)*

The intact and damage stability of the installation are to be evaluated in accordance with the requirements of the Flag and Coastal States. Ship-type installations are to comply with the IMO Code on Intact Stability, the 1966 Load Line Convention, SOLAS Convention or IMO MODU Code as applicable, and MARPOL 73/78. Non-ship-type installations are to meet the requirements in Section 5B-1-3, 5B-2-2, or 5B-3-2 of this Guide. See 3-3-1/9 of this Guide for general requirements pertaining to the makeup and issuance of loading guidance with respect to stability.

(Add new Subsection 3-3-1/17 as follows:)

17 Onboard Computers for Stability Calculations *(1 July 2012)*

The use of onboard computers for stability calculations is not a requirement of class. However, if stability software is installed onboard floating installations contracted on or after 1 July 2005, it needs to cover all stability requirements applicable to the floating installation and is to be approved by ABS for compliance with the requirements of Appendix 3-3-A2, "Onboard Computers for Stability Calculations" of the *MODU Rules*.

PART 3 INSTALLATION TYPES, FUNCTIONS, FEATURES AND GENERAL REQUIREMENTS

APPENDIX 1 ABBREVIATIONS AND REFERENCES

SECTION 2 REFERENCES *(1 July 2012)*

(Revise ABS and American Petroleum Institute references, as follows:)

ABS:

Facilities Rules	*The ABS Rules for Building and Classing Facilities on Offshore Installations*
MODU Rules	*The ABS Rules for Building and Classing Mobile Offshore Drilling Units*
Offshore Chain Guide	*The ABS Guide for Certification of Offshore Mooring Chain*
Single Point Mooring Rules	*The ABS Rules for Building and Classing Single Point Mooring Systems*
Steel Vessel Rules	*The ABS Rules for Building and Classing Steel Vessels*
UWILD	*The ABS Rules for Survey After Construction (Appendix 7-A-1)*
Synthetic Rope Guidance Notes	*The ABS Guidance Notes on the Application of Synthetic Ropes for Offshore Mooring*
Risk Guidance Notes	*The ABS Guidance Notes on Risk Assessment Application for the Marine and Offshore Oil and Gas Industries*
Fatigue Guide	*Guide for the Fatigue Assessment of Offshore Structures*
Remote Control and Monitoring Guide	*Guide for Remote Control and Monitoring for Auxiliary Machinery and Systems (other than Propulsion) on Offshore Installations*
Risk Guide	*Guide for Risk Evaluations for the Classification of Marine-Related Facilities*
Buckling Guide	*Guide for Buckling and Ultimate Strength Assessment for Offshore Structures*
SFA Guide	*Guide for Spectral-Based Fatigue Analysis for Floating Production, Storage and Offloading (FPSO) Installations*
DLA Guide	*Guide for "Dynamic Loading Approach" for Floating Production, Storage and Offloading (FPSO) Installations*

American Petroleum Institute:

API RP 2A	*Recommended Practice for Planning, Designing, and Constructing Fixed Offshore Platforms*
API RP 2 SK	*Recommended Practice for the Design and Analysis of Stationkeeping Systems for Floating Structures, Third Edition - 2005*
API RP 2Q	*Replaced by API RP 16Q*
API RP 2RD	*Recommended Practice for Design of Risers for Floating Production Systems (FPSs) and Tension-Leg Platforms (TLPs)*
API RP 2T	*Recommended Practice for Planning, Designing, and Construction Tension Leg Platforms, Third Edition - 2010*
API Bull 2U	*Bulletin on Stability Design of Cylindrical Shells, Third Edition - 2004*
API Bull 2V	*Bulletin on Design of Flat Plate Structures, Third Edition - 2004*
API Spec 9A	*Specification for Wire Rope Twenty-fifth Edition - 2004*

(Other references remain unchanged.)

PART 4 PROCESS AND IMPORT/EXPORT SYSTEMS

CHAPTER 1 HYDROCARBON PRODUCTION AND PROCESS SYSTEMS

SECTION 1 GENERAL

(Revise Subsection 4-1-1/3 as follows:)

3 Installations Classed as FSO or FOI (Production Facilities not Classed) *(1 July 2012)*

The entire production facility need not comply with the requirements of this Chapter. However, the following systems and equipment for the production facilities are to be in accordance with the requirements of the *Facilities Guide*.

System/Equipment	*Facilities Guide Section*
Facility Layout	3-3/5
Area Classification	3-6/15
Electrical System Circuit Protection	3-6/5.9
Electrical Installations in Classified Areas	3-6/15
Fire Water Systems	3-8/5.1
Dry Chemical Systems, as applicable	3-8/5.3
Fixed Fire Extinguishing Systems	3-8/5.5
Paint Lockers, Laboratory Spaces, and Flammable Material Store Rooms	3-8/5.7
Emergency Control Station	3-8/5.11
Operation After Facility Total Shutdown	3-8/5.13
Portable and Semi-portable Extinguishers	3-8/5.15
Gas and Fire Detection Systems	3-8/7
Structural Fire Protection	3-8/9
Muster Areas	3-8/11
Means of Escape	3-8/13
Lifesaving Requirements	3-8/15
Personnel Safety Equipment and Safety Measures	3-8/17

For installations with the **FOI** classification symbol equipment certification is required for equipment in the above listed systems.

PART 4 PROCESS AND IMPORT/EXPORT SYSTEMS

CHAPTER 1 HYDROCARBON PRODUCTION AND PROCESS SYSTEMS

SECTION 4 SUBSEA EQUIPMENT *(1 July 2012)*

(Revise Section 4-1-4 as follows:)

Subsea equipment is not a part of the classification boundaries as defined in 1-1-2/1 of this Guide. However, subsea equipment may be classed if desired by the Owner, provided these items are approved by ABS for compliance with the requirements of the *Facilities Guide* and applicable Sections of this Guide.

ABS is prepared to certify the subsea equipment if the manufacturers/owners wish to obtain ABS certification. The design, construction and testing of the subsea equipment are to be in accordance with 3-3/17.19 of the *Facilities Guide.*

For a unit that has the riser system classed by ABS, the riser installation winch needs to comply with the following:

i) For a winch that is on board for the installation of the risers only (and removed after installation), the equipment does not need to be reviewed by ABS. However, the supporting structure needs to be designed to provide satisfactory strength for the reaction forces specified by the manufacturer or the maximum anticipated loads during the installation process.

ii) If the riser installation winch is to remain on board after the installation, the equipment will need to be in compliance with recognized industry standards. The manufacturer will need to submit details to demonstrate compliance with the industry standards, either in the form of certificates issued by recognized certification bodies or by submitting details and calculations to ABS for review and approval.

PART 4 PROCESS AND IMPORT/EXPORT SYSTEMS

CHAPTER 2 IMPORT AND EXPORT SYSTEMS

SECTION 1 GENERAL

(Revise first paragraph of Section 4-2-1 as follows:)

(1 July 2012) This Chapter applies to import and export systems utilized in Floating Installations when the class notations specified in 1-1-2/5.5 are requested. These systems include rigid and flexible risers, connecting flow lines, submerged jumpers and floating offloading hoses. (See Section 3-1-5 for definitions of related items.)

PART 5A SHIP-TYPE INSTALLATIONS

CHAPTER 1 DESIGN CONSIDERATIONS

SECTION 1 GENERAL

(Revise last paragraph of 5A-1-1/1, as follows:)

1 Introduction *(1 July 2012)*

(Preceding paragraphs remain unchanged.)

The design and construction of the hull, superstructure and deckhouses of ship-type installations that are new builds or conversions are to be based on the applicable requirements of Part 5A of this Guide and where referenced in the *Steel Vessel Rules*. Part 5A of this Guide reflects the different structural performance and demands expected for an installation transiting and being positioned at a particular site on a long-term basis compared to that of a vessel engaged in unrestricted seagoing service.

The design criteria for new build or conversions of ship-type installations are located in Part 5A, Chapters 1 and 3, with additional design criteria for ship-type conversions in Part 5A, Chapter 2 of this Guide, which are applicable to installations of 150 meters (492 feet) or more in length. Part 5A, Chapter 4 applies to installations under 150 meters in length. In addition, the applicable criteria contained in the Load Line, SOLAS and MARPOL Conventions issued by the International Maritime Organization are to be considered. It is further suggested that the local authorities having jurisdiction where the installation is to operate be contacted to obtain any further criteria that are applicable to the floating installations.

Note: This Guide is applicable to installations not exceeding 500 m (1640 ft) in length, *L*, having breadths not exceeding one-fifth of the length nor 2.5 times the depth to the strength deck. Installations beyond these proportions will be reviewed on a case-by-case basis.

The design criteria contained in Part 5A, Chapter 3 are applied in two phases. The first phase provides the basic hull design to reflect overall hull girder and local structural component strength, including fatigue strength. This is referred to as the *Initial Scantling Evaluation (*or *ISE)* phase. For ship-type conversions, the reassessed and renewal scantlings are calculated in the *ISE* phase, as described in Section 5A-2-2. The reassessed scantlings are the required scantlings for the site-specific location and transit condition, and are used to establish the minimum renewal scantlings of an FPI conversion. The second phase requires the performance of finite element structural analyses using either a three cargo tank-length model or cargo block-length model to validate the selected scantlings from the first phase. This is referred to as the *Total Strength Assessment (*or *TSA)* phase. For ship-type conversions, the *TSA* phase is used to validate the reassessed scantlings obtained in the *ISE* phase.

Performance of additional structural analyses can lead to the granting of the optional **DLA** classification notation, which signifies that the design meets the Dynamic Load Approach criteria. Also, the optional **SFA** classification notation can be granted, which signifies that the design satisfies fatigue strength criteria based on Spectral Fatigue Analysis.

The application of the design criteria in Part 5A, Chapter 3 to reflect the site-dependent nature of the floating offshore installation is accomplished through the introduction of a series of Environmental Severity Factors (ESFs). Reference is to be made to 5A-1-2/1 and Section 5A-3-2 for the applicable structural design and analysis criteria that have been modified to reflect site-specific service conditions.

PART 5A SHIP-TYPE INSTALLATIONS

CHAPTER 1 DESIGN CONSIDERATIONS

SECTION 2 LONGITUDINAL STRENGTH

(Revise Subsection 5A-1-2/1 and delete Paragraph 5A-1-2/1.1 as follows:)

1 Longitudinal Hull Girder Strength *(1 July 2012)*

Longitudinal strength is to be based on Section 3-2-1 of the *Steel Vessel Rules*. The required hull girder section modulus for 0.4L amidships is to be the greater of the values obtained from the following equation or the minimum section modulus SM_{min} in the table below:

$$SM = M_t/f_p \quad \text{cm}^2\text{-m (in}^2\text{-ft)}$$

where

M_t = total bending moment, as described below

f_p = nominal permissible bending stress

= 17.5 kN/cm^2 (1.784 tf/cm^2, 11.33 Ltf/in^2)

The total bending moment, M_t is to be considered as the maximum algebraic sum of the maximum still water bending moment (M_{sw}) for operation on site or in transit combined with the corresponding wave-induced bending moment (M_w) expected on-site and during transit to the installation site. Due account is to be given to the influence of mooring loads and riser weights in calculating the vertical still water bending moments and shear forces.

In lieu of directly calculated wave-induced hull girder vertical bending moments and shear forces, recourse can be made to the use of the Environmental Severity Factor (ESF) approach (see 5A-3-2/1.1 and Appendix 5A-3-A1) , which can be applied to modify the *Steel Vessel Rules* wave-induced hull girder bending moment and shear force formulas (see 5A-3-2/5.2 and 5A-3-2/5.2).

Depending on the value of the Environmental Severity Factor, β_{vbm}, for vertical wave-induced hull girder bending moment (see 5A-3-A1/3 of this Guide), the minimum hull girder section modulus, SM_{min}, of the installation, as specified in 3-2-1/3.7.1(b) of the *Steel Vessel Rules*, may vary in accordance with the following:

β_{vbm}	SM_{min}
<0.7	$0.85SM_{svr}$
0.7 to 1.0	$(0.5 + \beta_{vbm}/2)SM_{svr}$
> 1.0	SM_{svr}

Where SM_{svr} = minimum hull girder section modulus as required in 3-2-1/3.7.1(b) of the *Steel Vessel Rules*

PART 5A SHIP-TYPE INSTALLATIONS

CHAPTER 1 DESIGN CONSIDERATIONS

SECTION 3 STRUCTURAL DESIGN AND ANALYSIS OF THE HULL

3 Engineering Analysis of the Hull Structure

(Revise Paragraph 5A-1-3/3.3 as follows:)

3.3 Strength Analysis of the Hull Structure *(1 July 2012)*

For installations of 150 m (492 feet) in length and above, the required strength assessment of the hull structure is to be based on a three cargo tank length finite element model amidships where the strength assessment is focused on the results obtained from structures in the middle tank. For FPI conversions, as an alternative, a complete hull length or full cargo block length finite element model can be used in lieu of the three cargo tank length model as described in 5A-2-1/5.6. Details of the required Finite Element Method (FEM) strength analysis are indicated in 5A-3-4/11 and Appendix 5A-3-A4 of this Guide. The net scantlings used in the strength analysis of new build FPI and conversions to FPI differ as follows:

i) For new build FPI, a three cargo tank length finite element strength analysis is performed using the new build net scantlings obtained by deducting the nominal design corrosion values in 5A-3-1/Table 1 from the new build design scantlings.

ii) For FPI conversions, a three-cargo tank length, or alternatively a complete hull length or full cargo block length finite element strength analysis is performed using the reassessed net scantlings obtained by deducting the nominal design corrosion values in 5A-3-1/Table 1 from the reassessed scantlings as determined in Section 5A-2-2.

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

For installations less than 150 m (492 feet) in length, it is recommended that a Finite Element Method (FEM) analysis be performed if the installation is of double hull construction or of unusual design (see 5A-4-1/1.3.3 of this Guide). When the design is permitted to be based on site-specific environmental conditions, the load components to be used in the strength analyses can be determined using 5A-1-2/1, 5A-1-3/1 and Section 5A-3-2 of this Guide.

Generally, the strength analysis is performed to determine the stress distribution in the structure. To determine the local stress distribution in major supporting structures, particularly at intersections of two or more members, fine mesh FEM models are to be analyzed using the boundary displacements and load from the 3D FEM model. To examine stress concentrations, such as at intersections of longitudinal stiffeners with transverses and at cutouts, fine mesh 3D FEM models are to be analyzed.

The accidental load condition, where a cargo tank is flooded, is to be assessed for longitudinal strength of the hull girder consistent with load cases used in damage stability calculations.

3.5 Three Cargo Tank Length Model *(1 July 2009)*

(Revise Subparagraph 5A-1-3/3.5.1 as follows:)

3.5.1 Structural FE Model *(1 July 2012)*

The three cargo tank length FE model is considered representative of cargo and ballast tanks within the 0.4*L* amidships. The same FE model may be used for hull structures beyond 0.4*L* amidships with modifications to the hull geometry, plate and stiffener properties and the applied loads, provided that the structural configurations are considered as representative of the location under consideration. Where the tanks in the 0.4*L* amidships are of different lengths, the middle tank of the FE model is to represent the cargo tank of the greatest length.

The assessment of the hull structure to resist hull girder vertical shear loads in the forward and aft cargo block regions may be based on the midship cargo tank finite element model with modifications to the structural properties, where appropriate. The strength assessment is calculated according to Section 5A-3-4 for the load cases described in 5A-1-3/3.5.3.

For FPI conversions, reassessed net scantlings are to be used in the finite element model, and are obtained by deducting the nominal design corrosion margins from the reassessed scantlings of the structure. For FPI conversions, as an alternative, a complete hull length or full cargo block length finite element model can be used in lieu of the three cargo tank length model.

Details of the modeling, mesh size, element types used and boundary conditions are described in Appendix 5A-3-A4. Detailed local stress assessment using fine mesh models to evaluate highly stressed critical areas are to be in accordance with 5A-3-A4/21.

(Relocate existing Paragraph 5A-1-3/3.7 to new Paragraph 5A-2-1/5.6 and renumber Paragraphs 5A-1-3/3.9 and 5A-1-3/3.11 as 5A-1-3/3.7 and 5A-1-3/3.9, respectively)

(Add new Paragraph 5A-1-3/3.11 as follows:)

3.11 Renewal Scantlings *(1 July 2012)*

3.11.1 New Construction

Future steel renewals are to be based on the FPI required new build scantlings considering the wastage allowance as determined by the smaller of the % wastage allowance (see 5A-2-2/Table 1) or the allowable wastage based on buckling strength (see Appendix 5A-2-A1).

3.11.2 Conversion of Existing Vessel to FPI

Future steel renewals for FPI conversions are to be based on the FPI required scantlings, regardless of the original design renewal scheme. The process of determining the required and renewal scantlings, as described in 5A-2-2 for an FPI vessel conversion, requires a reassessment of the vessel's scantlings based on transit condition and the specific site of the installation.

PART 5A SHIP-TYPE INSTALLATIONS

CHAPTER 1 DESIGN CONSIDERATIONS

SECTION 4 DESIGN AND ANALYSIS OF OTHER MAJOR HULL STRUCTURAL FEATURES

7 Acceptance Criteria

7.1 Yielding Checks

(Revise Subparagraph 5A-1-4/7.1.1, as follows:)

7.1.1 For DEC 100-Years Return Periods, Transit 10-Year Return Period and/or North Atlantic Loads:

i) For one-stiffener spacing element size FE analysis:

f_e (Von Mises) < $0.9f_y$ plate membrane stresses at element centroid

f_{1x} (axial stress) < $0.8f_y$ bar and beam elements

f_{xy} (shear) < $0.53f_y$

ii) *(1 July 2012)* The effects of notches, stress risers and local stress concentrations are to be taken into account when considering load carrying elements. When stress concentrations are considered to be of high intensity in certain elements, the acceptable stress levels will subject to special consideration. The following guidance may be used in such circumstances.

For local detail FE model analyses (localized highly stressed area, 50 × 50 mm approximate element size):

- f_e small area < $1.25S_m f_y$
- f_{1x} element stress < $1.25S_m f_y$

(Revise Subparagraph 5A-1-4/7.1.2, as follows:)

7.1.2 For DOC (Deadweight + Maximum Functional Loads), with 1-Year Minimum Return Period Loads *(1 July 2009)*:

i) For one-stiffener spacing element size FE analysis:

$f_e < 0.7f_y$ plate membrane stresses at element centroid

$f_{1x} < 0.6f_y$ bar and beam elements

$f_{xy} < 0.4f_y$

Note: These load cases often govern for benign environmental loads.

ii) *(1 July 2012)* For local detail FE model analyses (localized highly stressed area, 50 × 50 mm approximate element size):

- f_e small area < $0.97S_m f_y$
- f_{1x} element stress < $0.97S_m f_y$

(Revise Subparagraph 5A-1-4/7.1.3, as follows:)

7.1.3 For Damaged Condition *(1 July 2009)*:

Same as above for a minimum 1-year return period, except for the following, as applicable:

i) For one-stiffener spacing element size FE analysis:

$f_e < 0.9f_y$ plate membrane stresses at element centroid

$f_e < 0.8f_y$ bar and beam elements

$f_{xy} < 0.53f_y$

ii) *(1 July 2012)* For local detail FE model analyses (localized highly stressed area, 50 × 50 mm approximate element size):

- f_e small area < $1.25S_m f_y$
- f_{1x} element stress < $1.25_m f_y$

where

S_m = 1.0 for mild steel

= 0.95 for Grade HT32 steel

= 0.908 for Grade HT36 steel

= 0.875 for Grade HT40 steel

For material grades other than the above, the allowable stresses will be specially considered.

(Revise 5A-1-4/Table 1, as follows:)

TABLE 1
Safety Factors for Fatigue Life of Hull Interface Structures *(1 July 2012)*

Importance	*Inspectable and Repairable*	
	Yes	*No*
Non-Critical	2	5
Critical	3	10

Note: "Critical" implies that failure of these structural items would result in the rapid loss of structural integrity and produce an event of unacceptable consequence.

PART 5A SHIP-TYPE INSTALLATIONS

CHAPTER 1 DESIGN CONSIDERATIONS

SECTION 6 OTHER SYSTEMS

1 Other Systems

(Revise Paragraph 5A-1-6/1.9 as follows:)

1.9 Hydrocarbon Storage in Hull Tanks *(1 July 2012)*

If the ship-type installation is designed to store hydrocarbons in hull tanks, criteria for hull storage of hydrocarbons are to meet flag and coastal state requirements and applicable international requirements. The designs for scantlings and strength for such storage tanks are to be in accordance with Part 5A, Chapter 3. See 3-5/5.9 of the *Facilities Guide* for the storage facility arrangement requirements.

5 Acceptance Criteria for the Hull Structure *(December 2008)*

5.5 Engineering Analyses of the Hull Structure

(Revise Subparagraph 5A-2-1/5.5.2, as follows:)

5.5.2 Strength Analysis of the Hull Structure *(1 July 2012)*

When the design of the hull is accepted based on the criteria in 5A-2-1/7 accounting for the on-site environmental effects, finite element structural analysis using the reassessed net scantlings is to be performed. The reassessed net scantlings are obtained by deducting the nominal design corrosion values in 5A-3-1/Table 1 from the reassessed scantlings as determined in Section 5A-2-2.

A three cargo tank length model or full cargo block model as described in 5A-1-3/3.3 may be used for finite element analyses. Finite element analyses should also be performed in areas where structural configurations or novel features are present that affect the basic hull design.

The loading conditions to be analyzed for the three cargo tank length model or cargo block/full ship model are described in 5A-1-3/3.5 and 5A-2-1/5.6, respectively.

The loads from the hull mounted top side production and support systems, and other equipment are to be included in the strength analysis. The accidental load condition, where a cargo tank is flooded, is to be assessed for longitudinal strength of the hull girder consistent with load cases used in damage stability calculations.

The additional loads and load effects of 5A-1-3/1.1 are also to be considered in the strength analysis.

(Relocate 5A-1-3/3.7 to 5A-2-1/5.6 and revise, as follows:)

5.6 Alternative Structural Model – Cargo Block or Full Length Ship Model *(1 July 2012)*

5.6.1 Structural FE Model

As an alternative to the three cargo tank length model in 5A-1-3/3.5, the finite element strength assessment for FPI conversions can be based on a full length or cargo block length of the hull structure, including all cargo and ballast tanks. All main longitudinal and transverse structural elements are to be modeled. These include outer shell, floors and girders, transverse and vertical web frames, stringers and transverse and longitudinal bulkhead structures. All plates and stiffeners on the structure, including web stiffeners, are to be modeled. Topside stools should also be incorporated in the model. The modeling mesh and element types used should follow the principles that are described in Appendices 5A-3-A4/9 and 5A-3-A4/11.

An acceptable alternative to the full length hull structure model analysis is the DLA analysis in accordance with the ABS *Guide for 'Dynamic Loading Approach' for Floating Production, Storage and Offloading (FPSO) Installations* provided that the loading conditions in 5A-2-1/5.6.2 are used.

Boundary conditions should be applied at the ends of the cargo block model for dynamic equilibrium of the structure.

The strength assessment is calculated according to the loading conditions in 5A-2-1/5.6.2 associated with each load case. The plates and stiffeners in the model are to be assessed against the yielding and buckling requirements of 5A-3-4/3 and 5A-3-4/5, respectively.

Detailed local stress assessment using fine mesh models to evaluate highly stressed critical areas are to be in accordance with Appendix 5A-3-A4/21.

5.6.2 Loading Conditions

In the strength analyses of the cargo block or full ship length model, the static on site FPI operating load cases are to be established to provide the most severe loading of the hull girder and the internal tank structures. The operating load cases found in the Loading Manual and Trim & Stability Booklet provide the most representative loading conditions to be considered for analysis. The static load cases should include as a minimum tank loading patterns resulting in the following conditions:

i) Ballast or minimum draft condition after offloading

ii) Partial load condition (33% full)

iii) Partial load condition (50% full)

iv) Partial load condition (67% full)

v) Full load condition before offloading

vi) Transit load condition

vii) Inspection and repair conditions

viii) Tank testing condition – during conversion and after construction (periodic survey)

The tank testing condition is to be considered as a still water condition. The static load cases *i)* to *vii)* are to be combined with environmental loading conditions to develop static plus dynamic load cases that realistically reflect the maximum loads for each component of the structure.

5.6.3 Dynamic Loading

Hydrodynamic loading analysis of a full length model of the FPI hull in the static load conditions is to be carried out using a recognized vessel motions and loads hydrodynamic seakeeping software. In quantifying the dynamic loads, it is necessary to consider a range of wave environments and headings at the installation site, which produce the considered critical responses of the FPI structure. The maximum 100-year design response is to be determined based on the motion and structural load effects from 3-2-3/3.1. The static and dynamics of the position mooring and topside module loads contribution shall also be included.

Wave loads are to be determined based on an equivalent design wave approach where an equivalent design wave is defined as a regular wave that gives the same response level as the maximum design response for a specific response parameter. The equivalent design wave is characterized by wave amplitude, wave length, wave heading, and wave crest position referenced to amidships of the hull structure. This maximum design response parameter or Dominant Load Parameter is to be determined for the site-specific environment with a 100-year return period, transit environment with a 10-year return period, and inspection and repair condition with a 1-year return period. In selecting a specific response parameter to be maximized, all of the simultaneously occurring dynamic loads induced by the wave are also derived. These simultaneous acting dynamic load components and static loads, in addition to the quasi-static equivalent wave loads, are applied to the cargo block model. The Dominant Load Parameters essentially refer to the load effects, arising from vessel motions and wave loads, that yield the maximum structural response for critical structural members. Each set of Dominant Load Parameters with equivalent wave and wave-induced loads represents a load case for structural FE analysis.

The wave amplitude of the equivalent design wave is to be determined from the maximum design response of a Dominant Load Parameter (DLP) under consideration divided by the maximum RAO amplitude of that DLP. RAOs are to be calculated using a range of wave headings and periods. The maximum RAO occurs at a specific wave frequency and wave heading where the RAO has its own maximum value. The equivalent wave amplitude for a DLP may be expressed by the following equation:

$$a_w = \frac{R_{\max}}{RAO_{\max}}$$

where

a_w = equivalent wave amplitude of the DLP

R_{max} = maximum response of the DLP

RAO_{max} = maximum RAO amplitude of the DLP

The following DLPs are identified as necessary to develop the load cases for the hull structure:

- Vertical bending moment – sag and hog
- Vertical shear force
- Horizontal bending moment
- Horizontal shear force
- Vertical acceleration
- Lateral acceleration
- Roll angle

Vertical bending moment and shear force are to be evaluated in way of an internally mounted mooring turret. Accelerations are to be determined at a sufficient number of process equipment locations to represent accurately the load effects arising from their motion. As appropriate, roll angle calculations may include simultaneous effects of waves and winds.

Other DLPs that may be deemed critical can also be considered in the analysis. The need to consider other DLPs or additional DLPs is to be determined in consultation with ABS.

5.6.4 Load Cases

Load cases are derived based on the above static and dynamic loading conditions, and DLPs. For each load case, the applied loads to be developed for structural FE analysis are to include both the static and dynamic parts of each load component. The dynamic loads represent the combined effects of a dominant load and other accompanying loads acting simultaneously on the hull structure, including external wave pressures, internal tank pressures, deck loads and inertial loads on the structural components and equipment. For each load case, the developed loads are then used in the FE analysis to determine the resulting stresses and other load effects within the FPI hull structure.

7 Assessing the Design of the Hull Structure *(December 2008)*

(Revise Paragraph 5A-2-1/7.1, as follows:)

7.1 General *(1 July 2012)*

The FPI conversion approach relies on a review of the hull's design. The review consists of an assessment of the hull girder strength and cargo region scantling review including main supporting members, local plating and stiffeners that directly contribute to the hull girder strength.

Two major purposes for this review are to assess the adequacy of the hull girder and local strength, and to "benchmark" the values upon which local scantling renewals are to be based for future in-service surveys. For this latter purpose, several approaches which can be applied are listed in 5A-2-1/7.3.

An existing vessel can be sorted into one of three basic categories, as follows.

a. Vessel satisfies ABS Rules from its original classification [✠ Maltese Cross in the classification symbol and not accepted under 1-1-4/7.5 of the ABS *Rules for Conditions of Classification (Part 1)*]. *Note:* ABS Rules also includes IACS Common Structural Rules for Double Hull Oil Tankers (ABS *Steel Vessel Rules* Part 5A) *b.* Vessel currently classed by an IACS member or taken into ABS classification under 1-1-4/7.5 of the ABS *Rules for Conditions of Classification (Part 1).*

c. Vessel was never classed by an IACS member.

A vessel in category (*a*) or (*b*) can be considered for an FPI conversion. The acceptance criteria to be applied to a category (*c*) vessel will based on special consideration determined in consultation with ABS.

(Revise Paragraph 5A-2-1/7.3, as follows:)

7.3 Hull Design Review Acceptance Criteria *(1 July 2012)*

The review of the design of an existing hull structure, which is applicable to a vessel classed for unrestricted service, does not account for the increased or reduced local structural element strength requirements that could result from the long-term, moored operation of the installation at an offshore site. The approach to the design review also allows variations in the acceptance criteria that can be based on:

i) ABS Rules from the year of build of the vessel with ABS permissible corrosion limits for renewal; or

ii) ABS current Rules with ABS permissible corrosion limits for renewal; or

iii) The prior IACS member's approved scantlings (or as-built values) using that society's permissible corrosion limits for renewal. However the permissible corrosion limits for the longitudinal members are to be based on ABS limits for the year of build of the vessel if the IACS member society's limits are greater.

When the acceptance criteria is based on *i)*, *ii)* or *iii)*, the renewal scantlings for plates and stiffeners in the deck and bottom structure, within 0.15 Depth from deck and bottom, and for plates in side shell and longitudinal bulkheads must be established at the time of conversion. The allowable material diminution of these plates and stiffeners is to be based on the smaller of:

a) The wastage allowance based on *i), ii)* or *iii)*, or

b) The allowable wastage based on buckling strength. The allowable wastage based on buckling strength is to apply to these plates and stiffeners subject to hull girder bending and shear stresses as required by Appendix 5A-2-A1. When the acceptance criteria are based on *iii)*, the IACS member's allowable wastage based on buckling considerations may be used.

The combination of the variety of ways to review local scantlings and the permissibility to account for site-dependent effects on global and local hull structural strength requirements can lead to a range of acceptable procedures.

If it is desired to account for the on-site environmental effects and how these affect the required scantlings, it will be necessary to establish the required renewal scantlings on this basis. This results in a reassessment of the hull structure design to establish the converted structure's renewal scantlings. The acceptance criteria for the hull structure are defined in 5A-2-1/5.

PART 5A SHIP-TYPE INSTALLATIONS

CHAPTER 2 ADDITIONAL DESIGN CONSIDERATIONS FOR CONVERSIONS TO FPI

SECTION 2 STEEL RENEWAL ASSESSMENT

(Revise 5A-2-2/Table 1 as follows:)

TABLE 1
Individual Wastage Allowances, Newbuilds and Vessels Converted to FPI, 90 meters and Over (1, 2, 3) *(1 July 2012)*

Ordinary and High Strength Steel	*Newbuilds or Vessels Converted 2009 or Later*		*Vessels Converted before 2009*	
	Double Bottom	*Single Bottom with Single Side or Double Side*	*Double Bottom*	*Single Bottom with Single Side or Double Side*

(Remainder of table and notes are unchanged.)

PART 5A SHIP-TYPE INSTALLATIONS

CHAPTER 3 STRUCTURAL DESIGN REQUIREMENTS

SECTION 1 GENERAL

1 Design Considerations and General Requirements

(Revise title of Paragraph 5A-3-1/1.7, Subparagraph 5A-3-1/1.7.1, and 5A-3-1/Table 1 and add new Subparagraph 5A-3-1/1.7.2, as follows:)

1.7 Net Scantlings and Nominal Design Corrosion Values (NDCV) *(1 July 2012)*

1.7.1 General

The "net" thickness or scantlings correspond to the minimum strength in Part 5A, Chapter 3 regardless of the design service life of the installation. In addition to the coating protection specified in the Rules for all ballast tanks, minimum corrosion values for plating and structural members as given in 5A-3-1/Table 1 and 5A-3-1/Figure 1 are to be added to the net scantlings. These minimum corrosion values are intended for a design service life of 20 years. Where the design life is greater than 20 years, the minimum corrosion values of the hull structure are to be increased in accordance with 5A-3-1/1.7.2. These minimum values are introduced solely for the purpose of scantling requirements and strength criteria as indicated in 5A-3-1/1.1, and are not to be interpreted as renewal standards.

In view of the anticipated higher corrosion rates for structural members in some regions, such as highly stressed areas, additional design margins should be considered for the primary and critical structural members to minimize repairs and maintenance costs. The beneficial effects of these design margins on reduction of stresses and increase of the effective hull girder section modulus can be appropriately accounted for in the design evaluation.

1.7.2 Nominal Design Corrosion Values for Design Life Greater than 20 Years

When the structural design life is greater than 20 years, the nominal design corrosion values (NDCV) of the hull structure are to be increased from those in 5A-3-1/Table 1 as follows:

1.7.2(a) For plating and structural members with 2.0 mm (0.08 in.) NDCV for 20-years design life, additional 0.1 mm (0.004 in.) per year for design life greater than 20-years. For example, 2.5 mm (0.1 in.) NDCV for 25-year design life.

1.7.2(b) For plating and structural members with 1.5 mm (0.06 in.) NDCV for 20-years design life, additional 0.075 mm (0.003 in.) per year for design life greater than 20-years. For example, 1.875 mm (0.075 in.) NDCV for 25-year design life.

1.7.2(c) For plating and structural members with 1.0 mm (0.04 in.) NDCV for 20-years design life, additional 0.05 mm (0.002 in) per year for design life greater than 20-years. For example, 1.25 mm (0.05 in.) NDCV for 25-year design life.

1.7.2(d) For void spaces, no change in NDCV as it is considered independent of design life.

The NDCV values are to be considered minimum nominal design corrosion values. Actual corrosion could be more or less than the NDCV values. The designer or owner may specify additional design corrosion margins based on maintenance plans.

Note: Local allowable wastage allowance of plates and stiffeners for floating installations designed for uninterrupted operation on-site without any drydocking and having a design life longer than 20 years is described in 7-2-6/3.1.10.

The rounding of the calculated thickness is to be the nearest half millimeter. For example:

- For 10.75 ≤ t_{calc} < 11.25 mm, the required thickness is 11 mm
- For 11.25 ≤ t_{calc} < 11.75 mm, the required thickness is 11.5 mm

When the difference between the required net thickness and the offered net thickness is less than 0.25 mm, the offered net thickness is acceptable if the rounded required gross thickness is smaller or equal to the offered gross thickness.

For US customary unit system, a similar exercise is to be carried out as described in the above for the Metric unit system.

TABLE 1
Nominal Design Corrosion Values (NDCV) *(1 July 2012)*

Structural Element/Location		*Nominal Design Corrosion Values in mm (in.)*		
		Cargo Tank	*Ballast Tank Effectively Coated*	*Void Space*
Deck Plating		1.0 (0.04)	2.0 (0.08)	1.0 (0.04)
Side Shell Plating		NA	1.5 (0.06)	1.0 (0.04)
Bottom Plating		NA	1.0 (0.04)	1.0 (0.04)
Inner Bottom Plating		1.5 (0.06)		1.0 (0.04)
Longitudinal Bulkhead Plating	Between cargo tanks	1.0 (0.04)	N.A.	1.0 (0.04)
	Other Plating	1.5 (0.06)		1.0 (0.04)
Transverse Bulkhead Plating	Between cargo tanks	1.0 (0.04)	N.A.	1.0 (0.04)
	Other Plating	1.5 (0.06)		1.0 (0.04)
Transverse & Longitudinal Deck Supporting Members		1.5 (0.06)	2.0 (0.08)	1.0 (0.04)
Double Bottom Tanks Internals (Floors and Girders)		N.A.	2.0 (0.08)	1.0 (0.04)[5]
Double Bottom Tanks Internals (Stiffeners)		N.A.	2.0 (0.08)	1.0 (0.06)
Vertical Stiffeners and Supporting Members Elsewhere		1.0 (0.04)	1.0 (0.04)	1.0 (0.04)
Non-vertical Longitudinals/Stiffeners and Supporting Members Elsewhere		1.5 (0.06)	2.0 (0.08)	1.0 (0.04)

Notes:

1. It is recognized that corrosion depends on many factors including coating properties, cargo composition, inert gas properties and temperature of carriage, and that actual wastage rates observed may be appreciably different from those given here.
2. Pitting and grooving are regarded as localized phenomena and are not covered in this table.
3. For nominal design corrosion values for single hull ship-type installations, see Section 5A-3-6.
4. *(1 July 2012)* Side stringer plating in Void Space: Watertight adjacent to ballast tank 1.5 mm (0,06), Non-Tight: 1.0 mm (0.04).
5. *(1 July 2012)* Watertight bottom girder adjacent to ballast tank: 1.5 mm (0.06).

1.9 Application *(1 July 2012)*

(Delete Subparagraph 5A-3-1/1.9.4.)

PART 5A SHIP-TYPE INSTALLATIONS

CHAPTER 3 STRUCTURAL DESIGN REQUIREMENTS

SECTION 2 LOADS

5 Wave-induced Loads

(Relocate Paragraph 5A-1-2/1.1 to new Subparagraphs 5A-3-2/5.2.1 through 5A-3-2/5.2.3, as follows:)

5.2 Vertical Wave Bending Moment and Shear Force *(1 July 2012)*

5.2.1 Wave Bending Moment Amidships

The wave bending moment, expressed in kN-m (tf-m, Ltf-ft), may be obtained from the following equations.

$$M_{ws} = -k_1 \beta_{VBM} C_1 L^2 B(C_b + 0.7) \times 10^{-3} \qquad \text{Sagging Moment}$$

$$M_{wh} = +k_2 \beta_{VBM} C_1 L^2 B C_b \times 10^{-3} \qquad \text{Hogging Moment}$$

where

k_1 = 110 (11.22, 1.026)

k_2 = 190 (19.37, 1.772)

β_{VBM} = ESF for vertical bending moment

$$C_1 = 10.75 - \left(\frac{300 - L}{100}\right)^{1.5} \qquad 90 \le L \le 300 \text{ m}$$

$$= 10.75 \qquad 300 < L \le 350 \text{ m}$$

$$= 10.75 - \left(\frac{L - 350}{150}\right)^{1.5} \qquad 350 \le L \le 500 \text{ m}$$

$$C_1 = 10.75 - \left(\frac{984 - L}{328}\right)^{1.5} \qquad 295 \le L \le 984 \text{ ft}$$

$$= 10.75 \qquad 984 < L < 1148 \text{ ft}$$

$$= \quad 10.75 - \left(\frac{L-1148}{492}\right)^{1.5} \qquad 1148 \le L \le 1640 \text{ ft}$$

L = length of vessel, as defined in 3-1-1/3.1 of the *Steel Vessel Rules*, in m (ft)

B = breadth of vessel, as defined in 3-1-1/5 of the *Steel Vessel Rules*, in m (ft)

C_b = block coefficient, as defined in 3-1-1/11.3 of the *Steel Vessel Rules*

5.2.2 Envelope Curve of Wave Bending Moment

The wave bending moment along the length, L, of the vessel*,* may be obtained by multiplying the midship value by the distribution factor, M, given in 5A-3-2/Figure 2.

5.2.3 Wave Shear Force

The envelopes of maximum shearing forces induced by waves, F_w, as shown in 5A-3-2/Figure 3 and 5A-3-2/Figure 4, may be obtained from the following equations.

$$F_{wp} = +k\,\beta_{VSF}\,F_1 C_1 L\,B\,(C_b + 0.7) \times 10^{-2} \qquad \text{for positive shear force}$$

$$F_{wn} = -k\,\beta_{VSF}\,F_2 C_1 L\,B\,(C_b + 0.7) \times 10^{-2} \qquad \text{for negative shear force}$$

where

F_{wp}, F_{wn} = maximum shearing force induced by wave, in kN (tf, Ltf)

C_1 = as defined in 5A-3-2/5.2.1

β_{VSF} = ESF for vertical shear force

L = length of vessel, as defined in 3-1-1/3.1 of the *Steel Vessel Rules*, in m (ft)

B = breadth of vessel, as defined in 3-1-1/5 of the *Steel Vessel Rules*, in m (ft)

C_b = block coefficient, as defined in 3-1-1/11.3 of the *Steel Vessel Rules*

k = 30 (3.059, 0.2797)

F_1 = distribution factor, as shown in 5A-3-2/Figure 3

F_2 = distribution factor, as shown in 5A-3-2/Figure 4

(Relocate 5A-1-2/Figures 1 through 4 to new 5A-3-2/Figures 2 through 5, as follows:)

FIGURE 1
Sign Convention *(1 July 2012)*

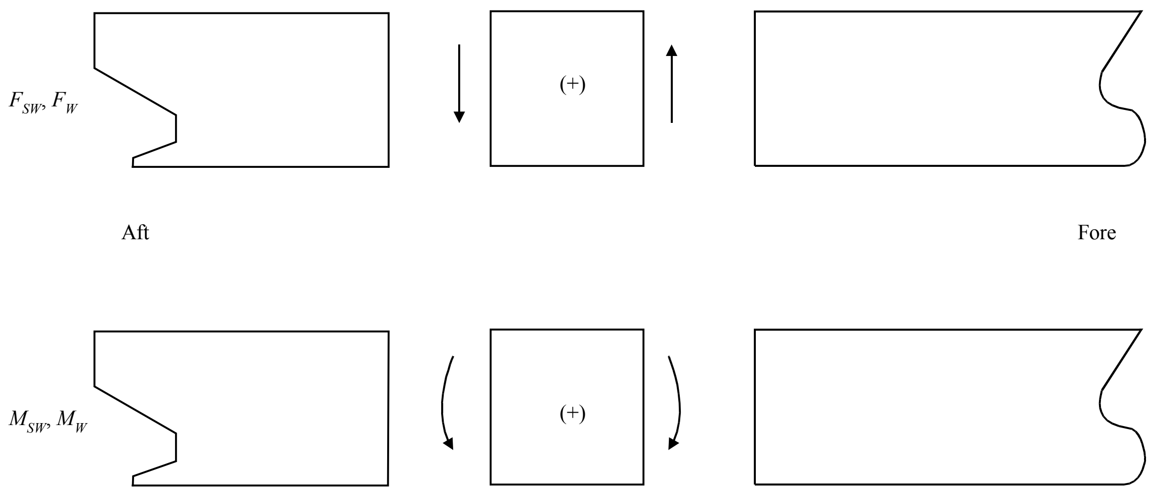


FIGURE 2
Distribution Factor *M* (1 July 2012)

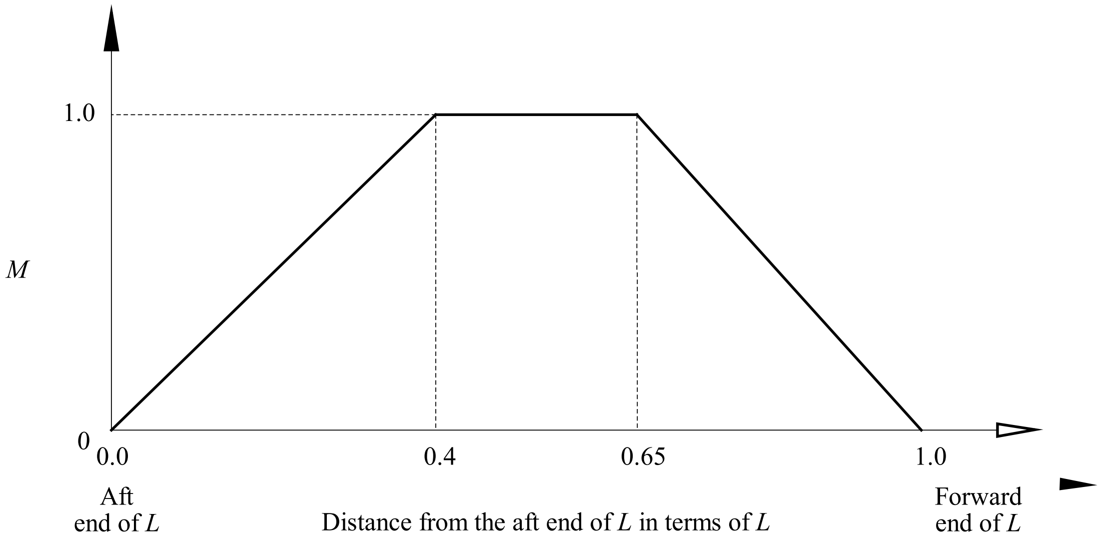


FIGURE 3
Distribution Factor F_1 (1 July 2012)

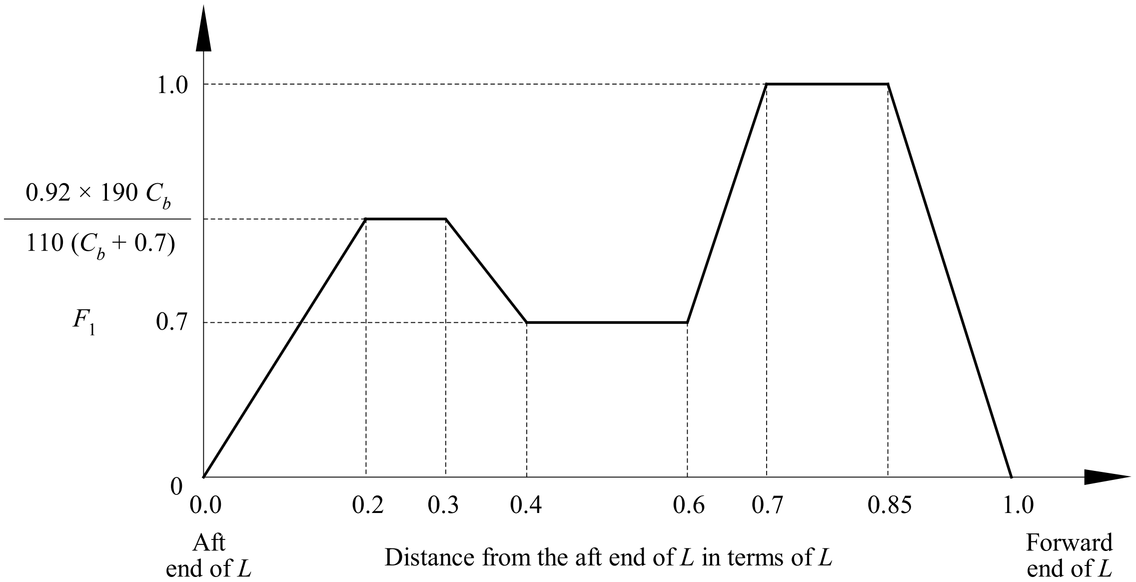
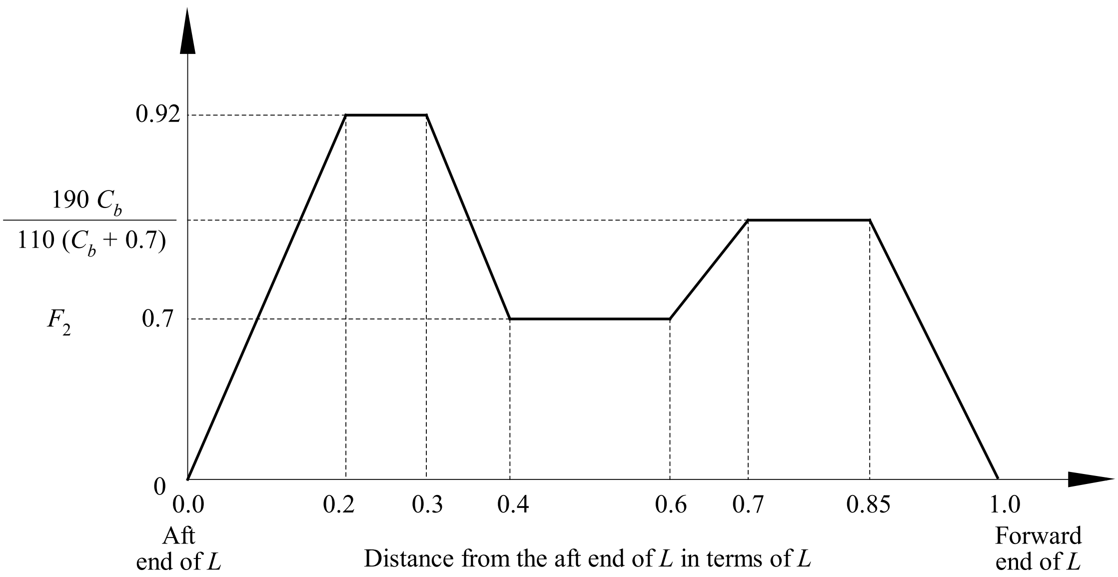


FIGURE 4
Distribution Factor F_2 *(1 July 2012)*



(Renumber existing 5A-3-2/Figure 2 through 5A-3-2/Figure 18 as 5A-3-2/Figure 6 through 5A-3-2/Figure 22.)

13 Impact Loads

(Revise first paragraph of Paragraph 5A-3-2/13.3 as follows:)

13.3 Bottom Slamming *(1 July 2012)*

For ship-type installations with heavy weather ballast draft forward less than 0.04L, bottom slamming loads are to be considered for assessing strength of the flat of bottom plating forward and the associated stiffening system in the fore body region.

(Subparagraph 5A-3-2/13.3.1 remains unchanged.)

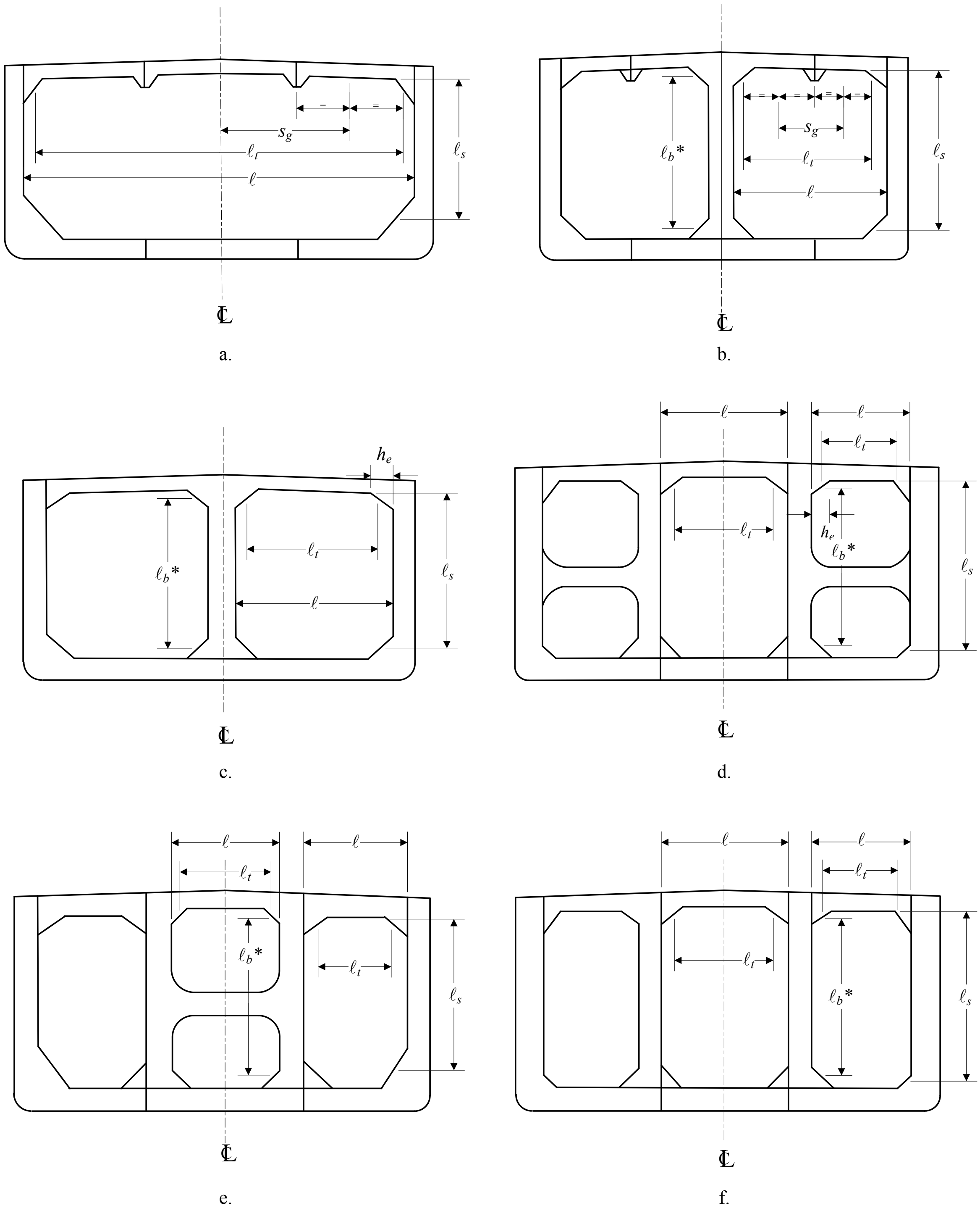
PART 5A **SHIP-TYPE INSTALLATIONS**

CHAPTER 3 **STRUCTURAL DESIGN REQUIREMENTS**

SECTION 3 **INITIAL SCANTLING EVALUATION**

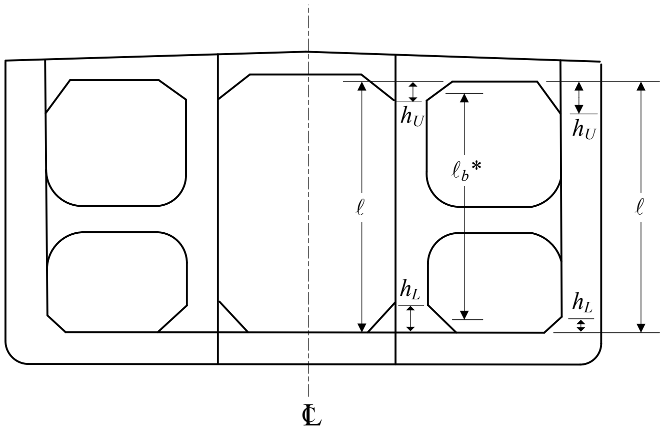
(Revise 5A-3-3/Figure 2A and 5A-3-3/Figure 2B as follows:)

FIGURE 2A
Definitions of Spans (A) *(1 July 2012)*

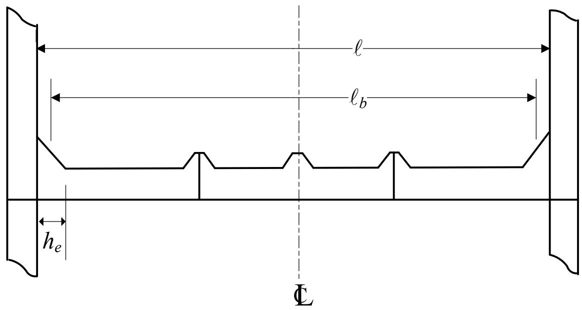


* Where both lower and upper ends of the vertical web are fitted with a bracket of the same or larger size on the opposite side, the span ℓ_b may be taken between the toes of the effective lower and upper brackets.

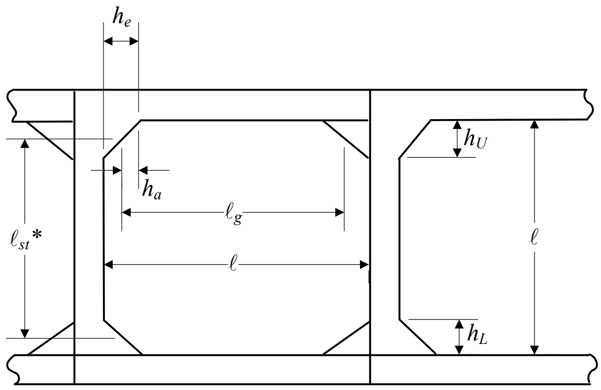
FIGURE 2B
Definitions of Spans (B) *(1 July 2012)*



a. Side Transverse and Vertical Web on Longitudinal Bulkhead



b. Horizontal Girder on Transverse Bulkhead



c. Deck Girder and Vertical Web on Transverse Bulkhead

* Where both lower and upper ends of the vertical web are fitted with a bracket of the same or larger size on the opposite side, the span ℓ_b or ℓ_{st} may be taken between the toes of the effective lower and upper brackets.

3 Hull Girder Strength

(Revise Paragraphs 5A-3-3/3.1 and 5A-3-3/3.3 as follows:)

3.1 Hull Girder Section Modulus *(1 July 2012)*

3.1.1 Hull Girder Section Modulus Amidships

The required hull girder section modulus amidships is to be calculated in accordance with 5A-1-2/1 of this Guide and 3-2-1/3.7, 3-2-1/5 and 3-2-1/9 of the *Steel Vessel Rules*. For the assessment of ultimate strength as specified in 5A-3-3/3.5 and the determination of initial net structural scantlings, the net hull girder section modulus amidships, SM_n, is to be calculated in accordance with 5A-3-3/3.1.2 below.

3.1.2 Effective Longitudinal Members

The hull girder section modulus calculation is to be carried out in accordance with 3-2-1/9 of the *Steel Vessel Rules*, as modified below. To suit the strength criteria based on a "net" ship concept, the nominal design corrosion values specified in 5A-3-1/Table 1 are to be deducted in calculating the net section modulus, SM_n.

3.1.3 Extent of Midship Scantlings

The items included in the hull girder section modulus amidships are to be extended as necessary to meet the hull girder section modulus required at the location being considered. The required hull girder section modulus can be obtained as M_t/f_p at the location being considered except if $(M_t)_{max}/f_p$ is less than SM_{min} in 5A-1-2/1. In this case, the required section modulus is to be obtained by multiplying SM_{min} by the ratio of $M_{ti}/(M_t)_{max}$ where M_{ti} is the total bending moment at the location under consideration and $(M_t)_{max}$ is the maximum total bending moment amidships.

3.3 Hull Girder Moment of Inertia *(1 July 2012)*

The hull girder moment of inertia, I, amidships, is to be not less than:

$$I = L \cdot SM/33.3 \quad \text{cm}^2\text{-m}^2 \ (\text{in}^2\text{-ft}^2)$$

where

L = length of installation, as defined in 3-1-1/3.1 of the *Steel Vessel Rules*, in m (ft)

SM = required hull girder section modulus, in cm^2-m (in^2-ft). See 5A-1-2/1.

9 Side Shell and Deck – Plating and Longitudinals

(Revise Paragraph 5A-3-3/9.3, as follows:)

9.3 Deck Plating *(1 July 2012)*

(Preceding text remains unchanged.)

The t_3 requirement for a converted ship-type FPI may be adjusted based on the ratio M_r, where M_r = total maximum sagging bending moment as a ship-type FPI/total maximum sagging bending moment as a trading vessel. The total sagging bending moment as a ship-type FPI is the sum of the maximum sagging still water and wave bending moments for the onsite condition. The sagging wave bending moment may be obtained from 5A-3-2/5.2.1.

(Following text remains unchanged.)

11 Side Shell and Deck – Main Supporting Members

(Revise Paragraph 5A-3-3/11.1, as follows:)

11.1 General *(1 July 2012)*

The main supporting members, such as transverses and girders, are to be arranged and designed with sufficient stiffness to provide support to the installation's hull structures. In general, the deck transverses, side transverses and bottom floors are to be arranged in one plane to form continuous transverse rings. Deck girders, where fitted, are to extend throughout the cargo tank spaces and are to be effectively supported at the transverse bulkheads.

Generous transitions are to be provided at the intersections of main supporting members to provide smooth transmission of loads and to minimize the stress concentrations. Abrupt changes in sectional properties and sharp re-entrant corners are to be avoided. It is recommended that the intersection of the inner skin and inner bottom be accomplished by using generous sloping or large radiused bulkheads. Stool structures, where fitted, are to have sloping bulkheads on both sides.

The net section modulus and sectional area of the main supporting members required by Part 5A, Chapter 3 apply to those portions of the member clear of the end brackets. They are considered as the requirements of initial scantlings for deck transverses, side transverses, vertical webs on longitudinal bulkheads and horizontal girders and vertical webs on transverse bulkheads, and may be reduced, provided that the strength of the resultant design is verified with the subsequent total strength assessment in Section 5A-3-4. However, in no case should they be taken less than 85% of those determined from 5A-3-3/11 or 5A-3-3/15. (See also 5A-3-4/11.1.) The structural properties of the main supporting members and end brackets are to comply with the failure criteria specified in 5A-3-4/3.

The section modulus of the main supporting members is to be determined in association with the effective plating to which they are attached, as specified in 3-1-2/13 of the *Steel Vessel Rules*.

In the calculation of the nominal pressure, ρg of the liquid cargoes is not to be taken less than 0.1025 kgf/cm^2-m (0.4444 lbf/in^2-ft) for main supporting members.

Section modulus and web sectional area of the deck transverses and deck girders may be obtained in accordance with the procedure given below or other recognized design procedures.

The section modulus and web sectional area of the deck transverse and deck girders are not to be less than loading pattern 1 as specified in 5A-3-3/11.3.

For a deck transverse and/or deck girder that is subjected to reactions (forces and moments) from the topside structure, the section modulus and web sectional area of the deck transverse and/or deck girders are also not to be less than for loading pattern 1 as specified in 5A-3-3/11.3 and for loading pattern 2 as specified in 5A-3-3/11.5.

(Delete existing Paragraphs 5A-3-3/11.3 and 5A-3-3/11.5 and replace, as follows:)

11.3 Deck Transverses and Deck Girders – Loading Pattern 1 *(1 July 2012)*

11.3.1 Section Modulus of Deck Transverses

The net section modulus of deck transverses is to be not less than obtained from the following equation (see also 5A-3-3/1.3 of this Guide):

$$SM = M/f_b \qquad \text{cm}^3\ (\text{in}^3)$$

For deck transverses in wing cargo tanks (See 5A-3-3/Figure 2A-a, b, c, d, e, and f):

$$M = k(10{,}000\, c_1 \varphi\, ps\, \ell_t^2 + \beta_s M_s) \geq M_o \qquad \text{N-cm (kgf-cm, lbf-in)}$$

For deck transverses in center cargo tanks (see 5A-3-3/Figure 2A-d, e and f)

$$M = k(10{,}000\, c_1 \varphi\, ps\, \ell_t^2 + \beta_b M_b) \geq M_o \qquad \text{N-cm (kgf-cm, lbf-in)}$$

where

M_s = $10{,}000 c_2 p_s s \ell_s^2$

M_b = $10{,}000 c_2 p_b s \ell_b^2$

M_o = $10{,}000 k c_3 p s \ell_t^2$

k = 1.0 (1.0, 0.269)

p = nominal pressure, in kN/m^2 (tf/m^2, Ltf/ft^2), at the mid span of the deck transverse under consideration, as specified in 5A-3-2/Table 3, item 16. In no case is p to be taken less than 2.06 N/cm^2 (0.21 kgf/cm^2, 2.987 lbf/in^2).

p_s = corresponding nominal pressure, in kN/m^2 (tf/m^2, Ltf/ft^2), at the mid-span of the side transverse (5A-3-2/Table 3, item 12)

p_b = corresponding nominal pressure, in kN/m^2 (tf/m^2, Ltf/ft^2), at the mid-span of the vertical web on longitudinal bulkhead (5A-3-2/Table 3, item 13)

c_1 for tanks without deck girders:

= 0.30 for 5A-3-3/Figure 2A-c with non-tight centerline bulkhead

= 0.42 for all other cases

c_1 for tanks with deck girders:

= $0.30\alpha^2$ for 5A-3-3/Figure 2A-b with a non-tight centerline bulkhead, 0.05 min. and 0.30 max.

= $0.42\alpha^2$ for 5A-3-3/Figure 2A-a or 5A-3-3/Figure 2A-b with an oil-tight centerline bulkhead, 0.05 min. and 0.42 max.

α = $(\ell_g/\ell_t)[(s_g/s)(I_t/I_g)]^{1/4}$

ℓ_g = span of the deck girder, in m (ft), as indicated in 5A-3-3/Figure 2B-c

ℓ_t = span of the deck transverse, in m (ft), as indicated in 5A-3-3/Figure 2A, but is not to be taken as less than 60% of the breadth of the tank, except for ship-type vessels with a non-tight centerline bulkhead (5A-3-3/Figure 2A-b), for which the span is not to be taken as less than 30% of the breadth of the tank.

I_g, I_t = moments of inertia, in cm^4 (in^4), of the deck girder and deck transverse, clear of the brackets, respectively

s_g = spacing of the deck girder, in m (ft)

s = spacing of the deck transverses, in m (ft)

When calculating α, if more than one deck girder is fitted, average values of s_g, ℓ_g and I_g are to be used when the girders are not identical.

φ = $1 - [5(h_a/\alpha\ell_t)]$, for cargo tanks with deck girders, 0.6 minimum

= $1 - 5(h_a/\ell_t)$, for cargo tanks without deck girders, 0.6 minimum

h_a = distance, in m (ft), from the end of the span to the toe of the end bracket of the deck transverse, as indicated in 5A-3-3/Figure 8

β_s = $0.9[(\ell_s/\ell_t)(I_t/I_s)]$, 0.10 min. and 0.65 max.

β_b = $0.9[(\ell_b/\ell_t)(I_t/I_b)]$, 0.10 min. and 0.50 max.

ℓ_s, ℓ_b = spans, in m (ft), of side transverse and vertical web on longitudinal bulkhead, respectively, as indicated in 5A-3-3/Figure 2A. Where a cross tie is fitted and is located at a distance greater than $0.7\ell_s$ or $0.7\ell_b$ from the deck transverse, the effective span of the side transverse or the vertical web may be taken as that measured from the deck transverse to the cross tie and all coefficients determined as if there were no cross tie.

I_s, I_b = moments of inertia, in cm^4 (in^4), clear of the brackets, of side transverse and vertical web on longitudinal bulkhead, respectively

f_b = permissible bending stress, in N/cm^2 (kgf/cm^2, lbf/in^2)

= $0.70\, S_m f_y$

S_m and f_y, as defined in 5A-3-3/7.3.1.

c_2 is given in 5A-3-3/Table 1.

c_3 = $2.0c_1$ for ship-type vessels with oil-tight longitudinal bulkheads and without deck girders (5A-3-3/Figure 2A-c, d, e and f)

= $1.6c_1$ for ship-type vessels with non-tight centerline longitudinal bulkhead and without deck girders (5A-3-3/Figure 2A-c)

= $1.1c_1$ for cargo tanks with deck girders

The section modulus of the deck transverse in the wing cargo tank is to be not less than that of the deck transverse in the center tank.

11.3.2 Sectional Area of Deck Transverses

The net sectional area of the web portion of deck transverses is to be not less than obtained from the following equation:

$A = F/f_s$ cm^2 (in^2)

$F = 1000k[c_1ps(0.50\ell - h_e) + c_2DB_c s]$ N (kgf, lbf)

where

k = 1.0 (1.0, 2.24)

c_2 = 0.05 for wing cargo tanks of ship-type vessels with four longitudinal bulkheads (5A-3-3/Figure 2A-d, e and f)

= 0 for other tanks (5A-3-3/Figure 2A-a, b, c, d, e and f)

c_1 for tanks with deck girders:

= $0.90\alpha^{1/2}$ for 5A-3-3/Figure 2A-a without longitudinal bulkhead and for 5A-3-3/Figure 2A-b with an oil-tight centerline bulkhead, 0.50 min. and 1.0 max.

= $0.60\alpha^{1/2}$ for 5A-3-3/Figure 2A-b with a non-tight centerline bulkhead, 0.45 min. and 0.85 max.

c_1 for tanks without deck girders:

= 1.10 for 5A-3-3/Figure 2A-c, with a nontight centerline longitudinal bulkhead

= 1.30 for all other cases (5A-3-3/Figure 2A-c, d, e and f)

ℓ = span of the deck transverse, in m (ft), as indicated in 5A-3-3/Figure 2A

h_e = length of the bracket, in m (ft), as indicated in 5A-3-3/Figure 2A-c and 5A-3-3/Figure 2A-d and 5A-3-3/Figure 8

D = depth of the vessel, in m (ft), as defined in 3-1-1/7 of the *Steel Vessel Rules*

B_c = breadth of the center tank, in m (ft)

P, s and α are as defined in 5A-3-3/11.3.1 of this Guide.

f_s = permissible shear stress, in N/cm^2 (kgf/cm^2, lbf/in^2)

= $0.45\ S_m f_y$

S_m and f_y, as defined in 5A-3-3/7.3.1 of this Guide.

11.3.3 Section Modulus of Deck Girders

The net section modulus of deck girders is to be not less than obtained from the following equation (see also 5A-3-3/1.3):

$SM = M/f_b$ cm^3 (in^3)

M equals M_1 or M_2, whichever is greater, as given below:

M_1 = $4200kps_g \ell_g^2$ N-cm (kgf-cm, lbf-in)

M_2 = $k(3000\varphi ps_g \ell_g^2 + 0.15M_b)$ N-cm (kgf-cm, lbf-in)

M_b = $10{,}000p_{st} s_g \ell_{st}^2$ N-cm (kgf-cm, lbf-in)

where

k = 1.0 (1.0, 0.269)

ℓ_g = span, in m (ft), of the deck girder, as indicated in 5A-3-3/Figure 2B-c

ℓ_{st} = span, in m (ft), of the vertical web on transverse bulkhead, as indicated in 5A-3-3/Figure 2B-c

s_g = spacing, in m (ft), of the deck girder considered, as indicated in 5A-3-3/Figure 2A

φ = $1 - 5(h_a/\ell_g)$, 0.6 min.

h_a = distance, in m (ft), from the end of the span to the toe of the end bracket of the deck girder, as indicated in 5A-3-3/Figure 2B-c and 5A-3-3/Figure 9

p = nominal pressure, in kN/m^2 (tf/m^2, Ltf/ft^2), as specified in 5A-3-2/Table 3, item 17 for the girder considered. Where three or more deck girders are fitted in the cargo tank, p is to be not less than its value determined for the outermost girder clear of the end bracket of the deck transverse. In no case is p to be taken less than 2.06 N/cm^2 (0.21 kgf/cm^2, 2.987 lbf/in^2).

p_{st} = corresponding nominal pressure, in kN/m^2 (tf/m^2, Ltf/ft^2), at the mid-span of the vertical web on the forward transverse bulkhead of cargo tank under consideration (5A-3-2/Table 3, item 17)

f_b = permissible bending stress, in N/cm^2 (kgf/cm^2, lbf/in^2)

= $0.45\ S_m f_y$

= $(1.0 - 0.55\alpha_2 SM_{RD}/SM_D)S_m f_y \le 0.52 S_m f_y$ for $L < 190$ m

S_m and f_y, as defined in 5A-3-3/7.3.1 of this Guide.

11.3.4 Sectional Area of Deck Girders

The net sectional area of the web portion of deck girders is to be not less than obtained from the following equation:

$A = F/f_s$ cm^2 (in^2)

$F = 1000kcps_g(0.5\ell - h_e)$ N (kgf, lbf)

where

k = 1.0 (1.0, 2.24)

c = 0.55 for one or two girders in the tank

= 0.67 for three or more girders in the tank

ℓ = span of the deck girder, in m (ft), as indicated in 5A-3-3/Figure 2B-c

h_e = length of the bracket, in m (ft), as indicated in 5A-3-3/Figure 2B-c and 5A-3-3/Figure 9.

p and s_g are defined in 5A-3-3/11.3.3.

f_s = permissible shear stress, in N/cm^2 (kgf/cm^2, lbf/in^2)

= $0.30\, S_m f_y$

S_m and f_y, as defined in 5A-3-3/7.3.1 of this Guide.

11.5 Deck Transverses and Deck Girders – Loading Pattern 2 *(1 July 2012)*

11.5.1 Section Modulus of Deck Transverses

The net section modulus of deck transverses, in association with the effective deck plating, is to be obtained from the following equation:

$SM = M/f_b$ cm^3 (in^3)

11.5.1(a) For deck transverses in wing tanks

$M = 10^5\, k\, (M_p + M_g + M_s)$ N-cm (kgf-cm, lbf-in)

11.5.1(b) For deck transverses in center tanks

$M = 10^5\, k\, (M_p + M_g + M_b)$ N-cm (kgf-cm, lbf-in)

where

K = 1.0 (1.0, 0.269)

M_p = bending moment due to reactions from topside structure

= $\left|(M_v + M_m) f_t\right|$

M_v = $\ell_t \sum_n P_n (k_{1n} + k_{2n})$

M_m = $\sum_n M_n (k_{3n} + k_{4n})$

P_n = reaction deck force number n, in kN (tf, Ltf), applied to the deck transverse in tank under consideration, see 5A-3-3/Figure 8

M_n = reaction deck moment number n, in kN-m (tf-m, Ltf-ft), applied to the deck transverse in tank under consideration, see 5A-3-3/Figure 8

n = 1, 2,….., N_v to obtain bending moment M_v

n = 1, 2,….., N_m to obtain bending moment M_m

N_v = total number of reaction forces at deck transverse under consideration, (in tank under consideration)

N_m = total number of reaction moments at deck transverse under consideration, (in tank under consideration)

ℓ_t = span of the deck transverse under consideration, in m (ft), as defined in 5A-3-3/Figure 2A

k_{1n} = $(1 - \bar{a}_n)^2 [\bar{a}_n - \bar{z}\ (1 + 2\bar{a}_n)]$

k_{2n} = 0 if $\bar{z} \le \bar{a}_n$

= $(\bar{z} - \bar{a}_n)$ if $\bar{z} > \bar{a}_n$

k_{3n} = $(1 - \bar{a}_n)(3\bar{a}_n - 1 - 6\bar{a}_n\ \bar{z})$

k_{4n} = 0 if $\bar{z} \le \bar{a}_n$

= 1 if $\bar{z} > \bar{a}_n$

$\bar{a}_n$ = a_n/ℓ_t

$\bar{z}$ = z/ℓ_t, $(0 \le \bar{z} \le 1)$

a_n = distance, in m (ft), from a point of application of reaction (force P_n or moment M_n) to the end of the deck transverse span ℓ_t, in m (ft), as shown in 5A-3-3/Figure 8

z = coordinate (measured from the end of the span ℓ_t) of the section of the deck transverse under consideration, in m (ft), as shown in 5A-3-3/Figure 8

For the toe of the deck transverse end brackets, $\bar{z} = h_a/\ell_t$ and $\bar{z} = 1 - h_a/\ell_t$.

h_a = distance, in m(ft), from the end of the span to the toe of the end bracket of the deck transverse, as shown in 5A-3-3/Figure 9 of the Guide.

Note: For a wide topside bracket, the vertical load on a deck transverse can be considered uniformly distributed with pressure $q_n = P_n/c$, and the concentrated bending moment can be substituted by force couples.

$$P_m = M_n/(k\ c)$$

where

P_n, M_n = concentrated force and moment obtained from FE analysis of topside structure

c = width of the topside bracket

k = shape bracket factor, and may be taken as 0.8, unless otherwise specified

Bending moment at the toe of the end brackets due to green water pressure, M_g:

$$M_g = 0.1\ c_3\ \varphi\ P_{gi}\ s\ \ell_t^2$$

where

P_{gi} = nominal green water pressure imposed on the deck, in kN/m² (tf/m², Ltf/ft²), as defined in 5A-3-2/13.7 of this Guide

s = spacing, in m (ft), of the deck transverses

c_3 = $2.0c_1$ for ship-type vessels with oil-tight longitudinal bulkheads and without deck girders (5A-3-3/Figure 2A-c, d, e and f)

= $1.6c_1$ for ship-type vessels with non-tight centerline longitudinal bulkhead and without deck girders (5A-3-3/Figure 2A-c)

= $1.1c_1$ for cargo tanks with deck girders

φ = $1 – [5(h_a/\alpha\ell_t)]$, for cargo tanks with deck girders, 0.6 minimum

= $1 – 5(h_a/\ell_t)$, for cargo tanks without deck girders, 0.6 minimum

h_a = distance, in m (ft), from the end of the span to the toe of the end bracket of the deck transverse, as indicated in 5A-3-3/Figure 9

ℓ_t = span of the deck transverse, in m (ft), as indicated in 5A-3-3/Figure 2A, but is not to be taken as less than 60% of the breadth of the tank, except for ship-type vessels with a non-tight centerline bulkhead (5A-3-3/Figure 2A-b), for which the span is not to be taken as less than 30% of the breadth of the tank.

c_1 for tanks without deck girders:

= 0.30 for 5A-3-3/Figure 2A-c with non-tight centerline bulkhead

= 0.42 for all other cases

c_1 for tanks with deck girders:

= $0.30\alpha^2$ for 5A-3-3/Figure 2A-b with a non-tight centerline bulkhead, 0.05 min. and 0.30 max.

= $0.42\alpha^2$ for 5A-3-3/Figure 2A-a or 5A-3-3/Figure 2A-b with an oil-tight centerline bulkhead, 0.05 min. and 0.42 max.

α = $(\ell_g/\ell_t)[(s_g/s)(I_t/I_g)]^{1/4}$

ℓ_g = span of the deck girder, in m (ft), as indicated in 5A-3-3/Figure 2B-c of this Guide

I_g, I_t = moments of inertia, in cm^4 (in^4), of the deck girder and deck transverse with effective deck plating, clear of the the end brackets, respectively

s_g = spacing of the deck girder, in m (ft) as shown in 5A-3-3/Figure 2A

s = spacing of the deck transverses, in m (ft)

When calculating α, if more than one deck girder is fitted, average values of s_g, ℓ_g and I_g are to be used when the girders are not identical.

Bending moments due to pressure on side transverse and vertical web of longitudinal bulkhead:

$$M_s = k_s \beta_s c_2 p_s s \ell_s^2$$

$$M_b = k_b \beta_b c_2 p_b s \ell_b^2$$

where k_s = 0.1, and k_b = 0.1, unless otherwise specified.

ℓ_s, ℓ_b = spans, in m (ft), of side transverse and vertical web on longitudinal bulkhead, respectively, as indicated in 5A-3-3/Figure 2A. Where a cross tie is fitted and is located at a distance greater than $0.7\ell_s$ or $0.7\ell_b$ from the deck transverse, the effective span of the side transverse or the vertical web may be taken as that measured from the deck transverse to the cross tie and all coefficients determined as if there were no cross tie.

p_s	=	nominal pressure, in kN/m^2 (tf/m^2, Ltf/ft^2), at the mid-span of side transverse when wing tank is empty, adjacent tanks full (5A-3-2/Table 3, item 12)
p_b	=	nominal internal cargo pressure, in kN/m^2 (tf/m^2, Ltf/ft^2), at the mid-span of the vertical web on longitudinal bulkhead when center tank is empty, adjacent tanks full (5A-3-2/Table 3, item 13)
β_s	=	$0.9[(\ell_s/\ell_t)(I_t/I_s)]$, 0.10 min. and 0.65 max.
β_b	=	$0.9[(\ell_b/\ell_t)(I_t/I_b)]$, 0.10 min. and 0.50 max.
I_s, I_b	=	moments of inertia, in cm^4 (in^4), clear of the brackets, of side transverse and vertical web on longitudinal bulkhead, respectively

c_2 are given in 5A-3-3/Table 1 of this Guide.

f_t	=	1 for tanks without deck girders
f_t	=	$1 - [0.67/(1 + 2\delta)]$ is not to be taken less than 0.70 for tanks with deck girders
δ	=	$(\ell_g/\ell_t)^3\ (I_t/I_g)$
f_b	=	permissible bending stress, in N/cm^2 (kgf/cm^2, lbf/in^2)
	=	$0.70\ S_m f_y$

S_m and f_y as defined in 5A-3-3/7.3.1 of this Guide.

11.5.2 Section Modulus of Deck Girders

The net section modulus of deck girder with effective deck plating is to be not less than that obtained from the following equation:

$SM = M/f_b$ cm^3 (in^3)

$M = k\ 10^5\ (M_p + M_g)$ N-cm (kgf-cm, lbf-in)

where

k = 1.0 (1.0, 0.269)

11.5.2(a) Bending moment due to reactions from topside structure, M_p

$$M_p = \left|(M_v + M_m) f_g\right|$$

$$M_v = \ell_g \sum_n P_n (k_{1n} + k_{2n})$$

$$M_m = \sum_n M_n (k_{3n} + k_{4n})$$

where

P_n	=	reaction force number n, in kN (tf, Lt-ft), applied to the deck girder under consideration
M_n	=	reaction moment number n, in kN-m (tf-m, Lt-ft), applied to the deck girder under consideration
N	=	1, 2,….., N_v to obtain bending moment M_v
N	=	1, 2,….., N_m to obtain bending moment M_m
N_v	=	total number of reaction forces at the deck girder between transverse bulkheads in the tank under consideration

N_m = total number of reaction moments at the deck girder between transverse bulkheads in the tank under consideration

k_{1n} = $(1 - \bar{b}_n)^2 [\bar{b}_n - \bar{x}(1 + 2\bar{b}_n)]$

k_{2n} = 0 if $\bar{x} \le \bar{b}_n$

= $(\bar{x} - \bar{b}_n)$ if $\bar{x} > \bar{b}_n$

k_{3n} = $(1 - \bar{b}_n)(3\bar{b}_n - 1 - 6\bar{b}_n\bar{x})$

k_{4n} = 0 if $\bar{x} \le \bar{b}_n$

= 1 if $\bar{x} > \bar{b}_n$

$\bar{b}_n$ = b_n/ℓ_g

$\bar{x}$ = x/ℓ_g

b_n = distance, in m (ft), from reaction force P_n to the end of the deck girder span ℓ_g

x = coordinate, in m (ft), of the section of the deck girder under consideration, measured from the end of span ℓ_g

For the toe of the brackets, $\bar{x} = h_a/\ell_g$ and $\bar{x} = 1 - h_a/\ell_g$.

h_a = distance, in m (ft), from the end of the deck girder span to the toe of the end of the bracket, as shown in 5A-3-3/Figure 2B-c and 5A-3-3/Figure 9 of this Guide

f_g = $1 - 0.13[(\ell_g/\ell_t)^3 (\ell_g/s)(I_t/I_g)]^{0.25}$ is not to be taken less than 0.65

I_t, I_g, s, ℓ_g, ℓ_t are as defined in 5A-3-3/11.5.1, above.

11.5.2(b) Bending moment at the toe of the end brackets due to green water pressure, M_g

$M_g = 0.083\ \varphi\ p_{gi}\ s_g\ \ell_g^2$

where p_{gi} and s_g are as defined in 5A-3-3/11.5.1, above.

φ = $1 - 5(h_a/\ell_g)$, 0.6 min.

f_b = permissible bending stress, in N/cm^2 (kgf/cm^2, lbf/in^2)

= $0.45\ S_m f_y$

= $(1.0 - 0.55\alpha_2 SM_{RD}/SM_D)S_m f_y \le 0.52 S_m f_y$ for $L < 190$ m

α_2, SM_{RD} and SM_D are as defined in 5A-3-3/9.5. S_m and f_y, are as defined in 5A-3-3/7.3.1.

11.5.3 Web Sectional Area of Deck Transverses

The net sectional area of the web portion of deck transverse is to be obtained from the following equation:

$A = F/f_s$ cm^2 (in^2)

where

F = $1000\ k\ (F_p + F_g + c_2\ s\ D\ B_c)$, in N (kgf, lbf)

F_p = $|(F_v + F_m) f_1|$

F_v = $\sum_n \left[P_n (1 - \bar{a}_n)^2 (2\bar{a}_n + 1) + \Delta F \right]$

F_m = $6\sum_n \bar{a}_n (1 - \bar{a}_n) M_n / \ell_t$

F_g = $c_1\, p_{gi}\, s\, (0.50\ell - h_e)$

k = 1.0 (1.0, 2.24)

ΔF = 0 if $\bar{z} \le \bar{a}_n$

= $-P_n$ if $\bar{z} > \bar{a}_n$

f_1 = $1 - [0.5/(1 + 4\delta)]$

c_2 = 0.05 for wing cargo tanks of ship-type vessels with four longitudinal bulkheads (5A-3-3/Figure 2A-d, e and f of this Guide)

= 0 for other tanks (5A-3-3/Figure 2A-a, b, c, d, e and f of this Guide)

c_1 for tanks with deck girders:

= $0.90\alpha^{1/2}$ for 5A-3-3/Figure 2A-a without longitudinal bulkhead and for 5A-3-3/Figure 2A-b with an oil-tight centerline bulkhead, 0.50 min. and 1.0 max.

= $0.60\alpha^{1/2}$ for 5A-3-3/Figure 2A-b with a non-tight centerline bulkhead, 0.45 min. and 0.85 max.

c_1 for tanks without deck girders:

= 1.10 for 5A-3-3/Figure 2A-c, with a nontight centerline longitudinal bulkhead

= 1.30 for all other cases (5A-3-3/Figure 2A-c, d, e and f)

ℓ = span of the deck transverse, in m (ft), as indicated in 5A-3-3/Figure 2A of this Guide

h_e = length of the bracket, in m(ft), as indicated in 5A-3-3/Figures 2A and 2B and 5A-3-3/Figure 9 of this Guide

D = depth of a vessel, in m (ft), as defined in 3-1-1/7 of the *Steel Vessel Rules*

B_c = breadth of the center tank, in m (ft)

f_s = permissible shear stress

= $0.45\, S_m f_y$, in N/cm^2 (kgf/cm^2, lbf/in^2)

P_n, M_n, p_{gi}, ℓ_t, s, $\bar{a}_n$, $\bar{z}$, α and δ are as defined in 5A-3-3/11.5.1, above.

11.5.4 Web Sectional Area of Deck Girders

The net sectional area of the web portion of deck girders is to be not less than that obtained from the following equation:

$A = F/f_s$ cm^2 (in^2)

where

F = $1000\, k\, (F_p + F_g)$, in N (kgf, lbf)

F_p = $|(F_v + F_m) f_g|$

$$F_v = \sum_n P_n \left(1-\bar{b}_n\right)^2 \left(2\bar{b}_n + 1\right)\left(1+2\bar{b}_n\right) + \Delta F$$

$$F_m = 6\sum_n \bar{b}_n \left(1-\bar{b}_n\right) M_n / \ell_{tg}$$

$$\Delta F_n = 0 \quad \text{if } \bar{x} \le \bar{b}_n$$

$$= -P_n \quad \text{if } \bar{x} > \bar{b}_n$$

F_g = $c\, p_{gi}\,(0.5\ell - h_e)\, s_g$

k = 1.0 (1.0, 2.24)

c = 0.55 for one or two girders in the tank

= 0.67 for three or more girders in the tank

ℓ = span of the deck girder, in m (ft), as indicated in 5A-3-3/Figure 2B-c

h_e = length of the bracket, in m (ft), as indicated in 5A-3-3/Figure 2B-c and 5A-3-3/Figure 9.

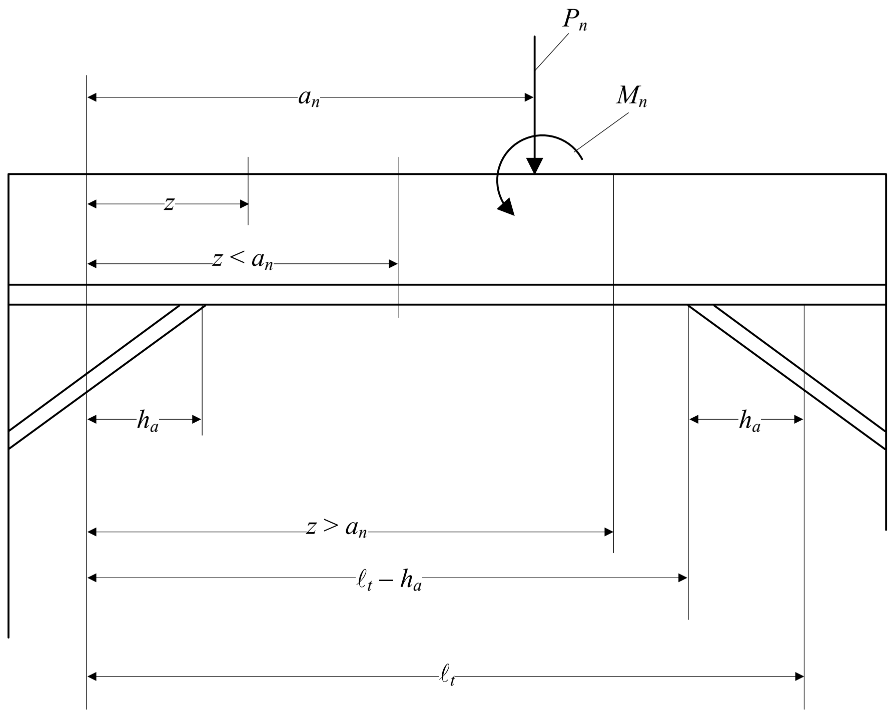
f_s = permissible shear stress, in N/cm^2 (kgf/cm^2, lbf/in^2)

= $0.30\, S_m f_y$

P_n, M_n, ℓ_g, s_g, $\bar{b}_n$, $\bar{x}$, p_{gi}, f_g, S_m, f_y are as defined in 5A-3-3/11.5.2, above.

(Add new 5A/3.3/Figure 8, as follows and renumber subsequent figures accordingly.)

FIGURE 8
Deck Transverse – Definition of Parameters *(1 July 2012)*



(Relocate existing text of Paragraph 5A-3-3/11.6 to new Subsection 5A-3-5/9.)

15 Bulkheads – Main Supporting Members *(1995)*

15.7 Vertical Web on Transverse Bulkhead

15.7.1 Section Modulus of Vertical Web on Transverse Bulkhead *(1 July 2012)*

(Revise definition of ℓ_{st}, as follows:)

ℓ_{st} = span of the vertical web, in m (ft), (5A-3-3/Figure 2B-c). Where both lower and upper ends of the vertical web are fitted with a bracket of the same or larger size on the opposite side, the span ℓ_{st} may be taken between the toes of the upper and lower brackets

(Revise Paragraph 5A-3-3/15.13, as follows:)

15.13 Nontight Bulkheads *(1 July 2012)*

Nontight bulkheads referred to in 5A-3-2/11.3.1 are to be fitted in line with transverse webs, bulkheads or other structures with equivalent rigidity. They are to be suitably stiffened. Openings in the nontight bulkhead are to have generous radii and their aggregate area is not to exceed 33%, nor to be less than 10% of the area of the nontight bulkhead, but it is recommended to be as close to 33% as practicable. The opening area is to be evenly distributed between 0.1 and 0.9 of the bulkhead depth. The net thickness of nontight bulkheads is to be not less than 11.0 mm (0.433 in.). Section moduli of stiffeners and webs may be half of those required for watertight bulkheads in 5A-3-3/13.5, 5A-3-3/15.3.1, 5A-3-3/15.5.1, 5A-3-3/15.7.1 and 5A-3-3/15.9.

Alternatively, the opening ratio and scantlings may be determined by an acceptable method of engineering analysis.

PART 5A SHIP-TYPE INSTALLATIONS

CHAPTER 3 STRUCTURAL DESIGN REQUIREMENTS

SECTION 4 TOTAL STRENGTH ASSESSMENT

3 Failure Criteria - Yielding

(Revise Paragraph 5A-3-4/3.5, as follows:)

3.5 Plating *(1 July 2012)*

For plating away from knuckle, horizontal girder or stringer or cruciform connections of high stress concentrations and subject to both in-plane and lateral loads, the combined effects of all of the calculated stress components are to satisfy the limits specified in 5A-3-4/3.3 with f_L and f_T modified as follows:

$$f_L = f_{L1} + f_{L2} + f^*_{L2} + f_{L3} \qquad \text{N/cm}^2 \text{ (kgf/cm}^2\text{, lbf/in}^2\text{)}$$

$$f_T = f_{T1} + f_{T2} + f^*_{T2} + f_{T3} \qquad \text{N/cm}^2 \text{ (kgf/cm}^2\text{, lbf/in}^2\text{)}$$

where

f_{L3}, f_{T3} = plate bending stresses between stiffeners in the longitudinal and transverse directions, respectively, and may be approximated as follows.

f_{L3} = $0.182p(s/t_n)^2$ N/cm^2 (kgf/cm^2, lbf/in^2)

f_{T3} = $0.266p(s/t_n)^2$ N/cm^2 (kgf/cm^2, lbf/in^2)

p = lateral pressures for the combined load case considered (see 5A-3-2/9), in N/cm^2 (kgf/cm^2, lbf/in^2)

s = spacing of longitudinals or stiffeners, in mm (in.)

t_n = net plate thickness, in mm (in.)

$f_{L1}, f_{L2}, f^*_{L2}, f_{T1}, f_{T2}$ and f^*_{T2} are as defined in 5A-3-4/3.3.

For plating within two longitudinals or stiffeners from knuckle or cruciform connections of high stress concentrations, the combined effects of the calculated stress components are to satisfy the following stress limit:

$f_i \leq 0.80\, S_m f_y$

where

f_i = stress intensity

= $(f_L^2 + f_T^2 - f_L f_T + 3 f_{LT}^2)^{1/2}$ N/cm^2 (kgf/cm^2, lbf/in^2)

f_L = calculated total in-plane stress in the longitudinal direction including primary and secondary stresses

= $f_{L1} + f_{L2}$ N/cm^2 (kgf/cm^2, lbf/in^2)

f_T = calculated total direct stress in the transverse/vertical direction, including secondary stresses

= $f_{T1} + f_{T2}$ N/cm^2 (kgf/cm^2, lbf/in^2)

In addition, the failure criteria for knuckle or cruciform connections in 5A-3-4/13 are to be complied with.

11 Calculation of Structural Responses *(1995)*

(Revise Paragraphs 5A-3-4/11.1 and 5A-3-4/11.3 as follows:)

11.1 Methods of Approach and Analysis Procedures *(1 July 2012)*

Maximum stresses in the structure are to be determined by performing structural analyses, as outlined below. Guidelines on structural idealization, load application and structural analysis are given in Appendix 5A-3-A4.

The strength assessment of the hull structure for new build FPIs is based on a three cargo tank lengths finite element model about midships where the strength assessment is focused on the results obtained from structures in the middle tank. For an FPI conversion, as an alternative, a complete hull length or full cargo block length finite element model including all cargo and ballast tanks in the hull structure can be used in lieu of the three cargo tank length model.

In the three tank length model the strength assessment is to be focused on the results obtained from the mid tank structure. However, the deck transverse, the side transverse, the vertical web on longitudinal bulkheads, the horizontal girder and the vertical web on transverse bulkheads and the cross ties are also to be assessed using the end tanks of the three tank length model analysis.

11.3 3D Finite Element Models *(1 July 2012)*

A simplified three-dimensional (3D) finite element model is required to determine the load distribution in the structure.

The three-hold length finite element model represents three bays of tanks within 0.4*L* amidships of the hull structure. The same 3D model may be used for hull structures beyond 0.4*L* amidships with modifications to the structural properties and the applied loads, provided that the structural configurations are such that they are considered as representative of the location under consideration.

The full length or cargo block length finite element model may be used for the alternative method of analysis for FPI conversions.

PART 5A SHIP-TYPE INSTALLATIONS

CHAPTER 3 STRUCTURAL DESIGN REQUIREMENTS

SECTION 5 HULL STRUCTURE BEYOND 0.4L AMIDSHIPS

(Revise Subsection 5A-3-5/7 as follows:)

7 Forebody Strengthening for Slamming

(1 July 2012) Where the hull structure is subject to slamming as specified in 5A-3-2/13, proper strengthening will be required as outlined below. For strengthening to account for bottom slamming, the requirements of this Subsection apply to installations with a heavy ballast draft forward of less than 0.04*L*.

(Relocate existing text of Paragraph 5A-3-3/11.6 to new Subsection 5A-3-5/9, as follows:)

9 Forebody Deck Structures *(1 July 2012)*

The deck plating, longitudinals, girders and transverses forward of 0.25*L* from the FP are to meet the requirements specified in 5A-3-3/9 and 5A-3-3/11 with the deck pressure, $p = p_g$, where p_g is the nominal green water loading given in 5A-3-2/13.7 and the permissible stresses as specified below.

9.1 Deck Plating

The net thickness of deck plating is to be not less than t_1 and t_2, as specified in 5A-3-3/9.3, with the following modifications:

$f_1 = 0.50\, S_m f_y$, in N/cm^2 (kgf/cm^2, lbf/in^2), for main deck within 0.1*L* from the FP.

$f_1 = 0.60\, S_m f_y$, in N/cm^2 (kgf/cm^2, lbf/in^2), for forecastle deck

$f_2 = 0.80\, S_m f_y$, in N/cm^2 (kgf/cm^2, lbf/in^2)

where

S_m = strength reduction factor obtained from 5A-3-3/7.3

f_y = minimum specified yield point of deck plating material

The permissible stress, f_1, for main deck between 0.25*L* and 0.1*L* from the FP is to be obtained by linear interpolation between midship region ($f_1 = 0.15\, S_m f_y$ as in 5A-3-3/9.3) and the permissible stress at 0.1*L* from the FP, as specified above.

In addition, the net thickness of main deck plating is also not to be less than t_3, as specified below.

$t_3 = 0.30s(S_m f_y/E)^{1/2}$ mm (in.) for main deck within 0.1L from the FP

The net thickness, t_3, between 0.30L and 0.1L from the FP is to be obtained by linear interpolation between midship region and the t_3 above. t_3 in midship region is defined as:

$t_3 = cs(S_m f_y/E)^{1/2}$ mm (in.) .... (5A-3-3/9.3)

where

c	=	$0.5(0.6 + 0.0015L)$	for SI or MKS Units
	=	$0.5(0.6 + 0.00046L)$	for U.S. Units

The net thickness, t_3, may be determined based on S_m and f_y of the hull girder strength material required at the location under consideration.

The net thickness of deck plating should not be less than the minimum gross thickness specified in Section 3-2-3 of the *Steel Vessel Rules (January 2005)* minus the nominal corrosion value specified in 5A-3-1/1.7.

Finally, the net thickness of deck plating is not to be less than 85% of the net thickness requirement based on nominal green water load, p_g, calculated for North Atlantic environment.

9.3 Deck Longitudinals

The net section modulus is not to be less than obtained from 5A-3-3/9, with the following modifications.

$f_b = 0.70\ S_m f_y$, in N/cm² (kgf/cm², lbf/in²), for main deck longitudinals within 0.1L from the FP and forecastle deck longitudinals

$f_b = 0.80\ S_m f_y$, in N/cm² (kgf/cm², lbf/in²), for main deck beams forward of the foremost hatch opening (No. 1 hatch) and forecastle deck beams

The permissible bending stress, f_b, for main deck longitudinals between 0.25L and 0.1L from the FP is to be obtained by linear interpolation between midship region (see 5A-3-3/9.5) and the permissible stress at 0.1L from the FP, as specified above.

Finally, the net section modulus of deck longitudinals is not to be less than 85% of the net section modulus requirement based on nominal green water load, p_g, calculated for North Atlantic environment.

9.5 Deck Transverse and Deck Girders

The deck girders and transverses forward of 0.25L from the FP are to be verified based on appropriate analysis (e.g., grillage analysis) and should meet the requirements specified in the following with the deck pressure, $p = p_g$, where p_g is the nominal green water loading given in 5A-3-2/13.7 and the permissible stresses as specified below.

Permissible bending stress for net thickness

$f_b = 0.70 S_m f_y$ (5A-3-3/11.3.1)

Permissible shear stress for net thickness

$f_b = 0.45 S_m f_y$ (5A-3-3/11.3.2)

The required section modulus of members such as girders, transverse etc., is to be obtained on an effective width of plating basis in accordance with 3-1-2/13.3 of the *Steel Vessel Rules (January 2005)*.

Finally, the net section modulus and sectional area of deck girders and transverses is not to be less than 85% of those required based on nominal green water load, p_g, calculated for North Atlantic environment.

PART 5A SHIP-TYPE INSTALLATIONS

CHAPTER 3 STRUCTURAL DESIGN REQUIREMENTS

SECTION 6 APPLICATION TO SINGLE HULL SHIP-TYPE INSTALLATIONS

3 Main Supporting Structures

(Revise Paragraph 5A-3-6/3.3, as follows:)

3.3 Bottom Girders *(1 July 2012)*

3.3.1 Section Modulus of Bottom Girders

The net section modulus of the bottom girder, in association with the effective bottom plating, is not to be less than obtained from the following equation (see also 5A-3-3/1.3).

$SM = M/f_b$ cm^3 (in^3)

$M = 10{,}000kcps_g \ell_g^2$ N-cm (kgf-cm, lbf-in)

where

k = 1.0 (1.0, 0.269)

c = α^2

α = $(\ell_b/\ell_g)[(I_g/I_b)(s/s_g)]^{1/4} \le 1.0$

p = nominal pressure, in kN/m^2 (tf/m^2, Ltf/ft^2), at the mid-span of the bottom girder, as specified in 5A-3-6/Table 1

ℓ_b, ℓ_g, I_g, I_b, s and s_g are as defined in 5A-3-6/3.1.1.

f_b = $0.70S_m f_y$

S_m and f_y are as defined in 5A-3-3/7.3.1.

3.3.2 Web Sectional Area of Bottom Girder

The net sectional area of the web portion of the bottom girder is not to be less than obtained from the following equation:

$A = F/f_s$ cm^2 (in^2)

The shear force, F, in N (kgf, lbf), can be obtained from the following equation (see 5A-3-3/1.3).

$F = 1000kcps_g(0.5\ell_s - h_e)$

where

k = 1.0 (1.0, 2.24)

ℓ_s = span of the bottom girder, in m (ft), as indicated in 5A-3-6/Figure 1

h_e = length of bracket of bottom girder, in m (ft), as indicted in 5A-3-6/Figure 1

s_g is as defined in 5A-3-6/3.1.1.

c is as defined in 5A-3-6/3.3.1.

p is as defined in 5A-3-6/3.3.1.

f_s = permissible shear stress

= $0.45\, S_m f_y$

S_m and f_y are as defined in 5A-3-3/7.3.1.

(Revise 5A-3-6/Table 1, as follows:)

TABLE 1
Design Pressure for Local and Supporting Structures *(1 July 2012)*

A. Plating & Longitudinals/Stiffeners

The nominal pressure, $p = |p_i - p_e|$, is to be determined from load cases "a" & "b" below, whichever is greater, with k_u = 1.10 and k_c = 1.0 unless otherwise specified in the table

	Case "a" – At fwd end of the tank				*Case "b" – At mid tank/fwd end of tank*			
Structural Members/ Components	*Draft/Wave Heading Angle*	*Location and Loading Pattern*	*Coefficients* p_i	*Coefficients* p_e	*Draft/Wave Heading Angle*	*Location and Loading Pattern*	*Coefficients* p_i	*Coefficients* p_e
1. Bottom Plating & Long'l	2/3 design draft/0°	Full center and wing tanks	A_i	A_e	Design draft/0°	Midtank of empty center and wing tanks	—	B_e
2. Side Shell Plating & Long'l	2/3 design draft/60°	Starboard side of full wing tank	B_i	A_e	Design draft/60°	Midtank of empty wing tank	—	B_e

B. Main Supporting Members

The nominal pressure, $p = |p_i - p_e|$, is to be determined at the midspan of the structural member at starboard side of installation from load cases "a" & "b" below, whichever is greater, with k_u = 1.0 and k_c = 1.0 unless otherwise specified in the table

	Midtank for Transverses				*Midtank for Transverses*			
Structural Members/ Components	*Draft/Wave Heading Angle*	*Location and Loading Pattern*	*Coefficients* p_i	*Coefficients* p_e	*Draft/Wave Heading Angle*	*Location and Loading Pattern*	*Coefficients* p_i	*Coefficients* p_e
3. Bottom Transverse & Girder	2/3 design draft/0°	Full center and wing tanks	A_i	A_e	Design draft/0°	Midtank of empty center and wing tanks	—	B_e
4. Side Transverses	2/3 design draft/60°	Wing tanks full	B_i	—	Design draft/60°	Midtank of empty wing tank	—	B_e
5 *(1 July 2012)* *Deck Transverses with cross ties in wing tanks (5A-3-6/Figure 1)	2/3 design draft/60°	Wing tanks full, Center tank empty	C_i	—	2/3 design draft/60°	Center tank full, wing tank empty	C_i	—

* See note 5

Notes:

1 For calculating p_i and p_e, the necessary coefficients are to be determined based on the following designated groups:

a) For p_i

A_i: w_v = 0.75, w_ℓ(fwd bhd) = 0.25, w_ℓ(aft bhd) = –0.25, w_t = 0.0, c_ϕ = –1.0, c_e = 0.0

B_i: w_v = 0.4, w_ℓ(fwd bhd) = 0.2, w_ℓ(aft bhd) = –0.2, w_t(starboard) = 0.4, w_t(port) = –0.4, c_ϕ = –0.7, c_e = 0.7

b) For p_e

A_e: $k_{\ell o}$ = 1.0, k_u = 1.0, k_c = –0.5

B_e: $k_{\ell o}$ = 1.0

2 For structures within 0.4L amidships, the nominal pressure is to be calculated for a tank located amidships. The longest cargo and ballast tanks in the region should be considered as located amidships

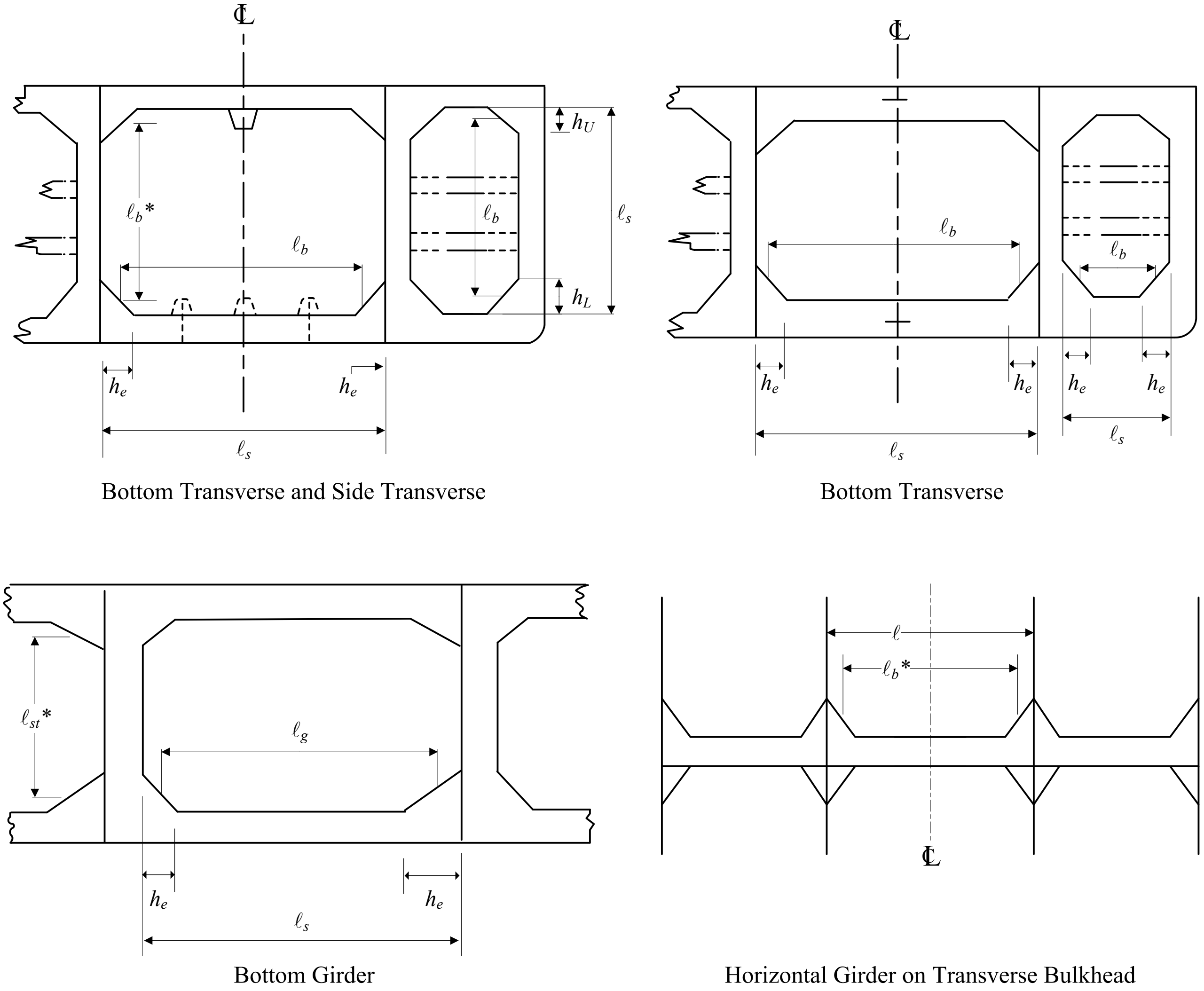
3 In calculation of the nominal pressure, ρg of the liquid cargoes is not to be taken less than 0.1025 kgf/cm^2-m (0.4444 lbf/in^2-ft) for structural members 1 and 2 and is not to be taken less than 0.09 kgf/cm^2-m (0.3902 lbf/in^2-ft) for cargo tanks and 0.1025 kgf/cm^2-m (0.4444 lbf/in^2-ft) for ballast tanks for structural members 3 and 4.

4 For all other structures, 5A-3-2/Table 3 is applicable.

5 *(1 July 2012)* Case-a is applied for deck transverse in wing tanks and case-b is applied for deck transverse in center tank

(Revise 5A-3-6/Figure 1, as follows:)

FIGURE 1
Spans of Transverses and Girders *(1 July 2012)*



* Where both lower and upper ends of the vertical web are fitted with a bracket of the same or larger size on the opposite side, the span ℓ_b or ℓ_{st} may be taken between the toes of the effective lower and upper brackets.

(Delete existing Paragraph 5A-3-6/3.7 and 5A-3-6/Table 4 and replace with new Paragraphs 5A-3-6/3.7 and 5A-3-6/3.8 and new 5A-3-6/Table 4, as follows:)

3.7 Deck Transverses – Loading Pattern 1 *(1 July 2012)*

3.7.1 Section Modulus of Deck Transverses

The net section modulus of deck transverses, in association with the effective deck plating, is not to be less than obtained from the following equation (see also 5A-3-3/1.3).

$$SM = M/f_b \qquad \text{cm}^3 \text{ (in}^3\text{)}$$

For deck transverses in wing tanks:

$$M = k(10{,}000\, c_1 \varphi\, p s\, \ell_t^2 + \beta_s M_s) \geq M_o \qquad \text{N-cm (kgf-cm, lbf-in)}$$

For deck transverses in center tanks:

$$M = k(10{,}000\, c_1 \varphi\, ps\, \ell_t^2 + \beta_b M_b) \geq M_o \qquad \text{N-cm (kgf-cm, lbf-in)}$$

where

M_s = $10{,}000 c_2\, p_s\, s\, \ell_s^2$

M_b = $10{,}000 c_2\, p_b\, s\, \ell_b^2$

M_o = $10{,}000 k c_3 \varphi\, ps\, \ell_t^2$

k = 1.0 (1.0, 0.269)

p = nominal pressure, in kN/m^2 (tf/m^2, Ltf/ft^2), at the mid-span of the deck transverse under consideration, as specified in 5A-3-6/Table 1, Item 5

p_s = corresponding nominal pressure, in kN/m^2 (tf/m^2, Ltf/ft^2), at the mid-span of the side transverse (5A-3-2/Table 3 , Item 16)

p_b = corresponding nominal pressure, in kN/m^2 (tf/m^2, Ltf/ft^2), at the mid-span of the vertical web on longitudinal bulkhead (5A-3-2/Table 3 , Item 16)

c_1 = 0.42 for tanks without deck girder

= $0.42\alpha^2$ for tanks with deck girders, min. 0.05 and max. 0.42

α = $(\ell_g/\ell_t)[(s_g/s)(I_T/I_g)]^{1/4}$

ℓ_g = span of the deck girder, in m (ft), as indicated in 5A-3-3/Figure 2B-c

ℓ_t = span of the deck transverse, in m (ft), as indicated in 5A-3-3/Figure 2A, but is not to be taken as less than 60% of the breadth of the tank

I_g, I_t = moments of inertia, in cm^4 (in^4), of the deck girder and deck transverse, clear of the brackets, respectively

s_g = spacing of the deck girders, in m (ft)

s = spacing of the deck transverses, in m (ft)

When calculating α, if more than one deck girder is fitted, the average values of s_g, ℓ_g and I_g are to be used when the girders are not identical.

φ = $1 - 5(h_a/\ell_t)\alpha^{-1}$, to be not less than 0.6 for cargo tanks with deck girders

= $1 - 5(h_a/\ell_t)$, to be not less than 0.6 for cargo tanks without deck girders

h_a = distance, in m (ft), from the end of the span to the toe of the end bracket of the deck transverse, as indicated in 5A-3-3/Figure 9

β_s = $0.9[(\ell_s/\ell_t)(I_t/I_s)]$, but is not to be taken less than 0.10 and need not be greater than 0.65

β_b = $0.9[(\ell_b/\ell_t)(I_t/I_b)]$, but is not to be taken less than 0.10 and need not be greater than 0.50

ℓ_s, ℓ_b = spans, in m (ft), of side transverse and vertical web on longitudinal bulkhead, respectively, as indicated in 5A-3-3/Figure 2A

I_s, I_b = moments of inertia, in cm^4 (in^4), clear of the brackets, of side transverses and vertical web on longitudinal bulkhead

f_b = permissible bending stress, in N/cm^2 (kgf/cm^2, lbf/ in^2)

= $0.70\ S_m f_y$

S_m and f_y are as defined in 5A-3-3/7.3.1.

c_2 is given in 5A-3-6/Table 4 below.

c_3 = 0.83 for tanks without deck girders

= $1.1c_1$ for tanks with deck girders

Where no cross ties or other effective supporting arrangements are provided for the wing tank vertical webs, the deck transverses in the wing tanks are to have section modulus not less than 70% of that required for the upper side transverse.

TABLE 4
Coefficient c_2 For Deck Transverse *(1 July 2012)*

Arrangement of Cross Ties	*Center Tank*	*Wing Tank*
No Cross Tie	0.4	
One Cross Tie in Wing Tank	0.13	~~0.37~~ 0.28
Two Cross Ties in Wing Tank	0.05	0.12

3.7.2 Web Sectional Area of Deck Transverse

The net sectional area of the web portion of deck transverses is not to be less than obtained from the following equation:

$A = F/f_s$ cm^2 (in^2)

$F = 1000k[c_1\ ps(0.50\ell - h_e) + c_2\ DB_c s]$ N (kgf, lbf)

where

k = 1.0 (1.0, 2.24)

c_1 = 1.30 for tanks without deck girder

= $0.90\alpha^{1/2}$ for tanks with deck girder, min. 0.50 and max. 1.0

c_2 = 0 for center tank

= 0.045 for wing tank

ℓ = span of the deck transverse, in m (ft), as indicated in 5A-3-3/Figure 2A

h_e = length of the bracket, in m (ft), as indicated in 5A-3-3/Figure 2A-c and d and 5A-3-3/Figure 9

D = depth of the ship-type vessel, in m (ft), as defined in 3-1-1/7 of the *Steel Vessel Rules*

B_c = breadth of the center tank, in m (ft)

p, s and α are as defined in 5A-3-6/3.7.1.

f_s = permissible shear stress, in N/cm^2 (kgf/cm^2, lbf/in^2)

= $0.45\ S_m f_y$

S_m and f_y are as defined in 5A-3-3/7.3.1.

Area A is not to be less than the area obtained based on 5A-3-3/11.9 and 5A-3-3/11.11.

3.8 Deck Transverses – Loading Pattern 2 *(1 July 2012)*

3.8.1 Section Modulus of Deck Transverses

In addition to satisfying the net section modulus requirements of 5A-3-3/3.7.1, the net section modulus of a deck transverse, that is loaded with reactions (forces and moments) from the topside structure, is to be obtained from the following equation:

$SM = M/f_b$ cm^3 (in^3)

3.8.1(a) For deck transverses in wing tanks

$M = 10^5\, k\, (M_p + M_g + M_s)$ N-cm (kgf-cm, lbf-in)

3.8.1(b) For deck transverses in center tanks

$M = 10^5\, k\, (M_p + M_g + M_b)$ N-cm (kgf-cm, lbf-in)

where

K = 1.0 (1.0, 0.269)

M_p = bending moment due to reactions from topside structure

= $|(M_v + M_m) f_t|$

M_v = $\ell_t \sum_n P_n (k_{1n} + k_{2n})$

M_m = $\sum_n M_n (k_{3n} + k_{4n})$

P_n = reaction deck force number n, in kN (tf, Ltf), applied to the deck transverse in tank under consideration, see 5A-3-3/Figure 8

M_n = reaction deck moment number n, in kN-m (tf-m, Ltf-ft), applied to the deck transverse in tank under consideration, see 5A-3-3/Figure 8

n = 1, 2,….., N_v to obtain bending moment M_v

= 1, 2,….., N_m to obtain bending moment M_m

N_v = total number of reaction forces at deck transverse under consideration, (in tank under consideration)

N_m = total number of reaction moments at deck transverse under consideration, (in tank under consideration)

ℓ_t = span of the deck transverse under consideration, in m (ft), as defined in 5A-3-3/Figure 2A

k_{1n} = $(1 - \overline{a}_n)^2 [\overline{a}_n - \overline{z}\,(1 + 2\overline{a}_n)]$

k_{2n} = 0 if $\overline{z} \le \overline{a}_n$

= $(\overline{z} - \overline{a}_n)$ if $\overline{z} > \overline{a}_n$

k_{3n} = $(1 - \overline{a}_n)(3\overline{a}_n - 1 - 6\overline{a}_n\,\overline{z})$

k_{4n} = 0 if $\overline{z} \le \overline{a}_n$

= 1 if $\overline{z} > \overline{a}_n$

$\overline{a}_n$ = a_n/ℓ_t

$\overline{z}$ = z/ℓ_t, $(0 \le \overline{z} \le 1)$

a_n = distance, in m (ft), from a point of application of reaction (force P_n or moment M_n) to the end of the deck transverse span ℓ_t, in m (ft), as shown in 5A-3-3/Figure 8

z = coordinate (measured from the end of the span ℓ_t) of the section of the deck transverse under consideration, in m (ft), as shown in 5A-3-3/Figure 8

For the toe of the deck transverse end brackets $\bar{z} = h_a/\ell_t$ and $\bar{z} = 1 - h_a/\ell_t$.

h_a = distance, in m(ft), from the end of the span to the toe of the end bracket of the deck transverse, as shown in 5A-3-3/Figure 9 of this Guide.

Note: For a wide topside bracket, the vertical load on a deck transverse can be considered uniformly distributed with pressure $q_n = P_n/c$, and the concentrated bending moment can be substituted by force couples.

$$P_m = M_n/(k\,c)$$

where

P_n, M_n = concentrated force and moment obtained from FE analysis of topside structure

c = width of the topside bracket

k = shape bracket factor, and may be taken as 0.8, unless otherwise specified

Bending moment at the toe of the end brackets due to green water pressure, M_g:

$$M_g = 0.1\, c_3\, \varphi\, P_{gi}\, s\, \ell_t^2$$

where

P_{gi} = nominal green water pressure imposed on the deck, in kN/m² (tf/m², Ltf/ft²), as defined in 5A-3-2/13.8 of this Guide

s = spacing, in m (ft), of the deck transverses

c_3 = 0.83 for tanks without deck girders

= $1.1c_1$ for tanks with deck girders

φ = $1 - [5(h_a/\alpha\ell_t)]$, for cargo tanks with deck girders, 0.6 minimum

= $1 - 5(h_a/\ell_t)$, for cargo tanks without deck girders, 0.6 minimum

h_a = distance, in m (ft), from the end of the span to the toe of the end bracket of the deck transverse, as indicated in 5A-3-3/Figure 9

ℓ_t = span of the deck transverse, in m (ft), as indicated in 5A-3-3/Figure 2A, but is not to be taken as less than 60% of the breadth of the tank, except for ship-type vessels with a non-tight centerline bulkhead (5A-3-3/Figure 2A-b), for which the span is not to be taken as less than 30% of the breadth of the tank.

c_1 for tanks without deck girders:

= 0.30 for 5A-3-3/Figure 2A-c with non-tight centerline bulkhead

= 0.42 for all other cases

c_1 for tanks with deck girders:

= $0.30\alpha^2$ for 5A-3-3/Figure 2A-b with a non-tight centerline bulkhead, 0.05 min. and 0.30 max.

= $0.42\alpha^2$ for 5A-3-3/Figure 2A-a or 5A-3-3/Figure 2A-b with an oil-tight centerline bulkhead, 0.05 min. and 0.42 max.

α	=	$(\ell_g/\ell_t)[(s_g/s)(I_t/I_g)]^{1/4}$
ℓ_g	=	span of the deck girder, in m (ft), as indicated in 5A-3-3/Figure 2B-c of this Guide
I_g, I_t	=	moments of inertia, in cm^4 (in^4), of the deck girder and deck transverse with effective deck plating, clear of the end brackets, respectively
s_g	=	spacing of the deck girder, in m (ft) as shown in 5A-3-3/Figure 2A
s	=	spacing of the deck transverses, in m (ft)

When calculating α, if more than one deck girder is fitted, average values of s_g, ℓ_g and I_g are to be used when the girders are not identical.

Bending moments due to pressure on side transverse and vertical web of longitudinal bulkhead:

$$M_s = k_s\, \beta_s\, c_2\, p_s\, s\, \ell_s^2$$

$$M_b = k_b\, \beta_b\, c_2\, p_b\, s\, \ell_b^2$$

where $k_s = 0.1$, and $k_b = 0.1$, unless otherwise specified.

ℓ_s, ℓ_b	=	spans, in m (ft), of side transverse and vertical web on longitudinal bulkhead, respectively, as indicated in 5A-3-3/Figure 2A. Where a cross tie is fitted and is located at a distance greater than $0.7\ell_s$ or $0.7\ell_b$ from the deck transverse, the effective span of the side transverse or the vertical web may be taken as that measured from the deck transverse to the cross tie and all coefficients determined as if there were no cross tie.
p_s	=	nominal pressure, in kN/m^2 (tf/m^2, Ltf/ft^2), at the mid-span of side transverse when wing tank is empty, adjacent tanks full (5A-3-6/Table 1, item 4)
p_b	=	nominal internal cargo pressure, in kN/m^2 (tf/m^2, Ltf/ft^2), at the mid-span of the vertical web on longitudinal bulkhead when center tank is empty, adjacent tanks full (5A-3-2/Table 3, item 13)
β_s	=	$0.9[(\ell_s/\ell_t)(I_t/I_s)]$, 0.10 min. and 0.65 max.
β_b	=	$0.9[(\ell_b/\ell_t)(I_t/I_b)]$, 0.10 min. and 0.50 max.
I_s, I_b	=	moments of inertia, in cm^4 (in^4), clear of the brackets, of side transverse and vertical web on longitudinal bulkhead, respectively

c_2 are given in 5A-3-6/Table 4 of this Guide.

f_t	=	1 for tanks without deck girders
f_t	=	$1 - [0.67/(1 + 2\delta)]$ is not to be taken less than 0.70 for tanks with deck girders
δ	=	$(\ell_g/\ell_t)^3\,(I_t/I_g)$
f_b	=	permissible bending stress, in N/cm^2 (kgf/cm^2, lbf/in^2)
	=	$0.70\, S_m f_y$

S_m and f_y as defined in 5A-3-3/7.3.1 of this Guide.

3.8.2 Web Sectional Area of Deck Transverse

In addition to satisfying the net web sectional area requirements of 5A-3-3/3.7.2, the net sectional area of the web portion of the deck transverse, that is loaded with reactions (forces and moments) from the topside structure, is to be obtained from the following equation:

$$A = F/f_s \quad cm^2\ (in^2)$$

where

F	=	$1000\,k\,(F_p + F_g + c_2\,s\,D\,B_c)$, in N (kgf, lbf)
F_p	=	$\lvert (F_v + F_m) f_1 \rvert$
F_v	=	$\sum_n \left\lfloor P_n (1-\bar{a}_n)^2 (2\bar{a}_n + 1) + \Delta F \right\rfloor$
F_m	=	$6 \sum_n \bar{a}_n (1-\bar{a}_n) M_n / \ell_t$
F_g	=	$c_1\,p_{gi}\,s\,(0.50\ell - h_e)$
k	=	1.0 (1.0, 2.24)
ΔF	=	0 if $\bar{z} \le \bar{a}_n$
	=	$-P_n$ if $\bar{z} > \bar{a}_n$
f_1	=	$1 - [0.5/(1 + 4\delta)]$
c_1	=	1.30 for tanks without deck girder
	=	$0.90\alpha^{1/2}$ for tanks with deck girder, min. 0.50 and max. 1.0
c_2	=	0 for center tank
	=	0.045 for wing tank
ℓ	=	span of the deck transverse, in m (ft), as indicated in 5A-3-3/Figure 2A of this Guide
h_e	=	length of the bracket, in m(ft), as indicated in 5A-3-3/Figures 2A and 2B and 5A-3-3/Figure 9 of this Guide
D	=	depth of a vessel, in m (ft), as defined in 3-1-1/7 of the *Steel Vessel Rules*
B_c	=	breadth of the center tank, in m (ft)
f_s	=	permissible shear stress
	=	$0.45\,S_m f_y$, in N/cm^2 (kgf/cm^2, lbf/in^2)

P_n, M_n, p_{gi}, ℓ_t, s, $\bar{a}_n$, $\bar{z}$, α, δ, S_m and f_y are as defined in 5A-3-6/3.8.1, above.

3.9 Longitudinal Bulkhead Vertical Webs

3.9.1 Section Modulus of Vertical Web on Longitudinal Bulkhead *(1 July 2012)*

(Revise definition of ℓ_b, as follows:)

ℓ_b = span of vertical web, in m (ft), as indicated in 5A-3-6/Figure 1. Where both lower and upper ends of the vertical web are fitted with a bracket of the same or larger size on the opposite side, the span ℓ_b may be taken between the toes of the effective lower and upper brackets.

(Add new Paragraph 5A-3-6/3.10, as follows:)

3.10 Horizontal Girder on Transverse Bulkhead *(1 July 2012)*

3.10.1 Section Modulus of Horizontal Girder on Transverse Bulkhead

The net section modulus of the horizontal girder is to be not less than obtained from the following equation (see also 5A-3-3/1.3).

$SM = M/f_b$ cm^3 (in^3)

$M = 10{,}000kcps\,\ell_b^2$ N-cm (kgf-cm, lbf-in)

where

k = 1.0 (1.0, 0.269)

ℓ_b = span of the horizontal girders, in m (ft), as indicated in 5A-3-6/Figure 1. Where both ends of the horizontal girder are fitted with a bracket of the same or larger size on the opposite side, the span ℓ_b may be taken between the toes of the effective brackets.

s = sum of the half lengths, in m (ft), of the frames supported on each side of the horizontal girder

p = nominal pressure, in kN/m^2 (tf/m^2, Ltf/ft^2), calculated at the mid-span of the horizontal girder under consideration, as specified in 5A-3-2/Table 3

f_b = permissible bending stress, in N/cm^2 (kgf/cm^2, lbf/in^2)

= $0.70\,S_m f_y$

S_m and f_y, as defined in 5A-3-3/7.3.1.

c = 0.83 in wing tanks of vessels for transverse bulkhead without vertical webs

= 0.63 in center tanks of vessels for transverse bulkhead without vertical webs

= $0.73\alpha^2$ for $\alpha < 0.5$ in center tanks of vessels for transverse bulkhead with vertical webs

= $0.467\alpha^2 + 0.0657$ for $0.5 \le \alpha \le 1.0$ in center tanks of vessels for transverse bulkhead with vertical webs

= $0.1973\alpha + 0.3354$ for $\alpha > 1.0$ in center tanks of vessels for transverse bulkhead with vertical webs

c is not to be taken less than 0.013 and need not be greater than 0.73.

α = $0.9(\ell_{st}/\ell_b)[(I/I_v)(s_v/s)]^{1/4}$

if more than one vertical web is fitted on the bulkhead, average values of ℓ_{st}, s_v and I_v are to be used when these values are not the same for each web.

ℓ_{st} = span of the vertical web, in m (ft) (5A-3-6/Figure 1)

s_v = spacing of the vertical webs, in m (ft)

I, I_v = moments of inertia, in cm^4 (in^4), of the horizontal girder and the vertical web clear of the end brackets

3.10.2 Web Sectional Area of the Horizontal Girder on Transverse Bulkhead

The net sectional area of the web portion of the horizontal girder is to be not less than obtained from the following equation:

$A = F/f_s$ cm^2 (in^2)

$F = 1000\, kscp(0.5\ell - h_e)$ N (kgf, lbf)

where

k	=	1.0 (1.0, 2.24)	
c	=	0.80	for transverse bulkheads without vertical webs
	=	$0.72\alpha^{1/2}$	in center tanks of vessels for transverse bulkheads with vertical webs for $\alpha \geq 0.70$
	=	$0.452\alpha^{1/2}$	in center tanks of vessels for transverse bulkheads with vertical webs for $\alpha \geq 0.70$ if depth of centerline vertical web is the same or larger than that of horizontal girder under consideration
	=	$0.887\alpha - 0.02$	in center tanks of vessel for transverse bulkheads with vertical webs for $\alpha < 0.7$, min. 0.1 and max. 0.8
	=	$0.554\alpha - 0.02$	in center tanks of vessel for transverse bulkheads with vertical webs for $\alpha < 0.7$, min. 0.1 and max. 0.8 if depth of centerline vertical web is the same or larger than that of horizontal girder under consideration

ℓ = distance, in m (ft), between longitudinal bulkheads, as indicated in 5A-3-6/Figure 1

s = sum of the half lengths, in m (ft), on each side of the horizontal girder, of the frames supported

h_e = length of the bracket, in m (ft), as indicated in 5A-3-6/Figure 1

p and α are as defined in 5A-3-6/3.10.1.

f_s = permissible shear stress, in N/cm^2 (kgf/cm^2, lbf/in^2)

= $0.45\, S_m f_y$

S_m and f_y are as defined in 5A-3-3/7.3.1.

The equations in 5A-3-6/3.10.1 and 5A-3-6/3.10.2 are not applicable to horizontal girders in wing cargo tanks of vessels where vertical webs exist. In that case, the load effects may be determined from 3D structural analysis as specified in 5A-3-3/1.3.

(Revise Paragraph 5A-3-6/3.11, as follows:)

3.11 Other Main Supporting Members *(1 July 2012)*

The strength and stiffness requirements specified in 5A-3-3/11 and 5A-3-3/15 for deck girders, vertical webs on transverse bulkheads and cross ties are applicable to single hull ship-type installations.

PART 5A SHIP-TYPE INSTALLATIONS

CHAPTER 3 STRUCTURAL DESIGN REQUIREMENTS

APPENDIX 1 DETERMINATION OF ENVIRONMENTAL SEVERITY FACTORS

(Revise Subsection 5A-3-A1/1, as follows:)

1 General *(1 July 2012)*

This Appendix provides information for the determination of ESFs for ship-type installation design criteria to account for site-specific conditions compared to unrestricted service conditions.

The formulations from Part 5A, Chapter 1 and Section 5A-3-2 are modified to reflect the incorporation of various ESF β-types. In the modified formulations, the ESF (β) factors are applied to the dynamic load parameters in the load components.

The general concept of ESF α-types is to compare fatigue damage resulting from different environmental conditions. This type of ESF has two applications. First, it can be used to adjust the fatigue damage induced by the wave-induced dynamic loads at the installation site. Second, it can be used to assess the fatigue damage accumulated during previous services as either a trading vessel or an existing ship-type installation. The α-type ESFs are obtained at different locations for longitudinal stiffeners of the hull structure.

ESF (α) factors are applied to longitudinal stiffener members in the ISE fatigue analysis. ESF (β) factors are applied to the dynamic load components of the load formulations in the ISE strength analysis and the TSA strength and fatigue analysis.

3 ESFs of the Beta (β) Type *(1 July 2012)*

(Revise definition of Ls, as follows:)

Ls = most probable extreme value based on the intended site (100 years return period), transit (10 years return period), repair/inspection (1 year return period) and fatigue (20 years return period) environments for the dynamic load parameters specified in 5A-3-A1/Table 1

PART 5A SHIP-TYPE INSTALLATIONS

CHAPTER 3 STRUCTURAL DESIGN REQUIREMENTS

APPENDIX 2 GUIDE FOR FATIGUE STRENGTH ASSESSMENT OF SHIP-TYPE INSTALLATIONS

5 Fatigue Strength Assessment

(Revise Paragraph 5A-3-A2/5.7, as follows:)

5.7 Cumulative Fatigue Damage *(1 July 2012)*

The content of this section is applicable to ship-type installations. For fatigue strength assessment for service as a trading vessel, refer to 5A-3-A2/21.1.

Unless otherwise specified, the resultant cumulative damage is to be taken as:

$$DM = 0.15DM_1 + 0.35DM_2 + 0.35DM_3 + 0.15DM_4$$

where

DM_i = cumulative fatigue damage ratio for the applicable loading condition *i*, where *i* =1 to 4, as specified in 5A-3-A2/Figure 2, including 8 loading cases, as shown in 5A-3-A2/Tables 2A through 2D

= $f_{i,1\text{-}2}DM_{i,1\text{-}2} + f_{i,3\text{-}4}DM_{i,3\text{-}4} + f_{i,5\text{-}6}DM_{i,5\text{-}6} + f_{i,7\text{-}8}DM_{i,7\text{-}8}$

$f_{i,j\text{-}k}$ = heading probability for loading condition *i*, to be based on submitted actual heading information.

In case the actual heading information is not available prior to application of these requirements, the following table of $f_{i,j\text{-}k}$ factors can be used.

$f_{i,j\text{-}k}$ Factors (1,2,3)

Loading Pair, j-k	*1-2*	*3-4*	*5-6*	*7-8*
Direction	*0*	*90*	*60*	*30*
A	0.40	0.10	0.20	0.30
B	0.60	0.00	0.10	0.30
C	1.00	0.00	0.00	0.00

Notes:

1. When an installation's mooring system type and arrangement, and heading orientation have not been determined prior to application of these requirements, cases A, B and C are to be investigated and more onerous results are to be used.

2. If an installation's mooring system type and arrangement have been determined, but the actual heading information is not available, case A and B are to be used for installations with spread mooring, or, installations with turrets located more than 25% of the installation length aft of the bow, or for locations with non-colinear wind, wave and current conditions regardless of the mooring system. More onerous results of these two cases are to be used.

3. If an installation's mooring system type and arrangement has been determined, but the actual heading information is not available, Case B and C are to be applied for installations with turrets located less than 25% of the installation length aft of the bow. More onerous results of these two cases are to be used.

(Remainder of text is unchanged.)

PART 5A SHIP-TYPE INSTALLATIONS

CHAPTER 3 STRUCTURAL DESIGN REQUIREMENTS

APPENDIX 4 GUIDE FOR FINITE ELEMENT ANALYSIS FOR SHIP-TYPE INSTALLATIONS

9 Element Types

(Revise Items iii), x), and xi) in Paragraph 5A-3-A4/9.1, as follows:)

9.1 Plate Elements

iii) *(1 July 2012)* One element between every web stiffener on transverse and vertical web frames, cross ties and stringers, see 5A-3-A4/Figure 2 and 5A-3-A4/Figure 4.

x) *(1 July 2012)* The bracket flange of a transverse is not to be connected to the longitudinal plating, see 5A-3-A4/Figure 5. An acceptable mesh is shown in 5A-3-A4/Figure 5.

xi) *(1 July 2012)* Typical mesh arrangements of the cargo tank structures are shown in 5A-3-A4/Figure 1.

(Revise Paragraph 5A-3-A4/9.7, as follows:)

9.7 Rod Elements for Face Plates of Primary Supporting Members *(1 July 2012)*

All face plates are to be accounted for and may be modeled by rod elements.

For a typical hull structure, there are numerous secondary flat bars, stiffeners, tripping brackets and panel "breakers". These structural members are mainly to provide local stiffness to plate panels against buckling or vibration. These secondary stiffening members generally need not be included in the global model as their influence on the overall response of the hull structure is negligible.

13 Loading Conditions

(Revise Paragraphs 5A-3-A4/13.5 and 5A-3-A4/13.7, as follows:)

13.5 Target Hull Girder Vertical Bending Moment and Vertical Shear Force *(1 July 2012)*

13.5.1 Hull Girder Vertical Bending Moment

The hull girder vertical bending moment is to reach the following required target value, $M_{v\text{-}targ}$, which is a combination of the rule-required still water bending moment and the wave- induced vertical bending moment, at a section within the length of the middle tank of the three tanks FE model:

$$M_{v\text{-}targ} = M_{sw} + k_u k_c \beta_{VBM} M_{wv}$$

where

M_{sw} = still water bending moment to be applied to the FE load case, as specified in 3-2-1/3.7 of the *Steel Vessel Rules*

M_{wv} = vertical wave bending moment for the dynamic load case under consideration, calculated in accordance with 3-2-1/3.5 of the *Steel Vessel Rules*

β_{VBM} = ESF for vertical bending moments as defined in 5A-3-A1/3

k_u = load factor, is taken as 1.0 as specified in 5A-3-2/Tables 1A through 1C and 5A-3-2/Table 3

k_c = correlation factor, is taken value as specified in 5A-3-2/Tables 1A through 1C and 5A-3-2/Table 3

13.5.2 Hull Girder Vertical Shear Force

The hull girder vertical shear force is to reach the following required F_{targ} value at the forward transverse bulkhead position of the middle tank. The target hull girder vertical shear force is a combination of the rule-required still water shear force and the wave-induced vertical shear force:

$$F_{targ} = F_{sw} + k_u k_c \beta_{VSF} F_{wv}$$

where

F_{sw} = vertical still water shear force to be applied to the FE load case, as specified in 3-2-1/3.9 of the *Steel Vessel Rules*

F_{wv} = vertical wave shear force for the dynamic load case under consideration, calculated in accordance with 3-2-1/3.5 of the *Steel Vessel Rules*

β_{VSF} = ESF for vertical shear force as defined in 5A-3-A1/3

k_u = load factor, is taken as 1.0 as specified in 5A-3-2/Tables 1A through 1C and 5A-3-2/Table 3

k_c = correlation factor, is taken value as specified in 5A-3-2/Tables 1A through 1C and 5A-3-2/Table 3

13.5.3 Balance of Hull Girder Bending Moment and Shear Force

The required target values of hull girder vertical bending moment and shear force are to be achieved in the same load case where required by 5A-3-2/Tables 1A through 1C and 5A-3-2/Table 3. The procedure to apply the required shear force and bending moment distributions is described in 5A-3-A4/15.1.

13.7 Target Hull Girder Horizontal Wave Bending Moment *(1 July 2012)*

The hull girder horizontal wave bending moment at a section within the length of the middle tank of the three tanks FE model is to reach the target value required by the dynamic load case where required by 5A-3-2/Tables 1A through 1C and 5A-3-2/Table 3, calculated in accordance with 5A-3-2/7.3.2.

The procedure to adjust the required hull girder horizontal bending moment is described in 5A-3-A4/15.1.

15 Procedure to Adjust Hull Girder Shear Force and Bending Moment

(Revise Paragraph 5A-3-A4/15.1, as follows:)

15.1 General *(1 July 2012)*

The procedure described in this Subsection is to be applied to adjust the hull girder horizontal bending moment, vertical shear force and vertical bending moment distributions on the three cargo tanks FE model to achieve the required target values.

Vertical distributed loads are applied to each frame position, together with a vertical bending moment applied to the model ends to produce the required target value of vertical shear force at the forward bulkhead of the middle tank of the FE model, and the required target value of vertical bending moment at a section within the length of the middle tank of the FE model. The required target values are specified in 5A-3-A4/13.5.

A horizontal bending moment is applied to the ends of the model to produce the required target value of horizontal bending moment at a section within the length of the middle tank of the FE model. The required values are specified in 5A-3-A4/13.7.

(Revise title of Paragraph 5A-3-A4/15.5 and Subparagraph 5A-3-A4/15.5.2, as follows:)

15.5 Procedure to Adjust Vertical Shear Force Distribution to Target Values *(1 July 2012)*

15.5.2 Adjustment in Shear Forces at Aft and Forward Transverse Bulkheads of Middle Tank of FE Model

The required adjustments in shear forces at the aft and forward transverse bulkheads of the middle tank of the FE model in order to generate the required target shear forces at the bulkheads are given by:

$$\Delta Q_{aft} = -Q_{targ} - Q_{aft}$$

$$\Delta Q_{fwd} = Q_{targ} - Q_{fwd}$$

where

ΔQ_{aft} = required adjustment in shear force at aft bulkhead of middle tank

ΔQ_{fwd} = required adjustment in shear force at forward bulkhead of the middle tank

Q_{targ} = required shear force value to be achieved at forward bulkhead of middle tank, see 5A-3-A4/13.5.2

Q_{aft} = shear force due to local loads at aft bulkhead of middle tank

Q_{fwd} = shear force due to local loads at fore bulkhead of middle tank

(Revise Paragraph 5A-3-A4/15.7, as follows:)

15.7 Procedure to Adjust Vertical and Horizontal Bending Moments to Target Values *(1 July 2012)*

15.7.1 End Vertical Bending Moment

An additional vertical bending moment is to be applied at both ends of the cargo tank finite element model to generate the required target vertical bending moment in the middle tank of the model. This end vertical bending moment can be calculated as follows:

$$M_{v\text{-}end} = M_{v\text{-}targ} - M_{v\text{-}peak}$$

where

$M_{v\text{-}end}$ = additional vertical bending moment to be applied at both ends of finite element model

$M_{v\text{-}targ}$ = required target hogging (positive) or sagging (negative) vertical bending moment, as specified in 5A-3-A4/13.5.1

$M_{v\text{-}peak}$ = maximum or minimum bending moment within the length of the middle tank due to the local loads described in 5A-3-A4/15.3.3 and the additional vertical loads applied to generate the required shear force, see 5A-3-A4/15.5. $M_{v\text{-}peak}$ is to be taken as the maximum bending moment if $M_{v\text{-}targ}$ is hogging (positive) and as the minimum bending moment if $M_{v\text{-}targ}$ is sagging (negative). $M_{v\text{-}peak}$ can be obtained from FE analysis. Alternatively, $M_{v\text{-}peak}$ may be calculated as follows based on a simply supported beam model:

= $\max\{M_o + xF + M_{lineload}\}$

M_o = vertical bending moment at position x, due to the local loads described in 5A-3-A4/15.3.3

$M_{lineload}$ = vertical bending moment at position x, due to application of vertical line loads at frames to generate required shear force, see 5A-3-A4/15.5

F = reaction force at ends due to application of vertical loads to frames, see 5A-3-A4/15.5

x = longitudinal position of frame in way of the middle tank of FE model from end, see 5A-3-A4/15.5

15.7.2 End Horizontal Bending Moment

For beam and oblique sea load cases, an additional horizontal bending moment is to be applied at the ends of the cargo tank FE model to generate the required target horizontal bending moment at a section within the length of the middle tank of the model. The additional horizontal bending moment can be calculated as follows:

$$M_{h\text{-}end} = M_{h\text{-}targ} - M_{h\text{-}peak}$$

where

$M_{h\text{-}end}$ = additional horizontal bending moment to be applied to ends of FE model

$M_{h\text{-}targ}$ = required positive or negative target horizontal bending moment, see 5A-3-A4/13.7

$M_{h\text{-}peak}$ = maximum or minimum horizontal bending moment within the length of the middle tank due to the local loads described in 5A-3-A4/13.3.3. $M_{h\text{-}peak}$ is to be taken as the maximum horizontal bending moment if $M_{h\text{-}targ}$ is positive (starboard side in tension) and as the minimum horizontal bending moment if $M_{h\text{-}targ}$ is negative (port side in tension).

15.7.3 Application of End Bending Moments to Achieve Target Values

The vertical and horizontal bending moments are to be calculated over the length of the middle tank of the FE model to identify the position and value of each maximum/minimum bending moment as specified in 5A-3-A4/15.7.1 and 5A-3-A4/15.7.2.

The additional vertical bending moment, $M_{v\text{-}end}$, and horizontal bending moment, $M_{h\text{-}end}$, are to be applied to both ends of the cargo tank model.

The vertical and horizontal bending moments may be applied at the model ends by distributing axial nodal forces to all longitudinal elements according to the simple beam theory as follows:

$$(F_x)_i = \frac{M_{v-end}}{I_z}\frac{A_i}{n_i}y_i \qquad \text{for vertical bending moment}$$

$$(F_x)_i = \frac{M_{h-end}}{I_y}\frac{A_i}{n_i}z_i \qquad \text{for horizontal bending moment}$$

where

$M_{v\text{-}end}$ = vertical bending moment to be applied to the ends of the model

$M_{h\text{-}end}$ = horizontal bending moment to be applied to the ends of the model

$(F_x)_i$ = axial force applied to a node of the *i*-th element

I_z = hull girder vertical moment of inertial of the end section about its horizontal neutral axis

I_y = hull girder horizontal moment of inertial of the end section about its vertical neutral axis (normally centerline)

y_i = vertical distance from the neutral axis to the centre of the cross sectional area of the *i*-th element

z_i = horizontal distance from the neutral axis to the centre of the cross sectional area of the *i*-th element

A_i = cross sectional area of the *i*-th element

n_i = number of nodal points of *i*-th element on the cross section, n_i = 2 for 4-node plate element

17 Boundary Conditions

(Revise Paragraph 5A-3-A4/17.1, as follows:)

17.1 General *(1 July 2012)*

All boundary conditions described in this Subsection are in accordance with the global co-ordinate system defined in 5A-3-A4/7. The boundary conditions to be applied at the ends of the cargo tank FE model are given in 5A-3-A4/Table 2. The analysis may be carried out by applying all loads to the model as a complete load case or by combining the stress responses resulting from several separate sub-cases.

Ground spring elements (i.e., spring elements with one end constrained in all 6 degrees of freedom) with stiffness in global *z* degree of freedom are to be applied to the grid points along deck, inner bottom and bottom shell as shown in 5A-3-A4/Figure 9.

Ground spring elements with stiffness in global *y* degree of freedom are to be applied to the grid points along the vertical part of the side shells, inner hull longitudinal bulkheads and oil-tight longitudinal bulkheads as shown in 5A-3-A4/Figure 9.

21 Detailed Stress Assessment – Local FEA

21.5 Analysis Criteria

(Revise Subparagraph 5A-3-A4/21.5.1, as follows:)

21.5.1 Allowable Stress *(1 July 2012)*

Von Mises equivalent stresses in plate elements and axial stresses in line elements within refined areas are not to exceed the allowable stresses defined in 5A-3-4/13.3.

PART 5A SHIP-TYPE INSTALLATIONS

CHAPTER 3 STRUCTURAL DESIGN REQUIREMENTS

APPENDIX 5 OFFSHORE HULL CONSTRUCTION MONITORING PROGRAM *(1 July 2012)*

(Add new Appendix 5A-3-A5, as follows:)

1 Introduction

The structural strength criteria specified in the ABS Rules are used by designers to establish acceptable scantlings in order for vessels constructed to such standards and properly maintained will to have adequate durability and capability to resist the failure modes of yielding, buckling and fatigue.

The application of the FPI Guide and other review techniques to assess a design for compliance with Rule criteria also gives the designer and ABS the ability to identify areas that are considered critical to satisfactory in-service performance.

Knowing that the actual structural performance is also a function of construction methods and standards, it is prudent to identify ‘critical’ areas, particularly those approaching design limits, and use appropriate specified construction quality standards and associated construction monitoring and reporting methods to limit the risk of unsatisfactory in-service performance.

Accordingly, this Appendix defines what is meant by critical areas, describes how they are to be identified and recorded, delineates what information the shipyard is to include in the construction monitoring plan and lays out the certification regime to be followed.

3 Application

Ship-type installations designed and reviewed to the FPI Guide are to comply with the requirements of this Appendix and have the notation **OHCM**.

5 Critical Area

The term critical area, as used in this Guide, is defined as an area within the structure that may have a higher probability of failure during the life of the vessel compared to the surrounding areas, even though they may have been modified in the interest of reducing such probability. The higher probability of failure can be a result of stress concentrations, high stress levels and high stress ranges due to loading patterns, structural discontinuities or a combination of these factors.

In order to provide an even greater probability of satisfactory in-service performance, the areas that are approaching the acceptance criteria can be identified so that additional attention may be paid during fabrication.

The objective of heightened scrutiny of building tolerance and monitoring in way of the critical areas is to minimize the effect of stress increases incurred as a result of the construction process. Improper alignment and fabrication tolerances may be potentially influential in creating construction-related stress.

7 Determination of Critical Areas

Critical areas can be determined in a number of ways, including but not limited to:

i) The results of engineering strength and fatigue analyses, such as specified in the *FPI Guide*, Finite Element Analysis or a Dynamic Loading Approach analysis, particularly for areas approaching the allowable criteria.

ii) The application of ABS Rules, such as 3-1-2/15.3.

iii) Details where fabrication is difficult, such as blind alignment, complexity of structural details and shape, limited access, etc.

iv) Input from owners, designers and/or shipyards based on previous in-service experience from similar vessels, such as corrosion, wear and tear, etc.

9 Construction Monitoring Plan

The Construction Monitoring Plan for critical areas is to be prepared by the shipyard and submitted for ABS approval prior to the start of fabrication. The plan is to include:

i) Structural drawings indicating the location of critical areas as identified by the ABS review (see 5A-3-A5/7)

ii) Construction standards and control procedures to be applied

iii) Verification and recording procedures at each stage of construction, including any proposed nondestructive testing

iv) Procedures for defect correction

An approved copy of the Construction Monitoring Plan is to be placed onboard the floating installation.

11 Surveys After Construction

To monitor critical areas during service, an approved copy of the Construction Monitoring Plan is to be available on board for all subsequent surveys.

13 Notation

Ship-type installations having been found in compliance with the requirements of this Guide may be distinguished in the *Record* with the notation **OHCM**.

PART 5B OTHER INSTALLATION TYPES

CHAPTER 1 COLMUN-STABILIZED INSTALLATIONS

SECTION 2 STRUCTURES

5 Engineering Analysis of the Installation's Primary Structure

5.1 Hull and Topside Deck Structure

5.1.6 Acceptance Criteria

(Revise Items 5B-1-2/5.1.6(a) and 5B-1-2/5.1.6(c), as follows:)

5.1.6(a) Material Yielding (1 July 2012). For the hull and topside deck structure, the yielding criteria based on the safety factors in 5B-1-2/Table 1 are to be used for bar and beam elements. For plate structures the allowable von Mises equivalent stress is to be 0.7 of the yield strength for the Design Operating and Loadout Conditions, and 0.9 of the yield strength for the Design Environmental, Transit and Damaged Conditions.

Note: The yield strength is to be based on the specified minimum yield point or yield stress as defined in 2-1-1/13 of the ABS *Rules for Materials and Welding (Part 2)* for higher strength material or 72 percent of the specified minimum tensile strength, whichever is the lesser.

5.1.6(c) Fatigue (1 July 2012). For the hull, including the main intersections defined in 5B-1-2/5.1.3, the fatigue damages can be calculated using the ABS Offshore S-N curves for environment in air, in seawater with cathodic protection, and free corrosion, as specified in Section 3 of the ABS *Guide for the Fatigue Assessment of Offshore Structures*. The S-N curves are applicable to thicknesses that do not exceed the reference thickness of 22 mm ($^{7}/_{8}$ in.). For members of greater thickness, thickness correction is to be applied with an exponent of 0.25. Other recognized standards equivalent to ABS requirements are also acceptable.

The fatigue life is determined by safety factors and the design life of the column-stabilized installation. Safety factors depend on the inspectability, repairability, redundancy, the ability to predict failure damage, as well as the consequence of failure of the structure. Minimum safety factor requirements are listed in 5B-1-2/Table 2.

TABLE 2
Safety Factors for Fatigue Life of Hull, Integrated Deck, and Column Top Frame *(1 July 2009)*

Importance	*Inspectable and Field Repairable*	
	Yes	*No*
Non-critical	3	5
Critical	5	10

Note: "Critical" implies that failure of these structural items would result in the rapid loss of structural integrity and produce an event of unacceptable consequence.

For topside deck structure, ABS Offshore S-N curves and AWS S-N curves can be used. 5B-1-2/Table 3 provides general safety factor requirements for fatigue life.

(Add new 5B-1-2/Table 3, as follows:)

TABLE 3
Safety Factors for Fatigue Life of Topside Deck Structures *(1 July 2012)*

Importance	*Inspectable and Field Repairable*	
	Yes	*No*
Non-critical	2	5
Critical	3	10

Note: "Critical" implies that failure of these structural items would result in the rapid loss of structural integrity and produce an event of unacceptable consequence.

For existing installations, the remaining fatigue life of the installation is to be assessed and the supporting calculations are to be submitted for review. Special consideration is to be given to the effects of corrosion and wastage on the remaining fatigue life of existing structures.

Any areas determined to be critical to the structure are to be free of cracks, and the effects of stress risers is to be determined and minimized. Critical areas may require special analysis and survey.

PART 5B OTHER INSTALLATION TYPES

CHAPTER 1 COLMUN-STABILIZED INSTALLATIONS

SECTION 3 STABILITY

(Revise Subsection 5B-1-3/1, as follows:)

1 Stability *(1 July 2012)*

1.1 Transit Voyage Stability

Stability during wet tow to location is to comply with Coastal and Flag State requirements. If personnel will be on board during the tow, the stability is to meet the criteria for column-stabilized units in the ABS *MODU Rules* at all transit drafts in association with wind speeds to be agreed with ABS based on the environmental parameters and procedures associated with the tow route.

During the installation phase (ballasting and deballasting on site), the installation is to have a positive metacentric height (GM) after correction for free surface effects. When evaluating GM, the effect of free surface from partially filled tanks during the ballasting/deballasting sequence is to be considered.

1.3 On-Site Stability

All installations are to have positive metacentric height (GM) in calm water equilibrium position for all afloat conditions after correction for free surface effects. The minimum GM used in design is to be specified by the designer and included in the operations manual.

Installations are to comply with the intact and damage stability criteria of 3-3-2/1 and 3-3-2/3 of the *MODU Rules* using the site-specific wind or 50 knots (25.7 m/s), whichever is greater. Height profile is to be taken from the *MODU Rules* or other recognized standard.

i) *Wind speed for normal operations* V_n – the 1-year, 1-minute average wind in the DOC as defined in 5B-3-1/5.3

ii) *Wind speed for storm survival* V_s – the 100-year, 1-minute average wind in the DEC as defined in 5B-3-1/5.3

iii) *Wind speed for damage conditions* V_d – the 1-year 1-minute average wind in the DOC as defined in 5B-3-1/5.3

The design wind velocities are to be selected by the designer and submitted with the design documentation.

1.5 Lightweight and Center of Gravity

The inclining test required by 3-3-1/3 of this Guide is to be carried out while the installation is floating at a draft where pontoons are submerged. Braces or other structures should not affect the waterplane properties at any point during the test.

Alterations in the lightweight data during service (e.g., new equipment, structural modifications) are to be recorded in the operation manual and be taken into account in daily operation.

1.7 Watertight and Weathertight Integrity

Watertight and weathertight integrity are to be established in accordance with 3-3-2/5 of the *MODU Rules*.

1.9 Penetrations

Penetrations are to comply with 3-3-2/5.5 of the *MODU Rules*.

Cable penetrations are to be installed in accordance with the manufacturer's specifications and procedures. Evidence of prototype testing at the water pressure of the watertight boundary under consideration is to be provided.

PART 5B OTHER INSTALLATION TYPES

CHAPTER 1 COLMUN-STABILIZED INSTALLATIONS

SECTION 4 MACHINERY AND SYSTEMS

(Revise Subsection 5B-1-4/9, as follows:)

9 Hydrocarbon Storage in Hull Tanks *(1 July 2012)*

If the Column-Stabilized Installation is designed to store hydrocarbons in hull tanks, criteria for hull storage of hydrocarbons are to meet flag and coastal state requirements and applicable international requirements. The designs for scantlings and strength for such storage tanks are to be in accordance with 5B-1-2/1. See 3-5/5.9 of the *Facilities Guide* for the storage facility arrangement requirements.

PART 5B **OTHER INSTALLATION TYPES**

CHAPTER 2 **TENSION LEG PLATFORMS**

SECTION 2 **STABILITY**

1 Stability

(Revise Paragraph 5B-2-2/1.1, as follows:)

1.1 Intact and Damaged Stability *(1 July 2012)*

Stability during wet tow to location is to comply with Coastal and Flag State requirements. If personnel will be on board during the tow, the stability is to meet the criteria for column-stabilized units in the ABS *MODU Rules* at all transit drafts in association with wind speeds to be agreed with ABS based on the environmental parameters and procedures associated with the tow route.

During the installation phase (ballasting and deballasting for tendon connection), the installation is to have a positive metacentric height (GM) after correction for free surface effects. When evaluating GM, the effect of free surface from partially filled tanks during the ballasting/deballasting sequence is to be considered.

Under in-place conditions, positive tendon tension is to be maintained to ensure integrity of the platform and tendons, and account for tendon slacking. The intact condition is to include the full range of possible center of gravity variations permitted by acceptable operating procedures during severe conditions.

The TLP is to maintain positive tendon tension in Design Operating Condition (DOC) after sustaining any one of the following flooding scenarios:

i) Any one compartment at or below the still water line, or

ii) Damage is assumed to be 3 m (10 ft) wide and 3 m (10 ft) high with a horizontal penetration of 1.5 m (5 ft) inboard of the hull plating. This extent of damage is to be considered at all levels between 3 m (10 ft) below to 5 m (16.4 ft) above the waterline in consideration. No vertical bulkhead needs to be considered damaged unless the nearest vertical bulkhead is placed closer than $^1/_8$ of the perimeter of the column at the waterline or 3 m (10 ft), whichever is less, or

iii) Any one tendon compartment.

The environmental condition is to be assumed as Design Operating Condition at the time of flooding. Positive tendon tension is to be demonstrated through analysis. Ballast pump capacity is to meet API RP 2T specifications.

The ability to compensate for damage incurred, by pumping out or ballasting other compartments, is not to be considered when determining whether positive tendon tension can be maintained.

(Revise Paragraph 5B-2-2/1.3, as follows:)

1.3 Weight Control *(1 July 2012)*

An inclining test is to be conducted to accurately determine the platform weight and the position of the center of gravity. If integration of topsides takes place offshore, an alternative procedure may be applied using an inclining test or lightweight survey of the hull combined with weighing of the topside components to be installed.

A global weight verification plan is to be submitted. Procedures for the lightweight survey, each weighing, and permanent ballast measurement are to be submitted for approval and are to include estimates of weight and center of gravity. An ABS surveyor is to attend each activity.

When weighing components, these parts are to be as complete as possible with not more than 2% of the weight of the component remaining to be incorporated.

The result of each weight verification activity is to be compared to the estimated weight. When the measured weight is within ±1% of the estimated weight, the vertical center of gravity is to be the estimated value in the calculation. When it is outside the 1% tolerance, the vertical center of gravity is to be computed by taking the difference between the estimated and the measured weight and placing it at an indisputably conservative location.

Changes of onboard load conditions after the inclining test and during service are to be carefully accounted for. The operations manual is to provide guidance for the maintenance of a weight change log and periodical correlation between calculated and measured tendon tension. The weight log and the records of the periodical correlations are to be kept onboard.

3 Watertight/Weathertight Integrity *(1 September 2007)*

(Revise Paragraph 5B-2-2/3.3, as follows:)

3.3 Watertight Integrity *(1 July 2012)*

All internal and external openings whose lower edges are below the levels to which watertight integrity is to be ensured, as shown by the diagrams submitted in accordance with 5B-3-2/3, are to be fitted with appliances to ensure watertight integrity.

3.3.1 Internal Openings

Internal openings fitted with appliances to ensure watertight integrity are to comply with the following.

3.3.1(a) Doors and hatches are to be of the quick-acting type and an indicating system (e.g., light signals) is to be provided showing personnel, both locally and at a normally manned central position, whether the doors or hatches in question are open or secured closed. In addition, a sign is to be posted near the opening to the effect that the closing appliance is to be secured closed and opened only during actual use. If sliding doors are fitted they are to be capable of being remotely controlled from a normally manned central position as well as being operable locally from both sides of the bulkhead.

3.3.1(b) Manholes fitted with bolted covers need not be dealt with as under 5B-2-2/3.3.1(a).

3.3.1(c) The closing appliances are to have strength, tightness and means for securing which are sufficient to maintain watertightness under the water pressure of the watertight boundary under consideration.

3.3.2 External Openings

External openings are to comply with the following.

3.3.2(a) The lower edges of all openings, including air pipes, ventilators, ventilation intakes and outlets (regardless of closing appliances), non-watertight hatches and weathertight doors, are to be above the levels to which watertight integrity is to be ensured.

3.3.2(b) Manholes fitted with bolted covers need not be dealt with as under 5B-2-2/3.3.2(a).

3.3.2(c) External openings fitted with appliances to ensure watertight integrity are normally to be secured closed and are to comply with the requirements of 5B-2-2/3.3.1.

(Revise Paragraph 5B-2-2/3.5, as follows:)

3.5 Penetrations *(1 July 2012)*

Where watertight bulkheads and flats are necessary for damage stability, they are to be made watertight throughout. Where individual lines, ducts or piping systems serve more than one compartment or are within the extent of damage, satisfactory arrangements are to be provided to preclude the possibility of progressive flooding through the system. Valves fitted at watertight boundaries are to be operable from above the top of the hull.

Cable penetrations are to be installed in accordance with the manufacturer's specifications and procedures. Evidence of prototype testing at the water pressure of the watertight boundary under consideration is to be provided.

PART 5B OTHER INSTALLATION TYPES

CHAPTER 2 TENSION LEG PLATFORMS

SECTION 3 HULL AND PRIMARY STRUCTURES

5 Structural Strength Analysis and Design of Primary Structures

5.1 Hull, Integrated Deck and Top Column Frame

5.1.6 Acceptance Criteria

(Revise Item 5B-2-3/5.1.6(a), as follows:)

5.1.6(a) Material Yielding (1 July 2012). For the hull, integrated deck and column top frame, the yielding criteria indicated in 3-2-1/3 of the *MODU Rules* is to be used. The safety factors in 5B-2-3/Table 1 of this Guide are to be used for bar and beam elements. For plated structures the allowable von Mises equivalent stress is to be 0.7 of the yield strength for the Design Operating, Loadout and Deck Installation Conditions, and 0.9 of the yield strength for the Design Environmental, Transit and Damaged Conditions.

The yield strength is to be based on the specified minimum yield point or yield stress, as defined in 2-1-1/13 of the ABS *Rules for Materials and Welding (Part 2)* for higher strength material.

5.3 Non-integrated Deck

5.3.4 Allowable Stresses

(Revise Item 5B-2-3/5.3.4(d), as follows:)

5.3.4(d) (1 July 2012) For any two- or three-dimensional stress field within the scope of the working stress formulation, the equivalent stress (e.g., the von Mises stress intensity) is to be used in the design. The allowable von Mises stress is to be 0.7 of the yield strength for the Design Operating Condition (DOC) and 0.9 of the yield strength for the Design Environmental Condition (DEC). For highly localized areas, local yielding of the structure may be accepted, provided it can be demonstrated that such yielding does not lead to progressive collapse of the overall structure and that the general structural stability is maintained.

(Revise 5B-2-3/Table 3, as follows:)

TABLE 3
Safety Factors for Fatigue Life of Topside Deck Structures *(1 July 2012)*

Importance	*Inspectable and Field Repairable*	
	Yes	*No*
Non-critical	2	5
Critical	3	10

Note: "Critical" implies that failure of these structural items would result in the rapid loss of structural integrity and produce an event of unacceptable consequence.

PART 5B OTHER INSTALLATION TYPES

CHAPTER 3 SPAR INSTALLATIONS

SECTION 1 GENERAL REQUIREMENTS

7 Global Performance Analyses

(Add new Paragraph 5B-3-1/7.6, as follows:)

7.6 Maximum Inclination *(1 July 2012)*

The maximum angles of inclination in the storm survival, operating, and damage conditions in applicable DOC or DEC environment (see 5B-3-1/1.5.1) are to be established with consideration of the following:

i) Static and dynamic inclination limits of equipment and machinery on board the installation

ii) Strength of the mooring system, risers and umbilicals

Inclinations may be determined based on model tests or analytical methods.

PART 5B OTHER INSTALLATION TYPES

CHAPTER 3 SPAR INSTALLATIONS

SECTION 2 STABILITY

(Revise Subsection 5B-3-2/1, as follows:)

1 Stability *(1 July 2012)*

1.1 Wet Tow

Stability during wet tow to location is to comply with Coastal State requirements.

1.3 Installation

After the upending and during the installation phase, the installation is to have a positive metacentric height (GM). If the installation is to accommodate personnel during the installation and commissioning the installation's stability are to fully comply with in-service stability specified on 5B-3-2/1.5. The installation analysis is to be submitted for review.

1.5 In-Service Stability

The stability calculations are to reflect the actual configuration of the spar while afloat. Free flooding compartments are not accounted for in assessment of the installation's stability. In case the permanent ballast is installed in a free flooding compartment, the net weight of the permanent ballast (using the in-water density) is to be included in the loading calculation.

1.5.1 Environmental Loads

Installations are to comply with the intact and damage stability criteria presented below, using the site-specific wind or 50 knots (25.7 m/s), whichever is greater. Height profile is to be taken from the *MODU Rules* or other recognized standard.

i) *Wind speed for normal operations* V_n – the 1-year, 1-minute average wind in the DOC as defined in 5B-3-1/5.3

ii) *Wind speed for storm survival* V_s – the 100-year, 1-minute average wind in the DOC as defined in 5B-3-1/5.3

iii) *Wind speed for survival after damage* V_d – the 1-year 1-minute average wind in the DOC as defined in 5B-3-1/5.3

iv) *Current Speed* – The current at surface associated with the adopted wind speed as defined above.

The design wind and current velocities are to be selected by the designer and submitted with the design documentation.

1.5.2 Heeling Moment

Heeling moments represent an idealization of the total environmental force on the installation. For purposes of stability calculations they are taken as the moments, which result from wind forces on the installation at the speeds specified in 5B-3-2/1.5.1 and calculated in accordance with 3-2-4/7.1.

For each draft of the designated range of operating drafts, the wind heeling moment is to be calculated assuming the installation in the upright position for all directions. The critical wind direction is the direction that produces the greatest wind heeling moment. The analysis will assume this determined critical wind heeling moment acting in all directions and constant over the range of inclination angles.

The lever for the heeling moment is to consider the wind center of pressure and the attachment point of the mooring lines. In case that the current force increases the heeling moment, the adverse effect of the current is to be considered in the heeling moment lever calculation. The current force on the hull is to be calculated as shown in 3-2-4/5.

Heeling force and center of pressure derived from wind tunnel tests on a representative model of the installation may be considered alternatively. The wind profile to be adopted for wind tunnel tests is defined on 3-2-4/7.1 or a more conservative profile.

1.5.3 Stability Criteria

The installation is to meet stability requirements of this subparagraph for each mode of operation at all drafts in design. Other standards may be acceptable during abnormal operations, with due consideration to the hazards associated with the operation. Such operations and standards are to be submitted for approval.

The installation is to have positive metacentric height (GM) in calm water equilibrium position and the vertical center of buoyancy is to be above the height of center of gravity in all conditions.

1.5.3(a) Intact Stability Criteria. The area under the righting moment curve at 30 degrees is to reach a value of not less than 30% in excess of the area under the overturning moment curve to the same limiting angle. In all cases, the righting moment curve is to be positive over the entire range of angles from upright and all downflooding angles are to be greater than 30 degrees.

1.5.3(b) Damage Stability Criteria. After damage by collision or accidental flooding as described in 5B-3-2/1.5.3(b)i) and 5B-3-2/1.5.3(b)ii) respectively, the unit is to meet the following criteria:

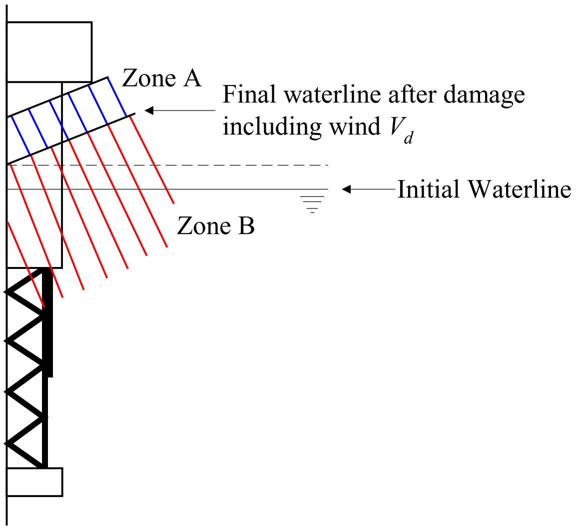
The final waterline, after damage with a wind speed V_d, is not to exceed the level of watertight integrity and is to be 1.5 m (5 ft) below any unprotected opening that could lead to further flooding of the hull or the lowest point of the hull upper deck, whichever is lower.

i) *Collision Damage.* Damage is assumed to be 3 m (10 ft) wide and 3 m (10 ft) high with a horizontal penetration of 1.5 m (5 ft) inboard of the hull plating. This extent of damage is to be considered at all levels between 3 m (10 ft) below to 5 m (16.4 ft) above the waterline in consideration.

Where a watertight flat is located within this zone, the damage is to be assumed to have occurred in both compartments above and below the watertight flat in question.

The distance between effective watertight bulkheads or their nearest stepped portions which are positioned within the assumed extent of horizontal penetration is to be not be less than 3.0 m (10 ft). Where there is a lesser distance, one or more of the adjacent bulkheads are to be disregarded.

FIGURE 1
Zones of Weathertight and Watertight Integrity *(1 September 2007)*



Zone A: (Minimum 1.5 m (5 ft) above final waterline after damage with wind V_d) - Zone of weathertight integrity

Zone B: (Below final waterline after damage with wind V_d) - Zone of watertight integrity

ii) *Accidental Flooding.* Any compartment at or below the waterline in consideration is to be assumed independently flooded, regardless of exposure and source of the assumed flooding.

When access openings are fitted on watertight divisions between compartments to provide access to one or more compartments, the compartments are to be assumed flooded simultaneously. Multiple compartment flooding may be dispensed, provided the following measures are taken to avoid operations that can result in the accidental flooding of such compartments when the covers are removed:

- Warning (or Notice) plates, e.g., "Watertight Door (or Hatch) – Keep closed" are placed on the access opening covers.
- Instructions and warnings are provided in the operations manual.
- System locks are available to prevent unintentional ballasting operations, where either compartment designed for ballast tank.
- The compartment can be pumped or blown dry without removal of the access cover.

The operations manual is to include guidance for operating personnel in determining the cause of unexpected inclination or draft changes and assessing the potential effects of corrective measures on stability and buoyancy.

1.7 Lightweight and Center of Gravity

The lightweight and center of gravity of the installation are to be established by a combination of a hull lightweight survey, measurement of permanent ballast and weighing of the major components. There are to be at least two (2) separate measures of the permanent ballast.

A global weight verification plan is to be submitted. Procedures for the lightweight survey, each weighing, and permanent ballast measurement are to be submitted for approval and are to include estimates of weight and center of gravity. An ABS surveyor is to attend each activity.

When weighing components, these parts are to be as complete as possible with not more than 2% of the weight of the component remaining to be incorporated.

The result of each weight verification activity is to be compared to the estimated weight. When the measured weight is within ±1% of the estimated weight, the vertical center of gravity is to be the estimated value in the calculation. When it is outside the 1% tolerance, the vertical center of gravity is to be computed by taking the difference between the estimated and the measured weight and placing it at an indisputably conservative location.

Reports of the results of each weight verification activity are to be submitted for review. An overall lightweight calculation, considering all individual approved lightweight components, is to be submitted for review.

Alterations in the lightweight data during service (e.g., new equipment, structural modifications) are to be recorded in the operation manual and be taken into account in daily operation.

(Revise Subsection 5B-3-2/3, as follows:)

3 Watertight/Weathertight Integrity *(1 July 2012)*

A plan, identifying the disposition (open or closed) of all non-automatic closing devices and locations of all watertight and weathertight closures, and unprotected openings is to be submitted for review prior to the unit's delivery. Upon satisfactory review the plan is to be incorporated into the Operating Manual.

3.1 Weathertight Integrity

External openings whose lower edges are below the levels to which weathertight integrity is to be ensured are to have weathertight closing appliances.

Openings fitted with appliances to ensure weathertight integrity are to effectively resist the ingress of water due to intermittent immersion of the closure.

3.3 Watertight Integrity

All internal and external openings whose lower edges are below the levels to which watertight integrity is to be ensured, as shown by the diagrams submitted in accordance with 5B-3-2/3, are to be fitted with appliances to ensure watertight integrity.

3.3.1 Internal Openings

Internal openings fitted with appliances to ensure watertight integrity are to comply with the following.

3.3.1(a) Doors and hatches are to be of the quick-acting type and an indicating system (e.g., light signals) is to be provided showing personnel, both locally and at a normally manned central position, whether the doors or hatches in question are open or secured closed. In addition, a sign is to be posted near the opening to the effect that the closing appliance is to be secured closed and opened only during actual use. If sliding doors are fitted they are to be capable of being remotely controlled from a normally manned central position as well as being operable locally from both sides of the bulkhead.

3.3.1(b) Manholes fitted with bolted covers need not be dealt with as under 5B-3-2/3.3.1(a).

3.3.1(c) The closing appliances are to have strength, tightness and means for securing which are sufficient to maintain watertightness under the water pressure of the watertight boundary under consideration.

3.3.2 External Openings

External openings are to comply with the following.

3.3.2(a) The lower edges of all openings, including air pipes, ventilators, ventilation intakes and outlets (regardless of closing appliances), non-watertight hatches and weathertight doors, are to be above the levels to which watertight integrity is to be ensured.

3.3.2(b) Manholes fitted with bolted covers need not be dealt with as under 5B-3-2/3.3.2(a).

3.3.2(c) External openings fitted with appliances to ensure watertight integrity are normally to be secured closed and are to comply with the requirements of 5B-3-2/3.3.1.

3.5 Penetrations

Where watertight bulkheads and flats are necessary for damage stability, they are to be made watertight throughout. Where individual lines, ducts or piping systems serve more than one compartment or are within the extent of damage, satisfactory arrangements are to be provided to preclude the possibility of progressive flooding through the system. Valves fitted at watertight boundaries are to be operable from above the top of the spar hull.

Cable penetrations are to be installed in accordance with the manufacturer's specifications and procedures. Evidence of prototype testing at the water pressure of the watertight boundary under consideration is to be provided.

PART 5B OTHER INSTALLATION TYPES

CHAPTER 3 SPAR INSTALLATIONS

SECTION 3 HULL AND PRIMARY STRUCTURES

5 Structural Analysis and Design of Primary Structures

5.1 Hull Structure

5.1.6 Acceptance Criteria

(Revise Item 5B-3-3/5.1.6(a), as follows:)

5.1.6(a) Material Yielding (1 July 2012). For the hull, the yielding criteria indicated in 3-2-1/3 of the *MODU Rules* are to be used. For the truss space frame of the mid-section, the yielding criteria in Chapter 3 of API RP 2A are to be used. The safety factors in 5B-3-3/Table 1 of this Guide are to be used for bar and beam elements. For plated structures the allowable von Mises equivalent stress is to be 0.7 of the yield strength for the Design Operating, Loadout, Upending and Topsides Installation Conditions, and 0.9 of the yield strength for the Design Environmental, Transit and Damaged Conditions.

The yield strength is to be based on the specified minimum yield point or yield stress, as defined in 2-1-1/13 of the ABS *Rules for Materials and Welding (Part 2)* for higher strength material.

5.3 Topside Deck

5.3.4 Allowable Stresses

(Revise Item 5B-2-3/5.3.4(d), as follows:)

5.3.4(d) (1 July 2012) For any two- or three-dimensional stress field within the scope of the working stress formulation, the equivalent stress (e.g., the von Mises stress intensity) is to be used in the design. The allowable von Mises stress is to be 0.7 of the yield strength for the Design Operating Condition (DOC) and 0.9 of the yield strength for the Design Environmental Condition (DEC). For highly localized areas, local yielding of the structure may be accepted, provided it can be demonstrated that such yielding does not lead to progressive collapse of the overall structure and that the general structural stability is maintained.

PART 6 MOORING SYSTEMS

CHAPTER 1 POSITION MOORING SYSTEMS

SECTION 1 MOORING SYSTEM

(Revise Subsection 6-1-1/13, as follows:)

13 Mooring Equipment *(1 July 2012)*

Mooring equipment for Floating Installations includes winches, windlasses, chain, wire rope, in-line buoys and fairleads. Anchors and single point mooring mechanical systems are addressed elsewhere in this Chapter.

For the review of mooring equipment, ABS will apply the published ABS requirements for such equipment. In instances where ABS does not have published requirements, the equipment will be reviewed for compliance with applicable recognized industry standards. The applicable references to ABS publications and industry standards are listed below:

- *Buoyancy Tanks* ASME Boiler and Pressure Vessel Code
- *Chain* ABS *Offshore Mooring Chain Guide*
- *Synthetic Ropes* ABS *Synthetic Ropes Guidance Notes*
- *Wire Rope* API Spec 9A and RP 9B

In general, the design load for the fairlead and its connection to the installation is the breaking strength of the mooring line.

Chain stoppers used in position mooring systems are to be designed for the breaking strength of the mooring line. The fatigue life for inspectable chain stoppers is not to be less than three times the service life. For chain stoppers that cannot be readily inspected, the fatigue life is to be at least 10 times the service life. The chain stoppers are to be function tested at the specified proof load to the satisfaction of the attending Surveyor. Position mooring systems without chain stoppers will be specially considered.

For a winch intended for mooring line hook-up and future retensioning activities, the equipment needs to be in compliance with recognized industry standards. The manufacturer needs to submit details to demonstrate compliance with the industry standards, either in the form of certificates issued by recognized certification bodies or by submitting details and calculations to ABS for review and approval.

(Revise title of Part 7 and add new Part 7, Chapter 1, as follows:)

PART 7 SURVEYS

CHAPTER 1 SURVEYS DURING INSTALLATION AND COMMISSIONING *(1 July 2012)*

SECTION 1 GENERAL

1 General

The requirements in this Chapter apply to the ABS approved procedures and the surveys to be performed on any type of Floating Production Installation (FPI).

Prior to carrying out the on-site installation, the ABS approved installation procedures are to be made available to the Surveyor. The ABS approved installation procedures are to at least cover the following, where applicable.

3 Pre-installation Verification

Pre-installation verification procedures for the seabed condition in way of the installation site and contingency procedures for removing any obstacles found on site.

5 Pile or Anchor and Mooring Line Installation

Pile or anchor and mooring line installation procedures which are to include, but are not limited to, the following:

i) General preparations for installation.

ii) Rigging arrangements for piles, chaser pile and driving hammers.

iii) Work barge setup during the various phases of installation, taking into consideration the prevailing weather conditions.

iv) Anticipated pile driving resistance.

v) Pile penetration acceptance criteria established by design and pile refusal and overdrive contingency procedures.

vi) Procedure for positioning of the pile orientation toward the center of the Position Mooring System and the criteria for allowable deviations of position and orientation.

vii) Procedure for installation of the mooring line and the precautions to be taken in order to prevent any twisting of the mooring chains during installation.

viii) Procedure for installation of anchors, including piggyback anchors, if applicable, and procedure for determining the installed positions and orientations of the anchors. Criteria for allowable deviations in positioning and orientation are also to be included.

7 Tensioning and Proof Load Testing

Tensioning and proof load testing procedures of the anchor piles or anchors and chain system are to include the following:

i) Rigging arrangements for proof load tension testing of the mooring chains, anchor or pile system.

ii) Work barge setup to perform the proof load testing of the chains and anchor or pile system.

iii) Detailed tensioning procedure, including type of tensioning device to be utilized and tensioning operations.

iv) Chain retrieval and abandonment procedures during tensioning.

v) Procedure for chain proof load tensioning by ballasting the FPI, if applicable.

9 Hook-up of the Anchor Chain System

Procedure for hook-up of the anchor chain system to the FPI, which is to include the following:

i) Rigging and towing procedures for positioning of the FPI for hook-up to the mooring system.

ii) Preferred ballast condition of the Floating Installation prior to the hook-up.

iii) Procedure for sequential hook-up of the chains, repositioning of the FPI and tensioning of the chains.

iv) Method of determining the correct tension of the chains and the acceptable design tolerance.

v) Procedure for determining the positioning of the SPM system relative to the PLEM or wellhead and the acceptable design tolerance for the position of the SPM center relative to the PLEM or wellhead.

vi) Method of securing the chain turntable from movement and the overall safety precautions for the entire hook-up installation.

vii) Procedure for chain tensioning by ballasting the Floating Installation, if applicable.

11 Import/Export System Installation

The Import/Export System installation procedure which verifies that all appropriate installation loadings have been considered. The manual is to describe procedures to be employed during the installation of the import/export systems. In addition, the manual is to include a list of allowable environmental limits under which system installation may proceed. Abandonment procedures, retrieval procedures and repair procedures are to be supplied, when deemed necessary.

11.1 Rigid and Flexible Risers

The procedure to hook-up the import/export risers to the FPI is to include the following items, where applicable:

i) Handling and rigging of the rigid and flexible riser during installation.

ii) Positioning of the work barge for the various phases of the installation.

iii) Procedure for installation of the buoyancy tank and arch support and clump weight, if applicable, including steps to avoid riser interference and precautions against damaging the riser during installation.

iv) Tie-in rigging technique for hook-up of both ends of the risers.

v) Procedure for hydrostatic testing of the risers. Hydrotest pressure and test duration are to be in accordance with API or other recognized code of practice.

11.3 Export Vessel Transfer System

The procedures for installing the export system are to include the following items, as applicable:

i) Rigging, handling and make-up of the export hose system and precautions against damage during installation.

ii) Fitting of all the necessary accessory and navigational aids.

iii) Procedure for paying out of the hose string into the sea.

iv) Procedure for filling and testing the hose string. The required design and testing pressure and testing duration are to be provided.

13 Disconnecting Procedure

For disconnectable mooring systems, the procedures for the disconnecting and connecting of the FPI's mooring system are to include the abandonment and retrieval of the import and export systems. (Also see 1-1-4/11 of this Guide for Operating Manual requirements.)

PART 7 SURVEYS

CHAPTER 1 SURVEYS DURING INSTALLATION AND COMMISSIONING

SECTION 2 SURVEYS DURING HOOK-UP

1 General

Survey during the hook-up onboard FPIs, whether classed as an FOI or not, is mandatory. Survey during hook-up is to be performed following reviewed procedures and is to include the following, where applicable.

3 Piping Systems

Piping hook-up is to be verified for compliance with the reviewed drawings and procedures. Welds are to be visually inspected and nondestructive testing (NDT) performed as required. Upon completion of hook-up, the affected sections are to be hydrostatically tested to 1.5 times the design working pressure and proven tight.

5 Electrical Systems

Electrical hook-up is to be verified for compliance with the approved drawings and procedures. Proper support for cables and proper sealing of cable entries to equipment are to be verified. Upon completion of the hook-up, the affected sections of the equipment and cabling are to be insulation tested and proven in order. All grounding is also to be verified as being in order.

7 Instrumentation

Instrumentation hook-up is to be verified for compliance with the reviewed drawings and procedures. Tubing supports are to be verified. Upon completion, all systems are to be functionally tested and proven as being in order. The manufacturer's limits on bend radii for any component of the instrumentation system are to be observed.

9 Mechanical Equipment

Mechanical equipment hook-up is to be verified for compliance with the reviewed drawings and procedures, including the grounding of the equipment. Upon completion, all equipment is to be functionally tested and proven as being in order.

PART 7 SURVEYS

CHAPTER 1 SURVEYS DURING INSTALLATION AND COMMISSIONING

SECTION 3 SURVEYS OF THE MOORING SYSTEM

1 General

Survey of the mooring system of all type of FPIs, whether classed as an FOI or not, is mandatory. During installation of the FPI's mooring system, the requirements as contained in this Section are to be verified or witnessed, where applicable, by the attending Surveyor.

3 Certification of Components and Transit Damage Survey

All applicable components required to be certified at the manufacturers' facilities have received certification.

All mooring components are to be examined for transit damages prior to installation. Any damages found are to be dealt with to the satisfaction of the attending Surveyor.

5 Survey of the Installation Site

The area at and in the vicinity of the mooring site is to be surveyed by divers or remotely operated vehicles (ROVs) to confirm that there are no obstructions or debris prior to installation.

7 Installation of Anchors/Piles and Mooring Lines

7.1 Anchors or Piles

During the installation of the anchors or anchor piles, the following are to be verified in order, where applicable:

i) Proper locking of all connecting shackles from chains to piles or anchors and chains to chains.

ii) Sealing of all Kenter shackle locking pins.

iii) All complements of anchor chains for correct sizes and lengths.

iv) All anchor pile or anchors are installed in the designed positions and orientations and are within the allowable design tolerance.

7.3 Mooring Lines

During the installation of the mooring lines, the following are to be verified in order, where applicable:

i) The paying out of the anchor chains after the installation of the piles is to be performed in accordance with the approved procedures.

ii) Unless otherwise approved by the attending Surveyor, the first pair of anchor chains to be cross-tensioned is the first pair to be installed.

iii) The cross-tensioning is to be verified to confirm all pretensioning loads are in accordance with the design and there is no movement or pullout of the anchor piles.

iv) Upon successful completion of the pretensioning, the subsequent hooking up of all of the chain legs to the chain stoppers in the turntable is to be verified.

v) During tensioning of the chains for the position mooring system, the relative position of the mooring system's center to the PLEM is to be verified for compliance with the design specifications and tolerance.

vi) Upon completion, the chain tension is to be verified by measuring the catenary angles of the chains for compliance with the design specifications and tolerance. Any excess length of chain above the chain stoppers is to be removed, unless it is designed to be retained in the chain well.

PART 7 SURVEYS

CHAPTER 1 SURVEYS DURING INSTALLATION AND COMMISSIONING

SECTION 4 SURVEYS OF THE IMPORT/EXPORT SYSTEM

1 General

Survey of the import/export system is required only if the system is to be classed with ABS and to be recommended with the optional classification notations explained in Section 1-1-2 of this Guide, Where the import/export system is to be classed, during installation of the system, the following items are to be witnessed by the Surveyor, as applicable.

3 Certification of Components and Transit Damage Survey

All applicable components required to be certified at the manufacturers' facilities have received certification.

The riser is to be examined for damage as it is being paid out, and sufficient tension is to be maintained to keep the riser free of deformations or buckles.

5 Buoyancy Tank and Arch Support

The buoyancy tank and arch support are to be verified as being installed in the correct position relative to the water surface end of the riser.

7 Installation of Riser Clamps and End Flanges

The installation of the riser clamps on the buoyancy tank and arch support are to be monitored to verify that the riser is adequately secured and not damaged due to excessive tightening of the clamps.

The installation of the end flanges of the riser is to be monitored for compliance with the approved procedures.

9 Underwater Examination

Upon completion of installation, the entire underwater complement of components is to be generally examined and verified by divers or ROVs for compliance with the reviewed design specifications and configurations. At a site with limited visibility, alternative means of verifying the installation are to be submitted for review and are to be performed to the satisfaction of the attending Surveyor.

11 Hydrostatic Testing

Hydro testing of the import/export system is to be performed in accordance with the approved procedure. The test pressure and duration of the hydro test are to follow the appropriate codes, such as ANSI/ ASME B31.8, API RP 2RD and RP 17B.

13 Floating Hose String

The make-up of the export floating hose string is to be verified for compliance with the approved procedures. Suitable gaskets for the hose flanges, positioning of all navigational aids, correct location of the breakaway couplings and tightening of the flange bolts are also to be verified.

During the paying out of the hose string, verification is to be made that the hose string bend radii are not smaller than the manufacturer's recommended limits.

Upon completion of installation, the entire export hose string is to be hydrostatically tested in accordance with the approved procedure and codes, such as the *OCIMF Guidelines for the Handling, Storage, Inspection, and Testing of Hoses in the Field.*

15 Subsea Control System

Subsea controls, if installed, are to be satisfactorily tested.

17 Navigational Aids

All navigational aids are to be functionally tested and proven in working order.

PART 7 SURVEYS

CHAPTER 1 SURVEYS DURING INSTALLATION AND COMMISSIONING

SECTION 5 SURVEYS OF THE DISCONNECTABLE SYSTEM

1 General

Survey of the disconnectable mooring system is required only if the system is to be classed with ABS and to be recommended with the optional classification notations explained in Section 1-1-2 of this Guide, Where the disconnectable system is to be classed, the system together with system's capability to disconnect free from its mooring system is to be demonstrated to the satisfaction of the attending Surveyor, in accordance with approved test procedures.

3 Disconnecting Time

During the disconnect operation, the time taken to effectively free the Floating Installation from the mooring system is to be recorded in the operation manual.

PART 7 SURVEYS

CHAPTER 1 SURVEYS DURING INSTALLATION AND COMMISSIONING

SECTION 6 SURVEYS DURING COMMISSIONING

1 General

Survey of the start up and commissioning of the production facilities is required only if the FPI's production facilities are to be classed with ABS and to be recommended with the optional classification notations explained in Section 1-1-2 of this Guide,

The start-up and commissioning of hydrocarbon production systems are to be verified by the attending Surveyor in accordance with the procedures reviewed and agreed by the attending Surveyor. The scope of the start-up and commissioning to be verified by the Surveyor is to include the following items:

3 Safety and Operational Readiness

Verify precautions for safety of personnel during commissioning, including checks of operational readiness of all life saving equipment, fire and gas detection systems, fire fighting equipment, emergency shutdown systems and unobstructed escape routes.

5 Communication Procedures

Verify establishment of communication procedures prior to the start of commissioning operations.

7 Emergency Procedures

Verify that emergency procedures are provided to deal with contingencies, such as spillage, fire and other hazards. Drills may have to be performed to demonstrate readiness to these procedures.

9 Start-up and Testing of Production Support Systems

Verify start-up and testing of all support utility systems, including main and auxiliary sources, for the process system prior to commissioning.

11 Hook-up and Testing

Verify proper hook-up and testing of the entire process system prior to commissioning, including the testing of entire system for leaks, the process control functions and emergency shutdown system.

13 Purging of the Production System

Verify purging of the entire production system of oxygen to an acceptable level prior to the introduction of hydrocarbons into the production system.

15 Introduction of Hydrocarbons and Control of Flow

Verify the introduction of hydrocarbon into the process system and the system's capability to control the flow of the well effluent in the system in a stabilized manner without undue control upsets.

17 Start-up of the Flare System (if applicable)

Verify the start-up of the flare system, if applicable, including the necessary precautions taken to eliminate the risk of explosion or fire. The functional capability of the flare system is to be verified.

19 Function of the Post Commissioned System

The post-commissioned process system is to be verified for operating satisfactorily for duration of at least 12 hours.

Equipment required verification but not used during initial start-up and commissioning is to be identified for verification at the next Annual Survey.

(Combine existing Chapters 1 through 7 into new Chapter 2 and revise, as follows:)

PART 7 SURVEYS

CHAPTER 2 SURVEYS AFTER CONSTRUCTION *(1 July 2012)*

SECTION 1 CONDITIONS FOR SURVEYS AFTER CONSTRUCTION

1 Application

General requirements regarding conditions for surveys after construction are contained in the ABS *Rules for Survey After Construction (Part 7)* and Part 7 of the *Rules for Building and Classing Mobile Offshore Drilling Units* (*MODU Rules*), as applicable. Additional requirements specific to floating production installations are contained in Part 7, Chapter 2, of this Guide.

3 Definitions

3.1 Ballast Tank

A *Ballast Tank* is a tank which is used primarily for the carriage of salt water ballast. Salt water ballast tanks are coated with a corrosion resistant hard coating such as epoxy or zinc on all structural surfaces that may or may not be supplemented by anodes.

3.3 Corrosion

Active Corrosion means gradual chemical or electrochemical attack on a metal resulting from a reaction with its environment and producing loose scale.

Allowable Corrosion or *Wastage Limit* is the acceptable corrosion limit for the installation's structure in a given area. Also known as the *Allowable Limit*.

Excessive Corrosion is an extent of corrosion that exceeds the allowable limit.

Extensive Area of Corrosion is corrosion of hard and/or loose scale, including pitting, over 70% or more of the plating surface in question, accompanied by evidence of thinning.

Grooving Corrosion is a localized, linear corrosion which occurs at structural intersections where water collects or flows. This corrosion is sometimes referred to as "in line pitting attack" and can also occur on vertical members and flush sides of bulkheads in way of flexing.

Localized Corrosion is by name local in nature and may be caused by a local breakdown in coating from contact damage, insufficient preparation or at areas of stress concentration.

Overall Corrosion appears as an non-protective rust which can uniformly occur on tank internal surfaces that are uncoated, or where coating has totally deteriorated. The rust scale continues to break off, exposing fresh metal to corrosive attack. Thickness cannot be judged visually until excessive loss has occurred.

Pitting Corrosion is a localized corrosion of a metal surface that is confined to a small area and takes the form of cavities called pits.

Substantial Corrosion is an extent of corrosion such that assessment of corrosion pattern indicates wastage in excess of 75% of the allowable corrosion, but within the acceptable limits.

Weld Metal Corrosion is defined as preferential corrosion of weld deposit. The most likely reason for this attack is galvanic action with the base metal which may start as pitting and often occurs on hand welds as opposed to machine welds.

3.5 Corrosion Control System

Corrosion Control System may be achieved by application of hard protective coating (usually epoxy coating or equivalent), impressed current cathodic protection (ICCP) system, sacrificial anodes, etc., provided that they are applied and maintained in compliance with the manufacturer's specification.

Corrosion control system for salt water ballast tanks is to be a corrosion resistant hard coating such as epoxy or zinc on all structural surfaces that may or may not be supplemented by anodes. Where a long retention of salt water ballast is expected, special consideration may be given to the use of inhibitors or sacrificial anodes.

3.7 Critical Structural Areas

Critical Structural Areas are locations which have been identified from calculation to require monitoring or from the service history of the subject unit or from similar sister units to be sensitive to cracking, buckling or corrosion which would impair the structural integrity of the unit.

3.9 Girth Belt/Belt (Transverse Section)

A *Girth Belt* includes the following:

Surface-Type Units: Deck, bottom, side shell and longitudinal bulkhead plating and internal framing.

Column-Stabilized Units: Column and bracing plating and internals as deemed necessary. Deck sides and bottom of lower hulls between columns, including internal stiffeners as deemed necessary.

3.11 In-Service Inspection Program (ISIP)

In-Service Inspection Program (ISIP) is a comprehensive program that outlines the procedures to be followed and the inspection frequency of the hull and mooring system of a floating facility. All Column-Stabilized Units (CSUs), Spars or Tension Leg Platforms (TLPs) are to be surveyed in accordance with an ABS approved ISIP plan. For further details, see Section 7-2-4.

3.13 Lightering Service

Lightering Service is the side-by-side mooring of two installations, either while underway or stationary, for the purpose of transferring petroleum cargo, excluding bunkers, from a installation to be lightered to a service vessel. Both the lightered installation and the service vessel are to be considered in lightering service.

3.15 Panel

Panel is the area between adjacent main frames or girders from stiffener to stiffener.

3.17 Survey

Close-up Survey is a survey where the details of structural components are within close visual inspection range of the Surveyor (i.e., normally within hand reach). In the offshore industry, this may be referred as the Close Visual Inspection (CVI).

Overall Survey is a survey intended to report on the overall condition of the structure and to determine the extent of additional close-up surveys. In the offshore industry, this may be referred as the General Visual Inspection (GVI)

3.19 Representative Spaces/Tanks

Representative Spaces/Tanks are those which are expected to reflect the condition of other spaces of similar type and service and with similar corrosion preventive systems. When selecting representative spaces, account is to be taken of the service and repair history onboard and identifiable critical and/or Suspect Areas.

3.21 Spaces

Spaces are separate compartments including tanks, cofferdams, machinery spaces, voids and other internal spaces.

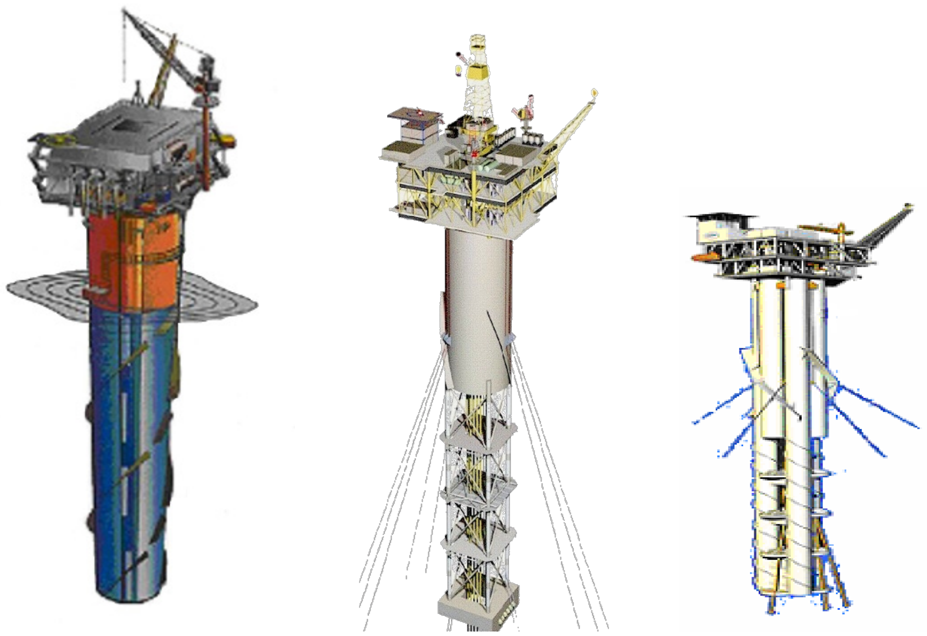
3.23 Spar

Spar is a single column-stabilized production installation that is moored to the seabed with conventional catenary mooring system.

Typical Spar configurations are:

- "Conventional" Spar which has one-piece cylindrical hull.
- "Truss" Spar where the midsection is composed of truss elements connecting the upper buoyant hull (hard tank) with the bottom soft tank containing permanent ballast.
- "Cell" Spar which is built from multiple vertical cylinders.

FIGURE 1
Spar Configurations *(1 July 2012)*



Conventional Spar **Truss Spar** **Cell Spar**

3.25 Splash Zone

Splash Zone on a Tension Leg Platform (TLP) is defined as follows:

- Upper Limit of Splash Zone (above the operating draft) = U1 + U2

  Where U1 = 65% of 1-year storm wave height

  U2 = motion of the installation

- Lower Limit of Splash Zone (below the operating draft) = L1 + L2

  Where L1 = 35% of 1-year storm wave height

  L2 = motion of the installation

Splash Zone on a Column-Stabilized Unit (CSU) or a Spar is defined as follows:

> "Splash Zone" means the external surfaces of the unit that are periodically in and out of the water when the unit is at its operating depth. In general, this zone is between 5m above and 4m below the waterline.

Splash zone of a floating offshore installation is to be defined and recorded for use during visual examinations and hull gauging required during periodical surveys carried out in accordance with this Guide.

3.27 Structural Critical Inspection Point (SCIP)

Structure Critical Inspection Point (SCIP) is a structural point defined in the ISIP (see 9-1-1/13) plan as a critical inspection area as a result of structural assessment using applicable calculations and analysis.

In general, SCIPs are locations with higher stresses and estimated lower fatigue life. These locations are locations which have been identified from calculation to require monitoring or from the service history of the subject unit or from similar sister units to be sensitive to cracking, buckling or corrosion which would impair the structural integrity of the unit.

3.29 Suspect Areas

Suspect Areas are locations showing substantial and/or are considered by the Surveyor to be prone to rapid wastage.

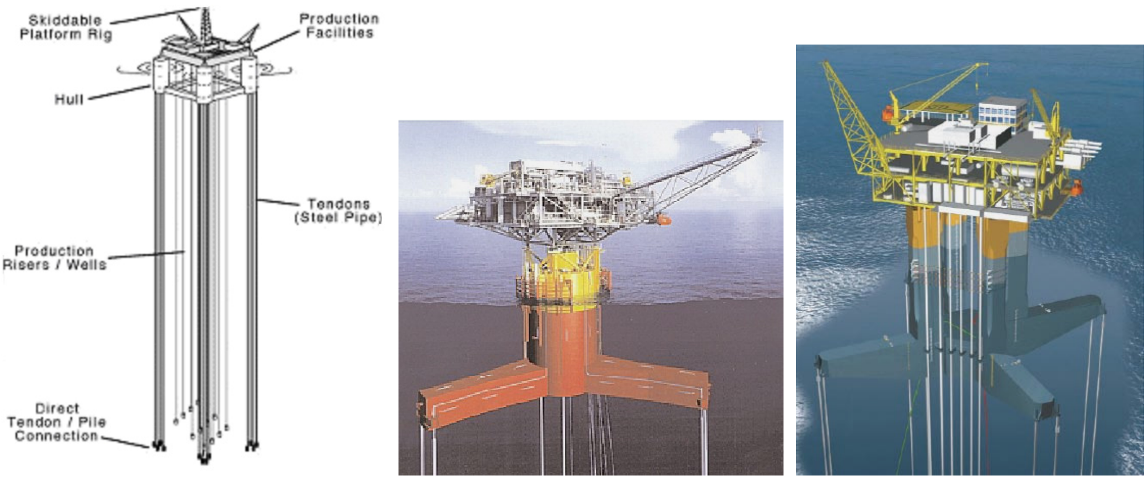
3.31 Tension Leg Platform (TLP)

Tension Leg Platform (TLP) is a floating production installation tethered to the seabed with taut-catenary mooring system in a manner that eliminates most vertical movement of the structure.

Typical TLP configurations are:

- "Conventional" TLP which has four corner columns with a ring pontoon, and has three tendons per corner.
- "Sea-Star" TLP which has one central column with three tendon support structures, and two tendons per support structure. Its mooring system consists of six tendons, top connectors, bottom connectors, top transition joints, bottom transition joints and foundation piles.
- "Moses" TLP which has four inner columns with four tendon support structures, and two tendons per support structure.

FIGURE 2
TLP Configurations *(1 July 2012)*



Conventional TLP **Sea-Star TLP** **Moses TLP**

3.33 Wind and Water Strakes

Wind and Water Strakes on a Column-Stabilized Unit (CSU), Spar and Barge- or Ship-Shaped Unit are the two (2) strakes or equivalent area located in the vicinity of the load waterline, operating draft or operating depth of the unit. For CSUs, this includes portions of columns and bracing members in the vicinity of the operating draft of the unit.

5 Notification and Availability for Survey

The Surveyors are to have access to classed floating production installations at all reasonable times. The Owners or their representatives are to notify the Surveyors on occasions when parts of the structure not ordinarily accessible can be examined.

The Surveyors are to undertake all surveys on classed installations upon request, with adequate notification, of the Owners or their representatives and are to report thereon to ABS. Where the Surveyors find occasion during any survey to recommend repairs or further examination, notification is to be given immediately to the Owners or their representatives in order that appropriate action may be taken. The Surveyors are to avail themselves of every convenient opportunity for performing periodical surveys in conjunction with surveys of damages and repairs in order to avoid duplication of work. See 1-1-8/5 of the ABS *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*.

7 Damage, Failure, and Repair

7.1 Examination and Repair

Damage, failure, deterioration or repair to the floating production installation or its elements that affects or may affect classification is to be submitted by the Owners or their representatives for examination by the Surveyor at the first opportunity. All repairs found necessary by the Surveyor are to be completed to his satisfaction.

7.3 Repairs

Where repairs to the floating production installation or its elements that may affect classification are planned in advance, a complete repair procedure, including the extent of the proposed repair and the need for the Surveyor's attendance, is to be submitted to and agreed upon by the Surveyor reasonably in advance. Failure to notify ABS in advance of the repairs may result in suspension of the installation's classification until such time as the repair is redone or evidence is submitted to satisfy the Surveyor that the repair was properly completed.

Note: The above applies also to repairs during voyage.

The above is not intended to include maintenance and overhaul to hull, machinery and equipment in accordance with recommended manufacturer's procedures and established marine practice and that does not require ABS approval. Any repair as a result of such maintenance and overhauls that affects or may affect classification is to be noted in the ship's log and submitted to the Surveyors.

7.5 Representation

Nothing contained in this Section or in a rule or regulation of any government or other administration or the issuance of any report or certificate pursuant to this section or such a rule or regulation is to be deemed to enlarge upon the representations expressed in 1-1-1/1 through 1-1-1/7 of the ABS *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*. The issuance and use of any such reports or certificates are to be governed in all respects by 1-1-1/1 through 1-1-1/7 of the ABS *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*.

7.7 Application of Rules

The applicable ABS Rules to the floating production installation's classification is to be applied to any repair without changing the original design, carried out on the installation's structure, machinery or equipment that affects or may affect classification. Application of the most recent Rules will be specially considered at the Owner's request or otherwise mandated by the current Rules.

9 Alterations/Modifications

No alteration or modification which affect or may affect classification or the assignment of load lines are to be made to the hull or systems of a classed floating production installation unless plans of the proposed alteration or modification are submitted and approved by an ABS Technical Office before the work is commenced, and such work, when approved, is to be performed to the satisfaction of the Surveyor. Nothing contained in this Section or in a rule or regulation of any government or other administration or the issuance of any report or certificate pursuant to this Section or such a rule or regulation is to be deemed to enlarge upon the representations expressed in 1-1-1/1 through 1-1-1/7 of the ABS *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)* and the issuance and use of any such reports or certificates are to be governed in all respects by 1-1-1/1 through 1-1-1/7 of the ABS *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*.

9.1 Application of Rules

The applicable ABS Rules to the floating production installation's classification are to be applied to minor alteration/modification carried out on the unit, including its structure, machinery or equipment, that affects or may affect classification. Application of the most recent Rules will be specially considered at the Owner's request or otherwise mandated by the current Rules.

The following cases may be considered as a major alteration or modification, and therefore require compliance with up-to-date Rules for the section being altered or modified:

- Changing configuration or material of structure that is defined as "Special Application Structure" or "Primary Application Structure" in accordance with these Rules.
- Changing a marine piping system (such as the ballast systems, bilge system, propulsion system, etc.) with all of its components (piping, valves, pumps, etc.).
- Changing a marine electrical system (such as the main power distribution, emergency power distribution, electrical propulsion system, etc.) with all of its components (cabling, electrical motors/pumps, panels, etc.).
- Changing layout and material used in the passive fire protection system, such as more than 10% of deck area alteration or modification to the footprint of the accommodation deckhouse/superstructure or its material used for fire protection.

  Note: Adding another deck on top of an existing accommodation deckhouse is not considered to be a major modification of the entire deckhouse.

- Changing an active fire protection system (such as the fixed-fire fighting system, fire and gas detection system, etc.) with all of its components (piping, pumps, hoses, panels, alarms, detectors, etc.).

11 Welding and Replacement of Materials

11.1 Ordinary and Higher Strength Structural Steels

Welding or other fabrication performed on the structural steels listed in 2-1-2/Table 5 and 2-1-2/Table 5 of the ABS *Rules for Materials and Welding (Part 2)* is to be in accordance with the requirements in Section 2-4-1 of the ABS *Rules for Materials and Welding (Part 2)*.

11.3 Special Materials

Welding or other fabrication performed on other steels of special characteristics or repairs or renewals of such steel or adjacent to such steel is to be accomplished with procedures approved for the special materials involved. The procedures are to be in accordance with the information provided in Section 1-1-6 of the *MODU Rules* Supplement to the ABS *Rules for Conditions of Classification – Offshore Units and Structures* (Part 1) and Chapter 4 of the ABS *Rules for Materials and Welding* (Part 2).

11.5 Substitutions and Alterations

Substitutions of steel differing from that originally installed, alteration of original structural configuration or change from bolted to welded joint is not to be made without approval by the ABS Technical Office.

13 Corrosion Prevention System – Ballast Tanks

13.1 Corrosion Prevention System

Corrosion protection system for salt water ballast tanks is to be a corrosion resistant hard coating such as epoxy or zinc on all structural surfaces that may or may not be supplemented by anodes. Where a long retention of salt water ballast is expected, special consideration may be given to the use of inhibitors or sacrificial anodes.

13.3 Coating Conditions

Condition of hard coatings is defined as follows:

GOOD is a condition with only minor spot rusting.

FAIR is a condition with local breakdown at edges of stiffeners and weld connections and/or light rusting over 20 percent or more of areas under consideration, but less than as defined for POOR condition.

POOR is a condition with general breakdown of coating over 20 percent or hard scale at 10 percent or more of areas under consideration.

13.5 Salt Water Ballast Spaces

In salt water ballast spaces, other than double bottom tanks, where poor coating condition is found and Owners or their representatives elect not to restore the coating, where a soft coating has been applied or a protective coating has not been applied, the ballast tanks are to be internally examined at each subsequent Annual Survey.

Double bottom tanks for the purpose of this requirement are those double bottom tanks separate from topside tanks, side tanks or deep tanks.

15 Requirements for Internal Examinations

The following apply to all internal examinations of any spaces adjacent to shell plating, such as tanks, holds, voids or machinery spaces, and are applicable at Annual, Intermediate or Special Periodical Survey.

15.1 Safety

Precautions are to be taken for safety during inspection. Tanks are to be made safe for entry and work.

15.3 Preparation for Survey

In preparation for survey and to allow for a meaningful examination, all spaces are to be cleaned, including removal from surfaces of all loose accumulated corrosion scale. Spaces are to be sufficiently clean and illumination is to be provided to reveal corrosion, deformation, fracture, damages or other structural deterioration.

15.5 Safe Access into Spaces with Soft Coatings

Where soft coatings are found, safe access is to be provided for the Surveyor to verify the effectiveness of the coatings and to perform an assessment of the conditions of internal structures that may include spot removal of the coating. Where the soft coatings are found no longer effective, the space shall be treated as an uncoated tank and sufficient cleaning, as required by 7-1-1/15.3, is to be performed prior to survey.

15.7 Extent of Overall Survey

Based on conditions found, thickness gauging and means of access to the upper part of the tank or space may be required. Where significant corrosion or structural damage is found, the extent of the overall examination may be expanded to other spaces. The requirements for Close-up Survey and thickness gauging, per Section 7-3-2 of the ABS *Rules for Survey After Construction (Part 7)*, will be applied to barge- and ship-shaped installations in some cases, as described in 7-2-3/3 of this Guide.

15.9 Examination of Plating and Framing

Casings, ceilings or linings, and loose insulation, where fitted, are to be removed as required by the Surveyor for examination of plating and framing.

15.11 Compositions on Plating

Compositions on plating are to be examined and sounded but need not be disturbed if found adhering satisfactorily to the plating.

17 Surveys Using Risk-Based Inspection (RBI) Techniques

A properly conducted Risk-Based Inspection (RBI) plan or Reliability Centered Maintenance (RCM) plan may be credited as satisfying requirements of Survey After Construction for the corresponding installation. The plan is to be in accordance with the ABS *Guide for Surveys using Risk-Based Inspection for the Offshore Industry* or the ABS *Guide for Surveys using Reliability-Centered Maintenance*.

The application of these Guides does not cover any statutory survey requirements that may apply to the installation being considered. Although ABS is authorized to perform statutory surveys on behalf of some authorities, ABS is not in a position to alter or waive them. The cognizant administration or regulatory body is the final determining body for statutory or regulatory requirements under their jurisdiction. The Owner is responsible in developing the inspection plan, to give due consideration to applicable requirements external to ABS.

19 Incomplete Surveys

When a survey is not completed, the Surveyor is to report immediately upon the work done in order that Owners and ABS may be advised of the parts still to be surveyed.

21 Lay-up and Reactivation

ABS is to be notified by the Owner that an installation has been laid-up. This status will be noted in the *Record*, and surveys falling due during lay-up may then be held in abeyance until the installation reactivates. Lay-up procedures and arrangements for maintenance of conditions during lay-up may be submitted to ABS for review and verification by survey.

In the case of installations that have been laid up for an extended period (i.e., six months or more), the requirements for surveys on reactivation are to be specially considered in each case, with due regard being given to the status of surveys at the time of the commencement of the lay-up period, the length of the period and the conditions under which the installation has been maintained during that period.

Where the lay-up preparations and procedures have been submitted to ABS for review and confirmed by Annual Lay-up Surveys, consideration may be given to deducting part or all of the time in lay-up from the progression of survey intervals.

For installations returning to active service, regardless of whether ABS has been informed previously that the installation has been in lay-up, a Reactivation Survey is required.

23 Onboard Documents and Records

The following documents are to be available onboard at all times.

Note: This is applicable to all drilling units built under a contract, signed between the Builder and the Owner, on or after 1 January 2012.

23.1 ABS Reviewed and Stamped Documents

As a minimum, the following documents reviewed and stamped by ABS are to be available onboard the drilling unit for Surveyor's verification and reference during survey after construction:

i) Operating Manual

ii) In Service Inspection Program (ISIP) Plan

iii) Drawings indicating locations of all "Special", "Primary" and "Secondary" application structures as defined in these Rules

iv) Drawings showing all watertight boundaries and access/closing devices for such boundaries

v) Drawings showing the Fire Protection Systems, clearly indicating all fire rated boundaries and access/closing arrangements for such boundaries, including location of fire dampers for 'A' class divisions

vi) Drawings showing the Fire Extinguishing Systems, clearly indicating layout of all fixed and portable fire extinguishing systems. Minor changes to these drawings may be accepted and endorsed by the attending Surveyor, however the endorsed copy of the drawings are to be submitted to ABS engineering at earliest opportunity for record purposes.

vii) Drawings showing layout of all Hazardous Areas, clearly indicating layout of different class hazardous divisions together with access/closing/ventilation arrangements for such division boundaries, the arrangement of ventilation shutdown and alarms, and a listing of Electrical Equipment in Hazardous Areas.

viii) Drawings showing layout of the Emergency Shutdown Systems

ix) Where the floating production installation is classed with a notation affecting its Automation System (such as **ACC**, **ACCU**, **AMCC**, or **AMCCU**), Automation System Operating Manual

x) Where the floating production installation is classed with a **DPS** notation, the Dynamic Positioning System (DPS) Manual and the Failure Modes and Effects Analysis (FMEA)

xi) Where the topside facilities of the floating production installation is also classed, drawings showing layout of the topside Production Facilities and associated Equipment, and a listing of all equipment and components of the Production, Process, and Support Systems

xii) Where the floating production installation is classed with optional **HIMP** Notation, the Owner's Hull Inspection and Maintenance Program (HIMP) used for hull inspection and maintenance purposes is to be available onboard the installation

Minor changes to the drawings regarding fire protection systems, fire extinguishing systems, and listing of electrical equipment in hazardous areas, may be accepted by the attending Surveyor and revised documents endorsed to show Surveyor's verification, however the endorsed copy of the drawings are to be submitted to ABS engineering at earliest opportunity for record purposes.

23.3 ABS Surveyor Reviewed and Endorsed Documents

As a minimum, the following documents endorsed by an ABS Surveyor are to be available onboard the floating production installation for Surveyor's verification and reference during any survey after construction:

i) Construction Booklet.

ii) ABS Certificates for temporary anchoring gear such as the anchors, chains and/or wires, and associated accessories (such as shackles, links, sockets, etc.) used for self-propelled installations units or installed on installations with the Á notation.

iii) ABS Certificates for all mooring gear components such as the anchors, piles, chains and/or wires, and associated accessories (such as shackles, links, sockets, etc.), tendons, etc., used for station keeping of the installation at its operational site.

iv) Record of all Nondestructive Testing (NDT) of critical structural areas carried out during each Drydocking Survey (or UWILD) or Special Periodical Survey – Hull.

23.5 Records

As a minimum, the following records are to be available onboard the floating production installation for Surveyor's verification and reference during any survey after construction:

i) All abnormalities found, including associated videos and photographic records

ii) All repairs performed on any abnormalities found and any further repetitive abnormalities found subsequent to the repairs

iii) All corrosion protection system maintenance, including records of all cathodic potential readings taken, records of depletion of all sacrificial anodes, impressed current maintenance records, such as voltage and current demands of the system, coating breaks and the monitoring records of the steel material wastage in way of the coating break areas

iv) Any findings of abnormalities by the crew personnel onboard, including all leakages in bulkheads and piping

PART 7 SURVEYS

CHAPTER 2 SURVEYS AFTER CONSTRUCTION

SECTION 2 SURVEY INTERVALS

1 In-Service Inspection Program (ISIP) (see Section 7-2-3)

Unless otherwise requested by the owner, all barge- or ship-shaped floating installations are to be surveyed in accordance with proceeding Subsections of this Section. Application of an ISIP to barge- or ship-shaped installations operating within the Outer Continental Shelf (OCS) of the United States of America (USA), Gulf of Mexico (GOM) is mandatory. Application of an ISIP to barge- or ship-shaped installations operating outside of the Outer Continental Shelf (OCS) of the United States of America (USA), Gulf of Mexico (GOM) is optional, and is to be requested by the Owner.

All Column-Stabilized Units (CSUs), Spars or Tension Leg Platforms (TLPs) are to be surveyed in accordance with an ABS approved plan for In-Service Inspection Program. Applicable class surveys of the floating installation's hull structure and mooring system are to be carried out in accordance with the ABS approved ISIP plan.

Unless otherwise requested by the owner, all installations surveyed in accordance with an ABS approved ISIP, are to be surveyed under Continuous Survey of the Hull and Mooring System. The due dates shown in ABS Survey Status are to be per the "Master Inspection Plan" mentioned in 7-2-3/3.5.2ii).

3 Annual Surveys (see Section 7-2-4)

Annual Surveys are to be carried out within three (3) months before or after each annual anniversary date of the crediting of the previous Special Periodical Survey – Hull or original construction date. For installations on Continuous Survey, all Continuous Survey requirements for those parts (items) due are generally to be completed each year. The Annual Survey will not be credited and the Certificate of Classification will not be endorsed unless Continuous Survey items which are due or overdue at the time of the Annual Survey are either completed or granted an extension.

5 Intermediate Surveys (see Section 7-2-5)

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

7 Special Periodical Surveys (see Section 7-2-6)

A Special Periodical Survey is to be completed within five years after the date of build or after the crediting date of the previous Special Periodical Survey. The interval between Special Periodical Surveys may be reduced by ABS under certain circumstances. If a Special Periodical Survey is not completed at one time, it will be credited as of the completion date of the survey, but not later than five years from date of build or from the date recorded for the previous Special Periodical Survey. If the Special Periodical Survey is completed prematurely but within three months prior to the due date, the Special Periodical Survey will be credited to agree with the effective due date.

Special consideration may be given to Special Periodical Survey requirements in the case of floating production installations of unusual design, in lay-up or in unusual circumstances. ABS reserves the right to authorize extensions of Rule-required Special Periodical Surveys under extreme circumstances.

A Special Periodical Survey may be commenced at the fourth Annual Survey and be continued with a view to completion by the due date. In connection with the preparation for the Special Periodical Survey, thickness gauging, as required for the forthcoming Special Periodical Survey, are to be taken to the extent accessible and practical in connection with the fourth Annual Survey.

Where the Special Periodical Survey is commenced prior to the fourth Annual Survey, the entire survey is normally to be completed within 12 months if such work is to be credited to the Special Periodical Survey.

7.1 Continuous Surveys

At the request of the Owner, and upon approval of the proposed arrangements, a system of Continuous Survey may be undertaken whereby the Special Periodical Survey requirements are carried out in regular rotation to complete all requirements of the particular Special Periodical Survey within a five-year period. The completion date will be recorded to agree with the original due date of the cycle. If the Continuous Survey is completed prematurely but within three months prior to the due date, the Special Periodical Survey will be credited to agree with the effective due date.

ABS reserves the right to authorize extensions of Rule-required Special Continuous Surveys under extreme circumstances.

Each part (item) surveyed becomes due again for survey approximately five years from the date of the survey. For Continuous Surveys, a suitable notation will be entered in the *Record* and the date of completion of the cycle published. If any defects are found during the survey, they are to be dealt with to the satisfaction of the Surveyor.

At a survey approximately four years after each Continuous Survey of Hull has been credited, all accessible thickness gauging, as required for the forthcoming Special Periodical Survey, are to be taken.

7.3 In-line Surveys

All items required to undergo Special Periodical Surveys, including but not limited to hull, machinery, mooring, topside facilities, and automation, are to be carried out at the same time and interval in order that they are recorded with the same crediting date. In cases where damage has necessitated extensive repairs and examination, the survey thereon may, where approved by ABS, be accepted as equivalent to Special Periodical Survey.

9 Drydocking Surveys or Equivalent (see Section 7-2-7)

For units operating in salt water, a minimum of two Drydocking Surveys is to be carried out two times in each five-year Special Periodical Survey period. One such examination is to be carried out in conjunction with the Special Periodical Survey – Hull. In all cases, the interval between any two Drydocking Surveys is not to exceed thirty-six (36) months.

For units operating in fresh water the interval between Drydocking Surveys is not to exceed five years.

Consideration may be given to special circumstances which may justify an extension of the interval. An underwater inspection by a diver may be required for such extensions.

9.1 Underwater Inspection in Lieu of Drydocking (UWILD) Survey

Underwater inspection by diver equivalent to a Drydocking Survey may be carried out at each Drydocking Survey up to and including Special Periodical Survey No. 4.

For each Drydocking after Special Periodical Survey No. 4, requests to carry out an Underwater Inspection in Lieu of Drydocking in accordance with previously approved plans are to be submitted for consideration well in advance of the proposed survey. Approvals to carry out the Underwater Inspection in Lieu of Drydocking after Special Periodical Survey No. 4 are to be made available onboard for the Surveyor's reference.

11 Tailshaft Surveys (see 7-2-8)

11.1 Water-Lubricated Bearings in Fresh Water Exclusively

Survey interval is five (5) years.

11.3 Water-Lubricated Bearings in Fresh Water and Sea Water

i) *Single Screw* – Survey interval is three (3) years.

ii) *Multiple Screw* – Survey interval is five (5) years.

iii) *Continuous Liner or Equivalent* – Survey interval of five (5) years provided:

a) The tailshaft is protected by a continuous metallic liner, or continuous cladding per 4-3-2/5.17.5 of the *Steel Vessel Rules* or fiberglass reinforced plastic coating between liners installed according to approved procedure per 4-3-2/5.17.4 of the *Steel Vessel Rules* which effectively prevents seawater from contacting the steel shaft, or which have shafts of corrosion-resistant materials.

b) In addition to the propeller hub details given in the 4-3-2/Figure 1 of the *Steel Vessel Rules*, the design includes other features that would further reduce stress concentration in the propeller assembly.

11.5 Oil-Lubricated Bearings

Survey interval is five (5) years.

11.7 Extensions – Water-Lubricated Bearings

i) *Extension up to Three (3) Months.* An extension up to three (3) months may be granted by the Surveyor, when requested by the Owner, provided a survey is carried out in accordance with 7-5-1/5.1.1 of the ABS *Rules for Survey After Construction (Part 7)*.

ii) *Extension up to One (1) Year.* An extension up to one (1) year may be granted by the Surveyor, when requested by the Owner, provided a survey is carried out in accordance with 7-5-1/5.1.2 of the ABS *Rules for Survey After Construction (Part 7)*.

11.9 Extensions – Oil-Lubricated Bearings

i) *Extension up to Three (3) Months.* An extension up to three (3) months may be granted by the Surveyor, when requested by the Owner, provided a survey is carried out in accordance with 7-5-1/5.3.1 of the ABS *Rules for Survey After Construction (Part 7)*.

ii) *Extension up to One (1) Year.* An extension up to one (1) year may be granted by the Surveyor, when requested by the Owner, provided a survey is carried out in accordance with 7-5-1/5.3.2 of the ABS *Rules for Survey After Construction (Part 7)*. An additional extension up to one (1) year may be considered, when requested by the Owner, provided a survey is carried out at the end of the first extension period, in accordance with 7-5-1/5.3.2 of the ABS *Rules for Survey After Construction (Part 7)*. No more than two (2) extensions may be granted.

iii) *Extensions not Exceeding Five (5) Years.* In lieu of 6-2-2/1.11.4(b), an extension not exceeding five (5) years may be granted by the Surveyor, when requested by the Owner, provided a survey is carried out at the fifth year, in accordance with 7-5-1/5.3.3 of the ABS *Rules for Survey After Construction (Part 7)*. Consideration may be given to an additional extension not exceeding five (5) years when requested by the Owner, provided a survey is carried out at the fifth year after the first extension, in accordance with 7-5-1/5.3.3 of the ABS *Rules for Survey After Construction (Part 7)*. No more than two (2) extensions may be granted.

13 Auxiliary Boiler Surveys (see Section 7-2-9)

Waste-heat or fired auxiliary boilers intended for working pressures above 3.4 bar (3.5 kgf/cm^2, 50 psi), a minimum of two surveys are to be carried out during each 5-year Special Periodical Survey period. One such survey is to be carried out in conjunction with the Special Periodical Survey. In all cases, the interval between any two such surveys is not to exceed 36 months.

An extension of the survey up to three (3) months may be granted by the Surveyor in exceptional circumstances*, provided a survey is carried out in accordance with 7-7-1/11 of the ABS *Rules for Survey After Construction (Part 7)*.

In addition, annual examinations are to be carried out in accordance with 7-7-1/13 of the ABS *Rules for Survey After Construction (Part 7)*.

For units on Continuous Survey of Hull, the two surveys are to be carried out during each 5 year cycle and may be aligned with the Drydocking Survey dates as long as the interval between surveys does not exceed 36 months.

* *Note* “Exceptional circumstances” means, e.g., unavailability of repair facilities, unavailability of essential materials, equipment or spare parts, or delays incurred by action taken to avoid severe weather conditions.

PART 7 SURVEYS

CHAPTER 2 SURVEYS AFTER CONSTRUCTION

SECTION 3 SURVEY PRE-PLANNING AND IN-SERVICE INSPECTION PROGRAM (ISIP)

1 Survey Pre-Planning

Plans and procedures for a Special Periodical Survey, Drydocking Survey, and Underwater Inspection in Lieu of Drydocking (UWILD) are to be made available onboard for the purpose of carrying out an on-board survey pre-planning meeting with the attending Surveyor.

The planning document is intended to identify critical structural areas and to stipulate the minimum extent, location and means of close up inspection, extent and type of NDT, and thickness measurements with respect to the major structural components as well as to nominated areas.

The document is to be worked out by the Owner in co-operation with ABS and submitted for review well in advance of the survey.

The basis for nomination of the critical structural areas is an assessment in consideration of possible deterioration and designated fatigue prone areas where the following elements on a particular unit are taken into account:

- Design feature with relatively low fatigue life.
- Former history available at Owner’s or ABS offices with respect to corrosion, cracking, buckling, indents and repairs for the particular installation as well as similar installations
- Installation’s service history since last survey (e.g., area of operation, environmental data, water depth, length of time at each location etc.)

1.1 Planning Document

The degree of criticality is to be judged and decided on the basis of the installation's structural and fatigue analyses and recognized principles and practice. The planning document is required to contain the following items:

i) Main particulars

ii) Plans to include details of major brace and column connections on column-stabilized units

iii) Detailed information on NDT methods and locations

iv) List of tanks with information on use, protection and condition of coating

v) Corrosion risk of tank and other major structural members

vi) Design risk nomination of major structure

vii) Nomination of areas for close up surveys and NDT

viii) Nomination of areas of structure for thickness measurement

ix) List of acceptable corrosion allowance of different structures

x) Method and extent of cleaning inspection points

1.3 In-Service Inspection Program (ISIP)

Where the installation is surveyed under an ISIP, the approved ISIP plan is to be used for the purpose of carrying out an on-board survey pre-planning meeting with the attending Surveyor.

All Column-Stabilized Units (CSUs), Spars or Tension Leg Platforms (TLPs) are to be surveyed in accordance with an ABS approved plan for In-Service Inspection Program. Applicable class surveys of the floating installation's hull structure and mooring system are to be carried out in accordance with the ABS approved ISIP plan.

3 In-Service Inspection Program (ISIP)

In-Service Inspection Program (ISIP) is a comprehensive program that outlines the procedures to be followed and the inspection frequency of the hull and mooring system of a Floating Production Installation (FPI).

All Column-Stabilized Unit (CSU), Spar or Tension Leg Platform (TLP) type floating production installations classed by ABS are to be surveyed in accordance with an ABS-approved ISIP plan.

An ISIP is mandatory for ABS class surveys on a non ship-shaped installation that is either classed as a Floating Offshore Installation (FOI) or together with its topside facilities of the CSU, Spar or TLP.

An ISIP is also mandatory for ABS class surveys on a ship-shaped production installation such as a Floating Production Storage and Offloading (FPSO) operating within the United States Outer Continental Shelf (OCS).

3.1 Coastal State Regulations

Compliance with an ISIP may be required by any Coastal State Authority. For example, for installations operating within the United States OCS, the United States Coast Guard (USCG) requires the installations to be inspected in accordance with an ISIP approved by the USCG (refer to the USCG D8(m) Policy Letter 03-2004 dated 03-May-2004). An ISIP plan in compliance with the ABS Rules will provide the basis for the owner's ISIP plan to be submitted to the USCG.

3.3 Contents of an ISIP Plan

Owner's ISIP plan is expected to at least cover the following items of 7-2-3/3.3.1 through 7-2-3/3.3.4 below. Additional documents such as tables, checklists, and procedural lists may be included as an Appendix to the plan.

3.3.1 Introduction and General Information

i) Description of the installation, together with its dimensions, main particulars, and the arrangement of ballast tanks and other spaces.

ii) Description of the installation's hull and special features. This is to include brief explanation of hull scantlings and locations with high stress.

iii) Description of special application structures and Structural Critical Inspection Points (SCIPs). The ISIP plan is to include a copy of the ABS review letter agreeing to the defined Structural Critical Inspection Points. The ISIP plan is also to include a listing of special application structures.

iv) Description and listing of primary and secondary application structures.

v) Description of the corrosion control system used throughout the installation, internally and externally, together with sacrificial anodes and the Impressed Current Cathodic Protection (ICCP) system, as applicable.

vi) Description of the "splash zone" or "wind-and-water strakes" as applicable. The ISIP plan is to include a copy of the ABS review letter agreeing to the defined "splash zone" or "wind-and-water strakes" of the installation.

vii) Arrangement and description of sea chest openings and sea valves.

viii) Arrangement and listing of accessible and inaccessible spaces throughout the installation.

ix) Supplementary drawings or sketches associated with above listed items (to be included in the ISIP plan as an Appendix).

3.3.2 Operational Procedures and Requirements

i) Following inspection procedures are to be included in the ISIP plan:

a) Description of underwater body inspections and internal structural inspection. The plan for UWILD is to be in accordance with applicable ABS Rules, and the ISIP plan is to briefly explain dive operations, safety standards and interaction with diving personnel and NDT specialists.

b) Detailed scope of individual inspections such as;

- Hull thickness gauging
- Examination by Remotely Operated Vehicle (ROV)
- Tank and space entry
- General Visual Inspection (GVI) and Close Visual Inspection (CVI)
- Non-Destructive Testing (NDT)

Special inspection techniques, interval and procedures for the SCIPs are to be included.

ii) An outline of the installation inspection schedule and frequency of all its hull structure and mooring system components are to be included in the ISIP plan. In general, this outline may be called the "Master Inspection Plan" and cover the entire life-cycle of the installation.

iii) Facility component identification

iv) Reporting and documentation, such as;

a) General record keeping procedures for reports and surveys (company policy).

b) Notification and report delivery procedures involving ABS.

c) Specific record-keeping procedures and report contents for each component category identified under 7-2-3/3.3.2iii) above.

d) Record-keeping for dive conducted during inspections of the underwater hull.

v) Damage assessment and repair procedures, such as:

a) Discussion of categories of damage and company procedures to mitigate.

b) Casualty notification procedures following to facility relating to underwater body and hull structure.

c) Specific procedures and methods to investigate damage or potential damage to the hull or internal structures.

d) Procedures to submit proposed methods, for repair of both underwater defects and damage, to ABS.

3.3.3 Structural Critical Inspection Points (SCIPs)

i) Details of structurally critical locations on the hull of the facility. This section is to at least include a listing, details, inspections cycles, and general inspection procedures of SCIPs.

ii) Drawing detailing the crucial or high stress inspection points as determined by ABS.

3.3.4 Post-Hurricane Structural Inspection

Timely and cost effective inspection of an offshore structure following a hurricane (or similar weather conditions such as a cyclone, typhoon, etc.) is critical before the operator safely re-man the unit/facility and brings production back on-line. In areas of the world where hurricane or equivalent weather events are common, an ISIP plan is required to contain owner's above-water and underwater inspection procedures before re-manning the unit/facility.

The API Bulletin "API BULL 2HINS: Guidance for Post-Hurricane Structural Inspection of Offshore Structures" published on 01-May-2009 is applicable to permanent fixed and floating structures in the Gulf of Mexico. In this bulletin, inspection refers to structural inspections only and does not include inspections of production equipment, process piping, electrical and instrumentation or other systems and components of the platform, unless noted otherwise. It provides necessary guidance regarding how a post-hurricane structural inspection needs to be carried out.

3.5 Structural Critical Inspection Point (SCIP)

SCIP is a structural point defined in the ISIP plan as a critical inspection area which has resulted from structural assessment using applicable calculations and analysis. In general, SCIPs are locations with higher stresses and estimated lower fatigue life. SCIPs are locations which have been identified from calculation to require monitoring, or from the service history of the subject unit or from similar sister units to be sensitive to cracking, buckling or corrosion which would impair the structural integrity of the unit. A tabular listing of the SCIPs, indicating the stress and fatigue life of each location is recommended to be included in the ISIP plan submitted to ABS Engineering Office. 7-2-3/Tables 1, 2 and 3 provide a list of typical structural areas/joints that are considered to be most critical and very critical.

TABLE 1
Critical Structures of a CSU *(1 July 2012)*

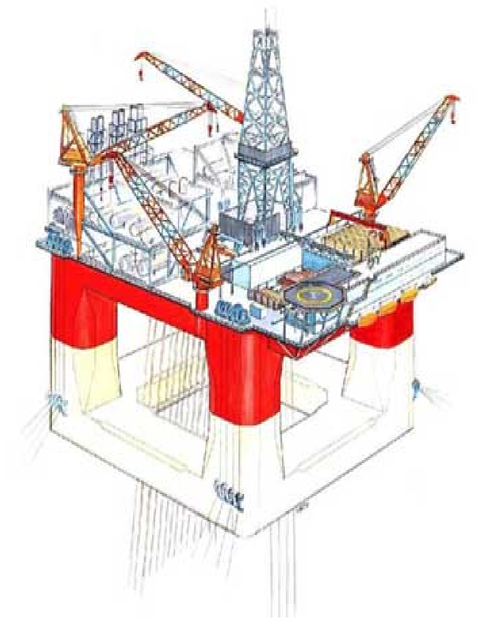
<table>
<tr><td>Special Application Structures (Most Critical)
• Structure in way of main intersections of lower hulls, columns, braces, deck boxes, column top frames and (integrated) deck structures
• Global strength members or portions of integrated deck structure which receive major concentrated loads
• Intersection of column top frame members
• Chain Jack & Fairlead foundations
• Riser porches</td><td rowspan="2"></td></tr>
<tr><td>Primary Application Structures (Very Critical)
• Lower hull shell and bulkheads
• Column shell and bulkheads
• Braces
• Deck box bulkheads which form “box” or “I” beam type structures that contribute to global strength
• Column top frame members
• Integrated deck main truss members and nodes
• Bulkheads, flats and framing which provide local reinforcement or continuity of structure in way of main intersections where not considered special</td></tr>
</table>

TABLE 2
Critical Structures of a Spar *(1 July 2012)*

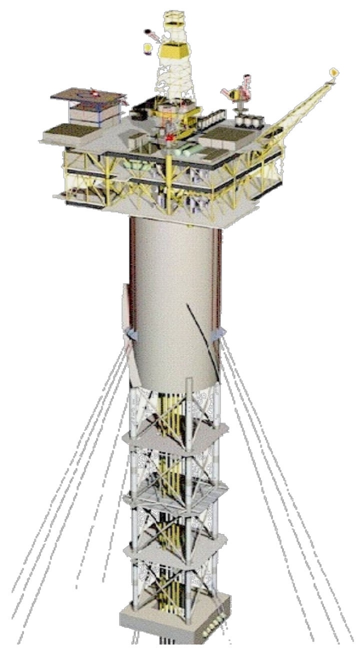
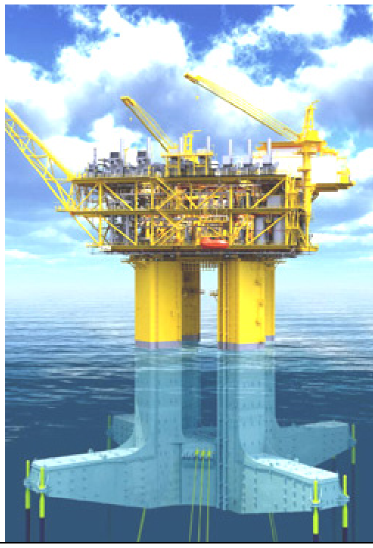
<table>
<tr><td>Special Application Structures (Most Critical)
• Hard tank – Topside deck leg connection
• Hard tank – Truss connection
• Truss – Soft tank connection
• Heave plate – Truss connection
• Truss tubular joint cans
• Chain jack & fairlead foundations
• Riser guide – Hull connection
• Riser porches</td><td rowspan="2"></td></tr>
<tr><td>Primary Application Structures (Very Critical)
• All inner and outer hull shell plating
• Hull top and bottom decks (incl. main girders)
• All radial hull bulkheads
• All hull ring frames and longitudinal girders
• All truss chords and braces
• Heave plate plating and girders
• Soft tank plating and girders
• All struts</td></tr>
</table>

TABLE 3
Critical Structures of a TLP *(1 July 2012)*

<table>
<tr><td>Special Application Structures (Most Critical)
• Structure in way of main intersections of lower hulls, columns, column top frames and (integrated) deck structures
• Global strength members or portions of integrated deck structure which receive major concentrated loads
• Intersection of column top frame members
• Tendon porches
• Riser porches</td><td rowspan="2"></td></tr>
<tr><td>Primary Application Structures (Very Critical)
• Lower hull shell and bulkheads
• Column shell and bulkheads
• Column top frame members
• Integrated deck main truss members and nodes
• Bulkheads, flats and framing which provide local reinforcement or continuity of structure in way of main intersections where not considered special</td></tr>
</table>

PART 7 SURVEYS

CHAPTER 2 SURVEYS AFTER CONSTRUCTION

SECTION 4 ANNUAL SURVEYS

1 General

The documents and records referenced in 7-2-1/23 of this Guide, as applicable, are to be sighted onboard during Annual Surveys, and the survey is to include the following items of this Section, as applicable.

3 Hull

3.1 Ship-Type Floating Production Installations

For ship-type installations, the weather decks, hull plating and their closing appliances together with watertight penetrations are to be generally examined as far as practicable and placed in satisfactory condition, and the following items are to be verified.

3.1.1 Structure

3.1.1(a) Main structure above waterline.

3.1.1(b) Interface structure between main hull and topside structures, including associated stools and elastomeric bearings, as fitted.

3.1.1(c) Topside main module structures supporting production facilities and supporting systems.

3.1.2 Protection of Openings

3.1.2(a) Hatchways, manholes and scuttles in freeboard and superstructure decks.

3.1.2(b) Machinery casings, fiddley covers, funnel annular spaces, skylights, companionways and deckhouses protecting openings in freeboard or enclosed superstructure decks.

3.1.2(c) Portlights together with deadcovers, cargo ports, bow or stern access, chutes and similar openings in installation's sides or ends below the freeboard deck or in way of enclosed superstructures.

3.1.2(d) Ventilators including closing devices where fitted, air pipes together with flame screens and weld connections to deck plating. All air pipe "closure devices" installed on the exposed decks are to be externally examined, randomly opened out and their condition verified. Scuppers, inlets and overboard discharges are to be externally examined as accessible including their attachment to shell and valves.

3.1.2(e) Watertight bulkheads, bulkhead penetrations, end bulkheads of enclosed superstructures and the operation of any doors in same.

3.1.2(f) Weathertight doors and closing appliances for all of the above including stiffening, dogs, hinges and gaskets. Proper operation of weathertight doors and closing appliances to be confirmed.

3.1.3 Freeing Ports

Freeing ports, together with bars, shutters and hinges.

3.1.4 Protection of Crew

Guard rails, lifelines, gangways and deckhouses accommodating crew.

3.1.5 Loading and Stability Information

Confirmation of loading guidance, stability data and damage control plans, as applicable.

Loading instruments accepted for classification or approved stability computers installed to supplement the Trim and Stability booklet are to be confirmed in working order by use of the approved check conditions, as applicable. The user's instruction manual for the loading instrument or the stability computer is to be confirmed onboard.

3.1.6 Load Line

Confirmation is required that no alterations have been made to the hull or superstructures which would affect the calculation determining the position of the load lines. Record of Conditions of Assignment is to be available onboard for reference. The Load Line marks are to be sighted, found plainly visible, and re-cut and/or painted, as required.

3.3 Column Stabilized Floating Production Installations

For column-stabilized floating production installations, including Spars and TLPs, the exposed parts of the hull, the deck, deck houses, structures attached to the deck, derrick substructure, including supporting structure, accessible internal spaces and their closing appliances together with watertight penetrations are to be generally examined as far as practicable and placed in satisfactory condition, and the following items are to be verified.

3.3.1 Structure

3.3.1(a) Main structure above waterline.

3.3.1(b) Structures attached to the deck, derrick substructure, including supporting structure,

3.3.1(c) Topside main module structures supporting production facilities and supporting systems.

3.3.2 Protection of Openings

3.3.2(a) Hatchways, manholes and scuttles in freeboard and superstructure decks.

3.3.2(b) Machinery casings, fiddley covers, funnel annular spaces, skylights, companionways and deckhouses protecting openings in freeboard or enclosed superstructure decks.

3.3.2(c) Portlights together with deadcovers, cargo ports, bow or stern access, chutes and similar openings in installation's sides or ends below the freeboard deck or in way of enclosed superstructures.

3.3.2(d) Ventilators including closing devices where fitted, air pipes together with flame screens and weld connections to deck plating. All air pipe "closure devices" installed on the exposed decks are to be externally examined, randomly opened out and their condition verified. Scuppers, inlets and overboard discharges are to be externally examined as accessible including their attachment to shell and valves.

3.3.2(e) Watertight bulkheads, bulkhead penetrations, end bulkheads of enclosed superstructures and the operation of any doors in same.

3.3.2(f) Weathertight doors and closing appliances for all of the above including stiffening, dogs, hinges and gaskets. Proper operation of weathertight doors and closing appliances to be confirmed.

3.3.3 Upper Hull Support Structure above Waterline

Columns, diagonals and other parts of the upper hull supporting structure as accessible above the waterline.

3.3.4 Protection of Crew

Guard rails, lifelines, gangways and deckhouses accommodating crew.

3.3.5 Loading and Stability Information

Confirmation of loading guidance, stability data and damage control plans, as applicable.

Loading instruments accepted for classification or approved stability computers installed to supplement the Trim and Stability booklet are to be confirmed in working order by use of the approved check conditions, as applicable. The user's instruction manual for the loading instrument or the stability computer is to be confirmed onboard.

3.3.6 Load Line (where assigned by ABS)

Where Load Line is assigned, confirmation that no alterations have been made to the hull or superstructures which would affect the calculation determining the position of the load lines. Record of Conditions of Assignment is to be available onboard for reference. The Load Line marks are to be sighted, found plainly visible, and recut and/or painted, as required.

3.5 Suspect Areas

Suspect areas of the hull are to be overall examined, including an overall and Close-up Survey of those suspect areas which were identified at the previous surveys.

Areas of substantial corrosion identified at previous surveys are to have thickness measurements taken.

Where extensive areas of corrosion are found or when considered necessary by the Surveyor, thickness measurements are to be carried out and renewals and/or repairs made when wastage exceeds allowable margins.

Where substantial corrosion is found, additional thickness measurements in accordance with 7-3-2/7 of the ABS *Rules for Survey After Construction (Part 7)*, are to be taken to confirm the extent of substantial corrosion. These extended thickness measurements are to be carried out before the survey is credited as completed.

Where reduced scantlings on the basis of effective corrosion control have been adopted, the results of any measurements are to be evaluated based on the scantlings before reduction.

3.7 Ballast Tanks and Combined Cargo/Ballast Tanks

3.7.1 Installations Over 5 Years of Age

Examination of the following tanks is to be carried out.

i) Ballast tanks and combined cargo/ballast tanks other than double bottom tanks, where the following conditions have been identified at previous surveys.

- A hard protective coating was found in POOR condition, or
- A soft coating has been applied, or
- A hard protective coating has not been applied from the time of construction.

ii) Double bottom ballast tanks, where substantial corrosion was found within the tank, and the following conditions have been identified at previous surveys.

- A hard protective coating was found in POOR condition, or
- A soft coating has been applied, or
- A hard protective coating has not been applied from the time of construction.

3.7.2 Installations Over 15 Years of Age

In addition to the requirements of 7-2-1/3.7.1 of this Guide, the following tanks are also to be examined.

i) Ballast tanks and combined cargo/ballast tanks other than double bottom tanks in way of spaces designated for the carriage of cargo, where FAIR coating conditions were identified at previous surveys, a minimum of three (3) so identified tanks (i.e., one (1) forward, one (1) midship and one (1) aft).

ii) Peak tanks, where FAIR coating conditions were identified at previous surveys.

Where extensive areas of corrosion are found or when considered necessary by the Surveyor, thickness measurements are to be carried out and renewals and/or repairs made when wastage exceeds allowable margins.

Where substantial corrosion is found, additional thickness measurements in accordance with 7-3-2/7 of the ABS *Rules for Survey After Construction (Part 7)* are to be taken to confirm the extent of substantial corrosion. These extended thickness measurements are to be carried out before the survey is credited as completed.

Where reduced scantlings on the basis of effective corrosion control have been adopted, the results of any measurements are to be evaluated based on the scantlings before reduction.

3.9 Helicopter Deck

Where areas of the installation are designated for helicopter operations, the helicopter deck, deck supporting structure, deck surface, deck drainage, tie downs, markings, lighting, wind indicator, securing arrangements where fitted safety netting or equivalent, access arrangements including emergency escape, and access for fire fighting and rescue personnel, are to be examined.

3.11 Floating Production Installations in Lightering Service

In addition to the applicable requirements of 7-2-4/1.1 of this Guide, the Annual Survey is also to include an external examination of hull structures where fenders for lightering operation were located. Where extensive areas of wastage are found, or when considered necessary by the Surveyor, thickness measurements and internal examination, including Close-up Survey, may be required.

3.13 Non Self Propelled Floating Production Installations

Machinery items installed consistent with the services of the installation are subject to a general examination and are to be placed in satisfactory condition.

3.15 Cargo Tanks

Cargo tank openings including gaskets, covers and coamings.

Pressure/vacuum relief valves, flame arrestors and flame screens. Tank vent protective devices are to be examined externally for proper assembly and installation, damage, deterioration or traces of carryover at the outlet. Where deemed suspect, the tank protective device is to be opened for examination.

3.17 Cargo Pump Room

Examination of pump room bulkheads for signs of leakage or fractures and, in particular, the sealing arrangement of all penetrations of bulkheads.

Confirmation that there are no potential sources of ignition in or near the cargo pump room and cargo area and that pump room access ladders are in good condition.

Pump room ventilation system including ducting, dampers and screens.

5 Mooring System

Annual Surveys of the mooring system is mandatory for all types of floating production installations, and are to comply with following requirements of 7-2-3/5.1 or 7-2-3/5.3, as applicable.

5.1 Spread Mooring System

At each Annual Survey, the spread mooring system is to be generally examined so far as can be seen and placed in satisfactory condition as necessary. In addition, the following above water items are to be examined, placed in satisfactory condition and reported upon, where applicable:

i) The anchor chain stopper structural arrangements are to be visually examined, including the structural foundations of all of the stoppers or holders. Tensioning equipment is to be generally examined.

ii) The anchor chain catenary angles are to be measured to verify that the anchor chain tensions are within the design allowable tolerances. Where anchor cables are used, their tensions are to be verified to be within the allowable tensions.

iii) The anchor chains or anchor cables above the water are to be visually examined for wear and tear.

5.3 Single Point Mooring (SPM) Systems

At each Annual Survey, the single point mooring system is to be generally examined insofar as can be seen above water and placed in satisfactory condition as necessary. In addition, the following above water items are to be examined, placed in satisfactory condition and reported upon, where applicable:

i) The anchor chain stopper structural arrangements are to be visually examined, including the structural foundations of all of the stoppers.

ii) The anchor chain's catenary angles are to be measured to verify that the anchor chain tensions are within the design allowable tolerances. Where anchor cables are used, their tensions are to be verified to be within the allowable tensions.

iii) The anchor chains or anchor cables above the water are to be visually examined for wear and tear.

iv) The condition of the bearings is to be verified for continued effectiveness of the lubrication system.

v) The entire assembly of the single point mooring structure above water is to be generally examined for damage, coating breaks and excessive signs of corrosion. This survey is to include all turret wall structures, accessible turret well structures, mooring arms, all structures supporting the disconnectable operations of the mooring system, etc., whichever are applicable.

7 Fire and Safety Systems

Annual Survey of the entire fire and safety systems installed throughout the floating production installation is mandatory for all types of floating production installations.

Following systems are to be verified to confirm no significant changes have been made to any of the systems and that they remain in satisfactory condition.

7.1 Passive Fire Protection Systems

Passive fire protection systems, including the following items are to be generally examined and function tested as necessary:

i) Examination of structural fire protection as well as protection of accommodation spaces, service spaces and control stations, as accessible

ii) Examination and function testing of fire doors

iii) Examination and testing of ventilation fire-dampers

iv) Examination and testing of ventilation system closures and stoppage of power ventilation

v) Examination and testing of shutters or water curtains (where fitted)

7.3 Active Fire Protection – Fixed Systems

Active fire protection fixed systems, including the following items are to be generally examined and function tested as necessary:

i) Examination of all items shown on the fire control plan, and confirmation that no alteration has been made to the ABS endorsed plan

ii) Examination and testing of all fire pumps. Other pumps used for active fire protection are also to be examined. This is to include confirmatory testing of the fire pump capacity, and where installed, testing of relief valves of the fixed fire main system.

iii) Examination and function testing of the fire main system

iv) Examination of all hydrants, hoses, nozzles, and shore connections, and testing of these as necessary

7.5 Active Fire Protection – Additional Fixed Systems

Where installed, active fire protection additional fixed systems, including the following items are to be generally examined and function tested as necessary:

i) Examination and testing of the gas smothering system, including confirmatory examination of the storage of the gas medium, gas alarms, and examination and testing of manual controls

ii) Examination of the high or low expansion foam systems

iii) Examination and function testing of fixed water spraying systems

iv) Protection of helicopter decks with or without refueling capacity

v) Examination of paint and flammable liquid lockers

7.7 Active Fire Protection – Portable Systems

All portable fire-fighting equipment fitted onboard, are to be in accordance with ABS approved plans. In addition, the following items are to be generally examined:

i) Examination of all portable and semi-portable extinguishers

ii) Examination and testing of the firefighter's outfit, as necessary

7.9 Fire Detection and Alarm Systems

Fire detection and alarm systems, as installed, are to be examined and tested as necessary.

7.11 Gas Detection and Alarm Systems

Gas detection and alarm systems, as installed, are to be examined and tested as necessary.

7.13 Outfitting

Outfitting arrangements, including the following items are to be examined and tested as necessary:

i) All escape routes from accommodation spaces, service spaces and control stations, from Category 'A' machinery spaces, from other machinery spaces, deckhouses, together with stairway or ladders in way of any escape route, and the accessibility and access through the routes

ii) Lighting and gratings in way of all escape routes

iii) Guards and rails along floor deck areas and openings, and helicopter landing deck

iv) Contact makers for general alarm system, communication system installed in all emergency control stations

v) Fire precautions taken in all machinery spaces

7.15 Emergency Shutdown Arrangements

Emergency shutdown arrangements provided to disconnect or shutdown, either selectively or simultaneously, of the electrical equipment as outlined in the floating production installation's operating manual, are to be examined and tested.

Services such as the emergency lighting, general alarm system, public address system, distress and safety radio system, that are required to be operable after an emergency shutdown of the installation, are to be verified for their proper operation.

All equipment in exterior locations w*h*ich is capable of operation after an emergency shutdown is to be verified as being suitable for installation in Zone 2 locations.

9 Machinery and Electrical Systems (Marine & Safety Systems)

Annual Survey of machinery and electrical systems servicing the marine and safety systems is mandatory for all types of floating production installations.

9.1 Machinery and Electrical Parts to be Examined

Surveys for ship- or barge-type installations are to comply with applicable requirements of 7-6-2/1 of the ABS *Rules for Survey After Construction (Part 7)*.

Surveys for column-stabilized installations are to comply with applicable requirements of 7-2-4/3 of the *MODU Rules*.

9.3 Self Propelled Installations – Main Propulsion Apparatus

Surveys of self propelled installations is to comply with applicable requirements of 7-6-2/1 of the ABS *Rules for Survey After Construction (Part 7).*

9.3.1 Thrusters (where installed)

Thruster surveys are to comply with the requirements of Section 7-9-6 of the ABS *Rules for Survey After Construction (Part 7)*.

9.5 Preventative Maintenance Techniques

Surveys of machinery that has been accepted for surveys based on preventative maintenance techniques are to comply with the requirements of Appendix 7-A-14 of the ABS *Rules for Survey After Construction (Part 7)*.

9.7 Hazardous Areas

Surveys of hazardous areas and electrical equipment installed in hazardous areas are to comply with applicable requirements of the ABS *Guide for Building and Classing Facilities on Offshore Installations*.

11 Inert Gas Systems (where installed)

Applicable requirements of 7-6-2/1.1.12 of the ABS *Rules for Survey After Construction (Part 7)* are to be complied with.

13 Liquefied Gas Installations (where installed)

The Annual Survey, except First Annual Survey, is to be carried out during a loading or discharging operation, as far as practicable.

In addition to the applicable requirements of 7-2-4/3.17 and 7-2-4/3.19 of this Guide, the Annual Survey is to include the following:

13.1 First Annual Survey

i) *Cargo Containment System.* An Overall Survey is to be made of the cargo containment system including the supporting and positioning arrangements, hatches, access arrangements and penetrations, the secondary barrier where fitted, adjacent hull structure and the insulation, insofar as possible without removing fixed insulation or structural members unless deemed necessary by the attending Surveyor.

ii) *Secondary Barriers.* The secondary barrier is to be checked for its effectiveness by means of a pressure/vacuum test, a visual inspection or some other acceptable method.

iii) *Other Items.* See 7-2-1/13.3 of this Guide for additional items to be included in the first Annual Survey.

13.3 All Annual Surveys

i) *General.* The logbooks are to be examined with regard to correct functioning of the cargo containment and cargo handling systems. The hours per day of the reliquefaction plants or the boil-off rate is to be considered.

ii) *Interbarrier Space Venting System.* The venting system or other arrangements provided for the emergency removal of gas from the interbarrier spaces (i.e., between the primary and secondary barriers) is to be confirmed in satisfactory condition.

iii) *Cargo Tank Venting System.* The venting system for the cargo tanks and hold spaces is to be confirmed in satisfactory operating condition. The vent line drainage arrangement is to be examined.

iv) *Instrumentation and Safety Systems.* Gas leakage detection equipment, including indicators and alarms, is to be confirmed in satisfactory operating conditions. Systems for temperature, pressure and liquid level indication of the cargo, cargo tank, insulation, the hull adjacent to the cargo containment system, and cargo refrigerating installations where fitted, including alarms, are to be confirmed in satisfactory operating condition. The piping of the gas detection system is to be visually examined for corrosion and damage and the integrity of the line between suction points and analyzing units is to be confirmed as far as possible.

The logbooks are to be examined for confirmation that the emergency shutdown system has been tested.

v) *Environmental Control of Hold Spaces.* Inert gas and dry air systems, including indicators and alarms, are to be confirmed in satisfactory operating condition. Means for prevention of backflow of cargo vapor into gas-safe spaces is to be confirmed in satisfactory operating condition. For membrane containment systems, normal operation of the nitrogen control system for insulation and interbarrier spaces shall be confirmed.

vi) *Cargo Handling Piping and Machinery.* All piping, cargo hoses, emergency shut-down valves, remote operating valves, machinery and equipment for loading, unloading, venting, compressing, refrigerating, liquefying, heating or otherwise handling the liquefied gas or vapor is to be examined, as far as possible. Records of stopping of the cargo pumps and compressors upon emergency shut-down of the system is to be verified/confirmed.

Cargo hoses are to be verified, where appropriate, type-approved or marked with date of testing.

vii) *Cargo Tank Tightness.* The tightness of cargo tanks is to be confirmed. For this purpose, the installation's gas leak detectors, micro-flow meters, etc. may be utilized providing that they are first proved to be in good order. The installation's logbooks are also to be reviewed to confirm the tightness of the cargo tanks.

viii) *Heating Coils.* Heating coils and other heating systems which are essential to keep the temperature of the hull structure from falling below the minimum allowable value for the material used are to be proven in satisfactory operating condition.

ix) *Ventilating System.* Examination of the ventilation system is to be made for all gas dangerous spaces and zones, including air locks, cargo pump rooms, cargo compressor rooms, cargo control rooms and spaces used for cargo handling operations. All portable ventilating equipment required for use in the gas dangerous spaces is to be examined. Provision of spares for mechanical ventilation fans for gas dangerous spaces and zones, recommended by manufacturer is to be confirmed.

x) *Spaces in Cargo Areas.* Air locks, cargo pump rooms, cargo compressor rooms, rooms containing electric motors for driving cargo pumps or compressors, cargo control rooms and spaces used for cargo handling operations are to be examined. All accessible gas-tight bulkhead penetrations including gas-tight shaft seals are to be examined. The means for accomplishing gas tightness of the wheelhouse doors and windows is to be examined.

The closing devices for all air intakes and openings into accommodation spaces, service spaces, machinery spaces, control stations and openings in superstructures and deckhouses facing the cargo area or bow and stern loading/unloading arrangements are to be examined.

All windows and sidescuttles within the area required to be of the fixed type (nonopening) are to be examined for gas tightness.

xi) *Drip Trays.* Portable and fixed drip trays and insulation for the protection of the deck in the event of cargo leakage are to be examined.

xii) *Gas Burning Installations.* Gas burning installations, including instrumentation and safety systems, are to be examined and confirmed in satisfactory operating condition. See also 7-2-1/13.3iv) of this Guide.

xiii) *Sealing Arrangements.* Sealing arrangements on the weather deck in way of openings for the cargo containment system are to be examined.

xiv) *Fire Protection and Fire Extinguishing Equipment.* The fire water main equipment, water spray equipment, dry chemical powder fire extinguishing systems in the cargo area, and fixed inerting and fixed smothering installations in gas-dangerous spaces are to be examined and operationally tested, as far as practicable.

xv) *Electrical Equipment.* Electrical equipment in gas-dangerous spaces or zones is to be examined as far as practicable with particular respect to the following:

- Protective earthing
- Physical condition of electrical cables and supports
- Integrity of enclosures
- Intrinsically safe, explosion proof, or increased safety features of electrical equipment
- Functional testing of pressurized equipment and associated alarms
- Testing systems for de-energizing electrical equipment which is not certified safe for use in gas-hazardous areas but which is located in spaces protected by air-locks (e.g., electrical motor rooms or cargo control rooms)
- Insulation resistance readings of circuits. Where a proper record of testing is maintained, consideration may be given to accepting recent readings.

Note: See also IACS Recommendation No.35 – Inspection and maintenance of electrical equipment installed in hazardous areas.

xvi) *Personnel Protection.* Firemen's outfits, protective clothing, and respiratory protection equipment are to be examined. Decontamination showers and eye wash are to be examined and operationally tested, as far as practicable.

xvii) *Tightness of Hull.* Means for detecting leakage into the hold space through the ship's structure forming the boundary of the hold space are to be examined.

xviii) *Operating Instructions.* Instructions and information material, such as cargo handling plans, loading manual, filling limit information, cooling-down procedure, are to be confirmed as being aboard the installation.

xix) *Relief Valves.* All relief valves in the cargo containment and venting system are to be examined, including protective screens and flame screens, if provided, and seals confirmed intact. Records of opening and closing pressures of relief valves are to be confirmed onboard.

15 Dynamic Positioning Systems (if classed)

Dynamic Positioning Systems are to comply with the requirements of Section 7-9-6 of the ABS *Rules for Survey After Construction (Part 7)*.

17 Automatic and Remote-Control Systems (if classed)

For Shipboard Automatic and Remote-Control System, applicable requirements of Chapter 8 of the ABS *Rules for Survey After Construction (Part 7)* are to be complied with.

19 Production Facilities (if classed)

Where the floating production installation's production facilities are classed, applicable requirements of the ABS *Guide for Building and Classing Facilities on Offshore Installations* are to be complied with.

Maintenance records are to be kept and made available for review by the attending Surveyor. The maintenance records will be reviewed to establish the scope and content of the required Annual and Special Periodical Surveys. During the service life of the facilities, maintenance records are to be updated on a continuing basis. The operator is to inform ABS of any changes to the maintenance procedures and frequencies, as may be caused, for example, by changes or additions to the original equipment. The Surveyor may determine during the periodic survey if the changes are sufficient to warrant review by ABS' technical staff.

21 Import and Export Systems (if classed)

Where the floating production installation's import-export systems are classed, the import and export systems are to be examined as far as can be seen and placed in satisfactory condition as necessary. In addition, the following items are to be examined, placed in satisfactory condition and reported upon where applicable:

i) A general examination is to be performed on all electrical and fluid swivels, flexible risers, floating hoses, cargo piping and valves associated with the import and export systems, expansion joints, seals, etc.

ii) The fluid swivels are to be examined for signs of leaks through their "tell-tale" apertures.

iii) Records of maintenance are to be reviewed, including records of hose hydrostatic testing.

iv) Navigational aids for all floating hoses are to be examined and functionally tested.

v) Riser tensioning arrangements are to be examined for proper functioning order.

vi) All electrical equipment, fitted in hazardous location is to be examined for integrity and suitability for the continued service.

PART 7 SURVEYS

CHAPTER 2 SURVEYS AFTER CONSTRUCTION

SECTION 5 INTERMEDIATE SURVEYS

1 General

The documents and records referenced in 7-2-1/23 of this Guide, as applicable, are to be sighted onboard during Annual Surveys, and the survey is to include the following items of this Section, as applicable.

The Intermediate Survey requirements are in addition to the Annual Survey requirements stated in Section 7-2-4 of this Guide.

3 Hull

3.1 Ship-Type Floating Production Installations

Intermediate Surveys of self-propelled barge- or ship-type installations are to comply with the applicable requirements of 7-3-2/3 of the ABS *Rules for Survey After Construction (Part 7)*.

The scope of the second or third Annual Survey is to be extended to include the following.

3.1.1 Survey Planning Meeting

A survey planning meeting is to be held prior to the commencement of the survey.

3.1.2 Survey of Ballast Tanks

i) *For Installations 5 < Age ≤ 10 years*

Overall Survey of a minimum of three (3) representative ballast tanks selected by the Surveyor is to be carried out. Where a hard protective coating is found in POOR condition, where soft coating has been applied or where a hard protective coating has not been applied from time of construction, the examination is to be extended to other ballast tanks of the same type.

ii) *For Installations Age > 10 years*

Overall Survey of all ballast tanks is to be carried out.

If survey of ballast tanks reveals no visible structural defects, the examination may be limited to verification that the corrosion prevention system remains effective.

3.1.3 Survey of Ballast Tanks and Combined Cargo/Ballast Tanks Other than Double Bottom Tanks

Where provided, the condition of corrosion prevention system of ballast tanks and combined cargo/ballast tanks is to be examined.

Ballast tanks and combined cargo/ballast tanks, other than double bottom tanks, where a hard protective coating is found in POOR condition and Owners or their representatives elect not to restore the coating, where a soft coating has been applied or where a hard protective coating has not been applied from time of construction, the tanks in question are to be internally examined at each subsequent Annual Survey. Thickness measurements are to be carried out as considered necessary by the Surveyor.

3.1.4 Survey of Ballast Tanks in way of Double Bottom

Double bottom ballast tanks, where a hard protective coating is found in POOR condition and Owners or their representatives elect not to restore the coating, where a soft coating has been applied or where a hard protective coating has not been applied from time of construction, the tanks in question are to be internally examined at each subsequent Annual Survey where substantial corrosion is documented. Thickness measurements are to be carried out as required.

3.1.5 Survey of Cargo Tanks

At each Intermediate Survey after Special Periodical Survey No. 2, at least three (3) cargo tanks of integral type: one (1) center, one (1) port wing and one (1) starboard wing tank, are to be examined internally.

3.3 Column Stabilized Floating Production Installations

Intermediate Survey of column stabilized installations is to comply with the requirements of Section 7-2-6 of the ABS *Rules for Building and Classing Mobile Offshore Drilling Units*, applicable to column stabilized units.

3.5 Floating Production Installations in Lightering Service

In addition to the applicable requirements of 7-2-5/3.1, 7-2-5/3.3. 7-2-5/3.7, and 7-2-5/3.9 of this Guide, the Intermediate Survey is to include an external examination and internal Close-up Survey of hull structures, including thickness measurements, where fenders for lightering operation were located.

3.7 Hull Thickness Measurement

When extensive areas of wastage are found, thickness measurements are to be carried out and renewals made where wastage exceeds the allowable margin. Where reduced scantlings on the basis of effective corrosion control have been adopted, the results of any measurements are to be evaluated based on scantlings before reduction.

3.9 Tank Testing

Pressure testing of cargo and ballast tanks is not required unless deemed necessary by the attending Surveyor.

5 Liquefied Gas Installations (where installed)

The Intermediate Survey is preferably to be carried out with the installation in a gas free condition. The extent of the testing required for the Intermediate Survey will normally be such that the survey cannot be carried out during a loading or discharging operation.

In addition to the applicable requirements of 7-3-2/1.13.7 of the ABS *Rules for Survey After Construction (Part 7)*, the Intermediate Survey is also to include the following.

5.1 Instrumentation and Safety Systems

i) The instrumentation of the cargo installation with regard to pressure, temperature and liquid level is to be visually examined and to be tested by changing the pressure, temperature and level, as applicable, and comparing with test instruments. Simulated testing may be accepted for sensors which are not accessible or for sensors located within cargo tanks or inerted hold spaces. The testing is to include testing of the alarm and safety functions.

ii) Gas detectors are to be calibrated or verified with sample gases.

iii) The emergency shutdown system is to be tested, without flow in the pipe lines, to verify that the system will cause the cargo pumps and compressors to stop.

5.3 Gas Burning Installations

The instrumentation and safety systems for gas burning installations are to be examined and tested in accordance with the requirements of 7-2-5/5.1i) of this Guide.

PART 7 SURVEYS

CHAPTER 2 SURVEYS AFTER CONSTRUCTION

SECTION 6 SPECIAL PERIODICAL SURVEYS (SPS)

1 General

The documents and records referenced in 7-2-1/23 of this Guide, as applicable, are to be sighted onboard during Annual Surveys, and the survey is to include the following items of this Section, as applicable.

The Special Periodical Survey requirements are in addition to the Annual Survey and Intermediate Survey requirements stated in Sections 7-2-4 and 7-2-5 of this Guide.

3 Hull

3.1 Ship-Type Floating Production Installations

In addition to the requirements of the Annual Survey – Hull, the SPS – Hull is to include sufficient examination, tests and checks carried out by the Surveyors to satisfy themselves that the hull and its outfitting are in or are placed in satisfactory condition and are fit for the intended purpose for the new period of class of five (5) years to be assigned, subject to proper maintenance and operation and to periodic surveys being carried out at the due dates. Special Periodical Survey is to include the following:

3.1.1 Survey Planning Meeting

A survey planning meeting is to be held prior to the commencement of the survey.

3.1.2 Drydocking Survey (or UWILD)

Drydocking survey is to be carried out in accordance with Section 7-2-7 of this Guide.

3.1.3 Rudder

When the steering gear is maintained operational the rudder is to be examined and, when required, lifted and the gudgeons rebushed. The condition of carrier and steadiment/rudder stock bearings and the effectiveness of stuffing boxes are to be ascertained when the rudder is lifted.

3.1.4 Shell Openings and Their Closures

All openings in the shell including overboard discharges are to be examined.

3.1.5 Decks, Bulkheads and Shell Plating

All decks, watertight bulkheads, and internal and external surfaces of shell plating are to be examined. Plating in way of side shell or superstructure portlights is to be especially examined.

3.1.6 Overall Survey Requirements

3.1.6(a) Spaces. An Overall Survey of all spaces including holds and their tween decks, where fitted; double bottom, deep, ballast, peak and cargo tanks; pump rooms, pipe tunnels, duct keels, machinery spaces, dry spaces, cofferdams and voids, including the plating and framing, bilges and drain wells, sounding, venting, pumping and drainage arrangements.

Internal examination of fuel oil, lube oil and fresh water tanks is to be carried out in accordance with 7-2-6/3.1.6(d) of this Guide.

Where sounding pipes are fitted, the Surveyor is to confirm that a thick steel plate is securely fixed below the sounding pipe for the rod to strike upon.

This examination is to be supplemented by thickness measurement and testing as required to confirm that the structural integrity remains effective. The aim of the examination is to discover substantial corrosion, significant deformation, fractures, damages or other structural deterioration, that may be present.

3.1.6(b) Engine Room Spaces. Engine room structure is to be examined. Particular attention is to be given to tank tops, shell plating in way of tank tops, brackets connecting side shell frames and tank tops, and engine room bulkheads in way of tank top and bilge wells. Particular attention is to be given to the sea suction, seawater cooling pipes and overboard discharge valves and their connection to the side shell plating. Where extensive areas of wastage are found, thickness measurements are to be carried out, and renewals and/or repairs made where wastage exceeds allowable margins.

3.1.6(c) Ballast Tanks and Combined Cargo/Ballast Tanks. Where provided, the condition of corrosion prevention system of ballast tanks and combined cargo/ballast tanks is to be examined.

Ballast tanks and combined cargo/ballast tanks other than double bottom tanks, where a hard protective coating is found in POOR condition and Owners or their representatives elect not to restore the coating, where soft coating has been applied or where a hard protective coating has not been applied from time of construction, the tanks in question are to be internally examined at each subsequent Annual Survey. Thickness measurements are to be carried out as deemed necessary by the Surveyor.

When such breakdown of hard protective coating is found in double bottom ballast tanks and Owners or their representatives elect not to restore the coating, where a soft coating has been applied, or where a hard protective coating has not been applied from time of construction, the tanks in question are to be internally examined at each subsequent Annual Survey where substantial corrosion is documented. Thickness measurements are to be carried out as required.

3.1.6(d) Fuel Oil, Lube Oil, Freshwater and Permanent Ballast Tanks. Internal examination requirements will be specially considered for tanks used exclusively for permanent ballast which are fitted with an effective means of corrosion control.

Where tanks of integral structural type, except for peak tanks, are used primarily for heavy fuel oil or exclusively for light oils or fresh water, the internal examination may be specially considered, provided a general external examination and the following internal examinations are carried out.

Minimum requirements for internal examination of fuel oil, lube oil and fresh water tanks at Special Periodical Surveys are as follows.

i) *Special Periodical Survey No. 1 (Age ≤ 5 Years)*

None

ii) *Special Periodical Survey No. 2 (5 < Age ≤ 10 Years)*

- One (1) fuel oil tank in the Cargo length area. For installations without a defined cargo area a minimum of one (1) fuel oil tank.
- One (1) freshwater tank

iii) *Special Periodical Survey No. 3 (10 < Age ≤ 15 Years)*

- One (1) fuel oil tank in way of the engine room
- Two (2) fuel oil tanks in the Cargo length area. For installations without a defined cargo area a minimum of two (2) fuel oil tanks. One (1) deep tank is to be included, if fitted
- All freshwater tanks

iv) *Special Periodical Survey No. 4 and Subsequent Special Periodical Surveys (Age > 15 Years)*

- One (1) fuel oil tank in way of the engine room
- Half of all fuel oil tanks in the Cargo length area, minimum two (2). For installations without a defined cargo area, half of all fuel oil tanks, a minimum of two (2). One (1) deep tank is to be included, if fitted
- One (1) lube oil tank
- All freshwater tanks

Note: If a selection of tanks is accepted for examination, then different tanks are to be examined at each Special Periodical Survey on a rotational basis.

Independent oil tanks in machinery spaces are to be externally examined and, if deemed necessary, tested under a head of liquid.

3.1.7 Protection of Other Openings

3.1.7(a) Tank Protective Devices

i) All tank protective devices, where fitted, are to be examined externally for proper assembly and installation, damage, deterioration or traces of carryover at the outlets.

ii) All pressure-vacuum valves and pressure relief valves are to be opened out, pressure and vacuum valve discs checked for good contact with their respective seats and/or proved by testing.

3.1.7(b) Air Pipes. All air pipes are to be opened out and closing arrangements and flame screens, if fitted, are to be examined both externally and internally. For designs where the inner parts cannot be properly examined from outside, this is to include removal of the head from the air pipe. Particular attention is to be paid to the condition of the zinc coating in heads constructed from galvanized steel.

3.1.7(c) Watertight Bulkheads. Watertight bulkheads, bulkhead penetrations, end bulkheads of enclosed superstructures are to be examined. In addition, watertight doors are to be operationally tested and effectiveness to maintain tightness is to be confirmed.

3.1.8 Close-up Survey Requirements

The requirements for Close-up Survey and thickness gauging, per 7-3-2/5.13 or 7-3-2/5.14 of the ABS *Rules for Survey After Construction (Part 7)*, will be applied to ship- and barge-type installations in the following cases:

i) The ballast tanks are uncoated.

ii) Tank coatings are in FAIR or POOR condition as defined by 7-2-1/13.3 of this Guide

iii) Soft coatings are found to be no longer effective, 7-2-1/15.5 of this Guide

iv) Substantial corrosion is present

Thickness Measurements are to be carried-out as per Section 7-2-5/3.1.2 of this Guide.

3.1.9 Tank Testing

Boundaries of double bottom, deep, ballast, peak and other tanks, including holds adapted for the carriage of salt water ballast, are to be tested with a head of liquid to the top of air pipes or to near the top of hatches for ballast/cargo holds, except that cargo tanks on ship-type installations of both single and double hull construction may be tested to the highest point that liquid will rise under service condition. Boundaries of fuel oil, lube oil and fresh water tanks may be tested with a head of liquid to the highest point that liquid will rise under service condition. Tank testing of fuel oil, lube oil and fresh water tanks may be specially considered based on a satisfactory external examination of the tank boundaries, and a confirmation from the Master stating that the pressure testing has been carried out according to the requirements with satisfactory results, provided that representative tanks for fuel oil, lube oil and fresh water are tested.

The testing of double bottoms and other spaces not designed for the carriage of liquid may be omitted, provided a satisfactory internal examination together with an examination of the tank top is carried out.

Stagger testing of bulkheads is acceptable as alternative means of testing.

The Surveyor may require further tank testing, as deemed necessary.

3.1.10 Hull Thickness Measurement (Gauging)

These requirements do not apply to independent cargo tanks.

i) *Special Periodical Survey No. 1 (Age ≤ 5 Years)*

- Suspect areas throughout the installation.

ii) *Special Periodical Survey No. 2 (5 < Age ≤ 10 Years)*

- All main deck plates within the amidships 0.5*L* or cargo tank section, whichever is longer.
- One (1) transverse section within the amidships 0.5*L*.
- Plates in wind-and-water strakes outside the amidships 0.5*L*.
- All complete transverse web frame rings in a ballast wing tank or ballast double hull tank, if any.
- One (1) deck transverse in each of the remaining ballast tanks, if any.

- Both transverse bulkheads including girder system in a ballast wing tank or ballast double hull tank, if any, or a cargo wing tank used primarily for water ballast.
- Lower part of transverse bulkhead including girder system in each remaining ballast tank, one (1) cargo wing tank and two (2) cargo center tanks.
- Internals in forepeak and afterpeak tanks.
- Suspect areas throughout the installation.

iii) Special Periodical Survey No. 3 (10 < Age ≤15 Years)

- All main deck plates within the amidships 0.5*L* or cargo tank, whichever is longer.
- Two (2) transverse sections within the amidships 0.5*L*.
- Plates in wind-and-water strakes outside the amidships 0.5*L*.
- All complete transverse web frame rings in all ballast tanks and in a cargo wing tank.
- A minimum of 30% of all complete transverse web frame rings in each remaining cargo wing tank. (In calculating the 30% minimum, the number of web frame rings is to be rounded up to the next whole integer.)
- A minimum of 30% of deck and bottom transverse in each cargo center tank. (In calculating the 30% minimum, the number of transverses is to be rounded up to the next whole integer.)
- All transverse bulkheads including girder and stiffener systems in all cargo and ballast tanks.
- Additional complete transverse web frame rings as considered necessary by the Surveyor.
- Internals in forepeak and afterpeak tanks including plating and stiffeners of forepeak and afterpeak tank bulkheads.
- Suspect areas throughout the installation.

iv) Special Periodical Survey No. 4 and Subsequent Special Periodical Surveys (Age > 15 Years)

- All exposed main deck plates, full length. Also, exposed first-tier superstructure deck plates (poop bridge and forecastle decks).
- All keel plates full length. Also, additional bottom plates in way of cofferdams, machinery space and aft ends of tanks.
- A minimum of three (3) transverse sections within the amidships 0.5*L*.
- All complete transverse web frame rings in all ballast tanks and in a cargo wing tank.
- A minimum of 30% of all complete transverse web frame rings in each remaining cargo wing tank. (In calculating the 30% minimum, the number of web frame rings is to be rounded up to the next whole integer.)
- A minimum of 30% of deck and bottom transverse in each cargo center tank. (In calculating the 30% minimum, the number of transverses is to be rounded up to the next whole integer.)
- All transverse bulkheads including girder and stiffener systems in all cargo and ballast tanks.
- Additional complete transverse web frame rings as considered necessary by the Surveyor.
- Any additional tanks and structure as considered necessary by the Surveyor.
- Internals in forepeak and afterpeak tanks including plating and stiffeners of forepeak and afterpeak tank bulkheads.

- All plates in two (2) wind-and-water strakes, port and starboard full length.
- Suspect areas throughout the installation.
- Plating of seachests. Shell plating in way of overboard discharges as considered necessary by the attending Surveyor.

Note: Thickness measurements of any one entire girth belt(s) (transverse section(s)) shall be completed within 15 months from commencement of gaugings of a girth belt (transverse section.)

Thickness measurements review to be carried-out in accordance with 7-A-4/5 of the ABS *Rules for Survey After Construction (Part 7).*

Individual plate and stiffener wastage allowances – Individual plate and stiffener wastage allowances for ship-type floating installations with design life of 20 years are to satisfy Appendix 7-A-4 of the ABS *Rules for Survey After Construction (Part 7)*. Local wastage allowable margins of plates and stiffeners for floating installations with design life longer than 20 years will remain the same as applied to the required 20 year life scantlings to determine minimum scantlings at which renewals are required. Accordingly, based on percent wastage allowance, renewals would be required when scantling were wasted to values as if the installation were a 20 year life installation. The allowable wastage is to be based on the smaller of the percent wastage allowance (see 5A-2-2/Table 1) or the allowable wastage based on local buckling strength.

3.1.11 Application of Requirements for Close-Up Survey and Gauging per ESP Vessels

The requirements for close-up survey and thickness gauging, per 7-3-2/5.13 or 7-3-2/5.14 of the ABS *Rules for Survey After Construction (Part 7)* will be applied to ship- and barge-type installations in the following cases:

i) The ballast tanks are uncoated.

ii) Tank coatings are in POOR condition as defined by 7-2-1/13.3 of this Guide

iii) Soft coatings are found to be no longer effective, 7-2-1/15.5 of this Guide

iv) Substantial corrosion is present.

3.3 Column Stabilized Floating Production Installations

For column-stabilized installations, the following are to be performed, as applicable, the parts examined, placed in satisfactory condition and reported upon:

3.3.1 General Examination

The hull or platform structure, including tanks, watertight bulkheads and decks, cofferdams, void spaces, sponsons, chain locker, deck, keels, helicopter pad, machinery spaces, peak spaces, steering gear spaces and all other internal spaces are to be examined externally and internally for damage, fractures or excessive wastage.

3.3.2 Examination of Tanks, Compartments and Free-Flooding Spaces

All tanks, compartments and free-flooding spaces throughout the installation are to be examined externally and internally. Internal examinations of lower hull are to be specially considered. Watertight integrity of tanks, bulkheads, hull, bulkhead deck and other compartments are to be verified by visual inspection. Suspect areas may be required to be tested for tightness, nondestructively tested or thickness gauged. Tanks and other normally closed compartments are to be ventilated, gas-freed and cleaned, as necessary, to expose damage and allow for a meaningful examination for excessive wastage. Internal examination and testing of void spaces, compartments filled with foam or corrosion inhibitors and tanks used only for lube oil, light fuel oil, diesel oil or other non-corrosive products may be waived, provided that, upon general examination, the Surveyor considers their condition to be satisfactory. External thickness gauging may be required to confirm corrosion control.

3.3.3 Attachments of Anchor Racks, Fairleads, and Anchorlines

Attachments of anchor racks and anchor cable fairleads are to be examined. Foundations in way of selective anchor line fairlead support structures are to be cleaned and nondestructive examinations performed. Internal support structures in way of these foundations are to be closely examined.

3.3.4 Other Structures

Applicable structures, such as pipe racks, process support structures, deck houses, superstructures, helicopter landing areas and their respective attachments to the deck or hull.

3.3.5 Foundations

Foundations and supporting headers, brackets and stiffeners for process related apparatus, where attached to hull, deck, superstructure or deck house.

3.3.6 Connections of Columns and Diagonals to Upper Hull, etc.

Connections of columns and diagonals to upper hull or platform and lower hull or pontoons. Joints of supporting structure, including diagonals, braces and horizontals, together with gussets and brackets. Internal continuation or back-up structure for the above. Nondestructive testing (NDT) may be required at suspect areas.

3.3.7 Survey of Underwater Parts

Survey of parts of the installation that are underwater and inaccessible to the Surveyor may be accepted on the basis of an examination by a qualified diver, conducted in the presence of the Surveyor. Video or photo records, nondestructive testing and thickness gauging may be required in addition to the diver's report. Refer to Section 7-2-6 of the *MODU Rules*.

Where inspection of underwater joints is required, sufficient cleaning is to be performed in way, and water clarity to be adequate, to permit meaningful visual, video, camera or NDT, as required. Every effort is to be made to avoid cleaning damage to special coatings.

3.3.8 Hull Thickness Measurement

At each Special Periodical Survey, hull thickness measurement (gauging) is to be performed where wastage is evident or suspected. At Special Periodical Survey No. 2 and subsequent Special Periodical Surveys, representative gaugings are required in accordance with 7-2-5/Table 3 of the *MODU Rules*. Special attention is to be given to the splash zones on hulls, columns and ballast tanks, free-flooded spaces and the bottom hulls. The thickness gauging requirements indicated in the table may be reduced or increased, as deemed necessary or appropriate by the Surveyor, in accordance with Notes 2 and 3 of 7-2-5/Table 3 of the *MODU Rules*.

3.5 Floating Production Installations in Lightering Service

In addition to the applicable requirements of 7-2-6/3.1 of this Guide, the Special Periodical Survey is also to include an external examination and internal Close-up Survey of hull structures, including thickness measurements, where fenders for lightering operation were located.

5 Mooring System

SPS of the mooring system is mandatory for all types of floating production installations, and are to comply with following requirements of this Subsection, as applicable.

Since it is impractical to cover all types of mooring systems, the following are provided as guidance to show the basic intent of the requirements. Operators and designers may submit alternative survey requirements based either on service experience or manufacturer's recommendations. Upon ABS review and acceptance, these alternative survey procedures will form the basis for the Special Periodical Survey of the Mooring System.

Typically, the SPS – Mooring System is to include all items listed under the Annual Survey and, in addition, the following are to be performed, where applicable:

i) A Drydocking Survey or equivalent underwater inspection of the SPM system is to be performed. This survey is to include examination of the entire structure of the SPM, the protective coating, cathodic protection system, the chain stoppers and their locking devices.

Any suspect areas where excessive corrosion is evident are to be thickness gauged. Gaugings are to be taken on the structures of the SPM when it has undergone service for 15 years or more.

ii) An examination is to be made on all anchor chains for excessive corrosion and wastage. In particular, the areas to be specially examined are the areas having the most relative movement between the chain links. These areas are normally located in way of the seabed touchdown sections of the catenary part of the chains. The chains are to be inspected for looses studs and link elongations. Sufficient representative locations are to be gauged for wear and wastage. Areas susceptible to corrosion, such as the wind-and-water areas, are to be specially gauged, if considered necessary by the attending Surveyor.

iii) A close examination is to be performed on all mooring components and accessible structural members that carry the mooring loads. These structures include the chain stoppers or cable holders, the structures in way of the chain stoppers or cable holders, structural bearing housing and turret/structural well annulus areas. These structures are to be thoroughly cleaned and examined and any suspect areas are to be nondestructively tested.

iv) A general inspection is also to be carried out on the degree of scour or exposure in way of the anchor or anchor piles to ascertain that these components are not overexposed.

v) An examination is to be performed on the main bearing of the SPM system. This examination is to include visual inspection of bearing, if accessible, for water egress into the structural housing, corrosion, pitting and excessive wear. If the bearing is inaccessible, at least the weardown is to be ascertained and the condition of the bearing seals verified. If disassembled, the bearing rollers and the racer housings are to be examined.

vi) For inaccessible structures, special alternative inspection procedures for inspection of these areas are to be submitted for approval.

vii) The chain tensions are to be checked and where found not in compliance with the specifications are to be readjusted accordingly. Excessive loss of chain or tendon tensions is to be investigated.

viii) Representative areas of the chains are to be examined and checked for excessive wastage. In particular, areas in way of the chain stoppers and the seabed touchdown areas are to be specially examined and measured for excessive wear.

ix) For disconnectable type mooring systems, the disconnect and connect system for the mooring system is to be tested as considered necessary by the attending Surveyor. Alternatively, records of disconnect/connect operations between the credit date of the last Special Periodical Survey and the current due date of same may be reviewed, and if found satisfactory, it may be considered to have been in compliance with this requirement.

7 Fire and Safety Systems

SPS of the entire fire and safety systems installed throughout the floating production installation is mandatory for all types of floating production installations.

Special Periodical Survey – Fire and Safety Systems is to include compliance with the Annual Survey requirements and, in addition, the following requirements as listed below are to be carried out, as applicable, the parts examined, placed in satisfactory condition and reported upon.

Following systems are to be verified to confirm no significant changes have been made to any of the systems and that they remain in satisfactory condition.

7.1 Passive Fire Protection Systems

Passive fire protection systems, including the following items are to be tested:

i) Function testing of all fire doors

ii) Function testing of all ventilation fire-dampers

iii) Function testing of all ventilation system closures and stoppage of power ventilation

iv) Function testing of all shutters or water curtains (where fitted)

7.3 Active Fire Protection – Fixed Systems

Active fire protection fixed systems, including the following items are to be tested:

i) Function testing of all fire pumps. Other pumps used for active fire protection are also to be tested. This is to include confirmatory testing of the fire pump capacity, and where installed, testing of relief valves of the fixed fire main system.

ii) Hydrostatic testing of the fire main system

iii) Hydrostatic testing of fire hoses, as necessary

7.5 Active Fire Protection – Additional Fixed Systems

Where installed, active fire protection additional fixed systems, including the following items are to be tested:

i) Gas smothering system, including confirmatory examination of the storage of the gas medium, gas alarms, and manual controls

ii) Function testing of fixed water spraying systems

7.7 Active Fire Protection – Portable Systems

All portable fire-fighting equipment fitted onboard, are to be in accordance with ABS approved plans. In addition, testing of the firefighter's outfit, as necessary.

7.9 Fire Detection and Alarm Systems

Fire detection and alarm systems, as installed, are to be tested.

7.11 Gas Detection and Alarm Systems

Gas detection and alarm systems, as installed, are to be tested.

7.13 Outfitting

Outfitting arrangements, including the following items are to be tested:

i) Lighting tings in way of all escape routes

ii) Contact makers for general alarm system, communication system installed in all emergency control stations

7.15 Emergency Shutdown Arrangements

Emergency shutdown arrangements provided to disconnect or shutdown, either selectively or simultaneously, of the electrical equipment as outlined in the floating production installation's operating manual, are to be tested.

Services such as the emergency lighting, general alarm system, public address system, distress and safety radio system, that are required to be operable after an emergency shutdown of the installation, are to be verified for their proper operation.

9 Machinery and Electrical Systems (Marine & Safety Systems)

SPS – Machinery and Electrical Systems servicing the marine and safety systems is mandatory for all types of floating production installations.

Special Periodical Survey – Machinery is to include compliance with the Annual Survey requirements and, in addition, the following requirements as listed below are to be carried out, as applicable, the parts examined, placed in satisfactory condition and reported upon.

9.1 Correlation with Special Periodical Survey – Hull

Main and auxiliary engines of all types of installations are to undergo Special Periodical Survey at intervals similar to those for Special Periodical Survey – Hull in order that both may be recorded at approximately the same time. In cases where damage has involved extensive repairs and examination, the survey thereon may be considered as equivalent to a Special Periodical Survey.

9.3 Machinery Parts to be Examined

In addition to the requirements for Annual Survey, at each Special Periodical Survey, special attention is to be given to the following requirements, as applicable.

9.3.1 Openings to the Sea and Fastenings

All openings to the sea, including sanitary and other overboard discharges together with the cocks and valves connected therewith, are to be examined internally and externally while the installation is in drydock or at the time of underwater examination in lieu of drydocking, and the fastenings to the shell plating are to be renewed when considered necessary by the Surveyor.

9.3.2 Pumps and Pumping Arrangements

Pumps and pumping arrangements, including valves, cocks, pipes, and strainers, are to be examined.

9.3.3 Nonmetallic Expansion Pieces

Nonmetallic flexible expansion pieces in the main salt-water circulating system are to be examined internally and externally.

9.3.4 Bilge and Ballast System, and other Systems

The Surveyor is to be satisfied with the operation of the bilge and ballast systems. Other systems are to be tested as considered necessary.

9.3.5 Machinery Foundations

The foundations of machinery, particularly those categorized as "Primary Application Structure" are to be examined.

9.3.6 Pressure Vessels

Heat exchangers and other unfired pressure vessels (except those used solely for drilling operations and complying with a recognized standard) with design pressures over 0.7 bar (7 kgf/cm^2, 100 psi) are to be examined, opened out or thickness gauged and pressure tested as considered necessary, and associated relief valves proven operable. Evaporators that operate with a vacuum on the shell need not be opened, but may be accepted on the basis of satisfactory external examination and operational test or review of operating records

9.5 Electrical Parts to be Examined

9.5.1 Main Switchboards and Distribution Panels

Fittings and connections on main switchboards and distribution panels are to be examined, and care is to be taken to see that no circuits are over fused.

9.5.2 Cables

Cables are to be examined as far as practicable without undue disturbance of fixtures.

9.5.3 Generator Run

All generators are to be run under load, either separately or in parallel; switches and circuit breakers are to be tested.

9.5.4 Equipment and Circuits

All equipment and circuits are to be inspected for possible development of physical changes or deterioration. The insulation resistance of the circuits is to be measured between conductors and between conductors and ground and these values compared with those previously measured. Any large and abrupt decrease in insulation resistance is to be further investigated and either restored to normal or renewed as indicated by the conditions found.

9.5.5 Electrical Auxiliaries, Generators and Motors

The specified electrical auxiliaries for vital purposes, generators and motors are to be examined and their prime movers opened for inspection. The insulation resistance of each generator and motor is to be measured.

9.5.6 Accumulator Batteries

The accumulator batteries are to be examined, including their maintenance schedule and ABS reviewed procedure of maintenance.

9.5.7 Bilge Alarm (if fitted)

Bilge alarm system, if fitted, is to be tested and proven satisfactory.

9.7 Hazardous Areas

Surveys of hazardous areas and electrical equipment installed in hazardous areas are to comply with applicable requirements of the ABS *Guide for Building and Classing Facilities on Offshore Installations*.

9.9 Preventative Maintenance Techniques

Surveys of machinery that has been accepted for surveys based on preventative maintenance techniques are to comply with the requirements of Appendix 7-A-14 of the ABS *Rules for Survey After Construction (Part 7)*.

9.11 Self Propelled Installations – Main Propulsion Apparatus

On self-propelled installations, in addition to the requirements for Annual Survey and the applicable requirements of 7-2-6/9.3, the main and auxiliary machinery, including pressure vessels, are to be surveyed in accordance with the requirements of the latest edition of the ABS *Rules for Survey After Construction (Part 7)*, as applicable to self-propelled vessels.

Where the installation maintains the optional **AMS** Notation, the windings of generators and motors are to be thoroughly examined and found or made dry and clean. Particular attention is to be paid to the ends of the windings of stator and rotors. After the winding have been cleaned and found dry, they are to be varnished, if necessary, with a standard insulating varnish applied preferably by spraying.

9.11.1 Thrusters (where installed)

Thruster surveys are to comply with the requirements of Section 7-9-6 of the ABS *Rules for Survey After Construction (Part 7)*.

9.13 Major Repairs

On the occasion of major repairs, the coils repaired or renewed are to be subjected to a dielectric strain test, as specified under the applicable parts of Part 4, Chapter 3 of the *MODU Rules*. In addition, the circuits containing the repairs or renewals and coils which have been disturbed during repairs are to be subjected to dielectric strain tests for one minute by application of a potential of 125% of the maximum operating voltage of the circuits to which it is applied. The direct current fields of generators and motors are to be subjected for one minute to a test potential equal to 50% of the value specified under the applicable parts of Part 4, Chapter 3 of the *MODU Rules* and the whole apparatus operated under full-load conditions.

11 Inert Gas Systems (where installed)

Applicable requirements of 7-6-2/3.1.1(o) of the ABS *Rules for Survey After Construction (Part 7)* are to be complied with.

13 Liquefied Gas Installations (where installed)

In addition to the applicable requirements of 7-2-4/1.3.2 and 7-2-4/1.1 of this Guide, the SPS of Liquefied Gas Installations is to include the following:

13.1 SPS No. 1 and No. 2

i) An internal examination is to be made of all cargo tanks (primary containers), after being gas freed, including internal mountings and equipment.

ii) For independent tanks, foundations, chocks, sway braces, keys, anti-flotation arrangements, the secondary barriers or hull plating or both are to be examined, with special attention being given to the cargo tanks and insulation in way of the above. See 7-2-6/13.1vi) for insulation removal. Framing adjacent to the cargo containment system is also to be examined.

Where the arrangement is such that the insulation cannot be examined, the surrounding structures in the wing tanks, double bottom tanks and cofferdams are to be examined for cold spots while the cargo tank is in cold condition, unless sufficient evidence of the integrity of the insulation is available from the voyage records.

iii) Venting systems, relief valves or other arrangements provided for emergency removal of gas from the interbarrier spaces and hold spaces are to be opened, inspected, tested and readjusted as necessary.

iv) Relief valves, liquid-level indicators and venting systems for the primary cargo containment system are to be examined. All relief valves are to be opened, inspected, tested and readjusted as necessary. If the cargo tanks are equipped with relief valves with non-metallic membranes in the main or pilot valves, such non-metallic membranes are to be replaced. Liquid-level indicators and alarms are to be proven satisfactory. Where a proper record of continuous overhaul and retesting of individually identifiable relief valves is maintained, consideration will be given to acceptance on the basis of opening, internal examination and testing of a representative sampling of valves including each size of each type of liquefied gas or vapor relief valve in use, provided there is logbook evidence that the remaining valves have been overhauled and tested since the crediting of the previous Special Periodical Survey. The testing and setting of relief valves may be carried out in place or after removal.

v) All piping, machinery and equipment for loading, unloading, venting, compressing, refrigerating, liquefying, heating or otherwise handling the liquefied gas or vapor and liquid nitrogen, and gas burning installations is to be examined including removal of insulation and opening for examination, as deemed necessary. Where deemed suspect, a hydrostatic test to 1.25 times the Maximum Allowable Relief Valve Setting (MARVS) for the pipeline is to be carried out. After reassembly, the complete piping is to be tested for leaks. Where water cannot be tolerated and the piping cannot be dried prior to putting the system into service, the Surveyor may accept alternative testing fluids or alternative means of testing. All emergency shut-down valves and remote operating valves in the cargo piping systems are to be inspected and proven operable. The pressure relief valves are to be function-tested. A random selection of valves is to be opened for examination and adjusted.

vi) Insulation is to be removed in way of any distorted or otherwise suspect insulation or structural part of the cargo tanks or elsewhere to carry out any of the examinations as required by the Surveyor.

vii) Where there is evidence of corrosion, or where one side of the cargo tank is exposed to possible corrosive atmosphere, the plating of the cargo tanks is to be gauged by nondestructive means to determine the thickness.

viii) All cargo pump tower structures are to be examined including stiffeners, bracings, fasteners and locking devices, spray nozzles, wiring with associated conduits and pipe connections. Where deemed necessary by the Surveyor, dimensional measurements and/or nondestructive testing may be required. See also 7-2-6/13.1x).

ix) The secondary barrier is to be checked for its effectiveness by means of a pressure/vacuum test, a visual inspection or other acceptable method.

x) Nondestructive Testing is to be carried out as follows:

a) Nondestructive testing is to supplement cargo tank inspection with special attention to be given to the integrity of the main structural members, tank shell and highly stressed areas, including welded connections as deemed necessary by the Surveyor. The following items are, inter alia, considered as highly stressed areas:

- Cargo tank supports and anti-rolling/anti pitching devices
- Web frames or stiffening rings
- Y-connections between tank shell and a longitudinal bulkhead of bilobe tanks
- Swash bulkhead boundaries
- Dome and sump connections to the tank shell
- Foundations for pumps, towers, ladders etc.
- Pipe connections

b) For independent tanks type C, in addition to the requirements of *a)* above, at alternate Special Periodical Surveys, at least 10% of the length of the welded connections in each highly stressed area is to be tested. This testing is to be carried out internally and externally, as applicable. Insulation is to be removed, as necessary, for the required nondestructive testing.

c) For independent tanks type B, the extent of the nondestructive testing is to be in accordance with a planned program specially prepared and approved for the cargo tank design.

xi) Where nondestructive testing, or other evidence such as leakage or distortion, raises doubts as to the structural integrity of a cargo tank, a hydrostatic or hydropneumatic pressure test is to be carried out. For integral tanks and independent tanks type A and B, the test pressure is to be at least MARVS at the top of the tank. For independent tanks type C and pressurized tanks B with MARVS 2.06 bar (2.1 kgf/cm^2, 30 psi) and over, the test pressure is to be 1.25 times MARVS.

xii) Electrical bonding arrangements, including bonding straps where fitted, of the piping systems located within cargo tanks, ballast tanks, pipe tunnels, cofferdams and void spaces bounding cargo tanks are to be examined.

xiii) Systems for removing water or cargo from interbarrier spaces and holds are to be examined and tested as deemed necessary.

xiv) For membrane and semi-membrane tanks systems, inspection and testing are to be carried out in accordance with programs specially prepared in accordance with an approved method for the actual tank system.

xv) All gas-tight bulkheads are to be examined. The effectiveness of gas-tight shaft sealing is to be verified.

xvi) The hoses and spool pieces used for segregation of piping systems for cargo, inert gas and bilge are to be examined.

13.3 SPS No. 3 and Subsequent Special Periodical Surveys

In addition to all of the requirements of Special Periodical Survey No. 1 or 2, the following requirements are to be complied with for Special Periodical Survey No. 3 and all subsequent Special Periodical Surveys.

i) The plating of at least one (1) cargo tank, including membrane tanks and pressure vessels is to be gauged by nondestructive means to determine the thickness. Where only cargoes of a non-corrosive nature are carried, modifications to the extent of thickness measurements may be specially considered.

ii) The plating of metallic secondary barriers which are structural supports for the primary barrier is to be gauged by nondestructive means to determine the thickness.

15 Dynamic Positioning Systems (if classed)

Dynamic Positioning Systems are to comply with the requirements of Section 7-9-6 of the ABS *Rules for Survey After Construction (Part 7)*.

17 Automatic and Remote-Control Systems (if classed)

For Shipboard Automatic and Remote-Control System, applicable requirements of Chapter 8 of the ABS *Rules for Survey After Construction (Part 7)* are to be complied with.

19 Production Facilities (if classed)

Where the floating production installation's production facilities are classed, applicable requirements of the ABS *Guide for Building and Classing Facilities on Offshore Installations* are to be complied with.

Maintenance records are to be kept and made available for review by the attending Surveyor. The maintenance records will be reviewed to establish the scope and content of the required Annual and Special Periodical Surveys. During the service life of the facilities, maintenance records are to be updated on a continuing basis. The operator is to inform ABS of any changes to the maintenance procedures and frequencies, as may be caused, for example, by changes or additions to the original equipment. The Surveyor may determine during the periodic survey if the changes are sufficient to warrant review by ABS' technical staff.

21 Import and Export Systems (if classed)

Since it is impractical to cover all types of import and export systems, the following are provided as guidance to show the basic intent of the requirements. Operators and designers may submit alternative survey requirements based either on service experience or manufacturer's recommendations. Upon review and if found acceptable, these alternative survey procedures will form the basis for the SPS of the Import and Export System.

Typically, the SPS is to include all items listed under the Annual Survey and, in addition, the following are to be performed:

i) Fluid and electrical swivels are to be disassembled, if considered necessary, and examined for wear and tear. The seals are to be examined. Upon completion of the reconditioning, the fluid swivels are to be hydrostatically tested. Similarly, the electrical swivels are to be insulation tested upon reassembly.

ii) During underwater inspection of the SPM system, flexible risers are to be examined, including all arch support buoyancy tanks. Risers are to be inspected for damage in high stress areas, such as areas in way of the end flanges, areas in way of the arch support clamps and the bottom of all looped areas. Spreader bars, if fitted to separate one riser string from another, are to be inspected for wear and tear. Hydrostatic tests may be required to be conducted on the risers, as deemed necessary by the attending Surveyor.

iii) For deep sea applications, riser suspension or support systems are to be examined for deterioration and loss of tension. Support areas in way of the riser are to be closely examined for fretting corrosion, wear, kinks, creases, etc.

iv) Floating export hoses are to be examined for kinks, surface cracks, chafing damages, etc. Hydrostatic and vacuum tests may be required to be conducted on the floating hose string, as deemed necessary by the attending Surveyor.

v) All piping systems are to be opened up for examination. Nondestructive and hydrostatic tests may be required, where considered necessary by the attending Surveyor.

vi) For disconnectable type mooring systems, the disconnect and connect arrangements for the import and export systems are to be tested, as considered necessary by the attending Surveyor. Alternatively, records of disconnect/connect operations between the credit date of the last SPS and the current due date of same may be reviewed, and if found satisfactory, it may be considered to have complied with this requirement.

vii) Hoses designed and manufactured based on OCIMF standards are to be tested in accordance with the OCIMF *Guide for the Handling, Storage, Inspection, and Testing of Hoses in the Field*.

PART 7 SURVEYS

CHAPTER 2 SURVEYS AFTER CONSTRUCTION

SECTION 7 DRYDOCKING SURVEYS OR EQUIVALENT

1 Underwater Inspection in Lieu of Drydocking Survey (UWILD)

For site-specific floating production installations, UWILD by a diver and a remotely operated vehicle may be considered equivalent to a Drydocking Survey, provided the UWILD is carried out in accordance with Section 7-2-6 of the *MODU Rules* and ABS approved UWILD procedure. This approved procedure is to be made available onboard. In addition, the procedure is to also consist of the following:

i) Scope of inspection that is not to be less than as noted in 7-2-7/3 of this Guide.

ii) Procedure for divers to identify the exact location at which they are conducting their inspection.

iii) Procedure for cleaning the marine growth for inspection purposes that is to include the extent and location of the underwater cleaning.

iv) Procedure and extent for measuring the cathodic potential readings in way of the structures.

v) Procedure and extent for taking thickness gaugings of the structures and NDT of critical joints.

vi) Qualifications of all divers conducting the inspection, NDT and thickness gaugings.

vii) The type of underwater video and photography, including means of communication, monitoring and recording.

viii) For Underwater Inspections in lieu of Drydocking Surveys (UWILD) associated with Special Periodical Surveys, means are to be provided to permit the opening up of all sea valves and overboard discharges for internal examination. In addition, all Special Periodical Survey items related to the underwater portion of the hull or structure, including the gauging requirements are to be dealt with during the underwater survey.

For each drydocking or equivalent underwater examination after Special Periodical Survey No. 4, requests to conduct an UWILD, in accordance with previously approved plans, are to be submitted for consideration well in advance of the proposed survey. Approvals to conduct the UWILD after Special Periodical Survey No. 4 are to be made available onboard for the Surveyors' reference.

3 Parts to be Examined

3.1 Ship-type and Barge-type Floating Production Installations

For ship-type and barge-type installations, the following items are to be examined, as applicable:

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

3.3 Column Stabilized Floating Production Installations

For column-stabilized installations, the following are to be examined:

i) External surfaces of the upper hull or platform, footings, pontoons or lower hulls, underwater areas of columns, bracing and their connections, as applicable, are to be selectively cleaned and examined. These areas include joints of critical structural members, areas susceptible to damage from supply installations, anchor chains, dropped equipment, corrosion and erosion from loss of coating, or sand scouring and areas of progressed and accumulated wear-and-tear.

ii) Nondestructive testing may be required of areas found to be suspect. Joints of different configurations of major structural members are to be selected, cleaned and magnetic particle inspected. The selection of these joints is to be such that all joints underwater are to be inspected every five years.

iii) Sea chests and strainers are to be cleaned and examined.

iv) External portions of propulsion units are to be examined, if applicable.

v) The type, location and extent of corrosion control (coatings, cathodic protection systems, etc.), as well as effectiveness, and repairs or renewals to same are to be reported in each survey. Particular attention is to be given to corrosion control systems in ballast tanks, free-flooding areas and other locations subjected to sea water from both sides.

vi) All tanks and voids that are to be internally examined are to be thoroughly ventilated and gas freed prior to being entered and are to be carefully monitored for pocketing or emissions of hazardous gases during examination.

vii) In conjunction with Drydocking Surveys (or equivalent), the following ballast spaces are to be internally examined, and the effectiveness of coatings or corrosion control arrangements are to be verified either visually by indicator strips or by thickness gauging (as considered necessary), placed in satisfactory condition, as found necessary, and reported upon:

a) Representative ballast tanks in footings, lower hulls or free-flooding compartments, as accessible

b) At least two ballast tanks in columns or upper hull, if applicable

5 Corrosion Protection System – Underwater Body

In addition to the above requirements, the following are to be to be performed during all of the Drydocking (or equivalent) Surveys:

i) Cathodic potential readings are to be taken from representative positions on the entire underwater body and evaluated to confirm that the cathodic protection system is operating within design limits.

ii) Sacrificial anodes are to be examined for depletion and placed in satisfactory condition, as considered necessary.

iii) Impressed current system anodes and cathodes are to be checked for damage, fouling by marine growth and carbonate deposits. The current and voltage demands of the system are also to be checked to confirm the system is functioning properly.

iv) Additional examinations are to be performed on the wind and water areas of the structures where coating breaks are evident. Thickness measurements in these areas may be required if found necessary by the attending Surveyor.

7 Mooring System

In addition to the above requirements, the following items of the mooring system are to be cleaned and examined, where applicable:

i) The mooring anchor chain or cable tensions are to be measured and the end connections of these components are to be examined. All mooring chains are to be generally examined for their entire lengths.

ii) Anchors, cables and their respective handling means are to be examined.

iii) The buoyancy tanks are to be cleaned and examined, if applicable.

iv) Chain and stopper assemblies are to be cleaned, examined and NDT performed, as considered necessary by the attending Surveyor.

v) Areas of high stress or low fatigue life are to be preselected, cleaned and NDT performed, if considered necessary.

vi) Scour in way of anchors or anchor piles is to be examined.

vii) Cathodic potential readings are to be taken from representative positions on the entire underwater structure of the mooring system to confirm that the cathodic protection system is operating within design limits.

viii) Highly stressed, high wear and tear areas of the mooring chain are to be closely examined and nondestructively tested, if found necessary by the attending Surveyor. These include areas in way of the stoppers and sea bed touchdown areas.

9 Import and Export Systems (if classed)

9.1 Import System

For import systems, the following are to be cleaned and examined, where applicable:

i) The entire riser system.

ii) The arch support buoyancy tanks, their structures and the clamping devices.

iii) The flexible riser, including all end flanges and bolting arrangements and spreader bars, if applicable.

Hoses designed and manufactured based on OCIMF standards are to be tested in accordance with the OCIMF *Guide for the Handling, Storage, Inspection, and Testing of Hoses in the Field.*

9.3 Export System

For export systems, the following are to be cleaned and examined, where applicable:

i) The entire export flexible system is to be examined for damage due to chafing and fatigue fractures.

ii) Hoses designed and manufactured based on OCIMF standards are to be tested in accordance with the OCIMF *Guide for the Handling, Storage, Inspection, and Testing of Hoses in the Field.*

iii) All navigation aids are to be examined and functionally tested.

PART 7 SURVEYS

CHAPTER 2 SURVEYS AFTER CONSTRUCTION

SECTION 8 TAIL SHAFT AND TUBE SHAFT SURVEYS

1 Tail Shaft and Tube Shaft Surveys

For Tail Shaft Surveys of self-propelled floating production installations, applicable requirements of Chapter 5 of the ABS *Rules for Survey After Construction (Part 7)* are to be complied with. However, due to low running hours on tail shafts of installations, the interval between tail shaft surveys may be extended based on the following being performed to the satisfaction of the attending Surveyor:

1.1 Parts to be Examined

Following items are to be carried out:

i) Diver's external examination of stern bearing and outboard seal area, including weardown check as far as is possible.

ii) Examination of the shaft area (inboard seals) in propulsion room(s).

iii) Confirmation of lubricating oil records (satisfactory oil loss rate, no evidence of unacceptable contamination).

iv) Shaft seal elements are to be examined/replaced in accordance with seal manufacturer's recommendations.

PART 7 SURVEYS

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SECTION 9 BOILER SURVEYS

Boiler Surveys are to comply with the requirements of Chapter 7 of the ABS *Rules for Survey After Construction (Part 7)*.