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RULES

FOR THE CLASSIFICATION, CONSTRUCTION AND EQUIPMENT OF FLOATING OFFSHORE OIL-AND-GAS PRODUCTION UNITS

НД No 2-020201-009-E

2009

Rules for the Classification, Construction and Equipment of Floating Offshore Oil-and-Gas Production Units (FPU) of Russian Maritime Register of Shipping have been approved in accordance with the established approval procedure. The date of coming into force of the present Rules is 1 July 2009.

The Rules set forth specific requirements for FPU, consider the recommendations of the IMO Code for the Construction and Equipment of MODU, as adopted by the IMO Assembly on 19 October 1989 (Resolution A.649 (16)), take account of international practice of FPU construction and operation, requirements of the rules of the IACS members, international standards, as well as experience of Russian Maritime Register of Shipping relating to the classification and construction of ships, mobile offshore drilling units and fixed offshore platforms, stated in the relevant Rules.

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CLASSIFICATION AND CONSTRUCTION OF FLOATING OFFSHORE OIL-AND-GAS PRODUCTION UNITS (FPU)

PART I. CLASSIFICATION

1 GENERAL

1.1 APPLICATION

1.1.1 These Rules for the Classification, Construction and Equipment of Floating Offshore Oil-and-Gas Production Units (FPU)[1] cover the following types of self-propelled and non-self-propelled floating offshore structures:

floating production, storage and offloading unit (FPSO);

floating production and offloading unit (FPO);

floating storage and offloading unit (FSO);

single point moorings (SPM).

Mobile offshore drilling units, fixed offshore platforms and drilling ships shall meet the requirements of the Rules for the Classification, Construction and Equipment of Mobile Offshore Drilling Units and Fixed Offshore Platforms[2] of the Russian Maritime Register of Shipping[3].

1.1.2 Technical requirements apply to machinery, arrangements, instruments and equipment installed on floating offshore structures except for structures, machinery, arrangements, instruments and equipment of systems for production, treatment and processing of hydrocarbons.

1.1.3 The equipment, machinery and piping of the structure, which ensure its operation as a floating offshore structure, shall meet the requirements of the Rules for the Classification and Construction of Sea-Going Ships[4] and the MODU/FOP Rules of the Register to the extent that they are applicable and sufficient unless otherwise specified.

The definitions and explanations relating to the equipment, machinery and piping are specified in the relevant parts, sections and chapters of the RS Rules, and also in this Section.

1.1.4 The materials, products, welding and inspection of welded joints used for hull structures, machinery and equipment parts shall comply with the

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[1] Hereinafter referred to as “the FPU Rules”.

[2] Hereinafter referred to as “the MODU/FOP Rules”.

[3] Hereinafter referred to as “the Register”.

[4] Hereinafter referred to as “the RS Rules”.

RS Rules and the MODU/FOP Rules to the extent that they are applicable and sufficient.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 For the purpose of the FPU Rules, the following definitions have been adopted.

Bridle is a chain cable connecting a ship or a mooring buoy to an anchor.

Combined bridle is a bridle with intermediate lengths of chains (lengths between an inboard end lengths of chains and the anchor one) replaced with the wire rope ones.

Upper deck is the uppermost continuous deck extending the full length of the FPU.

Swivel is a rotating device which provides the transportation of hydrocarbons, water, gas, as well as electric power, signals, etc. to the FPU.

Accommodation area is the FPU area used for attendants accommodation.

Hull is a watertight structure which ensures the FPU strength, buoyancy, stability and unsinkability. The hull strength shall be sufficient to withstand external design loads without undergoing destruction and permanent deformation.

Ice strake is the part of the FPU hull shell plating capable of withstanding ice loads.

Superstructure is a decked structure on the upper deck extending from side to side or with the side plating not being inboard of the shell plating more than 4 per cent of the FPU breadth.

Compartment is the part of the internal hull space bounded by shell plating, watertight bulkheads, decks and platforms.

Productive swivel is a swivel joint for pipes with a special seal.

Floating production, storage and offloading unit (FPSO) is a floating offshore self-propelled or non-self-propelled ship-, pontoon- or otherwise-shaped structure intended for oil production, processing, storage and offloading.

Floating storage and offloading unit (FSO) is a floating offshore self-propelled or non-self-propelled ship-, pontoon- or otherwise-shaped structure intended for oil intake, storage and offloading.

Floating Single point mooring (FSPM) is a floating offshore structure intended for mooring tankers or FPU and for offloading at sea or at anchorage.

Design ambient temperature (DAT) is the minimum average daily air temperature in degrees Celsius (C°), which can take place during a five-year period of operation on the routs passing in the most unfavourable area of FPU operation as regards cooling conditions.

Deckhouse is a decked structure on the upper deck or superstructure deck with its side plating, on one side at least, being inboard of the shell plating more than 4 per cent of the FPU breadth.

Process area is the FPU area wherein the equipment for production, processing and offloading is installed.

Turret is a cylindrical or conical device located in the special hull trunk of FPU or on a cantilever providing the intake and piping of formation fluid, having position mooring system and allowing FPU maneuvering around.

2 CLASS OF FPU

2.1 GENERAL

2.1.1 Floating offshore structures are covered by the requirements of 2.1, Part I "Classification" of the RS Rules considering a ship as a floating offshore structure of any type.

2.2 CLASS NOTATION

The class notation assigned by the Register to a floating offshore structure consists of the character of classification and distinguishing marks and descriptive notations defining design and purpose of a floating offshore structure.

2.2.1 The character of classification assigned by the Register to a floating offshore structure comprises distinguishing marks:

KM⊛, KM★, (KM)★ – for self-propelled floating structures;

KE⊛, KE★, (KE)★ – for non-self-propelled floating structures with the total power output of prime movers 100 kW and upwards;

K⊛, K★, (K)★ – for other non-self-propelled floating structures.

2.2.2 Depending on the Rules on the basis of which a floating structure was surveyed, and on the classification society which carried out the survey, the character of classification is established as follows:

.1 floating structures built according to the RS Rules and surveyed by the Register are assigned a class notation with the character of classification: **KM⊛**

or **KE⊛** or **(K)⊛** (see 2.2.1);

.2 floating structures which were, as a whole (or their hull, machinery installation, machinery, equipment), built and/or manufactured according to the Rules of another classification society recognized by the Register and surveyed by that society during their construction and manufacture, when classed with the Register, are assigned a class notation with the character of classification: **KM★** or **KE★** or **K★** (see 2.2.1);

.3 floating structures which were, as a whole (or their hull, machinery installation, machinery, equipment), built and/or manufactured without being surveyed by a classification society recognized by the Register or without any survey of a classification society at all, when classed with the Register, are assigned a class notation with the character of classification: **(KM)★** or **(KE)★** or **(K)★** (see 2.2.1);

.4 floating structures, for which their design does not permit the character of classification out of those listed in 2.2.2.2, are assigned a class notation with the character of classification: **KM★** or **KE★** or **K★**.

This also applies when floating structures change a class to the Register from one of the IACS Member Societies. The possibility of such a change is subject to special consideration by the Register Head Office in each case.

2.2.3 Ice category marks.

Ice category marks are assigned to self-propelled FPU in compliance with the requirements of 2.2.3, Part I "Classification" of the RS Rules.

For non-self-propelled FPU ice category marks are omitted in the class notation, but may be entered in column "Other characteristics" of the Classification Certificate.

2.2.4 Subdivision distinguishing marks.

Floating structures complying with the applicable requirements of Part V "Subdivision" in case of flooding any one compartment or any two adjacent compartments over the entire length of the floating structure in case of design side damage are assigned the subdivision distinguishing mark 1 or 2 added to the character of classification, respectively.

2.2.5 Distinguishing marks for restricted areas of operation.

If a floating structure is designed to operate in a particular area and the maximum loads due to wind, waves, ice, currents, earthquakes, etc. are considered, these areas and loads are indicated in the Classification Certificate.

2.2.6 Distinguishing automation marks.

The floating structures fitted with automation equipment meeting the requirements of Part XV "Automation" are assigned one of the following distinguishing marks added to the character of classification, namely:

.1 AUT1 – where the automation extent is sufficient for the FPU machinery installation operation with unattended machinery spaces and main machinery control room;

.2 AUT2 – where the automation extent is sufficient for the FPU machinery installation operation by one operator in the main machinery control room with unattended machinery spaces;

.3 AUT3 – where the automation extent is sufficient for the FPU machinery installation operation with the main machinery power output not more than 2250 kW is sufficient for the machinery installation operation with unattended machinery spaces and the main machinery control room;

.4 AUT1-C, AUT2-C or **AUT3-C** – where automation is based on computers or programmable logic controllers (PLC) meeting the requirements in Section 5, Part XV "Automation";

.5 AUT1-ICS, AUT2-ICS or **AUT3-ICS** – where automation is made with the use of a computerized integrated monitoring and control system meeting the requirements of Section 5, Part XV "Automation".

2.2.7 Distinguishing marks for floating structures fitted with a dynamic positioning system.

If a floating structure is fitted with a dynamic positioning system complying with the requirements of Section 8, Part XV "Automation"of the RS Rules, one of the following marks: **DYNPOS-1, DYNPOS-2** or **DYNPOS-3** is added to the character of classification, depending on the redundancy of the dynamic positioning system.

2.2.8 Distinguishing marks for floating structures fitted with an automated position mooring system.

2.2.8.1 If a floating structure is fitted with an automated position mooring system complying with the requirements of Section 8, Part XV "Automation" of the RS Rules, the distinguishing mark **POSIMOOR** is added to the FPU character of classification.

2.2.8.2 If a floating structure is fitted with an automated thruster assisted position mooring system, complying with the requirements of Section 9, Part XV "Automation" of the RS Rules, with the use of thrusters, the mark **POSIMOOR-TA** is added to the FPU character of classification.

2.2.9 Descriptive notation in the class notation.

Floating structures complying with a definite scope of the requirements of the FPU Rules taking account of their structural particulars and service conditions are assigned the appropriate descriptive notation added to the character of classification which reflects specific feature of the floating structure:

FPSO – Floating Production, Storage and Offloading unit;
FPO – Floating Production and Offloading unit;
FSO – Floating Storage and Offloading unit;
FSPM – Floating Single Point Mooring;
SSPM – Stationary Single Point Mooring.

3 TECHNICAL DOCUMENTATION

3.1 General provisions pertinent to the review and approval of technical documentation on FPU, materials and products are given in Section 3 Part I "Classification" of the RS Rules and in Section 4, Part I "Classification" of the MODU/FOP Rules.

3.2 The technical design and detail design documentation, as well as working documentation for FPU under construction shall be submitted to the Register for review and approval in accordance with the requirements of Section 3, Part I "Classification" of the RS Rules and Section 4, Part I "Classification" of the MODU/FOP Rules to the extent applicable to floating structures.

3.3 Technical documentation reflecting the specific feature of FPU shall be additionally submitted, namely:

area and conditions of operation, anchorage system (in accordance with 4.1.2 to 4.1.12, Part I "Classification" of the MODU/FOP Rules);

drawings and diagrams of an offloading system, hull structures in way of production complexes, of a turret, torch, an integrated automatic control system, a mooring arrangement, helideck equipment.

3.4 Prior to the commencement of work on conversion or reconstruction of FPU, technical documentation for those parts of the hull, machinery and equipment of FPU, which are liable to conversion or reconstruction shall be submitted to the Register for review.

3.5 When fitting new machinery or arrangements on FPU in operation, which meet the requirements of the FPU Rules, and which differ substantially from those fitted initially, the additional technical documentation concerning the items of new equipment shall be submitted to the Register for review.

3.6 Upon completion of construction, trails and commissioning of FPU, the final documentation shall be submitted to the Register.

The amount of the documentation and the order of its submission shall be agreed upon with the Register prior to completion of the FPU construction.

4 SURVEY PROCEDURE AND SCOPE

4.1 Survey is an integral part of technical supervision, including the following:

checking availability of approved technical documentation on the items of technical supervision;

checking availability of the Register documents, recognized and competent organizations or persons on the items of the technical supervision;

examinations including (where necessary) openings-up and dismantling;

participation in measurements and tests;

assessment of the measurements and tests results;

drawing-up, issue and endorsement, renewal and extension of the Register documents.

4.2 Survey is carried out in compliance with the requirements of Section 2 of the General Regulations for the Classification and Other Activity, Section 3, Part I "Classification" of the MODU/FOP Rules, and of the Rules for the Classification Surveys of Ships in Service to the extent that is practicable and reasonable, unless otherwise specified.

4.3 The following types of surveys are performed by the Register:

initial survey during construction under the Register supervision;

initial survey during construction under the supervision of another classification society (ACS) or any other competent body, or without any supervision at all;

periodical surveys which are divided into:

special surveys;

annual surveys;

drydocking surveys;

intermediate surveys;

occasional surveys.

4.4 Prior to each survey the Survey Program, which takes into account the technical condition of FPU structures and includes the specific instructions on survey performance, shall be developed and approved by the Register.

4.5 Special surveys for class renewal shall be carried out at intervals not exceeding 5 years.

4.6 Annual surveys for class confirmation shall be carried out within 3 months before and after each anniversary date of the Classification Certificate.

4.7 Drydocking surveys of the underwater part of the unit (if practicable) shall be carried out as part of initial, special and intermediate surveys at 30±6 months intervals, but at least two times within a 5 year period of Classification Certificate validity.

The survey of the FPU underwater part the docking of which is impracticable shall be carried out once in 10 years as part of the Survey Program. The survey shall be carried out by means of underwater television, underwater photography, remotely operated submersibles and instrumentation for assessment of technical condition of the hull, anchors and anchor chain cables.

4.8 Intermediate surveys are carried out instead of the second or third annual survey.

4.9 Occasional surveys of FPU or their components are carried out:

during repairs and modernization;

after conservation;

after each storm when a wave height at the FPU location has exceeded a design height, as well as after accidents which could impact the FPU structural integrity or unsinkability.

PART II. HULL

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of this Part of the FPU Rules apply to steel welded FPU of 12 m to 250 m in length which main dimensions ratios do not exceed those given in Table 1.1.1.

Table 1.1.1

L/D	*B/D*
20	4

Main dimensions ratios of floating single point moorings are not regulated.

1.1.2 FPU which dimensions do not comply with those given in Table 1.1.1 are subject to special consideration by the Register.

1.2 GENERAL REQUIREMENTS

1.2.1 The FPU ship-shaped hull shall meet the requirements of Part II "Hull" of the RS Rules and additional requirements set forth in the FPU Rules. Structural members which are not regulated by the RS Rules may be covered by the MODU/FOP Rules.

The hull of column-stabilized FPU, tension leg FPU and self-elevating FPU shall meet the requirements of Part II "Hull" of the MODU/FOP Rules.

1.2.2 All structures regulated by this Part of the FPU Rules are subject to the Register survey. For this purpose an access shall be provided for their survey.

The FPU hull structures are covered by the provisions, which specify the scope of survey, given in Section 2 of the General Regulations for the Classification and Other Activity of the RS Rules, and in 1.3, Part II "Hull" of the MODU/FOP Rules.

1.2.3 The scantlings of FPU hull structural elements are regulated based on the FPU Rules design loads, calculation methods and safety factors with due regard to corrosion allowance.

1.2.4. Derivation of the hull structural elements scantlings is based on structural idealization using beam models subject to bending, shear, longitudinal loading and torsion having regard to the effect of adjacent structures.

1.3 DEFINITIONS AND EXPLANATIONS

1.3.1 The definitions and explanations relating to the FPU hull are given in Part I "Classification" and Part II "Hull" of the RS Rules and in Part I "Classification" of the FPU Rules.

1.3.2 For the purpose of this Part, the following definitions have been adopted.

Special structural elements are those which ensure the overall strength of the structure and are subject to the highest level of stress due to total and local loads including alternate ones. In most cases these members ensure the fatigue strength of the hull.

Primary structural elements are those which ensure the overall strength of the structure and integrity (if required proceeding from service conditions), sa well as those whose importance is due to their role in the attendants safety ensurance.

Secondary structural elements are those which, when damaged, do not substantially impair the safety of the technical construction.

2 MATERIALS

2.1 Materials applied for the FPU hull structures shall meet the requirements of Part XIII "Materials" of the RS Rules, Part XII "Materials" of the MODU/FOP Rules and Part XIII "Materials" of the FPU Rules.

2.2 The steel for hull structure components, including those which are open to the long-term exposure of low temperatures, shall be selected in accordance with 1.2.2 and 1.2.3, Part II "Hull" of the RS Rules and 1.5.1, Part II "Hull" of the MODU/FOP Rules, as applicable.

Where any other recommendations are unavailable, the minimum average daily air temperature T_{air} recorded during a ten-year period in the potential operational area of the FPU is assumed as the value of design temperature of ambient air.

2.3 Steel for the structures exposed to acid environment/hydrogen sulfide shall be highly corrosion resistant and have special anticorrosive protection.

2.4 The materials and products relating to the Register competence shall be manufactured according to the Register approved technical documentation.

2.5 The design characteristics of the FPU hull structures material assumed in the Rules are determinated in accordance with 1.1.4.3, Part II "Hull" of the RS Rules, and 1.5.1, Part II "Hull" of the MODU/FOP Rules, as applicable.

3 DESIGN LOADS

3.1 The design loads acting on FPU shall be determined with due regard to the environmental conditions of FPU operational area.

3.2 The basic parameters of the environmental conditions are determined in accordance with 2.2, Part II "Hull" of the MODU/FOP Rules, unless otherwise specified by the FPU Rules.

3.3 The design load value is defined in compliance with 2.2, Part II "Hull" of the RS Rules, and 2.3, Part II "Hull" of the MODU/FOP Rules.

3.4 The loads acting on the FPU structure are classified in accordance with 2.3.8, Part II "Hull" of the MODU/FOP Rules.

3.5 Wind loads shall be determined in compliance with 2.3.8 Part II "Hull" of the MODU/FOP Rules.

3.6 Wave load acting on FPU presents the system of mutually balanced hydrodynamic surface loads and inertial loads caused by the FPU motions in waves.

Loads shall be determined by the calculation procedure taking the FPU motions and the random character of waves into consideration.

Wave loads acting on ship-shaped and pontoon-type FPU, as well as on single point moorings, shall be determined in compliance with 1.3, Part II "Hull" of the RS Rules.

Design loads for the longitudinal strength longitudinal strength assessment of ship-shaped and pontoon-type FPU, as well as of single point moorings, shall be determined in compliance with 1.4, Part II "Hull" of the RS Rules. Additionally to the loading conditions specified in 1.4.3.1, Part II "Hull" of the RS Rules, all actual possible loading and unloading with oil products conditions for FPU shall be considered. For these conditions the wave bending moment is taken equal to 0,1 of the bending moment, determined in compliance with 1.4.4, Part II "Hull" of the RS Rules.

The value of hull section modulus in the assessments is determined taking into account the corrosion additions.

3.7 Current loads shall be determined according to 2.3.10, Part II "Hull" of the MODU/FOP Rules.

3.8 Ice loads.

Global ice loads in the horizontal plane are used for specifying requirements to provide the FPU proper positioning.

Local components of ice loads are used for evaluating the local strength of the FPU ice strake.

The level of the ice load design values is determined by the FPU ice category set in compliance with 2.2.3, Part I "Classification" of the RS Rules and 2.2.1, Part I "Classification" of the FPU Rules.

The global ice load acting on FPU P_{ice}, in kN, in the direction of its centre plane shall be determined by the formula:

$$P_{ice} = B\, h_{ice}^{1,2} \frac{1}{\Delta^{0,2}} K_h, \tag{3.8}$$

where $K_h = 580\ \{(\cos\beta_1)^{0,6} (\sin\varphi_1)^{0,7} [1 - 0{,}006\ (\beta_2 - 18)]\} \times [1 + 0{,}4\,\Delta L/L]\}$
L = FPU length, in m;
B = FPU breadth, in m;
ΔL = length of parallel middlebody, in m;
Δ = displacement, in thousand tons;
φ_1 = slope of stem, in deg.;
β_1 = slope of frame at the first station section, in deg;
β_2 = slope of frame at the midsection, in deg;
h_{ice} = ice thickness.

The global ice load value may be refined on the basis of field observation or laboratory research data, and also on the basis of using special methods approved by the Register.

Local ice loads acting on FPU with a hull shape corresponding to 3.10.1.2, Part II "Hull" of the RS Rules shall be determined in compliance with 3.10.3, Part II "Hull" of the RS Rules.

Where the FPU hull shape does not meet the requirements stated in 3.10.1.2, Part II "Hull" of the RS Rules, the ice loads determination is subject to special consideration by the Register.

3.9 Seismic loads shall be determined in compliance with 3.3.2.4, Part II "Hull"of the MODU/FOP Rules.

3.10 Deck loads shall be determined in compliance with 2.3.6 Part II "Hull" of the MODU/FOP Rules.

3.11 The design pressure on the watertight bulkhead shall be determined in compliance with 2.7.3.1, Part II "Hull" of the RS Rules.

3.12 Towing operation loads shall be determined in compliance with 2.3.13, Part II "Hull" of the MODU/FOP Rules.

3.13 Loads on the helideck shall be determined in compliance with 2.12.5.8, Part II "Hull" of the RS Rules and 2.5.6.1, Part II "Hull"of the MODU/FOP Rules.

3.14 Combination of loads shall meet the requirements of 2.3.11, Part II "Hull"of the MODU/FOP Rules. Combinations of loads which result in extreme stresses in the structure shall be taken as the design ones.

3.15 When evaluating accidental loads due to the ship-FPU collision, the following information shall be considered and taken into account:

ship displacement in full load and ballast condition;

fully loaded and ballast draught;

speed;

shape of stem and stern post, and of special side strengthenings;

presence of special cargoes and arrangements which may lead to especially severe consequences including damage to the environment.

3.15.1 The total impact energy E, in MJ, in the ship-FPU collision at a speed v, in m/s, shall be determined by the formula:

$$E = 0{,}5\,\Delta/g\,(1 + \alpha)\,v^2, \qquad (3.15.1)$$

where Δ = ship displacement in question;
$g = 9{,}81$ – acceleration due to gravity, in m/s^2;
α = parameter defining the effect of water added mass;
$\alpha = 0{,}1$ – for bow or stern impact;
$\alpha = 0{,}4$ – for side impact.

Where such data are unavailable, the minimum values of the impact energy shall be assumed as follows:

for bow or stern impact equal to 11 MJ;

for side impact equal to14 MJ.

3.15.2 Unless otherwise specified and parameters of ship motion in waves are not available, collision velocity due to the wave motion of a ship moored to FPU shall be obtained from the formula:

$$V = 0{,}5\,H_s, \text{ in m/s}, \qquad (3.15.2)$$

where H_s = significant wave height close to FPU, in m.

3.16 The falling objects accidental load, critical areas and structures where objects falling may occur, shall be determined for two stages of the FPU life cycle:

during construction;

in operation.

For each stage the most critical regions for FPU strength shall be estimated taking into account actual location of the structures and crane facilities.

3.16.1 Critical regions including unfavorable regions, where cargoes falling may occur, shall be identified based on the study of the actual region of the objects handling by crane taking into account the supplementary angle of incidence.

The supplementary angle of incidence with reference to the vertical is assumed as follows:

outdoors in operation equal to +5°;

outdoors during construction equal to +10°;

outdoors for both stages equal to +15°.

3.16.2 The impact energy E, in MJ, of falling objects shall be determined by the formula:

$$E = \eta P g H 10^{-3}, \quad (3.16.2)$$

where P = hooked cargo weight, in t;
$\eta = 0{,}95$ – for pallet and package cargoes;
$\eta = 1{,}0$ – for other types of cargoes.

The impact energy at sea level shall be assumed at least 5 MJ for cargo cranes with a lifting capacity more than 30 t. The impact energy for cranes with a greater lifting capacity shall be subject to special consideration by the Register.

.3 A velocity v for the object falling from a height H shall be determined by the formula:

$$v = \sqrt{2gH}. \quad (3.16.3)$$

3.17 The helicopter falling impact energy shall be obtained from the Formula (3.16.2), where H is determined considering the cloudiness frontiers common to the area.

3.18 The impact kinetic energy dispersal A may be evaluated using the "force-deformation" relationship.

In the assessment of the unit damages and the impact consequences, the finite element method (FEM) may be used with due regard to the plastic deformation of material. The criterion of structural adequacy of the unit at impact shall be considered as true for any type of the loads applied.

$$A \geq E. \quad (3.18)$$

3.19 The loads induced by position mooring systems, including a turret and used for calculating the hull strengthening in way of the turret supporting structures are determined as follows:

for FPU operating under ice conditions – by the Formula (3.18);

for FPU operating in open water – according to Section 3, Part III "Equipment, Arrangements and Outfit" of the RS Rules, as well as 6.6 of this Part of the FPU Rules.

3.20 The loads on hull structures in way of an internal turret, in the areas of securing the cantilever of an external turret, as well as in the areas of process equipment foundations are determined with due regard for the equipment weight, inertia forces in motions, etc.

4 STRENGTH CRITERIA

4.1 FPU shall be so designed that its structural strength meets the adopted criteria throughout the entire service life under the design loading conditions and the states defined in the FPU Rules.

4.2 As the basic safety requirement the following shall be considered:

$$Q_{ult} \geq K_s Q_{\Sigma max}, \tag{4.2}$$

where Q_{ult} = ultimate strength (load) of FPU in question at the most unfavourable local and global loads combination;

$Q_{\Sigma max}$ = maximum possible total value of constant and variable load components acting on the structure, and which may affect its ultimate strength;

K_s = safety factor for ultimate strength.

In structure design (without corrosion additions) the factor K_s is equal to 1,5. In safety assessment between special surveys (without corrosion additions before the following survey) the factor K_s is equal to 1,3.

4.3 If the requirements of 4.2 are met the buckling of the structural elements compressed shall be avoided taking the factor K_s not less than the above values.

In determining Q_{ult}, the potential deterioration wear of the structure and its elements by the end of the design service life or prior to the next survey scheduled shall be considered following the recommendations given below in Section 7.

5 STRENGTH CALCULATION PROVISIONS

5.1 Strength calculations shall be made for all FPU primary structural elements. As applied to the secondary structural elements, the safety factor K_s stated in 4.2 may be reduced by 10 per cent.

5.2 The strength calculations are divided in the following stages:

determination of values, characteristics and distribution of design global and local loads, their combinations for the specified design modes and states, as well as their simultaneous action rate;

verification for compliance of these loads combination with the strength conditions specified in 3.2 taking into account the nature of their action and the state of the unit structures exposed to those loads.

All the steps of the calculation are equally important, and the requirements for their accuracy and validity are the same as for the whole calculation.

5.3 The specific procedure for calculating the hull structure shall take into account its features. In developing the procedure, the technical theory of bending and limiting states of beams, plates and shells shall be applied. Where practicable, "Normative Regulations on Calculations of Sea-Going Ships Strength" given in the Collection of Regulating Documents of the Register, Book 11, 2002 shall be used.

5.4 The design model of a structure shall reflect its features – mutual location and the geometry of primary supporting members, section geometrical characteristics.

It is recommended to subdivide the model into subsystems of various levels where practicable.

6 RECOMMENDATIONS ON DESIGN OF SEPARATE STRUCTURES

6.1 Superstructures and deckhouses are generally designed as the structures, which do not contribute to ensuring general strength of the hull. Thus they are subject to the provisions given below. Otherwise the scantlings of the structural elements of superstructures and deckhouses shall be determined with due regard to all the provisions of Sections 4 and 5.

Superstructures and deckhouses shall be designed to meet the requirements of 2.12, Part II "Hull" of the RS Rules.

In any case, the breadth of the superstructures and deckhouses structural elements shall not exceed:

5 mm for side plating;

4 mm for deck plating.

Attachments of superstructures and deckhouses to the hull shall be designed considering the interaction forces of the above structures and providing smooth transitions where necessary.

6.2 Large openings in the hull decks and platforms shall be protected by strong casings.

6.3 The bulwarks construction shall be such that the bulwark contributes to longitudinal bending of the hull.

If the bulwark is designed as an ice/wave deflector, its construction and scantlings are subject to special consideration by the Register.

6.4 Supporting structures of cranes (deck reinforcements, supports, etc.) and securing device for crane in the stowed for sea position shall be submitted to the Register for approval.

6.5 Seatings for machinery and boilers shall meet the requirements of 2.11, Part II "Hull" of the RS Rules.

6.6 Hull structures in their attachments to the mooring and anchor arrangements shall be capable to withstand the forcers equal to the breaking load of ropes with the ultimate strength margin of at least 10 per cent.

6.7 Construction of helideck shall meet the requirements of Part II "Hull" of the MODU/FOP Rules

7 CALCULATON PROCEDURE FOR STRUCTURAL ELEMENTS WEAR

7.1 The thicknesses of FPU structural elements obtained from strength assessment shall be increased by corrosion addition.

7.2 Corrosion addition Δs, in mm, shall be obtained in accordance with 1.6, Part II "Hull" of the MODU/FOP Rules. The design corrosion rate shall be taken according to Table 7.4.

7.3 The structural surfaces inaccessible for survey, e.g. surfaces of turrets, shall be provided with the effective corrosion protection. Where it is impracticable, the design corrosion rate u shall be assumed not less than 0,2 mm/year, factor k equal to 1.

7.4 In strength assessment of FPU converted from ships, the thickness of structural elements shall be taken equal to the thickness determined during survey of the structures without corrosion addition.

Table 7.4

Structural element	Design corrosion rate, mm/year
1. External structures of hull, sides, ends in way of alternating waterlines	0,20
2. External hull structures outside of alternating waterlines	0,12
3. Sides of compartments filled with oil products: crude oil, light oil products; oil-water-hydrogen sulfide mixture; dark oil products	 0,20 0,30 0,10
4. Sides of compartments filled with seawater	0,20
5. Structures connected to the hull to provide FPU positioning	0,15
6. Sides of compartments filled with fresh water	0,15

8 STANDARDS FOR EVALUATION OF VIBRATION

8.1 Calculations of the main and local vibration of the hull, superstructures and deckhouses, as well as of the floating structure machinery and equipment vibration shall be carried out for the preliminary estimation at the design stage using the procedure approved by the Register.

Vibration standards shall be adopted according to 1.5, Part II "Hull" of the RS Rules.

Vibration standards for machinery and equipment shall meet the requirements of Part VII "Machinery Installations" of the RS Rules for the following conditions:

after the FPU construction or repair during commissioning;

during normal operation.

8.2 Vibrations shall be measured in the first FPU of a series and in single buildings. The procedure, scope and sequence of vibration measurement shall be approved by the Register.

8.3 After mooring tests and sea trails, a report on vibration shall be submitted to the Register. The requirements for the report are specified in 1.5.2, Part II "Hull" of the RS Rules.

PART III. EQUIPMENT, ARRANGEMENTS AND OUTFIT

1 GENERAL

1.1 APPLICATION

1.1.1 Floating offshore structures or units are covered by the applicable requirements of Part III "Equipment, Arrangements and Outfit" of the RS Rules and Part III "Equipment, Arrangements and Outfit of MODU/FOP" of the MODU/FOP Rules unless otherwise specified in this Part.

1.1.2 The requirements of this Part do not apply to the following equipment, arrangements and outfit:

industrial equipment used for drilling or associated operations;

equipment for formation fluid production;

equipment for liquid hydrocarbon treatment;

equipment for liquid hydrocarbon processing.

1.1.3 This Part contains the requirements for the equipment, arrangements and outfit which are specific for floating offshore structures.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 Definitions and explanations are given in the General Regulations for the Classification and Other Activity, Part I "Classification" and Part III "Equipment, Arrangements and Outfit" of the RS Rules, Part I "Classification" and Part III "Equipment, Arrangements and Outfit of MODU/FOP" of the MODU/FOP Rules, as well as in Part I "Classification" and Part II "Hull" of the FPU Rules.

1.2.2 For the purpose of this Part the following abbreviations have been adopted:

ACS – automated control system;

LHC (product) – liquid hydrocarbons, i.e. crude oil, liquefied gas with a flash point 60 °C and below, gas condensate, formation fluid, oil fuel, diesel oil;

TS – transport ship (tanker, gas carrier, supply vessel);

STL – submerged turret loading system;

MBL – minimum breaking load;

FEA – finite element analysis;

OCIMF – Oil Cmpanies International Marine Forum;

PLEM – pipeline end manifold;

SWL – safe working load;
APIRP – American Petroleum Institute. Recommended practice.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 General provisions on the technical supervision of equipment, arrangements and outfit are set forth in the General Regulations for the Classification and Other Activity and in Part I "Classification" of the RS Rules, Part I "Classification" and Part III "Equipment, Arrangements and Outfit of MODU/FOP" of the MODU/FOP Rules, as well as in Part I "Classification" of the FPU Rules.

1.3.2 Technical supervision covers the products included into equipment, arrangements and outfit of FPU and stated in the list given in 1.3, Part III "Equipment, Arrangements and Outfit" of the RS Rules to the extent which is reasonable for the particular type of FPU.

1.3.3 The items of equipment, arrangements and outfit listed in 1.3, Part III "Equipment, Arrangements and Outfit" of the RS Rules shall be monitored by the Register to meet the requirements of Part XIII "Materials" and Part XIV "Welding" of the RS Rules, as well as Part XIII "Materials" and Part XIV "Welding" of the FPU Rules.

1.3.4 The equipment, arrangements and outfit listed in Table 1.3.4 are subject to the Register technical supervision during FPU construction/conversion in accordance with the requirements of relevant sections and chapters of the RS Rules, MODU/FOP Rules, as well as the FPU Rules.

Table 1.3.4

Item	FPSO	SPM
1	2	3
Rudder and steering gear	(+)	-
Anchor arrangement	+	+
Position-keeping system	+	+
Mooring arrangement	+	+
Towing arrangement	+	+
Fendering equipment	+	+
Boarding arrangement	+	+
Signal masts	+	+
Cargo handling gear	+	+

Table 1.3.4 – continued

1	2	3
Openings in hull, superstructures and deckhouses and their closing appliances	+	+
Arrangement and equipment of spaces	+	+
Emergency outfit	+	+
Offloading system	+	+
N o t e . In brackets – for self-propelled units.		

1.4 GENERAL REQUIREMENTS

1.4.1 On the units intended for storage of flammable liquids with the flash point 60 °C and below no deck machinery shall be fitted directly on the decks being the top of cargo and fuel oil tanks, in compliance with 1.4.1, Part III "Equipment, Arrangements and Outfit" of the RS Rules.

1.5 MATERIALS AND WELDING

1.5.1 Steel products shall comply with the requirements of Part II "Hull" and Part XIII "Materials".

Materials for other items of equipment, arrangements and outfit shall meet the requirements specified in the design documentation approved by the Register, unless expressly provided otherwise in the FPU Rules.

1.5.2 Welding of structural elements of equipment, arrangements and outfit shall be performed in compliance with the requirements of Part II "Hull" and Part XIV "Welding".

1.6 DESIGN ACCELERATIONS DUE TO HEAVE AT SEA

1.6.1 The dimensionless accelerations due to heave at sea shall be applied when determining the load upon arrangements and equipment on the ship-shaped units of the unrestricted service and those restricted area of navigation **R1** given in 1.7, Part III "Equipment, Arrangements and Outfit" of the RS Rules.

1.6.2 With regard to non-ship-shaped units of other areas of navigation, accelerations may be applied different from those required herein which shall be substantiated by calculations approved by the Register.

2 RUDDER AND STEERING GEAR

2.1 GENERAL

2.1.1 The rudder and steering gear and the active means of the FPU steering shall meet the requirements of Section 2, Part III "Equipment, Arrangements and Outfit" of the RS Rules.

3 ANCHOR ARRANGEMENT

3.1 GENERAL

3.1.1 The anchor arrangement on self-propelled units shall meet the requirements of Section 3, Part III "Equipment, Arrangements and Outfit" of the RS Rules as applied to transport ships.

3.1.2 The anchor arrangement on manned FSPM shall meet the requirements of Section 3, Part III "Equipment, Arrangements and Outfit of MODU/FOP" of the MODU/FOP Rules.

3.1.3 The anchor arrangement on SSPM or unmanned FSPM may be of a temporary nature.

Taking into account the personnel, machinery and power source the temporary anchor arrangement shall provide:

unit anchorage during its fitting-out afloat (loading of solid ballast, systems testing);

unit position-keeping (additionally to the tug service) while holding anchorage in transit under conditions which severity is in excess of the permissible ones;

unit positioning and position-keeping during installation on the seabed.

3.1.4 Chain lockers and chain pipes shall be located outside the hazardous area. If such arrangement is impracticable, these structures shall be protected from gas penetration.

3.2 TEMPORARY ANCHOR ARRANGEMENT

3.2.1 General requirements.

3.2.1.1 The anchor arrangement may be fitted not only on the unit hull, but on the temporary overhang (exposed) platforms, and the individual items of the anchor arrangement (hawse pipes, chocks, connecting shackles etc.) may be located to be

used for other arrangements (towing, mooring etc.) taking into account the possibility of their further application in transit to the new operational area or for utilization.

3.2.1.2 The development and use of temporary anchor arrangement is subject to special consideration by the Register in each particular case. In so doing, the following shall be submitted:

data on the seabed, seismic activity and prevailing hydrometeorological conditions in the area;

necessary data and calculations defining the operation conditions of all the anchor arrangement elements;

arrangement plans showing temporary anchor arrangement location including anchors, anchor lines comprising chains, wire and synthetic fibre ropes or a combination of them, machinery and any other elements;

design calculation of anchor arrangements during the performance of particular operations.

3.2.2 Calculation principles for temporary anchor arrangement.

3.2.2.1 The anchor equipment of the unit shall be determined by special calculations based on the environmental conditions and corresponding loads during performance of specific operations, having regard for additional position-keeping and positioning of the unit provided by auxiliary tow order vessels.

The anchor equipment may be selected according to 3.1.5, 3.1.6, Part III "Equipment, Arrangements and Outfit of MODU/FOP" of the MODU/FOP Rules by the equipment number N_e determined by the formula:

$$N_e = K_1 K_2 \Delta^{2/3} + K_3 A, \qquad (3.2.2.1)$$

where K_1, K_2, K_3 = coefficients accounting for the hull shape, wave effect and wind conditions at the anchorage, respectively;

Δ = displacement volume of the unit during the operation, in m^3;

A = total windage projected area of the structures above the waterline on the plane normal to the horizontal projection of an anchor line, in m^2.

The coefficient K_1 is recommended to obtain from the ratio R/R', where R' and R are resistances of the submerged part of a conventional ship and a unit with the same displacements and towing speed, respectively.

The coefficients K_2 and K_3 shall be taken in compliance with Table 3.2.2, Part III "Equipment, Arrangements and Outfit of MODU/FOP" of the MODU/FOP Rules.

The Register may accept other values of coefficients provided it is proved that the proposed values are in agreement with the actual construction, service and repair conditions.

3.2.2.2 The anchor arrangement elements shall be designed taking into account 4.3.3, Part III "Equipment, Arrangements and Outfit of MODU/FOP" of the MODU/FOP Rules.

3.2.2.3 Safety factors for each particular element of the anchor arrangement are recommended to obtain similarly to anchor arrangements in accordance with 3.1.5 and 3.3.4, Part III "Equipment, Arrangements and Outfit of MODU/FOP" of the MODU/FOP Rules.

The rated forces for the particular elements of the anchor arrangement are determined based on the breaking load value for anchor lines meeting the requirements of 3.6, Part III "Equipment, Arrangements and Outfit" and 6.3, Part IX "Machinery" of the RS Rules.

3.2.3 Temporary anchor arrangement structure.

3.2.3.1 The unit is recommended to be provided with at least two anchors.

Temporary anchor arrangement shall generally include:

bower anchors;

anchor lines;

devices for securing and releasing the inboard end of the chain cable (senhouse slips etc.);

machinery for dropping and hoisting bower anchors and the unit positioning with the dropped anchors (where the anchor arrangement is used for the unit positioning);

stoppers ensuring the unit riding at anchors;

chain lockers or platforms for storage of anchor ropes and chain cables, and other special equipment necessary for a specific marine operation.

The number of separate anchor arrangement elements is determined by calculations. The need for provision of stoppers to secure the anchors for sea is subject to special consideration by the Register.

3.2.3.2 Hall's or Gruson's anchors and admiralty stocked anchors may be used as bower anchors.

3.2.3.3 Chains of various strength grades are recommended to be used as anchor lines. If specially justified with due regard for the short-term nature of operations, the chains may be replaced with wire and synthetic fibre ropes of adequate strength.

3.2.3.4 The anchor lines characteristics shall be determined on the basis of special calculations on the assumption that they will ensure the required holding power and anchor loading under specific conditions at the design environmental effects. The complete set of anchor lines shall meet the requirements of GOST 228 and Section 7, Part XIII "Materials" of the RS Rules. Where combination anchor lines are used, which include chain and rope inserts, the complete set shall ensure

the continuous rope tension (due to the weight of chain sections) to preclude formation of sheepshank knots on the rope inserts.

3.2.3.5 Each bower-anchor chain cable and rope shall be provided with a stopper intended for riding the unit at anchor. Where the length of the anchor lines is fixed and there is no need for position mooring the stopper may be replaced with the device for securing and releasing the inboard end of the chain cable.

The stoppers shall be supplemented with the devices for securing and releasing the inboard end of the anchor chain cables and ropes where the unit position mooring is necessary for its installation.

3.2.3.6 Laying of anchor lines shall provide for their free run when dropping or hoisting the anchors in compliance with the requirements of 3.6.3, Part III "Equipment, Arrangements and Outfit" of the RS Rules.

Chain lockers shall meet the requirements of 3.6.4, Part III "Equipment, Arrangements and Outfit" of the RS Rules.

The platforms for stowing chain cables or ropes shall be dimensioned and located so that they ensure the free stowage of the specified length of anchor chain cables using the unit cargo handling gear, the free lead of chain cables through the chain pipes and their free veering away when dropping the anchors.

3.2.3.7 If fitted with the proper equipment, the carriage, dropping and hoisting the anchors and anchor chain cables or ropes may be provided by the auxiliary tow order vessels.

3.2.3.8 Anchor machinery shall be fitted for dropping and hoisting the bower anchors, and also for position mooring during the unit installation. If there is no need for the unit position mooring, as well as where the carriage, dropping and hoisting of anchors are provided by the auxiliary tow order vessels, the unit may be the not equipped with anchor machinery.

The power of anchor machinery shall be determined based on the actual mass and overall characteristics of anchor equipment, the requirements for unit positioning, the conditions during operations performance etc.

Where the unit is provided with the anchor machinery, or the winches available on the unit are used for anchor and chain cable handling operations, these machinery shall meet the requirements of the RS Rules and MODU/FOP Rules. Where the auxiliary tow order vessels machinery is used for anchor handling operations, it shall be verified for compliance with the MODU/FOP Rules considering the characteristics of the unit anchor arrangement. Anchor machinery shall be designed to meet the requirements of 6.3, Part IX "Machinery" of the RS Rules.

3.2.3.9 A spare set of anchor equipment (anchor, anchor line and joining devices) is recommended to be provided on board the unit for the prolonged (more than a week) towings at sea.

4 POSITION-KEEPING SYSTEMS

4.1 GENERAL

4.1.1 The requirements of this Section apply to the systems intended for position-keeping of the unit afloat at a certain location with restriction of shiftings within the prescribed limits and ensuring normal conditions to perform technological processes at a site.

4.1.2 The requirements cover the following:

.1 anchoring systems which include anchors and flexible anchor lines;

.2 anchoring systems which include anchors and tension anchor lines;

.3 dynamic positioning systems;

.4 thruster assisted position mooring systems.

4.1.3 The position-keeping system including winches and chain stoppers having a source of ignition shall be located on the open deck outside the hazardous areas unless special measures are provided to avoid risk of ignition during normal operations and accidental disconnection.

4.2 POSITION MOORING SYSTEM

4.2.1 Position mooring system of the units shall provide their position-keeping:

under operational conditions at the design external loads and with a tied up transport ship (TS) (including condition with one anchor line broken at reduced safety factors meeting the requirements of 4.3.10 and 4.3.11, Part III "Equipment, Arrangements and Outfit" of the MODU/FOP Rules);

under extreme conditions without a tied up transport ship and at the stormy weather potential once in 100 years (including condition with one anchor line broken at reduced safety factors).

4.2.2 Position mooring system shall ensure the limitation of the unit horizontal movements at design conditions.

4.2.3 The laying out of anchor lines for the unit position-keeping shall not result in the limitations on the TS maneuvering and draught.

4.2.4 Position mooring system are divided by the way of position-keeping into the following:

type I: positioned with the anchor lines which ensure position-keeping above the specified seabed location being exposed to horizontal loads;

type II: positioned with the tension anchor lines which ensure both the position-keeping above the specified seabed location and the minimum changes of the distance from the structure bottom to the seabed being exposed to horizontal and vertical loads at the maximum depression (lowering) of sea level (due to waves, ebb-tide, natural level depression).

4.2.5 Multi-anchor (distributed) and single-anchor type I systems are recommended for position-keeping of the units in question.

4.2.6 Position mooring system shall be designed in compliance with Section 4, Part III "Equipment, Arrangements and Outfit of MODU/FOP" of the MODU/FOP Rules.

4.2.7 Position mooring system parameters are recommended to be determined using the step-by-step approach as follows:

determine the laying out, mass and number of anchors (anchor lines), the length, diameter and strength grade of bridles with the use of analogues taking into account the level of external loads due to natural factors and the distribution of sea depths at the position mooring system location;

determine the mass of anchors and the forces of anchor lines pretension;

calculate the maximum forces in bridles exposed to external loads due to the natural factors potential once in 100 years;

determine safety factors and compare them with the standard ones;

make the corrections of position mooring system parameters according to the comparison results and repeat the calculation if needed;

calculations shall be continued until the satisfactory precision of values of acting and permissible forces is reached.

4.2.8 When performing calculations for position mooring system the program system "ANCHORED STRUCTURES" having Type Approval Certificate issued by the Register is recommended.

4.2.9 The documentation meeting the requirements of 4.2.2 and 4.2.3, Part III "Equipment, Arrangements and Outfit of MODU/FOP" of the MODU/FOP Rules shall be submitted to the Register.

4.2.10 System design shall meet the requirements of 4.3, Part III "Equipment, Arrangements and Outfit of MODU/FOP" of the MODU/FOP Rules.

4.2.11 System equipment (winches, tensioning devices, fairleads and guiding devices) and system control stations shall meet the requirements of 4.4

and 4.8, Part III "Equipment, Arrangements and Outfit of MODU/FOP" of the MODU/FOP Rules, respectively.

4.3 ANCHORS

4.3.1 Depending on the seabed, pile, plate, suction, gravity, shot-driven and explosive-driven anchors, as well as ship anchors may be used for position-keeping of the unit.

4.3.1.1 Pile anchors are capable to withstand vertical and horizontal loads and are installed (embedded) using hammers, drilling and washout with a water jet under pressure.

4.3.1.2 Plate anchors are manufactured by welding of plate components, and they have high holding power in clay and silt seabed.

4.3.1.3 Suction anchors are caissons used in soft and medium hard soils, and are embedded by pumping out water from the caisson.

4.3.1.4 Gravity anchors are reinforced concrete/steel and concrete structures which holding power is equal to its weight in water along all directions.

4.3.1.5 Explosive-driven anchors are used in shallow water, and embedded into the seabed by a shot or a series of explosions and turned around by the anchor line tension towards the position corresponding to the maximum resistance to loading.

4.3.1.6 Ship anchors embedded during dragging are used for the grounds other than the hard ones.

4.3.2 Anchors are subdivided subject to:

direction of operation (all-around and directional);

operating principle (gravity, pile and circular);

material (steel and reinforced concrete);

design (solid, combined, pontoons, frames and composite).

Gravity anchors are subdivided subject to:

shape of cross-section (pyramid-shaped, segment, mushroom-shaped, plate-type and a "frog" with one or two knives);

mass: small (<50 t), medium (>50 t, but <100 t), large (>100 t, but <300 t) and very large (>300 t, but <900 t).

4.3.3 Characteristics of anchors shall be selected subject to the load applied, soil properties, safety factors for shear (1,05 – 1,3) and capsizing (1,1 – 1,4). In this case, anchor displacements while in operation shall be prevented and the requirements for the accuracy of anchor installation (normally 5 per cent of the sea depth unless the additional requirements for the installation accuracy are specified) shall be considered.

When selecting the anchor type, the characteristics of the facilities which may be used during the anchor transportation and installation shall also be considered.

4.3.4 The anchor mass shall be defined by the holding power value with due regard to a safety factor, which is assumed according to normative documents, and depends on the anchor type and shape, soil characteristics and effective loads.

4.3.5 Anchor holding power shall ensure its resistance to displacements and rotations exposed to external forces due to its design and the scheme of transmitting bridle-to-anchor forces.

4.3.6 The load transmitted to an anchor is defined by the value of a rated force on the bridle at the seabed level and the angle of its approach to the seabed surface which shall be determined by calculating the unit position-keeping system.

4.4 BRIDLES

4.4.1 Bridles intended for transmitting load to an anchor may consist of a chain cable, a wire rope, synthetic ropes or combinations thereof. Chain bridles, sometimes with the wire rope inserts, are generally used for position-keeping of large units.

4.4.2 Both chain cables according to GOST 228 and more strong chain cables of categories R3, R3S and R4 according to 7.2, Part XIII "Materials" of the RS Rules may be used. The latter are preferable due to their lesser weight at the same strength.

4.4.3 Bridle diameter is determined considering the maximum design load on the unit.

4.4.4 "Long" and "short" bridles may be used in the position mooring system. "Long" bridle means the one that has the section adjacent to an anchor which rests on the seabed within the entire range of design loads. "Short" bridle means the one that may be lifted off the seabed over its entire length at design loads.

4.4.5 For gravity reinforced concrete anchors, angle α between the bridle and the horizontal plane at the point of its securing to the anchor shall not exceed 15° to 20°. In this case, the vertical component of the force transmitted to the anchor and the corresponding reduction of its holding power shall be considered.

4.4.6 Suspended weight may be used for reducing the angle α and for increasing the damping properties of the bridle.

4.4.7 The bridle rigidity is defined as the ratio of the horizontal force increment to the initiated displacement of its top end. The rigidity depends on the location depth, bridle length, initial tension of the bridle and its linear weight.

4.5 CALCULATION BACKGROUND

4.5.1 Design external loads for the position mooring system design shall be determined in accordance with Section 3, Part II "Hull".

4.5.2 The unit response to external effects may conventionally be divided into four frequency ranges:

quasi-static or a zero frequency range determined by the sea level, averaged wind and current;

slowly varying (low-frequency) range induced by gust wind and second order wave loads (drift loads), and by current;

medium-frequency range determined by first order wave loads and diffraction;

high-frequency range (including heave, pitch and roll resonances) associated with higher order wave effects and resulted in the longitudinal and transverse vibrations of lines.

The first two may be conventionally considered as the static ones, while the rest two as the dynamic ones. When using the static approach, it is assumed that the line tension depends on the co-ordinates of the line ends only, while the dynamic one additionally considers the speed and accelerations thereof.

4.5.3 The following parameters are critical for units:

maximum and minimum tensions of lines;

horizontal, vertical and angular displacements of the unit and its accelerations due to wind, current and wave;

displacements of the unit movable joint of the main pipeline;

parameters affecting fatigue strength of the lines (moments of zero-, second– and fourth-order displacement spectra).

4.5.4 For prolonged holding of the bend and rotation angle of the bottom flexible assembly of the rigid pipe within 1° to 2°, it is recommended to ensure at first approximation the horizontal mean displacement (statics + drift) equal to 2 – 4 per cent of the sea depth under the unit bottom (the lesser figure refers to depths of 600 m to 1000 m, the greater one, to depths under 100 m; the values for depths of 100 m to 600 m are obtained by linear interpolation).

It is recommended to ensure at first approximation the maximum horizontal displacement (dynamics) under the bottom equal to 8 – 12 per cent of the sea depth with the same depth ratios in order to be within the limits for the angles of deformations of pipe slip joints due to surging, swaying and heaving motions, and also in order to ensure the angular oscillation amplitudes for flexible ground joint within 4,5° to 6°.

Where a flexible pipe is available, the permissible horizontal displacements are much greater (per cent of the depth under the bottom with the same depth ratios):

mean: 3–5 and 5–10;

maximum: 10-15 and 15-30.

4.5.5 In addition to the factors and external loads specified in Part II "Hull", the temperature of water and air, fouling, as well as all types of unit motions, and FSPM-FPU motions (heave, roll, pitch, sway, surge, yaw) shall be considered.

4.5.6 Various loading conditions of a storage (different amount of product and liquid ballast) shall be additionally considered for FSPM-FPU, and limiting mooring and offloading conditions, i.e. TS position-keeping conditions shall be calculated.

4.5.7 Considering the position mooring system particular response to resonance oscillations on the environmental effect frequencies, special attention shall be paid to the evaluation of the resonance oscillations in determining design loads, in particular:

sway and yaw motions of the moored TS;

surge motions of TS;

pitch motions of the hull, and FSPM-FPU which may cause the formation of "snakes" in slack chains;

heave motions of FSPM with the moored TS (or without it) which causes the change of the anchor line tension;

yaw of FSPM with the moored TS (or without it) including instantaneous loads on a tension anchor line.

In addition, the secondary factors which may initiate the resonance shall be considered:

head sea impact in calculating wave loads within a coastal strip in an splash zone (FSPM is fully in the splash zone);

change of the water particle velocities direction at the joint action of current and waves;

dynamic effects due to the vortex shedding at high current velocities.

4.5.8 Due to the complicated development of theoretical methods for such calculations, it is recommended to determine the motions and loading by model tests together with design methods. In doing so, the following shall be considered:

reduced effect of field dampening compared to the model test;

effect of fouling on wave resistance and inertia forces;

effect of resonance on anchor lines sagging.

4.5.9 Position mooring system shall be designed so that the sudden failure of any anchor line will not cause progressive failure of the remaining anchor lines and position-keeping system as a whole.

4.5.10 The position mooring system elements shall be designed with due regard to the corresponding safety factors using the procedures which allow to identify extreme loading conditions for each element.

Safety factors shall be obtained in compliance with the modes and conditions specified in 1.2.2 and 1.2.3, Part IV "Stability" of the MODU/FOP Rules.

Safety factors given in Tables 4.3.10 and 4.3.11, Part III "Equipment, Arrangements and Outfit of MODU/FOP" of the MODU/FOP Rules, which may be reduced considering the operational conditions, unit's purpose and anchor line type, may be used as a first approximation.

Safety factors for bridles shall be taken in reference to the rated static breaking strength. Safety factors for anchors shall be taken in reference to their holding power.

4.5.11 The maximum tension T_{max} at the safety factor *SF* value shall be determined by the formula:

$$SF = PB/T_{max}, \qquad (4.5.11\text{-}1)$$

where PB = minimum rated breaking strength of the anchor line.

The maximum movements of the unit shall meet the condition:

$$x_{ult}/x \geq k, \qquad (4.5.11\text{-}2)$$

where x_{ult} = ultimate values of the unit movements established by the requirements for the design and by the equipment operating manuals;
x = maximum rated movements for the rated operating mode under consideration;
k = safety factor the value of which may be taken equal to 1,15 when the quasi-static method is used, and equal to 1,05 when the dynamic method is used.

4.5.12 The fatigue endurance level of anchor lines, determined by the calculation, shall be not less than thrice the rated service life of the position mooring system. When there are no true data on fatigue curves and when access for inspections and repair cannot be provided, a higher endurance level may be required.

4.5.13 The total forces due to wind, current and wave shall be calculated at various angles between them and taking into account the dynamic effect of waves. The angular displacements of the hull and the horizontal displacements of the unit

and TS in motions, as well as the deviations of the horizontal force acting on the bridle shall be calculated according to the procedure and the program recognized and certified by the Register, respectively.

4.5.14 In addition to the above loads, the initial tension of anchor lines shall be considered.

4.5.15 The diameter of an anchor chain cable, which safety factor is assumed at least 1,5, shall be selected taking into account the effect of the maximum total loads due to initial tension, wind, wave and current on the bridle.

4.5.16 The minimum breaking load (MBL) for the position mooring system securing elements on board the unit (chain locker pipes and chain stoppers) shall exceed the MBL of the most weak link of an anchor line by 30 per cent.

4.5.17 The calculation of the unit high-frequency oscillations shall take into account the position mooring system rigidity at depths below 70 m and the dynamic calculation of the position mooring system behaviour shall be carried out at depths exceeding 450 m. In particular cases, such a calculation may be required for the lesser water depths as well.

The position mooring system rigidity characteristic shall be determined according to the procedure approved by the Register, and computer program shall have a certificate issued by the Register.

4.6 DYNAMIC POSITIONING SYSTEM

4.6.1 The dynamic positioning system shall meet the requirements of 4.9, Part III "Equipment, Arrangements and Outfit of MODU/FOP" of the MODU/FOP Rules.

4.7 MOORING SWIVEL

4.7.1 The mooring swivel shall provide free rotation about the vertical axis of the unit and monitor the movement of the tied up transport ship.

4.7.2 The mooring swivel structure shall withstand the following loads:

mooring line;

its own weight;

dynamic loads due to unit motions, wind and current.

4.7.3 The bearings of the mooring swivel/turret shall have sufficient rigidity to prevent impermissible displacements.

4.7.4 When designing bearings the following factors shall be taken into consideration:

plastic deformation of rolling components and raceways (bearing capacity);

fatigue in critical local sections of the outer and inner races;

bolts fatigue;

carrying capacity of the bearings on the whole, determined by the bearing capacity of the bolts and cross sections of the races, taking into account the rigidity of structures supporting the races (fixed and rotating).

4.7.5 Carrying capacity of the bearing shall be determined taking into account the balance of forces acting on the rolling elements and the following loads on the race components:

forces caused by securing bolts including possible shear forces;

possible pressure at connection point of the component in question with the structure supporting the race;

forces in the cross section of the race (i.e. on end surfaces of the component in question).

4.7.6 The safety factor for the bearing races shall be not less than:

1,7 by the maximum bearing capacity of the race and bolts;

1,5 by the fatigue strength (90 per cent probability) at the load factor of 0,7.

4.7.7 The bolt tightness force shall be from 65 to 80 per cent of their yield strength.

4.7.8 For bolts subject to strong tension account shall be taken of cracking due to stress-actuated corrosion.

4.7.9 Pressure bolts shall be as far as possible equally spaced over a circle.

4.8 TURRET

4.8.1 The turret shall provide free rotation about the vertical axis of the unit, securing of a number of anchor lines and reliable connection of the fixed and moving parts of cargo pipeline (see 4.7.1).

4.8.2 The turret is subject to special consideration by the Register in each particular case.

4.8.3 In addition to the loads mentioned in 4.7.5, account shall be taken of forces caused by most adverse operating conditions of the anchor lines. Particular emphasis shall be placed on design tolerances and stresses during transfer of critical load.

The support of leading blocks shall be designed for a load equal to minimum strength in case of anchor line being broken. The nominal equivalent stress in the support structure shall not exceed 0.8 the yield strength of the material.

Strength calculations and finite element analysis (FEA) made for unfavourable load acting on the anchor lines shall be submitted.

4.8.4 The turret belongs to special structures, welds of which and of a support structure shall be of high strength.

Welds of the turret outer plating may be butt welds.

4.8.5 The turret machinery essential to its functioning shall be considered as main one. Components and systems shall be chosen with a margin so that failure of a single component cannot result in loss of operability of the turret.

The turret machinery in case of the blackout accident shall be supplied from the emergency source of power within 18 h.

Emergency shutdown system shall be activated automatically when a fire is detected and when maximum permissible concentration of hydrocarbon gas is up to 50 per cent of the permissible level in way of the turret.

4.8.6 To monitor and control the machinery of the turret or float-free buoy for STL it is necessary to submit documentation given in Table 4.8.6.

Table 4.8.6

Name	Turret machinery	STL machinery
Description of functions	+	+
Block diagrams of system (T)	–	+
System diagram	–	+
Location of power supply source (T)	+	+
Arrangement plan (T)	+	+
List of devices and equipment (T)	+	+
Tables of data on the environment	+	+
Test program for software used by manufacturer (T)	+	+
Operating Manual*	–	+
Schematic diagrams of input and output circuits	–	+
Notes. T – is also required for typical approved diagrams. * – a copy shall be submitted for information only.		

5 MOORING ARRANGEMENT

5.1 GENERAL

5.1.1 The mooring arrangement on self-propelled units shall meet the requirements of Section 4, Part III “Equipment, Arrangements and Outfit” of the RS Rules.

5.1.2 TS mooring shall be as follows:

stern mooring with flexible mooring lines;

side mooring with flexible mooring lines.

5.1.3 Each unit shall be provided with the mooring arrangement which ensures TS warping and its maintaining at a certain distance.

5.1.4 In determining the mooring arrangement characteristics it is recommended to consider the following conditions:

complex solution of the problems associated with mooring and cargo handling operations (approach, TS position-keeping near the unit, limits for movements during cargo handling operations);

monitoring of mooring and cargo handling operations taking into account the dynamic effects of external forces;

simplicity, workability and repairability of the structure, availability of a "weak link";

dimensions and position of the mooring arrangement shall provide transmission of the loads carried to the unit hull structure;

relative position of the mooring arrangement components shall contribute to the more safe system "Unit-TS" including the attending personnel injury risk reduction.

5.1.5 The type and location of the mooring arrangement, the loads applied shall be determined in each particular case considering the TS characteristics, environmental loads, operational restrictions, structural features of the unit and vessels involved.

5.1.6 The mooring arrangement shall ensure position-keeping of a tied up ship exposed to the following:

wind;

current;

tides;

waves;

ice;

draught changes;

negative and positive water setup.

5.1.7 The forces caused by draught changes, tidal oscillations, and during cargo handling operations shall be balanced by the proper handling of mooring lines, in particular, by the installation of appropriate winches.

5.1.8 The wave and ice effect is recommended to assume according to the results of model tests, in-situ measurements or with the use of computer programs.

5.2 INITIAL CALCULATION BACKGROUND

5.2.1 The strength calculation of the mooring arrangement and its supporting hull structures shall be performed by using recognized procedures (e.g. the OCIMF guidelines). The arrangement for stern mooring with a mooring winch of high capacity shall be subject to special consideration by the Register.

6 TOWING ARRANGEMENT

6.1 The towing arrangement on self-propelled units shall meet the requirements of Section 5, Part III "Equipment, Arrangements and Outfit" of the RS Rules.

6.2 FPU shall be provided with the emergency towing arrangement in compliance with 5.7, Part III "Equipment, Arrangements and Outfit" of the RS Rules.

7 FENDERING EQUIPMENT

7.1 The fendering equipment shall withstand glancing blow of a transport ship (TS) in the fully loaded condition or in ballast and ensure the absence of sparking on impact.

7.2 The dimensions and arrangement of the fendering equipment shall be selected so that to ensure protection against the TS of various types considering the rise of tide.

7.3 Where auxiliary vessels are supposed to mooring at the unit, provision shall be made for fenders to protect the unit hull against damages.

7.4 The characteristics, design and arrangement of the fendering equipment and fenders shall meet the requirements of the effective standards for the design of berthing facilities specified in RD 31.31.27, and the recommendations on the sea-going ships fendering.

7.5 It is recommended to use the structures of high power-capacity rubber shock-absorbers of various types, e.g. axially-compressed cylindrical or specially sectioned (V-shaped, M-shaped).

7.6 The attachment points of the fendering equipment shall include safety devices ("weak link") to prevent damage to this equipment due to accidental overloading.

7.7 The fendering equipment strength shall be determined in compliance with the provisions of 5.2.

7.8 The fendering equipment parameters shall be taken considering the following:

power-capacity, reaction force and deformation of the fendering equipment shall take into account the impact energy determined according to 3.17.1, Part II "Hull";

necessity of individual design for specific conditions;

use of slowly-restorable structures which have high power-capacity at a small reaction force and low pressure on the side of the ship being moored, as well as a capability of dissipating the ship impact energy with transmitting the loads to the unit hull structures;

low friction coefficient and stability to shear loads;

simplicity, workability and repairability;

installation of a system to monitor the ship mooring and the means to prevent damage to the ship hull due to accidental overloading.

8 BOARDING ARRANGEMENT

8.1 Regardless of the unit type, a designer shall develop the structures and measures, which ensure access to the unit in service at any time, and specify the relevant restrictions.

8.2 For manned units methods and equipment shall be additionally developed for emergency evacuation in accident situations.

8.3 Two ways of carrying/evacuation the personnel shall be considered: by ships and helicopters.

8.4 A cargo crane provided with a man-riding cage is recommended as a general means for access to manned units elevated above the water surface, and a verical ladder for access to low unmanned units.

8.5 The transfer of people shall be assured at least under the following conditions:

wind velocity: 8 to 12,5 m/s;

wave height with 3 per cent probability $h_{3\%}$: 0,75 to 1,25 (force 3);

current speed: up to 1 knot.

8.6 The boarding arrangement is recommended to be located on both sides of the unit.

8.7 The boarding arrangement shall provide the safe approach of ships with displacement below 2500 t at a speed of up to 1 knot, and withstand the

appropriate loads produced by ships swinging foul without damage to their particular elements and structure.

8.8 The action of ice on the boarding arrangement being inoperable shall be precluded.

9 SIGNAL MASTS

9.1 Signal masts intended for carrying signal means and aerials shall be designed to meet the requirements of Section 6, Part III "Equipment, Arrangements and Outfit" of the RS Rules.

10 CARGO HANDLING GEAR

10.1 Cargo handling gear shall be designed so that to comply with the Rules for the Cargo Handling Gear of Sea-Going Ships.

11 OPENINGS IN HULL, SUPERSTRUCTURES, DECKHOUSES AND THEIR CLOSING APPLIANCES

11.1 The requirements given below apply to the arrangement and closing appliances of openings located above the unit margin line. The margin line means the line of the intersection of the upper surface of the bulkhead deck (or its continuation) with the outer surface of side shell plating at side.

11.2 Openings located below the margin line and their closing appliances are subject to special consideration by the Register.

11.3 Openings in hull, superstructures and deckhouses of the unit to which a the minimum freeboard has been assigned, and their closing appliances shall meet the Register requirements specified for ships of unrestricted service given in Section 7, Part III "Equipment, Arrangements and Outfit" of the RS Rules and in Section 8, Part III "Equipment, Arrangements and Outfit" of the MODU/FOP Rules to the extent that is reasonable and practicable for the unit in question.

11.4 The coaming height of openings for doors, companion hatches, skylights, ventilation trunks and ventilators, as well as closing appliances of these openings shall be determined with regard to the requirements for intact and damage stability.

Covers of companion hatches shall be watertight and fitted with quick acting devices for securing and opening, and also with position indicators.

11.5 Tight manholes having clear dimensions of at least 500×600 mm shall be fitted for access to tanks and cofferdams.

11.6 Side scuttles in mooring and cargo control room shall have electric heating and screen wipers. In addition, the control station shall be provided with a washing system for glasses and with light filters.

11.7 Openings in the unit watertight subdivision bulkheads and their closing appliances shall meet the requirements of 7.12, Part III "Equipment, Arrangements and Outfit" of the RS Rules.

Doors in those bulkheads shall be remotely operated from the central control station on the deck, which is above the damage waterline after flooding.

Water-and-gastight doors made of steel shall be fitted in superstructures, while "B" class doors meeting the requirements of 2.1.2.5, Part VI "Fire Protection" of the RS Rules shall be fitted in inner spaces.

The detachable panels of doors used as an emergency exit shall be dimensioned at least 400×500 mm.

12 ARRANGEMENT AND EQUIPMENT OF SPACES

12.1 The arrangement and equipment of spaces shall meet the requirements of Section 8, Part III "Equipment, Arrangements and Outfit" of the RS Rules as in the case of cargo ships.

12.2 Stairways shall be at least 600 mm wide (between stringers), their angle of inclination shall not exceed 55° (60° in cargo tanks), and in extraordinary cases, it may be equal to 65°. The width of vertical ladders shall be at least 300 mm and of spar ladders, at least 250 mm.

12.3 The means of access to cargo tanks shall meet the requirements of 7.14.2, Part III "Equipment, Arrangements and Outfit" of the RS Rules.

12.4 Guard rails of open decks and working stations thereon shall be four-rowed and of 1100 mm high, and in inner spaces, three-rowed and of 1000 mm high.

12.5 Inventory and tools shall be stocked according to RD 31.00.14 and kept in lockers, cabinets, boxes and on shelves.

12.6 Deck machinery and devices shall be provided with covers.

12.7 Spare parts and appliances shall be taken according to the supplier's recommendations given in specifications for the supply of machinery, apparatus

and other equipment, and for arrangements and systems, according to the requirements of the Register and other regulatory documents.

Spare parts and appliances shall be kept in lockers, cabinets, boxes and on shelves, and ashore as well.

12.8 The requirements for mooring and cargo control room, and for a main machinery control room are specified in Part VII "Machinery Installations" and Part XV "Automation".

13 EMERGENCY OUTFIT

13.1 The unit emergency outfit is subject to special consideration by the Register.

13.2 Emergency outfit and fire fighting equipment shall be stored in specially equipped spaces providing free access to them.

PART IV. STABILITY

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of this Part apply to:

.1 new floating offshore structures, subsequently referred to as "units", if they are afloat and their hull shape cannot be considered as traditional for ships or barges;

.2 structural components of FPU, subsequently referred to as "units", if they are afloat;

.3 sea-going ships, subsequently referred to as "units", which position-keeping systems ensuring ship's functioning according to its purpose, cannot be considered as traditional anchoring systems complying with the requirements of Part III "Equipment, Arrangements and Outfit" of the RS Rules;

.4 existing FPU and the above stated ships, subsequently referred to as "units", if their stability has deteriorated after repairs and/or conversion;

.5 FPU in operation and the above stated ships in service, subsequently referred to as "units", to the extent that is reasonable and practicable.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 The definitions and explanations are given in the General Regulations for the Classification and Other Activity, in Part I "Classification" and Part IV "Stability" of the RS Rules, in Part I "Classification", Part II "Hull" and Part IV "Stability" of the MODU/FOP Rules taking MODU and FOP as FPU (if they have similar design), and also in Part I "Classification", Part II "Hull" and Part III "Equipment, Arrangements and Outfit" of the FPU Rules.

1.2.2 Design modes shall be taken according to 1.2.2, Part IV "Stability" of the MODU/FOP Rules.

1.2.3 Design conditions shall be taken according to 1.2.3, Part IV "Stability" of the MODU/FOP Rules.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 The scope of technical supervision shall meet the requirements of 1.3, Part IV "Stability" of the MODU/FOP Rules.

1.4 GENERAL TECHNICAL REQUIREMENTS

1.4.1 Calculations and diagrams shall be made in compliance with 1.4, Part IV "Stability" of the MODU/FOP Rules.

1.5 INCLINING TEST

1.5.1 The inclining shall be carried out in compliance with 1.5, Part IV "Stability" of the MODU/FOP Rules.

1.5.2 FPU as a complete unit is inclined with use of solid ballast in two conditions:

with missing anchor lines (chain cables, wire ropes) of the position-keeping system;

after fitting anchor lines at the operational draught, but prior to their tensioning.

2 GENERAL REQUIREMENTS FOR STABILITY

2.1 POSITION-KEEPING SYSTEM. SUPPORT ON SEABED

2.1.1 The effect of the position-keeping system (passive: anchoring system, mooring ropes of ships/buoys, towing lines, crane ship's slings; or active: dynamic positioning and thruster assisted position mooring systems) on stability shall be considered if it results in more severe consequences. This effect shall be considered:

.1 in normal condition:

.2 in survival condition if it offers the reduced criteria in terms of stability (e.g. on breaking one, some or all tensioned lines) and no technique is provided to break free the unit of the position-keeping system action within three hours;

.3 in temporary condition if the use of the position-keeping system is specified by the Guidelines on Marine Operations Performance.

2.2 LOADING CONDITIONS

2.2.1 The FPU loading conditions shall meet the requiremens of 2.2, Part IV "Stability" of the MODU/FOP Rules. In addition, the FPU stability shall be verified for the following conditions of an intact unit (considering icing and snow) according to 2.5.5, Part IV "Stability" of the MODU/FOP Rules:

fully equipped, free floating (without anchor lines);

floating with free hanging anchor lines;
operational position at the maximum sea level (tide + storm surge);
operational position at the minimum sea level (low-tide).

2.3 RIGHTING MOMENT CURVES

2.3.1 The unit's righting moment curves shall be computed and plotted in compliance with the requirements of 2.3, Part IV "Stability" of the MODU/FOP Rules.

2.4 HEELING MOMENT CURVES

2.4.1 The unit's heeling moment curves shall be computed and plotted in compliance with the requirements of 2.4, Part IV "Stability" of the MODU/FOP Rules.

2.4.2 The heeling moments M_V, M_R, M_S, in kNm, and the corresponding forces shall be determined, as a rule, with the use of physical simulation techniques following the Register-approved procedures. Where the physical simulation data are unavailable, it is allowed to determine the wind force and its lever about a waterline according to 2.4.2, Part IV "Stability" of the MODU/FOP Rules, the levers of the resistance force to drift, according to 2.4.3, Part IV "Stability" of the MODU/FOP Rules, and the ice load, according to the Register-approved procedure.

3 STABILITY CRITERIA

3.1 GENERAL REQUIREMENTS

3.1.1 The FPU stability criteria shall meet the requirements of 3.1, Part IV "Stability" of the MODU/FOP Rules.

3.1.2 In addition to the requirements listed in 3.1.5, Part IV "Stability" of the MODU/FOP Rules, the stability of units when the float-on method is used, i.e. mating afloat with underlying structures during the unit's assembly or transshipment, is subject to special consideration by the Register.

3.2 DESIGN AMPLITUDE OF MOTIONS

3.2.1 The FPU design amplitude of motions shall meet the requirements of 3.2, Part IV "Stability" of the MODU/FOP Rules.

3.3 REQUIREMENTS FOR THE STATICAL STABILITY CURVE

3.3.1 The FPU statical stability curve shall meet the requirements of 3.3, Part IV "Stability" of the MODU/FOP Rules.

3.4 ADDITIONAL REQUIREMENTS FOR STABILITY

3.4.1 The FPU stability in the normal condition and survival condition with the position mooring system detached and the worst loading condition, in terms of stability, shall meet the following requirements.

The corrected metacentric height with the presence of free surfaces of liquids simultaneously in all cargo tanks and ballast tanks in any loading condition up to the load-line displacement shall be at least 0,15 m ignoring icing and snow on the open parts of the deck, and at least 0,10 m adjusted for both factors.

The statical stability curve shall meet the requirements of 2.2.1, Part IV of the RS Rules or the requirements of 3.3, Part IV "Stability" of the MODU/FOP Rules depending on the hull design.

The weather criterion determined in compliance with the requirements of 2.1, Part IV of the RS Rules shall be not less than 1,5.

3.4.2 The FPU stability under survival condition with due regard to the position mooring system shall meet the requirements of 3.4.1.2, Part IV "Stability" of the MODU/FOP Rules.

3.4.3 The stability of FSPM and the units mentioned in 1.1.1.2 shall meet the requirements of 3.4.5, Part IV "Stability" of the MODU/FOP Rules.

3.4.4 The stability of the sea-going ships being subject to 1.1.1.3 shall meet the requirements of 3.4.4, Part IV "Stability" of the MODU/FOP Rules.

PART V. SUBDIVISION

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of this Part apply to the floating offshore structures, subsequently referred to as "units", listed in 1.1.1, Part IV "Stability" of the FPU Rules.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 The definitions and explanations are given in the General Regulations for the Classification and Other Activity, in Part I "Classification" and Part V "Subdivision" of the RS Rules, in Part I "Classification" and Part V "Subdivision" of the MODU/FOP Rules taking MODU and FOP as FPU (if the FPU hull design corresponds to the types which are defined in 1.2, Part I"Classification" of the MODU/FOP Rules, and also in Part I "Classification", Part II "Hull" and Part III "Equipment, Arrangements and Outfit" of the FPU Rules).

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 The scope of technical supervision shall meet the requirements of 1.3, Part V "Subdivision" of the MODU/FOP Rules.

1.4 GENERAL TECHNICAL REQUIREMENTS

1.4.1 The general technical requirements shall comply with 1.4, Part V "Subdivision" of the MODU/FOP Rules.

1.5 GENERAL REQUIREMENTS FOR SUBDIVISION

1.5.1 Subdivision of units is considered to be satisfactory if damage trim and stability meet the requirements of Section 2 of this Part.

1.5.2 Depending on the unit's type the requirements of Section 2 shall be met in the following cases:

.1 in transit – for all units;

.2 in operation afloat – for FPSO and FSPM.

2 TRIM AND STABILITY OF DAMAGED UNIT

2.1 GENERAL

2.1.1 The general requirements shall comply with 2.1, Part V "Subdivision" of the MODU/FOP Rules.

2.2 EXTENT AND ZONES OF DESIGN DAMAGES

2.2.1 FPU subdivision shall meet the requirements of Part V "Subdivision" of the RS Rules for the trim and stability of damaged oil tankers.

2.2.2 The extent of FSO side damage shall meet the requirements of Regulation 24, Annex I "Regulations for the Prevention of Pollution by Oil" to MARPOL 73/78, but not less than that specified in 2.2.4.

2.2.3 The zones of FPU side damage shall be assumed depending on the unit length according to 3.4.6.4.1, Part V "Subdivision" of the RS Rules.

2.2.4 The requirements for FPU damage trim and stability shall be met to the following extent of the side damages:

.1 longitudinal extent shall be 1/12 of the waterline perimeter or 7,2 m (whichever is less);

.2 transverse extent of damage shall be 1,5 m, measured inboard from the inner surface of the shell plating normal thereto;

.3 vertical extent as measured from the base line upwards without limit.

2.2.5 Protective measures like the fendering equipment are also recommended for use to keep to a minimum the impact side damage, e.g. as may happen during the unloading and mooring of supply vessels. However, such protection shall not be considered as reducing the design transverse extent of the side damage.

2.2.6 Design extent of side and transom damages for SPM in transit condition and for FSPM in operating condition:

.1 longitudinal extent shall be $1/3L^{2/3}$ or 14,5 m (whichever is less);

.2 transverse extent shall be 1,5 m or 0,2 of the breadth (whichever is less);

.3 vertical extent as measured from the base line upwards without limit.

At unusually large draughts and elevations of the bulkhead deck above the waterline in transit, the vertical extent may be assumed from the line located 10 m below the waterline (with due regard for trim) and upwards up to the line located 7 m above the waterline (with due regard for trim as well).

2.2.7 Design extent of bottom damages of the units specified in 2.2.6:

.1 longitudinal extent shall be $1/3L^{2/3}$ or 5 m (whichever is less);

.2 transverse extent shall be 1/6 of the breadth or 5 m (whichever is less);

.3 vertical extent as measured in the centreline from the hull body lines, 1 m.

2.3 PERMEABILITY INDEX

2.3.1 In the calculations of damage trim and stability the permeability index of flooded space shall be assumed equal to:

.1 0,85 – for spaces occupied by machinery, electric generating sets and by processing equipment as well;

.2 0,95 – for accommodation spaces and empty spaces including empty tanks;

.3 0,6 – for the spaces intended for dry stores.

2.3.2 Permeability of flooded tanks with liquid cargo or liquid stores or water ballast is determined on the assumption that all the cargo is discharged from the tank and sea water is ingressed taking into consideration the permeability index being equal to 0,95.

2.3.3 The permeability index of spaces may be assumed lower than specified above only in case a special calculation is performed which is approved by the Register.

2.3.4 Where the arrangement of spaces or their service conditions are such that the expediency of the application of other permeability indices resulting in more severe requirements is evident, the Register is entitled to require the application of those permeability indices.

2.4 NUMBER OF FLOODED COMPARTMENTS

2.4.1 The requirements for trim and stability of a damaged unit shall be met at flooding of any compartment with the damages specified in 2.2.

2.4.2 The requirements for the trim and stability of damaged unit shall be met at flooding of two or more adjacent compartments with the damages specified in 2.2 in the following cases:

when adjacent watertight bulkhead spacing is less than the design longitudinal damage extent specified in 2.2.2 and 2.2.4.1;

at the option of the unit's owner to ensure unsinkability with the design damage at any hull location.

2.5 REQUIREMENTS FOR DAMAGED UNIT'S TRIM AND STABILITY CHARACTERISTICS

2.5.1 The trim and stability characteristics of damaged FPU and FSPM shall meet the requirements of 2.5, Part V "Subdivision" of the MODU/FOP Rules.

2.5.2 The case, when the requirements for damage trim and stability with the number of flooded compartments according to 2.2.3 and 2.4 are not met, is subject to special consideration by the Register. In this case, certain structural arrangements shall be implemented to reduce the risk of the unit's loss. The arrangements efficiency shall be evaluated by the quantitative assessment of risks in compliance with the IACS procedure.

3 REQUIREMENTS FOR FREEBOARD

3.1 When the unit with unclosed openings is afloat in the protected water area or is towed on river:

freeboard shall be at least 0,6 $h_{3\%}$, where $h_{3\%}$ is a wave height of 3 per cent probability of exceeding at the maximum potential intensity of waves in a relevant water area;

elevation above the waterline of the lower edges of unclosed openings through which the unit's hull may be flooded shall be not less than 1,2 $h_{3\%}$.

3.2 All units in transit or when towed at sea shall meet the requirements of the Load Line Rules for Sea-Going Ships. The freeboard and reserve-buoyancy ratio values given below shall be ensured in marine operations and at the maximum permissible draught of units without taking into account the icing and snow on the open areas of deck, superstructures and deckhouses.

.1 The freeboard F, in mm, with the permanent personnel aboard the type A unit shall be not less than $58\nabla^{1/3}$ (∇ is the unit's displacement volume, in m^3, at the maximum permissible draught in sea water with a specific gravity of 1,025 t/m^3).

.2 The freeboard for the type B unit shall be not less than $76\nabla^{1/3}$.

.3 The reserve-buoyancy ratio shall not be less than:

15 per cent for the type A unit with no openings on the freeboard deck except manholes having covers with closely-spaced bolts;

40 per cent for the type A unit with openings apart from manholes;

45 per cent for the type B unit.

.4 When it is difficult to meet the above requirements, these may be mitigated provided that the substantiation, which evidences the unit's safety, will be submitted to the Register in each particular case.

3.3 The SSPM freeboard at the operational location shall be taken as the largest value among the recommended in terms of sea and ice conditions specified in Part II "Hull"of the MODU/FOP Rules, and also determined by the formula, in m:

$$F_1 = h_{50} + \Delta_{50} + 2{,}0. \quad (3.3)$$

3.4 FPU freeboard at the operational location shall be determined by the formula, in m:

$$F_1 = 0{,}6h_{50} + 1{,}50, \quad (3.4)$$

where h_{50} = wave height potential once in 50 years, m;
Δ_{50} = extreme height of tide potential once in 50 years, m.

PART VI. FIRE AND EXPLOSION PROTECTION

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of this Part apply to structural fire and explosion protection of a floating production unit (FPU), its fire extinguishing, fire detection and alarm systems, systems for explosion effect mitigation, as well as fire-fighting equipment and outfit.

1.1.2 In addition to the requirements of this Part, applicable requirements of Part VI "Fire Protection" of the RS Rules and Part VI "Fire Protection" of the MODU/ FOP Rules shall be met.

1.1.3 FPU complying with the FPU Rules may at the same time be subject to the requirements and regulations imposed by other authorities. If so, more stringent requirements shall be followed.

1.1.4 Equipment and outfit intended for fire prevention and fighting in the wellhead and process areas of FPU and not covered by this Part shall meet the requirements to the extent agreed upon with the Register in each particular case.

The necessity of installation of such equipment and outfit and characteristics thereof shall be determined by the customer having regard to the presence and number of special salvage teams on board the FPU and the presence of ships with the mark **FF** in their class notation in the FPU water area.

The scope of the Register technical supervision of the said equipment and outfit is determined by the customer and agreed with the Register.

1.1.5 Arrangement of the process equipment, as well as technical solutions to ensure safe well operations, collection, storage, treatment and offloading of the well products shall comply with the requirements of the competent State bodies exercising supervision of safety in oil and gas industry.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 The definitions and explanations are given in the General Regulations for the Classification and Other Activity, Part VI "Fire Protection" of the RS Rules, in Part I "Classification" and Part VI "Fire Protection" of the MODU/FOP Rules, as well as in the previous parts of the FPU Rules.

1.2.2 Unless otherwise specified, the following definitions have been adopted in this Part.

Emergency response is an action taken by the personnel on or outside the FPU to control or mitigate the effects of a hazardous event or initiate and execute evacuation from FPU.

Emergency depressurization (EDP) is controlled disposal of pressurized fluids to a flare or ventilation system when required to avoid or minimize a hazardous situation.

Emergency shutdown (ESD) are control actions undertaken to shut down equipment or processes in response to a hazardous situation.

Emergency station is a place where emergency response personnel go to undertake their emergency duties.

Zone (area classification) is a distance in any direction from the source of emission to the point where the flammable atmosphere has been diluted by air to a sufficiently low level.

Source of ignition is any source with sufficient energy to initiate combustion.

Source of release is a point from which flammable gas, liquid or a combination of both can be released into the atmosphere.

Integrated installation is an offshore structure which contains accommodation spaces and auxiliary systems with process and/or wellhead equipment.

Structural fire protection is a complex of structural means of structural fire protection intended for:

prevention of fire;

containment of flame and smoke spreading throughout the FPU;

creation of conditions for safe evacuation of people from the unit spaces and from FPU, as well as for effective fire extinction.

Class of fire (type of fire) characterises fire intensity and extent.

Note: This classification is based on the materials which may be present and the probability of a flammable atmosphere developing. Area classification is primarily used in the selection of electrical equipment to minimize the risk of ignition if emission occurs.

Unmanned installation is an offshore structure that is designed to be operated without constant presence of the personnel.

Manned installation is an offshore structure that is designed to be operated by the personnel normally present on board.

Flammable atmosphere is a mixture of flammable gas or vapour in the air which burns when ignited.

Hazard is a potential for human injury, damage to the environment, material damage or their combination.

Hazardous event is an incident which occurs when a hazard is realized.

Hazardous area is a three-dimensional space in which a flammable atmosphere may be expected to be present at such frequencies as to require special precautions for monitoring of potential ignition sources.

Hazard assessment is a process of hazard or hazardous event analysis in relation to standards or criteria which have been developed as a basis for decision-making.

Pool fire is a combustion of flammable or combustible liquid spilled and retained at a surface.

Running liquid fire is a combustion of flammable liquid flowing over a surface.

Prevention (of a hazardous event) is a reduction of potential risk of a hazardous event.

Propagation is an effect of fires and of toxic gas releases on the equipment or other areas causing extent of the consequences of a hazardous event.

Risk is a combination of probabilities suggesting that an undesirable event will occur and lead to serious consequences.

Grade of release is a measure of potential frequency and duration of a release (independent of release rate, quantity of substances released, ventilation rate and fluid properties).

Fire and explosion strategy (FES) is results of the process involving fire assessment data to define measures required to control these hazardous events and importance thereof.

Jet fire is an ignited release of pressurized and flammable fluids.

Control (of hazards) is a limitation on the extent and/or duration of a hazardous event to prevent its escalation.

Physical explosion is a result of a sudden release of stored energy lasting 1 – 2 s, e.g. pressure vessel rupture, gas fittings failure or high voltage electrical discharge.

Functional requirements are minimum criteria which shall be satisfied to meet the stated health, safety and environmental objectives.

Chemical explosion is a violent combustion of a flammable gas or mist which generates pressure effects due to confinement of the combustion-induced flow and/ or the acceleration of the flame front by obstacles in the flame path.

Cellulosic fire (CF) – fire involving combustible material such as wood, paper, furniture, etc.

1.3 ABBREVIATIONS

1.3.1 The following abbreviations have been adopted in this Part:
ESD – emergency shutdown;
EDP – emergency depressurization;
TR – temporary refuge;
FM – fire monitor ;
CPR – cargo pump room;
CT – cargo tank;
AS – accommodation spaces;
LHC – liquid Hydrocarbon;
UPS – uninterruptible power supply;
BR – boiler room;
ER – engine room;
LFL – low flammable limit;
OS – offloading system;
PF – pool fire;
SSSV – sub-surface safety valve ;
SSIV – sub-surface isolation valve;
CS – control station;
FES – fire and explosion strategy;
JF – jet fire;
EMPS – explosion mitigation and protection system;
PA – process area ;
WH – wellhead area;
CF – cellulosic fire;
CCS – central control station;
EER – evacuation, escape and rescue.

1.4 SCOPE OF SURVEY

1.4.1 The scope of survey shall comply with the requirements of 1.3.1 and 1.3.2, Part VI ”Fire Protection” of the RS Rules.

1.4.2 To obtain the approval of the Register for the newly applied active fire-fighting means and passive means of structural fire protection, the materials specified in 1.3.3, Part VI “Fire Protection” of the RS Rules shall be submitted to the Register, together with the results of «H» class divisions fire tests carried out according to IMO Resolution A.754(18) “Recommendation on Fire

Resistance Tests for «A», «B» and «F» Class Divisions", considering that the time-dependent standard temperature curve corresponds to the international standard ISO 834-1 "Fire Resistance Tests – Elements of Building Construction. General Requirements", DS/EN1362-2.

1.4.3 Standard fire tests in compliance with the International Code for Application of Fire Test Procedures are the tests in which specimens of the relevant bulkheads, decks or materials are exposed in a test furnace to temperatures corresponding to the temperatures of cellulosic and pool fires.

The following features of the units shall be taken into account:

jet fire with high impulse and efficient burning;

very large size of the object;

actual fire may have characteristics different from those which can be reproduced in a fire test;

testing critical equipment (see 2.3.5).

It shall be stressed that many important parameters concerning the serviceability of structural fire protection materials or systems are not taken into account in the standard tests and test reports. Such parameters include resistance to different environmental conditions, ageing and mechanical effect.

1.4.4 When selecting material consideration shall be given to the fire type and size, duration of protection, environment, material application and maintenance, and smoke generation in fire situations.

Structural fire protection materials shall be approved for their intended use. Where approval from a recognized third party or governmental body are not available, their fire integrity shall be documented by test reports from a recognized testing laboratory. Interpolation of test results to optimize the quantity of material to be applied shall be documented.

1.4.5 Documentation on structural fire protection material shall vary according to the type of application and may include:

quality control aspects:

- verification of applicable temperatures and humidity requirements;
- installation time;
- inspection and control requirements;
- surface preparation;

mechanical tests:

- damage from friction and impact damage;
- mechanical damage;
- destruction at compression;
- seawater absorption;

bending;
adhesion and vibration;
resistance to drenching and hose-stream;
corrosion protection:
quality of protection;
inspection requirements for fouling ;
effects of temperatures and thermal shocks;
cathodic disbonding;
ozone and/or ultraviolet ageing;
ease of reinstatement after fouling;
fire tests:
cellulosic fire characteristic;
hydrocarbon fire characteristic;
jet fire characteristic;
fire spread characteristic;
combustion products;
other characteristics:
relative conditions resource/effect;
explosion resistance;
full-scale experiments;
health care activities.

1.4.6 The test requirements shall not be defined only by the above. The need for each type of test shall be based on engineering judgment and intended use. For example, seawater absorption may be considered for structural fire protection materials submerged or directly exposed to seawater.

1.5 FIRE PLANS

1.5.1 On all units with superstructures and deckhouses, at the control stations or in conspicuous positions in service spaces, there shall be exhibited general arrangement plans in compliance with 1.4.1, Part VI "Fire Protection" of the RS Rules.

1.5.2 Where the personnel is present on the unit permanently or temporarily, then a stitched set of plans with information specified in 1.5.1 shall be available at all times on board in a readily accessible position (e.g. at the control station).

Where the personnel is present on the unit occasionally, then one stitched set of plans shall be available on board in a readily accessible position, while the other – be permanently kept on the shore base and the operator's represen-

tative shall hand it in to the officer in charge of the personnel before sending him to the unit.

1.5.3 A set of plans protected against marine environment shall be permanently stowed outside the superstructure in a weathertight enclosure. The set of plans and its location on the unit shall be in compliance with the requirements of 1.3.3, Part VI "Fire Protection"of the MODU/FOP Rules.

1.5.4 Plans and booklets referred to in this Chapter shall be made in the state language and be in compliance with 1.3.4, Part VI "Fire Protection" of the MODU/FOP Rules.

The symbols for items listed in 1.4.1, Part VI "Fire Protection" of the RS Rules shall be in compliance with IMO Resolution A.952 (23) "Graphical Symbols for Fire Control Plans".

1.5.5 Technical instructions for maintenance and use of all installations for extinction and containment of fire shall be kept in a separate file in an accessible position.

1.5.6 Demonstration materials containing instructions shall be located on the unit with a warning that the removable sheets for the equipment transfer shall remain at their places until the installation is gas-free.

1.6 CATEGORIES OF SPACES

1.6.1 Categories of spaces shall meet the requirements of 1.5, Part VI "Fire Protection" of the RS Rules and 2.1.1.7, Part VI "Fire Protection" of the MODU/FOP Rules.

1.7 SUBDIVISION OF MATERIALS

1.7.1 Subdivision of materials according to the International Code for Application of Fire Test Procedures shall meet the requirements of 1.6, Part VI "Fire Protection" of the RS Rules.

2 STRUCTURAL FIRE PROTECTION

2.1 GENERAL

2.1.1 Structural fire protection shall provide for the following objectives:
to prevent escalation of fire by separating different fire hazardous areas;
to protect essential safety systems;

to protect critical components, such as separators, risers, ESD and topside;

to minimize damage to the unit by protecting the critical structural members, and in particular those members essential to the support of temporary refuge (TR), escape routes leading to TR and other critical equipment;

to expedite controlled destruction of fragments of structures to minimize the risk of collapse of structures and equipment onto TR/ means of evacuation;

to protect personnel in the TR(s) until safe evacuation can take place;

to protect any sections of escape routes from TR(s) to evacuation station.

2.1.2 Structural fire protection shall comply with the following functional requirements:

structural fire protection shall be provided in compliance with the requirements of the fire and explosion strategy (FES);

structural fire protection of essential systems and equipment or enclosures containing such systems and equipment shall be provided where failure in a fire is intolerable;

where structural fire protection is required to provide protection following an explosion, it shall be designed and installed such that deformation of the structure caused by an explosion will not affect its operation.

Selection of structural fire protection systems shall take into account the duration of protection required, type of fire that may occur and critical temperature for the structure/ equipment to be protected.

2.1.3 Review of evaluations of most common fire scenarios may be sufficient to determine the structural fire protection requirements without more detailed calculations. These evaluations may show that certain fire scenarios are beyond the capability of essential safety systems.

It may then be necessary to undertake risk assessment to evaluate whether it is reasonably practicable to provide additional structural fire protection or to use some other approach to prevent, control or reduce fire hazard.

2.1.4 Materials shall meet the requirements of 2.1.1, Part VI "Fire Protection" of the RS Rules.

2.1.5 Fire-resisting and fire-retarding divisions shall meet the requirements of 2.1.2, Part VI "Fire Protection" of the RS Rules and 2.1.4, Part VI "Fire Protection" of the MODU/FOP Rules.

2.1.6 Closures of openings in fire-resisting and fire-retarding divisions shall meet the requirements of 2.1.3, Part VI "Fire Protection" of the RS Rules and 2.1.5, Part VI "Fire Protection" of the MODU/FOP Rules.

2.1.7 Closures of doorways, trunks and other openings shall meet the requirements of 2.1.4, Part VI "Fire Protection" of the RS Rules.

2.1.8 Stairways and escape routes shall meet the requirements of 2.1.3, Part VI "Fire Protection" of the MODU/FOP Rules.

2.1.9 Service spaces (high fire risk) (galleys, saunas, storerooms for flammable materials) shall meet the requirements of 2.1.5, Part VI "Fire Protection" of the RS Rules.

2.1.10 Helicopter facilities shall meet the requirements of 2.3, Part VI "Fire Protection" of the MODU/FOP Rules.

2.1.11 Spaces for electric and gas welding operations and oxygen and acetylene cylinders storerooms shall meet the requirements of 2.1.5.4, Part VI "Fire protection" of the RS Rules.

2.1.12 Fixed piping system for oxygen and acetylene shall meet the requirements of 2.4.3, Part VI "Fire Protection" of the MODU/FOP Rules.

2.2 LOCATION OF SPACES AND EQUIPMENT

2.2.1 General arrangement of the unit shall meet the following objectives:

to minimize the possibility of hazardous accumulations of both liquids and gaseous hydrocarbon, and to provide for the rapid removal of any accumulations which do occur;

to minimize the risk of ignition;

to minimize the spread of flammable liquids and gases which may result in a hazardous event;

to segregate areas required to be non-hazardous from those designated as being hazardous by vertical zones at a distance not exceeding 30 m measured horizontally and up to the upper edge of the superstructure/deckhouse of the production module block measured vertically;

to reduce the consequences from fire and explosion;

to provide for adequate arrangements for evacuation, escape and rescue (EER plans);

to facilitate effective emergency response.

2.2.2 General arrangement of the unit shall meet the following functional requirements:

to minimize fire risks as it may have a major effect on the consequences from fires and on the EER plans,

to locate so far as is reasonably practicable the temporary refuge (TR), accommodation spaces and EER facilities at a maximum possible distance from the areas containing equipment handling hydrocarbons;

to use fire resistance barriers for preventing the escalation of fire to another area; any penetration through such a barrier shall not endanger the barrier integrity;

to consider the provision of such barriers when designing ventilation, ESD/EDP systems, fire water supply and when developing the EER routes;

essential safety systems (such as control stations, temporary refuge, muster areas, fire pumps) shall be located where they are least likely to be affected by fires; in some situations such systems shall be designed to withstand fire at least until the personnel on board have been safely evacuated or the situation has been brought under control.

2.2.3 Location of non-hazardous areas surrounded or partly surrounded by hazardous ones is not normally accepted.

2.2.4 Each area shall be arranged so that to minimize the consequences of fire and explosion, in particular:

.1 the process area (areas of production, treatment, storage, and disposal of well products) shall not be adjacent to the service area and shall be enclosed by "H-60" class divisions;

.2 the service area (control stations, service and accommodation spaces, temporary refuge shall be segregated by "A-60" class divisions;

.3 the auxiliary area (equipment for generating and distributing electrical energy, fuel tanks, fire pumps and equipment not directly associated with performing cargo handling operations) shall be enclosed by "A-60" class divisions.

2.2.5 The unit shall be divided into different areas according to the type of activities that will be carried out and the associated hazard potential. Areas of high risk potential shall be segregated from areas of low risk potential, and from areas containing important safety functions. Incidental escalation between areas shall be avoided.

2.2.6 Accommodation and other spaces important for safety shall be located in areas classified as non-hazardous by location, and as far as practicable away from hazardous areas.

Use of fire-resisting bulkheads, blast bulkheads, cofferdams, etc. shall be considered in cases where segregation by physical distance is not sufficient.

2.2.7 Cofferdams shall be of sufficient size for easy access and shall cover the entire adjacent tank bulkhead. Minimum distance between bulkheads shall be 600 mm.

Pump rooms and ballast tanks may serve as cofferdams.

2.2.8 Stores for hazardous substances shall be segregated from, and located at a safe distance from accommodation spaces and control stations. Indoor storage areas shall have access from open deck and have efficient ventilation.

2.2.9 The cuts in the barriers between zones shall be reduced to minimum and any cut for a pipeline, cables, etc. shall be effectively isolated and have the same fire integrity as the barrier through which the systems pass.

2.2.10 It is accepted that FPSO and FPU of the main type is a ship with machinery spaces and deckhouse positioned aft. Where deemed necessary and on agreement with the Register the above-mentioned spaces may be positioned forward if the requirements of 2.4.10, Part VI "Fire Protection" of the RS Rules are met.

2.2.10.1 Cargo tanks (CT) shall be isolated from adjacent machinery, accommodation and service spaces, control stations, chain lockers, storerooms, drinking and fresh water tanks by cofferdams.

2.2.10.2 The whole length of the cargo tanks shall be protected by side compartments of at least 2.0 m width and by bottom compartments of appropriate height. The side compartments shall extend along the whole height of the side.

2.2.10.3 The lower portion of the cargo pump room (CPR) may be recessed into machinery space and boiler room (BR) to accommodate the pumps. Deck head of the recess is, in general, not to exceed one-third of the moulded depth above the keel. However, in ship-shaped units of less than 25000 t deadweight, where it can be demonstrated that this hight does not allow satisfactory access and piping arrangement, a recess up to one-half of the moulded depth above keel may be acceptable.

Access to the pump room shall be provided from the open deck.

2.2.10.4 Fuel oil tanks shall not be located within the cargo area. Such tanks may, however, be located at forward and aft ends of cargo tank area instead of cofferdams.

Fuel oil bunker in double bottom tanks situated under CT is not permitted.

2.2.10.5 CT deck shall be arranged to allow efficient external fire fighting assistance.

2.2.10.6 CT shall not have a common boundary with ER, and accommodation, service spaces and control stations shall be located outside CT or hazardous areas.

Access doors and passageways into the said spaces shall be located at a distance of at least 3 m but not exceeding 5 m from the end of the superstructure or deckhouse and shall not face either CT, or bow or stern offloading system (OS). All working areas, large spaces in the superstructure or deckhouse and all corridors of more than 5 m in length shall have two escape routes.

2.2.10.7 Where arrangement of accommodation spaces is provided in the same superstructure with the process equipment, consideration shall be given to the appropriate location of the accommodation spaces to avoid impairment from

fire and explosion. In some cases, it may be appropriate to locate accommodation spaces on a lower level of the unit (under the process area).

Wheelhouse doors may be fitted within the limits specified in 2.2.10.6 if their arrangement provides their quick closing and efficient gas tightness of the wheelhouse.

2.2.10.8 Openings, such as doors, windows and ventilation ducts, shall normally be avoided in the boundaries between the main areas. In particular, this applies to openings in accommodation spaces, control stations and other spaces important for safety which face areas for hydrocarbon storage.

Sidescuttles on the external bulkheads of the superstructures or deckhouses facing CT, bow or stern offloading system (OS), those on the side bulkheads of the superstructure or deckhouse which are located at a distance less than specified in 2.2.10.6 from CT, those in the shell plating below the upper deck, as well as in the first tier of the superstructure or deckhouse shall be of the fixed (non-opening) type. It is recommended to cover the windows in the wheelhouse or control station with removable steel plates.

2.2.10.9 Anodes, tank washing machines and other permanently attached equipment units in tanks and cofferdams shall be securely fastened to the structure and shall be able to withstand sloshing in the tanks and vibration and other operational loads.

Due consideration shall be given to avoid spark-production in case of impact.

2.2.10.10 Access shall be provided for the inspection of CT, void and other gas-hazardous spaces by personnel wearing protective clothing and a self-contained breathing apparatus as well as for unobstructed evacuation of injured persons by means of stretches and rescue baskets.

Clear openings shall be not less than 800 mm × 800 mm.

2.2.10.11 Hatches, openings for ventilation, sounding pipes and other deck openings for CT shall not be arranged in enclosed compartments.

The closing of deck openings may be done by use of screwed plugs of metal or a suitable synthetic material.

Upon agreement with the Register access openings from the cargo pump room and from the spaces positioned forward may be accepted provided their closures are of an approved type.

2.2.10.12 Bolted plates for removal of equipment/machinery may be fitted in the boundaries facing CT.

2.2.10.13 To avoid ignition of potential flammable release provision shall be made for well killing e.g. assisted by multipurpose supply ship and using blowout preventer (BOP) or diverter.

2.3 REQUIREMENTS FOR FIRE INTEGRITY

2.3.1 To provide effective structural fire protection all relevant requirements of Part VI "Fire Protection"of the MODU/ FOP Rules and Part VI "Fire Protection" of the RS shall be met.

2.3.2 On units with superstructures and deckhouses the minimum fire integrity of bulkheads separating the adjacent spaces and of decks shall meet the requirements specified in Tables 2.1.1.7-1 and 2.1.1.7-2 of Part VI "Fire Protection" of the MODU/FOP Rules and in Tables 2.4.2-1 and 2.4.2-2 of Part VI "Fire Protection" of the RS Rules.

2.3.3 The recommendations on standard application of structural fire protection on units are specified below (Table 2.3.3).

Table 2.3.3

Fire area	Accommodation spaces (AS/TR)	Non-hazardous service areas (SA)	Wellhead and drilling areas (WH)	Process areas including gas compression areas (PA)	Control stations (CS)
AS/TR	1/CF/400	1/CF/400	Not applicable	Not applicable	1/CF/400
SA	1/CF/400	1/CF/400	1/CF/400	1/CF/400	1/CF/400
WH	1/JF[1]/400	1/JF[1]/400	1/JF[1]/400	1/JF[1]/400	1/JF[1]/400
PA	1/JF[1]/400	1/JF[1]/400	1/JF[1]/400	1/JF[1]/400	1/JF[1]/400
CS	1/CF/400	1/CF/400	Not applicable	Not applicable	1/CF/400

[1] "PF" type of fire may be considered as appropriate if the evaluation of fires in the area proves that "JF" is not a credible basis for the calculation of structural fire protection.

Notes: 1. Rating is specified as: Period of resistance (hours)/Type of fire/Critical temperature (°C).

2. Type of fire: PF – pool fire, CF – cellulosic fire, JF – jet fire.

The above-stated temperature (400 °C) has been used as a typical value for structural steel. For aluminum alloys, the critical temperature is the temperature at which the yield stress is reduced to the minimum allowable strength under operating loading conditions.

Table 2.3.3 is read as follows.

Where supports for accommodation spaces depend on structures in a process area, then the load-bearing structure shall be protected against jet fires for one hour at a critical temperature of the steel structure equal to 400 °C.

Where several different fires are possible in the area the type of fire which results in the establishment of the most essential requirements for structural fire protection shall be selected.

2.3.4 Table 2.3.4 specifies standard requirements for integrity and continuity of fire barriers between areas.

Table 2.3.4

Fire area	Accommodation spaces (AS)	Non-hazardous service areas (SA)	Wellhead and drilling areas (WH)	Process areas including gas compression areas (PA)	Control stations (CS)
AS	1/CF-60	1/CF-60	Not to be adjacent	1/CF-60	1/CF-60
SA	1/CF-60	1/CF-0	1/CF-0	1/CF-0	1/CF-60
WH	Not to be adjacent	1/JF[1]-0	1/JF[1]-0	1/JF[1]-0	1/JF[1]-60
PA	1/JF[1]-120	1/JF[1]-60	1/JF[1]-0	1/JF[1]-0	1/JF[1]-60
CS	1/CF-60	1/CF-60	1/CF-60	1/CF-60	1/CF-60
See footnotes to Table 2.3.3					

The functional requirements for fire barriers can be divided into three categories:

preservation of bearing capacity (permissible loads) of a structural member or a fire barrier;

integrity, i.e. to prevent flame, smoke, transmission;

insulation, i.e. to maintain a definite temperature of the back side of a barrier not exposed to fire.

2.3.5 Table 2.3.5 prescribes fire integrity requirements for critical equipment which shall perform its emergency function.

Structural fire protection may be provided in the enclosure containing this equipment to prevent the temperature rise to the level when this enclosure is exposed to fire.

Table 2.3.5

Type of equipment	Protection criteria	
	Surface temperature, °C	Protection period, min
1	2	3
Riser sections	< 200[1]	60[2]
Riser supports	< 400	60[2]
Topside riser ESD valve	< 200	60[2]
Fire pumps	< 200	60

Table 2.3.5 – continued

1	2	3
Emergency generators	< 200	60
UPS systems	40	30
Control panels for SSIV/SSSV/BOP	40	15

[1] When there is no information concerning fire location on the riser, ESD valves and the contents of the riser, it is assumed that the fire is near the ESD valves and the riser is filled with liquid hydrocarbon. As a result, the temperature of 200 °C is used as the anticipated surface temperature for the riser sections to ensure the integrity of the ESD valves.

[2] Minimum time period considered sufficient for complete evacuation of the unit.

2.4 EXPLOSION MITIGATION AND PROTECTION SYSTEMS

2.4.1 Explosion mitigation and protection system (EMPS) aim to reduce explosion probability up to acceptable level.

2.4.2 The EMPS shall meet the following functional requirements:

to prevent, control and mitigate explosions in compliance with the requirements of the FES, i.e. to meet at least one of the following requirements:

reduction of the probability for explosion occurence;

monitoring of an explosion by mitigation techniques that reduce explosion loads to acceptable levels;

mitigation of the consequences from an explosion and reduction of the accident progression as a result of explosion loads;

to determine pressure/loadings time histories, which are generated either from experimental/test data or form suitable computer models;

to provide the explosion mitigation measures to limit explosion overpressure and/or to ensure adequate strength.

2.4.3 An explosion is a sudden and major release of energy normally lasting from 1 to 2 s. Any measures intended to control or mitigate an explosion shall take this behaviour into account.

Explosion damage depends on the rate at which energy is released and the type of energy. In offshore design, two types of energy shall be considered, namely physical energy and chemical energy.

2.4.4 Physical energy may be represented as pressure energy in gases, strain energy in metals and electrical energy. Physical energy may cause destructions affecting accident progression if they result in damage to hydrocarbon-containing equipment.

2.4.5 Chemical energy is released following a chemical reaction. Chemical energy creates overpressure/impulse.

2.4.6 Evaluation of explosion loads and relevant probabilities of exceedance of those loads shall be performed, as well as evaluation of probabilities of critical structures and equipment response to those explosion loads.

Evaluation for the development of EMPS shall:

determine the systems required to preserve the integrity of the structure, most of the equipment or piping systems;

evaluate the possiblity of using water deluge system for explosion control;

determine the potential for accident progression resulting from blast damage which might impair the essential safety systems operation, and from the effect of any fire which may occur after an explosion.

2.4.7 When developing FES the following effects of explosions shall be considered:

equipment destruction;

explosion overpressure;

drag forces which are developed behind the flame front, and which may impose significant loads on equipment, pipeline or structure, and which may escalate the damage created by the explosion.

2.4.8 Consequences of an explosion can be minimized by the use of blast barriers, by arrangement, grouping and relevant positioning of equipment, by application of active explosion suppression systems or equipment of sufficient strength.

However, the most preferable method of protection is to prevent high overpressures in structures and to provide adequate ventilation to allow unburnt gas and combustion products to flow out of the compartment.

Explosion overpressures can be effectively reduced by adopting the approach of inherent safety by design. This requires that the arrangement and location of equipment is such as to minimize equipment and pipelines congestion, limit the use of confining walls, limit module volumes and provide adequate ventilation.

2.4.9 The following explosion-mitigation measures shall be provided:

to locate equipment in a well ventilated compartment handling hydrocarbon where the consequences of an explosion are limited or where the structure can be fitted to withstand the loads generated by an explosion;

to limit the number of bulkheads to separate areas or modules;

to use grated flooring;

to avoid long and narrow modules;

to locate process equipment in the open areas, if environmental conditions allow, as explosion pressure is dependent on the level of congestion and confinement;

to avoid significant obstructions, if this cannot be achieved, ventilation outlets in the bulkheads with frequent obstructions shall be provided.

2.4.10 Where explosion pressure relief valves are provided, they shall be so placed as to minimize the distance between any potential source of ignition and the valve. Such valves shall have the maximum possible free area, as the arrangement of equipment near them, can have major influence on the maximum overpressures expected in the area.

Main escape routes, essential safety systems and vulnerable process equipment shall not be located in the path of the pressure relief valves, due to possible damage by blast effects and flying fragments. Such equipment shall not be placed close to barriers which may be displaced in the event of an explosion.

Cable trays, junction boxes, pipelines and miscellaneous equipment shall not be allowed to block the explosion pressure relief valves and reduce the free area near them, nor shall they be located in the areas where they will increase turbulence and thus explosion overpressures.

2.4.11 Besides the above said, to minimize explosion effects due to overpressures and drag forces, the following shall be adopted for equipment arrangement:

to minimize number of ignition sources;

to orient horizontal pressure vessels so that the largest dimension thereof will be in the direction of main ventilation flow;

to keep the openings in the module boundaries clear of obstructions;

to maximize openings, particularly in floors and ceilings;

to take into account that the accuracy of any explosion overpressure prediction is not fully known, and in particular depends on the prediction technique applied;

to make critical equipment/ structures/ barriers as strong as reasonably practicable, and not to limit a design by calculated explosion overpressure;

to consider explosion suppression by means of ventilation, water sprays, chemicals and dilution;

to perform successive calculation of destruction (failure) so that the accident first occurs in less critical directions;

to minimize the passage of flame;

to increase the strength of supports for pipeline, pressurized vessels and equipment to prevent damage caused by drag forces;

consider the likelihood of impact and damage caused by the flying fragments.

The recommended variants of module layout are shown in Fig. 2.4.11.

2.4.12 Variants of ventilation and equipment arrangement shall be compared on the basis of explosion analysis and/or model tests for specific situations.

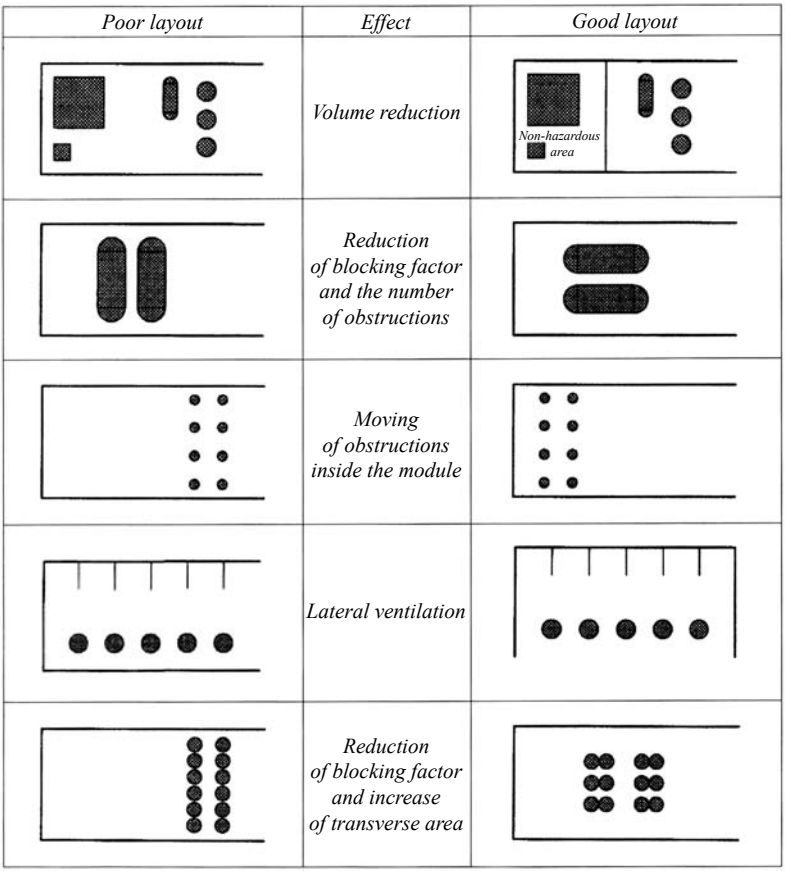

Fig. 2.4.11 Effect of layout on explosion severity

Models used for explosion load calculation shall be tested to the extent possible and allowance for model correction shall be made.

A decision to use design overpressure less than predicted maximum shall be based on the assessment of importance of such pressure for personnel safety.

2.4.13 Requirements for explosion-proof structures, equipment, pipelines and supports shall be documented with calculations which take into account the dynamic behaviour related to the short duration of explosion load.

3 FIRE-FIGHTING EQUIPMENT AND SYSTEMS

3.1 GENERAL

3.1.1 The requirements of this Section apply to all FPU fire-fighting equipment and systems.

Where provision is made for extra fire-fighting equipment and systems on FPU in addition to those prescribed by this Section, such equipment and systems shall comply with the requirements set out below, to the extent approved by the Register in each particular case.

3.1.2 The fire extinguishing systems shall also meet the requirements of Sections 3 Part VI "Fire Protection" and Sections 2, 4 and 5 Part VIII "Systems and Piping" of the RS Rules, Section 3, Part VI "Fire Protection" of the MODU/FOP Rules and Part VIII "Systems and Piping"of the FPU Rules unless expressly provided otherwise.

3.1.3 Fire-fighting equipment and systems shall provide:

control of fires and development of accident situation;

reduction the effect of fires to enable emergency actions or personnel evacuation;

extinguishinf of fires;

limitation of damage to structures and equipment.

3.1.4 Fire-fighting equipment and systems shall comply with the following functional requirements:

provide fire-fighting strategy;

meet the recognized standards for specific application;

intended purposes and environmental conditions shall be considered;

most of the fire-fighting equipment and systems components shall be type approved by the recognized testing laboratories for the environment where they will operate;

operating manual shall be available;

actuation time of the fire-fighting equipment and systems shall not affect their ability of performing the intended function;

automatically activated systems shall be provided with a manual shutdown station.

3.1.5 The activation of fire-fighting equipment and systems can be automatic, manual or both. The starting devices depend on the intended location, size and type of fire, and on FES.

3.1.6 The selection of fire-fighting equipment and fire extinguishing system is influenced by many factors, e.g. the installation size and complexity,

mode of operation, presence of a ship with the mark **FF** in its class notation and FES availability.

In addition to the water fire main system and in accordance with the purpose for which they are intended, the FPU spaces shall be protected by one of the fixed fire extinguishing systems according to Table 3.1.2 of Part VI "Fire Protection" of the MODU/ FOP Rules.

At initial design stage of a unit with the personnel onboard Table 3.1.6 can be used.

The final choice of type, quantity and standards shall be based on the fire analysis and assessments of the fire extinguishing systems.

3.1.7 The following spaces shall be protected by automatic fire extinguishing installations:

spaces for diesel-generators and fire pumps with liquid fuel motor drives;

accommodation spaces defined in the design on the basis of the fire risk analysis;

spaces for electrical equipment (transformers, distribution gears/devices, control cabinets) without permanent work stations;

cable containing spaces (tunnels, ducts, shafts, double floors, galleries, chambers, etc.) if the cables and wires are rated for 220 V voltage or more and their number is 12 or more.

3.1.8 The type of automatic fire extinguishing installation, fire-fighting technique, extinguishing medium, etc. shall be determined at a technical design stage on the basis of technological, structural, layout and arrangement features of the protected spaces.

3.1.9 Automatic fire extinguishing installations shall include fire detection and alarm system functions.

3.1.10 Fire control stations shall be located outside the areas protected by them.

Table 3.1.6

Area / Spaces	Type of protection in addition to portable	Water discharge rates, in l/min/m^2	Notes
1	2	3	4
Wellhead/manifold area	Drenching/foam/dry powder	10 or 400 l/min/per well	
Process area	Drenching/foam/dry powder	10	
Pumps/compressors	Drenching/foam	20	

Table 3.1.6 – continued

1	2	3	4
Gas treatment area	Drenching/dry powder	10	Foam if area contains significant flammable liquids
Methanol treatment area	Alcohol-resistant foam or water jet	10	Portable foam extinguisher, if the methanol area is small
Water-injection treatment area	None, if there is no hydrocarbon risk		
Blowout preventer (BOP) area	Drenching/foam	400 l/min/per well	
Sack or bulk storage area	None		
Control station (CS)	None		To be confirmed in developing FES
Central control station (CCS)	None		Ditto
Instrument room adjacent to CS/CCS	None		Ditto
False floor and ceiling in CS/CCS and instrument rooms			Lifting gear for floor hatches
Turbine area	Drenching	10	Dedicated system only if inflammable materials within the room
Turbine hood	CO_2, gaseous or water mist		Block the access to the hood, if gas is used
Switchgear room	None		To be confirmed in developing FES
Battery room	None		
Emergency generator room	Water mist/foam/drenching	10	Effect of water on equipment in the room shall be evaluated
Fire pump room	Water mist/foam/deluge	10	Ditto
HVAC room	None		

1	2	3	4
Mechanical workshop	Sprinkler	6	
Instrumentation workshop	Sprinkler	6	
Storage of gas bottles	None		Provided stored externally and not exposed to radiant heat
Paint store	Sprinkler		
Accommodation spaces	None		Impregnate inflammable materials to limit risk of ignition
Ventilation ducts from galley	Gaseous		Operated local in galley
Total galley floor area	None		
Galley equipment and cooking range	Local fire extinguishing systems		According to the supplier recommendation
Crane cabin	None		
Crane engine room	Portable/water mist		Drenching, water mist for diesels
Helideck	Foam/dry powder	6	
Hangar	Sprinkler/foam/dry powder	10	
Chain locker	Water	60	
Ballast control station	None		
Turret area	Drenching/foam	10	
Vertical/horizontal structures	Drenching	10/4	
Exits and escape routes	Water screen	15-45 l/min/m	

3.2 WATER FIRE MAIN SYSTEM

3.2.1 The water fire main system shall meet the applicable requirements of 3.2.1.10, 3.2.1.12, 3.2.3.4, 3.2.3.5, 3.2.3.7, 3.2.5.2, 3.2.5.3, 3.2.6.1, 3.2.6.6, 3.2.6.9 of Part VI “Fire Protection” of the RS Rules.

3.2.2 The system shall be designed considering structural features of the unit as a multi-level structure and shall include:

ring mains at the level of accommodation spaces, other levels and compartments shall be fitted with pipes branching from the inner fire main with the necessary number of fire monitors (FM), hydrants;

at least two diesel driven fire pumps supplying water to FM, hydrants, pressure water-spraying and foam fire-extinguishing systems (on manned units of usual type);

pipelines and shut-off fittings for water supply to fire extinguishing installations (sprinkler, foam, etc.).

3.2.3 Pumps shall be capable of delivering untreated sea water. The water treatment shall be provided if fouling can impair the system operation, as well as input filter shall be fitted if the unit waste can damage the pump.

3.2.4 The capacity and head of each fire pump shall be sufficient to ensure simultaneous operation of water or foam fire extinguishing installations and hand fire monitors for design basis fire and are determined by calculation.

3.2.5 As a rule, the system shall cover one most probable fire zone (if water drenching systems are provided) and some hand fire-fighting equipment (jets from FM/hoses). If FES requires, the fire containment measures and any planned temporary drenching systems shall be considered.

3.2.6 The capacity of fire pumps is chosen so that they shall be capable of delivering sufficient amount of water to the systems consuming it in operation.

3.2.7 The capacity of an emergency fire pump shall provide the fire main pressure for fire-fighting and drenching in case of a fire specified in 3.2.5.

3.2.8 The fire pumps shall be located in different compartments of the unit so as not to be damaged simultaneously in the event of an accident. The compartments shall be equipped with an automatic fire alarm system.

3.2.9 The fire pumps shall be connected with the sea water collector below the unit waterline and protected from penetration of ice and bottom suspended matter.

The fire pumps inlets shall be separated so that in case of failure of one pump the other pump inlet remains operable.

3.2.10 The fire pumps location shall allow inspection of the system functioning within the whole range of its operational characteristics.

Equipment (local, and, where necessary, remote control one) shall be provided in sufficient amount for the personnel to determine the operational condition of each pump.

3.2.11 Fire pump relief pressure valves may be required to prevent damage to the pipeline due to high working pressures.

3.2.12 Sea water storage tanks shall meet the requirements of 3.3.2, Part VIII "Systems and Piping" of the MODU/ FOP Rules.

The capacity of the tanks shall be such that minimum permissible amount of water therein permits the operation of at least one fire hose nozzle whithin 15 min, but in any case the capacity shall be not less than 10 m^3.

Where fixed foam fire extinguishing system is provided, the capacity of the tanks shall be such that minimum permissible amount of water therein permits the operation of at least one fire hose nozzle whithin 15 min and at least one foam fire extinguishing apparatus whithin 30 min, but in any case the capacity shall be not less than 20 m^3.

3.2.13 The fire pumps diesel engines shall be fitted with independent fuel tanks. Reserves of fuel shall provide continuous pump operation for at least 6 h.

3.2.14 All seawater consumers on the unit (except fire pumps) shall be automatically disconnected from the seawater supply system in case of fire. The said requirement does not apply to separate water supply systems for fire-fighting and other seawater consumers.

3.2.15 The required parameters of water in the ring fire main shall be constantly maintained.

3.2.16 Fire pumps shall be started:

automatically:

upon receiving the fire detection signal;

upon receiving the signal of low pressure in the ring fire mains;

upon receiving the signal from the manual fire detectors.

manually:

from the button in CCS;

from the button in temporary refuge;

from the button on helideck (if available).

If the communication with the control room is lost the fire pumps shall be started automatically.

3.2.17 The indicators of the fire main water pressure drop shall be provided in CCS.

3.2.18 Once started, the fire pump may be switched off only manually.

3.2.19 Fire pumps shall be located and protected so that they will be capable to deliver water during the fire. Protection from damage to the associated power cables, hydraulic systems/pipeline and control circuits shall be provided.

3.2.20 The system shall be fitted with cut-off valves allowing, if necessary, disconnection of only one fire pump during maintenance operations or repairs.

3.2.21 The ring mains shall be routed so that the unit metal structures can screen them from possible fire or impact damage.

3.2.22 The system shall be provided with devices sending signals to CCS about remote opening and closing of shut-off fittings.

3.2.23 The fire main shall be provided with branch pipes for receiving water from service and fire-fighting vessels. The branch pipes shall be located on the opposite sides of the unit.

3.2.24 The unit protected by water fire main system shall be provided with at least one international shore connection in compliance with 5.1.18, Part VI "Fire Protection" of the RS Rules, by means of which water can be delivered to the water fire main system of a transport ship if this is required for fire-fighting on board the ship.

3.2.25 The ring fire mains shall be equipped with the necessary fittings and connections for testing, holding periodical checks, washing and air venting during the initial filling.

3.2.26 The fire hydrants arrangement and the length of hoses shall ensure the delivery of at least two jets of water from different hydrants to any area of the unit.

3.2.27 Each fire hydrant shall be provided with a fire hose of equal diameter and sufficient (as a rule, up to 25 m) length and with a fire hose nozzle capable of both jet and spray discharge of water/foam.

3.2.28 The fire hoses contained in the lockers shall be connected to the fire hydrants and nozzles.

3.2.29 The places where the fire hydrants are located and fire extinguishing systems are activated shall be fitted with lighted or fluorescent signs and emergency lighting.

3.2.30 The connection of fire hydrants and fire monitors to the fire main shall be such that shutoff of water supply to the sprinkler or foam fire extinguishing systems shall not disrupt water supply to fire hydrants or fire monitors in this area.

3.2.31 Fire monitors (FM) may be used to provide water-spraying, foam fire extinguishing or drenching.

3.2.31.1 The design of monitors shall consider their location, diameter of the supply pipe, arrangement of control valves and environment conditions.

3.2.31.2 A fire monitor may be remotely or locally operated. Remotely started monitors shall be arranged so that they cannot cause injury or block escape routes when operated. Any remotely operated monitor shall have local manual override control.

3.2.31.3 The monitor shall be provided with an access far removed from the unit protected area and so located as to protect a person from the effects of heat radiated by the fire, unless the monitor is started only automatically/remotely.

3.2.31.4 Each monitor shall have sufficient movement horizontally and vertically in order to permit the monitor to cover the complete area of protection. Monitors shall be provided with locking devices.

3.3 DRENCHING SYSTEM

3.3.1 Fixed drenching system may be used to:

control of pool fires and thus reduce the fire spread probability;

provide cooling of equipment and structures not impinged by jet fires;

limit effects of fires to facilitate emergency response and EER activities.

3.3.2 The drenching system is intended to protect:

areas with hydrocarbon equipment and with the pipeline carrying hydrocarbons;

critical equipment such as pressure vessels and well heads;

specific structural members;

personnel during escape and evacuation by reducing heat radiation and smoke spreading.

3.3.3 When designing drenching system the following shall be taken into account:

approved technique for hydraulic analysis shall be used;

water pressure available at the inlet to the system or an individual section shall be sufficient for the efficient operation of all nozzles in that system or section under design water rate;

selected nozzle type, location and operation shall be suitable for the fulfilment of the system function during a fire;

size of nozzles and associated pipeline shall be selected to prevent them from becoming clogged by corrosion products;

nozzles location and orientation shall be so that to ensure the supply of the required quantity of water on the protected surfaces (due attention shall be paid to the effects of obstructions and air movements);

expected time of system operation shall be at least 3 h.

3.3.4 Release of the system shall be possible both manually at the fire risk area and remotely at the control station where the operating status of the system (e.g. valve is open/ closed) is monitored.

3.3.5 Piping shall be designed to be robust and adequately secured and supported, as well as protected against the effects of fires and explosions (with due account to the oscillations).

3.3.6 Means shall be provided to enable the valve testing without discharging water through the pipeline and nozzles.

3.4 PRESSURE WATER-SPRAYING SYSTEM

3.4.1 When evaluating pressure water-spraying system the following shall be considered:

system suitability for specific application;

sufficient water and air supply;

size of the area to be protected and arrangement of the equipment;

the fuel type and the nature of the occurring fire;

effect on electrical and other sensitive equipment within the area of pressure water-spraying system application.

3.4.2 At a first approximation it is recommended to use applicable requirements specified in 3.4, Part VI "Fire Protection" of the RS Rules.

3.5 FOAM FIRE EXTINGUISHING SYSTEM

3.5.1 The unit shall be provided with a fixed deck foam fire extinguishing system.

3.5.2 Foam fire extinguishing system shall meet the applicable requirements of 3.7, Part VI "Fire Protection" of the RS Rules.

3.5.3 The estimated time for fire extinguishing shall be taken equal to 15 min.

3.5.4 The deck in way of cargo tanks (CT) and CT themselves shall be protected by a fixed deck foam fire extinguishing system or equivalent fixed fire extinguishing system approved by the Register.

The requirements of 3.1.4, Part VI "Fire Protection" of the MODU/ FOP Rules shall be also considered.

Method of CT deck area protection and of CT themselves is subject to special consideration by the Register in case of any difficulties of fixed deck fire extinguishing systems arrangement on board the unit (e.g. due to the absence of a deckhouse).

The installation of fixed deck foam fire extinguishing system is not obligatory if the unit is designed to prevent product penetration onto the upper deck and if the unit hull is not intended for product storage.

3.5.5 Provisions shall be made for the installation in the process area of fixed foam generators connected to the foam solution distribution pipeline which provides foam supply sufficient to cover the whole area but not less than 500 m^2.

3.5.6 The installation shall provide foam solution discharge rate of at least 0,08 l/s per m^2.

3.5.7 The foam generators shall be equally spaced along the unit perimeter.

3.5.8 Sufficient foam concentrate and water shall be supplied to ensure foam solution generation in the volume equal to 3-fold supply. The percentage of foam concentrate in the solution is determined depending on the type of foam concentrate and the water used (fresh or sea water). To increase the resistance of medium expansion mechanical foam (expansion ratio 80 – 100) to the effect of sea water, the foam concentration in the solution shall be at least 12 per cent.

3.5.9 The number of portable foam generators, foam applicators or portable combination foam units shall be determined by calculations. For making such calculations Table 3.7.1.3 shall be used and requirements of 3.7.2.3, Part VI "Fire Protection" of the RS Rules shall be considered.

In all cases the unit shall be equipped with at least one portable foam generator, or one foam applicator, or one portable combination foam unit of the required capacity. This number of the said devices shall be confirmed by the appropriate calculation.

3.5.10 Supply system may be constantly filled with the solution of foam concentrate or be dry (not filled with the solution). The possibility of using dry system is determined by calculation.

3.5.11 The system allowable response time from the moment of fire occurrence including the time of sensors (detectors) activation shall not exceed 3 min.

3.5.12 On the supply pipelines (delivering water and foam) at every process area, the installation of fire hydrants or manifolds with coupling heads shall be provided for connecting ships with the mark **FF** in their class notation and supply vessels with the valves to provide water and foam concentrate delivery into their piping system.

3.5.13 The pipeline valves, as well as fire hydrants, manifolds and other fire-fighting equipment shall be manufactured in accordance with the Register requirements.

3.5.14 The number and location of manifolds shall be in compliance with the calculation based on the required quantities of water and foam solution for fire extinction but it shall be not less than two for each process area.

3.5.15 The manifolds shall be provided with common gate fitted directly at the supply pipeline, as well as with valves at each coupling head and drainage arrangements.

3.5.16 For extinguishing fires on the helideck two fixed water-foam nozzles shall be provided.

The nozzles shall be safely located on the opposite sides of the helideck.

3.5.17 The foam concentrate consumption for fire-fighting purpose shall be determined by calculation based on the standard rate of foam solution supply, design fire extinguishing area and foam concentration in the solution.

3.5.18 The standard rate of foam solution supply shall be determined in accordance with the required type of the foam concentrate and helicopter fuel.

3.5.19 The design fire extinguishing area for fighting helideck fires shall be taken equal to overall helideck size.

3.5.20 The hoses of the ship with the mark **FF** in its class notation shall be easily accessible, located near the ends of fire mains, preferably in the areas where the ships may safely moor and shall make it possible to connect four hoses, each 64 mm in diameter. The system inlet openings shall be provided with valves.

3.6 SPRINKLER SYSTEM

3.6.1 Automatic sprinkler system shall be used in areas where cellulosic fires are expected.

3.6.2 The system shall meet the applicable requirements of 3.3, Part VI "Fire Protection" of the RS Rules.

3.7 DRY POWDER SYSTEM

3.7.1 Fixed dry powder system shall provide effective fire extinguishing. The nature of potential fires shall be considered in selecting the type of dry powder and equipment.

3.7.2 When powder and foam concentrate are expected to be used at the same location, their compatibility shall be confirmed.

Self-contained combined systems are available for simultaneous or sequential use of foam and dry powder.

3.7.3 Portable dry powder fire extinguishers or fixed systems may be used.

3.7.4 Dry powder systems shall meet the applicable requirements of 3.10, Part VI "Fire Protection" of the RS Rules.

3.7.5 Several powder fire extinction stations may be used.

3.8 WATER-SCREEN SYSTEM

3.8.1 Water-screen system wall shall be provided in the process area. The design length of the water-screen shall be taken equal to the length of the process area plus 10 m in both directions or equal to the length of cylindrical part of the cargo ship hull if mooring alongside is provided. Sea water may be used in the water-screen system.

3.8.2 The quantity of water, water-screen nozzles, capacity and pressure head, as well as inner diameter of the supply and distribution pipelines shall be calculated so that to provide a continuous water screen of at least 3 m higher above the cargo deck level at the beginning of loading. The pressure head in the water-screen system pipes shall be at least 0,7 MPa.

3.8.3 The distance between the nozzles shall not exceed 0,5 m. The minimum water discharge rate shall be at least 1 l/s per 1 linear metre of the screen length.

3.8.4 The fire main, considering the quantity of water necessary for the sufficient operation of the water-screen system, shall provide the water discharge rate for cooling metal structures of 0,05 l/s per 1,0 m^2 or 0,1 l/s per 1,0 m of the process area length plus 10 m outside the area.

3.8.5 Water screens can be used to protect escape routes and survival craft embarkation stations against heat radiation from possible fires.

3.8.6 The activation of the water screen systems shall be performed both manually, from the place of possible fire, and remotely.

4 FIRE DETECTION AND ALARM SYSTEMS

4.1 GENERAL

4.1.1 Fire detection and alarm systems shall meet the requirements of 4.1, Part VI "Fire Protection" of the RS Rules.

4.1.2 Fire detection and alarm systems shall be designed to serve the following purposes:

fire, smoke, inflammable gases detection;

continuous automatic monitoring to warn the personnel of fire or explosion hazard.

Fire detection and alarm systems shall provide manual or automatic control.

4.1.3 Fire detection and alarm systems shall meet the following functional requirements:

ensure compliance with the FES requirements;

have devices to allow testing of the arrangements and system internal functions;

be easily accessible in the control station to initiate fire or explosion alarm (where provided) and control actions;

visual alarm signal shall be given for personnel assembly, and supplemented with the audible alarm signal in high-noise areas.

4.1.4 Fire detection and alarm systems shall solve the following tasks:

initiate EDP;

isolate electrical equipment to prevent further propagation of fire;

ventilation shutdown;

activate fire extinguishing systems where they are intended for monitoring or mitigation of hydrocarbon fires;

initiate personnel assembly.

4.1.5 Monitoring functions of fire detection and alarm systems shall provide detection of the following:

hazardous accumulations of gases/oil mist;

pump seal leaks;

fires in the early stage.

4.1.6 Fire detection and alarm systems shall have the following functions:

manual activation of alarm signal;

indication of fire location or hazardous accumulation of inflammable gases or oil mist.

4.2 AUTOMATIC FIRE DETECTION AND FIRE ALARM SYSTEMS

4.2.1 Automatic fire detection and fire alarm systems shall be installed on FPU in compliance with the requirements of 4.2.1, Part VI "Fire Protection" of the RS Rules and 4.1, Part VI "Fire Protection" of the MODU/FOP Rules.

4.2.2 The detectors of flammable gas detection system shall be located at the areas where flammable gases are most likely to accumulate, and have operating level of 20 per cent and 50 per cent of the lower flammable limit (LFL), with the exception of air intakes of the heating, ventilation and air conditioning systems where these levels shall be 10 per cent and 20 per cent of LFL to provide immediate system response under intensive air flows.

4.2.3 Different gas detection levels may be used to enable monitoring operations at low gas concentrations without stopping the production process.

4.2.4 Fire detection and alarm systems shall contain test facilities. Faults detected in the system shall be monitored on the control panel.

After the installation of fire detection and alarm systems they shall be tested to confirm that detectors arrangement provides adequate communication. Typical areas of fire/gas detectors application are given in Table 4.2.4.

Table 4.2.4

Hazard	Type of detector	Typical areas	Signals at
Fire	Heat	Process, wellhead	ESD, EDP, closure of SSSV, fire-fighting equipment and systems
		Turbine hoods, workshops, stores, engine rooms, process, wellhead, utilities	ESD, EDP, fire-fighting equipment and systems
		Process, wellhead, generators, gas turbines	ESD, EDP, fire-fighting equipment and systems
	Smoke	Control rooms, special electrical spaces, accommodation area	fire-fighting equipment and systems
		Air intakes to TR and control stations	ventilation shutdown
Flammable gas		Process, wellhead[1], engine rooms[1]	ESD, EDP
		Air intakes	ESD, EDP, ventilation shutdown
Oil mist		Enclosed areas with low gas/oil ratio of liquid hydrocarbons	ESD, EDP
Manual call point		All areas, escape routes, muster stations	Start of fire pumps
[1] Only for the spaces containing safety systems.			

4.3 MANUAL FIRE ALARMS

4.3.1 Manual fire alarms shall be provided on FPU in compliance with the requirements of 4.2.2, Part VI "Fire Protection" of the RS Rules and 4.2 of Part VI "Fire Protection" of the MODU/FOP Rules.

4.3.2 Manual call points shall be easily accessible and located so that the personnel will be able to give an alarm signal in a hazardous situation and immediately start the prescribed actions.

4.4 FIRE PROTECTION AND ALARM SYSTEMS OF UNMANNED SINGLE POINT MOORING (SPM)

4.4.1 Fire protection and alarm systems of unmanned SPM and unattended machinery spaces shall meet the requirements of 4.2.3, Part VI "Fire Protection" of the RS Rules.

4.4.2 For accommodation protection an automatic water fire main system shall be provided, while for other spaces an automatic gas fire extinguishing system shall be actuated, and alarms shall be given by an automatic fire alarm and fire detection systems.

4.4.3 All fire extinguishing systems shall be activated remotely from the FPU control station.

4.5 GAS DETECTION AND ALARM SYSTEMS AND EQUIPMENT

4.5.1 Fixed automatic gas detection and alarm systems shall be provided on FPU in compliance with the requirements of 4.3, Part VI "Fire Protection" of the MODU/FOP Rules.

4.5.2 Where smoke generation and gas ignition may be expected to occur in the temporary refuge, the fire detection and alarm systems shall be worked out for giving signals to provide closing of the ventilation systems before gas reaches the temporary refuge.

4.5.3 Electrical, electronic and programmable devices of detectors shall meet the requirements for ESD.

4.5.4 Temporary shutdown of the fire detection and alarm systems, or part of the system, is reasonable if adequate alternative arrangements are provided.

4.5.5 The fire detection and alarm system control scheme shall be designed, located or protected so that it will be available in hazardous situations where fire and gas detection is required.

4.6 FIRE WARNING ALARMS

4.6.1 Alarms to warn that fire extinguishing medium is released shall meet the requirements of 4.3, Part VI "Fire Protection" of the RS Rules.

4.6.2 Table 4.6.2 specifies the alarm systems. The primary alarm shall be audible, supplemented by flashing lights in high noise areas.

Table 4.6.2

Alarm type	Primary	Supplementary
Assembly	Intermittent signal of constant frequency	Flashing yellow
Prepare to abandon	Continuous signal of variable frequency	Ditto
Gas	Continuous signal of constant frequency	Flashing red in affected area

4.6.3 The following alarm signals shall be provided:

general alarm;
fire detection;
hydrocarbon gas detection;
toxic gas, e.g. hydrogen sulfide gas;
release of fire extinguishing medium in lethal concentration;
closing of mechanically operated watertight doors;
electric power plant failure.

Information on visual and audible alarm signals shall be provided at the central control station.

4.6.4 The alarm signals shall be transmitted automatically or manually.

4.6.5 The alarm signals shall be clearly audible everywhere throughout the unit and be easily identified. In addition to visual alarm an audible alarm shall be provided.

Alarms may be provided by different devices.

4.6.6 Actuation of general alarm shall be possible from the central control station, main control station, wheelhouse and radioroom.

4.6.7 The alarm system shall be connected to the uninterruptible power supply (UPS) in accordance with the requirements of 3.6, Part XI "Electrical Equipment".

4.6.8 The fire detection and alarm systems shall be regularly tested without interruption of the unit operation.

5 FIRE-FIGHTING OUTFIT, SPARE PARTS AND TOOLS

5.1 GENERAL

5.1.1 Spare parts and tools shall meet the applicable requirements of 5.2 Part VI "Fire Protection"of the RS Rules, unless otherwise stated.

5.1.2 Items of fire-fighting outfit shall be of approved type and be ready for use at any time. Fire-fighting outfit shall be located in a readily accessible place.

5.1.3 As a minimum, the fire-fighting outfit shall comply with 5.1, Part VI "Fire Protection" of the RS Rules as applied to oil tankers and shall ensure fire fighting in the process area.

5.1.4 Additionally, units equipped with helidecks shall be provided with fire-fighting outfit in compliance with 6.1, Part VI "Fire Protection" of the RS Rules.

5.1.5 Spare parts for fire extinguishing systems and tools (except one set of fire tools) may be kept in the appropriate shore base.

PART VII. MACHINERY INSTALLATIONS

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of this Part apply to the machinery installations, equipment of machinery spaces, shafting lines, propellers, machinery condition monitoring systems, spare parts and active means of steering ensuring functioning of a floating offshore structure or a unit for its intended purpose and observance of safety requirements thereon.

The said equipment is also covered by the applicable requirements of Part VII "Machinery Installations"of the RS Rules and Part VII "Machinery Installations and Machinery" of the MODU/FOP Rules.

1.1.2 On units without machinery spaces but provided with machinery and arrangements for functioning of the unit for its intended purpose the requirements of this Part are applied to the extent that is reasonable and practicable.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 Definitions and explanations are given in the General Regulations for Classification and Other Activity, in Part I "Classification" and Part VII "Machinery Installations" of the RS Rules, in Parts I "Classification" and VII "Machinery Installations and Machinery" of the MODU/FOP Rules as well as Part I "Classification", Part III "Equipment, Arrangements and Outfit" and Part VI "Fire and Explosion Protection" of the FPU Rules.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 General provisions covering the procedure of classification, technical supervision during construction, as well as technical documentation to be submitted to the Register for consideration and approval are stated in the General Regulations for Classification and Other Activity and in Part I "Classification" of the RS Rules, in Part I "Classification" of the MODU/FOP Rules and in Part I "Classification" of the FPU Rules.

1.3.2 During FPU construction, the manufacture, installation and testing of component parts of machinery installation are subject to technical supervi-

sion by the Register in compliance with 1.3, Part VII "Machinery Installations" of the RS Rules.

2 GENERAL REQUIREMENTS

2.1 POWER OF MAIN MACHINERY

2.1.1 The power of ship-shaped self-propelled FPU shall meet the requirements of 2.1, Part VII "Machinery Installations" of the RS Rules.

2.2 NUMBER OF MAIN BOILERS

2.2.1 The number of main boilers when a steam power plant is used shall be subject to special consideration by the Register in each particular case.

2.3 ENVIRONMENTAL CONDITIONS

2.3.1 Environmental conditions shall meet the requirements stated in 2.3.1, Part VII "Machinery Installations" of the RS Rules.

2.3.2 Main and auxiliary machinery, as well as emergency machinery and equipment on the ship-shaped self-propelled FPU in transit shall meet the requirements of Table 2.3.1-1, Part VII "Machinery Installations" of the RS Rules.

2.3.3 All machinery, equipment and systems which ensure safe operation of non-self-propelled FPU, ship-shaped and non-ship shaped, as well as manned FSPM shall remain operable at static inclination of 15°, dynamic inclination of 22,5° inclusive, in any direction.

2.3.4 Requirements for operating conditions of the machinery installation of SSPM and unmanned FSPM used in marine operations shall be subject to special consideration by the Register.

2.3.5 Upon agreement with the Register, the values of inclinations given in 2.3.2 to 2.3.4 may be changed depending on the type, size and operating conditions of the units.

2.4 MATERIALS

2.4.1 Materials for the manufacture of parts of the shafting and propellers of self-propelled FPU shall meet the requirements of 2.4, Part VII "Machinery Installations" of the RS Rules.

2.5 INDICATING INSTRUMENTS

2.5.1 All the indicating instruments shall meet the requirements of 2.5, Part VII "Machinery Installations" of the RS Rules.

2.6 APPLICATION OF RELIABILITY MEASURES

2.6.1 The reliability measures are established in compliance with the requirements of 2.6, Part VII "Machinery Installations" of the RS Rules.

2.7 FUEL OIL

2.7.1 Fuel oil used on the unit shall meet the requirements of 1.1.2, Part VII "Machinery Installations" of the RS Rules.

2.7.2 Crude oil may be used as fuel for boilers providing that the requirements of 13.11, Part VIII "Systems and Piping" of the RS Rules are met.

2.7.3 Natural gas (methane) may be used as fuel for dual-fuel internal combustion engines (ICE) providing that the requirements of 13.12, Part VIII "Systems and Piping" and Section 9, Part IX "Machinery" of the RS Rules are met.

3 CONTROL DEVICES AND STATIONS. MEANS OF COMMUNICATIONS

3.1 CONTROL DEVICES

3.1.1 Control devices of self-propelled FPU shall meet the requirements of 3.1, Part VII "Machinery Installations" of the RS Rules.

3.2 CONTROL STATIONS

3.2.1 The bridge control stations of main engines and propellers, as well as main machinery control room on self-propelled FPU shall be equipped in compliance with the requirements of 3.2.1, Part VII "Machinery Installations" of the RS Rules.

3.2.2 Main machinery control room and cargo control room (CCR) shall be located as far from machinery spaces as practicable.

3.2.3 CCR shall be equipped with means of communication, control devices, means of monitoring and alarm devices in compliance with the requirements of 3.2.11, Part VII "Machinery Installations" of the RS Rules.

3.3 MEANS OF COMMUNICATION

3.3.1 At least two independent means shall be provided for communicating orders from the navigating bridge of self-propelled FPU to the position in the machinery space or in the main machinery control room meeting the requirements of 3.3.1, Part VII "Machinery Installations" of the RS Rules.

3.3.2 Two-way communication shall be provided between:

CCR and navigating bridge on self-propelled FPU;

CCR and spaces containing cargo and ballast pumps;

process control station, CCR, main machinery control room and other spaces containing equipment essential for the unit safety.

4 MACHINERY SPACES. ARRANGEMENT OF MACHINERY AND EQUIPMENT

4.1 ARRANGEMENT OF MACHINERY AND EQUIPMENT

4.1.1 Arrangement of machinery and equipment shall meet the requirements of 4.2, Part VII "Machinery Installations" of the RS Rules and 2.3, Part VII "Machinery Installations and Machinery" of the MODU/FOP Rules.

4.2 ARRANGEMENT OF FUEL OIL TANKS

4.2.1 Arrangement of fuel oil tanks shall meet the requirements of 4.3, Part VII "Machinery Installations" of the RS Rules.

4.3 INSTALLATION OF MACHINERY AND EQUIPMENT

4.3.1 Installation of machinery and equipment shall meet the requirements of 4.4, Part VII "Machinery Installations" of the RS Rules.

4.4 MEANS OF ESCAPE FROM MACHINERY SPACES

4.4.1 Means of escape from machinery spaces shall meet the requirements of 4.5, Part VII "Machinery Installations"of the RS Rules and 2.6, Part VII "Machinery Installations and Machinery" of the MODU/FOP Rules.

4.5 INSULATION OF HEATED SURFACES

4.5.1 Insulation of heated surfaces shall meet the requirements of 4.6, Part VII "Machinery Installations" of the RS Rules.

5 SHAFTING AND PROPELLERS

5.1 Shafting and propellers of self-propelled FPU shall meet the requirements of Sections 5 and 6, Part VII "Machinery Installations" of the RS Rules, respectively.

6 DYNAMIC POSITIONING SYSTEM

6.1 The steerable propellers of the dynamic positioning system shall meet the requirements of Section 7, Part VII "Machinery Installations" of the RS Rules.

7 TORSIONAL VIBRATION

7.1 Torsional vibration calculations of propulsion plants, diesel-generators and ICE-driven auxiliary machinery shall be made in compliance with the requirements of Section 8, Part VII "Machinery Installations" of the RS Rules.

8 VIBRATION OF MACHINERY AND EQUIPMENT

8.1 The allowable vibration level of machinery and equipment of floating offshore structures shall meet the vibration standards given in Section 9, Part VII "Machinery Installations" of RS the Rules.

9 SPARE PARTS AND TOOLS

9.1 The lists of machinery spare parts which are essential to the propulsion and safety of self-propelled FPU shall meet the requirements of 10.2, Part VII "Machinery Installations" of the RS Rules.

9.2 The lists of machinery spare parts which are essential to the safety of non-self-propelled units are subject to special consideration by the Register.

9.3 The main machinery shall be supplied with a set of appropriate tools and appliances necessary for dismantling and assembling of the machinery in service conditions.

10 MACHINERY TECHNICAL CONDITION MONITORING SYSTEM

10.1 When the technical condition monitoring and control system is applied to the classification survey item on the basis of the Planned Maintenance Scheme, it shall meet the requirements of Section 11, Part VII "Machinery Installations" of the RS Rules.

PART VIII. SYSTEMS AND PIPING

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of this Part cover the following systems and piping:
.1 bilge systems;
.2 ballast systems;
.3 cargo handling systems;
.4 air, overflow, sounding pipes;
.5 ventilation systems;
.6 domestic service systems;
.7 fuel oil systems;
.8 lubricating oil systems;
.9 water cooling systems;
.10 compressed air systems;
.11 exhaust gas systems;
.12 steam and blow-off systems;
.13 feed water systems;
.14 thermal liquid systems;
.15 condensate systems;
.16 product heating systems;
.17 exhaust gas systems;
.18 systems for level control in tanks;
.19 cargo tank washing systems;
.20 fuel oil systems for helicopters.

1.1.2 Pumping and piping shall meet the applicable requirements of Part VIII "Systems and Piping" of the RS Rules and Part VIII "Systems and Piping"of the MODU/FOP Rules.

1.1.3 The fuel oil used on the unit shall meet the requirements of 2.7, Part VII "Machinery Installations" of the FPU Rules.

1.1.4 Machinery and elements of the systems indicated in 1.1.1 to 1.1.5 shall remain operative under climatic conditions specified in 2.1.1, Part XI "Electrical Equipment"and in 2.3.2 to 2.3.6, Part VII "Machinery Installations" of the FPU Rules.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 For the purpose of the present Part, the definitions given in 1.2, Part VIII "Systems and Piping" of the RS Rules have been adopted, where by the ship is meant a unit.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 The scope of technical supervision shall meet the requirements of 1.3, Part VIII "Systems and Piping" of the RS Rules.

1.3.2 The technical documentation submitted to the Register for review and approval shall also include schematic diagrams of the process systems conveying dangerous and flammable media.

1.4 PROTECTION AND INSULATION OF PIPING

1.4.1 Protection and insulation of pipes shall meet the requirements of 1.4, Part VIII "Systems and Piping" of the RS Rules.

1.5 WELDING AND NON-DESTRUCTIVE TESTING OF WELDED JOINTS OF PIPES

1.5.1 Welding and non-destructive testing of welds in pipes shall be effected in compliance with the applicable requirements of 2.5 and 3.2.3, Part XIV "Welding" of the RS Rules.

1.6 MACHINERY, APPARATUS AND CONTROL DEVICES

1.6.1 Machinery, apparatus and control devices used in the systems shall meet the requirements of 1.6, Part VIII "Systems and Piping" of the RS Rules.

2 GENERAL REQUIREMENTS FOR SYSTEMS AND PIPING

2.1 Materials used for manufacture of metal pipes, the allowable radii of pipe bends and heat treatment thereof after bending, allowable pipe wall thickness and types of pipe joints shall meet the requirements of Section 2, Part VIII "Systems and Piping" of the RS Rules.

2.2 Plastic pipes in the units shall be manufactured, assembled and tested in compliance with the requirements of Section 3, Part VIII "Systems and Piping" of the RS Rules.

2.3 Construction of the manually and remotely operated valves, their marking, arrangement and installation, construction of the sea-inlet water boxes and ice boxes, bottom and side valves, openings in shell plating shall meet the requirements of 4.1 to 4.3, Part VIII "Systems and Piping" of the RS Rules, as well as 2.4, Part VIII "Systems and Piping" of the MODU/FOP Rules.

2.4 The air pipe automatic closing devices shall meet the requirements of 4.4, Part VIII "Systems and Piping" of the RS Rules and 2.4.2, Part VIII "Systems and Piping" of the MODU/FOP Rules.

2.5 Piping laying through watertight and fire-resisting structures, in tanks and holds in the vicinity of electrical and radio equipment, inside machinery and other spaces shall be effected with due regard for the requirements of Section 5, Part VIII "Systems and Piping" of the RS Rules and 2.5, Part VIII "Systems and Piping" of the MODU/FOP Rules.

2.6 Tests of piping and fittings shall meet the requirements of Section 21, Part VIII "Systems and Piping" of the RS Rules.

3 REQUIREMENTS FOR THE GENERAL PURPOSE PIPING SYSTEMS

3.1 BILGE SYSTEM

3.1.1 The bilge system shall meet the applicable requirements of Section 7, Part VIII "Systems and Piping" of the RS Rules and 3.1.1, Part VIII "Systems and Piping" of the MODU/FOP Rules.

3.2 WATER BALLAST SYSTEM

3.2.1 The ballast system shall meet the applicable requirements of Section 8, Part VIII "Systems and Piping" of the RS Rules, 3.1.2, Part VIII "Systems and Piping" of the MODU/FOP Rules and 2.4.2, Part V "Subdivision" of the FPU Rules.

3.2.2 The system equipped with fixed pumps shall be capable to remove and take in ballast for all ballast tanks irrespective of their replacement in any combination and sequence.

3.2.3 A system equipped with submersible pumps shall be divided in such a way so that ballast tanks can be filled/emptied independently of one another where tanks are emptied by means of pumps and filled by gravity or by means of pumps.

3.3 CARGO SYSTEM

3.3.1 The cargo system shall meet the requirements of Section 9, Part VIII "Systems and Piping" of the RS Rules as far as it is applicable and sufficient.

3.3.2 FPU shall be provided with stripping system for effective stripping of tanks.

3.4 CARGO TANK WASHING SYSTEM

3.4.1 Cargo tank washing system shall meet the requirements of 9.12, Part VIII "Systems and Piping" of the RS Rules.

3.5 OFFLOADING SYSTEM

3.5.1 General.

3.5.1.1 The Offloading System (OS) includes all components of piping system from connection with the underwater pipeline up to the inlet manifold of the transport ship (TS).

3.5.1.2 Ships intended for operations with units in open sea shall be equipped with bow or aft loading system in compliance with 9.5, Part VIII "Systems and Piping" of the RS Rules.

3.5.1.3 Structural measures shall be taken to ensure the following:

examination of the entire cargo line to provide reliability of attachment thereof;

check of emergency disconnecting systems provided for cargo handling equipment.

3.5.1.4 In the dark periods of time cargo operation areas shall be illuminated to ensure visual observation of cargo hose connections.

3.5.1.5 Materials shall be selected with consideration for the chemical and physical properties of the product.

3.5.1.6 Possible changes in pressure (fluctuations) in the process of normal operation and/or in emergency situations shall be considered and taken into account when selecting structural components of piping.

3.5.1.7 To ensure shut-down of cargo pumps when pressure in the system increases/drops over/below the set values pressure transducers shall be provided.

3.5.1.8 A shut-off device shall be provided to disconnect the unit from the underwater pipeline.

3.5.1.9 In case when automatic shut-off devices are used, provision shall be made for preventing hydraulic impact which can occur when the above devices come into action (appropriate blocking, discharge of product to special tank or to by-pass pipeline, etc.).

3.5.2 Underwater hoses/risers.

3.5.2.1 The length of the underwater hoses/risers, buoyancy components, cross ties between hoses/risers, external limiters (if required) shall be installed with due regard for at least the following:

maximum displacement of floating unit both under operating conditions with the ship secured alongside and under extreme design conditions without a ship secured alongside (in case of permanent joint);

displacements of the component parts of the system;

external forces acting on the system;

range of specific weights of the contents of the system including sea water.

3.5.2.2 All hoses with design pressure up to 1,6 MPa as regards their construction and tests, shall meet the requirements of Section 6, Part VIII "Systems and Piping" of the RS Rules.

3.5.2.3 The system shall be designed in such a way as to avoid wearing-out of underwater hoses/risers due their contact with the unit hull, anchoring or mooring lines, seabed or other hoses/risers.

3.5.2.4 In way of maximum bending and end parts of the hoses by which they are connected to unit, cargo pipeline or manifold, construction of the hoses shall be suitably strengthened.

3.5.3 Production swivel.

3.5.3.1 The production swivel shall ensure reliable connection of the fixed and rotating parts of the cargo pipeline.

3.5.3.2 The design of production swivel shall be approved by the Register.

3.5.3.3 The oil swivels shall be made of steel with flange or welded joints.

3.5.3.4 Account shall be taken of at least the following loads:

torque required to turn the swivel at maximum design pressure from fixed position;

weight of swivel and hose;

dynamic loads due to unit motions, wind and current;

loads due to pipeline;

loads due to pressure;

temperature loads.

Parts of the swivel exposed to pressure shall be designed in compliance with the requirements placed upon the cargo piping system.

3.5.3.5 The swivel shall be tested by the manufacturer in compliance with the approved test program. At least, the following tests shall be provided in the program:

by hydraulic pressure exceeding the design pressure not less than by 1.5 times during at least two hours (no leak or appreciable pressure drop is permitted);

by hydraulic pressure equal to the design pressure at two full revolutions in each direction at a speed of, approximately, ten minutes per revolution;

by hydraulic pressure equal to the design pressure during four full revolutions. The first three revolutions shall be clockwise and the last revolution – anticlockwise. Each turning shall be carried out by steps of 30° during, approximately, 30 s. The starting and rotational torque shall be recorded. If provision is made for simultaneous operation of the oil swivel and turret/mooring swivel their alignment shall be confirmed during the test.

3.5.4 Cargo hoses.

3.5.4.1 Materials used for manufacture of hoses shall meet the requirements of Section 6, Part VIII ”Systems and Piping” and Part XIII “Materials” of the RS Rules.

Materials specifications shall meet the adopted standards and contain strength characteristics.

3.5.4.2 Connection pieces and flanges of the hoses shall be manufactured of steel.

The flanges shall be forged and their outer surfaces including faces shall be protected by electroplating, zinc spraying or by other permissible method. Coating shall be applied in conformity with relevant standards and procedures.

Bolted joints, their material and construction shall meet the relevant standards.

3.5.4.3 The hoses shall be equipped with:

arrangement for transfer of the hose to ship;

quick-action device for emergency disconnection with shut-off valve;

special sections for bending the hose over the gun wall of TS, where necessary;

special sections protected from the action of broken ice.

3.5.4.4 When operating under ice conditions, contact of the cargo hoses with ice hummocks shall be precluded unless this is envisaged by the construction of the hose (clearance not less than 4 m above the consolidated ice level).

3.5.4.5 The floating hoses shall meet the following requirements:

buoyancy reserve is minimum 20 per cent;

buoyant material of the hoses which is applied around the hose body is firmly glued to the body and its coating and all longitudinal butts of that material are tightly glued together;

buoyant material is distributed over the entire length of the hoses in such a way so that the hoses jointed together as a single link be afloat and have similar draught.

3.5.4.6 Double wall hoses for holding any product shall be provided with leakage detection system.

3.5.5 Other structural units.

3.5.5.1 The composition of the equipment shall ensure emergency shut-off in case of excessive pressure increase.

3.5.5.2 A continuous monitoring of pressure in the pipeline and pump characteristics is required.

3.5.5.3 To ensure emergency stop of the product offloading, provision shall be made for:

automatic, remote and manual operation of the pipeline valves (to prevent oil spill and reduce fire hazard);

installation of safety valves on the inlet pipeline which in case of exceeding the permissible pressure discharge the product into the collection tank;

shut-off of the submerged pipeline;

shutdown valves on the pipelines between the SPM and storage or between FPU and TS.

When developing arrangements and apparatus for emergency stop of product supply the formation of hydrates, hydraulic impact and clogging shall be avoided.

3.5.6 Product transportation control.

3.5.6.1 Cargo control room (CCR) on FPU shall be located on the open deck (upper or 1-st tier deckhouse) far apart from the machinery spaces and far aft of all cargo tanks according to 2.4.9, Part VI "Fire Protection" and 3.2.10, Part VII "Machinery Installations" of the RS Rules.

CCR shall be equipped with:

control, monitoring means and alarm devices for cargo handling operations according to 3.2.11, Part VII "Machinery Installations" of the RS Rules;

means of communication according to 3.3.2, Part VII "Machinery Installations" of the RS Rules.

In particular, the cargo operations control system shall provide:

remote control of valves;

remote control of pump revolutions;

automatic closing of valves when the limiting level of cargo in tanks is reached;

remote monitoring of level in tanks;

alarm to indicate the highest level in ballast tanks;

remote monitoring of the discharge and suction pressure of cargo and ballast pumps;

automated operation of the inert gas system.

3.5.6.2 The pumps shall be stopped within a minimum possible time in case of emergency disconnection.

3.5.6.3 The pressure indicators shall be fitted in appropriate locations to stop cargo pump if the pressure in the pipeline exceeds the set value of the maximum permissible pressure or drops below the set minimum value thereof.

3.5.6.4 An interlocking shall be provided to ensure the following operations:

main distributing valves shall be closed unless the components have been connected;

valves located adjacent to joints shall be closed until the joint is disconnected.

3.5.6.5 For hydraulically driven valves accumulators shall be provided. They shall ensure two cycles of operation: "opening – closing".

3.5.6.6 The pressure release and reducing device in the cargo pipeline shall meet the following requirements:

pumping plants shall be equipped with pressure release devices in case of pressure increase above the maximum value;

the safety devices shall be adjusted to the pressure equal to maximum permissible working pressure;

if the product contains substances which can bring the safety valves out of service or rapid pressure rise can occur the bursting discs shall be installed in place of safety valves ;

all systems operating under pressure (containing toxic or flammable media) shall be equipped with a pressure release system in cases of fire;

the pressure release system shall reduce pressure in the system to the level at which the failure shall not occur having regard to the fire duration , heat input conditions and material properties;

when selecting material account shall be taken of the temperature decrease effect during pressure release in the shut-off fittings and outlet pipeline;

opening of the pressure release valves shall be supplied from the source of power ensuring uninterruptible power supply, or from the accumulator.

3.5.6.7 Two-way communication shall be provided between the unit and control stations of the users and suppliers and salvage vessels.

This equipment on the unit may be portable, fixed or combined and to ensure reliable communication the equipment shall be duplicated.

3.5.7 Corrosion protection

3.5.7.1 An appropriate corrosion-resistant coating shall be applied on productive swivels, piping and fittings. Such coating is not required for parts manufactured from corrosion-resistant materials.

3.5.7.2 When designing, the possibility of corrosion due to presence of CO_2, O_2 or H_2S in the product shall be taken into account.

3.6 AIR, OVERFLOW AND SOUNDING PIPES

3.6.1 Air, overflow and sounding pipes shall meet the applicable requirements of Section 10, Part VIII "Systems and Piping" of the RS Rules, 3.1.3, Part VIII, "Systems and Piping" of the MODU/FOP Rules.

3.6.2 In case when the unit is equipped with a fixed inert gas system it shall be provided with closed measurement devices for taking ullages of cargo and slop tanks.

3.7 VENTILATION SYSTEM

3.7.1 Ventilation systems shall meet the applicable requirements of Section 12, Part VIII "Systems and Piping" of the RS Rules and 3.3.1, Part VIII "Systems and Piping" of the MODU/FOP Rules.

3.7.2 Smoke ventilation.

3.7.2.1 Smoke ventilation shall be designed to ensure safe evacuation of people at the initial stage of fire.

3.7.2.2 Smoke extraction shall be provided from spaces and escape routes if the time of filling them with smoke is below the design time required to evacuate people from these spaces and by the specified escape routes.

3.7.2.3 It is recommended to provide smoke extraction from:

accommodation spaces;

escape routes;

corridors of more than 15 m in length having no natural lighting through light openings in external boundaries, in continuously or temporarily attended spaces in process and auxiliary areas.

3.7.2.4 The requirements of 3.7.2 do not cover:

spaces in which time for filling them with smoke exceeds the time required to evacuate people from the space;

spaces of less than 200 m^2, equipped with automatic water or foam fire extinguishing installations;

spaces equipped with automatic gas fire extinguishing installations;

corridors if for all spaces having doors leading to this corridor direct smoke extraction is designed.

3.7.2.5 The required capacity of smoke ventilation shall be determined by calculation.

3.7.2.6 For smoke protection of space provision shall be made for the following:

installation of fans of explosion-proof design corresponding to the hazardous zone category;

air ducts made of non-combustible materials with fire-resistance rating approved by the Register;

smoke valves made of non-combustible materials which automatically open in fire;

emission of smoke to atmosphere at a height not less than 2 m above the deck;

installation of devices to prevent penetration of smoke through the air ducts of smoke ventilation from one space to another.

3.7.2.7 Fans for smoke extraction shall be located in separate rooms with fire-resisting bulkheads.

3.7.2.8 In fire the outside air shall be delivered to smoke-free stairway trunks with air overpressure and to air locks.

3.7.2.9 In the spaces to be protected simultaneous activation of automatic fire extinguishing systems (gas or powder) and smoke ventilation is not allowed.

3.7.2.10 The system shall be designed so that to minimize the probability of smoke penetration to accommodation spaces and to areas temporarily occupied by the personnel during accidents.

3.7.3 Other requirements.

3.7.3.1 The temporary refuge shall be equipped with mechanical ventilation to ensure overpressure therein as compared with the pressure in adjacent spaces and the maximum pressure shall be safe for the personnel who stay in the shelter.

3.8 DOMESTIC SERVICE SYSTEMS

3.8.1 Steam shall be supplied to steam heaters in the machinery spaces, sanitary spaces, storerooms, conditioners, air and water heaters, to clear distant pieces, to steam sewage tanks, heating coils of ballast and fresh water tanks.

3.8.2 Spaces containing electrical equipment which ensures safety of the unit and functioning of the vital systems and arrangements shall be heated by electric heaters.

4 REQUIREMENTS FOR MACHINERY SYSTEMS

4.1 FUEL OIL SYSTEM

4.1.1 The fuel oil system shall meet the requirements of 3.2.1, Part VIII "Systems and Piping" of the MODU/FOP Rules, as well as Section 13, Part VIII "Systems and Piping" of the RS Rules to the extent that is reasonable and practicable.

4.2 LUBRICATING OIL SYSTEM

4.2.1 The lubricating oil system shall meet the requirements of Section 14, Part VIII "Systems and Piping" of the RS Rules and 3.2.2.2, Part VIII "Systems and Piping" of the MODU/FOP Rules to the extent that is reasonable and practicable.

4.3 WATER COOLING SYSTEM

4.3.1 The water cooling system shall meet the requirements of Section 15, Part VIII "Systems and Piping" of the RS Rules to the extent that is reasonable and practicable.

4.3.2 The sea water pumps used for cooling the internal combustion engines shall be located below the water level.

4.3.3 The cooling system of prime movers of the electric generators and auxiliary machinery shall ensure an uninterrupted operation thereof under all operational conditions.

4.4 COMPRESSED AIR SYSTEM

4.4.1 The compressed air system shall meet the requirements of Section 16, Part VIII "Systems and Piping" of the RS Rules to the extent that is reasonable and practicable.

4.5 EXHAUST GAS SYSTEM

4.5.1 The exhaust gas system shall meet the requirements of 3.2.5.2, Part VIII "Systems and Piping" of the MODU/FOP Rules, as well as Section 11,

Part VIII "Systems and Piping" of the RS Rules to the extent that is reasonable and practicable.

4.6 FEED WATER, STEAM AND BLOW-OFF, THERMAL LIQUID SYSTEMS

4.6.1 If the unit is equipped with a boiler (boilers), the feed water, steam and blow-off and thermal liquid systems shall meet the requirements of Sections 17, 18 and 20, Part VIII "Systems and Piping" of the RS Rules to the extent that is reasonable and practicable.

4.6.2 Provision shall be made for insertion of additives into the feed water.

4.6.3 Laying of steam pipes and blow-off pipes as well as calculation for thermal expansion shall meet the requirements of Section 18, Part VIII "Systems and Piping" of the RS Rules.

4.7 CONDENSER INSTALLATIONS

4.7.1 In case when main or auxiliary turbines are installed, the condenser installations shall meet the requirements of Section 19, Part VIII "Systems and Piping" of the RS Rules.

5 SPECIAL SYSTEMS

5.1 FUEL OIL SYSTEMS FOR HELICOPTERS

5.1.1 The fuel oil systems for helicopters shall meet the requirements of 13.13, Part VIII "Systems and Piping" of the RS Rules and 3.3.4, Part VIII "Systems and Piping" of the MODU/FOP Rules to the extent that is reasonable and practicable.

5.2 PROCESS PIPING

5.2.1 The process pipelines which, in case when the unit is used for its designed purpose, may contain dangerously explosive gases or flammable liquids shall not pass through accommodation and service spaces, control stations and machinery spaces, tanks and dry compartments.

5.2.2 The pipelines containing incompatible substances shall be laid as far as possible apart.

5.2.3 The pipelines shall be inclined (in practice, up to 0.02) to ensure their emptying when inoperative. When determined the inclination value account shall be taken of the viscosity properties of oil, extent of the pipeline, its laying conditions. In justified cases, the pipelines may be inclined less than specified above or laid without any inclination, but in this case measures shall be taken to ensure emptying of the pipelines.

5.3 INERT GAS SYSTEM

5.3.1 In case of application on FPU the inert gas system it shall meet the requirements of 9.16, Part VIII "Systems and Piping" of the RS Rules.

PART IX. MACHINERY

1 GENERAL

1.1 The requirements of the present Part apply to machinery and equipment intended to provide operation of the floating offshore structure (FPU) and to ensure fulfillment of safety requirements.

1.2 The above machinery and equipment are subject to the applicable requirements of Part IX "Machinery" of the RS Rules and Part VII "Machinery Installations and Machinery" of the MODU/FOP Rules.

2 GENERAL REQUIREMENTS

2.1 Internal combustion engines intended to operate on the item shall meet the requirements specified in Sections 2 and 9, Part IX "Machinery" of the RS Rules to the extent that is reasonable and practicable.

2.2 Auxiliary machinery shall meet the requirements specified in Section 5, Part IX "Machinery" of the RS Rules to the extent that is reasonable and practicable.

2.3 Deck machinery shall meet the requirements specified in Section 6, Part IX "Machinery" of the RS Rules.

2.4 All the external rotating parts of machinery shall be protected with casings.

2.5 Where the equipment with high noise level is used measures shall be taken to protect personnel from the noise.

2.6 Machinery, equipment and pipelines with surface temperatures exceeding 220 °C shall be insulated.

3 ARRANGEMENT OF MACHINERY AND EQUIPMENT

3.1 Installation of internal combustion engines in hazardous spaces is not allowed.

3.2 Arrangement of machinery and equipment shall comply with the requirements specified in Section 4, Part VII "Machinery Installations" of the RS Rules.

PART X. BOILERS, HEAT EXCHANGERS AND PRESSURE VESSELS

1 GENERAL

1.1 The scope of technical supervision, materials used, strength of structural elements, heat treatment and scope of testing of boilers, heat exchangers and pressure vessels shall comply with the requirements of Sections 1 and 2, Part X “Boilers, Heat Exchangers and Pressure Vessels” of the RS Rules.

2 BOILERS

2.1 Boilers, their oil burning equipment, control, regulation, protection and alarm systems shall comply with the requirements of Sections 3 to 5, Part X “Boilers, Heat Exchangers and Pressure Vessels” of the RS Rules.

3 HEAT EXCHANGERS AND PRESSURE VESSELS

3.1 Heat exchangers and pressure vessels shall comply with the requirements of Section 6, Part X “Boilers, Heat Exchangers and Pressure Vessels” of the RS Rules.

PART XI. ELECTRICAL EQUIPMENT

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part cover electrical equipment of machinery installations, systems and arrangements of floating offshore structures (FPU) subject to the Register technical supervision, as well as particular kinds of electrical equipment in compliance with 1.3.

1.1.2 The applicable requirements of the present Part shall be applied to fixed electrical equipment and automation equipment not listed in 1.3 but capable to adversely affect the operation of essential machinery and appliances in case of their fault or failure.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 Definitions and explanations shall be found in General Regulations for the Classification and Other Activity, in Part I "Classification" and in Part XI "Electrical Equipment" of the RS Rules, in Part I "Classification" and in Part X "Electrical Equipment" of the MODU/FOP Rules, as well as in Part I "Classification", Part III "Equipment, Arrangements and Outfit" and Part VI "Fire and Explosion Protection" of the FPU Rules.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 The applicable kinds of essential equipment listed in 1.3.2 and 1.3.3, Part X «Electrical Equipment» of the MODU/FOP Rules are subject to technical supervision.

1.3.2 On floating offshore structures (FPU) with rotatable structures the distribution boards, control and monitoring desks and panels of rotating structures, arrangements for transmitting electric power and control and monitoring signals to (slip-ring unit) swivels/rotatable structures are also subject to technical supervision.

1.4 TECHNICAL DOCUMENTATION

1.4.1 Prior to the technical supervision of electrical equipment manufacture, the documentation on each kind of equipment, listed in 1.4.2, Part X «Electrical equipment» of the MODU/FOP Rules shall be submitted to the Register for consideration.

1.4.2 For floating offshore structures (FPU) with rotatable structures the slip-ring unit busbar calculation for dynamic and thermal short circuit stability shall be submitted to the Register for consideration prior to the technical supervision of electrical equipment manufacture.

2 GENERAL REQUIREMENTS

The applicable requirements of Section 2, Part X "Electrical Equipment" of the MODU/FOP Rules cover electrical installations and electrical equipment of the unit with consideration of stated below.

2.1 OPERATING CONDITIONS

2.1.1 Climatic operating conditions of electrical equipment shall meet the requirements stated in 2.1.1, Part X «Electrical Equipment» of the MODU/FOP Rules.

2.1.2 Electrical equipment shall be capable of reliable performance under the mechanical effects given in 2.1.2, Part X «Electrical Equipment» of the MODU/FOP Rules.

2.1.3 Requirements to operating conditions of electrical equipment of unmanned FSPM and SSPM used during marine operations are subject to special consideration by the Register.

2.1.4 Electrical equipment shall be designed to comply with the deviations in power supply parameters given in 2.1.3, Part X «Electrical equipment» of the MODU/FOP Rules.

2.2 ELECTROMAGNETIC COMPATIBILITY

2.2.1 The equipment shall operate trouble-free under conditions of interference stated in 2.2, Part XI "Electrical Equipment" of the RS Rules and 2.2, Part X "Electrical Equipment" of the MODU/FOP Rules.

2.3 MATERIALS

2.3.1 Materials shall meet the requirements of 2.3, Part X "Electrical Equipment" of the MODU/FOP Rules.

2.4 DESIGN REQUIREMENTS AND PROTECTION OF ELECTRICAL EQUIPMENT

2.4.1 Protection of electrical equipment shall meet the requirements of 2.4, Part X «Electrical Equipment» of the MODU/FOP Rules.

2.5 PROTECTIVE EARTHING OF NON-CURRENT CARRYING METAL PARTS OF ELECTRICAL EQUIPMENT

2.5.1 Earthing of metal parts of electrical equipment shall meet the requirements of 2.5, Part X "Electrical Equipment" of the MODU/FOP Rules.

2.6 LIGHTNING PROTECTION

2.6.1 Lightning protection shall meet the requirements of 2.6, Part X "Electrical Equipment" of the MODU/FOP Rules.

2.7 ARRANGEMENT OF ELECTRICAL EQUIPMENT

2.7.1 Arrangement of electrical equipment shall meet the requirements of 2.7, Part X "Electrical Equipment" of the MODU/FOP Rules.

2.8 SPECIAL ELECTRICAL ROOMS

2.8.1 Special electrical rooms shall meet the requirements of 2.8, Part X "Electrical Equipment" of the MODU/FOP Rules.

2.9 HAZARDOUS AREAS

2.9.1 Floating production, storage and offloading unit (FPSO) and floating production and offloading unit (FPO) shall be divided into hazardous and non-hazardous areas in accordance with the requirements of 2.9.2-2.9.4.

2.9.2 Hazardous areas are divided as follows:

Zone “0” in which an explosive gas/air mixture is continuously present or present for a long period;

Zone “1” in which an explosive gas/air mixture is likely to occur in normal operation;

Zone “2” in which an explosive gas/air mixture is not likely to occur, and if it occurs, it will exist for a short time.

2.9.3 FPU hazardous zones and areas are given in Table 2.9.3.

Table 2.9.3

Nos.	Areas and spaces	Explosion category/ zones
1	2	3
1	1.1 Internal spaces of closed tanks and pipelines relating to processing equipment of the gas-saturated (active) drilling mud (i.e. mud between a well mouth and a final degassing discharge) system and internal spaces of oil and gas product tanks and pipelines, as well as other spaces in which an oil/gas/air mixture is continuously present or present for long periods.	0
	1.2 Internal spaces of open-type processing equipment from the surface of drilling mud to upper openings.	
	1.3 Internal spaces of vent pipes discharging oil/gas/air mixture from spaces specified in 1.1 and 1.2 of this Table.	
2[1]	2.1 Enclosed spaces, in which open-type processing equipment for oil and drilling mud containing oil and oil gases are installed.	
	2.2 Internal volumes of trunk, ducts, trays and other similar structures from which the dispersion of accumulated gases and vapours is impossible.	
	2.3 Storerooms for cargo hoses carrying highly inflammable fluids (HIF) having a flashpoint 60 °C and less.	
	2.4 Paint lockers, storerooms containing paints, dissolving agents, etc.	
3	3.1 Enclosed spaces containing any part of the gas-saturated (active) mud circulating system (e.g. between the wellhead and shale shaker) that is provided with releasable connections or open through which are potential sources for release of oil-gas-air mixture.	1
	3.2 Enclosed spaces or semi-enclosed locations that are below the drill floor and contain possible sources of oil/gas/air mixture release.	
	3.3 Enclosed spaces that are on the drill floor and are not separated by a solid gas-tight floor from the spaces specified in previous subparagraph specified in 3.2 of this Table.	

1	2	3
	3.4 The area within 1,5 m from the boundaries of any openings to the equipment which is a part of the gas-saturated mud system, in outdoor or semi-enclosed locations, except for those specified in 3.2 of this Table, and also the area within 1,5 m from exhaust ventilation outlets of zone "1" spaces or from any other openings for access to zone "1".	
	3.5 Ducts, pits and other similar structures in locations which would otherwise be zone "2", but the removal of accumulated vapors and gases from them is impossible.	
4[1]	4.1 Enclosed spaces, in which enclosed-type processing plants and facilities, equipment, apparatus, pipelines, shutdown facilities and adjusting devices for HIF and combustible gases are installed.	
	4.2 Pumping and piping spaces for oil and technological drain water whenever the oil content in the effluent exceeds150 mg/litre.	
	4.3 Open areas within 5 m from the boundaries of open-type processing plant, equipment, apparatus containing oil and oil gases or HIF.	
5	5.1 Enclosed spaces, which contain open sections of the mud circulating system from the final degassing discharge to the mud pump suction connection at the mud pit (degassed drilling mud).	2
	5.2 Outdoor locations within the boundaries of the drilling derrick up to the height of 3 m above the drill floor.	
	5.3 Semi-enclosed locations below the drill floor and contiguous to the drilling derrick or beyond its boundaries to the extent of any enclosure (bulkhead), which is liable to trap gases.	
	5.4 Spherical outdoor locations below the drill floor and within a radius of 3 m from the potential source of oil/gas/air mixture release such as the top of a drilling nipple.	
	5.5 The area within 1,5 m beyond the zone "1" areas specified in 3.2 and 3.4 of this Table.	
	5.6 Spherical outdoor spaces within a radius of 1,5 m from the boundaries of exhaust ventilation outlets or any other openings for access to locations and spaces of zone "2" from non-hazardous area.	
	5.7 Semi-enclosed drilling derricks to the extent of their enclosure above the drill floor or to a height of 3 m above the drill floor, whichever is greater.	
	5.8 Air-closed spaces (locks) between zone "1" and a non-hazardous area.	
6[1]	6.1 Open areas within 3 m from the boundaries of enclosed-type processing facilities, equipment, apparatus, as well as from the boundaries of Christmas tree	
	6.2 Semi-enclosed areas, in which processing facilities, arrangements, equipment, apparatus are installed; areas within a radius of 15 m about the well axis from lower structures of the platform to the full height of the drilling derrick.	

Table 2.9.3 – continued

1	2	3
	6.3 Semi-enclosed locations below the drilling derrick working floor.	
[1] Areas and spaces specified in 2, 4, 6 of this Table form part of hazardous zones only under condition of FPU/MODU/FOP compliance with the requirements of RF supervisory bodies.		

2.9.4 Other locations and spaces not associated with zones "0", "1" and "2"relate to non-hazardous area.

2.9.5 Hazardous zones classification for locations and spaces in accordance with Table 2.9.3 (1, 3 and 5) may, in each particular case, be changed on the Register requirement depending on the structural features of the unit and the conditions of locations and spaces ventilation.

2.9.6 Hazardous zones classification for locations and spaces not mentioned in Table 2.9.3, but which may become hazardous under certain conditions, is subject to special consideration by the Register in each particular case.

2.10 OPENINGS. ACCESS AND VENTILATION CONDITIONS AFFECTING THE EXTENT OF HAZARDOUS AREAS

2.10.1 Openings and ventilation of hazardous zones shall meet the requirements of 2.10, Part X "Electrical Equipment" of the MODU/FOP Rules.

2.11 ELECTRICAL EQUIPMENT AND CABLES IN HAZARDOUS AREAS

2.11.1 Electrical equipment and cables in hazardous areas shall meet the requirements of 2.11, Part X "Electrical Equipment" of the MODU/FOP Rules, as well as the applicable requirements of 19.2, Part XI "Electrical Equipment" of the RS Rules, in particular:

regarding electrical equipment 19.2.4.1, 19.2.4.2, 19.2.4.4-19.2.4.12;

regarding cable laying 19.2.6;

regarding integrated cargo and ballast systems 19.2.7.

2.12 ANTISTATIC EARTHING

2.12.1 Antistatic earthing shall meet the requirements of 2.12, Part X "Electrical Equipment" of the MODU/FOP Rules.

3 MAIN SOURCE OF ELECTRICAL POWER

3.1 COMPOSITION AND CAPACITY OF MAIN SOURCE OF ELECTRICAL POWER

3.1.1 Composition and capacity of main source of electrical power shall meet the requirements of 3.1, Part X "Electrical Equipment" of the MODU/FOP Rules.

3.1.2 FPU main source might consist of two independent feeders from external power sources, laid in different cable runs spaced as far as possible.

3.1.3 Composition and capacity of electrical units of the main source or feeders from external power sources shall be determined with regard to the following modes of FPU operation:

.1 operation at sea and/or maneuvering;

.2 production and treatment of hydrocarbons;

.3 inboard/outboard transfer of products including preparatory and completion operations;

.4 emergency modes, for instance, fire, flooding or others emergency conditions affecting the safety of the unit;

.5 other modes in compliance with arrangement and purpose of the unit, for example:

living quarter operation (for manned SPM);

taking-in of fuels and supply;

routine maintenance.

3.2 GENERATING SETS

3.2.1 Generating sets shall meet the requirements of 3.2, Part X "Electrical Equipment" of the MODU/FOP Rules.

3.3 NUMBER AND CAPACITY OF TRANSFORMERS

3.3.1 Number and capacity of transformers shall meet the requirements of 3.3, Part X "Electrical Equipment" of the MODU/FOP Rules.

3.4 POWER SUPPLY FROM AN EXTERNAL SOURCE OF ELECTRICAL POWER

3.4.1 Power supply from external source of electrical power shall meet the requirements of 3.4, Part X "Electrical Equipment" of the MODU/FOP Rules.

3.5 CONNECTION OF UNITS OF MAIN SOURCE OF ELECTRICAL POWER

3.5.1 Connection of units of main source of electrical power shall meet the requirements of 3.5, Part X "Electrical Equipment" of the MODU/FOP Rules.

3.6 UNINTERRUPTIBLE POWER SUPPLY (UPS)

3.6.1 Uninterruptible power supply shall meet the requirements of 3.6, Part X "Electrical Equipment" of the MODU/FOP Rules.

4 DISTRIBUTION OF ELECTRICAL POWER

4.1 Distribution of electrical power shall meet the requirements of Section 4, Part X "Electrical Equipment" of the MODU/FOP Rules.

5 ELECTRIC DRIVES OF MACHINERY AND ARRANGEMENTS

5.1 Electric drives of machinery and arrangements shall meet the requirements of Section 5, Part "Electrical Equipment" of the MODU/FOP Rules.

6 LIGHTING

6.1 Lighting shall meet the requirements of Section 6, Part X "Electrical Equipment" of the MODU/FOP Rules taking into consideration of the following amendment:

6.2 Escape lighting shall meet the requirements of Part XVI "General Requirements and Safety Principles for Floating Production Units" of the FPU Rules, shall be provided at the escape routes, as well as in the staff muster stations.

7 INTERNAL COMMUNICATION AND ALARMS

7.1 Internal communication and alarms shall meet the requirements of Section 7, Part X «Electrical Equipment» of the MODU/FOP Rules.

8 ELECTRIC PROTECTION SYSTEM

8.1 Electric protection system shall meet the requirements of Section 8, Part X «Electrical Equipment» of the MODU/FOP Rules.

9 EMERGENCY ELECTRICAL INSTALLATIONS

9.1 GENERAL

9.1.1 Emergency electrical installations shall meet the requirements of Section 9, Part X "Electrical Equipment" of the MODU/FOP Rules.

9.1.2 In case the emergency lighting is provided mainly by emergency generator, some lighting fixtures shall be equipped with backup accumulator battery supply.

9.1.3 All manned areas of the unit shall be equipped with emergency lighting supplied from emergency power source.

Lighting shall be sufficient to effectively perform necessary operations in emergency situation, including reading of symbols and arrangement plans (see Table 9.1.3).

Emergency escape and entrance routes, as well as exit points shall be illuminated in such a way that they may be easily distinguished in emergency.

Muster and embarkation stations, launching arrangements and surface of sea under them shall be illuminated by emergency lighting.

Table 9.1.3

Area	Normal recommended illuminance	Power supply from emergency generator	Power supply from storage battery[1]
1	2	3	4
Common working areas and machinery spaces	200 lux, 300 lux at control boards	[2]	15 lux
Common passages from spaces	100 lux	[2]	15 lux

Table 9.1.3 – continued

1	2	3	4
Accommodation spaces, cabins and corridors	150 lux[3]	[2]	15 lux
Main control stations, bridge, radio room and standby control stations	500 lux (adjustable)	100 lux	100 lux
Emergency generator room and fire pump room	200 lux	[2]	25 lux
Temporary refuge	200 lux	100 lux	100 lux
Staff muster station	200 lux	100 lux	100 lux
Embarkation station and launching place of life-saving appliances	200 lux	100 lux	100 lux

[1] Operating period of storage battery shall comply with escape duration.

[2] Total illuminance shall be equal to 25 lux, special attention shall be paid to illuminance of entrances and exits, as well as area exits.

[3] Illuminance in service spaces, galley, mess room, laundry, etc. shall be higher, usually 300 lux and above.

9.1.4 Emergency power sources on FPU shall ensure supplying of applicable consumers stated in 9.3.1, Part X "Electrical Equipment" of the MODU/FOP Rules within 18 h, as well as:

.1 emergency lighting of turret room and cargo pump room;

.2 hazardous and toxic gas detection and alarm system;

.3 electric wires and turret control system;

.4 electric drives and control systems of blow-out preventer and of the gear disconnecting FPU from the well head arrangement, as well as electric drives and control systems of production and offloading systems ensuring safety shut-down of production and offloading processes.

9.1.5 Emergency electrical installations shall meet the requirements of Section 9, Part X «Electrical Equipment» of the MODU/FOP Rules.

9.1.6 Cables, feed wires of emergency electrical equipment from emergency power source laid out via high fire hazard shall be fire-resistant or flame-resistant as specified in 16.8.1.7 and 16.8.1.8, Part X of the MODU/FOP Rules. This requirement covers also remote control cables of these appliances.

9.1.7 Systems for tackling emergencies, emergency power supply as well as control and monitoring systems associated with them shall be self-contained and located in such a way that they are not damaged due to the causes affecting the main power supply system.

9.2 EMERGENCY SHUTDOWN AND SAFETY SYSTEMS

9.2.1 FPU shall be provided with an emergency shutdown system (ESD) and process equipment control and safety system (ECS). The ESD and ECS systems may be combined in one system.

9.2.2 The objective of an emergency shutdown system (ESD) is initiating actions to shut down and isolate electrical and processing equipment in order to prevent escalation of abnormal conditions into a major hazardous event and to limit the extent and duration of any such events which do occur.

9.2.3 The main objective of ECS is to shutdown the equipment for production, storage and offloading hydrocarbons, as well as to relieve overpressure by means of specially provided systems to prevent hazard for the whole installation protection of FPU, its personnel and equipment in emergency situations and to prevent the environmental pollution in case of equipment breakage or process failure.

9.2.4 Emergency Shutdown System (ESD).

9.2.4.1 Emergency shutdown system (ESD) shall comply with the following functional requirements:

isolate the installation from the major hydrocarbon inventories within pipelines and reservoirs which, if released on failure, would pose an intolerable risk to the personnel, environment and equipment;

where appropriate, sectionalize topside inventory to limit the quantity of material released on loss of containment;

monitor potential ignition sources such as fired units, engines and non-essential electrical equipment;

control subsurface safety valve(s) on FPU;

where appropriate, depressurize hydrocarbon inventory and vent it to a safe place.

9.2.4.2 ESD system shall be designed so that:

it shall provide all necessary information at the control station so that the operator could manage the emergency situation;

it may be initiated manually or automatically or both. When manual initiation is required, the systems shall be simple to operate and shall not require the operators to make complex or non-routine decisions;

once initiated, all control actions required by ESD system shall occur automatically;

manual stations for initiation of ESD shall be located in strategic positions, be easily accessible, well marked and protected against unintentional activation;

ESD system shall contain facilities for testing of both input/output devices and internal functions;

the reliability of the system is provided by redundancy of its elements;

the system contains means of automatic self-control of the operational condition of its elements and provides alarm signals to the personnel if an element is faulty;

the system maintains its operability under possible fire conditions within the period of time sufficient for restoring the process equipment safe condition.

9.2.4.3 ESD system shall provide 3 levels of emergency shutdown (the first level is the highest), which are selected based on the necessity of preventing the emergency situation escalation from one unit zone to another:

1st level – emergency shutdown initiated automatically during the fire or major oil spill. The personnel evacuation from the unit may become necessary. The 1st level emergency shutdown may also be initiated manually;

2nd level – process shutdown initiated automatically in case of significant deviation of process parameters on the unit from maximum allowable values or as a result of initiating the 1st or 2nd level of emergency shutdown, e.g., the emergency shutdown of a shore reservoir.

3rd level – local shutdown initiated by switching off of specific types of equipment.

9.2.4.4 Upon the emergency shutdown the following explosion proof electrical equipment located in non-enclosed spaces and certified for operation within zone "2" shall continue functioning:

.1 emergency lighting within 30 min;

.2 preventer emergency control system;

.3 general alarm system;

.4 public address system;

.5 communication radio equipment supplied from its own accumulator batteries;

9.2.4.5 All ESD levels shall be initiated automatically (on receiving fire protection system signals) or manually from CCS.

9.2.4.6 Manual initiating of each ESD level shall be performed by pushing one button. The time required for the process control systems to activate each ESD level after the latter has been initiated by the operator shall be reduced to minimum.

9.2.4.7 ESD system shall be arranged so that the highest level shutdown initiation provides for automatic activation of all the lower levels shutdown operations.

9.2.4.8 Protection shall be provided against the ESD activations caused by accidental or short-time signals of process disruption, including switching over from/to reserve or emergency power supply.

9.2.4.9 In case of complete power, compressed air or hydraulic supply failure the way for restoring safe condition of the process equipment shall be provided.

9.2.4.10 Taking into consideration exceptional circumstances under which the danger of explosion can spread onto hazardous areas, special means shall be provided for effecting selective manual disconnection or shutdown of:

ventilation;

all non-essential electrical equipment in non-hazardous areas;

all essential electrical equipment including the equipment supplied from accumulators and generator prime movers, except such previously tested equipment as emergency lighting, general alarm system etc., which shall function in case of emergency .

The radio installation supplied from accumulator batteries is not required to be previously tested or incorporated into ESD system.

9.2.4.11 Technical devices for ESD systems manual activation shall be located in the following rooms:

emergency control stations;

auxiliary control stations e.g., main escape routes, helideck, etc.

9.2.4.12 The valve activated automatic shutdown shall take place under the following conditions:

discovered fire in turret and crude oil tanks areas;

discovered hydrocarbon gas concentration is 50 per cent of LEL in turret and cargo tank areas.

9.2.4.13 The automatically activated ventilation shutdown shall be performed under the following conditions:

discovered maximum gas concentration is 25 per cent of LEL in air inlets in the non-hazardous areas;

discovered fire in the enclosed non-hazardous area.

9.2.4.14 ESD system shall be based on open valve and equipment circuits.

Electric ESD systems shall be designed so that the risk of unforeseen shutdown due to a failure in the functioning of the system or of unforeseen shutdown operation is minimized.

9.2.4.15 ESD initiation shall activate audible and visual alarm signals at the control stations.

The alarm signals shall be indicated so that the ESD location and source of activating or the equipment initiating the ESD activation can be easily identified at the control stations.

9.2.4.16 ESD system activating sensors, actuators/ triggers and the equipment and circuits associated with them shall be installed and operate independently of monitoring and control systems.

9.2.4.17 Manual ESD actuation system shall be, as far as practicable, independent of the automatic ESD actuation system.

9.2.4.18 ESD system shall be designed so that it can be tested when the unit is in operation.

9.2.5 Equipment safety and control system (ECS) in the FPU process area.

9.2.5.1 ECS system is intended to shutdown the equipment for production, treatment, storage and offloading hydrocarbons, as well as to relieve overpressure by means of specially provided systems to prevent hazard to the whole unit.

9.2.5.2 ECS design shall be developed in accordance with the FPU design, set of equipment installed and production process peculiarities. Requirements of Part XIV, "Automation" of the MODU/FOP Rules shall be considered as applicable.

9.2.5.3 ECS shall function automatically and independently of other control and monitoring systems.

ECS manual activation shall be provided as follows: from the control station, wellhead areas (well cutoff valves), helideck and embarkation stations. The possibility of ECS remote activation shall be provided.

9.2.5.4 ECS activation periodic checks shall be provided by simulating emergency situations specified in ECS design.

9.2.5.5 The requirements of this chapter apply to ECS equipment subject to technical supervision by the Register irrespective of an automation mark in the FPU class notation.

9.2.5.6 Depending on possible consequences of emergency situation, the following process shutdown shall be provided by ECS:

shutdown of separate FPU blocks and systems both with and without emptying them of the product and stopping the entire process;

complete shutdown of the hydrocarbon production and treatment of other systems both with and without emptying them of the product;

complete shutdown of all process equipment (except emergency life support systems), closing cutoff valves on the wellheads and pipelines connecting the unit with the other structures of the offshore oil and gas field facilities or with transport ships, emptying the process equipment and pipelines through the systems provided for this purpose.

9.2.5.7 In case of emergency situation in one of the wells or one of the equipment blocks the possibility of their shutdown shall be provided (i.e. partial shutdown of the process).

ECS shall provide the following compulsory stages of partial shutdown:

closing of all wellhead valves and plates (including those fitted in the block of submerged blowout preventer equipment);

complete shutdown of the production and treatment block and equipment and systems associated with it.

The number of stages depends on the particular FPU design.

9.2.5.8 The algorithm of closing/opening cutoff valves, switching on/off other devices, the list of possible process failures and troubleshooting, list of parameters values which are characteristic to partial or complete process stopping shall be specified in the corresponding sections of the equipment operating manuals.

9.2.5.9 All process shutdown operations shall be performed automatically upon the command given by the process control system.

In case of automatic control system failure the possibility for operator's intervention shall be provided and the work shall proceed manually.

9.2.5.10 The process shall be terminated in case of fire in the process area.

9.2.5.11 When the hydrocarbon concentration in the air of the hazardous zones (0, 1, 2) reaches 20 per cent of LEL (lower flame limit) alarm actuation shall be provided and emergency exhaust ventilation (EEV) shall be activated.

9.2.5.12 In case of further concentration increase up to 50 per cent LEL, blackout, fire, and high/low pressure in the wellhead product delivery pipeline, all the processes in the oil and gas production systems shall be shutdown, including EEV.

9.2.5.13 Realization of algorithms of emergency shutdown of hydrocarbon production process in any module or block shall not lead to an emergency situation on other modules or blocks of the unit.

9.2.5.14 The complete shutdown of all process equipment and processes upon the operator's signal from the CCS or other control stations is provided in case of the emergency situation escalation:oil/gas blowout; seal failure of the systems containing hydrocarbons; fire alarm actuation.

9.2.5.15 In case of complete process equipment and processes shutdown the following shall be provided:

closing of wellhead valves;

product treatment process shutdown;

disconnection of main sources of electric power;

9.2.5.16 The signal for automatic operation of closing devices (cutoff valves) shall be provided in response to:

the signal from air monitoring sensors;

fire alarm actuation;

loss of power supply;

safety systems failures;

ship contact with FPU when mooring;
installation loss of stability;
structures collapse due to the helicopter crash and fall onto the topside.

9.2.5.17 Response to above mentioned signals shall also be provided manually upon the signal from the control panel or by pressing emergency stop buttons located in other areas of the unit.

9.2.5.18 Provision shall be made for the possibility of remote control of all the steps of shutdown process

10 ELECTRICAL MACHINES

10.1 Electrical machines shall meet the requirements of Section 10, Part X «Electrical Equipment» of the MODU/FOP Rules.

11 TRANSFORMERS

11.1 Transformers shall meet the requirements of Section 11, Part X «Electrical Equipment» of the MODU/FOP Rules.

12 POWER SEMICONDUCTOR UNITS

12.1 Power semiconductor units shall meet the requirements of Section 12, Part X «Electrical Equipment» of the MODU/FOP Rules.

13 ACCUMULATOR BATTERIES

13.1 Accumulator batteries shall meet the requirements of Section 13, Part X «Electrical Equipment» of the MODU/FOP Rules.

14 ELECTRICAL APPARATUS AND ACCESSORIES

14.1 Electrical apparatus and accessories shall meet the requirements of Section 14, Part X «Electrical Equipment» of the MODU/FOP Rules.

15 ELECTRICAL COOKING AND HEATING APPLIANCES

15.1 Electrical cooking and heating appliances shall meet the requirements of Section 15 части X «Electrical Equipment» of the MODU/FOP Rules.

16 CABLES AND WIRES

16.1 Cables and wires shall meet the requirements of Section 16 Part X «Electrical Equipment» of the MODU/FOP Rules.

17 ELECTRIC PROPULSION PLANTS

17.1 Electric propulsion plants shall meet the requirements of Section 17, Part X «Electrical Equipment» of the MODU/FOP Rules.

18 REQUIREMENTS FOR ELECTRICAL EQUIPMENT DESIGNED FOR VOLTAGE ABOVE 1000 V UP TO 15000 V

18.1 Electrical equipment designed for voltage above 1000 V up to 15000 V shall meet the requirements of Section 18, Part X «Electrical Equipment» of the MODU/FOP Rules.

19 SPARE PARTS

19.1 Spare parts shall meet the requirements of Section 19, Part X «Electrical Equipment» of the MODU/FOP Rules.

PART XII. REFRIGERATING PLANTS

1 GENERAL

1.1 The refrigerating plants installed stationary onboard the floating offshore structure (FPU) shall meet the requirements of 1 to 8, 11 and 12, Part XII “Refrigerating Plants” of the RS Rules.

PART XIII. MATERIALS

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part apply to materials and products intended for welded structures, components of machinery and equipment of floating offshore structures (FPU) subject to the Register technical supervision in accordance with the requirements of the relevant parts of the FPU Rules.

1.1.2 Materials and products subject to technical supervision during manufacture shall meet the requirements of Part XIII "Materials" of the RS Rules and Part XII "Materials" of the MODU/FOP Rules as well as the requirements of the FPU Rules.

1.1.3 Materials, being part of a structure or a product, on which the requirements not included in the above Rules or the present Part are imposed due to conditions of their operation shall be specially considered by the Register.

It is permitted, after special consideration by the Register, to accept materials and products complying with the requirements of national and international standards or with other technical requirements agreed with the Register.

1.1.4. The materials differing in chemical composition, mechanical properties, condition of supply or manufacturing method from those specified in Part XIII "Materials" of the RS Rules shall be reviewed by the Register. In this case, data shall be submitted which confirm the possibility of these materials application in accordance with their purpose.

1.1.5 Materials and products subject to technical supervision of the Register shall be produced by manufacturers recognized by the Register and having the following documents:

Recognition Certificate for Manufacturer;

Type Approval Certificate.

The procedure of issue of the above certificates has been established in 1.1.4 and 1.3.2, Part XIII «Materials» of the RS Rules as well as in Sections 2 and 3, Part III "Technical Supervision during Manufacture of Materials" of Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

1.1.6 For structures affected by chemically aggressive media, e.g. hydrogen sulphide, data confirm material resistance to corrosion at their operation in such media shall be submitted.

In any case, the internal surfaces of tanks shall have protective epoxy coatings or other equivalent, or corrosion-resistant coatings applied in accordance with the manufacturer recommendations approved by the Register. Where necessary, anode protection shall be used.

2 STEEL FOR BOILERS, HEAT EXCHANGERS AND PRESSURE VESSELS

2.1 GENERAL

2.1.1 The requirements of this Section apply to rolled steel intended for boilers, heat exchangers and pressure vessels subject to the Register technical supervision in accordance with the requirements of other parts of the FPU Rules.

2.1.2 In general cases the steel for boilers, heat exchangers and pressure vessels as well as the scope and procedure of steel testing shall satisfy the requirements of 3.3, Part XIII "Materials" of the RS Rules as well as the Register recognized standards or other technical documentation.

2.1.3 The steel intended for manufacture of pressure vessels shall be subject to impact tests on specimens with sharp V-notch (KV_T) and longitudinal axes perpendicular to the direction of final rolling in addition to tests stipulated by Part XIII "Materials" of the RS Rules. Impact tests of carbon and carbon-manganese steel specimens intended for low-temperature use shall be carried out at a temperature at least 5 ºC lower than the design temperature.

3 STEEL TUBES AND PIPES

3.1 GENERAL

3.1.1 The requirements of this Section apply to steel tubes and pipes intended for the components of machinery, systems, piping and FPU equipment subject to the Register technical supervision in accordance with the requirements of other parts of the FPU Rules.

3.1.2 The tubes and pipes subject to the Register technical supervision shall meet the requirements of 3.4, Part XIII «Materials» of the RS Rules.

4 STEEL FOR WELDED CHAIN CABLE LENGTHS, ANCHOR AND MOORING CHAIN CABLES

4.1 GENERAL

4.1.1 The present requirements apply to steel, design, manufacture and testing of anchor and mooring chain cables subject to the Register technical supervision.

4.1.2 Steel for anchor chain cables subject to the Register technical supervision shall meet the requirements of 3.6, Part XIII "Materials" of the RS Rules.

4.1.3 Chain cables and accessories shall be manufactured and tested by Register-recognized manufacturers in accordance with Register-approved technical documentation.

4.1.4 The material and design of chain cables and accessories shall meet the requirements of Sections 3 and 7, Part XIII "Materials" of the RS Rules.

5 STEEL FORGINGS AND CASTINGS

5.1 GENERAL

5.1.1 The present requirements apply to steel forgings and castings intended for manufacture of machinery and structural components subject to the Register technical supervision in accordance with the requirements of the relevant parts of these Rules.

5.1.2 Steel forgings and castings shall meet the requirements of 3.7, 3.8, Part XIII "Materials" of the RS Rules.

Forgings and castings intended for components and products operating at temperatures below zero shall meet the requirements of 3.5, Part XIII "Materials" of the RS Rules.

PART XIV. WELDING

1 GENERAL

1.1 Requirements of the present Part apply to welding of FPU hull structures, machinery and machinery installations, steam boilers, heat exchangers, pressure vessels, piping, equipment and arrangements.

1.2 Welded joints and structures subject to the Register technical supervision shall meet the requirements of Part XIV "Welding" of the RS Rules and Part XIII "Welding" of the MODU/FOP Rules.

1.3 As far as structures stated in 1.1 are concerned, the following is subject to the Register technical supervision:

.1 welding consumables;

.2 welding procedures (selection of welding consumables, preparation of components for welding, assembly, pre- and postheating, heat treatment);

.3 methods and scope of inspection, criteria for evaluation of welded joints.

1.4. The scope of technical documentation on welding, which shall be agreed as part of the FPU design is set out in Part I "Classification" of the RS Rules. Technical documentation on items specified in 1.1 shall include information on welding required by those parts of the RS Rules, which cover the items concerned.

1.5 Welding of items stated in 1.1 shall be effected by certified welders (operators) and Register-approved welding works (shops, bays) using welding consumables and welding procedures approved by the Register.

1.6 To effect welding operations and non-destructive testing of welded joints in structures subject to the Register technical supervision the works shall have adequate equipment.

1.7 Where welding is performed at low temperatures working conditions shall be provided to enable the welder to produce sound welds. The welding site shall be protected from draught and precipitation. When welding is performed at low temperature, the weld, if necessary, shall be protected from excessively rapid cooling.

1.8 On condition proper quality of welded joints is ensured, welding operations on structures specified in 1.1 of hull structural steel of normal and higher strength 20 mm or below in thickness are permitted at ambient temperature –25 ºC, provided the welding consumables have been tested at this temperature according to the Register approved procedure.

1.9 The welding of piping made of low alloy steel, piping of the steam main as well as piping, which shall operate at temperatures above 350 ºC shall not be conducted at temperatures below zero.

1.10 The edge preparation of the parts to be welded shall be effected by methods which ensure the required quality of welded joints.

1.11 From the edges of the parts to be welded, oil, moisture, scale, rust and other contaminating substances shall be removed.

1.12 When welding of structures is effected at temperatures below zero the edges being welded shall be free from snow, hoar-frost and ice and be dry.

1.13 When structures are welded, the sequence of welding operations shall be such as to ensure the absence of excessive residual stresses or distortions.

1.14 Instances of welding and cutting under water as well as welding operations on structures on the reverse side of which water is present during welding shall be subject to special consideration by the Register.

1.15 Inspection of welding operations and welded joints during manufacture of structures and components shall be performed by the inspection authorities of the works. The results of the inspection shall be registered according to the procedure adopted at works, field not less than 5 years after the commissioning of the item and submitted to the surveyor to the Register at his request for examination.

1.16 The non-destructive testing of welded joints shall be effected according to the Register-approved standards or procedures and by laboratories recognized by the Register.

PART XV. AUTOMATION

1 GENERAL

1.1 APPLICATION

1.1.1 Requirements of Sections 1-5 and 8, 9 apply to the automation equipment liable to technical supervision without regard to the automation mark in the class notation of the floating offshore structure (FPU).

1.1.2 Requirements of Sections 6, 7 additionally apply to the equipment of objects which class notation is added with one of the automation marks and/or one of the dynamic positioning system marks in accordance with Part I "Classification".

1.1.3 Requirements of Section 6 also apply to the objects without the automation mark in the class notation but those equipped with the central control station and remote control systems for the machinery and arrangements.

1.1.4 The present part of the Rules contains technical requirements for the automation equipment and objects where it is installed as well as it contains the minimum scope of the remote, automated and automatic control, protection, alarm and indication systems.

1.1.5 The scope of automation of the electrically propelled objects or nuclear power plants to obtain relevant mark in the class notation is a matter of the special consideration by the Register.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 Definitions and explanations are given in the General Regulations for the Classification and Other Activity, Part I "Classification" and Part XV "Automation" of the RS Rules, Part I "Classification " and XIV "Automation" of the MODU/FOP Rules, as well as in Part I "Classification", Part III "Equipment, Arrangements and Outfit" and Part VI "Fire and Explosion Protection" of the FPU Rules.

1.2.2 Thruster assisted position mooring system is a position mooring system where an auxiliary dynamic positioning system is used to supplement a position mooring system.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 Automation components, control devices and systems listed in 1.3.2, Part XIV "Automation" of the MODU/FOP Rules in the applicable scope are liable to the technical supervision of the design and manufacture of equipment and its details.

1.4 TECHNICAL DOCUMENTATION

1.4.1 Technical documentation in accordance with the requirements of 1.4, Part XV "Automation" of the RS Rules and 1.4, Part XIV "Automation" of the MODU/FOP Rules shall be submitted to the Register in respect of the automation equipment listed in 1.3.1.

2 DESIGN OF AUTOMATION SYSTEMS, AUTOMATION COMPONENTS AND CONTROL DEVICES

2.1 GENERAL

2.1.1 Automation systems shall comply with the requirements of 2.1, Part XIV "Automation" of the MODU/FOP Rules.

2.1.2 Automation components, devices and systems fitted on open decks shall operate without fails at a design external temperature appropriate to the FPU area of operation.

2.2 REQUIREMENTS FOR COMPONENTS, DEVICES AND SYSTEMS OF THE AUTOMATED CONTROL, ALARM, PROTECTION, INDICATION AND LOGGING

2.2.1 Components, devices and systems of the automated control, alarm, protection, indication and logging shall comply with the requirements of 2.2, 2.3 and 2.4, Part XIV "Automation" of the MODU/FOP Rules correspondingly.

3 POWER SUPPLY OF AUTOMATION SYSTEMS

3.1 Power supply of the automation system shall comply with the requirements of Section 3, Part XIV "Automation" of the MODU/FOP Rules.

4 AUTOMATED MACHINERY AND INSTALLATIONS

4.1 Automated machinery and installations shall comply with the requirements of Section 4, Part XIV "Automation" of the MODU/FOP Rules.

5 COMPUTERS AND COMPUTER-BASED AUTOMATION SYSTEMS

5.1 Computers and computer-based automation systems shall comply with the requirements of Section 5, Part XIV "Automation" of the MODU/FOP Rules.

6 OBJECTS WITH THE AUT MARK IN THE CLASS NOTATION

6.1 Objects with the **AUT** mark in the class notation shall comply with the requirements of Section 6, Part XIV "Automation" of the MODU/FOP Rules.

7 DYNAMIC POSITIONING SYSTEMS

7.1 Dynamic positioning systems shall comply with the requirements of Section 7, Part XIV "Automation" of the MODU/FOP Rules.

8 POSITION MOORING SYSTEM

8.1 Position mooring system shall comply with the requirements of 8.1 and 8.2, Part XIV "Automation" of the MODU/FOP Rules.

9 THRUSTER ASSISTED POSITION MOORING SYSTEM

9.1 Thruster assisted position mooring systems are subject to special consideration by the Register.

9.2 Applicable requirements of 7.7, 7.8, 7.12 and 8.2, Part XIV "Automation" of the MODU/FOP Rules apply to the control systems of the thruster assisted position mooring system.

PART XVI. GENERAL REQUIREMENTS AND SAFETY PRINCIPLES

1 APPLICATION

1.1 The requirements of the present Part apply to floating production, storage and offloading.

2 GENERAL SAFETY PRINCIPLES

2.1 FPU safety shall comply with the requirements of Part XV "MODU and FOP Safety Assessment" of the MODU/FOP Rules, as well as with the requirements set forth below.

2.2 Safety and location of equipment, machinery and arrangements providing FPU operation as an offshore facility shall meet the requirements of the RS Rules to the extent that they are practicable and reasonable, unless otherwise specified.

2.3 Structural, technical and organizational measures shall be taken to ensure FPU safety.

2.4 The basic principle for FPU safety is the separation of functional areas (zones) of the unit (accommodation, storage, processing areas etc.) in accordance with their explosion hazard potential. Zones of high risk potential (hazardous zones) shall be separated from the others.

Hazardous zones are enclosed spaces, semi-enclosed and out-door locations and spaces in which, due to presence of explosive gas or explosive gas/air mixture, explosion hazard exists continuously or periodically.

Other zones and areas are considered to be non-hazardous.

2.5 Depending on the explosion hazard, the FPU zones shall be divided as follows:

Zone "0" in which an explosive gas/air mixture is continuously present or present for long periods;

Zone "1" in which an explosive gas/air mixture is likely to occur in normal operation;

Zone "2" in which an explosive gas/air mixture is not likely to occur, and if it occurs, it will exist for a short time.

One or another equipment or space shall be referred to a certain explosion category meeting the requirements of 2.9, Part XI "Electrical Equipment".

2.6 Electrical equipment installed in FPU hazardous zones shall be selected in compliance with the requirements of the normative documentation.

The equipment in zones "0" to "2" shall be of explosion-proof and safe type.

2.7 During installation of the equipment it shall be isolated from or located at a safe distance from hazardous zones, accommodation spaces and provided with effective ventilation. Adequate structural measures shall be also taken to protect process and accommodation areas from the effect of explosions and fires.

2.8 The locations within zone "2", as well as non-hazardous processing machinery spaces shall generally not be adjacent to hazardous spaces and areas. Where passageways are available, they shall be fitted with air-lock(s), where pressurization is provided by mechanical supply ventilation.

Hazardous processing machinery spaces shall have at least two exits, one of which shall give access directly to the open deck.

2.9 Electric power plants shall be segregated from hazardous zones with fire walls and divisions having fire resistance limit of 1 h (A-60 class) facing potential effect of fire.

2.10 Fixed heating appliances, boilers and internal combustion engines shall normally be located at a safe distance from hazardous areas. In areas where they may cause ignition as a result of accidental gas or liquid discharge special measures shall be taken (gas-tight closures, gas detection systems, insulation and cooling of hot surfaces, using fire-resisting bulkheads, etc).

2.11 The equipment shall be located to provide:

safe escape from working areas;

effective ventilation of working areas;

minimum excessive pressure in case of hot gas release;

access for fighting fires and combating accidents;

prevention of serious consequences from dropping objects;

minimum possibility of propagation of fires, damage and accidents;

safe suppression of hazardous liquid accidental blowout;

simultaneous performance of operations.

2.12 Essential safety systems shall be located so that in accident situations they can remain operable.

Safety systems control devices shall be located in such places where they are easily accessible and ready for simultaneous use in the event of an accident.

2.13 Accommodation and public spaces shall be located as far as practically away from hazardous zones taking into account prevailing winds.

Outer protective walls of accommodation spaces shall be capable of withstanding the effects of fire for at least 1 h (A-60 class).

2.14 Oil/gas filling and transfer system shall be located as far as practically away, but at least 10 m from accommodation and service spaces.

2.15 Radio stations, control stations of automated fire extinguishing installations and fire alarm system are located in the central control station (CCS), while duplicate control and means of communication shall be located in the temporary refuge.

2.16 Escape routes shall be provided for FPU personnel, in the event of an accident, to the survival craft embarkation stations and to the landing area. At least two escape routes shall be provided.

3 ESCAPE ROUTES

3.1 The recommendations of the present Section aim to ensure timely and unobstructed evacuation of FPU personnel in the event of fire and to provide continuous fire shelter from the effects of hazards along escape routes.

3.2 Escape routes shall provide safe escape of the personnel from FPU spaces.

3.3 The evacuation shall be provided to the temporary refuge, muster and survival craft embarkation station, landing area, as well as to other FPU areas where there are no fire hazards.

3.4 Escape routes protection from outside of the spaces shall be provided taking into account the following factors:

fire hazard category of the spaces from which the escape is performed;

number of personnel to be evacuated;

fire resistance of structures;

number of escape routes from FPU decks, platforms and spaces.

3.5 The number of escape routes from each deck, platform and tier of process and accommodation area shall be assumed in compliance with the design but shall in no case be less than two.

Dead-end corridors in FPU spaces shall not exceed 5 m in length.

3.7 Width in the clear of escape routes and doors shall be at least 1,2 m and 0,8 m, respectively, height of passageways along the escape routes shall be at least 2,2 m, and height in the clear of doors shall be at least 1,8 m.

3.8 Width of passageways leading to open areas of decks, muster and survival craft embarkation stations and to the landing area shall be at least 1,5 m. Outside the accommodation area the width of escape routes may be reduced up to 1 m from the spaces which can accommodate simultaneously not more than 5 persons.

3.9 In some justified cases sliding doors may be fitted in the spaces which can accommodate simultaneously not more than 5 persons. All escape route doors

shall be readily operable in the direction of escape, except for the sliding doors leading outside.

3.10 Escape routes, muster and survival craft embarkation stations shall be so located that various structures might protect them from direct heat effects in the event of fire in the most hazardous area of the processing.

3.11 Emergency lighting shall be provided along the escape route as well as signs of exits and escape routes which shall be applied in fluorescent paint or shall be of photoluminescent material.

4 TEMPORARY REFUGE

4.1 All FPU attended by the personnel shall be provided with temporary refuge. The temporary refuge is intended for protection of the personnel from the effect of fire and other accidents during the time necessary for accident elimination or safe escape in compliance with the approved escape plans.

4.2 The temporary refuge shall be located in the FPU accommodation area and be adequately equipped so as to provide life support and communications of the personnel for at least two hours in the event of an accident.

4.3 Escape routes shall ensure evacuation of all people on board the FPU to reach the temporary refuge in the shortest possible time but not exceeding 10 min.

4.4 The capacity of the temporary refuge shall be sufficient to shelter 100 per cent of the crew members and provide some reserve places for transient persons on board the FPU.

4.5 Bulkheads, decks, ceiling as well as doors, hatches, hatchways of the temporary refuge shall have a fire resistance limit not less than A-120.

4.6 No scuttles (windows) shall be permitted in the temporary refuge.

4.7 The FPU temporary refuge shall be provided with:

self-contained filter unit maintaining, where necessary, excessive pressure in relation to the adjacent spaces;

self-contained drenching system for protection of external surfaces of shelter bulkheads, decks and ceiling;

duplicating control means for fire extinguishing installations;

fire and gas detection systems;

emergency lighting with self-contained source of power;

emergency GMDSS communication with self-contained source of power;

monitor and control system for FPU main processing equipment;

self-contained ventilating and air conditioning system;

emergency power supply (accumulator batteries);

gas-tight doors with a fire resistance limit not less than A-120 at the all entrances and exits.

4.8 In the temporary refuge area it is recommended to arrange the following:

inlet for water pumped from salvage ships into the fire-fighting system;

external supply switchboard to provide the fire pump operation.

4.9 Temporary refuge shall be provided with emergency outfit, medicines, emergency supply of water and provisions and other items in accordance with the list approved by the Register.

5 BASIC PRINCIPLES OF SAFETY CONTROL

5.1 FPU safety assessment shall be carried out throughout the unit life cycle: design, construction, operation, utilization.

5.2 FPU safety assessment shall be performed at the stage of the offshore oil and gas field facilities design concept. The meaning of this assessment shall make sure at the early design stage that the selected FPU concept does not result in necessity to introduce principal alterations in the design and construction due to safety requirements. The objective of the FPU safety assessment shall ensure acceptable safety in accordance with the set criteria.

5.3 Safety assessment on the basis of FPU conceptual design shall be included in the plan of design development and FPU construction.

5.4 As a basis for safety assessment, a designer shall submit the following information:

description of FPU environment;

description of FPU functioning and operational details;

layout drawings showing machinery, arrangements and systems performing the most essential functions. Particular emphasis shall be placed on the location wherein works are performed and the equipment having a significant destructive potential, is installed, as well as on the fire safety, accommodation complexes, escape routes, protective zones and evacuation systems;

key structural diagrams;

description of the most impotent measures provided for accident probability reduction;

description of measures provided for restriction of accident consequences;

description of escape routes;

description of the level of safety associated with new processes and technical innovations planned for use;

accidents corresponding to the design accident effect on FPU;

calculation showing that the consequences of accident effects meet adequate safety criteria specified.

5.5 The safety assessments shall confirm the reasonably low probability of casualties evaluated by the use of annual individual risks, and also of societal risks, or large losses and unacceptable environment pollution that may happen as a result of the accident.

5.6 For FPU safety assessment the analysis of accident situations shall be carried out. This analysis falls into two main trends. The first one deals with the analysis through conformity to the existing standards, specifications, etc., and the second one, with the analysis of accident situations for scenarios of a higher risk

5.7 Analysis of potential accident situations is defined as a number of measures aimed to minimize the accident probability and severe consequences for FPU.

The sequence of the measures is usually as follow:

determination of potential accident situations;

assessment of the risk level to be accepted;

prevention or elimination of accident situations.

5.8 The analysis of accident situations is used in design (since a design concept), construction and operation of FPU. In this case, all the design modes of operation shall be considered: transportation, marine operations, installation on site, operational mode, extreme loading, removal from location, etc.

The analysis of accident situations shall be also applied to existing FPU if they are subjected to major modifications.

5.9 The analysis of potential accident situations shall be approved by the Register and shall include the following:

description of conditions at the beginning of an accident situation, initial data for analysis;

description of accident control measures, FPU equipment and systems specified for mitigating accident consequences;

information on analysis techniques, physical and statistical models;

description of the accident development process including its design presentation;

protective measures for personnel and individuals present on board the FPU in the event of an accident.

5.10 The risk evaluation is a part of FPU safety control which lies in the systematic use of all available information for identification of hazards and risk evaluation of potential undesirable events.

Risk assessment for FPU shall be conducted in compliance with the requirements of Part XV "MODU and FOP Safety Assessment" of Rules for the Classification, Construction and Equipment of MODU/FOP.

6 SAFETY ZONES

6.1 During operation the FPU shall be surrounded with safety zones and functional zones by means of mark and ice buoys as well as spars.

6.2 Safety and functional zones around the FPU shall be determined when necessary:

to provide the safety working environment for the personnel of interacting units;

to minimize probability of hazardous accidents and consequences due to their negative effects;

to protect the environment from emergency oil spillage.

The following safety measures shall be taken:

minimizing the number of ships;

conformity of ships to the conditions of the environment;

monitoring and efficient control of the interacting processes;

operative response to an accident

individual safety of personnel.

6.3 Safety zones specified around various units shall not intersect.

6.4 Federal executive bodies shall be notified about availability of the unit, its safety zones around, positions and characteristics of warning and navigational aids, as well as about partial or complete removal (liquidation) of the unit indicating depths, geographical coordinates and dimensions so as to include this information into the sailing directions and other navigational publications.

6.5 Safety circles (echelons) and functional zones with special regime of ship navigation and positioning around the FPU shall be established (Fig. 6.5-1):

high risk zone (offloading zone A) in which a tanker is under loading. In these conditions no other ships shall enter this zone except support vessel called for by the unit operator or master of the tanker for the purpose of rendering assistance and/or preventing accident situation;

hazardous zone (manoeuvring zone B) in which the tanker is manoeuvring so as to approach/depart the FPU. During these manoeuvring operations any other ships except a support vessel called for by the operator or master of the tanker are forbidden to enter this zone;

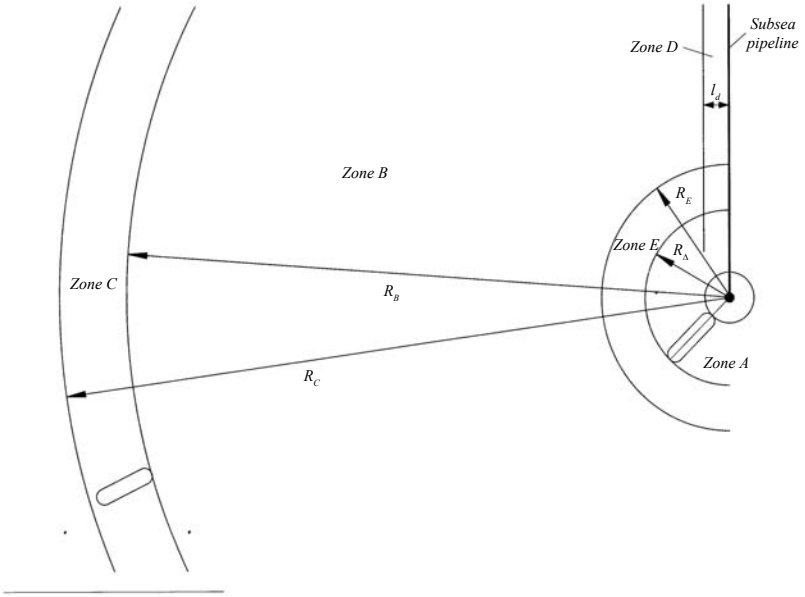

Fig. 6.5-1 Safety Zones
Zone A – high risk zone (offloading)
Zone B – hazardous zone (manoeuvring)
Zone C – estrangement zone (waiting)
Zone D – zone of subsea piping and cabling
Zone E – forbidden zone

estrangement zone (waiting zone C) which is specified for anchorage of other ships waiting for the operator's permission to approach the FPU;

zone of subsea piping and cabling (zone D);

forbidden zone (zone E).

Dimensions and navigation regimes of safety zones as well as the presence of ships therein shall be set forth for each particular FPU by special instructions and technical specifications which shall be agreed upon with the Register.

EQUIPMENT OF FLOATING OFFSHORE OIL-AND-GAS PRODUCTION UNITS (FPU)

PART I. LIFE-SAVING APPLIANCES

1 GENERAL

1.1 Life-saving appliances of floating offshore oil-and-gas production units (FPU) shall meet the requirements of Part II "Life-Saving Appliances" of the Rules for the Equipment of Sea-Going Ships which are applicable to oil tankers carrying cargoes with the flash point not exceeding 60 °C.

1.2 Life-saving appliances and equipment of survival craft items shall be reliable in use during operation under intended climatic conditions.

1.3 The installation of life-saving appliances on FPU to which, by virtue of their designation and purpose the application of the requirements specified in 1.1 rendered unreasonable or impracticable, is subject to special consideration by the Register.

1.4 Each life boat or liferaft shall be stowed in a safe position and protected from fire and explosion, as far as reasonable and practicable.

2 SURVIVAL CRAFT

2.1 Each FPU shall be provided on each side with one or more life boats complying with the requirements of 6.18, Part II "Life-Saving Appliances" of the Rules for the Equipment of Sea-Going Ships of an aggregate capacity sufficient to accommodate the total number of persons on board.

2.2 In addition to the requirements of 2.1 liferaft(s) complying with the requirements of 6.8 – 6.12, Part II "Life-Saving Appliances" of the Rules for the Equipment of Sea-Going Ships, capable of being launched on either side of the FPU and having an aggregate capacity sufficient to accommodate the total number of persons on board.

2.3 Where the survival craft are stowed in a position from the stem or stern to the closest survival craft is more than 100 m, the FPU shall carry, in addition to the life rafts required by 2.2, a life raft stowed as far forward or aft, or one as far forward and another as far aft, as is reasonable or practicable.

Such life rafts may be securely fastened so as to permit manual release.

2.4 Each FPU shall be provided with at least one rescue boat complying with the requirements of 6.19, Part II "Life-Saving Appliances" of the Rules for the Equipment of Sea-Going Ships.

2.5 A life boat may be accepted as a rescue boat provided that it and its launching and recovery arrangements also comply with the requirements for rescue boats.

3 PERSONAL LIFE-SAVING APPLIANCES

3.1 A lifejacket complying with the requirements of 6.3, Part II "Life-Saving Appliances" of the Rules for the Equipment of Sea-Going Ships shall be provided for every person on board the FPU.

3.2 In addition to the requirements of 3.1, each FPU shall be provided with lifejackets for the persons on watch, and also a sufficient number of lifejackets shall be located in accessible places for the members of industrial personnel who may be on duty in locations where their lifejackets are not readily accessible.

3.3 Additional lifejackets for the maximum permissible number of helicopter passengers shall be provided in way of a landing area.

3.4 Each lifejacket shall be fitted with a light complying with the requirements of 6.3.3, "Life-Saving Appliances" of the Rules for the Equipment of Sea-Going Ships.

3.5 Each FPU shall be provided with lifebuoys complying with the requirements of 6.2, Part II "Life-Saving Appliances" of the Rules for the Equipment of Sea-Going Ships.

FPU over 100 m in length shall be provided with lifebuoys according to Table 3.4.1

Table 3.4.1

Length, in m	Minimum number of lifebuoys
More than 100, but under 150	10
150, but under 200	12
200 and over	14

3.6 Not less than one-half of total number of lifebuoys shall be provided with self-igniting lights complying with the requirements of 6.2.3, Part II "Life-Saving Appliances" of the Rules for the Equipment of Sea-Going Ships, with approved source of power.

Not less than two of these shall be also provided with self-activating smoke signals complying with the requirements of 6.2.3, Part II "Life-Saving Appliances" of the Rules for the Equipment of Sea-Going Ships and be capable of quick release from the navigating bridge, main machinery control room, or a location readily accessible to operating personnel.

3.7 Each lifebuoy shall be marked in capital letters of the Roman alphabet with the name and port of registry of the FPU.

3.8 Each FPU shall be provided with immersion suits complying with the requirements of 6.4, Part II "Life-Saving Appliances" of Rules for the Equipment of Sea-Going Ships for the total number of persons on board.

4 LIFEBOATS, LIFERAFTS AND RESCUE BOATS ARRANGEMENT. LAUNCHING STATIONS

4.1 Lifeboats, liferafts and rescue boats arrangement, as well as launching stations shall comply with the requirements of Part II "Life-Saving Appliances" of the Rules for the Equipment of Sea-Going Ships.

4.2 Muster stations shall be provided as close to the embarkation stations as possible. Each muster station shall have sufficient space to accommodate all persons assigned to muster at that station.

4.3 Muster stations shall be readily accessible from accommodation and work areas.

4.4 Muster and embarkation stations shall be adequately illuminated by lighting supplied from the main and emergency sources of power.

PART II. SIGNAL MEANS

1 GENERAL

1.1 FPU in transit shall be provided with signal navigation lights in compliance with the requirements of Part I "Signal Means" of the Rules for the Equipment of MODU/FOP and the construction of FPU signal means shall comply with the requirements of Part III "Signal Means" of the Rules for the Equipment of Sea-Going Ships.

1.2 Navigational lights and sound signals at the anchorage shall comply with the requirements of International Lighthouse Service and RF Regulations for Providing Artificial Islands, Installations and Units with Warning Signals and Navigation Equipment (Ministry of Defence Head Office of Navigation and Oceanography of Russian Federation).

1.3 Pyrotechnic signal means shall be provided in compliance with the requirements of 2.5.1 and 3.5.1, Part III "Signal Means" of the Rules for the Equipment of Sea-Going Ships as for oil tankers.

1.4 Landing areas and obstacles to helicopter operations shall be marked and illuminated in compliance with "General Aviation Requirements for Maintenance of Helicopters on Board Ships and Raised Platforms" (OAT GA).

1.5 Places of location of mooring arrangements shall be marked by special lights, the range of visibility shall comply with meteorological conditions (fog, precipitations) under which the mooring is permitted.

1.6 Fitting and installation of lights and means specified in 1.2, 1.4 and 1.5 are subject to technical supervision by the relevant competent bodies.

PART III. RADIO EQUIPMENT

1 GENERAL

1.1 The requirements of this Part apply to the radio equipment of FPU in addition to the requirements of Part IV "Radio Equipment" of the Rules for the Equipment of Sea-Going Ships unless otherwise specified.

2 LIST OF RADIO EQUIPMENT

2.1 Each FPU shall be provided with radio equipment depending on the radio equipment complement of towing or escort vessel.

Where the towing or escort vessel is equipped in accordance with the requirements of Section 2, Part IV "Radio Equipment" of the Rules for the Equipment of Sea-Going Ships, the FPU shall be provided with the following radio equipment:

.1 VHF radio installation;

.2 MF radio installation;

.3 VHF EPIRB or satellite EPIRB depending on the sea area;

.4 facilities for reception of maritime safety information depending on the sea area:

NAVTEX service receiver;

EGC receiver;

HF direct-printing radiotelegraph receiver.

Where the towing or escort vessel is not equipped in accordance with the requirements of Section 2, Part IV "Radio Equipment" of the Rules for the Equipment of Sea-Going Ships, the FPU shall be provided with the full list of radio equipment meeting the requirements of Section 2, Part IV "Radio Equipment" of the Rules for the Equipment of Sea-Going Ships.

2.2 When the FPU is in tow mode with no persons on board, the radio equipment specified in 2.1 may not be installed.

2.3 Each FPU in operating or severe storm condition shall be provided with the main and duplicating radio equipment in accordance with Table 2.2.1 and 2.6.3, Part IV "Radio Equipment" of the Rules for the Equipment of Sea-Going Ships, depending on the sea area of FPU location.

2.4 Each FPU served by helicopters shall be provided with the two-way VHF radiotelephone apparatus for communication with aircrafts.

2.5 Each FPU shall be provided with effective means of communication between the main machinery control room and any station or stations, which have means of radio equipment control.

2.6 FPU constructed on or after 1 July 2004, shall be fitted with a security alarm system. FPS constructed before1 July 2004, shall be fitted with a security alarm system not later than the first survey of the radio equipment after 1 July 2006.

2.7 All FPU radio equipment shall meet the technical requirements given in Part IV "Radio Equipment" of the Rules for the Equipment of Sea-Going Ships.

2.8 The radio equipment installed in hazardous zones or being portable shall be of intrinsically safe type.

3 RADIO EQUIPMENT ARRANGEMENT

3.1 The control of radio equipment shall be carried out from the position where FPU is routinely controlled when in tow, and where a constant watch is kept while FPU is under operating or severe storm condition.

3.2 The duplicating radio equipment shall be arranged in a space, placed as far as possible from the location of the main radio equipment so that no single accident in any part of FPU could disable all means of radio communications.

3.3 If under operational conditions of FPU the acoustic noise level in spaces fitted with radio equipment is high and may interfere in the proper use of radio equipment, then the relevant noise protection shall be provided.

4 AERIALS

4.1 Transmitting aerials shall be located outside hazardous zones.

4.2 All transmitting and receiving aerials shall not be within 9 m from cargo crane booms and other high metal structures, which can give rise to screening effect.

PART IV. NAVIGATIONAL EQUIPMENT

1 GENERAL

1.1 The requirements of this Part apply to FPU navigational equipment and supplement the requirements of Part V "Navigational Equipment" of the Rules for the Equipment of Sea-Going ships.

1.2 FPU navigational equipment shall be installed in such a number and to have such technical performance as to ensure:

.1 determination of its own position and observation of surrounding conditions;

.2 the independent navigational support of a self-propelled FPU in sea transit while following to the operational location.

2 LIST OF NAVIGATIONAL EQUIPMENT

2.1 Depending on the group to which the particular FPU is related, it shall be provided with the navigational equipment in accordance with Table 2.1.

Table 2.1

Nos	Item	Quantity in groups	
		Self-propelled	Non-self-propelled
1	2	3	4
1	Standard magnetic compass	1	–
2	Steering magnetic compass installed at the main steering position	1	–
3	Gyrocompass	1	–
4	Dynamic pressure log, induction log or other of a ground type	1	–
5	Echo sounder	1	–
6	Automatic identification system (AIS) equipment	1	1
7	Radionavigation system/systems receiver	1	1
8	Hand lead	1	–
9	Navigational sextant	1	–

1	2	3	4
10	Chronometer	1	–
11	Stopwatch	2	1
12	Prismatic binocular	3	2
13	Anemometer	1	1
14	Barometer	2	1
15	Inclinometer	2	2
16	Sea water and air temperature indicator	1	1
17	Wave parameters indicator	1	1
18	Sea current speed and direction indicator	1	1
19	Radar station	1	1

2.2 The self-propelled FPU engaged on international voyages and constructed on or after 31 December 2008 shall be equipped with the system of long-range identification and tracking of ships (LRIT system).

The self-propelled FPU engaged on international voyages, constructed before 31 December 2008 and intended for navigation in sea areas **A1** and **A2** or in sea areas **A1**, **A2** and **A3**, shall be equipped with LRIT system not later than the first survey of the radio installation after 31 December 2008.

The self-propelled FPU engaged on international voyages, constructed before 31 December 2008 and intended for navigation in sea areas **A1**, **A2**, **A3** and **A4** shall be equipped with LRIT system not later than the first survey of the radio installation after 1 July 2009. However, whilst these self-propelled FPU operate within sea areas **A1**, **A2** and **A3** they shall be equipped with LRIT system not later than the first survey of the radio installation after 31 December 2008.

LRIT system is not obligatory for FPU, irrespective of the date of construction, fitted with an automatic identification system (AIS) and intended to operate exclusively within sea area **A1**.

3 NAVIGATIONAL EQUIPMENT ARRANGEMENT

3.1 The navigational devices listed in Table 2.1 shall be installed in the control station.

3.2 The navigational equipment fed by electric power shall not be installed in hazardous spaces and areas unless it is of the appropriate intrinsically safe type.

PART V. EQUIPMENT AND ARRANGEMENTS FOR PREVENTION OF POLLUTION OF THE ENVIRONMENT

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of this Part apply to FPU construction, arrangements, equipment and systems intended for the prevention of pollution by oil, sewage, and garbage, as well as air pollution.

1.1.2 The requirements are specified in the Rules for the Equipment of MODU/FOP, Part V "Equipment for Prevention of Pollution" and covers:

Annex I of MARPOL 73/78, "Regulations for the Prevention of Pollution by Oil";

Annex IV of MARPOL 73/78, "Regulations for the Prevention of Pollution by Sewage from Ships";

Annex V of MARPOL 73/78, "Regulations for the Prevention of Pollution by Garbage from Ships";

Annex VI of MARPOL 73/78, "Regulations for the Prevention of Air Pollution from Ships".

The application of the MARPOL Annex I requirements specially to FPU is regulated by IMO Guidelines adopted by Resolution MEPC.139(53) as amended by Resolution MEPC.142(54).

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