RUSSIAN MARITIME REGISTER OF SHIPPING

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RULES

FOR THE CLASSIFICATION AND CONSTRUCTION OF FLOATING OFFSHORE OIL-AND-GAS PRODUCT UNITS

PART VI

FIRE AND EXPLOSION PROTECTION

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RULES FOR THE CLASSIFICATION AND CONSTRUCTION OF FLOATING OFFSHORE OIL-AND-GAS PRODUCT UNITS

Rules for the Classification and Construction of Floating Offshore Oil-and-Gas Product Units (FPU) of Russian Maritime Register of Shipping (RS, the Register) have been approved in accordance with the established approval procedure and come into force on 1 January 2023.

The Rules are published in the following parts:

Part I "Classification";
Part II "Hull";
Part III "Equipment, Arrangements and Outfit";
Part IV "Stability";
Part V "Subdivision";
Part VI "Fire and Explosion Protection";
Part VII "Machinery Installations";
Part VIII "Systems and Piping";
Part IX "Machinery";
Part X "Boilers, Heat Exchangers and Pressure Vessels";
Part XI "Electrical Equipment";
Part XII "Refrigerating Plants";
Part XIII "Materials";
Part XIV "Welding";
Part XV "Automation";
Part XVI "General Requirements and Safety Principles".

The Rules supplement the Rules for the Classification and Construction of Sea-Going Ships and the Rules for the Classification, Construction and Equipment of Mobile Offshore Drilling Units and Fixed Offshore Platforms.

REVISION HISTORY[1]

(purely editorial amendments are not included in the Revision History)

Amended paras/chapters/ sections	Information on amendments	Number and date of the Circular Letter	Entry-into-force date
Paras 4.4.4 and 4.4.4.1	Requirements for fire protection of unmanned single point mooring have been introduced	313-15-1857c of 21.11.2022	01.01.2023

[1] Amendments and additions introduced at re-publication or by new versions based on circular letters or editorial amendments.

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of this Part of the Rules for the Classification and Construction of Floating Offshore Oil-and-Gas Product Units[2] apply to structural fire and explosion protection of FPU, its fire extinguishing, fire detection and alarm systems, systems for explosion effect mitigation, as well as firefighting equipment and outfit.

1.1.2 In addition to the requirements of this Part, the requirements of Part VI "Fire Protection" of the Rules for the Classification and Construction of Sea-Going Ships[3] and Part VI "Fire Protection" of the Rules for the Classification, Construction and Equipment of Mobile Offshore Drilling Units and Fixed Offshore Platforms[4] shall be met to the extent that is practicable and reasonable with regard to the requirements of this Part.

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 be determined by the customer. The necessity of installation of the equipment and outfit and characteristics thereof shall be determined by the customer with regard to the presence and number of special salvage teams on board 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 shall be 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 authorized State bodies exercising supervision of safety in oil and gas industry.

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[2] Hereinafter referred to as "the FPU Rules".

[3] Hereinafter referred to as "the Rules for the Classification".

[4] Hereinafter referred to as "the MODU/FOP 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, Part VI "Fire Protection" of the Rules for the Classification, 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 shutdown (ESD) are control actions undertaken to shut down equipment or processes in response to a hazardous situation.

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

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

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

for prevention of fire;

for containment of flame and smoke spreading throughout the FPU;

for creation of conditions for safe evacuation of personnel;

for effective fire extinction.

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 the products can be released into the atmosphere.

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

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

Critical temperature is the maximum temperature that the equipment, assembly or structure to be protected may be allowed to reach.

Passive fire protection material is coating or cladding that, in the event of a fire, will provide thermal protection to restrict the rate at which heat is transmitted to the object or area being protected.

Manned installation is a FPU 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.

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

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

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.

Passive fire protection (PFP) is coating or cladding arrangement or free-standing system which, in the event of fire, will provide thermal protection to restrict the rate at which heat is transmitted to the object or area being protected.

Pool fire is turbulent diffusion combustion of vaporizing hydrocarbon fuel spilled and retained on a surface above a horizontal body of the fuel that has zero or low initial momentum.

Prevention (of a hazardous event) is a reduction of potential risk of a hazardous event. Propagation is an effect of fire causing extent of the consequences of a hazardous event.

Fire barrier is a separating element that resists the passage of flame and/or heat and/or effluents for a period of time under specified conditions.

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

Passive fire protection system is a removable jacket or inspection panel, cable transit system, pipe penetration seal or other such system that, in the event of a fire, will provide thermal protection to restrict the rate at which heat is transmitted to the object or area being protected.

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 result of the process involving fire assessment data to define measures required to control these hazardous events and importance thereof.

Jet fire is turbulent diffusion flame resulting from the combustion of a fuel continuously released (with some significant momentum) in a particular direction.

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, 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) is 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;
UPS – uninterruptible power supply;
ER – engine room;
LFL – low flammable limit;
OS – offloading system;
SSSV – sub-surface safety valve;
CS – control station;
FES – fire and explosion strategy;
JF – jet fire;
PA – process area;
CCS – central control station;
EER – evacuation, escape and rescue.

1.4 SCOPE OF SURVEYS

1.4.1 The scope of surveys shall comply with the requirements of 1.3.1 and 1.3.2, Part VI "Fire Protection" of the Rules for the Classification.

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 Rules for the Classification shall be submitted to the Register.

1.4.3 For approval of the structural fire protection, the Register shall be provided with the results of the fire tests carried out according to procedure in Part 3 "Test for "A", "B" and "F" Class Divisions" of the International Code for Application of Fire Test Procedures, 2010, as adopted by IMO resolution MSC.307(88) (FTP Code) .

For "H" class divisions, fire tests shall meet the requirements given in the definition "H" class divisions" in Part VI "Fire Protection" of the MODU/FOP Rules.

The following FPU features shall be taken into account:

jet fire with high impulse and efficient burning;

very large size of FPU;

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

testing critical equipment (refer to 2.3.4).

It shall be noted that many important parameters concerning the serviceability of materials or systems are not taken into account in the standard tests and test reports, e.g. 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,
product fire characteristic,
jet fire characteristic,
fire spread characteristic,
combustion products;
other characteristics:
relative conditions resource/effect,
explosion resistance,
full-scale experiments,
health care activities.

1.5 FIRE PLANS

1.5.1 On FPU 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 Rules for the Classification.

1.5.2 Where the personnel is present on FPU 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 FPU 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 representative shall hand it in to the officer in charge of the personnel before sending him to FPU.

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 FPU 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 in compliance with 1.3.4, Part VI "Fire Protection" of the MODU/FOP Rules. The symbols for items listed in 1.3.1, Part VI "Fire Protection" of the MODU/FOP Rules shall be in compliance with IMO resolution A.952(23) "Graphical Symbols for Shipboard Fire Control Plans" as amended by IMO resolution A.1116(30).

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.

1.6 CATEGORIES OF SPACES

1.6.1 Categories of the FPU spaces shall meet the requirements of 1.5, Part VI "Fire Protection" of the Rules for the Classification and 2.1.1.8, 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 Rules for the Classification.

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 FPU 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 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:

to provide structural fire protection in compliance with the requirements of the fire and explosion strategy (FES);

to provide structural fire protection of essential systems and equipment or enclosures containing such systems and equipment;

to provide structural fire protection following an explosion in such a way 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 and critical temperature for the structures/equipment.

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 Rules for the Classification.

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.

The fire-fighting divisions located in the vicinity of potential sources of jet fires shall be additionally "J" class rated and subject to fire test procedure specified in ISO 22899-1 "Determination of the resistance to jet fires of passive fire protection materials – Part 1: General requirements".

These fire-fighting divisions shall have combined fire integrity that may be defined as fire integrity to resist two-phase fire – initial jet fire followed by a hydrocarbon pool fire. Potential sources of jet fires are considered to be valves, flange and other detachable joints, etc. in the process system that are maintained under pressure during fuel extraction and could release a jet of flammable liquid or gas.

The combined fire integrity (H/J) shall only apply for "H" class divisions.

For example, "H-60/J-30" class division" means:

"H" class fire integrity defined according to the requirements specified in the definition "H class divisions", Part VI "Fire Protection" of the MODU/FOP Rules;

additional "J-30" class fire integrity defined according to the requirements of ISO 22899-1; thus, the maximum temperature (at any point) of the unexposed side shall not rise more than 180 °C above the initial temperature identified in Part 3, Annex 1 of the FTP Code.

Thickness of the "J" class bulkhead or deck specimen subject to jet fire test according to 6.6 of ISO 22899-1 shall correspond to the thickness of the "H" class bulkhead or deck specimen tested.

Additional "J" class fire integrity is characterized by the additional PFP thickness to withstand the effects of the jet fire added to the thickness calculated during the "H" class division testing. The additional thickness shall be indicated in H/J Type Approval Certificate.

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 Rules for the Classification 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 Rules for the Classification.

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 Rules for the Classification.

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 Rules for the Classification.

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 ARRANGEMENT OF SPACES AND EQUIPMENT

2.2.1 General arrangement of spaces and equipment on FPU shall meet the following objectives:

to minimize the possibility of hazardous accumulations of both liquid and gaseous products, and to provide for the rapid removal of any possible accumulations;

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 spaces and equipment on FPU shall meet the following functional requirements:

to minimize fire risks, taking into account arrangement of spaces and equipment on FPU, 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 products;

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, TR, 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 FPU 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.

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 FPU of the main type is a ship with engine room and deckhouse positioned aft. The above-mentioned spaces may be positioned forward if the requirements of 2.4.10, Part VI "Fire Protection" of the Rules for the Classification 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 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 cargo pump room shall be provided from the open deck.

2.2.10.3 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.

2.2.10.4 CT deck shall be arranged in such a way as to allow efficient external fire fighting assistance.

2.2.10.5 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 7 m in length shall have two escape routes.

2.2.10.6 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 the FPU lower level of the unit (under the process area).

Wheelhouse doors may be fitted within the limits specified in 2.2.10.5 if their arrangement provides their quick closing and efficient gas tightness of the wheelhouse.

2.2.10.7 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 product 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 2.2.10.5 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.

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

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

2.2.10.9 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.

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

Access openings to CPR and to the forward and aft OS spaces may be allowed, provided their closures are of the type approved by the Register.

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

2.2.10.12 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 The minimum fire integrity of the bulkheads and decks separating the adjacent spaces shall meet the requirements of Tables 2.1.1.8-1 and 2.1.1.8-2, Part VI "Fire Protection" of the MODU/FOP Rules, as well as of Tables 2.4.2-1 and 2.4.2-2, Part VI "Fire Protection" of the Rules for the Classification.

2.3.2 Table 2.3.2 contains provisions on standard application of structural fire protection on FPU.

Table 2.3.2

Fire area	Accommodation spaces/Temporary refuge (AS/TR)	Non-hazardous service areas (SA)	Wellhead areas (WH)	Process areas (PA) including gas compression areas	Control stations (CS)
AS/TR	1/CF/400	1/CF/400	N/A	N/A	1/CF/400
SA	1/CF/400	1/CF/400	1/CF/400	1/CF/400	1/CF/400
WH	1/JF1/400	1/JF1/400	1/JF1/400	1/JF1/400	1/JF1/400
PA	1/JF1/400	1/JF1/400	1/JF1/400	1/JF1/400	1/JF1/400
CS	1/CF/400	1/CF/400	N/A	N/A	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.					

Temperature 400 °C stated in Table 2.3.2 is the critical temperature for load-bearing steel structures. The corresponding value for load-bearing aluminium structures is 200 °C.

The values given in Table 2.3.2 are read as follows:

where load-bearing structures for accommodation spaces are connected with structures in a process area, then the load-bearing structures shall be protected against jet fire for 1 h at the ultimate temperature of the steel structure equal to 400 °C;

where several different fires are possible in the area, the type of fire, for which the most strict requirements for structural fire protection are established, shall be selected.

2.3.3 Table 2.3.3 specifies standard requirements for integrity and continuity of fire barriers between areas.

Table 2.3.3

Fire area	Accommodation spaces (AS)	Non-hazardous service areas (SA)	Wellhead 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] J-0	1/JF[1] J-0	1/JF[1] J-0	1/JF[1] J-60
PA	2/JF[1] J-120	1/JF[1] J-60	1/JF[1] J-0	1/JF[1] J-0	1/JF[1] J-60
CS	1/CF-60	1/CF-60	1/CF-60	1/CF-60	1/CF-60
[1] Refer to Footnote to Table 2.3.2.					

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 unexposed side of a barrier.
The data given in Table 2.3.3 is read as follows:
time period of the structure fire integrity (hours), type of fire, time period (minutes), during which the average temperature on the unexposed side shall not rise more than 140 °C above the initial temperature, and the temperature at any point, including any joint, shall not rise more than 180 °C above the initial temperature. For example, "2/JF[1]/J-120" means the requirement to prevent a passage of smoke and flames through the system during 2 h standard fire test of the "H" class division and additional "J" class fire integrity, providing the above mentioned temperature changes during 120 min.

2.3.4 Table 2.3.4 prescribes fire integrity requirements for critical equipment which shall perform its emergency function.

Structural fire protection of the spaces shall prevent the temperature rise to the level specified in Table 2.3.4.

Table 2.3.4

Type of equipment	Protection criteria	
	Surface temperature, °C	Protection period, min
Riser sections	< 200	60[1]
Riser supports	< 400	60[1]
Topside riser ESD valve	< 200	60[1]
Fire pumps	< 200	60
Emergency generators	< 200	60
UPS systems	40	30
Control panels for SSIV/SSSV/BOP	40	15

[1] 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. 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 FPU 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 product-containing equipment.

2.4.5 Chemical energy is the result of 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 product residues 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 products where the consequences of an explosion are limited or where the explosion-proof structure can be fitted;

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 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 provide the maximum strenght of critical equipment/structures/barriers 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 flame spreading;

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

to 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.

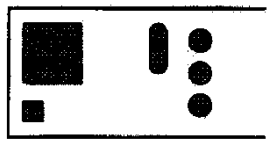
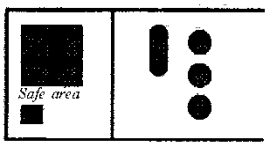
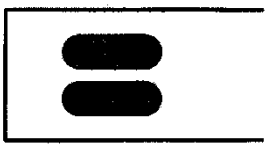
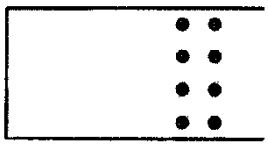
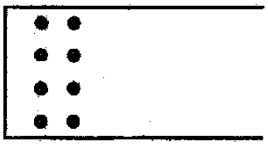
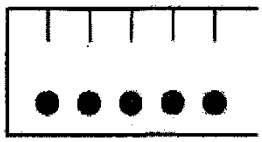
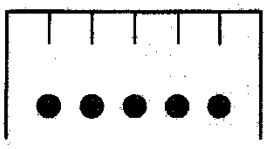
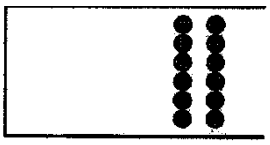
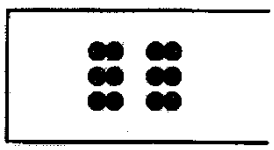
Poor layout	Effect	Good layout
	*Volume reduction*	
	*Reduction of blocking factor and the number of obstructions*	
	*Moving of obstructions inside the module*	
	*Lateral ventilation*	
	*Reduction of blocking factor and increase of transverse area*	

Fig. 2.4.11
Effect of layout on explosion severity

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.

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 fire extinguishing systems.

Where provision is made for extra fire-fighting equipment and fire extinguishing systems on FPU in addition to those prescribed by this Section, such equipment and systems may be allowed, provided the requirements thereto in this Section are met.

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

3.1.3 Fire-fighting equipment and fire extinguishing systems shall provide:

control of fire and development of accident situation;

reduction of fire effect to enable emergency actions or personnel evacuation;

fire extinction;

reduction of damage to structures and equipment.

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

to provide availability of fire-fighting strategy;

to meet the recognized standards for specific application;

to consider intended purposes and environmental conditions;

to provide type approval of the most fire-fighting equipment and system components by the recognized testing laboratories for specified operating conditions;

to provide availability of operating manual;

to preclude any effect of actuation time of the fire-fighting equipment and systems on their ability to perform the intended function;

to provide manual shutdown station for automatically activated systems.

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. size and installation 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 FPU with the personnel onboard Table 3.1.6 may be used.

The final choice of type and quantity of fire-fighting equipment and fire extinguishing systems 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 systems:

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.

Table 3.1.6

Area Spaces	Type of protection in addition to portable	Water discharge rates, in l/min/m^2	Notes
Wellhead/manifold area	Drenching/foam/dry powder	10 or 400 per well	
Process area	Drenching/foam/dry powder	10	
Pumps/compressors	Drenching/foam	20	
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 product risk	400 per well	
Blowout preventer (BOP) area	Drenching/foam		
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		
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		
Hangar	Sprinkler/foam/dry powder	6	
Chain locker	Water	10	
Ballast control station	None	60	
Turret area	Drenching/foam	10	
Vertical/horizontal structures	Drenching	10/4	
Exits and escape routes	Water screen	15 – 45	

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

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

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

3.2 WATER FIRE MAIN SYSTEM

3.2.1 The water fire main system shall meet the applicable requirements of 3.2.1.5, 3.2.1.10, 3.2.1.11, 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 Rules for the Classification.

3.2.2 The system shall be designed considering structural features of FPU 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 FPU of usual type);

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

3.2.3 Pumps shall be capable of delivering 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 FPU 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 systems 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 FPU compartments 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 Possibility of inspection of the system functioning within the whole range of its operational characteristics shall be provided.

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 unit whithin 30 min, but in any case the capacity shall not be 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 FPU (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 TR,

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 FPU opposite sides.

3.2.24 The FPU 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 Rules for the Classification, by means of which water can be delivered to the TS water fire main system 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 FPU area.

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 started and operated. Remotely started monitors shall be arranged so that they cannot cause injury or block escape routes when operated. Any remotely operated monitor shall be provided with 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 an operator 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 FPU 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;
to provide cooling of equipment and structures not impinged by jet fires;
to limit effects of fires to facilitate emergency response and EER activities.

3.3.2 The drenching system is intended to protect:
areas with the pipelines and equipment directly related to production;
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;
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 Rules for the Classification.

3.5 FOAM FIRE EXTINGUISHING SYSTEM

3.5.1 FPU 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 Rules for the Classification.

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.

The installation of fixed deck foam fire extinguishing system is not obligatory if FPU 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 FPU process areas 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 FPU 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 %.

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 Rules for the Classification shall be considered.

In all cases FPU 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 the FPU 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 The fixed foam fire extinguishing system of the FPU helideck shall meet the requirements in 6.4.1, Part XVII "Distinguishing Marks and Descriptive Notations in the Class Notation Specifying Structural and Operational Particulars of Ships" of the RS Rules.

3.5.17 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 Rules for the Classification.

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 Rules for the Classification.

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 FPU 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 Rules for the Classification.

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;

control and alarm panel shall be easily accessible at a permanently manned control station;

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 product ignition;

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 Rules for the Classification 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 % and 50 % 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 % and 20 % 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 Facilities for calibration, cleaning and testing of fire detection alarm systems shall be provided.

After the installation of fire detection and fire 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 products	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 Rules for the Classification and 4.2, 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 DETECTION AND FIRE ALARM SYSTEM OF UNMANNED SINGLE POINT MOORING

4.4.1 Fire detection and fire alarm system of unmanned SPM and unattended machinery spaces shall meet the requirements of 4.2.3, Part VI "Fire Protection" of the Rules for the Classification.

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 detection system.

4.4.3 All fire extinguishing systems shall be activated remotely from the FPU control station.

4.4.4 Fire protection of single point mooring.

4.4.4.1 Single point mooring shall be equipped with at least one B type portable fire extinguisher suitable for extinguishing oil fires. Where the risk of an electrical fire exists, an additional E type portable fire extinguisher shall be provided. In lieu of providing two above-mentioned portable extinguishers, consideration may be given to a single portable fire extinguisher complying with the requirements of 5.1.9, Part VI "Fire Protection" of the Rules for the Classification and suitable for both oil and electrical fires (B and E types).

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 ALARM

4.6.1 Alarm to warn that fire extinguishing medium is released shall meet the requirements of 4.3, Part VI "Fire Protection" of the Rules for the Classification.

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;

product vapour 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 and easily identified everywhere throughout FPU. 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 system shall be regularly tested without interruption of the system 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 Rules for the Classification, 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 Rules for the Classification as applied to oil tankers and shall ensure fire fighting in the process area.

5.1.4 Additionally, FPU equipped with helidecks shall be provided with fire-fighting outfit in compliance with 6.4.1.15, Part XVII "Distinguishing Marks and Descriptive Notations in the Class Notation Specifying Structural and Operational Particulars of Ships" 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.

Russian Maritime Register of Shipping

Rules for the Classification and Construction of Floating Offshore Oil-And-Gas Product Units
Part VI
Fire and Explosion Protection

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