CHINA CLASSIFICATION SOCIETY

RULES FOR CLASSIFICATION OF OFFSHORE FLOATING INSTALLATION

PART III STABILITY, SUBDIVISION AND LOAD LINES

CCS OFFSHORE ENGINEERING TECHNOLOGY CENTER

MARCH 2020

Contents

CHAPTER 1 GENERAL

Section 1 GENERAL REQUIREMENT

1.1.1 Scope of application

1.1.1.1 Unless provided otherwise, this PART applies to ship-type floating installation.

1.1.1.2 In addition to the requirements of this PART, the stability, subdivision and load lines of floating installation are to comply with the other relevant requirements of the Administration.

1.1.1.3 For new ship-type floating installation, the design and layout of the compartments shall meet the relevant requirements for the application of Article 12A of Annex I to the MARPOL Convention in resolution MEPC.142 (54) adopted by the International Maritime Organization on March 24, 2006.

1.1.2 Categories and definitions of stability for floating installation

1.1.2.1 The requirements for stability are different according to the various conditions of floating installation. The stability of floating installation may be divided into the following two categories:

(1) Intact stability;

(2) Damage stability;

1.1.2.2 The intact stability of a floating installation is the ability of this floating installation to resist external overturning moments by means of its righting moment induced by the inclination of the floating installation.

1.1.2.3 The damage stability of a floating installation is the ability of a damaged unit, after loss of buoyancy due to external damage or internal flooding, to meet the minimum requirements of the Rules on floatation and stability in still water by means of the righting moment induced by the inclination of that damaged unit, and to keep itself from continuous flooding under the action of specified wind pressure.

1.1.2.4 For the stability, subdivision, load line, watertight integrity and weathertight integrity of other types of floating installation, in addition to the applicable requirements in this PART, the requirements in PART 3 of CCS *Rules for Classification of Mobile Offshore Floating Installation* are to be complied with.

1.1.3 Plans and information

1.1.3.1 Plans and information to be submitted for approval

When it is intended to build or modify a floating installation to be classed with CCS, the following plans and information are to be submitted in quadruplicate to CCS for approval before commencement of construction. The scope of submitted plans and information may be required to broaden for approval if considered necessary by CCS.

(1) Intact stability calculations;

(2) Damage stability calculations;

(3) Freeboard calculations, if applicable;

(4) Load line marks and scale;

(5) Calculations and curves for permissible height of center of gravity;

(6) Arrangement of watertight and weathertight doors, scuttles and other openings together with their watertight and weathertight closing appliances;

(7) Extent of external watertight and weathertight integrity, if applicable;

(8) Plans and information to be submitted for information:

① Lines plan;

② Hydrostatic curves;

③ Cross curves of stability;

④ Capacity plan;

⑤ Plan of watertight boundaries of spaces.

CHAPTER 2 STABILITY

Section 1 INCLINING TEST

2.1.1 General requirements

2.1.1.1 An inclining test is to be required for each floating installation when the installation is as near to completion as possible, so as to determine accurately the light ship data (lightweight and position of centre of gravity).

2.1.1.2 The results of the inclining test, or lightweight survey and inclining experiment adjusted for weight differences, are to be submitted to CCS for approval before being included in the operating manual.

2.1.1.3 A record of all changes to machinery, structure, outfit and equipment that affect the light ship data, is to be maintained in the operating manual or a light ship data alterations log and be taken into account in daily operations.

2.1.1.4 Inclining test is to be performed on newly-built floating installation or those undergoing some refitting. However, if the following conditions are met and consent of the Administration is obtained by CCS, an inclining test can be exempted for newly-built installation and replaced by the weight checking result for the refitted installation:

(1) Newly-built or refitted ship-type floating installation: when the light displacement deviation with newly-built floating installation (or sister floating installation) or installation before refitting is less than 1% for ship of 160 m long or above and less than 2% for ship of 50 m long or below (intermediate ship length shall be determined by linear interpolation; ship length mentioned here refers to the length defined in Article 3 of International Convention on Load Lines), and vertical position deviation for center of gravity of light ship is smaller than 0.5%Ls (Ls is the subdivision length of ship defined in II-1/2.1 of Convention for Safety of Life at Sea in 1974);

(2) Newly-built or refitted non-ship-type floating installation: when the lightweight deviation with the newly-built floating installation (or sister floating installation) or installation before refitting is less than 1%, and deviation for position of center of gravity is smaller than 1% of main horizontal dimensions.

2.1.1.5 Inclining test or lightweight survey is to be carried out in the presence of a CCS surveyor.

Section 2 RIGHTING MOMENT AND WIND HEELING MOMENT

2.2.1 General requirements

2.2.1.1 Righting moment curves and wind heeling moment curves related to the most critical axis, with supporting calculations, are to be prepared for a sufficient number of conditions covering the full range of draughts corresponding to afloat modes of operation, including those in transit conditions (as shown in Fig. 2.2.1.1), taking into account the maximum deck load and equipment in the most unfavorable position as applicable and the free surface of liquids in tanks. For the purpose of calculation it is to be assumed that the floating installation is floating free of mooring restraints. However, the possible detrimental effects of mooring restraints are to be considered.

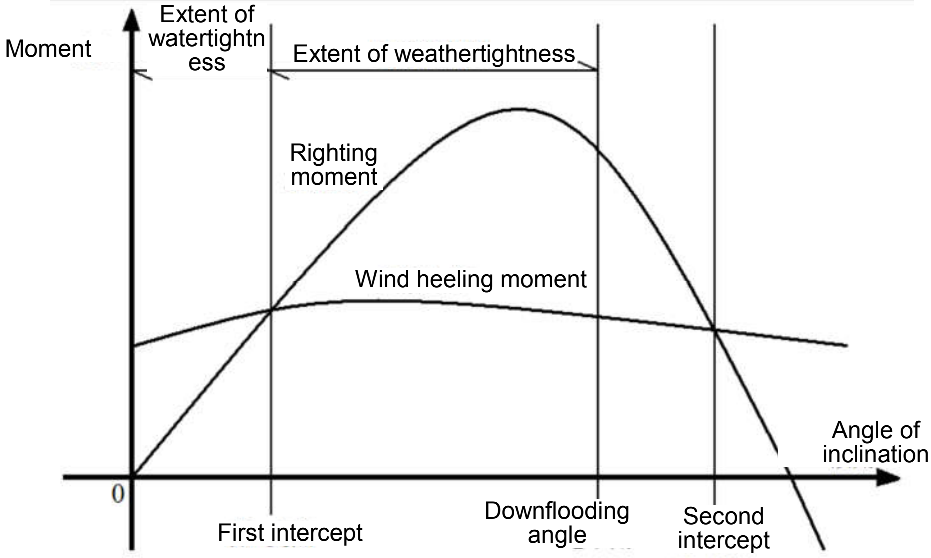


Figure 2.2.1.1

2.2.1.2 Where drilling equipment is of the nature that it can be lowered and stowed, additional wind heeling moment and righting moment curves may be required, and such data is to clearly indicate the position of such equipment.

2.2.1.3 The wind heeling moment curve is to be calculated for a sufficient number of heel angles to define the curve. For ship-type hulls, the curve may be assumed to vary as the cosine function of the vessel's heel angle.

2.2.1.4 The wind heeling moment Mq acting on floating installation is to be determined by the following formula:

$$M_q = FZ \qquad \text{kN·m}$$

Where:

F – wind force, in kN;

Z – lever for wind force, in m.

F in the above formula is defined as below:

$$F = C_h C_S SP$$

Where:

P – wind pressure, in kPa;

S – orthographic projection area of wind member under upright or heeling condition, in m^2;

C_h – height factor of wind member, which can be selected from Table 2.2.1.4 based on member height h (vertical distance from member centroid to designed still water level);

C_S – shape factor of wind member, which can be selected from Table 2.2.1.4 based on member shape or determined according to wind tunnel test.

P in the above formula is defined as below:

$$P = 0.613 \times 10^{-3} V^2 \qquad \text{kPa}$$

Where:

V – design wind velocity, in m/s.

Height Factor C_h and Shape Factor C_S **Table 2.2.1.4**

Height above sea level h(m)	Height factor C_h	Member shape	Shape factor C_S
0-15.3	1.00		
15.3-30.5	1.10	Sphere	0.4
30.5-46.0	1.20		
46.0-61.0	1.30	Cylinder	0.5
61.0-76.0	1.37		
76.0-91.5	1.43	Large plane (hull, deckhouse and smooth deck subface)	1.0
91.5-106.5	1.48		
106.5-122.0	1.52		
122.0-137.0	1.56	Clustered deckhouses or similar structures	1.1
137.0-152.5	1.60		
152.5-167.5	1.63	Steel rope	1.2
167.5-183.0	1.67		
183.0-198.0	1.70	Derrick/Tower	1.25
198.0-213.5	1.72		
213.5-228.5	1.75	Girder and truss exposed under deck	1.3
228.5-244.0	1.77		
244.0-259.0	1.79	Small parts	1.4
Above 259	1.80		

2.2.1.5 The lever for the wind force is to be taken vertically from the centre of lateral resistance of the underwater body to the centre of pressure of the areas subject to wind load. The effect of dynamic positioning thruster, if fitted, is to be reasonably and fully considered in the calculation.

2.2.1.6 Wind forces are to be considered from any direction relative to floating installation and the value of the wind velocity is to be as follows; for ship-type hull, the effect of lateral wind can be mainly considered:

(1) A minimum wind velocity of 36 m/s (70 kn) is to be used for transit conditions and normal operating conditions;

(2) A minimum wind velocity of 51.5 m/s (100 kn) is to be used for survival conditions;

(3) For floating installation with a service restriction notation, the wind velocity for transit conditions and normal operating conditions may be reduced as appropriate to not less than 25.8 m/s (50 kn), and the operating restriction is to be included in the operating manual.

2.2.1.7 Righting moment (RM) is the product of righting lever (RA) and displacement under corresponding draught (Δ), so is the relation between wind heeling moment (HM) and wind heeling lever (HA), viz.:

$$RM = RA \cdot \Delta; \quad HM = HA \cdot \Delta$$

$$RM = RA \cdot \Delta; \quad HM = HA \cdot \Delta$$

2.2.2 Wind tunnel tests

Wind heeling moments derived from wind tunnel tests on a representative model of floating installation may be considered as alternatives to the method given above. Such heeling moment determination is to include lift effects at various applicable heel angles, as well as drag effects.

Section 3 INTACT STABILITY

2.3.1 General stability criteria

2.3.1.1 The intact stability of ship-type floating installation in transit condition and each mode of operation is to meet the following criteria:

(1) Not considering the influence of wind speed: The intact stability shall meet the criteria requirements on the characteristics of the restoring arm curve in General Criteria of Chapter 2 of Part A of Code for Intact Stability, 2008 formulated by International Maritime Organization.

(2) Considering the influence of wind speed: The intact stability shall meet the requirements of the intact stability criteria for surface platforms in Chapter 3 of the Code for the Construction and Equipment of Mobile Offshore Drilling Units, 2009 of International Maritime Organization.

(3) In the full range of draughts corresponding to afloat modes of operation, the initial metacentric height corrected for free surface is to be not less than 0.15 m.

2.3.1.2 The capability is to be provided to change the mode of operation of floating installation to that of survival, with a sustained wind velocity of not less than 51.5 m/s, in a reasonable period of time for the particular unit. In all cases, the limiting wind velocities are to be specified and instructions are to be included in the operating manual for changing the mode of operation by redistribution of the variable load and equipment, by changing draughts, or both, and the approximate length of time required. For these operating procedures and the length of time required, both operating conditions and transit conditions are to be considered.

2.3.2 Alternative stability criteria

2.3.2.1 Alternative stability criteria may be considered acceptable provided an equivalent level of safety is maintained and if they are demonstrated to afford adequate positive initial stability. The following will be considered at least by CCS in determining the adequacy of alternative criteria submitted for review:

(1) Environmental conditions representing realistic winds (including gusts) and waves appropriate for worldwide service in various modes of operations;

(2) Dynamic response of a floating installation. Where appropriate, the analysis is to include the results of wind tunnel tests, wave tank model tests and nonlinear simulation. Any wind and wave spectra used are to cover sufficient frequency ranges to ensure that critical motion responses are obtained;

(3) Potential for flooding, taking into account dynamic responses and wave profile;

(4) Susceptibility to capsizing considering the floating installation's restoration energy, static inclination due to mean wind velocity and maximum dynamic responses;

(5) An adequate safety margin to account for uncertainties.

Section 4 DAMAGE STABILITY

2.4.1 General requirements

2.4.1.1 The calculation of damage stability is to be carried out in the worst anticipated service condition and it is to be assumed that the floating installation is floating free of mooring restraints. However, the possible detrimental effects of mooring restraints are to be considered.

2.4.1.2 In damage stability calculations, the permeability for each space or part thereof is to be in general as indicated in Table 2.4.1.2:

Permeability of Compartments   Table 2.4.1.2

Space	Permeability
Appropriated to stores	0.95
Occupied by accommodation	0.95
Occupied by machinery	0.85
Occupied by void compartment	0.95
Intended for liquids	0.00 or 0.95[1)]
Note 1: Whichever results in the more severe requirements.	

2.4.1.3 The ability to reduce the angle of inclination to compensate for damage incurred, by pumping out or by ballasting other compartments, etc., is not to be considered as alleviating the above requirements.

2.4.2 Damage stability criteria

2.4.2.1 When the influence of wind speed is not considered

Damage stability shall meet the requirements of Article 28 of Annex I of MARPOL, and be implemented with reference to the specific recommendations on how the requirement shall be applied to ship-type floating installation in IMO resolution MEPC.139 (53) adopted in 2005. The typical static stability curve corresponding to this requirement is shown in Figure 2.4.2.1.

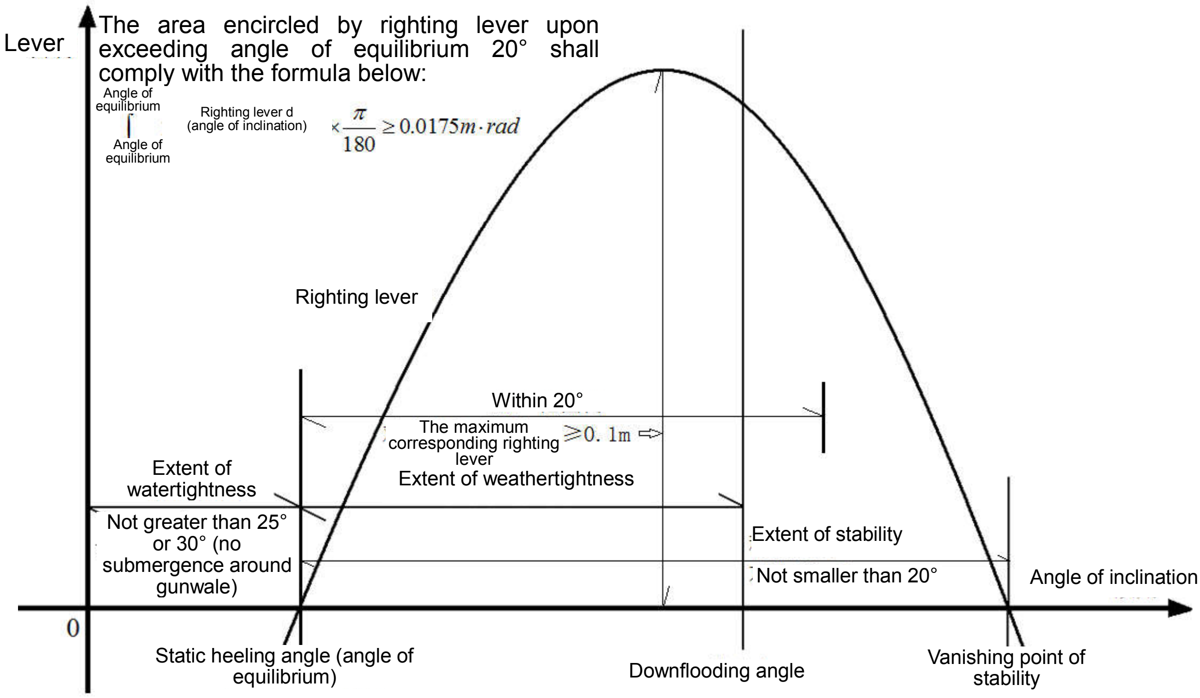


Fig. 2.4.2.1 Diagram of Static Stability Related to Article 28 in Annex I to MARPOL

2.4.2.2 With regard to the effect of wind velocity

(1) Enough freeboard, reserve buoyancy and stability are to be provided so that the final waterline is to be lower than the lower edge of any opening possible of further soaking when any compartment suffers from the damage specified in 2.4.2.2 (2) under any mode of operation or transit condition and under the action of wind heeling moment with a velocity of 25.8 m/s (50 kn) from any direction after the joint effect of sinking, longitudinal inclination and transverse inclination. That is, the actual extent of watertight is to be not less than the least required extent of watertight. See Fig. 2.4.2.2.

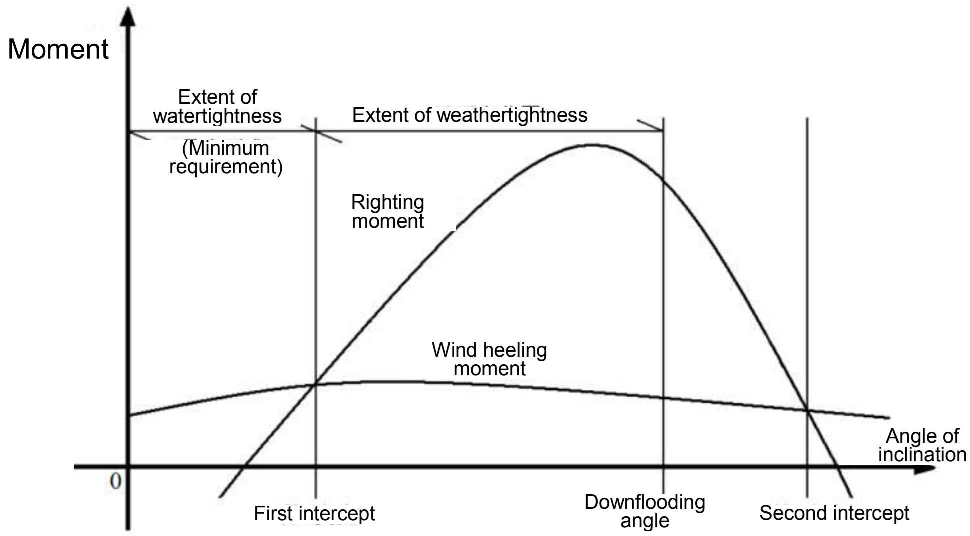


Fig. 2.4.2.2 Minimum Requirement for Extent of Watertight under Damage

(2) Extent of damage:

① In assessing the damage stability of ship-type floating installation, the following extent of damage is to be assumed to occur between effective watertight bulkheads:

- Horizontal penetration: 1.5 m;
- Vertical extent: bottom shell upwards without limit.

② The distance between effective watertight bulkheads or their nearest stepped portions which are positioned within the assumed extent of horizontal penetration is to be not less than 3.0 m; where there is a lesser distance, one or more of the adjacent bulkheads are to be disregarded.

③ If damage of a lesser extent than in ① results in a more severe condition, such lesser extent is to be assumed.

④ All piping, ventilating systems, trunks, etc., within this extent of damage referred to in ① are to be assumed damaged. Positive means of closure are to be provided at watertight boundaries to preclude the progressive flooding of other spaces which are intended to be intact.

2.4.3 Alternative stability criteria

Alternative stability criteria may be considered acceptable provided an equivalent level of safety is maintained. The following are to be considered at least in determining the acceptability of such criteria:

(1) The extent of damage as set out in 2.4.2.2 (2);

(2) The provision of an adequate margin against capsizing.

CHAPTER 3 LOADLINES

Section 1 GENERAL PROVISIONS

3.1.1 General requirements

3.1.1.1 The minimum freeboard of floating installation is in general to comply with the International Convention on Load Lines. The minimum freeboard of certain floating installation (e.g.: column-stabilized floating installation) which cannot be computed by the normal methods laid down by the International Convention on Load Lines is to be determined on the basis of meeting applicable intact stability, damage stability and structural requirements for transit conditions and the relevant operations while afloat.

3.1.1.2 The requirements of the International Convention on Load Lines with respect to weathertightness, watertightness and other requirements of decks, superstructures, deckhouses, doors, hatchway covers, other openings, ventilators, air pipes, scuppers, inlets and discharges, etc. are to be complied with for all floating installation. However, openings in the upper deck of column-stabilized floating installation are to be specially considered according to intact and damage stability requirements.

3.1.1.3 In general, heights of hatch and ventilator coamings, air pipes, door sills, etc., in exposed positions and their means of closing are to be determined by consideration of both intact and damage stability requirements.

3.1.1.4 For floating installation in intact afloat conditions, all openings which may be submerged before the first intercept as shown in Fig. 2.2.1.1 are to be fitted with watertight closing appliances, and all openings which may be submerged from the first intercept to the angle of inclination at which the required area under the intact righting lever curve is achieved are to be fitted with weathertight closing appliances.

3.1.1.5 Special consideration is to be given to the position of openings which cannot be closed in emergency cases (e.g.: air intakes for emergency generators), having regard to the intact righting lever curves and final waterline after assumed damage.

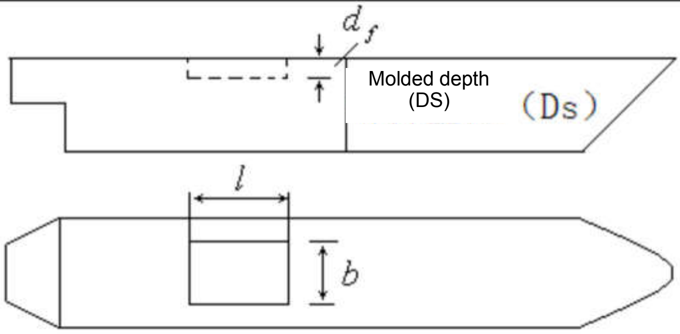
3.1.2 Load lines marks

3.1.2.1 The load line marks of an installation are to be complied with the provisions in Articles 4, 5, 6, 7 and 8 of International Convention on Load Lines, and be placed at locations on the structure visible to the person in charge of mooring or otherwise operating the installation.

3.1.2.2 Where it is necessary to assign a greater than minimum freeboard to meet intact and/or damage stability requirements, seasonal marks above the centre of the ring is not to be marked and any seasonal marks below the centre of the ring is to be marked. If a floating installation is assigned a greater than minimum freeboard at the request of responsible party, Article 6(6) need not apply.

3.1.3 Correction for moon-pools

3.1.3.1 Where open wells/recesses are arranged in the freeboard deck and such wells/recesses do not extend to sides of the floating installation, a correction equal to the volume of the well/recess to the freeboard deck divided by the waterplane area at 0.85 D_S is to be added for the lost buoyancy to the freeboard obtained after all other corrections have been applied, except bow height correction, as shown in Fig. 3.1.3.1. And where such freeboard corrected for the lost buoyancy is greater than the minimum freeboard determined by the molded depth measured to the bottom of the well/recess, this minimum freeboard may be applied. Free surface effects of the flooded well or recess are to be taken into account in stability calculations. (The molded depth calculated for freeboard (D_S) is the molded depth amid units (D) plus the thickness of the freeboard deck stringer plate.



Freeboard addition equal to $\frac{l \times b \times d_f}{A_W}$; A_W : waterplane area at 0.85Ds

Fig. 3.1.3.1

3.1.3.2 Where moon-pools are arranged within the hull in open communication with the sea, the volume of the moon-pool is not to be included in calculation of any hydrostatic properties.

An addition is to be made to the geometric freeboard if the moon-pool has a larger cross-sectional area above the waterline at $0.85D_S$ than below, corresponding to the lost buoyancy. This addition for the excess portion above the $0.85D_S$ waterline is to be made as prescribed in 3.1.3.1 for wells/recesses.

If an enclosed superstructure contains part of the moon-pool, deduction is to be made for the effective length of the superstructure.

3.1.3.3 The procedure described in 3.1.3.1 or 3.1.3.2 is to apply in cases of small notches or relatively narrow cut-outs at the stern of the floating installation.

3.1.3.4 Narrow wing extensions at the stern of the floating installation is to be considered as appendages and excluded for the determination of length (L) and for the calculation of freeboards.

Section 2 ASSIGNING OF LOAD LINES

3.2.1 Ship-type floating installation

In general, load lines are to be assigned to ship-type floating installation as calculated in accordance with the provisions for freeboard of category B ships in International Convention on Load Lines, and comply with all conditions for assessing freeboard therein.

If the minimum assessed freeboard is lower than the provisions on minimum freeboard of category B ship in International Convention on Load Lines, it can be assigned and calculated according to such provisions on category A ship therein, under the premise that all requirements on freeboard assessing of category A ship must be strictly met, esp. relevant contents in Articles 26 and 27 in Annex I to it.

3.2.2 Non ship-type floating installation

3.2.2.1 If geometric freeboard of non ship-type floating installation cannot be calculated according to provisions in International Convention on Load Lines (e.g.: column-stabilized and cylindrical floating installation), it is to be determined on the basis of meeting applicable intact stability, damage stability and structural requirements for transit conditions and the relevant operations while afloat.

3.2.2.2 If geometric freeboard of non ship-type floating installation can be calculated according to provisions in International Convention on Load Lines, it is to be calculated in accordance with the provisions for freeboard of category B ships in International Convention on Load Lines by reference to the requirements in Chapter 3 of PART 3 of CCS *Rules for Classification of Offshore Floating Installation*.

CHAPTER 4 WATERTIGHT AND WEATHERTIGHT INTEGRITY

Section 1 GENERAL PROVISIONS

4.1.1 General requirements

4.1.1.1 The number of openings in watertight subdivisions is to be kept to a minimum compatible with the design and proper working of the floating installation. Where penetrations of watertight decks and bulkheads are necessary for access, piping, ventilation, electrical cables, etc., arrangements are to be made to maintain the watertight integrity of the watertight deck and bulkheads.

4.1.1.2 Where valves are provided at watertight boundaries to maintain watertight integrity, these valves are to be capable of being remotely operated from a pump room or other normally manned space, a weather deck, or a deck which is above the final waterline after flooding, with valve position indicators provided at the remote control station. In the case of a column-stabilized installation this would be the central ballast control station.

4.1.1.3 The closing appliances required to maintain watertight integrity are to have strength, packing and means for securing which are sufficient to maintain watertightness under the design water pressure of the watertight boundary under consideration.

Section 2 OPENINGS RELATED TO WATERTIGHT INTEGRITY

4.2.1 Internal openings

4.2.1.1 Doors and hatch covers required for watertight integrity which are used during the operation of the installation while afloat are to be capable of being remotely controlled from the central ballast control station as well as being operable locally from both sides of the bulkhead. Open/shut indicators are to be provided at the control station. In addition, the doors provided to ensure watertight integrity of internal openings used at sea is to be sliding watertight type, and give audible and visual alerts when shut. The engines, controls and indicators are to function well in the case of main power failure. Special consideration is to be given to reducing the effect arising from failure of control systems. Each power-driven watertight sliding door is to be provided with an independent manual mechanical device which can be used to open or close the door manually from any side of the door.

4.2.1.2 The means to ensure the watertight integrity of internal openings which are intended only to provide access for inspection and are kept permanently closed during the operation of the floating installation, while afloat, is to comply with the following:

(1) A signboard to the effect that the opening is always to be kept closed while afloat is to be affixed to each such door or hatch cover; however, manholes fitted with close bolted covers need not be so marked;

(2) Opening and closing of such doors or hatch covers are to be noted in the floating installation’s logbook, or equivalent;

4.2.2 External openings

4.2.2.1 External openings fitted with appliances to ensure watertight integrity, which are used during operation of the floating installation while afloat, are not to submerge when the installation is inclined to the first intercept of the righting moment and wind heeling moment curves in any intact or damaged condition. These openings include air pipes, ventilators, ventilation intakes and outlets, non-watertight hatches and weathertight doors. Openings that are normally closed and fitted with appliances to ensure weathertight integrity, such as side scuttles of the non-opening type, manholes and small hatches, may be submerged. Small hatches, normally used for access by personnel, are to be closed by approved quick-acting watertight covers of steel or equivalent material. An allever system (e.g. light signals) is to be arranged showing personnel, both locally and at a central position, whether the covers in question are open or closed. In addition, a signboard to the effect that the closing appliance is to be closed while the installation is afloat, and is only to be used temporarily, is to be affixed to each such cover. Such openings are not to be regarded as emergency exits.

4.2.2.2 External openings fitted with appliances to ensure watertight integrity, which are kept permanently closed while afloat, are to comply with the requirements of 4.2.1.2.

4.2.2.3 Where flooding of chain lockers or other buoyant volumes may occur, the openings to these spaces are to be considered as flooding points in stability calculations.

Section 3 EXTERNAL OPENINGS RELATED TO WEATHERTIGHT INTEGRITY

4.3.1 General requirements

4.3.1.1 External openings of which the lower edge is submerged, such as air pipes, ventilators, ventilation intakes and outlets, non-watertight side scuttles, small hatches, companionways and doors are to be fitted with suitable weathertight closing appliances in the following two cases:

(1) The floating installation in intact afloat condition is inclined within the range from the angle of inclination corresponding to the first intercept in Fig.2.3.1.1 to an angle complying with the relevant requirements of 2.3.1.1 (2) ①;

(2) Column-stabilized floating installation is to comply with relevant applicable requirements in Chapter 4 of PART 3 of CCS *Rules for Classification of Mobile Offshore Units*.

4.3.1.2 A signboard to the effect that the opening is always to be kept closed while afloat is to be affixed to external openings fitted with appliances to ensure weathertight integrity, which are kept permanently closed while afloat.