



**CHINA CLASSIFICATION SOCIETY**

# **RULES FOR CLASSIFICATION OF OFFSHORE FLOATING INSTALLATION**

## **PART IX OTHER TYPES OF FLOATING INSTALLATION AND SPECIAL SYSTEMS**

**CCS OFFSHORE ENGINEERING TECHNOLOGY CENTER**

**MARCH 2020**

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## CHAPTER 1 TENSION LEG PLATFORM

### Section 1 GENERAL PROVISIONS

#### 1.1.1 General requirements

1.1.1.1 Tension leg platform (TLP) is to be designed and constructed in accordance with applicable requirements in the Rules, *Rules for Classification of Mobile Offshore Units* of CCS and *Recommended Practice for Planning, Designing and Constructing Tension Leg Platform* (API RP 2T) of American Petroleum Institute, as well as in other equivalently adopted petroleum industry rules. However, appropriate adjustment may be made according to TLP characteristics so as to show various properties and structure features of TLP.

1.1.1.2 TLP is to comply with the applicable requirements in *International Convention on Load Lines*, *International Regulations for Preventing Collisions at Sea*, *International Convention for the Safety of Life at Sea* (SOLAS) and its amendment, *International Convention for the Prevention of Pollution from Ships* and its amendment, and other conventions issued by International Maritime Organization (IMO).

1.1.1.3 TLP is to comply with the relevant requirements of flag state/coastal state of the proposed sea area of the Unit.

1.1.1.4 In case of any inconsistency between requirements of the Rules and those requirements of flag state/coastal state, those requirements of flag state/coastal state are to prevail.

1.1.1.5 Corrosion control system for TLP structure is to be designed in accordance with internationally recognized standards and be approved by CCS.

#### 1.1.2 Class notations

1.1.2.1 TLP: to be assigned to the TLPs in compliance with the relevant provisions in this Chapter.

#### 1.1.3 Plans and information

1.1.3.1 In addition to those plans and information as specified in other Parts of the Rules, the other plans and information are to be submitted to CCS for approval or information, as applicable to the Units.

## CHAPTER 2 COLUMN-STABILIZED (SEMI-SUBMERSIBLE) UNITS

### Section 1 GENERAL PROVISIONS

#### 2.1.1 General requirements

2.1.1.1 Column-stabilized units are to be designed and constructed in accordance with applicable requirements for column-stabilized units in the Rules and in *Rules for Classification of Mobile Offshore Units* of CCS and relevant requirements in *Recommended Practice for Planning, Designing and Constructing Floating Production Systems* (API RP 2FPS) and *Recommended Practice for Design and Analysis of Stationkeeping Systems for Floating Structures* (API RP 2SK) of American Petroleum Institute (API), Petroleum and Natural Gas Industries - *Floating Offshore Units - Part 1: Monohulls, Semi-submersibles and Single-column Stabilized Units with Heavy Draught* of International Organization for Standardization (ISO) (ISO 19904-1) and in other equivalently adopted petroleum industry rules. However, appropriate adjustment may be according to the characteristics of column-stabilized units so as to show different characteristics of column-stabilized units.

2.1.1.2 Column-stabilized units are to comply with the applicable requirements in *International Convention on Load Lines*, *International Regulations for Preventing Collisions at Sea*, *International Convention for the Safety of Life at Sea* (SOLAS), *International Convention for the Prevention of Pollution from Ships* and other conventions issued by International Maritime Organization (IMO).

2.1.1.3 Column-stabilized units are to comply with the relevant requirements of flag state and coastal state of the proposed sea area of the Unit.

2.1.1.4 In case of any inconsistency between requirements of the Rules and those requirements of flag state/coastal state, those requirements of flag state/coastal state are to prevail.

2.1.1.5 Structural corrosion control system for column-stabilized units is to be designed in accordance with internationally recognized standards and be approved by CCS.

#### 2.1.2 Class notations

2.1.2.1 Column Stabilized: to be assigned to the column-stabilized units in compliance with the relevant provisions in this Chapter.

#### 2.1.3 Plans and information

2.1.3.1 In addition to those applicable plans as specified in other Parts of the Rules, the special plans for column-stabilized units are to be submitted to CCS for approval and review.

## CHAPTER 3 SPAR UNITS

### Section 1 GENERAL PROVISIONS

#### 3.1.1 General requirements

3.1.1.1 SPAR unit refers to a deep-draught unit consisting of floating body and upper deck on the top of such body. Floating body falls into three kinds: upper floating body, middle floating body and lower floating body. Upper decks are spatial trussed decks which bear load (including operation load) of production equipment, drilling/workover devices, residential zone and offshore support system all arranged on the decks.

3.1.1.2 Design of floating installation is to comply with applicable requirements in *Rules for Classification of Mobile Offshore Units* of CCS and Petroleum and Natural Gas Industries - *Floating Offshore Units - Part 1: Monohulls, Semi-submersibles and Single-column Stabilized Units with Heavy Draught* of ISO (ISO 19904-1). Design and construction of upper decks are to comply with applicable requirements in *Recommended Practice for Planning, Designing and Constructing Fixed Offshore Units - Working Stress Design* of API (API RP 2A-WSD) or in other equivalently adopted petroleum industry rules. Given the characteristic of working permanently in a given location, SPAR units differ from mobile ones in structure performance and requirements. As a result, requirements in *Rules for Classification of Mobile Offshore Units* are to be adjusted to adapt to SPAR units' characteristics.

3.1.1.3 SPAR units are to comply with the applicable requirements in *International Convention on Load Lines*, *International Regulations for Preventing Collisions at Sea*, *International Convention for the Safety of Life at Sea* (SOLAS), *International Convention for the Prevention of Pollution from Ships* and other conventions issued by IMO.

3.1.1.3 SPAR units are to comply with the relevant requirements of flag state and coastal state of the proposed sea area of the Units.

3.1.1.4 In case of any inconsistency between requirements of the Rules and those requirements of flag state/coastal state, those requirements of flag state/coastal state are to prevail.

3.1.1.5 Structural corrosion control system for SPAR units is to be designed in accordance with internationally recognized standards and be approved by CCS.

#### 3.1.2 Class notations

3.1.2.1 Spar: to be assigned to the SPAR units in compliance with the relevant provisions in this Chapter.

#### 3.1.3 Plans and information

3.1.3.1 In addition to those applicable plans as specified in other Parts of the Rules, the special plans for SPAR units are to be submitted to CCS for approval and review.

## CHAPTER 4 OFFSHORE FLOATING LIQUEFIED GAS TERMINALS

### Section 1 GENERAL PROVISIONS

#### 4.1.1 Application

4.1.1.1 This Chapter is applicable to design, manufacturing and inspection of offshore floating liquefied gas terminals (hereinafter referred to as Terminals).

#### 4.1.2 Definition

4.1.2.1 Terminals refer to offshore floating structures which feature at least storage and transfer of liquefied gases, and generally fall into the following categories:

- (1) Offshore floating production terminal for liquefied natural gas (LNG);
- (2) Offshore floating production terminal for liquefied petroleum gas (LPG);
- (3) Offshore floating outlet terminal for LNG;
- (4) Offshore floating inlet (receiving) terminal for LNG.

#### 4.1.3 Character of classification

4.1.3.1 Character of classification, as a statement of major Terminal feature, is mandatory.

4.1.3.2 Awarding character of classification for Terminal (propelled or non-propelled) is to comply with the provisions in 2.3.1 of Chapter 2 of PART ONE in the Rules.

#### 4.1.4 Classification notation

4.1.4.1 Terminals which conform to the provisions in the Rules will be assigned with the following signs behind character of classification:

##### **Offshore Liquefied Gas Terminal.**

4.1.4.2 As required by the Rules and based on different functions of Terminals, one of the following signs will be assigned behind character of classification as specified in 4.1.4.1 of this Section:

- (1) **LNG FPLSO** refers to floating production, liquefaction, storage and offloading of LNG;
- (2) **LPG FPLSO** refers to floating production, liquefaction, storage and offloading of LPG;
- (3) **LNG+LPG FPLSO** refers to floating production, liquefaction, storage and offloading of LNG and LPG (i.e. LNG is being produced at the same time when LPG is extracted, separately stored and offloaded);
- (4) **LNG FLSO** refers to floating liquefaction, storage and offloading of LNG;
- (5) **LNG FSRO** refers to floating storage, re-gasification and offloading of LNG

#### 4.1.5 Class notations

4.1.5.1 In compliance with *Rules for Offshore Oil and Gas Process System* of CCS and based on different processes for purification, liquefaction and re-gasification of natural gas, one of the following class notations will be assigned behind character of classification:

- (1) **PROCESS (LNG)** refers to pretreatment, purification and liquefaction of natural gas;
- (2) **PROCESS (LPG)** refers to LPG recovery;
- (3) **PROCESS (LNG) + (LPG)** refers to pretreatment, purification and liquefaction of natural gas and LPG recovery;
- (4) **REGAS** refers to LNG re-gasification.

4.1.5.2 Class notations for special systems and equipment on Terminals, for engine room automation and machinery and for environmental protection are to comply with applicable requirements in 2.3.2 of Chapter 2 of PART ONE in the Rules and be assigned behind class notations as specified in 4.1.5.1 of this Section.

#### 4.1.6 Technical requirements

4.1.6.1 Terminals are to comply with applicable requirements in the following specifications of CCS:

- (1) *Rules for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk*;
- (2) *Guidelines for Survey of Membrane Tank LNG Carriers*;
- (3) *Rules for Offshore Oil and Gas Process System*

4.1.6.2 According to the provisions in MSC-MEPC.2/Circ.9 approved by IMO on May 25, 2010, safety, security and environmental protection of self-propelled Terminals are to comply with the provisions in relevant IMO conventions, regulations and resolutions and industrial guidelines.

## CHAPTER 5 IN-WATER SURVEYS

### Section 1 GENERAL PROVISIONS

#### 5.1.1 General provisions

5.1.1.1 The requirements in this Chapter apply to the floating installation which is applicable for class notation stipulated in 5.1.2 and subjected to in-water survey in lieu of docking survey.

#### 5.1.2 Class notations

5.1.2.1 IWS: to be assigned to the floating installation in compliance with the relevant provisions in this Chapter.

#### 5.1.3 Plans and information

5.1.3.1 The following plans and information are to be submitted to CCS for information, as applicable:

- (1) Gauging of clearances of rudder pintle/shaft and bearing and verification method of conditions;
- (2) Details and methods of inspection, maintenance and removal of the thruster;
- (3) Inspection and measurement methods of screwshaft bearings;
- (4) Maintenance and inspection details of sea chests and sea valves;
- (5) Underwater marking diagram and welding procedures;
- (6) Coating and cathodic protection for underwater structures.
- (7) Drawings for accessories to chain cables and ropes in mooring system.

5.1.3.2 The approved plans and information including those mentioned in 5.1.3.1 are to be kept on the floating installation.

### Section 2 UNDERWATER MARKINGS

#### 5.2.1 General provisions

5.2.1.1 Permanent markings for diver's positioning are to be made on shell plating of the underwater part of the platform intended to carry out in-water survey so as to indicate the positions of frames, bulkheads, unit and joints clearly and to be consistent with the underwater markings diagram.

5.2.1.2 Markings are to be consisting of raised lines, numerals and letters.

5.2.1.3 If marking is to be carried out by welding, the welds are to be made with continuous runs and the quality of the workmanship is to be to an equivalent standard as the main structures. Substantial runs are to be laid, continuously, using large diameter electrodes and avoid light runs. The surface of welds is to be formed continuously, tightly and smoothly transitioned to the parent material and without any cracks and defects could not be existed, such as overlap, crater and undercut. Marking by welding is not permitted in highly stressed areas or over existing butts or seams.

5.2.1.4 On steel of Grade D or E or on higher tensile steel, low hydrogen electrodes are to be used of a grade suitable for the parent material. The electrodes are to be pre-heated to around 100°C for welding markings on the high tensile steels.

## Section 3 PHYSICAL FEATURES

### 5.3.1 General provisions

5.3.1.1 The following physical features are to be incorporated into the floating installation's design in order to facilitate the underwater inspection. The results of inspection and measurement are to be noted in the floating installation's records and in the survey report for reference at subsequent surveys:

(1) Sea suction:

Means are to be provided to enable the diver to confirm that the sea suction openings are clear. Hinged sea suction grids would facilitate this operation;

(2) Sea valves:

For the docking survey associated with the special survey, means must be provided to examine any sea valve;

(3) Paint:

The protecting coating of the unit below the waterline is to be high resistant paint.

(4) Screwshaft bearing:

For self-propelled floating installation, means are to be provided for ascertaining that the seal assembly on oil-lubricated bearings is intact and for verifying that the clearance or wear-down of the bearing is not excessive. For use of the wear-down gauges, up-to-date records of the base depths are to be maintained on board. Whenever the stainless-steel seal sleeve is renewed or machined, the base readings for the wear-down gauge are to be re-established and noted in the unit's records and in the survey report;

(5) Rudder bearings:

For self-propelled floating installation with rudders, means and access are to be provided for determining the condition and clearance of the rudder bearings, and for verifying that all parts of the pintle and gudgeon assemblies are intact and secure. This may require bolted access plates and a measuring arrangement;

## CHAPTER 6 POSITIONING SYSTEMS

### Section 1 GENERAL PROVISIONS

#### 6.1.1 General requirements

6.1.1.1 There are two positioning systems for floating installation: dynamic type and mooring type. Mooring positioning is the main positioning type for floating production units while relevant requirements for dynamic positioning are to comply with applicable contents in *Rules for Classification of Mobile Offshore Units* of CCS.

6.1.1.2 This Chapter applies to position mooring systems for realize mooring positioning of floating installation, which involve the radiation-type position mooring systems, single-point position mooring systems and thruster assisted position mooring systems.

6.1.1.3 Position mooring systems will be considered for classification on the basis of operating restrictions and procedures specified by the owner/designer. Such operating restrictions and procedures as conditions for classification are to be recorded in the operation manual.

6.1.1.4 In addition to the requirements of this Chapter, the position mooring systems are also to be in compliance with the other applicable provisions of the Rules and the relevant provisions of the Administration.

#### 6.1.2 Additional notations

6.1.2.1 PM or PM-TA: to be assigned to the offshore floating installation in compliance with the relevant provisions in this Chapter.

6.1.2.2 PM-TA means a floating installation with a propeller-assisted positioning and mooring system, and this additional notation shall be added when the propeller control system meets the requirements.

6.1.2.3 PM-V means that there are other marine structures near the floating installation with positioning and mooring system, and this additional notation shall be added when the distance between the floating installation and other marine structures nearby meets the requirements.

#### 6.1.3 Definition

6.1.3.1 Unless otherwise provided, definitions in this Chapter are as follows:

(1) Radiation-type position mooring system: it refers to a system that is composed of multiple catenary mooring lines fastened to piles or drag anchors on the seabed. Generally, the other end of each catenary mooring line is connected onto windlasses or chain stopper through pilot hole on floating installation. Such rope can be in one or more sections, with buoys or clump weights arranged along the rope;

(2) Single-point position mooring system: it refers to a mooring and offloading unit that provides a kind of contact between submarine pipeline and moored unit, and if necessary, serves for transporting liquid cargos. In environmental conditions, the moored unit can rotate around mooring point. There are three common single-point mooring systems: catenary buoy type, single anchor leg type and turret type;

(3) Catenary buoy single-point position mooring system: it consists of a lighthouse buoy and multiple catenary mooring lines anchored to the seabed. The floating installation is connected to the buoy through flexible cable (multiple ones are allowed) or a rigid yoke arm;

(4) Single anchor leg single-point mooring system: it is generally composed of a cylinder as well as riser on seabed and steel arm of floating installation both connected to the cylinder. Mooring line can replace steel arm while chain cable can replace the riser. Such system generates a great amount of buoyancy which is born by pre-tensioned riser or chain cable;

(5) Turret single-point mooring system: multiple catenary mooring lines are connected to a turret whose bearing enables floating installation to rotate around the turret. Since only angular displacement is allowed between the floating installation and the turret, the floating installation has weathercock effect. The turret can be installed inside, at front or back end of the floating installation;

(6) Yoke arm: it refers to rigid structure that connects the end of floating installation and mooring buoy;

(7) Thruster assisted position mooring system: it refers to a system in which a thruster assists main mooring

positioning and releases load of main mooring system.

#### **6.1.4 Components of position mooring systems**

6.1.4.1 Catenary buoy and turret position mooring systems are to be composed by:

- (1) Anchors, suction anchors or anchor piles;
- (2) Mooring lines, including chain cables, steel wires and cables;
- (3) Mooring lines fittings, including shackles, connecting links, wire rope terminations and quick release devices;
- (4) Fairleads, including bent pipes, guide rollers and guide holes;
- (5) Chain/wire stoppers,
- (6) Winches/windlasses;
- (7) Other structural or mechanical items forming part of the position mooring system.

6.1.4.2 Thruster assisted position mooring systems also include:

- (1) Thruster and its prime mover, gearing, shafting, electrical installation;
- (2) Control, alarm and safety systems for thruster.

6.1.4.3 The components of single anchor leg single-point mooring system and other position mooring systems depends on their system type.

#### **6.1.5 Plans and information**

6.1.5.1 The applicant shall submit the following plans in quadruplicate or in electronic version to CCS for approval:

- (1) Positioning and mooring layout, including mooring mode, mooring components and equipment;
- (2) Details of mooring components and equipment, including bases and attachments to floating installation;
- (3) Structure diagram and power system diagram of windlass.
- (4) An auxiliary positioning and mooring system for the propeller, further comprising:
  - ① Layout of propeller-assisted positioning and mooring system, including propeller layout, mooring mode, mooring components and equipment;
  - ② Propeller (including auxiliary system) and its power system diagram;
  - ③ Propeller control (including heading sensor and position measuring device), alarm and safety system diagram.
  - ④ Operation condition specification of mixed positioning operation;
  - ⑤ FMEA report;

6.1.5.2 The following supporting drawings shall be submitted for future reference:

- (1) Information on design environmental conditions such as wind, wave, current, tide and water depth (including operation and self-storage conditions);
- (2) Calculation sheet or model test report of wind, current and wave forces acting on floating installation;
- (3) Wave frequency and low frequency motion calculation sheet or model test report of floating installation;
- (4) Mooring analysis and calculation sheet, including propeller-assisted mooring and positioning. The calculation and analysis report of auxiliary mooring and positioning mode of propeller shall be submitted, and the possible failure modes shall be considered. If there is no redundancy of propeller, the failure modes of all propellers shall be considered;
- (5) Strength calculation sheet for anchors, mooring lines and accessories, guides, chains/cables, windlasses and other components;

- (6) Power and thrust calculation sheet of propellers, including interactions between propellers, between propeller and floating installation, and between propeller and ocean current;
- (7) Hybrid positioning test procedure and operation manual.

## Section 2 ENVIRONMENTAL LOADS AND FLOATING INSTALLATION'S MOTIONS

### 6.2.1 General requirements

6.2.1.1 This Section covers only the environmental loads necessary for analysis of the mooring system and the motions of the moored floating installation due to wind, wave and current.

6.2.1.2 The normal operating and survival environmental conditions of mooring system are to be specified by the owner/designer and in general, matched with the design environmental conditions of the floating installation's main structure. The environmental conditions generally include wind, wave, current, tide and water depth, seabed soil parameters, as well as air temperature and water temperature. As water depth will have a large influence on the capability of mooring system, the extreme conditions of the system (wind, wave and current) may be varied at different water depths.

6.2.1.3 In design analysis of the position mooring system, sufficient numbers of heading angles together with the most severe combination of wind, current and wave are to be considered, usually from the same direction, to determine the maximum tension of each mooring line. Where a unit is intended to operate in a particular area, any applicable combined sea conditions of wind, wave and current from various directions are also to be considered in the event that they might induce higher mooring loads.

6.2.1.4 When the environmental loads and the moored floating installation's motions are determined by model testing, the shape of the test model above or under water is to reflect the actual conditions, taking due account of thrusters (if fitted), bilge keel and other fittings. The flowing characteristics of the test model are to be the same as those of the actual floating installation. The procedures and methods of the model testing are to be agreed by CCS.

### 6.2.2 Environmental conditions

6.2.2.1 In the design for position mooring system, both maximum design and operating conditions are generally to be considered for environmental load while only maximum design condition for permanent mooring.

6.2.2.2 Maximum design condition refers to the combinations of wind, wave and current environmental conditions used for mooring system design. Position mooring systems are to be designed based on the combinations of wind, wave and current causing extreme load in design environment. In actual design, the maximum design condition is generally obtained through combined approximations under multiple design criteria.

For example, as for design environment with a recurrence period of N years, the following three design criteria are generally studied:

- (1) Wave with a recurrence period of N years along with corresponding wind and current;
- (2) Wind with a recurrence period of N years along with corresponding wave and current;
- (3) Current with a recurrence period of N years along with corresponding wave and wind.

6.2.2.3 A design criterion with a recurrence period of at least 100 years is to be adopted for permanent position mooring systems. In case that a shorter recurrence period is more reasonable for position mooring systems whose design life is actually shorter than 20 years, the recurrent period is to be determined through risk analysis factoring in failure consequences of position mooring system.

6.2.2.4 With regard to permanent position mooring systems with quick release design, the worst environmental condition when floating installation is being moored can be taken as the maximum design condition. However, the position mooring system itself (not moored to floating installation) is also to be capable of resisting the maximum design environmental condition for permanent mooring.

6.2.2.5 Floating installation's motions are often dominated by low-frequency ones. Because the amplitude of low-frequency motion increases with decrease of wave period, waves with recurrence period of 100 years may not generate the worst mooring load, while smaller waves with shorter period are likely to generate bigger

low-frequency motions, thus generating bigger mooring load.

### 6.2.3 Direction of action of wind, wave and current relative to floating body

6.2.3.1 For floating installation moored in a fixed direction, it is assumed that wind, waves and currents act in the same direction. The directional distribution map of wind, wave and current can also be used for analysis (if any).

(1) For symmetrical positioning and mooring systems, at least the wind, wave and current direction conditions in heading, 45° direction and transverse direction shall be analyzed.

(2) For the positioning and mooring system with asymmetric arrangement, a directional condition of simultaneous action of wind, wave and current shall be carried out in the range of 0°-360° and at a maximum interval of 30°.

(3) At least an analysis of one directional condition in which the wind, wave, current and a mooring line are in the same direction and an analysis of a directional condition of wind, wave and current acting between two mooring lines at the same time shall be made.

6.2.3.2 For floating installation with weathervane effect, such as turret mooring positioning, field applicable documents of wind, wave and current direction distribution shall be used. If not, it can be replaced by the following two methods:

6.2.3.3 Direction distribution drawing of wind, wave and current, if any, also can be utilized for analysis.

6.2.3.4 When deviation of floating installation is calculated, another direction, from which wind, wave and current act on the middle of two mooring lines at the same time, is to be considered apart from the directions specified in 6.2.3.2 of this Section.

6.2.3.5 Directions on which wind, wave and current act at the same time are to be considered with a maximum spacing of 30° within a range from 0° to 360° for positioning systems moored asymmetrically. Besides, at least one of such directions is to be the same as that of a certain mooring line. Direction distribution drawing of wind, wave and current, if any, may be used instead.

6.2.3.6 Applicable site data distributed in directions of wind, wave and current are to be used for floating installation, whose weathercock effect relies on heading control, such as turret mooring positioning units.

6.2.3.7 In case that there are no applicable site data distributed in direction, one of the two following methods can substitute:

(1) In an environmental condition with the same direction, wind, wave and current act on the same direction, and the included angle between the direction and the heading of floating installation is 15°.

(2) In an environmental condition with different directions, the included angle is 0° between wave acting direction and the heading of floating installation, 30° between wind and wave directions and 45° between current and wave directions, with wind and current at the same side of the floating installation.

6.2.3.8 Substitutions in 6.2.3.7 are also applicable to floating installation with complete weathercock effect, i.e. floating installation rotate to a corresponding equilibrium position completely relying on the effect of environmental condition.

6.2.3.9 Floating installation with weathercock effect can also be analyzed based on direction distribution drawing of wind, wave and current (if any), assumed that direction distributions of wind, wave and current are irrelevant to one another.

### 6.2.4 Environmental loads

#### 6.2.4.1 Wind loads

(1) There are two kinds of wind loads generally considered: one is steady wind force on the moored floating installation and the other is low frequency wind force induced by combination of steady wind force and wind fluctuating component. In the stage of final design for permanent position mooring systems, the combination of steady wind force and low-frequency wind force is to be adopted unless sole consideration about steady wind force is proved safer. The wind loads may be obtained through model testing or calculation. For the calculation methods for wind loads, refer to the relevant provisions in Chapter 5 of PART TWO.

(2) When only steady wind force is to be determined, the design wind velocity could be taken as the 1 minute

mean value referenced to 10 m above sea level. Where low frequency wind force is to be additionally taken into account, the steady wind velocity is in general to be taken as the 1 hour mean value and its fluctuating wind velocity based on appropriate empirical gust spectra. The time span of the steady wind velocity is to be consistent with the mean speed used for determining wind velocity spectra.

#### 6.2.4.2 Current loads

- (1) The current load is normally taken as steady force. The current loads may be obtained through model testing or calculation.
- (2) For the calculation methods for current loads, refer to the relevant requirements in Chapter 5 of PART TWO.

#### 6.2.4.3 Wave loads and motions

- (1) The action of wave on floating installation will result in three forces acting on the floating installation:
  - ① First order force based on wave frequency oscillation, which will induce first order motion (also called oscillatory motion) of the floating installation;
  - ② Second order force lower than wave frequency oscillation, which will induce second order motion (also called low frequency motion) of the moored floating installation;
  - ③ Steady component of the second order force (also called wave-drift force).

The wave loads may be determined by model testing or analytical calculation.

- (2) The wave loads may be obtained in general through integration of the total water pressure acting on wet surfaces of the unit by applying diffraction analysis.

### 6.2.5 Motions of the moored floating installation

6.2.5.1 Under combined actions of steady wind, current and wave-drift forces, the moored floating installation will move from its initial equilibrium position where zero environmental force is acting on the unit, to a new mean position where the mooring system will have developed sufficient restoring force to balance the steady applied forces. Wave-induced oscillatory motions and low frequency motions of the unit take place about this new mean position.

6.2.5.2 The oscillatory motions and low frequency motions are to be determined by model testing or analytical calculation. In general, the oscillatory motions may be calculated apart from low frequency motions. In analyzing oscillatory motions, due to the fact that the natural period of the floating installation's surging, swaying and yawing motions are much greater than wave period, the effects of the mass and elasticity of the mooring system on oscillatory motions may generally be neglected. In analyzing low frequency motions, it is only to take consideration of the low frequency surging, swaying and yawing motions of the unit. The low frequency motions are responses of the extremely narrow bands concentrated near the natural frequency of the unit. The amplitude of motions depends on the stiffness and damping of the mooring system. The accurate evaluation of damping is therefore essential for calculating the low frequency motions.

## Section 3 Mooring Analysis and Design Criteria

### 6.3.1 General requirements

6.3.1.1 For multi-point mooring, the positioning and mooring system shall be designed so that the sudden failure of one mooring line will not lead to successive failure of other mooring lines. For the mooring system designed as a single anchor chain, it shall be considered separately according to its failure consequences.

6.3.1.2 The following designed working conditions are to be considered for analysis of position mooring system of floating installation:

- (1) Intact survival working condition: all calculation working conditions for all complete position mooring systems of mooring lines under the specified survival environmental conditions;
- (2) Damaged survival condition: failure of any single mooring line of the mooring system under the specified survival environmental conditions. After an intact mooring line which bears the largest load gets damaged, the worst mooring state will not necessarily arise. Such working conditions may not be calculated for position

mooring systems featuring quick release, but are generally calculated for mooring line systems distributed asymmetrically. For single anchor leg single-point mooring systems, it can be considered to replace them with a condition where a column compartment is flooded; for thruster assisted position mooring systems, to replace them with a condition where a thruster or mechanical device fails. However, selection of specific failing part is to be analyzed separately based on specific cases in each project;

(3) Transient survival condition: transient motions of the unit caused by failure of any mooring line under the specified survival environmental conditions. Such working conditions apply to situations where other structures exist around floating installation. The analysis is to include moving route and direction of the floating installation and tension of mooring lines during a transient motion before the moored floating installation reaches a new equilibrium position.

6.3.1.3 The analyzing methods of mooring system are divided into:

(1) Quasi-static analysis;

(2) Dynamic analysis, which is divided into frequency-domain method and time-domain method.

6.3.1.4 The analysis method shall be selected according to the object and complexity of analysis, and dynamic analysis method shall be adopted in the final design of permanent mooring system.

(1) The quasi-static analysis method is applicable to the analysis of complete mooring system, and also to the analysis of damaged mooring system after any mooring line fails. However, the quasi-static analysis method is not suitable for transient motion analysis of damaged mooring system, and time domain analysis is generally required. For the sake of simplification, the combined analysis method of time domain (transient motion) and frequency domain (floating installation motion) is often used.

(2) The dynamic analysis method can be applied to analysis of all mooring systems. In dynamic analysis, the effects of mass, damping and fluid acceleration changing with time shall be considered.

6.3.1.5 With regards to deepwater floating installation equipped with a large number of risers, riser loads, along with rigidity and damp of riser system and floating installation act on each other, are to be considered in mooring analysis.

6.3.1.6 Fatigue strength of mooring lines is to be analyzed for permanent position mooring systems.

### 6.3.2 Offset and mooring line tension

#### 6.3.2.1 Offset

(1) Mean offset is the displacement due to the combined effects of wind, current, and wave-drift forces.

(2) Maximum offset is the mean offset plus the amplitude of appropriately combined oscillatory motions and low frequency motions of the unit. The maximum offset is to be taken as the greater value obtained by the two following formulae:

$$X_{\max} = \bar{X} + X_{\max,lf} + X_{1/3,wf}$$

$$X_{\max} = \bar{X} + X_{1/3,lf} + X_{\max,wf}$$

Where:  $X_{\max}$  — Maximum offset, in m;

$\bar{X}$  — Mean offset, in m;

$X_{\max,lf}$  — Maximum single amplitude of floating installation's low frequency motion, in m;

$X_{1/3,lf}$  — Significant single amplitude of floating installation's low frequency motion, in m;

$X_{\max,wf}$  — Maximum single amplitude of floating installation's oscillatory motion, in m;

$X_{1/3,wf}$  — Significant single amplitude of floating installation's oscillatory motion, in m.

Any other method used for determining the maximum offset is to be approved by CCS.

### 6.3.2.2 Mooring line tension

(1) The mean tension means the mooring line tension corresponding to the mean offset of the unit.

(2) The maximum tension means the sum of the mean tension and the appropriately combined oscillatory tension and low frequency tension. The maximum tension is to be taken as the greater value obtained by the following formulae:

$$T_{\max} = \bar{T} + T_{\max,lf} + T_{1/3,wf}$$

$$T_{\max} = \bar{T} + T_{1/3,lf} + T_{\max,wf}$$

Where:  $T_{\max}$  — Maximum tension, in kN;

$\bar{T}$  — Mean tension, in kN;

$T_{\max,lf}$  — Maximum low frequency tension, in kN;

$T_{1/3,lf}$  — Significant low frequency tension, in kN;

$T_{\max,wf}$  — Maximum oscillatory tension, in kN;

$T_{1/3,wf}$  — Significant oscillatory tension, in kN.

Any other method used for determining the maximum tension is to be approved by CCS.

### 6.3.3 Statistical characteristics of random responses

6.3.3.1 Maximum and significant values of wave-frequency and low-frequency responses (such as motions and tensions) which can be expressed as the Gaussian random process for narrow band with Rayleigh distribution peaks may be obtained as follows:

$$\text{Maximum value} = \sqrt{2 \ln N} \text{RMS}$$

$$\text{Significant value} = 2\text{RMS}$$

Where:  $\text{RMS}$  — Root mean square of random process,  $\text{RMS} = \sqrt{m_0}$  when expressed in spectrum moment;

$N$  — Number of oscillations,  $N = \frac{T}{T_a}$ ;

$T$  — Duration of storm, in seconds;

$T_a$  — Average zero up crossing period, in seconds,  $T_a = 2\pi \sqrt{\frac{m_0}{m_2}}$ ;

$m_i$  —  $i^{\text{th}}$  order spectrum moment,  $m_i = \int_0^\infty \omega^i S_x(\omega) d\omega$ ;

$S_x(\omega)$  — Spectral density.

For low frequency motions,  $T_a$  could be taken as the natural period  $T_e$  of the unit and obtained as follows:

$$T_e = 2\pi \sqrt{m/c}$$

Where:  $m$  — Mass of moored floating installation, including low frequency added mass, in ton,

$c$  — Stiffness of mooring system taken at the unit's mean position, in kN/m.

The duration of storm is to be determined according to specific conditions, generally not less than 3 hours.

When the model testing or time-domain simulation is used to determine the maximum value, it is to be repeated to get several records of motion responses or tension responses, and the mean value of the recorded maximum values is to be taken as the maximum value of random responses.

It is to be noted that any non-Gaussian process may be underestimated in the above formulae for calculating maximum values.

### 6.3.4 Fatigue analysis of mooring line

6.3.4.1 The fatigue analysis of mooring line is to be conducted through the S-N method, and the detailed fatigue analysis is to be conducted to permanent mooring system.

6.3.4.2 The fatigue analysis to each piece of mooring line component is to be conducted, and the S-N curve of each mooring line component is to be established based on the fatigue test data and regression analysis.

### 6.3.5 Design criteria for position mooring systems

6.3.5.1 The following elements of position mooring systems are to be checked in accordance with this paragraph:

- (1) Mean offset and maximum offset;
- (2) Tension of mooring lines;
- (3) Length of mooring line;
- (4) Holding power of anchors.

#### 6.3.5.2 Offset

The owner/designer is to specify the permissible mean offset and the permissible maximum offset for floating installation on the basis of equipment limit and distance requirements.

#### 6.3.5.3 Design of mooring line

(1) The safety factor of mooring line tension depends on the design conditions and the adopted mooring analysis methods. The corrosion allowance and wear of mooring line are to be taken into consideration during the analysis.

(2) When the quasi-static analysis method and dynamic analysis method are used, the safety factor of chain cables or wire ropes is not to be less than that given in Table 6.3.5.3 (1). The safety factors of mooring lines made of other materials are to be specially approved by CCS.

(3) The tension safety factor  $F$  is specified as:

$$F = \frac{P_B}{T_{\max}}$$

Where:

$P_B$  — Minimum rated breaking strength of mooring line, in kN;

$T_{\max}$  — Maximum tension of mooring line obtained according to this paragraph, in kN.

**Safety Factors of Mooring Line Tension      Table 6.3.5.3 (1)**

	Quasi-static force	Motive force
Complete survival loading condition	2.00	1.67
Damage survival loading condition (new equilibrium position)	1.43	1.25
Damage survival loading condition (transient)	1.18	1.05

Note: If different analysis methods are used, other safety factors can be used to ensure the safety of floating

installation after applying for CCS review and approval.

(4) The fatigue safety factor of permanent position mooring system is related to the detectable conditions and positions of each component, and the fatigue safety factor of each component of mooring line is not to be less than the value ruled in Table 6.3.5.3 (2).

**Fatigue Safety Factor of Mooring Line Component Table 6.3.5.3 (2)**

	Detectable part	Undetectable but crucial part
Ratio of fatigue life to designed life	3	10

6.3.5.4 Length of mooring lines

Where a high holding power anchor is used, the mooring line is to be of sufficient in its outboard length so that a portion of the line still touches seabed when the maximum offset of the mooring system is reached in a damaged condition.

Shorter mooring lines could be adopted for the mooring systems with other anchor systems (such as anchor piles).

6.3.5.5 Holding power of anchor system

(1) For high holding power anchor, the friction force of mooring line on the seabed may be taken into consideration during the calculation of holding power. The friction factor depends on the actual situation of the seabed where the anchor is dropped and the type of anchor line. Refer to Table 6.3.5.5 (1) for general friction factors of chain cables and steel wire ropes. The owner/designer are to provide the analysis report on the holding power of anchor with certain anchor types and seabed conditions and submit the report to CCS for review;

(2) Traditional pile anchor possesses the capacity of bearing uplift force and horizontal force at the same time. The analysis of pile anchor bearing capacity and the fatigue analysis using the set soil conditions are to be submitted to CCS for review;

(3) Suction anchor possesses the capacity of bearing uplift force and horizontal force at the same time. The owner/designer are to provide the analysis report on holding power and structure of suction anchor, including the fatigue analysis report, to CCS for review.

(4) Refer to Table 6.3.5.5 (2) for requirements for the minimum safety factors of high holding power anchor and suction anchor. Pile anchor is to comply with the requirements for safety factor of pile bearing capacity specified in *Rules for the Construction and Survey of Fixed Offshore Units in Shallow Waters* of CCS. The maximum anchor holding power required by position mooring system of floating installation is to be obtained based on the dynamic analysis method considering dynamic effect of mooring line.

**Friction Factor of Mooring Line Table 6.3.5.5 (1)**

	Static friction	Sliding friction
Chain cable	1.00	0.70
Steel wire rope	0.60	0.25

**Safety Factor of Anchor Holding Power Table 6.3.5.5 (2)**

	Intact survival condition	Damaged survival condition
High holding power anchor	1.50	1.00
Suction anchor (transverse)	1.60	1.20
Suction anchor (axial)	2.00	1.50

6.3.5.6 Spacing

(1) Floating production device or units and their mooring systems shall avoid contact with other marine structures and maintain sufficient spacing, especially in harsh marine environments. Under normal working conditions or mild environmental conditions, when the spacing meets certain standards, the mooring systems can be similar. The distance between a floating production device or unit and other offshore structures shall be determined according to the analytical methods and conditions recommended in Table 6.3.5.6. The criteria for distance shall take into account the following factors: environmental conditions, water depth, size of floating production device or unit, risk of damage, loss of assets, environmental damage, etc.

**Recommended Analysis Methods and Conditions Table 6.3.5.6**

Limit state	Analysis method	Analysis working condition
Strength design	Intact	Dynamic analysis
	Transient (1)	Quasi-static analysis or dynamic analysis
Fatigue design	Intact	Dynamic analysis

Note: (1) Only when there are other facilities near the mooring system.

(2) In the complete mooring state, the mooring line crosses the high part of the catenary frame of the pipeline, and there is a vertical distance of at least 10 meters between the mooring line and the pipeline. In the complete mooring state, if there are protective measures for the pipeline, the mooring line can contact with the pipeline to a certain extent, but the contact point must not be in the area of violent swing.

(3) When mooring lines cross each other, if one mooring line lies at the bottom of the crossing section, the vertical distance between two mooring lines shall not be less than 10 meters under complete conditions; if the mooring lines are suspended at the crossing section, the vertical distance between mooring lines at the crossing point shall not be less than 20 meters.

(4) The horizontal distance between the moored floating production device or unit (or its mooring line) and other marine structures shall not be less than 10 meters. All operation conditions defined in 6.3.1.2 need to meet this distance requirement.

(5) If an offshore structure is located on a path dragged by a floating production device or unit and anchor, the final anchor shall be located at a distance of no less than 300 meters from the structure. Otherwise, the distance between anchor and structure shall not be less than 100 meters.

(6) The adverse effects of collision between mooring system and other floating structures, such as anchor frame, shall be considered.

**6.3.6 Analysis of propeller-assisted positioning and mooring system**

6.3.6.1 For floating installation with propeller assisted positioning, part or all of the net thrust effect may be considered under all design conditions. This effect depends on the propeller control system and design conditions. The propeller can be manually controlled or automatically controlled. The allowable thrust shall be selected according to table 6.3.6.1.

**Permissible Value of Thrust Effect in Propeller Assisted Mooring System <sup>(1)</sup> Table 6.3.6.1**

Design condition	Propeller control system	
	Manual remote control	Automatic remote control <sup>(3)</sup>
Intact survival condition	70% of the maximum usable thrust of the propeller <sup>(2)</sup>	100% of the maximum usable thrust of the propeller <sup>(2)</sup>
Damaged survival condition	70% of the maximum usable thrust of all propellers	100% of the maximum usable thrust of all propellers

Note: (1) This table is applicable to propeller systems with standby power sources;

(2) If the thrust effect of propellers is different, one propeller with maximum thrust effect shall be deducted;

6.3.6.2 The calculation of the maximum available thrust shall be based on the effective mooring thrust at zero

speed, and the effects of any directional confinement, floating installation motion, ocean currents, interactions between propellers and floating installation shells, and between propellers shall be taken into account.

6.3.6.3 The allowable thrusts used in mooring systems are to be proved by documents provided by the manufacturers, and to be verified during the thruster system testing at sea.

6.3.6.4 In thruster assisted systems, the load sharing between thrusters and mooring systems are complex, and could only be taken into fully consideration by a time-domain system dynamic analysis. In general, a simple mean load reduction method may be used for analysis of thruster assisted mooring. Where the system dynamic analysis method is used, special consideration is to be given.

## **Section 4 MOORING EQUIPMENT**

### **6.4.1 General requirements**

6.4.1.1 The materials, design, manufacture and testing of anchors, mooring lines and their fittings and fairleads, as well as chain/wire stoppers are to be in compliance with applicable requirements of Chapter 10 of PART ONE of *CCS Rules for Materials and Welding* or the recognized GB or international standards.

6.4.1.2 Where the floating installation is moored on the single point moored unit, the connection pattern between floating installation and single point moored unit is to be designed according to the mooring capacity of single point moored unit and environmental conditions of operating sea area.

6.4.1.3 For the position mooring connected with yoke support, its structure is to be designed on the basis of direct calculation. The equipment connected with single point moored pipeline is to be connected and released conveniently, and the yoke support type moored unit is to be released as soon as possible.

6.4.1.4 The position mooring with mooring line is to be equipped with rapid release device. Monitoring equipment which is used to display the relative positions of floating installation and single point moored unit is to be equipped in the control room.

6.4.1.5 The structure of connection part between the internal turret moored unit and the main hull is to be designed on the basis of direct calculation.

6.4.1.6 The floating installation is to be equipped with winch, mooring bitt, warping pipe and other facilities used for mooring of oil tanker for transportation according to the size, tonnage and berthing pattern of oil tanker for transportation. The board side of berthing and transportation oil tankers is to be equipped with board protection devices for absorbing energy. The design of board protection device is to comply with the rules of OCIMF "ship to ship".

### **6.4.2 Anchors**

6.4.2.1 The number and holding power of anchors used for position mooring are to be sufficient for their intended purpose, refer to 6.3.11.5 of this Chapter.

6.4.2.2 Type and design of anchors are to be to the satisfaction of CCS.

6.4.2.3 All anchors are to be stowed to prevent movement during transit.

### **6.4.3 Mooring lines**

6.4.3.1 Mooring lines are generally to be of stud link chain cable, wire rope, synthetic fiber rope or any combination thereof.

6.4.3.2 Stud link chain cables and accessories are generally to be of grades OM3, OM3S, OM4, OM4S and OM5 in represent to their strength, meeting the requirements for offshore mooring chain cables and accessories in Section 3, Chapter 10 of PART ONE of *CCS Rules for Materials and Welding*. Other equivalent materials may also be used, subject to the agreement of CCS.

6.4.3.3 Wire rope for mooring lines is to have a suitable construction for its purpose, and 6 \* 37 construction with independent wire rope core is generally acceptable. The wire rope is to be galvanized. Wire rope and its terminal fittings are to comply with a recognized standard.

6.4.3.4 The synthetic fiber rope is to comply with the relevant requirements in Section 2, Chapter 7 of PART TWO of *CCS Rules for Materials and Welding*.

6.4.3.5 The strength of mooring line accessories is not to be less than that of the mooring line.

#### **6.4.4 Fairleads**

6.4.4.1 Fairleads and sheaves are to be designed to permit free movement of the mooring line in all mooring configurations and designed to prevent excessive bending and wear of the mooring lines.

6.4.4.2 Fairleads and their supporting structures are to be designed for a load equivalent to the nominal minimum breaking strength of the mooring line, and the allowable stresses are to comply with the requirements of Chapter 8 of PART TWO for combined loading conditions.

6.4.4.3 Chain cable fairleads are to have a minimum of 5 pockets. Wire rope fairleads are generally to have a minimum diameter of 20 times the wire rope diameter.

#### **6.4.5 Chain/wire stoppers**

6.4.5.1 Chain/wire stoppers may require to be provided depending on the windlass/winch arrangements.

6.4.5.2 Chain/wire stoppers and their supporting structures are to be designed for a load equivalent to the nominal minimum breaking strength of the mooring line, and the allowable stresses are to comply with the requirements of Chapter 8 of PART TWO for combined loading conditions.

### **Section 5 WINDLASSES AND THRUSTERS**

#### **6.5.1 General requirements**

6.5.1.1 The windlasses/winches provided for position mooring are to comply with Chapter 5 of PART FOUR of *Rules for Classification of Mobile Offshore Units* of the Society.

6.5.1.2 Thrusters are to comply with the relevant requirements of *CCS Rules for Classification of Sea-Going Steel Ships* or the recognized standards.

### **Section 6 ELECTRICAL AND CONTROL EQUIPMENT**

#### **6.6.1 General requirements**

6.6.1.1 Control stations, display, control and alarm devices, and control modes shall comply with the provisions of Chapter 2 of Part Six of the Rules.

6.6.1.2 For the propeller auxiliary positioning mooring system, the propeller control system shall comply with the relevant provisions of Chapter 11 of Part Eight of *CCS Rules for Classification of Sea-Going Steel Ships*.

### **Section 7 SINGLE POINT POSITION MOORING SYSTEM**

#### **6.7.1 General requirements**

6.7.1.1 Other requirements of single point position mooring system are to comply with *CCS Rules for the Construction and Classification of Single Point Mooring Systems*, and those not included in the Rules are to comply with the recognized industrial standards.

### **Section 8 FIELD TEST**

#### **6.8.1 General requirements**

6.8.1.1 Each piece of mooring line is to undergo the tension test after the field arrangement of position mooring system is completed. During the test, each piece of mooring line is to be under the maximum tension under the intact survival condition calculated with the dynamic method and is to keep for 30 minutes.

6.8.1.2 For efficient drag anchor applied to soft soil conditions, the field test tension may be reduced, but is not to be less than 80% of the maximum designed tension under the intact condition.

6.8.1.3 For anchors of all types, it is necessary to verify that the inlay depth in the field reaches the minimum designed depth.

6.8.1.4 CCS will determine the necessity of the maximum tension test according to the seabed geotechnical survey data, size of load, geotechnical design analysis method and the experience concerning the regional seabed. For suction pile, CCS will review the installation record to guarantee that the installation suction pressure is consistent with the calculated suction pressure additionally. For traditional pile anchor, CCS will review the installation record, and verify whether the calculated quantity of hammering times for piling is consistent with that of actual hammering times, thus ensuring that the pile anchor is driven to the designed depth.

6.8.1.5 Where the maximum tension test is not to be conducted, CCS requires that each anchor is to be pre-tensioned to a load which can make the anchor exert the maximum anchor holding power, but this load is not to be less than the mean tension under the intact condition, so as to guarantee the intactness and lining up of mooring line.

6.8.1.6 For the releasable position mooring system, the maximum load of tension test is to be the maximum value of the following two values:

- (1) The maximum designed load under the release condition, that is to say, the floating device must be released from the position mooring system under the mentioned environmental condition;
- (2) The maximum designed load under the designed environmental condition of floating devices without connection, that is to say, the maximum load borne by the position mooring system independently under the extreme environmental condition after being released.

## Section 9 SURVEY DURING CONSTRUCTION

### 6.9.1 General requirements

6.9.1.1 The components used in the position mooring system are to be inspected and obtain the recognition of ship surveyor of CCS during the manufacturing. See Table 6.9.1.1 for components to be recognized.

6.9.1.2 The process of welding equipment is to comply with *CCS Rules for Materials and Welding*.

**Products of Position Mooring System to be Recognized** **Table 6.9.1.1**

Name of component	Certificate required or not
Anchor	Yes
Winch	Yes
Fairlead	Yes
Chain cable and its fittings	Yes
Wire rope	Yes
Fiber cable component	Yes
Chain stopper	Yes
Buoyancy unit of mooring line	Yes

## Chapter 7 HELICOPTER DECK FACILITIES

### Section 1 GENERAL PROVISIONS

#### 7.1.1 General requirements

7.1.1.1 This Chapter applies to all offshore floating devices provided with areas and facilities for normal lift-off and touchdown of helicopters

7.1.1.2 Helicopter deck facilities covered by this Chapter mean all truss-type independent deck structures and fire-fighting appliances used exclusively for lift-off, touchdown and (as necessary) stowage of helicopters and other equipment necessary for the safe operation of helicopters on the floating devices. The helicopter deck which is a part of floating device may be based on Section 18, Chapter 2 of PART TWO and Chapter 5 of PART SIX of *CCS Rules for Classification of Sea-Going Steel Ships*.

7.1.1.3 In addition to this Chapter, the design, construction and arrangement as well as safety requirements of helicopter deck facilities must comply with relevant regulations of the International Civil Aviation Organization, the civil aviation administration and maritime administration of the State with territorial jurisdiction over the sea area in which the floating device is to operate.

7.1.1.4 Where the helicopter deck is a part of a weather deck or a deck used for other purposes, the scantlings are to be not less than those required for such decks in the same position.

#### 7.1.2 Class notations

7.1.2.1 HELDK: to be assigned to the offshore floating devices in compliance with the relevant provisions of this Chapter.

#### 7.1.3 Definitions

7.1.3.1 *LD or LD-value* referred in this Chapter means the largest dimensions of the helicopter when rotor(s) are turning measured from the most forward position of the main rotor tip path plane to the most rearward position of the tail rotor path plane or helicopter structure.

7.1.3.2 *Final approach and take-off area (FATO)* referred in this Chapter is a defined area over which the final phase of the approach manoeuvre to hover or touchdown of the helicopter is intended to be completed and from which the take-off manoeuvre is intended to be commenced.

7.1.3.3 *Limited obstacle sector (LOS)* referred in this Chapter is a sector extending outward which is formed by that portion of the 360° arc, excluding the obstacle-free sector, the center of which is the reference point from which the obstacle-free sector is determined. Obstacles within the limited obstacle sector are limited to specified heights.

7.1.3.4 *Obstacle* referred in this Chapter is any object, or part thereof, that is located on an area intended for the movement of a helicopter on a helideck or that extends above a defined surface intended to protect a helicopter in flight.

7.1.3.5 *Obstacle-free sector* referred in this Chapter is a complex surface originating at, and extending from, a reference point on the edge of the FATO of a helideck, comprised of two components, one above and one below the helideck for the purpose of flight safety within which only specified obstacles are permitted.

7.1.3.6 *Touchdown and lift-off area (TLOF)* referred in this Chapter is a dynamic load-bearing area on which a helicopter may touch down or lift off. For a helideck it is presumed that the FATO and the TLOF will be coincidental.

#### 7.1.4 Plans and information

7.1.4.1 The following plans and information are to be submitted in quadruplicate to CCS for approval or examination:

(1) Details of helicopter deck arrangement, including overall dimensions, landing area, stowing, securing, tie-down points on deck and fittings;

- (2) Structural plan and strength calculations for helicopter deck;
- (3) Arrangement of stowage and securing of helicopters (if applicable);
- (4) Arrangement of structural fire protection of helicopter deck, including fire division, means of escape, openings, drainage facilities;
- (5) Arrangement of fire-fighting appliances provided for helicopter deck, including calculations of quantity of extinguishing agents to be used.

7.1.4.2 The operation manual with information on models and parameters of the largest helicopters, for which the deck is designed, including maximum lift-off weight, diameter of rotor, LD-value, tyre print dimensions and track width, is to be submitted to CCS for information.

## **Section 2 CONSTRUCTION AND ARRANGEMENT OF HELICOPTER DECK**

### **7.2.1 Construction of helicopter deck**

7.2.1.1 The helicopter deck is to be of sufficient size and located so as to provide a clear approach to enable the largest helicopter using the deck to operate under the most severe conditions anticipated for helicopter operations.

7.2.1.2 The arrangement of the helicopter deck is to take account of the largest helicopter to be used, the environmental and weather elements such as wind, turbulence, sea state, water temperature and ice, and comply with the following:

(1) Adverse weather conditions:

- ① The helideck is to be of sufficient size to contain an area within which can be drawn a circle of diameter not less than LD for single main rotor helicopters (LD as defined in 7.1.3.1 of this Chapter);
- ② A helideck obstacle-free sector is to comprise of two components, one above and one below helideck level (see Fig. 7.2.1.2 (1) a):

(a) Above helideck level: The surface is to be a horizontal plane level with the elevation of the helideck surface that subtends an arc of at least 210° with the apex located on the periphery of the LD reference circle extending outwards to a distance that will allow for an unobstructed departure path appropriate to the helicopter(s) the helideck is intended to serve; and

(b) Below helideck level: Within the (minimum) 210° arc, the surface is to additionally extend downward at a 5:1 falling gradient from the edge of the safety net below the elevation of the helideck to water level for an arc of not less than 180° that passes through the center of the FATO and outwards to a distance that will allow for safe clearance from the obstacles below the helideck in the event of an engine failure for the type of helicopter(s) the helideck is intended to serve (see Fig. 7.2.1.2 (1) a);

- ③ For single rotor helicopters, within the 150° LOS out to a distance of 0.12 LD, measured from the point of origin of the LOS, objects are not to exceed a height of 0.25 m above the helideck. Beyond that arc, out to a distance of an additional 0.21 LD, the maximum obstacle height is limited to a gradient of one unit vertically for each two units horizontally originating at a height of 0.05 LD above the level of the helideck (see Fig. 7.2.1.2 (1) b 1);
- ④ Objects with the function of which requires that they be located on the helideck within the FATO are to be limited to landing area (if required) and certain lighting systems and are not to exceed the surface of the landing area by more than 0.025 m. Such objects are only to be present provided they do not cause a hazard to helicopter operations; and
- ⑤ Operations by tandem main rotor helicopters are to be specially considered by the Administration.

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<sup>1</sup> Where the dynamic load bearing area of the helideck enclosed by the FATO perimeter marking is a shape other than circular, the extent of the LOS segments are represented as lines parallel to the perimeter of the landing area rather than arcs. Fig. 10.2.1.2 (1) b has been constructed on the assumption that an octagonal helideck is provided.

(2) Benign climate conditions:

- ① The helideck is to be of sufficient size to contain a circle of diameter no less than 0.83 LD (LD as defined in 7.1.3.1 of this Chapter);
- ② A helideck obstacle-free sector is to comprise of two components, one above and one below helideck level (see Fig. 7.2.1.2 (1) a):
  - (a) Above helideck level: The surface is to be a horizontal plane level with the elevation of the helideck surface that subtends an arc of at least 210° with the apex located on the periphery of the LD reference circle extending outwards to a distance that will allow for an unobstructed departure path appropriate to the helicopter(s) the helideck is intended to serve; and
  - (b) Below helideck level: Within the (minimum) 210° arc, the surface is to additionally extend downward at a 5:1 falling gradient from the edge of the safety net below the elevation of the helideck to water level for an arc of not less than 180° that passes through the center of the FATO and outwards to a distance that will allow for safe clearance from the obstacles below the helideck in the event of an engine failure for the type of helicopter(s) the helideck is intended to serve (see Fig. 7.2.1.2 (1) a);
- ③ For single rotor helicopters, within 0.415 LD to 0.5 LD objects should not exceed a height of 0.025 m. Within the 150° LOS out to a distance of 0.12 LD, measured from the point of origin of the LOS, objects are not to exceed a height of 0.05 m above the helideck. Beyond that arc, out to a distance of an additional 0.21 LD, the LOS rises at a rate of one unit vertically for each two units horizontally originating at a height of 0.05 LD above the level of the helideck (refer to Fig. 7.2.1.2 (2) 2) ;
- ④ Objects with the function of which requires that they be located on the helideck within the FATO are to be limited to landing nets (where required) and certain lighting systems and are not to exceed the surface of the landing area by more than 0.025 m. Such objects are only to be present provided they do not cause a hazard to helicopter operations; and
- ⑤ Operations by tandem main rotor helicopters are to be specially considered by the Administration.

7.2.1.3 The helideck is to have a skid-resistant surface.

7.2.1.4 Where the helideck is constructed in the form of a grating, the underdeck is to be such that the ground effect is maintained.

## 7.2.2 Arrangements of helicopter deck

7.2.2.1 The helideck is to have recessed tie-down points for securing a helicopter.

7.2.2.2 The periphery of the helideck is to be fitted with a safety net except where structural protection exists. The net should be inclined upwards at an angle of 10° and outwards from below the edge of the helideck to a horizontal distance of 1.5 m and is not to rise above the edge of the deck.

7.2.2.3 The helideck is to have both a main and an emergency personnel access route located as far apart from each other as practicable.

7.2.2.4 The helideck is to have drainage facilities to prevent the collection of liquids and prevent liquids from spreading to or falling on other parts of the unit, and the drainage facilities are to be:

- (1) Constructed of steel or other arrangements providing equivalent fire safety;
- (2) Lead directly overboard independent of any other system; and
- (3) Designed so that drainage does not fall onto any part of the floating device.

## 7.2.3 Visual aids

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<sup>2</sup> Where the dynamic load bearing area of the helideck enclosed by the FATO perimeter marking is a shape other than circular, the extent of the LOS segments are represented as lines parallel to the perimeter of the landing area rather than arcs. Figure 10.2.1.2 (2) has been constructed on the assumption that an octagonal helideck is provided.

## 7.2.3.1 Wind direction indicator

(1) A wind direction indicator is to be located on the floating device which, in so far as is practicable, indicates the wind conditions over the TLOF in such a way as to be free from the effects of airflow disturbances caused by nearby objects or rotor downwash. It is to be visible from a helicopter in flight or in a hover over the helideck. Where the TLOF may be subject to a disturbed air flow then additional wind direction indicators located close to the area are to be provided to indicate the surface wind on those areas. Placement of the wind direction indicators is not to compromise obstacle-protected surfaces;

(2) Floating devices on which night helicopter operations take place are to have provisions to illuminate the wind direction indicators;

(3) A wind direction indicator is to be a truncated cone made of lightweight fabric and is to have the following minimum dimensions:

Length	1.2 m
Diameter (larger end)	0.3 m
Diameter (smaller end)	0.15 m

(4) The colour of the wind direction indicator is to be so selected as to make it clearly visible and understandable from a height of at least 200 m above the helicopter, having regard to background. Where practicable, a single colour, preferably white or orange, is to be used. Where a combination of two colours is required to give adequate conspicuity against changing backgrounds, they are preferably to be orange and white, or red and white, and are to be arranged in five alternate bands the first and last band being the darker colour.

7.2.3.2 A heliport identification marking is to be located at the center of the touchdown/positioning marking described in paragraph 7.2.3.6 of this Chapter. It is to consist of a white “H” that is 4 m high, 3 m wide, with a stroke width of 0.75 m.

## 7.2.3.3 LD-value marking

(1) The actual LD-value of the helideck is to be painted on the helideck inboard of the chevron provided in accordance with paragraph 7.2.3.7 in alphanumeric symbols of 0.1 m in height;

(2) The helideck LD-value is also to be marked around the perimeter of the helideck in the manner shown in Fig. 7.2.3.3 (2) in a colour contrasting (preferably white: avoid black or grey for night use) with the helideck surface. The LD-value is to be to the nearest whole number with 0.5 rounded down, e.g., 18.5 marked as 18. Markings for some helicopters may require special consideration.<sup>3</sup>

## 7.2.3.4 Maximum allowable mass marking

(1) A maximum allowable mass marking is to be located within the TLOF and so arranged as to be readable from the preferred final approach direction, i.e. towards the obstacle-free sector origin;

(2) The maximum allowable mass marking is to consist of a two- or three-digit number followed by a letter “t” to indicate the allowable helicopter mass in t (1,000 kg). The marking is to be expressed to one decimal place, rounded to the nearest 100 kg;

(3) The height of the figures is to be 0.9 m with a line width of approximately 0.12 m and be in a colour (preferably white) which contrasts with the helideck surface. Where possible the mass marking is to be well separated from the installation identification marking in order to avoid possible confusion on recognition.

7.2.3.5 The TLOF perimeter marking is to be located along the perimeter of the TLOF and is to consist of a continuous white line with a width of at least 0.3 m. TLOF perimeter markings are typically for a 1 LD or 0.83 LD value (see Fig. 7.2.1.2 (1) b and 7.2.1.2 (2)).

<sup>3</sup> Helidecks designed specially for AS332L2 and EC225 helicopters, each having an LD-value of 19.5 m, are to be rounded up to 20 m in order to differentiate between helidecks designed specially for L1 models.

#### 7.2.3.6 Touchdown/positioning marking

- (1) A touchdown/positioning marking is to be located so that when the pilot's seat is over the marking the whole of the undercarriage will be within the TLOF and all parts of the helicopter will be clear of any obstacle by a safe margin;
- (2) The centre of the touchdown/positioning marking is to be concentric to the centre of the TLOF;<sup>4</sup>
- (3) A touchdown/positioning marking is to be a yellow circle and have a line width of 1 m. The inner diameter of the circle is to be half the LD-value of the largest helicopter for which the TLOF is designed.

#### 7.2.3.7 Helideck obstacle-free sector marking

- (1) Except as provided in paragraph 7.2.3.7 (2), a helideck obstacle-free sector marking is to be located on the TLOF perimeter marking and indicated by the use of a black chevron, each leg being 0.8 m long and 0.1 m wide forming the angle in the manner shown in Fig. 7.2.3.3 (2). The obstacle-free sector marking is to indicate the origin of the obstacle-free sector, the directions of the limits of the sector and the verified LD-value of the helideck. Where there is no room to place the chevron where indicated, the chevron marking, but not the point of origin, may be displaced towards the circle centre;
- (2) For a helideck less than 1 LD (i.e. a helideck meeting paragraph 7.2.1.2 (2) of this Chapter), a helideck obstacle free sector marking is to be located at a distance from the centre of the TLOF equal to the radius of the largest circle which can be drawn in the TLOF or 0.5 LD whichever is greater.
- (3) The height of the chevron is to be equal to the width of the TLOF perimeter marking, but is not to be less than 0.3 m. The chevron is to be black in colour and may be painted on top of the TLOF perimeter marking in paragraph 7.2.3.5 of this Chapter.

#### 7.2.3.8 Identification markings of floating device

- (1) The name of the floating device is to be clearly displayed on identification panels of floating device located in such positions that the floating device can be readily identified from the air and sea from all normal angles and directions of approach. The height of the figures is to be at least 0.9 m with a line width of approximately 0.12 m. The identification panels of floating device are to be highly visible in all light conditions and located high up on the floating device (e.g., on the derrick). Suitable illumination is to be provided for use at night and in conditions of poor visibility;
- (2) The name of floating device is to be provided on the helideck and be positioned on the obstacle side of the touchdown/positioning marking with characters not less than 1.2 m in height and in a colour contrasting with the background;

#### 7.2.3.9 Perimeter lights

- (1) The perimeter of the TLOF is to be delineated by green lights visible omnidirectionally from on or above the landing area. These lights are to be above the level of the deck but are not to exceed 0.25 m in height for helidecks sized in accordance with paragraph 7.2.1.2 (1) of this Chapter and 0.05 m in height for helidecks sized in accordance with paragraph 7.2.1.2 (2) of this Chapter. The lights are to be equally spaced at intervals of not more than 3 m around the perimeter of the TLOF, coincident with the white line delineating the perimeter in paragraph 7.2.3.5 of this Chapter. In the case of square or rectangular decks there are to be a minimum of four lights along each side including a light at each corner of the TLOF. Flush fitting lights may be used at the inboard (150° limited obstacle sector origin) edge of the TLOF where there is a need to move a helicopter or large equipment off the TLOF;
- (2) Perimeter lights are to meet the chromaticity characteristics given in table 7.2.3.9-1, and the vertical beam spread and intensity characteristics given in table 7.2.3.9-2.

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<sup>4</sup> The marking may be offset away from the origin of the obstacle-free sector by no more than 0.1 LD where an aeronautical study indicates such offsetting to be beneficial, provided that the offset marking does not adversely affect the safety of operations.

**Perimeter Lighting Chromaticity Table 7.2.3.9-1**

Yellow boundary	$x = 0.36 - 0.08 y$
White boundary	$x = 0.65 y$
Blue boundary	$y = 0.9 - 0.171 x$

**Green Perimeter Lighting Intensity Table 7.2.3.9-2**

Elevation	Intensity (cd)
0° - 90°	60 max <sup>(1)</sup>
> 20° - 90°	3 min
> 10° - 20°	15 min
0° - 10°	30 min
Azimuth angle +180° - 180°	

Notes (1) If higher intensity lighting is provided to assist in conditions of poor visibility during daylight, it is to incorporate a control to reduce the intensity to not more than 60 cd for night use.

7.2.3.10 Helideck floodlights are to be located so as to avoid glare to pilots, and provision is to be made for periodically checking their alignment. The arrangements and aiming of floodlights are to be such that helideck markings are illuminated and that shadows are kept to a minimum. Floodlights are to conform to the same height limitations specified in paragraph 7.2.3.9 of this Chapter for perimeter lights.

#### 7.2.3.11 Obstacle marking and lighting

(1) Fixed obstacles and permanent equipment, such as crane booms, which may present a hazard to helicopters, are to be readily visible from the air during daylight. If a paint scheme is necessary to enhance identification by day, alternate black and white, black and yellow, or red and white bands are recommended, not less than 0.5 m nor more than 6 m wide;

(2) Omnidirectional red lights of at least 10 cd intensity are to be fitted at suitable locations to provide the helicopter pilot with visual information on objects which may present a hazard to helicopters and on the proximity and height of objects which are higher than the landing area and which are close to it or to the limited obstacle sector boundary. Such lighting is to comply with the following:

- ① Objects which are more than 15 m higher than the landing area are to be fitted with intermediate red lights of the same intensity spaced at 10 m intervals down to the level of the landing area (except where such lights would be obscured by other objects);
- ② Structures such as flare booms and towers may be illuminated by floodlights as an alternative to fitting the intermediate red lights, provided that such lights are so arranged that they will illuminate the whole of the structure and not interfere with the helicopter pilot's night vision;
- ③ Alternative equivalent technologies to highlight dominant obstacles in the vicinity of the helideck may be utilized in accordance with the recommendations of the ICAO.

(3) An omnidirectional red light of intensity 25 to 200 cd is to be fitted to the highest point of the floating installation. Where this is not practicable (e.g., flare towers) the light is to be fitted as near to the extremity as possible.

7.2.3.12 Status lights are to be installed to provide warning that a condition exists on the floating installation which may be hazardous for the helicopter or its occupants. The status lights are to be a flashing red light<sup>5</sup> (or lights), visible to the pilot from any direction of approach and on any touchdown heading. The system is to be automatically initiated when the toxic gas alarm under Chapter 3 of PART FIVE of *CCS Rules for Classification of Mobile Offshore Units* is initiated as well as being capable of manual activation at the helideck. It is to be visible at a range in excess of the distance at which the helicopter may be endangered or may be commencing a visual approach. The status light system is to:

- (1) Be installed either on or adjacent to the helideck. Additional lights may be installed in other locations on the unit where this is necessary to meet the requirement that the signal be visible from all approach directions, i.e. 360° in azimuth;
- (2) Have an effective intensity of at least 700 cd between 2° and 10° above the horizontal and at least 176 cd at all other angles of elevation;
- (3) Be provided with a facility to enable the output of the lights (if and when activated) to be dimmed to an intensity not exceeding 60 cd while the helicopter is landed on the helideck;
- (4) Be visible from all possible approach directions and while the helicopter is landed on the helideck, regardless of heading with a vertical beam spread as describe above;
- (5) Use lights that are 'red' as defined by ICAO<sup>6</sup>;
- (6) Flash at a rate of 120 flashes per minute and, if two or more lights are needed to meet this requirement, they are to be synchronised to ensure an equal time gap (to within 10%) between flashes. Provision is to be made to reduce the flash rate to 60 flashes per minute if a helicopter is provided on the helideck. The maximum duty cycle is to be no greater than 50%;
- (7) Have facilities at the helideck to manually override the automatic activation of the system;
- (8) Reach full intensity in not less than three seconds at all times;
- (9) Be designed so that no single failure will prevent the system operating effectively. In the event that more than one light unit is used to meet the flash rate requirement, a reduced flash frequency of at least 60 flashes per minute is acceptable in the failed condition for a limited period, and;
- (10) Where supplementary “repeater” lights are employed for the purposes of achieving the “on deck” 360° coverage in azimuth, these are to have a minimum intensity of 16 cd and a maximum intensity of 60 cd for all angles of azimuth and elevation.

#### 7.2.4 Motion sensing system

7.2.4.1 Floating installation motions represent a potential hazard to helicopter operations. The ship-type floating installation are to be equipped with an electronic motion-sensing system capable of measuring or calculating the magnitude and rate of pitch roll and heave at the helideck about the true vertical datum. A motion-sensing system display is to be located at the aeromobile VHF radiotelephone station provided in accordance with the relevant requirements, so that this information may be relayed to the helicopter pilot. The form of the report is to be agreed with the aeronautical service provider.

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<sup>5</sup> The aeronautical meaning of a flashing red light is either “do not land, aerodrome not available for landing” or “move clear of landing area”.

<sup>6</sup> Reference is made to the ICAO Convention, Annex 14, Volume 1, Appendix 1, Colours for aeronautical ground lights.

## Section 3 STRUCTURE OF HELICOPTER DECK

### 7.3.1 General requirements

7.3.1.1 The structure in the helicopter deck area is to be designed in accordance with the largest helicopter type which it is intended to use.

### 7.3.2 Design conditions

7.3.2.1 The following three working conditions are to be taken into consideration for the design of the helicopter deck:

(1) Homogeneously distributed loadings:

① An homogeneously distributed loading of 2 kN/m<sup>2</sup> is to be taken over the entire helicopter deck.

(2) Helicopter landing impact loading: combination of the following loads is to be taken into account:

① For normal landing, vertical impact loading  $P_H = 1.5P$  ( $P$  being the maximum lift-off weight), homogeneously distributed on both tyre prints when landing (landing of both tyres at the same time is generally assumed). Where no data on actual print dimensions are available, the print dimensions may be taken as a square area of 0.30 m × 0.30 m. The structural members are to be designed for the most unfavorable landing position with regard to forces acting on them.

Where the upper deck of a superstructure or deckhouse is used as a helicopter deck and the spaces below are normally manned (control room, quarters, etc.), the above vertical impact loading  $P_H = 1.75P$ ;

② Self-weight of the helicopter deck structure;

③ Where necessary, an homogeneously distributed loading of 0.5 kN/m<sup>2</sup>, representing wet snow, ice or other environmental loads, is also to be considered;

(3) Stowed helicopter loading: combination of the following loads is to be taken into account:

① Wheel loads sustaining the maximum lift-off weight, with tyre print dimensions as assumed for the landing impact loading;

② Self-weight of the helicopter deck structure;

③ Where necessary, a homogeneously distributed loading of 0.5 kN/m<sup>2</sup>, representing wet snow, ice or other environmental loads, is also to be considered;

④ In addition, where stowage of helicopters is possible, the static and dynamic loads of helicopter and helicopter deck structure induced by the unit's motion and inclination under corresponding environmental conditions are to be considered. If no proper data are available, both the horizontal and vertical inertial forces may be taken as 0.5 times the loading corresponding to the self-weight of helicopter and helicopter deck structure.

7.3.2.2 For helicopters fitted with landing gear other than wheels, the tyre print dimensions are to be determined according to the data provided by manufacturers.

### 7.3.3 Strength check

7.3.3.1 The safety factors of structural members of the helicopter deck are given in Table 7.3.3.1.

Safety Factors of Structural Members on Helicopter Deck Table 7.3.3.1

Structural member Design condition	Deck plating <sup>(1)</sup>	Longitudinals, beams and other secondary members	Girders, deck transverses and other main deck members, stanchions, bracing member, etc. <sup>(2)</sup>
Homogeneously distributed loading	1.67	1.67	1.67
Landing impact loading	1.00 <sup>(1)</sup>	1.00	1.10
Stowed helicopter loading	1.00	1.10	1.25

Notes: (1) ① For calculation of stresses, the deck plating may be considered as plating articulated at four sides and subjected to vertically distributed loading. CCS may allow proper increase of stress for landing impact loading, provided the rationale of the analysis is sufficiently conservative;

② In addition to the above direct calculations, the thickness of the deck plating is to comply with the minimum thickness required by Table 7.3.3.1 (1).

(2) For members subjected to axial compression, the allowable bending stress or allowable critical buckling stress, whichever is less, is to be considered.

**Minimum Thickness Requirement**

**Table 7.3.3.1 (1)**

Stiffener spacing (mm)	Minimum thickness (mm)
460	4.0
610	5.0
760	6.0

7.3.3.2 The allowable bending stress and allowable critical buckling stress of structural members of the helicopter deck are to be determined by the methods specified in Chapter 3 of PART TWO of *Rules for Classification of Mobile Offshore Units* of CCS based on the safety factor obtained in 7.3.3.1.

7.3.3.3 The strength of structural members of the helicopter deck is to be calculated in accordance with the relevant requirements of Chapter 3 of PART TWO of *Rules for Classification of Mobile Offshore Units* of CCS based on 7.3.3.2.

## Section 4 FIRE PROTECTION

### 7.4.1 General requirements

7.4.1.1 Fire protection of the helicopter deck and its associated facilities are to meet the following functional requirements:

- (1) Helideck structure is to be adequately to protect the floating installation from the fire hazards related to helicopter operations;
- (2) Fire-fighting appliances are to be provided to adequately protect the floating installation from the fire hazards related to helicopter operations;
- (3) Refuelling facilities and operations are to provide the necessary measures to protect the floating installation from the fire hazards related to helicopter operations; and

(4) Helicopter facility operation manuals and training are to be provided.

7.4.1.2 The construction of the helidecks is to be of steel or other equivalent materials. If the helideck forms the deckhead of a deckhouse or superstructure, it is to be insulated to “A-60” class standard. Where the Administration permits aluminium or other low melting point metal construction that is not made equivalent to steel, the following provisions are to be satisfied:

(1) If the helideck is cantilevered over the side of the unit, after each fire that may have an effect on the structural integrity of the helideck or its supporting structures, the helideck is to undergo a structural analysis to determine its suitability for further use, and

(2) If the helideck is located above the unit’s deckhouse or similar structure, the following conditions are to be satisfied:

① The deckhouse top and bulkheads under the helideck are to have no openings;

② Windows under the helideck are to be provided with steel shutters; and

③ After each fire on the helideck or supporting structure, a structural analysis for the helideck is to be carried out to determine its suitability for further use.

7.4.1.3 A helideck is to be provided with both a main and an emergency means of escape and access for fire fighting and rescue personnel. These are to be located as far apart from each other as is practicable and preferably on opposite sides of the helideck.

7.4.1.4 In close proximity to the helideck, the following fire-fighting appliances are to be provided and stored near the means of access to that helideck:

(1) At least two dry powder extinguishers having a total capacity of not less than 45 kg but not less than 9 kg each;

(2) Carbon dioxide extinguishers of a total capacity of not less than 18 kg or equivalent;

(3) A foam application system consisting of monitors or foam-making branch pipes capable of delivering foam to all parts of the helideck in all weather conditions in which the helideck is intended to be available for helicopter operations. The minimum capacity of the foam production system will depend upon the size of the area to be protected, the foam application rate, the discharge rates of installed equipment and the expected duration of application:

① A minimum application rate of 6 l/m<sup>2</sup> within a circle having a diameter equal to the LD-value;

② A minimum of 5 min discharge capability is to be provided;

③ Foam delivery at the minimum application rate is to start within 30 s of system activation;

(4) The principal agent is to be suitable for use with salt water;

(5) At least two nozzles of an approved dual-purpose type (jet/spray) and hoses sufficient to reach any part of the helideck;

(6) The provision and storage of fire-fighter’s outfits are to comply with the relevant requirements of Section 1, Chapter 6 of PART EIGHT;

(7) At least the following equipment is to be stored in a manner so as to provide for immediate use and protection from the elements:

① Adjustable wrench;

② Blanket, fire-resistant;

③ Cutters, bolt, 600 mm;

- ④ Hook, grab or salving;
- ⑤ Hacksaw, heavy duty complete with six spare blades;
- ⑥ Ladder;
- ⑦ Lift line 5 mm diameter and 30 m in length;
- ⑧ Pliers, side-cutting;
- ⑨ Set of assorted screwdrivers;
- ⑩ Harness knife complete with sheath; and
- ⑪ Crowbar.

7.4.1.5 Where the unit has helicopter refuelling, the following provisions are to be complied with:

(1) A dedicated area is to be provided for the storage of fuel tanks which is to be:

- ① As remote as is practicable from accommodation spaces, escape routes and embarkation stations;
- ② Isolated from areas containing a source of vapour ignition.

(2) The fuel storage area is to be provided with arrangements whereby fuel spillage may be collected and drained to a safe location;

(3) Tanks and associated equipment are to be protected against physical damage and from a fire in an adjacent space or area;

(4) Where portable fuel storage tanks are used, special attention is to be given to:

- ① Design of the tank for its intended purpose;
- ② Mounting and securing arrangements;
- ③ Electric bonding;
- ④ Inspection procedures.

(5) Storage tank fuel pumps are to be provided with means which permit shutdown from a safe remote location in the event of a fire. Where a gravity-fuelling system is installed, equivalent closing arrangements are to be provided to isolate the fuel source;

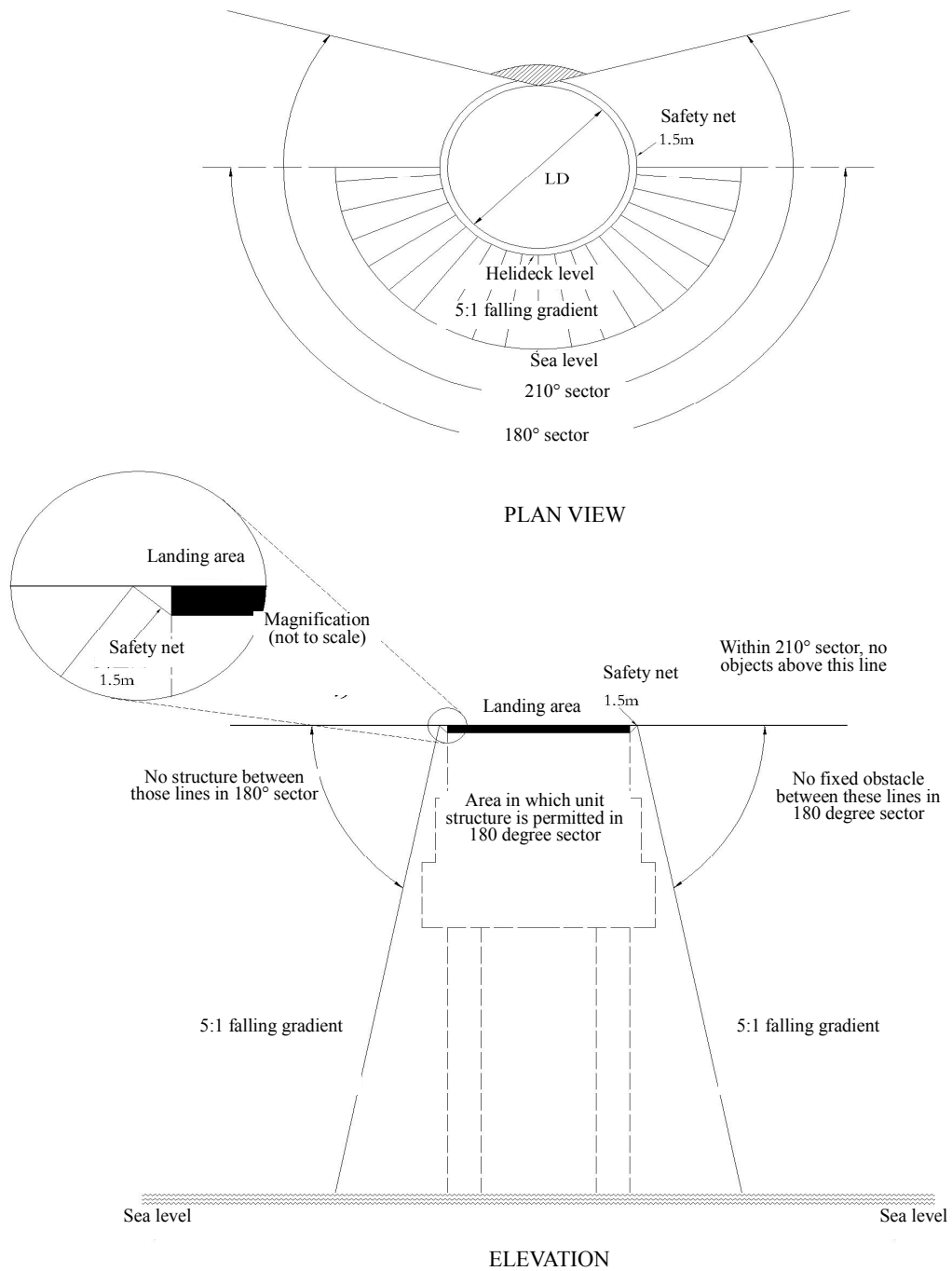
(6) The fuel pumping unit is to be connected to one tank at a time. The piping between the tank and the pumping unit is to be of steel or equivalent material, as short as possible, and protected against damage;

(7) Electrical fuel pumping units and their associated control equipment are to be of a type suitable for the location and potential hazards;

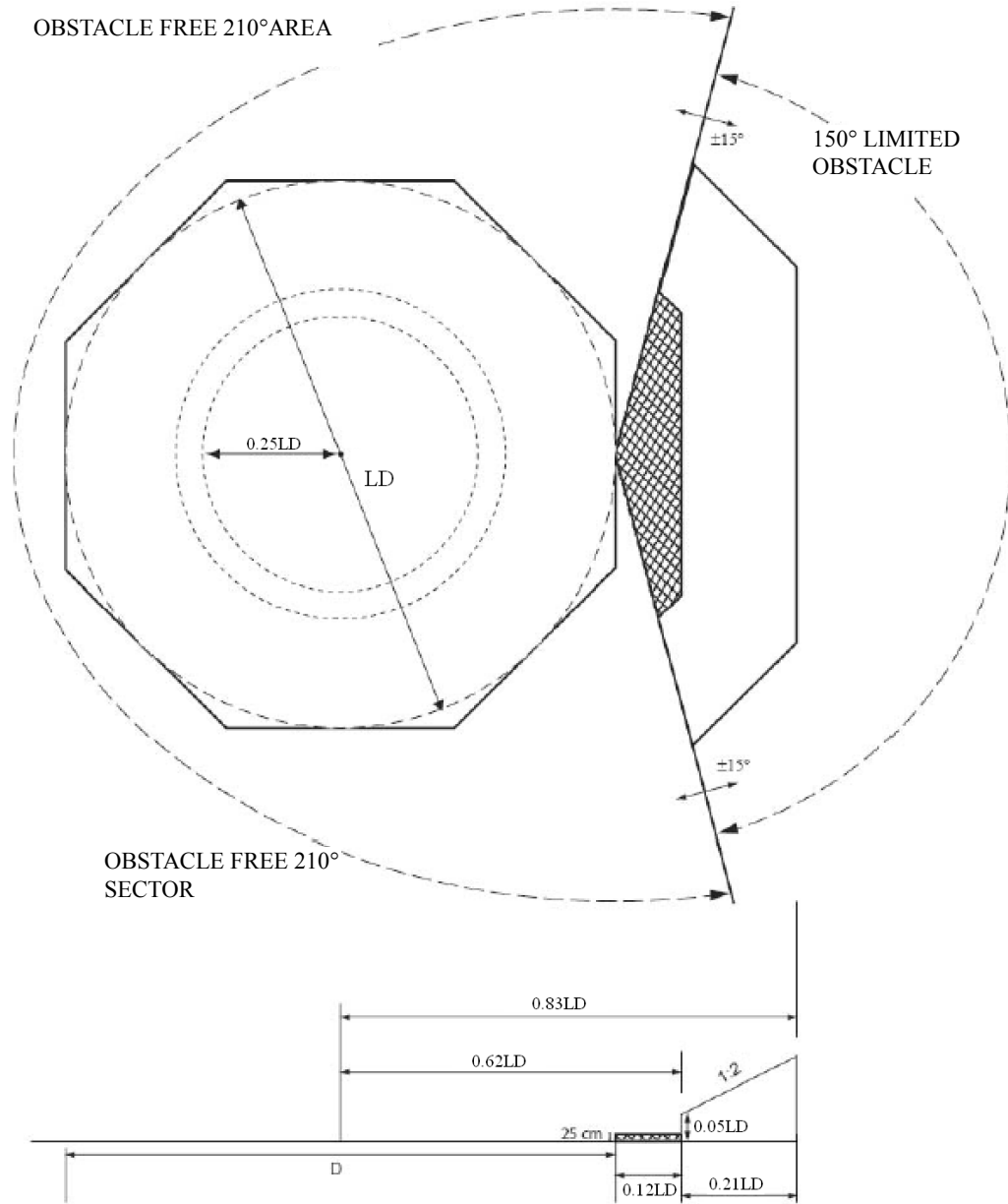
(8) Fuel pumping units are to incorporate a device which will prevent over-pressurization of the delivery or filling hose;

(9) Equipment used in refueling operations is to be electrically bonded;

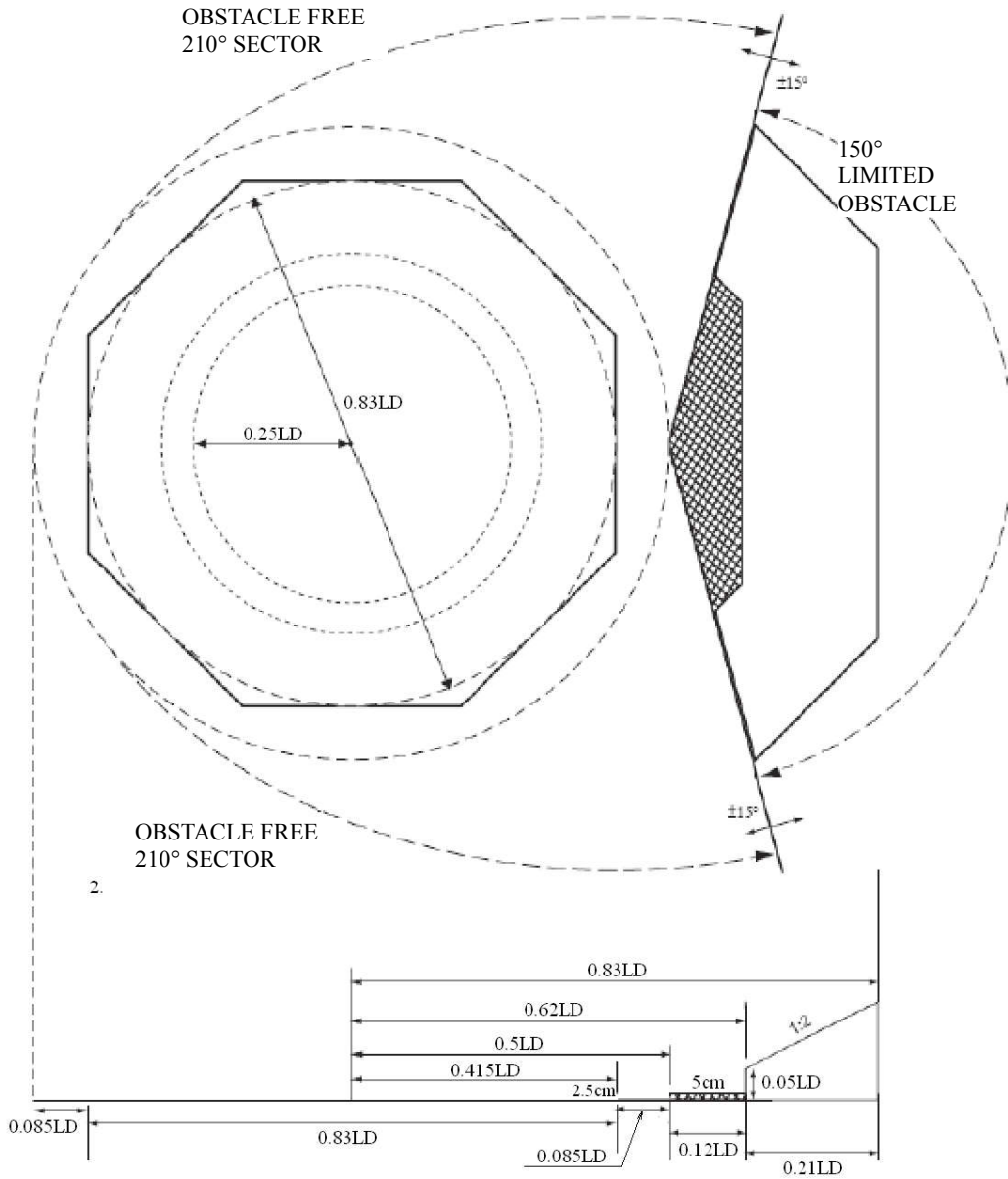
(10) "NO SMOKING" signs are to be displayed at appropriate locations.



**Fig. 7.2.1.2 (1) a Obstacle Free Areas – Below Landing Area Level**



**Fig. 7.2.1.2 (1) b Helideck Obstacle Limitation Sector:  
Single Main Rotor Helicopters**



Notes: Heights of 2.5 cm and 5 cm high shaded areas are not to scale.

**Fig. 7.2.1.2 (2) Helideck Obstacle Limitation Sector: Single Main Rotor Helicopters for Benign Climate Conditions as Accepted by the Coastal State**

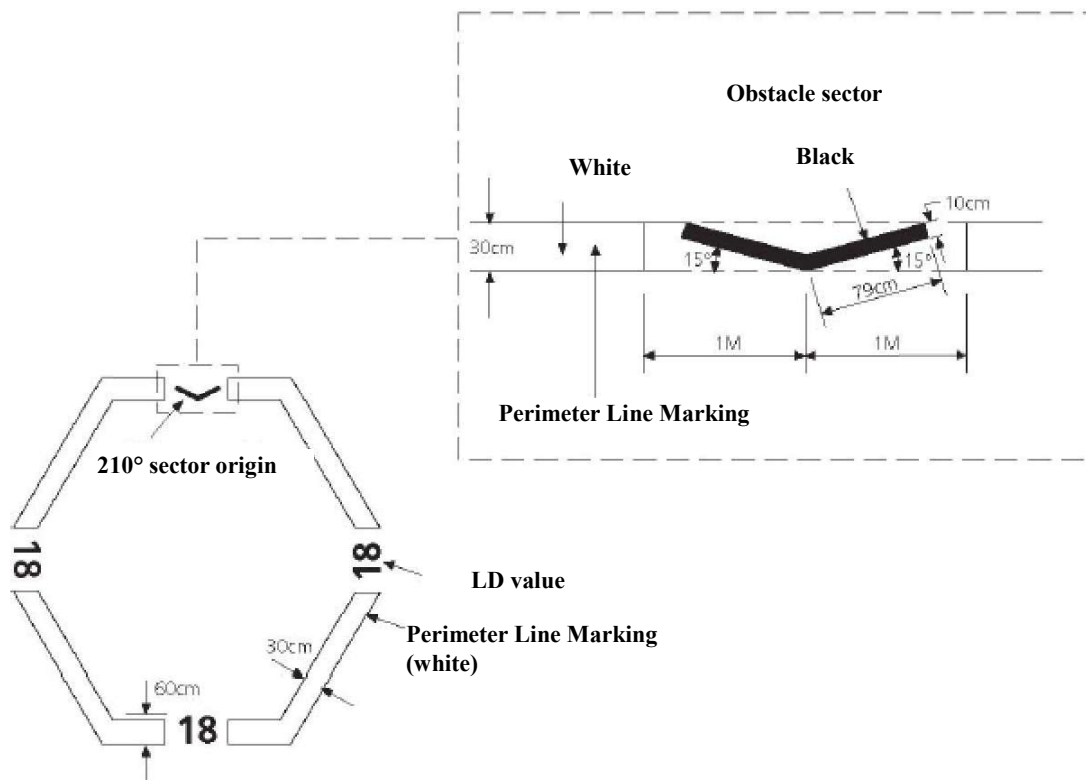


Fig. 7.2.3.3 (2) Obstacle-Free Sector Marking