RUSSIAN MARITIME REGISTER OF SHIPPING

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RULES

FOR THE OIL-AND-GAS EQUIPMENT OF FLOATING OFFSHORE OIL-AND-GAS PRODUCTION UNITS, MOBILE OFFSHORE DRILLING UNITS AND FIXED OFFSHORE PLATFORMS

Saint-Petersburg

2009

The Rules for the Oil-and-Gas Equipment of Floating Offshore Oil-and-Gas Production Units, Mobile Offshore Drilling Units and Fixed Offshore Platforms have been approved in accordance with the established approval procedure and come into force since the date of issue.

The Rules have been developed upon the results of research work NIR RS-4/2007, taking into consideration the Russian Federation acts of law, regulatory and normative and technical documents of the federal supervisory bodies of executive authorities, as well as the requirements of the leading foreign classification societies, standards used in the international practice and ISO standards.

The RS technical supervision for compliance with the Rules is carried out on a voluntary basis and does not relieve an organization (manufacturer) of responsibility to meet the requirements of the national supervisory bodies.

The Rules for the Oil-and-Gas Equipment of Floating Offshore Oil-and-Gas Production Units, Mobile Offshore Drilling Units and Fixed Offshore Platforms have been positively assessed by the RF Federal Service for Ecological, Technological and Atomic Supervision (letter No.11-10/5549 dated 25 December 2007).

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1 DEFINITIONS AND ABBREVIATIONS

Terms, definitions and explanations relating to the general terminology used in the normative documents of Russian Maritime Register of Shipping (hereinafter referred to as "the Register") are given in Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

For the purpose of the present Rules for the Oil-and-Gas Equipment of Floating Offshore Oil-and-Gas Production Units, Mobile Offshore Drilling Units and Fixed Offshore Platforms (hereinafter referred to as "the Rules"), the definitions given in 1.2, Part I "Classification" of the Rules for the Classification, Construction and Equipment of Mobile Offshore Drilling Units and Fixed Offshore Platforms (hereinafter referred to as "the MODU/FOP Rules"), in 1.2, Part I "Classification" of the Rules for the Classification, Construction and Equipment of Floating Offshore Oil-and-Gas Production Units (FPU) (hereinafter referred to as "the FPU Rules") and the following definitions and abbreviations (unless expressly provided otherwise in particular parts of the Rules) have been adopted.

1.1 DEFINITIONS

1.1.1 Drilling instrument is a drill string comprising drill pipes, drill collars and its tooling components, a downhole drill stem assembly and rock destruction tool.

Drilling derrick is a metallic structure over a wellhead used for installation of a block-and-tackle system, top drive, gear kit for round-trip operation and setting of drill pipe stands.

Drilling swivel is an arrangement for holding suspended a rotating drilling instrument with simultaneous admission of flushing fluid into the string during drilling and flushing out of the well. The swivel consists of two groups of components, one is non-rotating and connected to a block-and-tackle system and another is rotating and connected to a drill pipe string.

Drawworks is a winch designed to provide a set load on a rock destruction tool, to feed a drill string on the bottom of the well being drilled out, to trip the drill string when making a connection, changing the rock destruction tool and downhole motors, to extract the core, to run in a casing string during well casing and cementing, and also to trip various equipment when carrying out control, instrumentation and workover.

Drilling rig is a system of drilling machines, machinery, equipment and structures, which provides performance of full complex of operations on well construction with the use of a drilling instrument.

Flowline is piping, which directs well fluids from wellheads to a manifold or the first process vessel.

Gear kit for round-trip operation is a set of machinery located on a drilling derrick and drilling floor, which includes an automatic elevator, a mechanism for stand catching, raising and setting, racks and setbacks. It is designed for mechanization of making-and-breaking the pipes, setting and extending the stands during the round-trip operations.

Manifold is a piping system with the required shut-off, regulating and safety fittings, which is arranged in such a way that the fluid from one or more sources may be selectively directed to various process systems.

Pressure pipeline is a producing/injection line, booster pipeline or piping via which a fluid under overpressure is transferred.

Oil-and-gas equipment means the equipment designed for drilling, production, field development and transportation of well fluids.

Hazardous production facility means works or their shops, sections, areas and also other production facilities specified in Appendix 1 to Federal Law No.116-ФЗ "On Industrial Safety of Hazardous Production Facilities".

Treatment (preliminary processing) means the well fluid treatment performed to remove impurities and impart the property to the well fluids required for the following safe storage, transportation and application, as well as the separation of individual components and fractions.

Customer is a direct user of the Register services or products, which are under the Register technical supervision or subject to the Register inspections during their design, manufacture, application and utilization.

Recognized standard is a standard or another normative and technical document, which is recognized by the Register as acceptable for application to provide the confirmation of compliance with the requirements stipulated in the contract specification/ technical specifications by a customer and meets the requirements of the Register rules.

Industrial safety of hazardous production facilities is a security of individual and social vital interests against the accidents at hazardous production facilities and their consequences.

B l o w o u t p r e v e n t e r is a device installed at the wellhead to contain well-bore pressure either in the annular space between the casing and the tubulars or in an open hole during drilling, completion, testing or workover.

B l o w o u t e q u i p m e n t is a system of equipment designed for oil and gas wellhead sealing during well construction or repairs in order to provide safe work performance, prevent blowouts and oil spouters, conserve mineral resources and protect the environment. Blowout equipment includes preventers, manifolds and monitoring and control system.

T o p d r i v e s y s t e m is a movable rotary mechanism fitted with a set of equipment and arrangements for round-trip operation and designed for rotation and making a connection during drilling, for making-and-breaking of the drill and casing pipes during round-trip operations, and for admission of flushing fluid into a drill string.

C o n t r o l s y s t e m o f b l o w o u t e q u i p m e n t is a system intended to provide the remote control of the preventer hydraulic drives, as well as a mechanical drive to be used as a back-up device.

T r i p p i n g c o m p l e x is a complex, which includes a drawworks, rigging system, gear kit for round-trip operation and is designed for tripping and holding suspended a drill string, casing pipes and instrument during well construction.

B l o c k - a n d - t a c k l e s y s t e m is the load-carrying component of a drilling unit in the form of a tackle consisting of a fixed crownblock and travelling block with a hook or an automatic elevator for pipe suspension.

T e c h n i c a l m a i n t e n a n c e is a set of operations or an operation for maintenance of the product (equipment) operability during intended use, storage and transportation.

P r o c e s s s y s t e m is a system of oil-and-gas equipment for production, gathering, treatment and transportation of well fluids.

F l u i d is gas, vapour, liquid or their mixture transferred via piping systems of oil-and-gas equipment.

1.2 ABBREVIATIONS

BOP – blowout preventor.

FOP – fixed offshore platform.

FPU – floating offshore oil-and-gas production unit.

IEC – International Electrotechnical Commission.

MODU – mobile offshore drilling unit.

Register Nomenclature – Nomenclature of Items of the Register Technical Supervision of the FPU/MODU/FOP Oil-and-Gas Equipment.

RHO – Register Head Office.

The other most frequently used abbreviations typical for international practice are given in Appendix 1.

2 APPLICATION

2.1 GENERAL

2.1.1 The requirements of the Rules apply to the oil-and-gas equipment installed on floating or fixed offshore oil-and-gas structures: floating offshore oil-and-gas production units (FPU), mobile offshore drilling units (MODU), fixed offshore platforms (FOP), and also on drilling vessels (hereinafter all together referred to as "FPU/MODU/FOP").

2.1.2 The Rules have been developed in addition to the MODU/FOP Rules and the FPU Rules.

2.1.3 The requirements of the Rules refer to the following:

list of documentation for oil-and-gas equipment at review of the FPU/MODU/FOP designs;

classification of FPU/MODU/FOP to confirm the compliance of their oil-and-gas equipment;

list of the nomenclature of items and the procedures for the Register technical supervision of the oil-and-gas equipment;

systems and equipment for well drilling;

systems and equipment for production, gathering, treatment and transportation of well fluids;

functional components of oil-and-gas equipment and safety assessment of FPU/MODU/FOP during operation of oil-and-gas equipment.

2.1.4 The Rules apply during design, manufacture, operation and confirmation of compliance of FPU/MODU/FOP with regard to the set level of oil-and-gas equipment safety, prevention of environment pollution when performing operations on drilling, production, gathering, treatment and transportation of well fluids, as well as assessment of risks of the relevant critical events.

2.1.5 The Rules establish additional descriptive notations in the FPU/MODU/FOP class notation, which may be assigned to these objects if their oil-and-gas equipment complies with the requirements of the Rules.

2.1.6 The Rules may be used by all the organizations and manufacturers, which activities are associated with the FPU/MODU/FOP design and construction, exploration, construction and development of hydrocarbon fields on the continental shelf irrespective of their departmental affiliation and form of ownership. In case the manufacturer or organization has decided to apply the Rules on a voluntary basis, all the requirements of the Rules shall be met.

2.1.7 The Rules may be applied to the FPU/MODU/FOP oil-and-gas equipment manufactured without the Register technical supervision with regard to the given equipment for the purpose of survey, confirmation of compliance and technical supervision of given equipment in service.

2.1.8 The FPU/MODU/FOP oil-and-gas equipment manufactured and installed according to other rules and standards may be approved by the Register in case the data is provided confirming that they are as efficient as required by the Rules.

2.2 REQUIREMENTS OF NATIONAL SUPERVISORY BODIES

2.2.1 The fulfilment of the requirements of the Rules does not discharge of meeting the requirements of the national supervisory bodies for the oil-and-gas equipment used for the drilling, production, processing and transportation of hydrocarbons on the sea shelf, including the equipment installed on FPU/MODU/FOP, at the stages of design, manufacture, confirmation of compliance, mounting, welding, testing and operation of this equipment.

2.2.2 The Rules take into account the requirements of the following documents:

.1 federal legislation:

Federal Law No. 116- ФЗ "On Industrial Safety of Hazardous Production Projects" of July 21, 1997, as amended;

Federal Law No. 184-ФЗ "On Technical Regulation" of 27 December, 2002, as amended;

.2 normative and technical documents of the RF executive authority, which carries out supervision of industrial safety (Rostekhnadzor).

3 GENERAL REQUIREMENTS FOR TECHNICAL SUPERVISION

3.1 GENERAL

3.1.1 The technical supervision of the FPU/MODU/FOP oil-and-gas equipment includes verification of its conformity to the Register requirements:

during review and approval (agreement) of technical documentation;

survey of items of technical supervision at the stages of manufacture, mounting, service, as well as modernization and repairs.

3.1.2 The Register activities during review of technical documentation, technical supervision during manufacture, mounting and operation of oil-and-gas equipment are carried out on the basis of contracts with the customers.

3.1.3 The items of the Register technical supervision and the technical requirements thereto are determined by the Rules and listed in the Register Nomenclature (refer to Section 7). The Nomenclature omits the items relating to oil-and-gas equipment components and previously included into the Nomenclature of Items of the Register Technical Supervision as the items, which provide the FPU/MODU/FOP navigation safety, safety of life at sea and prevention of marine environment pollution (refer to Appendix I, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships).

3.1.4 During technical supervision of oil-and-gas equipment, the Register may permit the use of normative and technical documents of foreign classifiction socieies, other recognized national and international rules and standards.

3.1.5 Manufacture of oil-and-gas equipment and its mounting shall be carried out in compliance with the technical documentation approved by the Register.

3.1.6 In other respects the general regulations for technical supervision of the FPU/MODU/FOP oil-and-gas equipment shall comply with the requirements of Section 2, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

3.2 SERVICES RENDERED DURING TECHNICAL SUPERVISION

3.2.1 During technical supervision of the FPU/MODU/FOP oil-and-gas equipment the Register performs:

review of technical documentation (refer to Section 5) and provides a conclusion on the possible introduction of additional descriptive notations in the FPU/MODU/FOP class notation, which confirm the compliance of their oil-and-gas equipment with the requirements of the Rules (refer to Section 6);

approval of single types of oil-and-gas equipment with issue of a Certificate of Conformity (refer to 8.1, 8.2.1 to 8.2.4);

recognition of manufacturers of oil-and-gas equipment and materials therefore with issue of a Recognition Certificate for Manufacturer (refer to 8.3);

approval of welding consumables and welding procedures with issuing a Certificate of Approval for Welding Consumables, Welding Procedure Approval Test Certificate and certification of welders (refer to 8.1, 8.2.5 and 8.2.6);

recognition of testing laboratories with issue of a corresponding certificate (refer to 8.4);

technical supervision of oil-and-gas equipment during the FPU/MODU/FOP construction;

technical supervision of the FPU/MODU/FOP oil-and-gas equipment in service.

3.2.2 Upon the results of the technical supervision the Register issues to the items of technical supervision the following documents in the set form, which certify the compliance of the item of technical supervision to the Register requirements, as well as its manufacture (construction) under the Register technical supervision.

Certificate of conformity for a particular material or product (С, С3) is a document certifying the conformity of the particular materials, products or groups of products with the requirements of the Register rules and normative documents;

Type Approval Certificate (СТО) is a document certifying the conformity of types of products or groups of products with the requirements of the Register rules;

Recognition Certificate for Manufacturer (СПИ) is a document certifying the recognition by the Register of the firm as manufacturer of materials and products for ships subject to the Register technical supervision;

Certificate of Approval for Welding Consumables (СОСМ) and Welding Procedure Approval Test Certificate (СОТПС).

3.2.3 The basic requirements for issue and the period of validity of the Register Certificates shall comply with Section 3, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

4 REQUESTS AND CONTRACTS ON TECHNICAL SUPERVISION

4.1 To carry out works specified in 3.2.1, a firm shall apply to the Register with a written request to carry out technical supervision and to guarantee payment of the Register services, reimbursement of the Register expenses, as well as with the confirmation of familiarization and agreement with the General Conditions for Rendering Services (Carrying Out of Work) by Russian Maritime Register of Shipping, which are constituent and integral part of all the contracts concluded by the Register.

4.2 The request shall provide the information to an extent sufficient for review and execution thereof.

4.3 Upon reviewing the request depending on the particular conditions of the future technical supervision (scope and item of supervision, duration, etc.), the Register, being guided by the regulations in force, decides on the necessity to conclude a contract on technical supervision or carries out technical supervision based on the request without concluding the contract.

4.4 The contract on technical supervision of the Register, which is compiled as the single document, specifies the items of technical supervision and regulates mutual relations, rights and responsibilities of the parties in the course of the Register technical supervision during construction of FPU/MODU/FOP and manufacture of materials and products for oil-and-gas equipment.

The contract specifies cost of technical supervision, procedure and terms of payment. Where technical supervision is carried out based on the request, without concluding the contract, works are paid and expenses reimbursed according to the invoices made out by the Register.

5 TECHNICAL DOCUMENTATION

5.1 GENERAL REQUIREMENTS

5.1.1 Prior to commencement of technical supervision of the FPU/MODU/FOP design, construction and/or operation with regard to oil-and-gas equipment, technical documentation shall be submitted to the Register for consideration in the amount sufficient to make sure that the requirements of the Rules on the given equipment, materials and products therefore, as well as the quality of rendered services specified in 8.4 are fully met.

5.1.2 Amendments made in the technical documentation approved by the Register and dealt with the components and structures covered by the requirements of the Rules shall be submitted to the Register for approval prior to their implementation.

5.1.3 Technical documentation for oil-and-gas equipment may be submitted to the Register as one of the following alternatives depending on a design stage:

substantiation of investments in the FPU/MODU/FOP construction, particularly as the part of a project of field construction on the continental shelf;

FPU/MODU/FOP technical design or feasibility study (project) of field construction on the continental shelf;

FPU/MODU/FOP detailed design, process documentation and a project of repair-and-renewal operations;

normative and technical documents, specifications, process procedures, as well as schedules of processes and operation of oil-and-gas equipment;

technical documentation for oil-and-gas equipment components, certificates and operating instructions.

5.1.4 For the rest the general regulations for review of the technical documentation by the Register shall comply with the requirements of Section 3, Part II "Technical Documentation" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

5.2 TECHNICAL DOCUMENTATION OF THE FPU/MODU/FOP OIL-AND-GAS EQUIPMENT

5.2.1 Prior to commencement of the FPU/MODU/FOP construction, technical documentation for oil-and-gas equipment shall be submitted to the Register for review and approval in the amount specified in Section 4, Part I "Classification" of the MODU/FOP Rules and in Section 3, Part I "Classification" of the FPU Rules to the extent as it may be applied to the oil-and-gas equipment.

5.2.2 The technical documentation for oil-and-gas equipment shall, in addition to 5.2.1, include:

engineering certificates;

technical conditions and specifications;

test programmes and results;

plan of workmanship inspections of oil-and-gas equipment mounting and tests;

installation manuals;

operating and maintenance manuals;

analysis of risks and actions on provision of safe operation.

5.2.3 Review of technical documentation by the Register at the design stages of the FPU/MODU/FOP oil-and-gas equipment is confirmed by the Register conclusion letters for design stages or for an oil-and-gas equipment project as a whole, which confirm a possibility to introduce additional descriptive notations in the FPU/MODU/FOP class notation. Such letters are supplemented with the list of reviewed documentation.

5.2.4 Where necessary, a Certificate of Conformity of the FPU/MODU/FOP project supplemented with the list of reviewed documentation may be issued in compliance with a contract on technical supervision.

6 CLASSIFICATION AND DESCRIPTIVE NOTATION IN FPU/MODU/FOP CLASS NOTATION

6.1 Classification of the FPU/MODU/FOP objects is carried out in compliance with the requirements of Section 2, Part I "Classification" of the MODU/FOP Rules and Section 2, Part I "Classification" of the FPU Rules.

6.2 The FPU/MODU/FOP oil-and-gas equipment shall meet the requirements of the Rules and have the relevant Certificates and other documents confirming their compliance with the Register requirements (refer to Section 7).

6.3 In case the structures, machinery, arrangements and equipment of the systems used for drilling, production, gathering, treatment and transportation of well fluids, as well as the processes of their mounting and FPU/MODU/FOP tests comply with the requirements of the Rules, the additional descriptive notations, which define the main purpose of the oil-and-gas equipment installed, are introduced in the FPU/MODU/FOP class notation.

6.3.1 During manufacture, mounting and operation of oil-and-gas equipment under the Register technical supervision:

drilling (RS) – with a drilling rig fitted;

subsea system (RS) – with delivery of production from underwater production systems;

subsea pipeline (RS) – with delivery (offloading) of production via a subsea pipeline;

oil production/treatment (RS) – with an oil production and treatment system fitted;

gas production/treatment (RS) – with a gas and gas condensate production and treatment system fitted;

oil and gas production/treatment (RS) – with an oil and gas joint production and treatment system fitted;

6.3.2 During manufacture and mounting of oil-and-gas equipment without the Register technical supervision and operation of the equipment under the Register technical supervision:

drilling – with a drilling rig fitted;

subsea system – with delivery of production from underwater production systems;

subsea pipeline – with delivery (offloading) of production via a subsea pipeline;

oil production/treatment – with an oil production and treatment system fitted;

gas production/treatment – with a gas and gas condensate production and treatment system fitted;

oil and gas production/treatment – with an oil and gas joint production and treatment system fitted.

6.4 For the rest the requirements for assigning the character of classification, distinguishing marks and descriptive notations of the FPU/MODU/FOP class shall comply with the provisions of 6.1.

7 NOMENCLATURE OF ITEMS OF THE REGISTER TECHNICAL SUPERVISION OF THE FPU/MODU/FOP OIL-AND-GAS EQUIPMENT

7.1 The Nomenclature of Items of the Register Technical Supervision of the FPU/MODU/FOP Oil-and-Gas Equipment (refer to Table 7.1) specifies the items subject to the Register technical supervision during their manufacture at the works, mounting and testing on FPU/MODU/FOP and some equipment components to be branded.

7.2 The materials and products of FPU/MODU/FOP oil-and-gas equipment manufactured and installed under the Register technical supervision shall be delivered to the works, which perform the FPU/MODU/FOP construction, with the certificates or other documents evidencing their conformity to the requirements of these Rules and/or to the standards recognized by the Register as acceptable.

7.3 Any amendments to the Register Nomenclature may be introduced only if agreed with the Register.

7.4 In case of the technical supervision of the FPU/MODU/FOP constructed with use of brand-new materials and components for oil-and-gas equipment, the Register has a right to unilaterally introduce amendments to the Register Nomenclature.

Table 7.1

Nomenclature of Items of the Register Technical Supervision of the FPU/MODU/FOP Oil-and-Gas Equipment

The Nomenclature is presented in the form of the table comprising nine columns.

Column 1 ("Code of item of technical supervision"): identification code of the material, product, production process or software, which consists of eight characters, are indicated.

Column 2 ("Item of technical supervision"): name of the material, product, production process is indicated.

Columns 3 to 9 ("Technical supervision of the Register"): types of technical supervision are indicated:

technical supervision performed by the Surveyor (P), document C is issued;

technical supervision performed by the firm and confirmed by the Register, document C3 is issued;

technical supervision performed through type approval of the item of technical supervision, Type Approval Certificate (CTO), Certificate of Approval for Welding Consumables (COCM), Type Approval Certificate for Computer Program (СТОП), Welding Procedure Approval Test Certificate (СОТПС)) are issued.

Column 3 ("of prototype"): necessity of technical supervision of the prototype performed directly by the Surveyor (P) is indicated.

Column 4 ("type approval/recognition of manufacturer"): obligation of type approval of the item of technical supervision is indicated to be confirmed by Type Approval Certificate (CTO), as well as necessity of recognition of manufacturer to be confirmed by Recognition Certificate for Manufacturer (СПИ). In separate cases, at the discretion of the Register, where a single approval is given for the material or product, Certificate (C) may be issued without issuing the document on type approval, as well on recognition of the manufacturer.

Column 5 ("document issued"): the Register document is indicated, which is issued in case of the particular type of supervision providing the minimum permissible control for the particular material or product over fulfillment of the Register requirements.

In separate cases, at the Register discretion, types of supervision may be changed by the Register.

Column 6 ("branding"): obligation of branding of items of technical supervision is indicated.

Columns 7, 8, 9 ("mounting, application", "factory testing", "operational testing"): necessity of technical supervision during mounting, production and operational tests performed directly by the Surveyor is indicated.

Manufacturers supply materials or products according to column 5 with the originals of the Register-issued documents C and C3 or with a CTO copy.

Code of item of technical supervision	Item of technical supervision	Technical supervision of the Register						
		of prototype	type approval/ recognition of manufacturer	at the manufacturer		during FPU/MODU/FOP construction		
				document issued	branding	mounting, application	factory testing	operational testing
1	2	3	4	5	6	7	8	9
25000000	**OIL-AND-GAS EQUIPMENT**							
25010000	**ARRANGEMENTS, EQUIPMENT**							
25010100	**Drilling derrick**			C		P	P	P
25010200	**Flare boom**			C		P	P	P
25010300	**Arrangements of drilling mud system:**							
25010301	shale shakers	P	CTO	CTO		P	P	P
25010400	**Tensioners and compensators of displacements of:**							
25010401	risers			C		P	P	P
25010402	drill strings			C		P	P	P
25010500	**Arrangements for securing for sea of:**							
25010501	blowout equipment			C		P	P	P
25010502	wellhead components			C		P	P	P
25020000	**SYSTEMS AND PIPING**							
25020100	**Drilling support systems:**							
25020101	well cementing system	—	—	—	—	P	P	P
25020102	free-flowing material systems	—	—	—	—	P	P	P
25020103	choke and kill systems	—	—	—	—	P	P	P
25020104	drilling riser system	—	—	—	—	P	P	P
25020200	**Drilling mud systems:**							
25020201	storage system	—	—	—	—	P	P	P
25020202	gathering, cleaning and degassing system	—	—	—	—	P	P	P
25020203	high-pressure system	—	—	—	—	P	P	P
25020204	low-pressure system	—	—	—	—	P	P	P
25020205	seawater system	—	—	—	—	P	P	P
25020300	**Oil treating systems:**							
25020301	oil gathering system	—	—	—	—	P	P	P
25020302	oil separation, stabilization, desalting and dehydration systems	—	—	—	—	P	P	P
25020303	associated petroleum gas gathering, treatment and utilization system	—	—	—	—	P	P	P
25020400	**Gas treating systems:**							
25020401	gas gathering system	—	—	—	—	P	P	P
25020402	gas separation and dehydration systems	—	—	—	—	P	P	P

Code of item of technical supervision	Item of technical supervision	Technical supervision of the Register						
		of prototype	type approval/ recognition of manufacturer	at the manufacturer		during FPU/MODU/FOP construction		
				document issued	branding	mounting, application	factory testing	operational testing
1	2	3	4	5	6	7	8	9
25020403	gas condensate gathering and treatment system	—	—	—	—	P	P	P
25020404	absorbent regeneration system	—	—	—	—	P	P	P
25020405	gas compression system	—	—	—	—	P	P	P
25020406	gas-lift system	—	—	—	—	P	P	P
25020500	**Chemical agent reception, storage and delivery systems**	—	—	—	—	P	P	P
25020600	**Gas liquefaction systems**	—	—	—	—	P	P	P
25020700	**Flare systems, pressure release and gas withdrawal systems**	—	—	—	—	P	P	P
25020800	**Process heating/cooling systems**	—	—	—	—	P	P	P
25020900	**Compressed-air systems:**							
25020901	instrumentation systems	—	—	—	—	P	P	P
25020902	free-flowing component transportation systems	—	—	—	—	P	P	P
25021000	**Systems for water gathering, treatment and injection into the bed:**							
25021001	water treatment system	—	—	—	—	P	P	P
25021002	water distribution system	—	—	—	—	P	P	P
25021003	water injection system	—	—	—	—	P	P	P
25021100	**Hazardous drainage systems:**							
25021101	open systems	—	—	—	—	P	P	P
25021102	closed systems	—	—	—	—	P	P	P
25021200	**Well fluid offloading systems:**							
25021201	measuring system	—	—	—	—	P	P	P
25021202	transfer system	—	—	—	—	P	P	P
25021300	**Well completion and flushing systems**	—	—	—	—	P	P	P
25021400	**Drilling hoses:**							
25021401	high-pressure hoses	P	CTO	C3	—	P	—	P
25021500	**Manifolds of:**							
25021501	cementing system	P	CTO	C3	—	P	—	P
25021502	drilling mud	P	CTO	C3	—	P	—	P
25021503	choke line	P	CTO	C3	—	P	—	P
25021504	well kill line	P	CTO	C3	—	P	—	P
25021505	well fluid gathering system	P	CTO	C3	—	P	—	P
25021506	gas lift	P	CTO	C3	—	P	—	P
25021507	water injection	P	CTO	C3	—	P	—	P
25021600	**Blowout equipment control system units:**							
25021601	ram-type blowout preventers	P	CTO	CTO	—	—	—	—
25021602	universal blowout preventers	P	CTO	CTO	—	—	—	—
25021603	blowout equipment test benches	P	CTO	CTO	—	—	—	—
25021700	**Divertor units**	P	CTO	CTO	—	—	—	—
25021800	**Wellhead equipment:**							
25021801	casing string heads including mounting and sealing system	P	CTO	CTO	—	—	—	—
25021802	X-mas tree and tubing head	P	CTO	CTO	—	—	—	—
25021900	**Process and hydraulic system fittings:**							
25021901	shut-off and regulating fittings	P	CTO	C3	—	P	—	P
25021902	safety fittings	P	CTO	C3	—	P	—	P
25022000	**Fittings for free-flowing materials:**							
25022001	shut-off and regulating fittings	P	CTO	C3	—	P	—	P
25022002	safety fittings	P	CTO	C3	—	P	—	P
25022100	**Type production processes**	—	CTO	—	—	—	—	—
25030000	**MACHINERY**							
25030100	**Drilling mechanisms:**							
25030101	top drive for drilling	P	—	C	—	P	—	P
25030102	rotor and drive	P	—	C	—	P	—	P
25030103	iron roughnecks	P	—	C	—	P	—	P

Table 7.1 - continued

Code of item of technical supervision	Item of technical supervision	Technical supervision of the Register						
		of prototype	type approval/ recognition of manufacturer	at the manufacturer		during FPU/MODU/FOP construction		
				document issued	branding	mounting, application	factory testing	operational testing
1	2	3	4	5	6	7	8	9
25030200	**Winches:**							
25030201	drawworks	P	CTO	C3	—	P	P	P
25030202	drilling floor winches	P	CTO	C3	—	P	P	P
25030203	personnel raising winches	P	CTO	C3	—	P	P	P
25030204	general purpose winches	P	CTO	C3	—	P	P	P
25030300	**Mechanisms for oil and gas production and treatment:**							
	Gas-pumping compressors:							
25030301	piston	P	CTO	C3	—	P	P	P
25030302	centrifugal/axial flow	P	CTO	C3	—	P	P	P
25030303	turboexpanders	P	CTO	C3	—	P	P	P
25030304	others	P	CTO	C3	—	P	P	P
25030400	**Drilling system pumps:**							
25030401	piston (plunger) pumps	P	CTO	C3	—	P	P	P
25030402	centrifugal pumps	P	CTO	C3	—	P	P	P
25030403	others	P	CTO	C3	—	P	P	P
25030500	**Cementing system pumps:**							
25030501	centrifugal pumps	P	CTO	C3	—	P	P	P
25030502	plunger pumps	P	CTO	C3	—	P	P	P
25030600	**Sludge pumps:**							
25030601	centrifugal pumps	P	CTO	C3	—	P	P	P
25030602	plunger pumps	P	CTO	C3	—	P	P	P
25030700	**Pumps of well fluid treatment and offloading systems:**							
25030701	piston (plunger) pumps	P	CTO	C3	—	P	P	P
25030702	centrifugal pumps	P	CTO	C3	—	P	P	P
25030800	**Other pumps**	P	CTO	C3	—	P	P	P
25030900	**Hydraulic stations of:**							
25030901	drilling systems (top drive)	P	CTO	C3	—	P	P	P
25030902	automatic pipe handling systems	P	CTO	C3	—	P	P	P
25030903	drilling floor displacement systems	P	CTO	C3	—	P	P	P
25030904	displacement systems for control system of blowout equipment and wellhead components	P	CTO	C3	—	P	P	P
25030905	pipe handling mechanisms and cranes	P	CTO	C3	—	P	P	P
25031000	**Hydraulic cylinders of:**							
25031001	drilling floor displacement systems	P	CTO	C3	—	P	P	P
25031002	displacement systems of blowout equipment and wellhead components	P	CTO	C3	—	P	P	P
25031003	hydraulic pneumatic drives	P	CTO	C3	—	P	P	P
25031004	other hydraulic cylinders	P	CTO	C3	—	P	P	P
25031100	**Hydraulic accumulators of:**							
25031101	blowout equipment	P	CTO	C3	—	P	P	P
25031102	tensioners and compensators of displacements	P	CTO	C3	—	P	P	P
25031103	other hydraulic accumulators							
25031200	**Lifting jacks of:**							
25031201	drilling floor displacement systems	P	CTO	C3	—	P	P	P
25040000	**HEAT EXCHANGERS AND PRESSURE VESSELS**							
25040100	**Separators of:**							
25040101	drilling mud	P	СПИ	C3	—	P	P	P
25040102	oil treatment system	P	СПИ	C3	—	P	P	P
25040103	gas/condensate treatment system	P	СПИ	C3	—	P	P	P
25040200	**Multiphase separators**	P	СПИ	C3	—	P	P	P
25040300	**Electric dehydrators**	P	СПИ	C3	—	P	P	P
25040400	**Desalters**	P	СПИ					

Code of item of technical supervision	Item of technical supervision	Technical supervision of the Register						
		of prototype	type approval/ recognition of manufacturer	at the manufacturer		during FPU/MODU/FOP construction		
				document issued	branding	mounting, application	factory testing	operational testing
1	2	3	4	5	6	7	8	9
25040500	**Mass exchanger columns**	P	СПИ	С3	—	P	P	P
25040600	**Pig launchers/receivers**	P	СПИ	С3	—	P	P	P
25040700	**Heat exchangers:**							
25040701	plate-type heat exchangers	P	СПИ	С3	—	P	P	P
25040702	shell-and-tube heat exchangers	P	СПИ	С3	—	P	P	P
25040703	capacitive heat exchangers	P	СПИ	С3	—	P	P	P
25040800	**Heaters**	P	СПИ	С3	—	P	P	P
25040900	**Process water treatment plants**	P	СПИ	С3	—	P	P	P
25041000	**Modular process units**	P	СТО	С3	—	P	P	P
25041100	**Type production processes**	—	СТО	—	—	—	—	—
25050000	**ELECTRICAL EQUIPMENT**							
25050100	**Closed-circuit television systems (CCTV)**	P	СТО	С3	—	P	P	P
25050200	**Control systems of electric motor**	P	СТО	С3	—	P	P	P
25050300	**Electric drives of oil-and-gas equipment mechanisms:**							
25050301	electric motors with power output 100 kW and over	P	СТО	С	К	—	—	—
25050302	electric motors with power output more than 20 kW and less than 100 kW	P	СТО	С3	—	—	—	—
25050303	electric motors with power output up to 20 kW	P	СТО	СТО	—	—	—	—
25050400	**Electric drives of shut-off and regulating fittings**	P	СТО	С3	—	—	—	—
25050500	**Switchboards and control and monitoring panels**	P	СТО	С3	—	—	—	—
25060000	**REFRIGERATING PLANTS**							
25060100	**Refrigerating plants of:**							
25060101	gas liquefaction systems	P	—	С	—	P	P	P
25060102	oil/gas treatment systems	P	—	С	—	P	P	P
25070000	**MATERIALS**							
25070100	**Steel rolled products:**							
25070101	for heat exchangers, pressure vessels and pipes	P	СПИ	С3	К	—	—	—
25070102	pipes for heat exchangers and pressure vessels	P	СПИ	С3	К	—	—	—
25070103	pipes for process piping	P	СПИ	С3	К	—	—	—
25070104	parts of process piping	P	СПИ	С3	К	—	—	—
25070200	**Steel semi-finished products for boilers, pressure vessels and pipes**	P	СПИ	С3	К	—	—	—
25070300	**Welding consumables**	P	СОСМ	СОСМ	—	—	—	—
25080000	**CARGO-HANDLING GEAR**							
25080100	**Pipe handling/displacement arrangements:**							
25080101	horizontal pipe handling machines	P	СТО	С3	—	P	P	P
25080102	vertical pipe handling machines	P	СТО	С3	—	P	P	P
25080103	cat walk machine	P	СТО	С3	—	P	P	P
25080104	pipe deck cranes	P	СТО	С3	—	P	P	P
25080105	cross-members for pipes	P	СТО	С3	—	P	P	P
25080106	riser-handling systems	P	СТО	С3	—	P	P	P
25080200	**Overhead and pedestal cranes:**							
25080201	blowout equipment overhead cranes	P	СТО	С3	—	P	P	P
25080202	wellhead component overhead cranes	P	СТО	С3	—	P	P	P
25080203	deck pedestal cranes	P	СТО	С3	—	P	P	P
25080204	beam cranes	P	СТО	С3	—	P	P	P

Table 7.1 - continued

Code of item of technical supervision	Item of technical supervision	Technical supervision of the Register						
		of prototype	type approval/ recognition of manufacturer	at the manufacturer		during FPU/MODU/FOP construction		
				document issued	branding	mounting, application	factory testing	operational testing
1	2	3	4	5	6	7	8	9
25080300	**Others:**	P	CTO	C3	—	P	P	P
25080301	cradle of a drilling derrick	P	CTO	C3	—	P	P	P
25080302	basket for servicing a drilling well	P	CTO	C3	—	P	P	P
25080303	block-and-tackle unit	P	CTO	C3	—	P	P	P
25080304	top drive elevator	P	CTO	C3	—	P	P	P
25080305	crown block with pulleys	P	CTO	C3	—	P	P	P
25080306	hook/block-hook	P	CTO	C3	—	P	P	P
25080307	wireline anchor							
25090000	**AUTOMATION**							
25090100	Automated process control system of well fluid treatment and offloading systems, including emergency shutdown (ESD) system	P	CTO	C	—	P	P	P
25090200	Automated control system of drilling process, including drill man's workstation and emergency shutdown (ESD) system	P	CTO	C	—	P	P	P

8 TECHNICAL SUPERVISION DURING MANUFACTURE OF MATERIALS AND PRODUCTS AT THE MANUFACTURER

8.1 GENERAL

8.1.1 The requirements of this Section apply during technical supervision of materials and structural components used during manufacture and repair of the FPU/MODU/FOP oil-and-gas equipment and listed in the Register Nomenclature (refer to Table 7.1).

8.1.2 In separate cases, at the RS discretion, technical supervision may be performed of the materials and products not contained in the RS Nomenclature, which are newly developed or are the components of the products listed in the RS Nomenclature and which functionally provide the safety of the items of technical supervision. For this purpose, specimens of materials, products or new production processes after review of technical documentation by the Register shall be subject to the tests according to the program agreed with the Register.

8.1.3 In addition to the requirements of this Section, materials and products of oil-and-gas equipment shall comply with the requirements of the relevant sections of the Rules, as well as the requirements of the Register-approved technical documentation, specifications and other normative and technical documents adopted for the FPU/MODU/FOP project and recognized by the Register.

8.1.4 Materials and products of oil-and-gas equipment having no Certificates and other documents confirming their compliance with the Register requirements are not allowed for use during the FPU/MODU/FOP construction and operation.

8.1.5 The Register performs technical supervision at the manufacturer on the basis of the contract or request on technical supervision (refer to Section 4).

When rendering services specified in 8.2 and 8.3, concluding the contract the manufacturer shall be audited for conformity with the requirements of Sections 7 and 10.2, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

8.1.6 For drawing up of results of the Register technical supervision of the materials and products in compliance with the Register Nomenclature, use is made of three types of the Certificates of conformity:

Certificate filled-in and signed by the Register (C);

Certificate filled-in and signed by a manufacturer's official and drawn up (affirmed) by the Register (C3);

Type Approval Certificate (CTO).

8.1.7 The contents of the above Certificates (C, C3, CTO) shall identify the material or product, its types, main parameters, as well as the manufacturer of materials and products. Validity period of the Type Approval Certificate (CTO) is up to 5 years, validity period of the Certificates (C and C3) is not specified.

8.1.8 In order to obtain the Certificate of conformity, the manufacturer shall apply to the Register with a request. Technical documentation on the materials or products within the scope regulated by the Register rules shall be submitted together with the request.

8.1.9 Upon review of the technical documentation the Register sends a conclusion letter to the manufacturer. Where deemed necessary, the manufacturer shall submit the testing program to the Register to be agreed upon.

8.1.10 The manufacturer shall provide all the conditions necessary for the Register to carry out the technical supervision, namely:

to present the required technical documentation, in particular, manufacturer's documents on quality control of the products;

to prepare the items of technical supervision for survey in the scope required;

to provide for safety of surveys;

to provide for availability of the officials authorized to present the items of technical supervision for surveys and tests;

to timely inform the Register of the time and place of surveys and tests of the items of technical supervision.

Where the conditions required for performance of surveys are not fulfilled by the manufacturer, the Register has the right to refuse to carry out surveys or to witness tests.

8.1.11 In all other respects the general regulations on technical supervision during manufacture of the oil-and-gas equipment materials and products shall meet the requirements of Sections 5 to 12, Part I "General Regulations for Technical Supervision", Section 1 of Part III "Technical Supervision during Manufacture of Materials" and Section 1 of Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

8.2 APPROVAL OF TYPE MATERIALS, PRODUCTS AND PRODUCTION PROCESSES

8.2.1 Type Approval Certificate (CTO) is a document of the Register, which certifies that a construction, properties, parameters, characteristics of a type material or product, found in the course of surveys and indicated in the approved technical documentation, meet the Register requirements and may be used for items of technical supervision for the intended purpose.

8.2.2 The Type Approval Certificate (CTO) for the type production process certifies that an item of technical supervision manufactured according to the particular type production process and having characteristics and parameters indicated in the approved technical documentation meets the Register requirements and may be used for the intended purpose.

8.2.3 In order to obtain the Type Approval Certificate (CTO) the manufacturer shall apply to the Register with a request and submit the technical documentation on the material, product or production process, as well as the program and schedule of tests. When reviewing and approving this documentation, the scope of surveys during manufacture and testing of specimens shall be specified.

8.2.4 The Type Approval Certificate (CTO) is issued by the Register upon approval of the technical documentation and positive results of the surveys of the materials, products or production processes submitted. For the material or product manufactured according to the established production process the Type Approval Certificate (CTO) is issued, having regard to the data on earlier tests, production and operation experience. Account may be taken of the Type Approval Certificate (CTO) of another classification society or competent body or results of the tests of a type specimen conducted with participation of the above organizations.

8.2.5 For welding consumables the Certificate of Approval for Welding Consumables (COCM) is issued, being at the same time the document certifying recognition by the Register of the firm as the manufacturer of welding consumables in accordance with the requirements of the Register rules.

The Certificate of Approval for Welding Consumables (COCM) is issued for a period of up to 5 years subject to its annual endorsement.

8.2.6 The Welding Procedure Approval Test Certificate (СОТПС) is a Register document certifying that a welding procedure used at a shipyard or manufacturer of welded structures has been tested and approved by the Register for application.

The Welding Procedure Approval Test Certificate (СОТПС) is issued for a period of up to 5 years subject to its endorsement at least once every 2,5 years.

8.3 RECOGNITION OF MANUFACTURERS

8.3.1 The manufacturers producing the materials and products listed in the Register Nomenclature (refer to Table 7.1) and specified in 8.3.2 shall be recognized by the Register. Recognition of the manufacturer implies confirmation by the Register document the manufacturer capability to produce materials and products in compliance with the Register requirements.

8.3.2 In compliance with the Register Nomenclature (refer to Table 7.1), to be recognized by the Register are the manufacturers producing the following materials and oil-and-gas equipment:

.1 steel rolled products for heat exchangers and pressure vessels operating at a pressure above 0,07 MPa or a temperature by 10 °C above the saturation point of working liquid at the atmospheric pressure;

.2 steel pipes and piping parts for heat exchangers, pressure vessels and piping operating at a pressure above 0,07 MPa or a temperature by 10 °C above the saturation point of working liquid at the atmospheric pressure;

.3 steel semi-finished products (forgings, castings, billets) if they are produced for heat exchangers, pressure vessels and piping at works other than a rolling mill;

.4 heat exchangers operating at a pressure above 0,07 MPa or a temperature by 10 °C above the saturation point of working liquid at the atmospheric pressure;

.5 pressure vessels operating at a pressure above 0,07 MPa or a temperature by 10 °C above the saturation point of working liquid at the atmospheric pressure.

8.3.3 Recognition of the manufacturers of the oil-and-gas equipment materials and products shall be carried out in compliance with the provisions of Sections 7 and 10, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships, and the provisions of this Section.

8.3.4 Recognition procedure for a manufacturer is carried out on the basis of the request submitted by the manufacturer to the Register Branch Office. Recognition of the manufacturer by the Register shall be confirmed by issue of a Recognition Certificate for Manufacturer (СПИ).

8.3.5 Audit of conformity or recognition of the firm by the Register includes:

review of the documents confirming the compliance of the firm with the Register requirements;

survey of the firm.

8.3.6 The manufacturer documentation is reviewed to determine its compliance with the Register requirements. The manufacturer shall have normative and technical documents currently in force, which are necessary to perfrom activities in the specified area.

8.3.7 The target of the manufacturer survey is to directly determine its compliance with the Register requirements. The manufacturer shall carry out the check tests of the material and product specimens from the specified area according to the Register-approved program, which shall be witnessed by a Register representative. The tests shall confirm the compliance of production and product parameters with the requirements of documentation and the Rules, and also specify the proper level of quality stability.

8.3.8 The manufacturer participation in production of the materials and equipment specified in 8.3.2.1 to 8.3.2.5 without the Register recognition is subject to the special consideration by the Register.

8.4 RECOGNITION OF TESTING LABORATORIES

8.4.1 Testing laboratories engaged in non-destructive examination, destructive and other types of examination during manufacture, mounting, repair, re-equipment, operation and technical diagnosis of the FPU/MODU/FOP oil-and-gas equipment shall be recognized by the Register.

8.4.2 Recognition procedure for a testing laboratory is carried out on the basis of the request submitted by testing laboratory to the Register Branch Office.

8.4.3 The Register requirements for the testing laboratories are given in Sections 7 and 9, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

8.4.4 Recognition of the testing laboratory by the Register includes:

review of the documents confirming the compliance of the testing laboratory with the Register requirements;

survey of the testing laboratory, including performance of check tests.

8.4.5 Recognition of the testing laboratory by the Register shall be confirmed by the Recognition Certificate of Testing Laboratory (СПЛ) issued in accordance with requirements of 3.4 to 3.7, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

8.4.6 In individual cases, at the Register discretion, tests may be conducted in the testing laboratories not recognized by the Register. At that prior to performance of tests, compliance of the testing laboratory with the requirements of Section 7 and requirements of 9.2.1.1, 9.2.2.1, 9.2.2.2, 9.2.4.1, 9.2.4.2, 9.2.5, 9.2.6 of Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships shall be verified.

9 TECHNICAL SUPERVISION OF OIL-AND-GAS EQUIPMENT DURING FPU/MODU/FOP CONSTRUCTION

9.1 GENERAL

9.1.1 Technical supervision of oil-and-gas equipment during FPU/MODU/FOP construction is performed on the basis of the contract signed between the Register and the shipyard (refer to Section 4).

9.1.2 Scope and procedure of the Register technical supervision, types of checks, tests and control are indicated in the List of Items of Technical Supervision (hereinafter referred to as "the List"). Along with the surveys performed under the List, additional periodical checks may be conducted (refer to 9.1.4).

9.1.3 The List shall be elaborated by the firm (shipyard) and agreed upon with the Register Branch Office, which shall carry out technical supervision. The List is compiled on the basis of the Register Nomenclature for each prototype (single) structure and a series as well.

9.1.3.1 To be indicated in the List are items of technical supervision for arrangements, equipment, systems and piping, machinery, heat exchangers, pressure vessels, electrical equipment, refrigerating plants, cargo handling gear and automation having regard to the FPU/MODU/FOP oil-and-gas equipment.

9.1.3.2 Referred to the items of technical supervision are also production, mounting processes and individual works subject to technical supervision by the Register.

9.1.3.3 Scope of surveys, numbers of drawings, layouts, procedures and programs of tests, production processes, etc. shall be indicated in the List for each item of technical supervision.

9.1.3.4 One presentation to the Surveyor to the Register, covering one or several items of technical supervision or works completed in the particular production workshop or at the particular stage of the FPU/MODU/FOP oil-and-gas equipment mounting shall be made for each item of the List. The main target of surveys under the List is checking of the quality of the item of technical supervision at a particular stage of manufacture as provided by the production process and its admittance for further stages of the equipment mounting.

9.1.3.5 On agreement with the Register Branch Office, use may be made as the List of one or several documents elaborated by the firm (shipyard) in accordance with its existing practice, such as manufacturer's standard on presentation to the Register of works performed, acceptance log books, etc.

9.1.3.6 Surveys under the List are performed by the Surveyor upon presentation by the technical control body of the item of technical supervision or completed works together with the documents issued, finally verified by the shipyard and prepared for submission to the Register.

9.1.4 Along with the surveys performed according to the List, the Register carries out periodical inspections not associated with the official presentation by the firm (shipyard) technical control body but affecting workmanship.

9.1.5 Prior to mounting of machinery and arrangements of oil-and-gas equipment referred to the Register Nomenclature, the Surveyor to the Register shall check that these items of technical supervision are provided with the documents confirming their production under the Register technical supervision.

9.2 REQUIREMENTS FOR TESTING

9.2.1 Technical supervision of the Register in the course of tests of oil-and-gas equipment aims at checking the conformity of its quality and completeness with the approved technical design, Register rules and standards.

9.2.2 The Register technical supervision during testing of the FPU/MODU/FOP oil-and-gas equipment is carried out for machinery, arrangements, equipment and systems included in the Register Nomenclature.

9.2.3 Oil-and-gas equipment is tested according to the Register-approved program, which shall consider the requirements of standards and technical documents for delivery, as well as the requirements of manufacturer's programs for testing the equipment supplied. Concurrent with the item to be tested, the technical documentation required for survey is submitted. Surveys and tests of the item of technical supervision are carried out by the Register following the item acceptance by the manufacturer's technical control body.

9.2.4 The items of technical supervision, which test results do not meet the requirements of the applicable rules or the approved documentation, shall be re-tested upon elimination of causes of unsatisfactory test results. Elimination of deficiencies and re-testing shall be agreed upon with the Register. Re-testing shall not affect further tests or interfere with their safety.

9.2.5 Upon completion of oil-and-gas equipment tests, the Register communicates his remarks to the firm, which shall be eliminated before the Register issues the documents prescribed in 9.3, as well as a list of the items of technical supervision to be opened up and the scope of inspection.

9.2.6 Oil-and-gas equipment shall, where possible, be tested during the tests specified in 13.10 to 13.15, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision during Construc-

tion of Ships and Manufacture of Materials and Products for Ships, and shall meet the requirements for their performance as applicable.

9.3 DOCUMENTS ISSUED ON TECHNICAL SUPERVISION RESULTS

9.3.1 Technical supervision of oil-and-gas equipment during FPU/MODU/FOP construction results in issue of the folowing documents:

.1 Certificate of Test of Oil-And-Gas Equipment;

.2 Report on Survey of Oil-And-Gas Equipment after Construction/Initial Survey.

On the basis of the above documents, in order to confirm the compliance of oil-and-gas equipment with the requirements of the Rules, the Register inserts descriptive notations specified in 6.3 into the FPU/MODU/FOP class notation with a corresponding entry in a Classification Certificate.

10 TECHNICAL SUPERVISION OF OIL-AND-GAS EQUIPMENT IN SERVICE

10.1 GENERAL

10.1.1 Technical operation of the FPU/MODU/FOP oil-and-gas equipment in the Register class shall be carried out under the Register technical supervision as periodical surveys. When necessary (after accidents and incidents on FPU/MODU/FOP related to oil-and-gas equipment), occasional surveys of that equipment shall be carried out.

10.1.2 Periodical surveys are carried out by the Register to confirm/extend the FPU/MODU/FOP class with regard to oil-and-gas equipment. It is recommended to harmonize the oil-and-gas equipment survey system with the Register classification surveys of those structures on the whole.

10.1.3 General requirements for carrying out periodical surveys by the Register shall comply with Part I "General Provisions" of the Rules for the Classification Surveys of Ships in Service.

10.1.4 If agreed with the Register, the periodical surveys of the FPU/MODU/FOP oil-and-gas equipment may be based on the planned maintenance scheme and on implementing the technical condition monitoring system in compliance with the requirements of 2.7, Part II "Survey Schedule and Scope" of the Rules for the Classification Surveys of Ships in Service and Section 11, Part VII "Machinery Installations" of the Rules for the Classification and Construction of Sea-Going Ships to the extent, as appropriate.

10.2 SURVEY TYPES AND SCHEDULE

10.2.1 General.

10.2.1.1 The FPU/MODU/FOP oil-and-gas equipment is subject to the following surveys:

initial;

periodical (special, annual and intermediate);

occasional.

10.2.1.2 Initial surveys are divided into surveys carried out during the FPU/MODU/FOP construction and oil-and-gas equipment mounting under the Register technical supervision, and surveys of oil-and-gas equipment of FPU/MODU/FOP constructed under the supervision (or without supervision) of another classification society or supervisory body.

10.2.1.3 Special survey is carried out to renew a class with regard to oil-and-gas equipment (descriptive notations added to the class notation specified in 6.3), as a rule, at intervals not exceeding five years of FPU/MODU/FOP oil-and-gas equipment service, provided annual surveys and one intermediate survey are carried our within this period in the scope prescribed by the Rules.

10.2.1.4 Annual surveys are carried out to confirm the FPU/MODU/FOP class validity with regard to oil-and-gas equipment each calendar year.

10.2.1.5 Intermediate survey is carried out to confirm the class validity with regard to oil-and-gas equipment, generally, instead of the 2nd or 3rd annual survey.

10.2.1.6 Occasional survey is carried out after accidents, incidents, off-schedule repair of oil-and-gas equipment and in other necessary cases.

10.2.2 Initial surveys.

10.2.2.1 Initial survey is carried out to confirm the compliance of oil-and-gas equipment with the requirements of the Rules and to insert the descriptive notations into the FPU/MODU/FOP class notation, which equipment is submitted to the Register for the first time.

Also submitted to initial survey is the oil-and-gas equipment of the FPU/MODU/FOP, which previously had the appropriate descriptive notations added to the Register class notation but lost them due to some reasons (withdrawal of descriptive notations added to the class notation) or which were modernized with an extended area of application that requires change of the descriptive notations added to the FPU/MODU/FOP class notation.

Initial survey consists of thorough examination, checks, tests and measurements, which extent is each time determined by the Register depending on the environment and service period, procedures used in drilling, production, treatment and offloading systems, technical condition of equipment, etc.

10.2.2.2 The FPU/MODU/FOP oil-and-gas equipment manufactured and installed not in compliance with the Register rules, without supervision of the Register, another classification or supervisory body may be submitted to initial survey.

In this case initial survey, which scope is established by the Register, implies thorough examination and overall survey accompanied, where necessary, by testing of oil-and-gas equipment and its components to confirm their full compliance with the requirements of the Rules.

10.2.2.3 Where the FPU/MODU/FOP oil-and-gas equipment and the relevant technical documentation are provided with certificates or permits issued by another classification society or a supervisory body, initial survey may be carried out in the scope of a special survey.

Where the necessary technical documentation, certificates or permits for any component of oil-and-gas equipment is unavailable, the scope of the Register surveys for such equipment may be increased.

10.2.3 Special surveys.

10.2.3.1 Special surveys carried out for renewal of the validity of the descriptive notations added to the FPU/MODU/FOP class notation are aimed at establishing that the technical condition of oil-and-gas equipment, changes in its composition and design comply with the requirements of the Rules.

10.2.3.2 Special surveys, which scope is specified by the Rules, are carried out with the Register set intervals, generally, five-year intervals with renewal of validity of the descriptive notations added to the FPU/MODU/FOP class notation for the following five years.

10.2.3.3 Necessary examinations, measurements, tests, operarional testing and other actions to confirm the compliance of the FPU/MODU/FOP oil-and-gas equipment with the requirements of the Rules shall be carried out within a period between special surveys and immediately during the special survey.

10.2.3.4 The dates of special surveys of the FPU/MODU/FOP oil-and-gas equipment are determined starting from the date of initial survey, date of construction, date of changes of descriptive notations added to the class notation or date of insert of descriptive notations into the class notation of the FPU/MODU/FOP constructed without the Register supervision.

10.2.4 Annual surveys.

10.2.4.1 Annual survey of oil-and-gas equipment carried out to confirm the validity of the descriptive notations added to the FPU/MODU/FOP class notation is aimed at establishing that the technical condition of this equipment meets the conditions of retaining these descriptive notations, and also at checking the operation of single mechanisms, arrangements and units covered by the requirements of the Rules.

10.2.4.2 Scope of annual surveys is specified by the Register. Annual surveys may be carried out, as a rule, within ± 3 months from the appointed date of special survey.

10.2.5 Intermediate surveys.

Intermediate survey of the FPU/MODU/FOP oil-and-gas equipment is carried out between special surveys at the dates agreed with the Register. Scope of intermediate survey is specified by the Register.

10.2.6 Occasional surveys.

10.2.6.1 Occasional surveys of the FPU/MODU/FOP oil-and-gas equipment are carried out in all other cases, excepting initial and periodical surveys. Survey scope and procedure are specified by the Register proceeding from the survey purpose, service period and technical condition of the equipment.

10.2.6.2 Occasional surveys are carried out to reinstate the validity of the descriptive notations added to the FPU/MODU/FOP class notation after their suspension, to check the elimination of identified defects and damages, after accidents, at significant replacement of oil-and-gas equipment, re-equipment and repairs not concurring in terms with periodical surveys.

10.2.6.3 Occasional survey after accident is carried out to identify the type and nature of damage, its cause, to determine the extent of works for elimination of the accident consequences, as well as the possibility and conditions of retaining the descriptive notations added to the FPU/MODU/FOP class notation.

10.2.7 Scope of periodical surveys.

Scope of periodical surveys of the FPU/MODU/FOP oil-and-gas equipment carried out by the Register shall comply with Table 10.2.7.

10.2.8 Documents issued by the Register upon the survey results.

10.2.8.1 Upon the results of annual/intermediate/special surveys of oil-and-gas equipment, the Register

Table 10.2.7

Scope of periodical surveys of the FPU/MODU/FOP oil-and-gas equipment

Symbols:

O – examination with access, opening-up or dismantling being provided where necessary;
C – external examination;
M – measurements of wears, clearances, insulation resistance, etc.;
H – pressure tests;
P – operational testing of machinery, equipment, arrangements, external examination included;
E – control of the availability of valid documents and/or stamps testifying to the instrumentation being checked and calibrated by relevant competent authorities, if subject thereto;
И – testing of cargo-handling gear.

Nos.	Item to be surveyed	Surveys of oil-and-gas equipment														
		1st annual	2nd annual	3rd annual	4th annual	1st special	1st annual	2nd annual	3rd annual	4th annual	2nd special	1st annual	2nd annual	3rd annual	4th annual	3rd special
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1 ARRANGEMENTS, EQUIPMENT															
1.1	**Drilling derrick**	C	C	C	C	OM	C	C	C	C	OM	C	C	C	C	OM[1]
1.2	**Flare boom**	C	C	C	C	OMP	C	C	C	C	OMP	C	C	C	C	OM[1]P
1.3	**Arrangements of drilling mud system:**															
1.3.1	shale shakers	P	P	OP	P	OP	P	P	OP	P	OP	P	P	OP	P	OP
1.4	**Tensioners and compensators of displacements of:**															
1.4.1	risers	P	P	P	P	OM[2]P	P	P	P	P	OM[2]P	P	P	P	P	OM[2]P
1.4.2	drill strings	P	P	P	P	OM[2]P	P	P	P	P	OM[2]P	P	P	P	P	OM[2]P
1.5	**Arrangements for securing for sea of:**															
1.5.1	blowout equipment	P	P	P	P	OP	P	P	P	P	OP	P	P	P	P	OP
1.5.2	wellhead components	P	P	P	P	OP	P	P	P	P	OP	P	P	P	P	OMP
	2 SYSTEMS AND PIPING															
2.1	**Drilling support systems:**															
2.1.1	well cementing system[3]	C	OM	C	C	OM	C	OHM	C	C	OM	C	OM	C	C	OHM
2.1.2	free-flowing material systems[4]	C	C	C	C	C	C	OHM	C	C	C	C	C	C	C	OHM
2.1.3	choke and kill systems[3]	C	OM	C	C	OM	C	OHM	C	C	OM	C	OM	C	C	OHM
2.2	**Drilling mud systems:**															
2.2.1	cleaning and degassing system[5]	C	C	C	OM	C	C	OHM	C	C	C	OM	C	C	C	OHM
2.2.2	high-pressure system	C	OM	C	C	OM	C	OHM	C	C	OM	C	OM	C	C	OHM
2.2.3	low-pressure system [5]	C	C	C	OM	C	C	OHM	C	C	C	OM	C	C	C	OHM
2.2.4	seawater system	C	C	O	C	O	C	OHM	C	C	O	C	O	C	C	OHM
2.3	**Oil treating systems:**															
2.3.1	oil gathering and separation system[5]	C	C	C	OM	C	C	OHM	C	C	C	OM	C	C	C	OHM
2.3.2	oil stabilization, desalting and dehydration systems[5]	C	C	C	OM	C	C	OHM	C	C	C	OM	C	C	C	OHM
2.3.3	associated petroleum gas gathering, treatment and utilization system[5]	C	C	C	OM	C	C	OHM	C	C	C	OM	C	C	C	OHM

Nos.	Item to be surveyed	Surveys of oil-and-gas equipment														
		1st annual	2nd annual	3rd annual	4th annual	1st special	1st annual	2nd annual	3rd annual	4th annual	2nd special	1st annual	2nd annual	3rd annual	4th annual	3rd special
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2.4	**Gas treating systems:**															
2.4.1	gas separation and dehydration systems < 10 MPa	C	C	OM	C	C	OHM	C	C	OM	C	C	OHM	C	C	OM
2.4.2	gas separation and dehydration systems > 10 MPa	C	OM	C	C	OM	C	OHM	C	C	OM	C	OM	C	C	OHM
2.4.3	gas condensate gathering and treatment system < 10 MPa	C	C	OM	C	C	OHM	C	C	OM	C	C	OHM	C	C	OM
2.4.4	gas condensate gathering and treatment system > 10 MPa	C	OM	C	C	OM	C	OHM	C	C	OM	C	OM	C	C	OHM
2.4.5	absorbent regeneration system	C	C	OM	C	C	OHM	C	C	OM	C	C	OHM	C	C	OM
2.4.6	gas compression system < 10 MPa	C	C	OM	C	C	OHM	C	C	OM	C	C	OHM	C	C	OM
2.4.7	gas compression system > 10 MPa	C	OM	C	C	OM	C	OHM	C	C	OM	C	OM	C	C	OHM
2.4.8	gas-lift system	C	OM	C	C	OM	C	OHM	C	C	OM	C	OM	C	C	OHM
2.5	**Chemical agent reception, storage and delivery systems**	C	OM	C	C	OM	C	OHM	C	C	OM	C	OM	C	C	OHM
2.6	**Gas liquefaction systems**	C	C	OM	C	C	OHM	C	C	OM	C	C	OHM	C	C	OM
2.7	**Flare systems, pressure release and gas withdrawal systems**	C	C	OM	C	C	OHM	C	C	OM	C	C	OHM	C	C	OM
2.8	**Process heating/cooling systems**	P	OPH	P	OPH	P	OPH	P	OPH	P	OPH	P	OPH	P	OPH	P
2.9	**Compressed-air systems:**															
2.9.1	instrumentation systems	C	C	C	C	C	C	OHM	C	C	C	C	C	C	C	OHM
2.9.2	free-flowing component transportation systems	C	C	C	C	C	C	OHM	C	C	C	C	C	C	C	OHM
2.10	**Systems for water gathering, treatment and injection into the bed:**															
2.10.1	water treatment system	C	C	O	C	O	C	OHM	C	C	O	C	O	C	C	OHM
2.10.2	water distribution system	C	C	O	C	O	C	OHM	C	C	O	C	O	C	C	OHM
2.10.3	water injection system	C	C	O	C	O	C	OHM	C	C	O	C	O	C	C	OHM
2.11	**Hazardous drainage systems:**															
2.11.1	open systems	C	C	C	C	C	C	OHM	C	C	C	C	C	C	C	OHM
2.11.2	closed systems	C	C	C	C	C	C	OHM	C	C	C	C	C	C	C	OHM
2.12	**Well fluid offloading systems:**															
2.12.1	measuring system	CE	OE	CE	CE	OE	CE	OE	CE	CE	OE	CE	OE	CE	CE	OE
2.12.2	transfer system[6]	C	O	C	C	O	C	OHM	C	C	O	C	O	C	C	OHM
2.13	**Well completion and flushing systems**	C	OM	C	C	OM	C	OHM	C	C	OM	C	OM	C	C	OHM
2.14	**Drilling hoses:**															
2.14.1	high-pressure hoses	C	C	C	C	OH	C	C	C	C	OH	C	C	C	C	OH
2.15	**Manifolds of:**															
2.15.1	cementing system	P	OMP	P	P	OMP	P	OMPH	P	P	OMP	P	OMP	P	P	OMPH
2.15.2	drilling mud	P	OMP	P	P	OMP	P	OMPH	P	P	OMP	P	OMP	P	P	OMPH
2.15.3	choke line	P	OMP	P	P	OMP	P	OMPH	P	P	OMP	P	OMP	P	P	OMPH
2.15.4	well kill line	P	OMP	P	P	OMP	P	OMPH	P	P	OMP	P	OMP	P	P	OMPH

Table 10.2.7 - continued

Nos.	Item to be surveyed	Surveys of oil-and-gas equipment														
		1st annual	2nd annual	3rd annual	4th annual	1st special	1st annual	2nd annual	3rd annual	4th annual	2nd special	1st annual	2nd annual	3rd annual	4th annual	3rd special
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2.15.5	well fluid gathering system	P	OMP	P	P	OMP	P	OMPH	P	P	OMP	P	OMP	P	P	OMPH
2.15.6	gas lift	P	OMP	P	P	OMP	P	OMPH	P	P	OMP	P	OMP	P	P	OMPH
2.15.7	water injection	C	OM	C	C	OM	C	OHM	C	C	OM	C	OM	C	C	OHM
2.16	**Control system units of blowout equipment:**[7]															
2.16.1	ram-type blowout preventers	C	C	C	C	O	C	C	C	C	O	C	C	C	C	O
2.16.2	universal blowout preventers	C	C	C	C	O	C	C	C	C	O	C	C	C	C	O
2.16.3	blowout equipment test benches	C	C	C	C	O	C	C	C	C	O	C	C	C	C	O
2.17	**Divertor units**	C	C	C	C	O	C	C	C	C	O	C	C	C	C	O
2.18	**Risers:**															
	drilling	C	C	C	C	O	C	C	C	C	O	C	C	C	C	O
2.19	**Process and hydraulic system fittings:**															
2.19.1	shut-off and regulating fittings	P	OMP	P	P	OMP	P	OMPH	P	P	OMP	P	OMP	P	P	OMPH
2.19.2	safety fittings	P	OMP	P	P	OMP	P	OMPH	P	P	OMP	P	OMP	P	P	OMPH
2.20	**Fittings for free-flowing materials:**															
2.20.1	shut-off and regulating fittings	P	P	P	P	OP	P	OMPH	P	P	P	OP	P	P	P	OMPH
2.20.2	safety fittings	P	P	P	P	OP	P	OMPH	P	P	P	OP	P	P	P	OMPH
2.21	**Instrumentation**	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
	3 MACHINERY															
3.1	**Drilling mechanisms:**															
3.1.1	top drive for drilling	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.1.2	rotor and drive	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.1.3	iron roughnecks	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.2	**Mechanisms for oil and gas production and treatment:**															
3.2.1	gas-pumping compressors	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.2.2	turboexpanders	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.2.3	oil-transfer pumps	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.3	**Drilling mud pumps**															
3.3.1	piston (plunger) pumps	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.3.2	centrifugal pumps	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.3.3	submersible pumps	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.3.4	others	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.4	**Cementing system pumps:**															
3.4.1	centrifugal pumps	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.4.2	piston (plunger) pumps	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.5	**Sludge pumps:**															
3.5.1	centrifugal pumps	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.5.2	piston (plunger) pumps	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM

Nos.	Item to be surveyed	Surveys of oil-and-gas equipment														
		1st annual	2nd annual	3rd annual	4th annual	1st special	1st annual	2nd annual	3rd annual	4th annual	2nd special	1st annual	2nd annual	3rd annual	4th annual	3rd special
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
3.6	**Pumps of well fluid treatment systems:**															
3.6.1	piston (plunger) pumps	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.6.2	centrifugal pumps	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.7	**Other pumps**	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.8	**Hydraulic stations of:**															
3.8.1	drilling systems (top drive)	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.8.2	automatic pipe handling systems	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.8.3	drilling floor displacement systems	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.8.4	displacement systems for control system of blowout equipment and wellhead components	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.8.5	pipe handling mechanisms and cranes	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
3.9	**Hydraulic cylinders of:**															
3.9.1	drilling floor displacement systems	P	P	P	P	OP	P	P	P	P	OP	P	P	P	P	OP
3.9.2	displacement systems of blowout equipment and wellhead components	P	P	P	P	OP	P	P	P	P	OP	P	P	P	P	OP
3.9.3	other hydraulic cylinders	P	P	P	P	OP	P	P	P	P	OP	P	P	P	P	OP
3.10	**Hydraulic accumulators of:**															
3.10.1	blowout equipment	P	P	P	P	OP	P	P	P	P	OP	P	P	P	P	OP
3.10.2	tensioners and compensators of displacements	P	P	P	P	OP	P	P	P	P	OP	P	P	P	P	OP
3.10.3	other hydraulic accumulators	P	P	P	P	OP	P	P	P	P	OP	P	P	P	P	OP
3.11	**Lifting jacks of:**															
3.11.1	drilling floor displacement systems	P	P	P	P	OP	P	P	P	P	OP	P	P	P	P	OP
3.12	**Instrumentation**	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
	4 HEAT EXCHANGERS AND PRESSURE VESSELS															
4.1	**Separators of:**															
4.1.1	drilling mud	P	OP	P	OP	P	OP	OPH	P	OP	P	OP	P	OP	P	OPHM[8]
4.1.2	oil treatment system	P	OP	P	OP	P	OP	OPH	P	OP	P	OP	P	OP	P	OPHM[8]
4.1.3	gas/condensate treatment system	P	OP	P	OP	P	OP	OPH	P	OP	P	OP	P	OP	P	OPHM[8]
4.2	**Multiphase dividers**	P	OP	P	OP	P	OP	OPH	P	OP	P	OP	P	OP	P	OPHM[8]
4.3	**Mass exchanger columns**	P	OP	P	OP	P	OP	OPH	P	OP	P	OP	P	OP	P	OPHM[8]
4.4	**Pig launchers/receivers**	P	OP	P	P	OP	P	OPH	P	P	OP	P	OP	P	P	OPHM[8]
4.5	**Heat exchangers:**															
4.5.1	plate-type heat exchangers	P	OP	P	OP	P	OP	OPH	P	OP	P	OP	P	OP	P	OPHM[8]
4.5.2	shell-and-tube heat exchangers	P	OP	P	OP	P	OP	OPH	P	OP	P	OP	P	OP	P	OPHM[8]
4.5.3	capacitive heat exchangers	P	OP	P	OP	P	OP	OPH	P	OP	P	OP	P	OP	P	OPHM[8]
4.6	**Heaters**	P	OP	P	OP	P	OP	OPH	P	OP	P	OP	P	OP	P	OPHM[8]

Table 10.2.7 - continued

Nos.	Item to be surveyed	Surveys of oil-and-gas equipment														
		1st annual	2nd annual	3rd annual	4th annual	1st special	1st annual	2nd annual	3rd annual	4th annual	2nd special	1st annual	2nd annual	3rd annual	4th annual	3rd special
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4.7	**Process water treatment plants**	P	OP	P	OP	P	OP	OPH	P	OP	P	OP	P	OP	P	OPHM[8]
4.8	**Instrumentation**	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
	5 ELECTRICAL EQUIPMENT															
5.1	**Closed-circuit television systems (CCTV)**	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
5.2	**Electric dehydrators**	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
5.3	**Control systems of electric motor**	P	P	P	P	OPM	P	P	P	P	OPM	P	P	P	P	OPM
5.4	**Instrumentation**	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
	6 REFRIGERATING PLANTS															
6.1	**Refrigerating plants of:**															
6.1.1	gas liquefaction systems	P	P	P	P	OP[9]	P	P	P	P	OP[9]	P	P	P	P	OP[9]
6.1.2	process systems	P	P	P	P	OP[9]	P	P	P	P	OP[9]	P	P	P	P	OP[9]
	7 CARGO-HANDLING GEAR[10]															
7.1	**Winches:**															
7.1.1	drawworks	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ
7.1.2	drilling floor winches	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ
7.1.3	personnel raising winches	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ
7.1.4	general purpose winches	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ
7.2	**Pipe handling/displacement arrangements:**															
7.2.1	horizontal pipe handling machines	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ
7.2.2	vertical pipe handling machines	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ
7.2.3	cat walk machines	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ
7.2.4	pipe deck cranes	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ
7.2.5	cross-members for pipes	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ
7.2.6	riser-handling systems	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ
7.3	**Overhead and pedestal cranes:**															
7.3.1	blowout equipment overhead crane	OP	OP	ОРМИ	OP	OP	ОРМИ	OP	OP	ОРМИ	OP	OP	ОРМИ	OP	OP	ОРМИ
7.3.2	wellhead component overhead crane	OP	OP	ОРМИ	OP	OP	ОРМИ	OP	OP	ОРМИ	OP	OP	ОРМИ	OP	OP	ОРМИ
7.3.3	deck pedestal cranes	OP	OP	ОРМИ	OP	OP	ОРМИ	OP	OP	ОРМИ	OP	OP	ОРМИ	OP	OP	ОРМИ
7.3.4	beam cranes	OP	OP	ОРМИ	OP	OP	ОРМИ	OP	OP	ОРМИ	OP	OP	ОРМИ	OP	OP	ОРМИ
7.4	**Others:**															
7.4.1	cradle of a drilling derrick	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ
7.4.2	basket for servicing a drilling well	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ	ОРМИ
7.4.3	block-and-tackle unit	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ
7.4.4	top drive elevator	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ
7.4.5	crown block with pulleys	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ
7.4.6	wireline anchor	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ	P	P	ОРМИ

Nos.	Item to be surveyed	Surveys of oil-and-gas equipment														
		1st annual	2nd annual	3rd annual	4th annual	1st special	1st annual	2nd annual	3rd annual	4th annual	2nd special	1st annual	2nd annual	3rd annual	4th annual	3rd special
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	8 AUTOMATION															
8.1	Automated process control system of well fluid treatment and offloading systems, including emergency shutdown (ESD) system	MP	MP	MP	MP	MP	MP	MP	MP	MP	MP	MP	MP	MP	MP	MP
8.2	Automated control system of drilling process, including drill man's workstation and emergency shutdown (ESD) system	MP	MP	MP	MP	MP	MP	MP	MP	MP	MP	MP	MP	MP	MP	MP

Notes:
[1] Residual thickness measurements beginning from the 3rd survey.
[2] Measurement of cable wear.
[3] H – at least once in 8 years. O – sampling inspection.
[4] O – at least once in 8 years at a corrosion rate of up to 0,1 mm/year, and at least once in 6 years when the latter is over 0,1 mm/year, H – at least once in 8 years.
[5] O – at least once in 4 years at a corrosion rate of up to 0,1 mm/year, and once in 3 years if the latter is over 0,1 mm/year. H – at least once in 8 years at a corrosion rate of up to 0,1 mm/year, and once in 6 years if the latter is over 0,1 mm/year.
[6] Systems shall be degassed. Where necessary, measurements of residual thicknesses and hydraulic tests shall be conducted on the Surveyor's demand.
[7] On completing well drilling, the blowout equipment installed on a FOP may be dismounted and removed from the platform.
[8] When estimated service life is over or when excessive wear is detected.
[9] Operational testing of the refrigerating plant for checking its capability to set and maintain specified temperatures in cooling devices.
[10] Measurements of the residual thicknesses of crane structures, wears of cargo handling gear components and cable defects.

issues a Report, which confirms the validity of the descriptive notations added to the FPU/MODU/FOP class notation for the following annual period, provided the survey results are satisfactory.

10.2.8.2 Upon satisfactory results of special survey of the oil-and-gas equipment, the Register, on the basis of the Report specified in 10.2.8.1, renews the validity of the descriptive notations added to the FPU/MODU/FOP class notation specified in 6.3, making a relevant entry in the Classification Certificate being in force (annually confirmed) till the following special survey.

10.2.8.3 Upon the results of initial survey of the oil-and-gas equipment, the Register issues the Certificate and Report specified in 9.3.1.1 and 9.3.1.2. In case of the satisfactory results of initial survey of the oil-and-gas equipment, the Register, on the basis of the above documents, inserts the descriptive notations into the FPU/MODU/FOP class notation making a relevant entry in the Classification Certificate.

11 GENERAL REQUIREMENTS FOR DESIGN OF THE FPU/MODU/FOP OIL-AND-GAS EQUIPMENT

11.1 During design of the FPU/MODU/FOP oil-and-gas equipment, all the mandatory procedures prescribed by the national supervisory bodies shall be followed.

11.2 Systems, arrangements and machinery, comprising the part of the FPU/MODU/FOP oil-and-gas equipment, shall retain their operability under the environmental conditions specified in 1.3, Part II "Drilling Systems and Equipment" of the Rules.

11.3 Class of the oil-and-gas equipment shall correspond to the climatic conditions in the operational area.

11.4 During design of the FPU/MODU/FOP oil-and-gas equipment the following basic factors shall be considered:

a fault or malfunction of any system component shall not cause damage to or a fault in associated systems, the FPU/MODU/FOP on the whole and damage to the environment;

all the equipment shall be provided with the required means of monitoring and control, including the emergency ones;

in case of an accident, the equipment shall continue functioning to provide the safety of the system or FPU/MODU/FOP on the whole;

safety systems and their controls, hydraulic lines, cabling and other necessary equipment shall be safely located or properly protected to retain their operability within the time period sufficient for the accident localization or elimination;

measures shall be taken to protect the drilling rig equipment and systems against extreme loads associated with the operation or transportation of the FPU/MODU/FOP at sea;

the safety system components shall be designed in such a way that the typical failures (open-circuit fault, power failure, etc.) do not effect their operability;

the FPU/MODU/FOP oil-and-gas equipment and systems shall be divided into single process units (modules) to minimize the explosion hazard of the units and the entire system;

the FPU/MODU/FOP oil-and-gas equipment arrangements and systems shall be designed for a service life of at least 20 years, unless otherwise specified by a customer.

11.5 During development of the oil-and-gas equipment design, the extent of construction-and-assembling operations on the FPU/MODU/FOP at sea shall be minimal.

11.6 In order to prevent freezing of the equipment, arrangements and piping at a low temperature of ambient air, special measures shall be taken, which include, but are not limited to the following:

exclusion of "pockets" and dead-end sections at pipelines; all the pipelines directing freezing liquids shall be self-draining or the measures shall be provided to ensure their emptying;

provision of the liquid circulation in lines, which cannot be emptied, but wherein the liquid may be motionless (fire-fighting water supply lines, cooling water lines, etc.);

thermal insulation of the open sections of equipment and pipelines;

heating, in addition to thermal insulation, of the single sections of pipelines or equipment, heat sources may be the external (heating cables, steam tracers on pipelines) or internal components of the equipment (heating jackets, coils);

laying in closed casings in combination with the pipelines having a higher temperature where allowed;

use of heat-insulating layers on measuring, monitoring and control devices;

use of wind-proof walls and shelters for reducing heat losses;

addition of chemical agents (e.g. methanol) to reduce a liquid freezing point.

11.7 Heating shall be provided of the following units and equipment located in spaces, where heating is not

required, which uninterruptible operation is necessary during start, normal operation and tripping. These include, but are not limited to, the following:

equipment and piping with the minimal fluid flow, which is inadequate to maintain a temperature therein above a freezing point;

hydraulic seals;

discharge and safety valves and their flowlines;

piping and equipment, which may contain moisture during their start or deviations from operating conditions;

non-drainable low points and dead-end (stagnant) sections of piping and equipment;

monitoring and measurement devices, their lines, which reliable operation depends on the ambient temperature;

drain lines of piping, tanks, pumps and other equipment containing freezing liquids;

lubricating systems and seals on a hydrocarbon basis (where necessary).

11.8 The effect of weight change due to snow accumulation and ice formation on structures and equipment, and also potential resonance oscillations due to rotating equipment (pumps, compressors, gas turbines) shall be taken into account. Where necessary, special measures shall be taken to remove snow and ice from the structure and equipment components.

11.9 The single units (modules) of oil-and-gas equipment shall be tested to a full extent at a manufacturer's so that interunit mounting and precommissioning operations during the FPU/MODU/FOP final assembly are minimized.

11.10 The layout of machinery and equipment shall comply with the requirements in Part VII "Machinery Installations and Machinery" and Part VIII "Systems and Piping" of the MODU/FOP Rules.

11.11 Machinery spaces containing oil-and-gas equipment mechanisms and arrangements shall comply with the requirements of 2.6, Part VII "Machinery Installations and Machinery" of the MODU/FOP Rules.

11.12 The lighting system for oil-and-gas equipment locations shall comply with the requirements of Section 6, Part X "Electrical Equipment" of the MODU/FOP Rules.

11.13 The vibration levels of oil-and-gas equipment arrangements and mechanisms shall comply with the requirements of 2.7, Part VII "Machinery Installations and Machinery" of the MODU/FOP Rules.

11.14 Temperature of the outer surfaces of equipment and casings of heat-insulating coatings shall not exceed the self-ignition temperature of the most explosive and fire-hazardous product, and shall prevent potential burns in the areas accessible for attending personnel.

11.15 Safety systems shall provide two independent levels of equipment protection to prevent an emergency situation and minimize the effect of failures on the accident consequences. Such protection levels shall be provided by the functionally-various types of safety devices to increase a probability of preventing accidents or reducing their consequencies.

11.16 Single mechanisms shall be spaced at least 1 m apart with passages of at least 0,75 m (at least 0,5 m for modular units).

11.17 The items, which maintenance requires a worker to climb to a height of up to 0,75 m shall be provided with steps, and to a height of over 0,75 m, with staircases with railing.

11.18 Mechanical transmissions (chain, cardan, gear, etc.), half-couplings, pulleys, other rotating and moving oil-and-gas equipment components, as well as their protrusions shall be provided with metal guards.

PART II. DRILLING SYSTEMS AND EQUIPMENT

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part apply to the drilling rig, which means the equipment (technical facilities) installed on a FPU/MODU/FOP and designed for performance of the operation cycle associated with well construction on a sea shelf.

1.1.2 The items of the Register technical supervision, as regards the drilling equipment, are given in the Register Nomenclature in Section 7, Part I "General Regulations for Technical Supervision".

1.2 GENERAL REQUIREMENTS

1.2.1 Components of drilling equipment: technical facilities, systems, machinery, etc. listed in the Register Nomenclature are subject to confirmation of compliance (certification) with the requirements of the Rules with issue of the Register documents specified in 8.1.7, Part I "General Regulations for Technical Supervision".

The drilling rig systems stated in the Register Nomenclature are subject to the Register technical supervision for compliance with the requirements of the Rules during their mounting and tests on FPU/MODU/FOP.

1.2.2 Where the results of the technical supervision during construction of FPU/MODU/FOP show that the drilling equipment meets the requirements of the Rules, FPU/MODU/FOP shall be assigned descriptive notations added to the Register class notation in compliance with 6.3, Part I "General Regulations for Technical Supervision".

1.2.3 The drilling equipment installed on FPU/MODU/FOP under the Register technical supervision is subject to periodical surveys in service with the aim to confirm their compliance with the requirements of the Rules and to confirm/extend the FPU/MODU/FOP class with regard to the oil-and-gas equipment in compliance with the requirements of Section 10, Part I "General Regulations for Technical Supervision".

1.2.4 Electrical equipment, instrumentation and automated control systems, lighting, alarm and communication means of the drilling rig intended for use in hazardous areas shall comply with the requirements of Part IX "Special Requirements for Ensuring Explosion and Fire Safety".

1.2.5 All components of the drilling equipment systems and auxiliary systems, containing inflammable liquids, toxic substances or substances under high pressure, shall be provided with shut-off devices for proper isolation thereof from other systems.

1.2.6 The pneumatic system of the drilling unit (piping, cocks, connections, etc.) shall be tested by the manufacturer under pressure exceeding by 1,5 times the working pressure. After mounting at the drilling site, as well as after repairs, the pneumatic system shall be tested under pressure exceeding by 1,25 times the working pressure, but not less than by 0,3 MPa.

1.2.7 Arrangements shall be provided for gathering and disposal of liquid from the rig floor; the gathering system shall be isolated from the hazardous drainage system.

1.2.8 All the enclosed spaces of the drilling unit wherein flammable mixtures may be formed or penetrate shall be provided with gas detection and alarm systems and with forced plenum-exhaust ventilation. The ventilation shall ensure an air change in compliance with the requirements of the standards recognized by the Register. The ventilation shall be continuously operated from opening-up of the producing horizon till completion of the well construction.

When the hydrocarbon concentration in the air reaches 20 per cent of lower flame limit, a warning alarm and emergency exhaust ventilation shall be activated, and in case of further concentration increase up to 50 per cent of lower flame limit, the equipment, machinery and ventilation shall be deactivated.

1.2.9 Machinery, piping systems, cargo-handling gear, heat exchangers, pressure vessels, materials and means of automation forming the parts of the drilling rig shall comply with the requirements of Parts IV to IX.

1.3 ENVIRONMENTAL CONDITIONS

1.3.1 All machinery, equipment and systems of the FPU/MODU oil-and-gas equipment shall remain operative under the following conditions.

1.3.1.1 Static conditions:

.1 for semi-submersible and submersible MODU, when inclined up to 15° inclusive in any direction;

.2 for self-elevating MODU, when inclined up to 10° inclusive in any direction;

.3 for drilling ships, when heeled to 15° and simultaneously trimmed to 5°.

1.3.1.2 Dynamic conditions for self-propelled MODU and drilling ships:

.1 for semi-submersible and submersible MODU, when inclined up to 22,5° inclusive in any direction;

.2 for self-elevating MODU, when inclined up to 15° inclusive in any direction;

.3 for drilling ships, when rolled to 22,5° and simultaneously pitched to 7,5°.

1.3.2 Emergency sources of power shall remain operative under the following conditions:

.1 for semi-submersible and submersible MODU, when inclined up to 25° inclusive in any direction;

.2 for self-elevating MODU, when inclined up to 15° inclusive in any direction;

.3 for drilling ships, when rolled to 22,5° and simultaneously pitched to 10°.

1.3.3 The values of heeling angles given in 1.3.1 and 1.3.2 apply to inclinations by any ship's side and the values of trimming and pitching angles apply to inclinations by the bow or by the stern. On agreement with the Register, the values of inclinations given in 1.3.1 and 1.3.2 may be altered depending on the FPU/MODU type, size and operating conditions.

1.4 REQUIREMENTS FOR ARRANGEMENT OF EQUIPMENT

1.4.1 Machinery and equipment shall be arranged in compliance with the requirements of Section 4, Part VII "Machinery Installations" of the Rules for the Classification and Construction of Sea-Going Ships, as far as they are acceptable and sufficient.

1.4.2 The drilling rig equipment shall be located as far as possible from accommodation spaces and other systems of FPU/MODU/FOP, which are directly essential for the safety of these structures and prevention of environmental pollution.

1.4.3 Good visibility with straight view shall be provided from a driller's cabin on FPU/MODU/FOP or a video surveillance system shall be installed to monitor operation of the drilling rig equipment.

The drilling pumps shall be started from the local control station and their shutdown and running control shall be provided from the driller's control panel and local control station. The drawworks shall be controlled from the driller's control panel.

1.4.4 Essential equipment of the FPU/MODU/FOP drilling rig shall be arranged and designed in such a way that probability of damage caused by falling objects or handled cargoes is kept to a minimum.

1.4.5 Equipment having moving parts or surface heated to a temperature above 45 °C shall be properly isolated and guarded to avoid the contact with the attending personnel.

1.4.6 Means shall be provided for mechanization of operations associated with picking-up and laying-down of pipes, as well as with maintenance (replacement) of hydraulic units of the drilling pumps. Cargo-handling gear shall be remotely controlled.

To lift high-wear parts and assemblies with weight of more than 300 N, the cargo-handling gear (tackle, etc.) shall be installed.

The travelling and fixed ends of the drilling line shall not come in contact with the drilling derrick elements.

1.4.7 Lighting fixtures fitted on the FPU/MODU/FOP drilling units shall provide the following illumination intensity:

100 lx for rotary table;

30 lx for travel path of travelling block;

75 lx for derrick and pumping unit rooms;

75 lx for BOP unit;

10 lx for ladders, flights, companionways, catwalk.

2 REQUIREMENTS FOR THE DRILLING RIG EQUIPMENT AND SYSTEMS

2.1 DRILLING DERRICK AND ITS EQUIPMENT

2.1.1 Requirements for design loads.

2.1.1.1 Drilling derricks and derrick substructures shall be designed for strength and stability under the following conditions and design loads:

the maximum design static hook load (allowable hook load) for a certain ratio of the block-and-tackle system string-up (resulting from the maximum process hook load without regard to wind loads when there are no drill pipes on the pipe setback);

the maximum design wind velocity without regard to the complete set of drill pipes on the pipe setback;

design static hook load depending on the wind velocity, which varies between zero and the maximum allowable value with regard to complete set of drill pipes on the pipe setback at the maximum block-and-tackle system string-up;

the maximum design static load on the rotary table foundation;

the maximum design combination of loads on the pipe setback and rotary table foundation.

2.1.1.2 The derrick constructions shall be designed for the inertial load during movement depending on the mass of the drill pipe stands behind the stabbing fingers.

2.1.1.3 Drilling derricks, derrick portals of FPU/ MODU shall be designed for the above- mentioned loads in combination with dynamic loads induced by the FPU/ MODU motions under the following operating conditions:

round-trip operations with the drill string positioned in the well;

running-in of the casing strings with the drill string positioned on the pipe setback;

severe storm condition with the drill string positioned in the well;

sea passage/transit condition.

2.1.1.4 Drilling derricks of the FOP located in the seismic activity areas shall be designed for strength and stability, proceeding from the seismic activity conditions of the area concerned.

2.1.2 General requirements for the drilling derrick design.

2.1.2.1 Materials and products used for manufacture of structures of the FPU/MODU/FOP drilling derricks and derrick substructures shall meet the requirements of Part XII "Materials" of the MODU/FOP Rules. On agreement with the Register, use may be made of the materials and products complying with the requirements of the normative and technical documents of foreign classification societies, other recognized national and international rules and standards.

2.1.2.2 Requirements for welding of metal structures of the FPU/MODU/FOP drilling derricks and derrick substructures shall meet the requirements of Part XIII "Welding" of the MODU/FOP Rules.

2.1.2.3 Metal structure of the drilling derrick made of loop-type material shall preclude water accumulation in its elements.

2.1.2.4 In the design of drilling derricks on FPU/ MODU/FOP provision shall be made for the following:

anchoring devices of roller (sheave) for mounting/ dismounting of the crown block and its sections;

places for fastening safe navigational means;

places for installation of units for fastening power tongs suspension ropes, cargo rope of auxiliary winch, rope of suspended air and hydraulic tongs for making the casing pipes;

platform for crown block maintenance and drilling hose replacement;

platform for maintenance of the standpipe head - drilling hose connection;

derrickman's working platform with arrangement for his fast evacuation outside the derrick in case of emergency situation at the wellhead;

damper of the drilling line travelling end;

limiter of the travelling block rising height;

workstation heating system;

heated pipe setbacks with drilling and sewage water gathering system;

platform for maintenance and replacement of the flexible drilling hose on the manifold standpipe;

device for changing vertical position of power tongs;

anchoring device of power tongs' work and safety lines.

2.1.2.5 During mechanized round-trip operations without participation of the derrickman, a platform shall be provided for maintenance of the mechanisms of the automatic tripping device.

2.1.2.6 The metal floor of the derrickman cradle shall be designed for a load not less than 1300 N and provided with a railing sheathed throughout its entire height. The height of the railing shall be not less than 1,0 m. In order to prevent falling out of the cradle(s), the latter shall be provided with a safety device for securing to the mast.

2.1.2.7 The mast of the drilling unit shall be provided with step ladders of not less than 600 mm in width with inertial or other type devices for the derrickman safe going-up and -down or with tunnel-type ladders without landing platforms. Arc diameter shall not be less than 700 to 800 mm.

2.1.2.8 For going-up on the platforms located at a height of 250 to 750 mm, steps and staircases shall be provided and for going-up on the platforms located at a height more than 750 mm, stairways with railing.

The height of railing fitted on the landing platforms, service platforms and ladders at a height more than 2,5 m shall not be less than 1250 mm with two strings and toe board of not less than 150 mm in height adjoining the flooring. Thus, the minimum width of passages and gangways shall not be less than 500 mm including that on the stabbing board between the cradles.

2.1.2.9 The derrickman's working platform shall be fitted with hinge pins to rack drill pipe stands secured by a rope to prevent falling-down in the event of breakage and with vertically movable cradle to provide safe handling of drill pipe stands having deviation from the mean length (25, 27 and 36 m).

2.1.2.10 The derrickman's working platform protruding into the derrick or mast interior and fitted with a cap, shall not be less than 750 mm in width with boards of not less than 150 mm. The platform shall be provided with two safety slings. Railing of the above mentioned sizes or shelters shall be provided along the entire remaining perimeter of the platform.

2.1.2.11 Other working platforms for maintenance of the equipment elements at a height of 1800 mm and more shall be at least 750 mm in width with useful area not less than 0,6 m^2 and also shall be provided with the above-mentioned railing, boards and safety slings. Slings shall be provided in areas where no railing is fitted. All platforms shall have non-slip flooring.

2.2 DERRICK SUBSTRUCTURE

2.2.1 Derrick substructure (portal) shall be designed for strength with regard to the loads stated in 2.1.1.

2.2.2 Design of the drilling derrick substructure shall provide for placement and mounting of the following:

marine riser on the wellhead;

rotary table at the derrick's floor level;

automation and mechanization means and control panels;

heated pipe setback with the drilling mud drainage;

wireline anchor;

device for changing vertical position of power tongs;

power tongs' work and safety line anchor;

shot pits for making a connection, installation of a square kelly and the drill collars;

BOP unit on the wellhead above the deck level without any additional work with the metal structures of the derrick substructure;

dismounting of the derrick substructure with the Christmas tree or a part thereof installed;

devices for mechanization of operations associated with installation of the square kelly and drill collars into shot pits.

2.2.3 Supports of the derrick substructure shall be designed in such a way as to ensure its secure attachment to the supporting frame with regard to the design loads stated in 2.1.1.

2.3 DRILLING CONTROL SYSTEM

2.3.1 Drilling monitoring and control systems shall be integrated into the automated process control system to provide data on the progress of well drilling operations, as well as on emergency shutdowns in case of shows of oil, gas and water in the well, extension of hazardous zones and outbreaks of fire.

2.3.2 Drilling monitoring and control system shall be provided with uninterruptible power supplies (UPS) complying with the requirements of 3.6, Part X "Electrical Equipment" of the MODU/FOP Rules.

2.3.3 Provision shall be made for two-way communication between the drilling foreman's office and the main machinery control room located in the engine room, main control station and other spaces, which contain the equipment having the effect on the FPU/MODU/FOP safety.

2.3.4 The design of the drilling unit control system shall provide:

travelling block limit switch;

drawworks safe load indicator;

interlock precluding simultaneous actuation of the main and auxiliary drawworks drives;

interlock of pneumatic slips rise with the rotating rotor and the rotor start-up with the slips risen;

automatic shutting-down of the drilling pump drives when the pressure in injection line exceeds by 10 per cent the allowable pressure with simultaneous pressure release;

interlock precluding actuation of the drawworks drum when the boom of the automatic tripping device is extended, as well as extension of the automatic tripping device boom with the drawworks drum actuated;

interlock between the automatic tripping device boom and the drawworks, which precludes the movement of the automatic device boom when the travelling block is in the hazardous zone, and vice versa, which precludes the movement of the travelling block into the hazardous zone when the boom is extended.

2.3.5 When an automated measuring system is used during drilling operations, the automated process control system of the FPU/MODU/FOP shall contain an appropriate maintenance module for the system concerned.

2.3.6 Technical facilities of the drilling rig shall be monitored and controlled from the driller's cabin. The control system shall provide representation of the following data in the driller's cabin and foreman's office:

rotor torque and speed;

top drive torque and speed;

automatic drilling tongs torque;

travel speed and position of the travelling block in relation to the rotary table;

hook load, load on drilling tools;

drilling mud flow, density and pressure at the well inlet;

number of double strokes for each drilling pump;

total number of double strokes of the drilling pumps;

drilling mud flow, density and volumetric gas content at the well outlet;

level and volume for each drilling mud and filling-up tank;

percentage of the returned drilling mud.

2.3.7 Instruments representing hook weight, pressure in the drilling pump manifold, value of rotor torque, drilling mud flow at the well inlet and outlet shall be constantly within the driller's visibility.

2.3.8 During the well drilling the following parameters shall be monitored:

azimuth and zenith angle of the wellbore;

spatial arrangement of the wellbore;

relative positions of bores of the well being drilled and previously drilled neighboring wells.

2.3.9 The driller's cabin shall be equipped with control facilities providing:

.1 for drilling system actuated by the top drive and electrically driven rotor: control of start and shutdown, regulation and automatic maintenance of the specified speed;

.2 for electrically driven round-trip unit: control of the drawworks start and shutdown, regulation and automatic maintenance of the specified drill string and casing string movement speed during round-trip operations, regulation and automatic maintenance of the specified drilling instrument load, control of disk brakes;

.3 for electrically driven drilling pumps: shutdown, capacity (flow) regulation;

.4 for booster pumps: start and shutdown control;

.5 for manipulator of drill stand setting: control of the drill stand setting process during the round-trip operations;

.6 for automatic drilling tongs: control of the pipe screwing/unscrewing operations;

.7 alarms for hydraulic, cooling and lubricating systems of the drilling equipment;

.8 alarm to indicate lack of electrical equipment protection by pressurized enclosure "p";

.9 emergency shutdown of drilling equipment in the event of fire and extension of hazardous zones in the drilling rig spaces.

2.3.10 The driller's control panel shall be equipped with the instruments for continuous indication of basic parameters of the drilling process. List of instruments shall provide representation of the following data:

top drive torque;

rotor torque;

power tongs torque;

hook load;

discharge manifold pressure;

drilling mud flow.

2.3.11 Drilling control and monitoring systems shall also comply with the requirements of Section 2, Part IX "Special Requirements for Ensuring Explosion and Fire Safety".

2.4 EQUIPMENT FOR ROUND-TRIP OPERATIONS

2.4.1 Drawworks.

2.4.1.1 The drawworks shall comply with the requirements of 2.3, Part IV "Machinery Installations and Machinery".

2.4.2 Block-and-tackle system.

2.4.2.1 The block-and-tackle system shall comply with the requirements of 3.1, Part VI "Cargo-Handling Gear".

2.4.2.2 Wire ropes used to string up cargo-handling gear of the block-and-tackle system shall comply with the requirements of 3.15, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships, requirements of the national supervisory bodies and shall be manufactured in compliance with the recognized standards.

2.4.3 Catwalk.

2.4.3.1 The catwalk shall be installed near the derrick on the gate side and have a horizontal section of not less than 14 m in length and not less than 2 m in width.

2.4.3.2 Plating of the catwalk shall be provided with a chute for picking up and laying down pipes. The slope part of the catwalk shall be constructed in the same manner.

2.4.3.3 In the installation area of the catwalk a place shall be provided for installation of the pipe racks with the passageways to the catwalk. The pipe racks shall be fitted with detachable or folding posts to keep up the pipe stack and provide stacking of pipes to a height not more than 1250 mm.

2.4.3.4 Companionways of the catwalk onto the deck and entrance to the derrick substructure when the slope exceeds 20° shall be provided with a ladder with railing on one side (outer side in relation to the plating).

2.4.3.5 The pipe picking up and laying down operations on the catwalk shall be mechanized, the cargo-handling gear shall be remotely controlled.

2.4.4 Cargo-handling gear.

2.4.4.1 Technical facilities and equipment of the cargo-handling gear (block-hooks, swivels, etc.) shall comply with the requirements of 3.2, Part VI "Cargo-Handling Gear".

2.5 DRILL STRING (RISER) TENSIONING AND DISPLACEMENT COMPENSATION SYSTEMS

2.5.1 General.

2.5.1.1 Tensioning and displacement compensation systems shall provide constant tension force for risers (marine risers), pipelines, ropes at the FPU/MODU vertical displacement.

2.5.1.2 Compensators of the following types shall be used:

.1 compensators installed on the travelling block (block-hook) of the block-and-tackle system;

.2 compensators installed on the crown blocks.

2.5.1.3 Receivers of the tensioning and displacement compensation systems shall be separated from one another by shut-off fittings in such a way that a seal failure of a single receiver does not lead to the system overall failure.

2.5.1.4 Working medium flow discharged from compensators shall be directed to a safe side in such a way as not to affect the flexible hoses, components of equipment and structure. A pressure reducing valve may be used to reduce the discharged flow rate.

2.5.1.5 All control panels shall be fitted with safety valves. The discharge lines operated from safety valves shall be self-draining.

2.5.1.6 Total volume of the receivers shall exceed that of the working cylinders. Compressed air shall not contain vapours of combustible liquids and gases.

2.5.1.7 A continuous power supply of the system under all operating modes including emergency mode shall be provided.

2.5.1.8 Hydraulic cylinders shall be designed both for internal pressure loads arising during the system operation, and for external loads resulting from their function as bearing structural members.

2.5.1.9 The guide line tensioning systems shall provide continuous tension of the guide lines at the maximum line speed up to 100 m/min and length change compensation – up to 10 to 12 m.

2.5.2 Riser tensioning and displacement compensation systems.

2.5.2.1 Riser tensioning and displacement compensation systems shall consist of the following components:

hydraulic power cylinders and assembly of pulleys;

hydropneumatic accumulators (or compressed air cylinders);

control panels and piping system;

high pressure compressor unit;

vessels for working volume of compressed air;

vessels for storing compressed air.

2.5.2.2 Riser tensioning systems on the FPU/MODU with dynamic positioning systems shall be fitted with anti-recoil systems or equivalent, if required during drilling operations.

2.5.2.3 The system shall be designed to prevent any significant upward displacements of the riser (e.g. during deepwater drilling) that may cause a damage to the riser and the FPU/MODU structure. The system may be manually or automatically controlled and shall be integrated in the ESD system.

2.6 DEVICES FOR DRILL PIPE STRING ROTATION

2.6.1 Rotary table.

2.6.1.1 The rotary table shall comply with the requirements of 2.4, Part IV "Machinery Installations and Machinery".

2.6.2 Top drive.

2.6.2.1 The top drive shall provide performance of the following process operations:

rotation of the drill pipe string during wellbore drilling, reaming to nominal size and

enlargement;

making-up of drill pipes;

tripping operations with drill pipes, including making drill string connections by drill stands and single pipes;

run-in of the casing string;

crank of the drill string during drilling by downhole motors;

flushing of the well and crank of the drill string during tripping operations;

reciprocating of drill string and flushing of the well in case of accident and trouble elimination.

2.6.2.2 The safe working load of the top drive shall correspond to that of the drilling rig. The design of the top drive shall provide for installation of the BOP, sensors of actuator position, wellbore speed and torque.

2.6.2.3 In other respects, the requirements for the top drive shall comply with 2.5, Part IV "Machinery Installations and Machinery".

2.7 FREE-FLOWING MATERIAL RECEPTION, STORAGE AND DELIVERY SYSTEM

2.7.1 Free-flowing material reception, storage and delivery system shall provide:

reception of free-flowing materials (cement and weighting agent);

storage and delivery of these materials to the drilling mud and cement mixer;

preparation and weighting up of the drilling mud with dosed delivery of the materials to mixer;

filtration of dusty conveying air to remove suspended particles.

2.7.2 The system contains the following basic equipment:

discharger unit;

cyclone;

air filter;

feeder;

pipelines;

vent pipes with dampers;

air pipes;

tanks for storage of free-flowing materials;

hoses for loading of free-flowing materials.

2.7.3 Requirements for the system.

2.7.3.1 The number and capacity of tanks for storage of free-flowing materials on FPU/MODU/FOP shall be such that the total quantity of the materials (including that in storehouse) provides failure-free operation of the drilling rig during the period of the required self-contained operation.

2.7.3.2 Spaces shall be equipped with plenum ventilation to provide at least 10 air changes per hour.

2.7.3.3 Tight quick-demountable couplings shall be used as the pipeline joints. Hoses for loading free-flowing materials shall be fitted with standard international type flanges (or with other types, if required by the customer).

2.7.3.4 An uninterrupted supply of low pressure compressed air to equipment and instrumentation and automated control systems shall be provided.

2.7.3.5 Dew point of the air necessary to convey free-flowing materials shall be lower than the minimum ambient temperature by 10 °C, but not higher than -40 °C. To clean the air, use shall be made of the filters with efficiency not less than 99 per cent.

2.7.4 Pneumatic conveying system shall be monitored and controlled from the panel located in the spaces containing tanks for free-flowing materials.

2.7.5 The following data shall be represented to the foreman's office:

.1 for chamber-type feeders of drilling mud and cement components:

level and pressure indication;

alarm to indicate that working pressure, high and low level is reached;

.2 for dischargers of drilling mud and cement components:

weight and working pressure indication;

alarm to indicate that working pressure, high and low weight is reached;

.3 for disk gates:

opening and closing control;

alarm to indicate "open"/"closed" position;

.4 for air cleaning facilities:

filter clogging alarm.

2.8 DRILLING MUD SYSTEM

2.8.1 General requirements for drilling mud system.

2.8.1.1 Instrumentation shall be provided to monitor the following parameters of the drilling mud systems:

drilling mud flow at the well inlet and outlet;

pressure in the drilling pump manifold system with recording of its values;

mud level in receiving tanks during well deepening and flushing, and round-trip operations.

2.8.1.2 To collect sludge during cleaning of the drilling mud, special containers (sludge traps) shall be installed. At the location of containers, drip trays or guard coaming of not less than 200 mm in height shall be installed and a liquid drainage into the common sewage collection system shall be ensured.

2.8.1.3 Manifolding system of low pressure drilling and centrifugal pump shall provide:

the possibility of preparation, treatment and weighting of drilling mud with simultaneous flushing of the well;

complete drainage and purging of injection line with compressed air.

2.8.1.4 Drip trays and baths installed on FPU/MODU/FOP for the equipment near the wellheads of the wells being drilled and development wells shall be connected with the common sewage collection system.

2.8.1.5 Drilling hose shall be wounded by a soft wire rope of not less than 12,5 mm in diameter with loops spaced at 1,0 to 1,5 m apart throughout its length.

2.8.2 Requirements for drilling pumps and pipelines.

2.8.2.1 The drilling pumps shall comply with the requirements of 2.2.2, Part IV "Machinery Installations and Machinery".

2.8.2.2 The drilling pumps shall be started from the local control station and they shall be adjusted and stopped from the driller's control panel and the local control station.

2.8.2.3 Starting shut-off devices of the drilling pumps shall be remotely controlled with the extreme positions of their gates being monitored from the control panel.

2.8.2.4 A remotely controlled starting gate valve shall be fitted on the injection pipeline. The flowline shall be straight and securely fastened with an inclination toward the drainage side.

On the drilling rigs with a controllable pump drive, installation of the starting gate valves is not mandatory, but in the flowline a pressure release gate valve shall be provided.

2.8.2.5 Suction lines of the drilling pumps shall not have bends and turns, their diameter shall be not less than 200 mm and length – not more than 5 m.

2.8.2.6 Injection lines shall be laid with the minimum number of turns and bends to prevent erosive wear. Turn of the line shall not change flow direction by more than 90°. The design of the fasteners used for anchoring elements of the injection line (standpipe, etc.) to metal structure shall provide for alignment of the block-and-tackle system in relation to the well axis. Detachable metal clamps shall be installed on the flange joints of the injection line.

2.8.2.7 Injection line shall be provided with a pipe branch with the shut-off device to inject a liquid into the annular space through a four-way union of the BOP.

2.8.2.8 After assembly at the manufacturer's, as well as after repair welding, the injection pipelines with components and fittings installed thereon shall be tested by hydraulic pressure in compliance with the manufacturer's technical documentation. Otherwise, the test pressure shall be equal to the working pressure multiplied by a safety factor, which value is determined from Table 2.8.2.8. Exposure time shall not be less than 5 min.

Table 2.8.2.8

Working pressure, MPa	< 20	20 — 56	56 — 65	> 65
Safety factor	1,5	1,4	1,3	1,25

2.8.2.9 The manifold design shall provide rapid discharge of the drilling mud from the manifold with the pump shutdown, due to the optimal inclination angle being provided for the injection line.

2.8.2.10 Design of the elements of hydraulic part of the pump shall preclude injure to the attending personnel by liquid jet in the event of a seal failure.

2.8.2.11 Each pump shall be provided with sensors of the gas detection and alarm system.

2.9 CIRCULATION SYSTEM

2.9.1 Circulation system of the drilling rig shall provide gathering and purification of the waste drilling mud, preparation of new mud batches and injection of the purified mud into the well.

2.9.2 The circulation system shall include:

system for disposal of waste drilling mud from the wellhead;

mechanical means for separation of rock cuttings (shale shaker, hydraulic cyclone);

vessels for chemical treatment, accumulation and settling of the purified drilling mud;

sludge pump;

unit for preparation of fresh drilling mud;

drilling pumps for injection of drilling mud via the injection line into the well.

2.9.3 To connect subsystems and units of the circulation system, use shall be made of closed-type connecting elements (hoses, flexible joints, closed ditches).

2.9.4 Rotation angles of hydraulic mixers (hydraulic giants) in horizontal and vertical planes shall be limited in such a way that the mud jet remains inside the vessel.

2.9.5 The hydraulic giants and nozzles of the hydraulic mixers shall be readily accessible and quickly detachable. Hinges of the hydraulic giants shall prevent the reaction moment effect on the control handle.

2.9.6 Arrangements shall be made to provide structural protection of the attending personnel against the mud sprinkling from the nozzles of hydraulic cyclones and desanders.

2.9.7 Design of the shale shaker platforms shall provide for safe and convenient maintenance thereof and fast replacement of screens.

2.9.8 Vessels shall be fitted with hatches for discharge of liquid and maintenance. The maintenance hatch shall have dimensions not less than 600 x 700 mm. The lower edge of the discharge hatch shall be at the level of the vessel bottom.

2.9.9 The circulation system shall incorporate a gauging tank for controllable filling-up of the well, fitted with a level gauge and transfer facilities.

2.10 WELL CONTROL EQUIPMENT AND SYSTEMS

2.10.1 Blowout equipment.

2.10.1.1 Wellhead of the well being drilled shall be fitted with remote-controlled BOP unit, which working pressure shall correspond to that specified in the well construction project.

2.10.1.2 The type of the blowout equipment and casing string head shall comply with the technical documentation approved by the Register.

2.10.1.3 Installation diagram and piping layout of the blowout equipment, choke and kill units shall be developed by a contractor in compliance with the requirements of the national/international standards, approved by the Register and agreed with the customer and supervisory bodies. The blowout equipment shall be operated in accordance with the manufacturers' specifications approved by the Register.

2.10.1.4 All offshore wells shall be provided with four BOPs, including one shear ram-type BOP and one universal BOP. The control panel of the BOPs shall provide their remote opening and closing and the shear ram-type BOP shall be capable of shearing the thickest section of the high- strength drill pipe installed in the drill string assembly.

2.10.2 Blowout equipment control system.

2.10.2.1 General requirements.

2.10.2.1.1 The blowout equipment shall be equipped with the main and auxiliary control panels.

2.10.2.1.2 The main control panel of the blowout equipment and gate valve hydraulic drives shall be located behind the fire bulkhead.

2.10.2.1.3 The auxiliary control panels shall be located in the immediate vicinity of the driller's station and in the escape routes.

Control panels are supplied throughout the entire process of drilling or repair operations in the well.

2.10.2.1.4 At least two remotely controlled full-bore shut-off valves in series shall be provided on the flowline and injection line of the BOP assembly. For subsea BOP unit, these valves shall be of normally closed type. The valves shall be positioned in such places as to preclude accidental damage thereof (e.g. by falling objects).

2.10.2.1.5 The lines and the gate valves installed shall have an internal diameter identical to that of the four-way union pipe branch.

Downstream of the gate valve assembly, their diameter may be increased by not more than 30 mm.

2.10.2.1.6 Control system pipelines shall be fire-resistant for a period of time required for the closing-up of the BOPs.

2.10.2.1.7 The control panel shall be provided with visual and audible alarm for low level of the transported medium.

2.10.2.1.8 The control system of the blowout equipment shall be provided with a device for automatic shutdown of the hydraulic drive when system pressure exceeds the allowable value.

2.10.2.1.9 The injection system of the hydraulic accumulator shall include a device for automatic shutdown of pump when the nominal working pressure is reached. Volume of the hydraulic accumulator shall be sufficient to provide a double full cycle of works associated with the BOP opening/closing in the event of blackout.

2.10.2.1.10 Handwheels for manual locking of the BOP rams shall be installed in the readily accessible location, in shelter, and shall be provided with explosion-proof lighting. The shelter wall shall be marked with the arrows indicating direction of the handwheel rotation, number of revolutions required for closing-up of the BOP.

2.10.2.1.11 The ram-type BOP shall be periodically checked for opening and closing. Frequency and scope of these checks shall comply with Table 10.2.7, Part I "General Regulations for Technical Supervision".

2.10.2.2 Control and monitoring systems of blowout equipment.

2.10.2.2.1 Control and monitoring systems of the BOP stack shall provide:

.1 opening and closing of:

universal BOP;

single-gate and double-gate ram-type BOPs;

gate valves of the wellhead kill and choke lines;

.2 alarm to indicate:

low level of working liquid in the hydraulic unit;

low pressure in the hydropneumatic accumulators;

charger malfunction;

blackout;

emergency power-up.

2.10.2.2.2 For supply of the control and monitoring facilities of the blowout equipment, an UPS shall be provided to ensure control in the event of blackout.

2.10.2.2.3 The control and monitoring facilities of the blowout equipment shall be supplied from both the main and emergency power sources throughout the drilling process or repair operations in the well. Provision shall be made for the UPS to provide control in the event of blackout. Operating time when supplied from the UPS shall correspond to that of the ESD system UPS of the automated process control system.

2.10.2.2.4 Hydraulically controlled subsea wellhead equipment and lower riser equipment shall be provided with additional shut-off and disconnection (mechanical or hydraulic) facilities, which operate independently of the main facilities. The control panels shall be arranged in such a way that at least one of them is accessible in emergency situation.

2.10.2.2.5 For the control systems of the subsea blowout equipment, provision shall be made for interlock of the riser to wellhead connection system by means of tongs.

2.10.2.2.6 As a rule, the final BOP actuation time (from signal initiation to lock-up) shall be not more than 30 s for ram-type BOPs, not more than 45 s for annular BOPs. For subsea units of blowout equipment this time shall not exceed 45 s.

2.10.3 Diverter systems.

2.10.3.1 Design of diverter systems shall take account of possible erosion during operation. The allowable erosive wear shall be stated in the technical documentation approved by the Register.

2.10.3.2 The diverter piping shall have sufficient length to provide safe gas withdrawal from the FPU/MODU/FOP and shall not impair operation of other systems during gas ingress (e.g. heating, ventilation and air conditioning systems).

2.10.3.3 The diverter system shall be connected to the control panel manually operated from a place near the driller's station. The diverter control system shall be equipped with an interlock to provide that the diverter sealing around the drilling instrument is closed only after the full opening of the discharge line valve.

2.10.3.4 Shut-off valves shall be operable within the whole range of working parameters and environmental conditions.

2.10.3.5 Actuation time values of the control system shall comply with the national or international standards recognized by the Register.

2.10.3.6 Capacity of the hydropneumatic accumulators shall exceed by 1,5 times the volume required for the normal system operation.

2.10.3.7 Redundancy of power sources shall be provided (individual back-up hydropneumatic accumulators, uninterruptible supply of pneumatically operated valves, etc.).

2.10.3.8 The diverter shall be controlled:

from the main control panel located on the derrick substructure platform;

from the remote control panel located in the driller's cabin.

2.10.3.9 Hydraulically driven chokes of the blowout equipment manifolds shall be controlled from the control panel located on the drilling platform.

2.10.3.10 The diverter control and monitoring system shall provide opening and closing of the following:

ball valve in the filling-up line;

diverter packer;

overshot packer;

diverter joint;

ball valves for emergency starboard and port discharge.

2.10.4 Choke and kill systems.

2.10.4.1 Length of the lines from the kill and choke units shall be stated in the technical documentation approved by the Register.

2.10.4.2 Flare discharge lines from the choke and kill units shall be securely fastened on special supports and laid aside of the production facilities and welfare spaces with a slope from the wellhead.

2.10.4.3 The high pressure manifolds of the discharge and kill lines, connections, shut-off valves, etc. shall be rated to the same working pressure as of the BOP.

2.10.4.4 It shall be possible to inject the drilling mud in the discharge and kill lines up to the working pressure of the BOP.

2.10.4.5 It shall be possible to return the drilling mud via installed knock-out drum. Provision shall be also made for emergency overboard discharge of the mud via the fixed piping.

2.10.4.6 The working pressure of these lines and associated shut-off and control valves shall not be less than the working pressure of a buffer chamber of the discharge line.

2.10.4.7 Knock-out drum shall be fitted with a pressure monitoring system and, where necessary, with a hydraulic seal of not less than 3 m in height. The gas withdrawal lines shall not be less than 200 mm in diameter. The hydraulic seal shall be connected to the discharge lines in such a way as to prevent the gas breakthrough.

2.10.4.8 The choke and kill lines shall be provided with the following:

.1 at least 2 chokes, one remotely controlled choke and one manually controlled choke. It shall be possible to shutdown and change each choke while the system is in operation;

.2 valves in each outlet and inlet lines to isolate the lines from the manifolds.

The working pressure of the valves shall be equal to the working pressure of the choke manifold.

2.10.4.9 The drill pipe and choke line pressure shall be indicated on all control stations (remote and local). Data on the choke valve position and drilling pump capacity shall be displayed on the remote control panel.

2.10.4.10 The gate valve upstream of the choke shall be provided with a plate indicating the allowable pressure for the wellhead, the weakest well section and the mud density, on which basis this pressure is determined.

2.10.4.11 The control and monitoring system of the choke system shall provide:

control of chokes, setting and automatic maintenance of the set pressure;

indication of pressures in the kill and choke lines, pressure in the drilling pump manifold;

choke position alarm.

2.10.5 Cementing system.

2.10.5.1 The cementing system shall include:

cementing unit with cement slurry preparation system;

standby jet mixer with supercharger, settling drum and constant cement flow bin;

cement surge tank;

high pressure manifold of the cementing unit and manifolding system of the cementing system equipment;

cementing monitoring system.

2.10.5.2 The cementing system shall provide:

cement slurry preparation;

injection of cement slurry into the well;

maintenance of the cement slurry parameters;

control and monitoring of the well cementing;

monitoring of the cement slurry parameters;

pressure testing of the drill and casing strings, wellhead equipment;

maintenance of back pressure in the well.

2.10.5.3 Displacing fluid shall be supplied directly to the cementing unit via suction branch pipes of cementing pumps bypassing the open measuring tank of the cementing unit.

2.10.5.4 When the cementing system is supposed to be used for the drilling mud circulation, provision shall be made for the appropriate devices to transfer the drilling mud into the cementing system.

2.10.5.5 The cementing monitoring system shall provide indication of the following process parameters at the local control station, indication and recording of the following parameters at the foreman's office:

delivery of each cementing pump;

cumulative injected fluid volume;

cementing pump pressure;

cement slurry density.

2.10.5.6 The control system shall be integrated into the automated process control system to perform emergency shutdowns in the event of fire, gas ingress, extension of hazardous zones (refer to Section 2, Part IX "Special Requirements for Ensuring Explosion and Fire Safety").

2.10.6 Drilling waste water system.

2.10.6.1 The drilling waste water system shall provide:

collection of drilling waste waters of the drilling rig and their temporary storage in the drilling waste water and waste drilling mud collection tanks;

delivery of the drilling waste waters to support vessels for their transportation onshore.

2.10.6.2 All the equipment, which is a source of the drilling mud spills, and the deck areas where the drilling mud leaks are likely to occur shall be provided with coamings. Drainage from the possible spill areas shall be directed to receiving tanks of the drilling waste water collection system.

2.10.6.3 The drilling waste water collection system shall include:

drilling waste water and waste drilling mud tanks;

treated water tank;

flocculent tank;

tank for additives (generally, sodium bicarbonate);

pumps for supply of the drilling waste waters and waste drilling mud to a treating unit and delivery to a waste-removal vessel;

pumps for supply of treated water to circulation system and delivery to a waste-removal vessel.

2.10.6.4 Control and monitoring of the drilling waste water system shall provide the local start and remote shutdown of pumps from the drilling waste water delivery stations.

2.10.6.5 The main machinery control room shall provide:

.1 remote shutdown of pumps when the tanks are emptied;

.2 level indication in tanks for:

waste drilling mud;

drilling waste waters;

treated water;

.3 alarm to indicate:

pump running and overload;

high and low level in pits, waste drilling mud, drilling waste water and treated water tanks;

low temperature in treated water tank.

2.11 MARINE RISERS

2.11.1 Marine risers shall be designed to withstand the loads due to the following external factors:

waves;

current;

riser tensional loads;

FPU/MODU displacement;

drilling mud weight;

compression load;

loads during mounting and transportation;

ice loads.

2.11.2 Technical documentation for marine risers used on FPU/MODU/FOP, including dynamic strength calculations, design of connectors, telescope and flexible joints, sections for connecting spider shall be approved by the Register.

2.12 PIPE HANDLING EQUIPMENT AND SYSTEMS

2.12.1 Pipe handling equipment and systems shall be capable of delivering pipes from racks to the drilling floor, for which purpose the equipment shall include:

horizontal catwalk for placing pipes thereon from the racks;

sloping platform sections used for power delivery of pipes from catwalk to the drilling floor with the use of pipe manipulators and winches.

The sloping bridge with the equipment set may be replaced by a powered mechanism for delivery of pipes to the drilling floor.

2.12.2 Design of auxiliary winch shall provide smooth movement and reliable suspension of cargo. A clear view of the working area and pipe movement shall be provided for the operator from the control panel. Where necessary, a backup control panel shall be provided.

2.13 AUXILIARY EQUIPMENT AND SYSTEMS

2.13.1 Scope of application.

2.13.1.1 The requirements of the present Section apply to auxiliary equipment and systems forming part of the FPU/MODU/FOP drilling and process systems.

2.13.2 Low pressure compressed air system.

2.13.2.1 Low pressure compressed air system shall comply with the requirements of Sections 1,2 and 16, Part VIII "Systems and Piping" of the Rules for the Classification and Construction of Sea-Going Ships, unless otherwise specified in the present Section.

2.13.2.2 The low pressure compressed air system shall provide storage and supply of compressed air at an appropriate pressure to the consumers. Equipment and pressure vessels shall be equipped with instrumentation and safety devices.

2.13.2.3 To supply compressed air to the consumers, the FPU/MODU/FOP shall be provided with the following:

low pressure compressor units;

air drying units;

reducing valve assembly;

air receiver units (air reserve shall provide failure-free shutdown of the process system equipment in the event of blackout);

piping with connecting, shut-off and control fittings.

2.13.2.4 The low pressure compressed air system shall supply air to the following consumers:

instrumentation system;

pneumatically controlled fittings;

pneumatic drive of the wellhead component control stations and other consumers.

2.13.2.5 Compressors and drying units shall be equipped with the local monitoring and control stations providing:

selection of control modes: "Local/Automatic";

control of start and shutdown of the compressors and drying units;

adjustment and automatic maintenance of the set capacity by pressure;

alarm, indication, protection and interlock necessary for operation of the equipment

in normal and emergency situations.

2.13.2.6 The main machinery control room shall provide:

.1 indication of the following:

lubricating oil pressure of compressors;

air humidity at the drying unit outlets;

control air pressure;

pressure in air receiver;

.2 alarm to indicate:

control and operating mode of compressors and drying units;

increase of air temperature at the compressor outlet;

pressure drop of compressor lubricating oil;

pressure drop of control air;

pressure drop in air receiver;

failures and malfunctions of compressors and drying units.

2.13.2.7 Air supplied to the automation system shall be pre-dried to the dew point in compliance with the requirements of the equipment manufacturer but, as a rule, not more than -40 °C.

2.13.2.8 The compressed air system shall have a receiver, which provides the compressed air reserve for operation of instrumentation and automation facilities during at least one hour.

2.13.3 Inert gas (nitrogen) system.

2.13.3.1 The compressed nitrogen system shall provide storage and supply of inert gas (nitrogen) of the required pressure and purity as regards oxygen content to the consumers. As a rule, FPU/MODU/FOP shall be provided with a common inert gas system for all consumers.

2.13.3.2 The low pressure compressed nitrogen system shall comply with the requirements of 3.9, Part IV "Fire Protection" of the Rules for the Classification and Construction of Sea-Going Ships, unless otherwise specified in the present Section.

2.13.3.3 The compressed nitrogen system shall provide:

purging of the equipment and the process system units prior to commissioning and technical maintenance thereof;

purging of flare and vent headers;

purging of gas compressor seals;

supply of compressed air to the drilling rig equipment;

charging of hydropneumatic accumulators of the blowout equipment control station;

charging of hydraulic drilling pump pulsation dampeners.

2.13.3.4 The compressed nitrogen equipment shall include:

nitrogen station;

booster compressor;

receiver;

cylinders;

piping;

instrumentation.

2.13.3.5 Nitrogen reserve in cylinders shall be provided for use in emergency situations, which shall be kept up in a stand-by mode for connection to a nitrogen distribution system.

2.13.3.6 The nitrogen unit shall be equipped with the local control and monitoring station providing operation in automatic mode, necessary alarm, indication, protection and interlock. The nitrogen station room, where nitrogen concentration in the ambient air may be changed due to the nitrogen leaks, shall be equipped with monitoring and alarm devices for the minimum and maximum oxygen content in the room (not less than 19 per cent and not more than 23 per cent by volume). Alarm shall be provided outside the room and in the main machinery control room.

2.13.3.7 The main machinery control room shall provide:

.1 indication of the following:

oxygen concentration at the nitrogen unit outlet;

nitrogen pressure after nitrogen receiver and at the outlet of nitrogen booster compressor;

.2 alarm to indicate:

malfunctions;

failure and high concentration of nitrogen in the nitrogen unit;

low nitrogen pressure after nitrogen receiver and at the outlet of nitrogen booster compressor;

charging of hydropneumatic accumulators of the blowout equipment control station;

charging of hydraulic drilling pump pulsation dampeners.

2.13.4 Equipment lubrication system.

2.13.4.1 Equipment lubrication system shall provide performance of the following operations:

filling-in of oil storage tanks and engine crankcases with oil from barrels;

filling-in of engine crankcases with oil;

pumping-out of waste oil from engine crankcases;

delivery of waste oil from waste oil tank to the waste-removal vessel.

2.13.4.2 The equipment lubrication system shall comply with the requirements of Sections 1, 2 and 14, Part VIII "Systems and Piping" of the Rules for the Classification and Construction of Sea-Going Ships.

2.13.4.3 In case of the large single oil consumption from 0,5 m^3 and upwards, use shall be made of the fixed oil storage tanks with the oil being delivered from the tanks by means of portable or fixed oil transfer pumps.

2.13.4.4 In order to fill-in the tanks with oil from barrels, branch pipes and portable electrically driven pumps provided with coamings shall be fitted on the exposed decks and platforms.

2.13.4.5 Oil storage and waste oil tanks shall be provided with heating arrangements.

2.13.4.6 To collect waste oil, provision shall be made for one tank of sufficient capacity with a pump. Waste oil shall be pumped out through the fuel and oil receiving stations.

2.13.4.7 In the main machinery control room, monitoring and control of the following shall be performed:

.1 shutdown of the waste oil transfer pump and pure oil transfer pump when tanks are emptied;

.2 indication of temperature and level in the waste oil tank and oil storage tanks;

.3 alarm to indicate:

run and overload of the oil transfer pumps;

low and high temperature;

lower and upper levels in the waste oil tank and oil storage tanks;

the maximum level in the waste oil tank.

2.13.5 Process fresh water system.

2.13.5.1 Process fresh water system shall supply fresh water required for preparation of the drilling mud and flushing of the process equipment.

2.13.5.2 The process fresh water system shall comply with the requirements of Sections 1, 2 and 15, Part VIII "Systems and Piping" of the Rules for the Classification and Construction of Sea-Going Ships.

2.13.5.3 The system shall contain the following equipment:

process fresh water storage tanks;

pumps to supply water for preparation of the drilling mud and cement slurry, to coagulation and flocculation units, electric dehydrator, electric pumps of screw-type centrifuge and chemical agent tank;

pumps to supply water for flushing of the process equipment, collectors and tanks;

pneumatic tank.

2.13.5.4 A local monitoring and control station shall be provided to select control mode: "Local/Remote" for the process fresh water pumps.

2.13.5.5 The main machinery control room shall provide:

.1 remote control of start and shutdown of pumps;

.2 indication of the following:

pump discharge pressure;

level in the process fresh water tanks;

.3 alarm to indicate:

remote control mode;

pump running, overload and high discharge pressure;

running and malfunctions of desalinating units;

lower and upper levels in the process fresh water tanks.

2.13.5.6 In the absence of fresh water, in emergency cases, the system may be supplied by sea water from the sea water supply system.

2.13.6 Water cooling systems.

2.13.6.1 General requirements.

2.13.6.1.1 To cool the oil-and-gas equipment, sea or fresh water shall be used depending on the requirements of the specifications for delivery of the equipment.

2.13.6.1.2 The water cooling systems shall comply with the requirements of Sections 1, 2 and 15, Part VIII "Systems and Piping" of the Rules for the Classification and Construction of Sea-Going Ships.

2.13.6.1.3 Suction of sea water for the cooling systems shall be provided through fish protection structures (FPS). The FPS shall be designed taking into account the requirements of the national and/or international standards. The FPS throughput capacity shall provide operation of all sea water pumps with the maximum design capacity; in this case at least one stand-by FPS shall be provided. The FPS shall be located in an ice-protected area.

2.13.6.1.4 Suction lines of the sea water pumps shall be fitted with filters and sea water meters. Provision shall be made for cleaning of the filters without the pump shutdown.

2.13.6.1.5 In case the FPS installed in a water intake provide the proper sea water filtration, filters in the suction lines may be omitted.

2.13.6.1.6 The number of sea inlet and discharge openings with the fittings installed therein and located below the FPU/MODU/FOP operating waterline shall be kept to a minimum. Fittings installed in the inlet and discharge openings shall be remotely closed.

2.13.6.1.7 The number, capacity and head of pumps shall be accepted subject to the requirement that the equipment is cooled under the maximum load condition. At least, one pump shall be a stand-by pump.

2.13.6.2 Fresh water cooling system of the oil-and-gas equipment machinery.

2.13.6.2.1 A selector switch of control mode: "Local/Remote" shall be provided at the local control station of the system.

2.13.6.2.2 The main machinery control room shall provide:

.1 remote control of the pump start and shutdown;

.2 indication of the following:

water temperature and pressure at the inlet of heat exchangers;

water temperature and pressure at the outlet of heat exchangers;

at the inlet of pumps;

at the inlet of cooling circuit and collector;

water level in expansion tank;

.3 alarm to indicate:

selected control mode;

running, overload, high and low pressure of cooling pumps at the inlet of cooling circuit;

low water level in expansion tank.

2.13.6.3 Sea water cooling system.

2.13.6.3.1 A selector switch of control mode: "Local/Remote" shall be provided at the local control station of the system.

2.13.6.3.2 The main machinery control room shall provide:

.1 remote control of the cooling pump start and shutdown, opening and closing of sea water inlet valves, valves for delivery of sea water to the FPS;

.2 indication of the following:

cooling pump discharge pressure;

pressure, flow and temperature in sea water suction line;

temperature of water discharged overboard;

.3 alarm to indicate:

remote control mode;

running, overload and discharge pressure drop of the pumps;

position of sea water inlet valves and valves for delivery of sea water to the FPS;

pressure drop in the suction line of sea water and sea water to be delivered to the FPS.

2.13.6.4 Process equipment sea water flushing system.

2.13.6.4.1 A selector switch of control mode: "Local/Automatic" shall be provided at the local control station of the system.

2.13.6.4.2 The main machinery control room shall provide:

.1 indication of pressure in pneumatic tank;

.2 alarm to indicate:

automatic control mode;

running and overload of pumps;

low and high pressure in pneumatic tank.

2.13.7 Chemical agent injection system.

2.13.7.1 As a rule, the following chemical agents shall be used:

agents to prevent hydrating;

agents to prevent paraphining;

agents to prevent salt deposition;

oil demulsifiers;

corrosion inhibitors;

agents to prevent foaming.

Type of chemical agents to be used is determined by the project and depends on the composition of the well fluid.

2.13.7.2 Non-return valves shall be installed in places where chemical agents are injected into the pipelines.

2.13.7.3 Substances, which are chemically incompatible, shall be stored in such a way as to preclude their interaction.

2.13.7.4 Pipelines leading from the chemical agent receiving station to storage tank shall be arranged so that they can be emptied by gravity.

2.13.7.5 Equipment for emptying of transport tanks shall be located in the area provided with a leak-tight flanged edge along its perimeter. Fixed pipelines and flexible hoses shall be protected against the possible damages, which may occur during handling operations.

2.13.7.6 The injection systems containing cryogens (e.g. liquid nitrogen) shall be located at separate areas provided with leak-tight flanged edge. Volume of the guarded space shall be sufficient to gather all possible leaks and prevent the low temperature effect on other FPU/MODU/FOP structural components.

2.13.7.7 In the area where chemical agents are handled, the protective clothing and eye wash facility shall be provided.

2.13.7.8 Volume of all storage tanks shall be sufficient to store chemical agents for the entire period of self-contained operation of FPU/MODU/FOP. The system shall have a necessary degree of redundancy.

2.13.8 Well completion and flushing system.

2.13.8.1 The well completion and flushing system shall contain:

completion pump;

well completion and flushing tank;

piping, shut-off and safety fittings;

monitoring and control facilities.

2.13.8.2 The well completion and flushing system shall provide:

fluid circulation in well with replacement of flushing fluid by water, gas or air;

gathering and direction to utilization of the well flushing products;

well flow rate measurement;

safe well shutdown in case of abnormal situation.

PART III. SYSTEMS FOR PRODUCTION, GATHERING, TREATMENT AND TRANSPORTATION OF WELL FLUIDS

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part apply to process system – process equipment (technical facilities) installed on FPU/MODU/FOP and designed for performance of operation cycle associated with production, gathering, treatment and transportation of well fluids on a sea shelf.

1.1.2 The items of the Register technical supervision, as regards the equipment for production, treatment and transportation of well fluids are given in the Register Nomenclature given in Section 7, Part I "General Regulations for Technical Supervision".

1.2 GENERAL REQUIREMENTS

1.2.1 General provisions relating to the procedure of technical supervision of the systems for production, gathering, treatment and transportation of well fluids of the FPU/MODU/FOP during their manufacture, mounting and operation, as well as the requirements for the amount of technical documentation submitted to the Register for approval shall comply with the requirements of Sections 3 to 10, Part I "General Regulations for Technical Supervision".

1.2.2 Components for production, gathering, treatment and transportation of well fluids: technical facilities, systems, machinery, etc. listed in the Register Nomenclature are subject to confirmation of compliance (certification) with the requirements of the Rules with issue of the Register documents specified in 8.1.7 of Part I "General Regulations for Technical Supervision".

The systems for production, treatment and transportation of well fluids listed in the Register Nomenclature shall be subject to the Register technical supervision for compliance with the requirements of the Rules during their mounting and tests on FPU/MODU/FOP.

1.2.3 Where the results of the technical supervision during construction of FPU/MODU/FOP show that the equipment for production, gathering, treatment and transportation of well fluids complies with the requirements of the Rules, FPU/MODU/FOP shall be assigned descriptive notations added to the Register class notation in compliance with 6.3, Part I "General Regulations for Technical Supervision".

1.2.4 Equipment for production, gathering, treatment and transportation of well fluids installed on FPU/MODU/FOP under the Register technical supervision is subject to periodical surveys in service with the aim to confirm compliance with the requirements of the Rules and confirm/extend the FPU/MODU/FOP class as regards the oil-and-gas equipment in compliance with Section 10, Part I "General Regulations for Technical Supervision".

1.2.5 Machinery, piping systems, cargo-handling gear, heat exchangers, pressure vessels, material and means of automation forming part of the drilling rig and process systems shall comply with the requirements of Parts IV to IX.

1.2.6 Equipment for production, treatment and transportation of the FPU/MODU/FOP well fluids shall remain operative under the conditions specified in 1.3, Part II "Drilling Systems and Equipment".

1.3 REQUIREMENTS FOR ARRANGEMENT OF EQUIPMENT

1.3.1 Machinery and equipment shall be arranged in compliance with the requirements of Section 4, Part VII "Machinery Installations" of the Rules for the Classification and Construction of Sea-Going Ships, as far as they are acceptable and sufficient.

1.3.2 Working areas of the FPU/MODU/FOP process system where the well fluids are gathered, treated and transported shall be mandatorily provided with the following:

gas detection and alarm system;

fire detectors;

forced plenum-exhaust ventilation.

1.3.3 The systems shall contain measuring, monitoring, automation, control and interlocking devices in compliance with the project.

Inlet and outlet pipes of process apparatus, vessels or tanks, carrying combustible gases, readily ignitable or combustible liquids, shall be fitted with shut-off fittings operated remotely and, where necessary, automatically (by emergency alarm).

1.3.4 Working areas of the process system shall be provided with alarm which representation of the main process and indoor air parameters to the central control panel of the FPU/MODU/FOP (refer to Section 2,

Part IX "Special Requirements for Ensuring Explosion and Fire Safety").

1.3.5 In the working areas, where equipment, tanks and pipes with readily ignitable and combustible liquids are located, discontinuous floors shall not be used.

1.3.6 Layout of equipment, tanks and pipes with readily ignitable and combustible liquids shall prevent spreading of spills beyond the working areas and exposed deck areas. These working areas shall be provided with the closed drainage systems, which technical characteristics provide fire-proof emergency draining of the entire contents from the equipment, tanks and piping into the special tanks.

1.3.7 Tanks for oily drainages, chemical reagents and combustible liquids shall be fitted with overflow automatic control systems, remote tank level gauging devices and alarm.

1.3.8 The maximum liquid level in the tanks shall be determined with due regard to the operating time of actuators of the overflow automatic control system, including overflow due to thermal expansion of the stored liquid.

1.3.9 Design of the equipment and tanks, when vacuum is likely to occur therein, shall provide the inert gas supply pipes to preclude formation of explosive mixtures.

1.3.10 The oil-and-gas equipment, tanks and piping, which emptying in the event of fire is impossible, shall be fitted with safety valves to provide release of the excessive pressure.

1.3.11 Heating arrangements of the equipment and tanks containing combustible gases, readily ignitable and combustible liquids shall be fitted with the following:

devices for temperature control;

automatic devices for disengaging the heating elements when the temperature limit is

reached;

alarm for indication of fault conditions and inadmissible temperature rise.

1.3.12 On FPU/MODU/FOP, the items of group plants for gas treatment, the process in which is associated with the use of flame, shall be located as far as possible (not less than 15 m) from the apparatus containing gas, readily ignitable liquids, combustible liquids, as well as from producing wells and wells being drilled.

1.3.13 Spaces with the installed oil-and-gas equipment shall have at least two exits.

1.3.14 Items under control shall be provided with the alarm devices warning about disconnection of the items and the feedback to the main machinery control room.

1.3.15 Every item controlled from the main machinery control room shall be fitted with an interlocking system and manual control directly on the item.

1.3.16 Discharges from the safety valves fitted on the process equipment, as well as from the control system pipelines shall be directed to a tank (knockout drum), while gas shall be directed to discharge or utilization systems. The control system pipelines and wells shall be purged, discharged and pumped through the purging unit with subsequent pumping-out of liquid.

1.3.17 Piping of tanks for storage of readily ignitable liquids and combustible liquids shall provide, in the event of accident to the tank, transfer of the liquid from one tank to the other.

1.3.18 Tanks shall be fitted with the remote (automatic) tank level gauging devices (without opening-up of hatches, unions or pipe branches installed thereon).

1.3.19 The tanks for storing readily ignitable and combustible liquids shall be fitted with breathing, safety and shut-off fittings, sampler units and level gauges.

1.3.20 The method of arrangement of the shut-off fittings, pumping equipment, detachable joints and other sources of possible leaks of combustible substances shall provide gathering and fire-proof disposal of possible leaks (e.g. by means of the drip trays, drainage systems, etc.).

1.3.21 The equipment shall be arranged to provide the convenient and safe operation, possibility of performance of repair works and taking of the urgent measures to prevent emergency situations or confine accidents. The equipment shall be located on the exposed decks and platforms of FPU/MODU/FOP, accessible for fire extinguishing by water sprays including operations from the fire-fighting vessels.

1.3.22 To perform repair and preventive works, provision shall be made for connection of water, steam, inert gas lines for purging (flushing) them prior to commissioning or decommissioning, as well as prior to performance of repair and scheduled maintenance of the equipment, tanks and piping where combustible liquids and gases may be present.

1.3.23 Shut-off fittings, which enable disconnection of units by a command from the ESD system (refer to Section 2, Part IX "Special Requirements for Ensuring Explosion and Fire Safety"), shall be fitted at the functional interface between the system units.

1.3.24 Auxiliary and support systems (steam generation, heat transfer fluid, cooling, compressed air, drainage, etc. systems) servicing the systems containing toxic or fire explosive substances shall not come into contact with the similar systems located in safe zones.

1.3.25 Allowable service life shall be specified for the process equipment and pipeline fittings taking into account the specific service conditions. The manufacturer shall state the data on the service life in the certificates of the equipment and pipeline fittings. Design service life shall be indicated in the design documentation and the equipment certificate.

1.3.26 The necessary standby equipment shall be provided in compliance with the design approved by the Register.

1.3.27 The project shall specify the predetermined self-sufficiency period of the system operation (as a rule, not less than 15 days).

1.3.28 Provision shall be made for corrosion protection systems and corrosive wear monitoring systems. The requirements for the corrosion protection systems are established in accordance with the project depending on the service conditions.

1.3.29 Structural particulars and/or ESD systems of the process equipment shall prevent the possibility of the combustible liquid and gas emergency leaks falling on the escape routes provided for by the project within the period of time required for the people evacuation.

1.3.30 Communication of the inner space of the process apparatus, tanks and piping containing combustible gases and readily ignitable liquids with the ambient air shall be provided only via process lines and breathing arrangements fitted with flame arresters, which are intended for these purposes.

1.3.31 When it is impossible to release the combustible gases or vapours to the flare systems, they shall be discharged to the atmosphere outside the FPU/MODU/FOP spaces. Location of the combustion gas discharge or vapour release sources shall be determined by a calculation proceeding from explosion- and fire-proof conditions of their air dispersion.

1.3.32 Non-return valves shall be installed on the well flowlines upstream the modular unit for measuring and separation of well fluids.

1.3.33 For process equipment in service, which is subjected to vibrations, arrangements shall be made to protect it from vibration loads.

1.3.34 Typical layout of the equipment on the FPU deck is given in Appendix 2.

2 REQUIREMENTS FOR SYSTEMS FOR PRODUCTION, GATHERING, TREATMENT AND TRANSPORTATION OF WELL FLUIDS

2.1 SYSTEM FOR GATHERING OF WELL FLUIDS

2.1.1 The system for gathering of well fluids of FPU/MODU/FOP shall be leak-tight and prevent formation of dangerous concentration of explosive and toxic substances in the environment under all operational conditions.

2.1.2 Wellheads shall be provided with the well components designed for the maximum possible pressure on the wellhead in operation. The inlet and outlet pipelines of the system for gathering of well fluids shall be provided with remote-controlled (by a command from the ESD system) shut-off fittings.

2.1.3 The well components shall comply with the requirements of standards recognized by the Register.

2.1.4 The well component spacing across the well pattern shall not be less than:

the distance between oil wellheads – 24 m;

the distance between gas and gas condensate wellheads – 3 m.

2.1.5 The well components shall be effectively protected against possible falling of cargo and tools during cargo-handling operations.

2.2 SYSTEM FOR CONTROL AND MONITORING OF PRODUCING WELL

2.2.1 Every well shall be equipped with the following:

downhole surface-controlled subsurface safety valve (SCSSV), which provides sealing of development wells in the event of the well component failure, fire or other emergency situations;

well components with the remote-controlled shut-off master gate valves and remote-controlled shut-off gate valves on the flowlines.

2.2.2 To control the well components use shall be made of the following:

remote control stations of well components;

control station of downhole SCSSV;

remote control device of the well component gate valves.

The equipment shall be installed in a separate space outside an explosive zone isolated from the wellhead area (area where well components are installed) and at a distance not more than 30 m therefrom (refer also to Part IX "Special Requirements for Ensuring Explosion and Fire Safety" and Part X "Safety Assessment").

2.2.3 Serviceability of downhole SCSSV and shut-off gate valves shall be checked according to the schedule in compliance with the instructions of the manufacturer of the equipment concerned.

2.2.4 Wells, piping, separators, etc. shall be purged and discharged through purge recovery and discharge unit.

2.2.5 The well components and downhole SCSSV valves shall provide:

.1 remote control from the main machinery control room:

opening and closing of the well component gate valves and the valve for gas supply to the gas lift;

closing of SCSSV;

.2 automatic start and shutdown of the hydraulic pumps;

.3 indication in the main machinery control room of the following:

level in the hydraulic system oil tank;

pressure in the high-pressure and low-pressure hydraulic collectors;

well pressure;

pressure of gas supplied to the gas lift;

.4 alarm in the main machinery control room to indicate:

open/closed position of the gate valves, SCSSV of the well components and valve for gas supply to the gas lift;

low level in the hydraulic system tank;

low pressure in the air supply main line to the control station;

low pressure in the high-pressure hydraulic collector;

low pressure in the low-pressure hydraulic collector;

high pressure in the well;

clogging of the working fluid filters of the hydraulic system.

2.3 PRODUCING RISER SYSTEM

2.3.1 The Register technical supervision of producing risers is carried out in compliance with the requirements of the standards recognized by the Register and the approved technical documentation.

2.4 SYSTEM FOR TREATMENT OF WELL FLUIDS

2.4.1 The system for well fluid treatment shall be leak-tight and prevent formation of dangerous concentration of explosive and toxic substances in the environment under all operational conditions. In well-grounded cases, the equipment may be used, in which, according to the certificate data, regulated leaks of combustible substances may be possible (with indication of allowable values of these leaks under operational conditions). The procedure of their gathering and removal shall be stated in the design documentation.

2.4.2 Provision shall be made for alarm and shutdown systems incorporated in the automated process control system.

2.4.3 Systems and their components shall be designed for the most unfavourable combinations of pressure and temperature, as well as environmental conditions, FPU/MODU/FOP movement conditions and effects of other external factors and loads including those of short-duration.

2.4.4 During determination of loads acting on the equipment, consideration shall be generally given to the loads during:

cold start;

shutdown, change of operating mode;

deadlock;

hydraulic impacts, pressure change;

pressure and temperature fluctuations in the system;

pressure release and emptying;

pressure increase;

process cooling system failure;

heating above the allowed temperature (e.g. in the event of fire).

2.4.5 Working pressure of the system shall be calculated proceeding from the maximum expected well pressure or a pressure reduction system fitted with a safety device, which prevents the excess of pressure downwards the choke, shall be provided.

2.4.6 Flow diagram of the system operation shall prevent the possibility of pressure increase above the allowable values in its separate components (apparatus, pipe sections) both in normal operation and in the emergency situations.

2.4.7 All vessels under excessive pressure shall be equipped with arrangements providing pressure drop when exposed to excessive heat.

2.4.8 The ESD system of the automated process control system shall provide transfer of the process equipment into a safe condition (sealing of wells, isolation of process apparatuses, release of excess pressure to discharge or utilization systems, emptying of equipment to the closed drainage system, etc.).

2.4.9 Possibility of the emergency leaks of readily ignitable and combustible liquids penetrating to the personnel escape routes shall be excluded.

2.4.10 Operational reliability of the systems incorporated into the automated process control system (including the ESD system, overflow automatic control systems, systems of combustible gas and/or vapour detection, pressure monitoring systems, etc.) shall be provided, whenever necessary, by redundancy of the components providing functioning of the systems. Arrangement of standby control and monitoring facilities of the systems shall make it possible to control them by personnel under various accident scenarios.

2.4.11 Provision shall be made for means of automatic self-monitoring of serviceability of the said components activating alarm to notify the personnel about malfunction of the ESD system components.

2.4.12 The process systems shall be divided into segments, each segment shall be isolated from the other segments by a valve controlled by the ESD system (refer to Section 2, Part IX "Special Requirements for Ensuring Explosion and Fire Safety").

2.4.13 The following valves are used as shut-off devices of the ESD system:

well component gate valves;

downhole SCSSV connected to the well components;

valve on the pipeline (riser);

shut-off valves between the system sections with various design pressure;

valves between various stages of process.

2.4.14 Where necessary, provision shall be made for leak-tight systems for injection of chemical agents into the system apparatuses and piping.

2.4.15 Heat exchangers with different pressure between gas and refrigerant shall be provided with quick-acting safety devices on the low pressure side.

2.4.16 Locations of the points of vapour flow from the glycol regeneration system shall be chosen with regard to the presence of the aromatic hydrocarbons in the vapours and their effect on the personnel.

2.4.17 Gas (vapour) discharges from the safety valves installed on the equipment with combustible gases and liquids shall be directed to discharge or utilization systems.

2.4.18 Process equipment and pipelines shall be earthed with the aim to protect them from static electricity.

2.4.19 Thermal insulation of the process equipment shall be made of non-combustible materials.

2.4.20 Design values of wall thicknesses of the process equipment and pipelines intended for operation under effect of corrosion-aggressive agents shall be determined proceeding from the condition that the working stresses shall not exceed 0,4 yield strength normative limit having regard to a negative tolerance for manufacture.

2.4.21 Provision shall be made for a leak-tight closed drainage system for complete discharge of toxic liquids (including, where necessary, the tanks for their neutralization) and piping to supply nitrogen, steam or liquid into the equipment for displacement of toxic agent remains into the drainage or utilization system.

2.4.22 Toxic liquids shall be stored preferably in leak-tight tanks under gas-dynamic operational conditions with "nitrogen" breathing. The tanks shall be fitted with an alarm device to indicate the extreme high level, which is interlocked with the pumping equipment, and a system for emergency discharge of excess liquid into the drainage system.

2.4.23 The ESD systems for the explosive processes shall prevent formation of explosive medium in the process equipment under all possible operational conditions, and shall provide safe stoppage of production in possible emergency situations.

2.4.24 Each special purpose unit used in fire risk and hazardous zones shall be of safe-type, fitted with emergency visual and audible alarm and illumination system.

2.4.25 In order to prevent emergency leaks and environmental discharge of emissions, provision shall be made for the following:

installation of guards in the areas of possible oily mixture leaks;

installation of an open hazardous drainage system, which provides gathering of oily mixture from the areas of possible leaks into the drainage collection tank;

installation of a system for gas withdrawal or utilization from the process equipment during its preventive maintenance and repairs, as well as in emergency situations.

2.5 FLARE SYSTEM AND GAS WITHDRAWAL SYSTEM

2.5.1 The flare system is designed for withdrawal and subsequent burning of combustible gases and vapours in the following cases:

actuation of the emergency discharge devices, safety valves, manual discharge, as well as gases and vapour withdrawal from the process units in emergency situations by means of the automated systems and remote-controlled shut-off fittings;

permanent withdrawals specified by the technical regulations;

periodical withdrawals of gases and vapours (including those during the well testing), start, adjustment and shutdown of the process equipment.

2.5.2 The flare systems incorporated into the FPU/MODU/FOP process system shall comply with the requirements of the national supervisory bodies.

2.5.3 Supplies of discharged products to the high-pressure and low-pressure flare separators shall be grouped into collectors according to the working pressure and shall be separate for the high-pressure and low-pressure flare systems.

2.5.4 Flare boom shall be located on the opposite side of the accommodation block and with regard to prevailing wind direction.

2.5.5 Flare unit shall incorporate:

flare stack;

flare tip with gas seal;

monitoring and automation devices;

remote flame igniter;

pipelines supplying gas for igniter and combustible mixture;

pilot burners with igniters;

sampling device.

2.5.6 The flare unit shall be provided with a device to control pressure of combustible gas supplied to the pilot burners.

2.5.7 Calculation of the flare boom height shall be made in compliance with the current standards with due regard to the allowable thermal effect on the personnel, structures and the FPU/MODU/FOP equipment.

2.5.8 Materials of the flare tip, pilot burners, manifold piping, fastening parts shall be selected with regard to their heating due to thermal radiation.

2.5.9 Manifold piping at the flare stack section shall be made of the seamless heat resistant pipes.

2.5.10 Arrangement and design of the flare unit shall prevent formation of explosive mixtures within the zone where the FPU/MODU/FOP process equipment, modules and structures are located, in the areas of potential people crowding and creation of ignition sources in case of flame blowout during emergency discharge.

2.5.11 The flare and separator units shall meet the expected operational conditions in terms of pressure and capacity in each phase of discharged fluid.

2.5.12 The piping, shut-off fittings, safety devices and other equipment of the system shall be designed with due regard to the presence of hydrates, gas and liquid mixture in the flow, temperature drop or increase under normal and emergency operational conditions.

2.5.13 The gas withdrawal pipelines shall be cut in the flare collector from above to prevent them from being filled by liquid.

2.5.14 The flare collectors and pipelines shall be of minimum length and have minimum number of bends.

2.5.15 The flare collectors and pipelines shall be self-draining. The grade towards the liquid collection device (separator) shall be not less than 0,003.

2.5.16 The flare unit shall be provided with separators, pumps and condensate drain arrangements.

2.5.17 The pumps used for condensate drainage from the flare system separators shall be started and shutdown both automatically and from the place of their location. Number of the pumps shall provide 100 per cent redundancy.

2.5.18 The shut-off fittings installed in combination with safety devices shall be provided with interlock in open position and shall be kept permanently open.

2.5.19 No stuffing box compensators shall be fitted on the flare collectors and piping.

2.5.20 Provision shall be made for supply of purging inert gas to the system pipelines. Oxygen content in the purging and discharged gases and vapours shall not exceed 25 per cent of the minimum hazardous oxygen content.

2.5.21 Design of the flare system shall provide protection of the process equipment from the backflow pressure during discharge.

2.5.22 The flare system shall be provided with a device for continuous monitoring of ignition process and the automatic and remote ignition system with a signal output at the control panel.

2.5.23 Provision shall be made for automatic pressure control of fuel gas supplied to pilot burners and the amount of purging gas supplied to the flare collector inlet.

2.5.24 The ignition system shall be provided with 100 per cent redundancy, which shall ensure:

as a minimum, 2 attempts in each sequence;

parallel components to remove sources of a single failure.

2.5.25 The flare separator shall be located in the lower point of the flare system and shall be fitted with the extreme upper level sensor with a signal output in the automated process control system.

2.5.26 Where the high-pressure and low-pressure flare separators are installed on the exposed decks, arrangements shall be taken to prevent the liquid freezing therein.

2.5.27 Flame arresters installed in the system shall comply with the requirements of the national standards on fire safety.

2.5.28 Monitoring and control of the flare system operation shall be carried out:

for a common flare system – from the own control room (control room, main machinery control station) or from the control room of a process unit discharging gas into the flare system;

for separate and special flare systems – from the control room of a process unit discharging gas.

2.5.29 The flare systems shall be provided with facilities providing continuous recording (with indication representation to the main machinery control room) of the following data:

purging gas flow to the flare collector and gas seal;

liquid level in separators, condensate collectors;

liquid level in flare hydraulic seal;

quantities of discharged gases and vapours, as well as condensate returned from the hydrocarbon gas and vapour collection unit;

liquid temperature in flare hydraulic seal.

2.5.30 The flare systems shall be provided with alarm devices (with signal output at the main machinery control room) operating when the following parameters are reached:

the minimum allowable flow of the purging air to collector and gas seal;

the minimum allowable pressure or flow of fuel gas for the pilot burners;

loss of flame in the pilot burners;

creation of negative pressure at the base of flare stack, equal to or more than 1000 Pa;

the minimum and maximum allowable levels of liquid in separators, condensate collectors;

the minimum allowable level of liquid in flare hydraulic seals;

the maximum allowable temperature of gases supplied to the storage tanks;

the minimum allowable temperature in flare hydraulic seals;

start of condensate pumps;

start of compressors;

presence of combustible gases and vapours, which hydrocarbon concentration in the air reaches 20 per cent of lower flame limit in compressor room and hydraulic seal;

with duplication of visual and sound alarm and location of the said alarm devices above the entrance

door, as well as on the open deck installation at the areas where separators, storage tanks and pumps are arranged.

2.5.31 For monitoring of the fuel gas and air pressure in the ignition system and in lines upstream of the control valves, for monitoring of vapour pressure, liquid level and temperature, duplicating devices shall be installed in the separators and condensate collectors as required.

2.5.32 Automatic control (with due regard to delayed action of the instrumentation and automatic devices and opening time of the shut-off fittings) shall be provided in the flare systems of the following:

inert gas supply to the gas seal at a negative pressure in the flare collector equal to or exceeding 1000 Pa;

inert gas supply to the inlet of flare collector when supply of purging (fuel) gas is interrupted (continuous nitrogen supply with the mandatory justification in the design documentation may be allowed);

drainage of condensate from separators and condensate collectors except those with continuous drainage through the hydraulic seal when the maximum level is reached.

2.5.33 Arrangement of ladders and platforms shall comply with the requirements of 2.1.2, Part II "Drilling Systems and Equipment".

2.6 PRESSURE RELEASE AND GAS WITHDRAWAL SYSTEM

2.6.1 Pressure release system shall provide safety of the release and dissipation of hydrocarbons under normal and emergency operational conditions.

2.6.2 Places of pressure release by safety devices shall be located at safe distances from the FPU/MODU/FOP remaining equipment.

2.6.3 The pressure release system shall be associated with the ESD system of the automated process control system and shall be operated by its command in accordance with the operation algorithm of the automated process control system.

2.6.4 The gas withdrawal systems shall provide withdrawal of combustible gases and/or vapours to the atmosphere outside the spaces and platform structures. Design of the gas withdrawal system shall prevent formation of explosive mixtures (proceeding from the explosion- and fire-proof conditions of their dissipation in the atmosphere) within the zone where the process equipment and platform structures are located, in the areas of possible people crowding and creation of ignition sources.

2.6.5 The open discharge pipeline shall have:

wire mesh or venting branch pipe at the outlet flare tip;

flame arrester;

drain valve for discharge in the area of the possible liquid accumulation.

2.6.6 The pressure release system shall be fitted with breathing, safety and shut-off fittings.

2.6.7 The gas withdrawal systems shall be fitted with means of protection against flame spreading (flame arresters, liquid seals, etc.). The means of protection against flame spreading may be omitted when these lines are supplied with inert gases in quantities excluding formation of explosive mixtures therein.

2.6.8 On the exposed decks and areas, the pressure release pipelines shall be thermally insulated and/or provided with heating systems to prevent condensation and crystallization of substances.

2.7 SYSTEM FOR GATHERING, TREATMENT AND UTILIZATION OF PROCESSING WASTES, INCLUDING PRODUCED WATERS

2.7.1 Drainages, which contain or may contain (in emergency situations) combustible gases, readily ignitable and combustible liquids, as well as those, which may be produced by the contaminants dangerous for the environment, are considered dangerous.

2.7.2 The FPU/MODU/FOP shall be provided with the following:

open hazardous drainage system;

closed hazardous drainage system.

2.7.3 The closed hazardous drainage system shall be completely separated from the open hazardous drainage system.

2.7.4 Design of drainage systems shall prevent spread of combustible substances over them from one section of the platform to the other. The drainage systems shall be made of non-combustible materials.

2.7.5 To avoid gas pollution of the territory, installation and spread of flame through the drainage system during fire, hydraulic seals or scuppers with closing shall be installed thereon. The water layer forming the seal shall be at least 0,25 m high.

2.7.6 The hydraulic seals and piping of the drainage systems shall be protected against freezing.

2.7.7 Discharge of various substances, which mixture may result in reactions accompanied by heat release, formation of combustible and harmful gases, as well as solid precipitations is prohibited.

2.7.8 The closed hazardous drainage system shall provide fire-and explosion-proof discharge and removal of drainages containing combustible liquids and gases from process equipment under normal operating conditions, during routine operations and repair work, as well as in emergency situations.

2.7.9 Substances discharged to the closed hazardous drainage system shall be collected in the tanks of the closed drainage system for degassing. Gas released in the closed hazardous drainage system shall be directed to the gas withdrawal system or to the flare system. Drainage

liquid shall be pumped out from the closed hazardous drainage system tank to the system of well fluid treatment process.

2.7.10 Parameters of the closed hazardous drainage system (output and capacity) shall provide emptying of the platform process equipment.

2.7.11 Discharges from the equipment with different design pressure shall be directed to collectors in accordance with the design pressure of the equipment. Design arrangements shall be provided to prevent the fluid ingress from the high-pressure part of the system to the low-pressure part.

2.7.12 The open hazardous drainage system shall provide explosion- and fire-proof collection and disposal of liquid wastes (drainage) under normal operating conditions, during routine operations and repair work, as well as in the event of accidents, from the exposed and closed platforms and zones of the FPU/MODU/FOP.

2.7.13 Hazardous drainage from the process system equipment located in way of the wellheads, in spaces and on the exposed deck areas shall be directed to the drainage collection tank.

2.7.14 Hazardous drainage from the drainage collection tank shall be pumped out to the process system for well fluid treatment or to a waste-removal vessel.

2.7.15 The drainage collection tank of the open hazardous drainage system, its location and also location of drainage inlets where explosive gas-vapour-air mixtures are likely to be formed, shall be provided with alarm devices to indicate explosive concentrations of combustible gases and vapours with the signal output to the main machinery control room.

2.7.16 Parameters of the open hazardous drainage system (output and capacity) shall provide explosion- and fire-proof discharge of readily ignitable and combustible liquids in the event of potential accidents.

2.7.17 The inlet pipelines of the drainage collection tank shall be provided with hydraulic seals to prevent escape of combustible gases and vapours from the said tank. The height of liquid column in the hydraulic seal shall not be less than 0,25 m.

2.7.18 All tanks of the drainage systems shall be fitted with level gauges. Alarm indicating that the maximum allowable liquid level is reached in the said tanks shall be actuated at the main machinery control room. Where necessary, the drainage system tanks shall be provided with heating arrangements.

2.7.19 The drainage systems shall prevent ingress of untreated drainage to the environment.

2.7.20 The monitoring and control system of the reservoir water hydrocyclone units shall provide:

automatic control of oil show for repeated degassing, as well as treated water yield;

alarm to be actuated at the main machinery control room to indicate high and low reservoir water pressure difference across the hydrocyclone.

2.7.21 The monitoring and control system of the degassing buffer tank shall provide:

automatic adjustment of the following parameters in the tank:

gas pressure, oil phase level, water level;

automatic closing of valves on the following manifolds:

of water intake into the tank, discharge of gas, water and oil from the tank;

alarm in the main machinery control room to indicate: high and low oil and water level in the tank, high and low gas pressure in the tank, extreme high and low water and oil level in the tank, "open/closed" position of the valves on the well fluid inlet and outlet manifolds.

2.7.22 The monitoring and control system of the booster pumps to inject water into the filters shall provide:

.1 emergency shutdown of the booster pumps;

.2 automatic control of each pump supplying water to the injection pumps;

.3 alarm actuation in the main machinery control room to indicate:

high and low water flow;

.4 filter clogging.

2.7.23 The monitoring and control system of the water injection pumps shall provide:

.1 selection of control mode for the water injection pumps:

at the local control station: "Local/Remote";

in the main machinery control room: "Remote/ Automatic";

.2 remote start and shutdown of the water injection pumps from the main machinery control room;

.3 emergency shutdown of the water injection pumps;

.4 automatic control for each pump supplying water to the injection well;

.5 indication in the main machinery control room of the following:

water flow supplied to the injection well;

oil content;.

.6 alarm actuated in the main machinery control room to indicate:

running and malfunction of the pumps;

overload of the pumps;

selection of pump control station;

pump control mode;

high and low water flow at the pump outlet.

2.7.24 The monitoring and control system for collection of oily waters shall provide:

.1 remote shutdown of the pump from the oily water discharge stations;

.2 automatic emptying of drain sumps and removal of water from under the floor, shutdown of the pumps upon oily water tank filling;

.3 indication of the oily water tank level in the main machinery control room;

.4 alarm actuated in the main machinery control room to indicate:

selected mode of pump control, operation and overload;

position of the remote-controlled equipment;

the maximum allowable level in the drain sumps;

filling of the oily water tank, oil drainage tank, dirty oil and fuel tanks.

2.7.25 The monitoring and control system of the open hazardous drainage system shall provide:

.1 local start and shutdown of the pumps;

.2 remote control of the pump shutdown from the main machinery control room during emptying of pits and drainage collection tank;

.3 indication of the temperature and level in the drainage collection tank in the main machinery control room;

.4 alarm actuated in the main machinery control room to indicate:

running and malfunction of the pumps;

overload of the pumps;

upper and lower level in the pits and drainage collection tank;

high and low temperature in the drainage collection tank;

emergency high level in the drainage collection tank.

2.7.26 The monitoring and control system of the closed hazardous drainage system shall provide:

.1 automatic emptying of drainage tanks;

.2 selection of control mode for the pumps:

at the local control station: "Local/Remote";

in the main machinery control room: "Remote/ Automatic";

.3 remote start and shutdown of the water injection pumps from the main machinery control room;

.4 emergency shutdown of the pumps;

.5 indication in the main machinery control room of the following:

running of the pumps;

shutdown of the pumps;

the maximum allowable level of liquid in the system tanks;

the maximum allowable pressure in the system tanks.

2.8 SYSTEM FOR GAS DEHYDRATION

2.8.1 Plants shall be provided with automatic and manual regulation and control of the processes.

2.8.2 Each gas separator shall be fitted with at least two safety devices either of which shall provide failure-free operation of the apparatus.

2.8.3 Safety devices on the condensate collector shall be installed in the upper part of the apparatus.

2.8.4 Gas withdrawn by the safety devices shall be directed to the flare system.

2.8.5 Where the process apparatus is fitted with internal components (nozzles, partitions, knockout drums), for which the manufacturer has established an allowable pressure drop, necessary monitoring and interlocking means shall be provided.

2.8.6 A non-return valve and disconnecting device designed for the working pressure in the apparatus shall be installed on each steam line (thermal liquid supply line), absorbent (inhibitor) supply line at the apparatus inlet.

2.8.7 The automated process control system for the natural gas and gas condensate gathering and treatment shall provide:

corrosion inhibitor injection systems and other devices to provide taking of corrosion-preventing actions specified by the process regulations;

remote emergency shutdown of the installation process line from the duty operator's control panel and transfer of the process media to the flare line or emergency collecting tank;

remote control of the process parameter values and recording of the basic process parameters;

automatic control of the medium pressure in the process equipment in case of deviations of the process parameters;

automatic alarm actuated when the process parameters (pressure, temperature, etc.) are beyond the allowable values with the warning signals to be transmitted to the unit location and the main machinery control room;

gas detection and alarm at the facilities.

2.8.8 The monitoring and control system of the gas dehydration plant shall provide:

.1 automatic control of the glycol and condensate levels;

.2 automatic shut-off of the valve for gas outflow from absorber and gas discharge to the flare, shut-off of the valves on the gas intake line, glycol intake and discharge lines, condensate discharge line;

.3 alarm in the main machinery control room to indicate:

high and low glycol levels;

high and low condensate levels;

limiting high and low glycol levels;

limiting high and low condensate levels;

high temperature in the glycol heater and high gas humidity.

2.9 SYSTEM FOR GAS COMPRESSION

2.9.1 The compressor suction lines shall be provided with condensate collectors, the injection lines shall be provided with oil traps (where necessary) installed down-

stream of compressors. The condensate collectors shall be fitted with the extreme upper level sensor and a liquid removal system, visual and sound alarm, as well as with interlocking arrangement to shut down the compressor when the extreme upper level of the liquid in the separator is reached.

2.9.2 The system of fuel gas treatment for compressors shall comply with the requirements of Part IX "Machinery" of the Rules for the Classification and Construction of Sea-Going Ships.

2.9.3 The compressors and pumps, which transfer fluids via a pipeline from the FPU/MODU/FOP to the reception point, shall be fitted with systems for automatic emergency shutdown of the compressor and pump, which in their turn shall be connected to the automated process control system.

2.9.4 Continuous leak-tightness monitoring of the compressor sealing system shall be provided. When unacceptable leaks or other malfunctions are detected, the compressor shall be automatically shutdown and depressurized.

2.9.5 The gas recycle line shall be laid in such a way as to provide the liquid discharge therefrom to the tie-in point upstream of the compressor separator with the recycle line shut-off valve located at the uppermost point.

2.9.6 The valves on the recycle line, which are controlled from the emergency depressurization system, shall have separate solenoids controlled by this system.

2.9.7 The compressor connections and their piping shall be regularly tested for leak-tightness in due dates stipulated by the manufacturer's instructions and process regulations.

2.9.8 The compressor room shall be provided with continuously operating forced plenum-exhaust ventilation.

2.9.9 Compressors transferring hydrocarbon gases shall be provided with an automatic shutdown system actuated when the hydrocarbon gas concentration in the space reaches 50 per cent of lower flame limit.

2.9.10 Gas compressor plants shall be equipped with the following (refer also to Section 2, Part IX "Special Requirements for Ensuring Explosion and Fire Safety"):

instruments to monitor process parameters (pressure, flow, temperature, etc.) of the transported fluid;

system of instruments to monitor condition of the compressor equipment (vibrations, bearing temperature, etc.);

gas detection and alarm system in the compressor room;

ventilation system;

alarm system to give warning of the process parameter violation;

interlocking system providing shutdown of the compressor when the process parameters exceed the maximum allowable values, gas concentration in air exceeds lower flame limit, in case of malfunction of the ventilation system, actuation of the alarm system in the compressor room;

control panels in the compressor room and in the main machinery control room;

fire-fighting system.

2.9.11 Booster compressor stations at the natural gas production facilities shall be additionally equipped with the following:

automated control system of the equipment operation within the prescribed parameters;

automated system of emergency discharge of the equipment with supply of process fluids into utilization systems;

automated system of early fire detection and extinguishing;

emergency alert and communication system.

2.9.12 The automation level of the compressor stations shall provide recording of the basic process parameters, including:

pressure, flow and temperature of the transported fluids;

indoor air condition (concentration of hazardous and toxic substances);

alarms.

2.9.13 The monitoring and control system of the inlet compressor scrubbers shall provide:

level control;

emergency condensate disposal;

alarm in the main machinery control room to indicate the upper and lower condensate levels, extremely low condensate level.

2.9.14 The monitoring and control system of compressor units shall provide:

selection of control mode for compressors at the local control station – "Local/Remote";

remote control from the main machinery control room, including start and shutdown of compressors, compressor switchover to on-load operation;

emergency shutdown of compressors;

alarm indicating that the working pressure is reached, indicating malfunction and overload of the compressor, malfunction of the lubricating oil system, overheating and high pulsations.

2.9.15 The monitoring and control system of coolers at the compressor outlet shall provide:

automatic control of gas temperature;

alarm in the main machinery control room indicating the opening of safety bursting disk.

2.9.16 The monitoring and control system of the low-pressure gas piping shall provide:

emergency shut-off of the valve to discharge gas to the high-pressure compressor line and gas discharge to flare;

automatic control of gas surging, compressor loads and capacity;

alarm in the main machinery control room indicating low and high gas temperature, low and high gas flow.

2.10 SYSTEMS FOR WATER INJECTION, GAS INJECTION AND GAS LIFT SYSTEM

2.10.1 Capacity of the system shall be sufficient for operation in all modes.

2.10.2 A non-return valve and an automatic shut-off valve shall be fitted at the injection point to the well.

2.10.3 When operated in areas with outdoor temperature below −5 °C, the piping and wellhead manifolding of the water injection system shall be thermally insulated.

2.10.4 Places for storage of protective means and eye washing stations shall be provided in areas where biocides are used.

2.11 SYSTEM FOR STORAGE OF WELL FLUIDS

2.11.1 The fluid storage system shall comply with the requirements of Part VIII "Systems and Piping" of the FPU Rules.

2.12 SYSTEM FOR TRANSPORTATION OF WELL FLUIDS

2.12.1 The system for transportation of well fluids shall comply with the requirements of Part VIII "Systems and Piping" of the FPU Rules.

2.12.2 The monitoring and control system of the transfer pumping unit shall provide:

.1 selection of the pump control mode:

at the local control station – "Local/Remote";

in the main machinery control room – "Remote/Automatic";

.2 remote control of the pump start and shutdown from the main machinery control room;

.3 automatic start and shutdown of pumps by a signal of the upper and lower level in scrubbers;

.4 emergency shutdown of pumps;

.5 alarm in the main machinery control room to indicate:

pump running and malfunction;

pump overload;

pump control mode.

2.12.3 The monitoring and control system of pig launcher on the pipeline in the external transportation facility shall provide:

.1 remote control of opening and shut-off of the valves fitted on the lines for well fluid reception and discharge to the pipeline from the main machinery control room;

.2 emergency shut-off of the valves fitted on the lines for well fluid reception and discharge to the pipeline;

.3 indication in the main machinery control room of the following:

pressure in the pig launcher;

pressure in the bypass line;

.4 alarm in the main machinery control room to indicate the following:

closed/open positions of the valves fitted on the lines for well fluid reception and discharge to the pipeline, pig launcher covers;

high pressure in the pig launcher;

high and low pressure in the bypass line;

extremely high and low pressure in the bypass line;

.5 indication of the well fluid flow in the main machinery control room.

2.13 SYSTEM FOR PROCESS HEATING AND COOLING

2.13.1 The heating system shall be designed for the following purposes:

heating of working spaces;

heating of process equipment;

heating/cooling of process liquids and gases.

2.13.2 The pipelines shall be thermally insulated in the following cases:

when it is necessary to reduce heat dissipation (to maintain temperature, prevent formation of condensate, ice, hydrate, etc.);

when the pipe wall temperature exceeds 60 °C;

when the pipe wall temperature at working places or in corridors and spaces exceeds 45 °C.

In well-grounded cases, the pipeline thermal insulation may be replaced by casing or guard.

2.13.3 The cooling systems shall be designed for closed-circuit cooling of the following:

gas at all compression stages;

auxiliary compressor equipment;

pumps for heat supply of the platform;

glycol regeneration plants.

2.13.4 The equipment of the heating and cooling systems are covered by the requirements of Parts VII – IX of the MODU/FOP Rules in so much as they are applicable.

2.13.5 Primary heating or cooling circuits shall be provided with sensors to detect hydrocarbon leakages.

2.13.6 Design temperature of both sections of heat exchanger shall be determined for the hottest fluid.

2.13.7 Heat exchangers shall be protected from thermal expansion when thermal liquid is circulated only from one side.

PART IV. MACHINERY INSTALLATIONS AND MACHINERY

1 GENERAL

1.1 APPLICATION

1.1 The requirements of the present Part apply to machinery installations and machinery providing operation of the FPU/MODU/FOP oil-and-gas equipment to perform works associated with drilling and production of well fluids on a sea shelf, gathering, treatment and transportation of well fluids.

1.2 The items of the Register technical supervision as regards the machinery installations, engines and machinery providing operation of the oil-and-gas equipment are given in the Register Nomenclature in Section 7, Part I "General Regulations for Technical Supervision".

1.2 SCOPE OF TECHNICAL SUPERVISION

1.2.1 General provision relating to the procedure for technical supervision of the machinery installations and machinery of oil-and-gas equipment of the FPU/MODU/FOP during their manufacture, mounting and operation, as well as the requirements for amount of technical documentation submitted to the Register for review and approval shall comply with the requirements of Sections 3 to 10, Part I "General Regulations for Technical Supervision".

2 REQUIREMENTS FOR MACHINERY INSTALLATIONS AND MACHINERY

2.1 GENERAL REQUIREMENTS

2.1.1 Machinery installations, engines and machinery providing operation of the FPU/MODU/FOP oil-and-gas equipment shall remain operative under conditions specified in 1.3, Part II "Drilling Systems and Equipment".

2.1.2 Machinery installations, engines, machinery, equipment of the drilling rig machinery spaces and systems for production, treatment and transportation of well fluids of the FPU/MODU/FOP shall comply with the requirements of Part VII "Machinery Installations and Machinery" of the MODU/FOP Rules, to the extent as applicable.

2.2 PUMPING UNITS

2.2.1 Pumps and compressors.

2.2.1.1 Each pumping unit shall be disconnected from collectors by means of shut-off fittings. Remote control by the automated system, as well as local control of the shut-off fittings shall be provided.

For all the pumps transferring readily ignitable and combustible liquids, provision shall be made for remote disconnection from the permanently manned spaces.

2.2.1.2 Shut-off, cut-off, discharge and safety devices installed on injection and suction pipelines of a pump or compressor shall be located as close as possible to the pump/compressor and be in a zone convenient and safe for maintenance.

2.2.1.3 Position indicators "Open" and "Closed" shall be provided on the shut-off fittings (gate valves, cocks).

2.2.1.4 A non-return valve shall be fitted on the injection pipeline of centrifugal pumps and compressors.

2.2.1.5 Pumps used to inject readily ignitable and combustible liquids shall be fitted with alarm to give warning of deviations from normal operational parameters affecting the safety. The limiting values of the safe operational parameters shall be stipulated by the process regulations and operational manuals.

2.2.1.6 For pumps (pump group) transferring combustible products, provision shall be made for remote shutdown thereof and for remote-controlled shut-off or cut-off valves to be installed on the inlet and injection lines.

Purging cock of the oil transfer pump shall be fitted with a line to discharge oil to the collection tank.

2.2.1.7 Electric drive of the oil transfer pump shall be provided with remote switching-off and shall be of safe type.

2.2.1.8 To transfer readily ignitable and harmful liquids use shall be made of pumps, which preclude the well fluid leakage.

2.2.1.9 The pumping station control panel shall be fitted with meters, which provide monitoring of pressure, flow, pumping unit bearing temperature and indoor air composition.

2.2.2 Drilling pumps.

2.2.2.1 Drilling pumps shall be fitted with pressure surge chambers filled with air or inert gas. Design of the pneumatic surge chamber shall provide installation of a pressure gauge to measure pressure in gas pocket space and provide the possibility of complete depressurization.

2.2.2.2 Drilling pumps shall be fitted with safety devices. Design of these devices shall provide their reliable activation under specified pressure regardless of the duration of their contact with drilling mud and content of abrasive solid phase therein, duration of the effect, temperature difference. When activated, the safety devices shall prevent fouling of the equipment and the pump room. Liquid drainage lines shall be self-draining.

2.2.2.3 Membranes in the pump safety devices shall be opened at a pressure exceeding 10 per cent of the pump working pressure.

2.2.2.4 Seals in the pump hydraulic part, in the housings of the safety device and pneumatic surge chamber shall be designed for a pressure equal to 1,5 the maximum pump working pressure.

2.3 DRAWWORKS

2.3.1 Design of the drawworks drum shall provide fastening of the travelling end of the drilling line, which precludes its flattening or kinking, spontaneous slackening or detachment at its fastening point.

2.3.2 Design of the drawworks drum shall be provided with special plates with grooves for close and uniform spooling of the first layer of the drilling line. The plates shall be removable and be manufactured to match the different diameters of the drilling lines applied.

2.3.3 The braking gear of the drawworks shall be provided with at least two independent control systems, one of which (main) shall provide smooth regulation of braking torque. Drawworks, in which a controllable electric drive is the main braking system, a mechanical brake shall be provided for emergency stop and for holding the drum in a fixed position.

Design of the brake shall prevent spontaneous braking or releasing brake of the drawworks drum.

2.3.4 In the drilling units where main braking is provided by means of mechanical brake, the drawworks shall be fitted with an auxiliary adjustable brake (electric, hydraulic or pneumatic).

2.3.5 The drawworks shall be remotely controlled from the driller's control panel. The auxiliary brake control system:

in case of electric brake, shall be provided with an alarm to indicate existence of exciting current and voltage in the electrical brake control system;

in case of hydraulic brake, shall provide monitoring of liquid level in the braking system and possibility of its control.

2.3.6 Design of mechanical drive (transmissions, gear boxes, etc.) shall prevent simultaneous engagement of more than one gear, as well as spontaneous gear disengagement or shifting.

2.3.7 The drawworks control system shall provide automatic disconnection of the drive with simultaneous braking performed by a signal of the safety devices (indicator of the drawworks safe working load, limiter of the travelling block rising height).

2.3.8 Disconnection of the drive and braking of the drawworks shall be such as to prevent discarge and unspooling of the travelling part of the drilling line.

2.4 ROTARY TABLE

2.4.1 Design of the rotary table shall provide devices for stopping of the rotary table and for locking of the rotary bushings. Controls of the devices shall be located in a readily accessible place.

2.4.2 Clamps of the square kelly with guide rollers or the small rotary bushings, where applicable, shall be provided with the devices to prevent their spontaneous ejection from the rotary table.

2.5 TOP DRIVE

2.5.1 The top drive shall provide:

catching of pipe (string) for its raising;

catching of pipe (string) for its making (breaking);

screwing (unscrewing) of the pipe threaded joints;

connection to the flowline (wellbore) for flushing (cleaning) of the well;

rotation of the string;

laying of drill pipes in a shot pit.

2.5.2 The top drive shall consist of the following:

swivel reducer;

electric motor (hydraulic drive);

brake;

frame;

thread relief system;

pipe handling mechanism;

pipe clamp;

swivel head;

ball valve;

hydraulically driven bail deflection system;

hydraulic power plant and hydraulic line;

control station;

internal BOP (dual ball valve).

2.5.3 The top drive shall be compatible with the facilities for mechanization of the round-trip operations. Actuators and drive of the power unit shall be controlled from the control panel located close to the control panels of other drilling unit equipment (drawworks, automatic tongs, etc.). The components of the top drive (guide arms, actuator module, etc.) shall not impede other process operations.

2.5.4 The blowout elimination/well-kill components shall contain at least two built-in ball valves. One of the valves shall be remotely controlled from the driller's control panel. Working pressure of the ball valves shall not be less than the maximum allowable pressure of other components of the drilling unit injection line, and their flow section shall correspond to that of the wellbore part.

2.5.5 The control and measuring devices shall provide continuous monitoring of the following parameters:

rotating speed of the string;

torque value during making and drilling;

position of the pipe handling mechanism components;

position of the BOP system.

2.5.6 In the automatic tong control system provision shall be made for complete disconnection of the mechanisms from the energy supply line, as well as interlocking to prevent an accidental actuation.

PART V. SYSTEMS AND PIPING

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part apply to the following piping systems of the FPU/MODU/FOP oil-and-gas equipment.

1.1.1.1 Drilling support systems:
well cementing system;
free-flowing material systems;
choke and kill systems;
drilling riser system.

1.1.1.2 Drilling mud systems:
storage system;
gathering, cleaning and degassing system;
high-pressure system;
low-pressure system;
seawater system.

1.1.1.3 Oil treating systems:
oil gathering and separation systems;
stabilization, desalting and dehydration systems;
associated petroleum gas gathering, treatment and utilization system.

1.1.1.4 Gas treating systems:
gas separation and dehydration systems;
gas condensate gathering and treatment systems;
absorbent regeneration system;
gas compression system;
gas-lift system.

1.1.1.5 Chemical agent reception, storage and delivery systems.

1.1.1.6 Flare systems.

1.1.1.7 Process heating/cooling systems.

1.1.1.8 Compressed-air systems:
instrumentation systems;
free-flowing component transportation systems.

1.1.1.9 Systems of water treatment and injection into the bed:
water treatment system;
water distribution system;
water injection system.

1.1.1.10 Hazardous drainage systems:
open systems;
closed systems.

1.1.1.11 Well fluid offloading systems:
measuring system;
transfer system.

1.1.1.12 Pressure release and gas withdrawal systems.

1.1.1.13 Well completion and flushing systems.

1.2 SCOPE OF TECHNICAL SUPERVISION

1.2.1 General provisions relating to the procedure of technical supervision of the systems for production, gathering, treatment and transportation of well fluids of the FPU/MODU/FOP during their manufacture, mounting and operation, as well as the requirements for the amount of technical documentation submitted to the Register for review and approval shall comply with the requirements of Sections 3 to 10, Part I "General Regulations for Technical Supervision".

1.3 PROTECTION AND INSULATION OF PIPING

1.3.1 Pipes for seawater used for the process purposes shall be protected against corrosion and insulated with due regard to the requirements of 1.4, Part VIII "Systems and Piping" of the Rules for the Classification and Construction of Sea-Going Ships.

1.3.2 Depending on the corrosion rates of steel used for manufacture of the oil-and-gas equipment pipes the media are subdivided into the following groups:

non-corrosive and low corrosive – with corrosion rate up to 0,1 mm/year;

moderate corrosive – with corrosion rate from 0,1 to 0,5 mm/year;

high corrosive – with corrosion rate more than 0,5 mm/year.

1.3.3 Parameters of the process pipes exposed to the effect of hydrogen sulphide (as a rule, where the hydrogen sulphide content of the well fluids exceeds 6 per cent by volume), shall be selected with regard to the process parameters and characteristics of the corrosive medium. To protect such pipes against corrosion, use shall be made of corrosion inhibitors, special coatings and procedures to reduce corrosiveness of the well fluids.

1.3.4 Pipes resistant to sulphide-corrosion cracking shall be used in the following cases.

1.3.4.1 For multiphase "oil-gas-water" fluid with gas factor less than 890 nm^3/m^3:

.1 with absolute pressure of hydrogen sulphide below 1,83 MPa:

with volume concentration of hydrogen sulphide above 15 per cent;

with partial pressure of hydrogen sulphide above 73 kPa and volume concentration of hydrogen sulphide below 15 per cent;

.2 with absolute pressure of hydrogen sulphide above 1,83 MPa:

with volume concentration of hydrogen sulphide above 0,02 per cent;

with partial pressure of hydrogen sulphide above 345 Pa and volume concentration of hydrogen sulphide below 0,02 per cent.

1.3.4.2 For multiphase "oil-gas-water" fluid with gas factor more than 890 nm^3/m^3:

.1 with absolute pressure of hydrogen sulphide less than 450 kPa:

with volume concentration of hydrogen sulphide above 10 per cent;

.2 with absolute pressure of hydrogen sulphide more than 450 kPa:

with partial pressure of hydrogen sulphide above 345 kPa and volume concentration of hydrogen sulphide below 0,075 per cent.

1.3.5 Process equipment and piping designed for operation in contact with corrosive substances shall be fitted with instruments and devices to monitor corrosion and corrosion cracking.

1.3.6 The piping laid in spaces and boxes shall be thermally insulated when the substances conveyed have a temperature equal to or lower than the dew point for design conditions.

1.3.7 When it is necessary to apply outer thermal insulation on the process apparatus and piping, measures shall be taken to avoid contact thereof with combustible fluids. Temperature of outer surfaces of the equipment and (or) sheathing of the thermal insulating coatings shall not exceed 80 per cent of the self-ignition temperature of the most fire explosive fluid. In places accessible for the maintenance personnel the temperature shall not be higher than 45 °C indoors and 60 °C outdoors. Thermal insulation shall be made of non-combustible materials.

2 GENERAL REQUIREMENTS FOR SYSTEMS AND PIPING

2.1 REQUIREMENTS FOR DESIGN OF PIPING SYSTEMS

2.1.1 During determination of design flow of the piping systems with two-phase transported medium it is necessary to increase the flow value with regard to the pulsation factor accounting for unsteady fluid flow regime. The pulsation factors are determined by hydrodynamic calculations of the piping system or may be taken from Table 2.1.1.

Table 2.1.1

Purpose of piping	Pulsation factor, per cent
Piping installed on the same platform with producing wells	20
Primary treatment plant is located at a distance up to 45 m from the wells (across water surface)	30
Primary treatment plant is located at a distance of more than 45 m from the wells (across water surface)	40
Piping installed on the same platform with producing wells when the gas lift is used	
Plant receiving well fluids from another platform or remote well when gas lift is used	50

2.1.2 Sizes of piping for single-phase liquid shall be generally determined according to the flow rate. For the piping conveying single-phase liquids from one tank to another with a pressure difference, the recommended flow rate shall not exceed 5 m/s at the maximum liquid flow.

2.1.3 When selecting pipe materials the following shall be considered:

purpose of piping;

compatibility with other materials;

mechanical strength, plasticity, elasticity and impact toughness;

need for special welding procedures and other types of joints;

need for special types of inspection, testing and quality control;

possibility of incorrect application in service;

corrosion and erosion caused by the transported fluids and/or marine environment;

need for retention of operational characteristics in the event of fire.

2.1.4 Laying of piping shall provide (refer also to 2.5):

possibility of using hoisting and transportation facilities and fire extinguishing equipment contemplated by design;

division into process assemblies and units;

possibility of performing all kinds of works associated with inspection, heat treatment of welds and testing;

insulation and protection of piping against corrosion, atmospheric and static electricity;

prevention of formation of ice and other plugs in piping;

the minimum extension of piping;

exclusion of sagging and formation of stagnant pockets;

possibility of self-compensation for temperature strains of piping.

2.2 METAL PIPING

2.2.1 General requirements.

2.2.1.1 Requirements for the materials used during manufacture of piping and fittings, allowable radii of pipe bends and their heat treatment after bending, allowable pipe wall thicknesses and types of pipe joints shall comply with Section 2, Part VIII "Systems and Piping" of the Rules for the Classification and Construction of Sea-Going Ships, unless otherwise specified in the present Section.

2.2.1.2 Materials intended for manufacture of steel pipes and their parts shall comply with the requirements of standards agreed with the Register and technical documentation approved by the Register.

2.2.1.3 Chemical composition of steel is specified in compliance with standards/specifications agreed with the Register proceeding from the required mechanical properties, at the design elevated temperature inclusive. Along with that, the content of base elements shall not exceed the values stated in 3.4, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships.

2.2.1.4 The manufacturers of steel pipes and piping parts operated under a pressure higher than 0,07 MPa or at a temperature by 10 °C higher than the saturation temperature of the working liquid under atmospheric pressure shall be recognized by the Register in compliance with 8.3, Part I "General Regulations for Technical Supervision".

2.2.1.5 When calculating the piping wall thicknesses, corrosion allowance for the design wall thickness shall be selected in such a way that the required design service life and corrosion rate specified in 1.3.2 are provided.

2.2.1.6 Use of rimming steel for manufacture of pipe is not permitted, while use of semi-killed steel is permitted on agreement with the Register.

2.2.1.7 Pipes shall be tested by the manufacturer by a test hydraulic pressure specified in the normative and technical documentation for the pipes or the guaranteed value of test pressure shall be stated in the certificate.

The hydraulic tests of seamless pipes may be omitted if the pipes have been subjected to non-destructive testing over the entire surface.

2.2.1.8 Mechanical and process properties of steel pipes shall comply with the recognized standards/ specifications. Unless otherwise specified, the composition of pipe tests, sampling and scope of testing shall comply with the requirements of 3.4, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships.

2.2.2 Pipelines with nominal pressure up to 10,0 MPa.

2.2.2.1 Pipes and formed components of piping shall be manufactured of steel possessing process weldability, yield ratio not more than 0,75, breaking elongation of the metal on five-fold specimens not less than 16 per cent and impact toughness *KCU* not less than 30 J/cm^2 at the minimum design temperature of the pipe component wall.

2.2.2.2 For the pipelines conveying liquefied hydrocarbon gases with a diameter more than 400 mm, use of electric-welded pipes at corrosion rate up to 0,1 mm/year, with working pressure up to 2,5 MPa, which have been subjected to heat treatment, 100 per cent non-destructive testing, with satisfactory results of mechanical tests of welded joint specimen, including impact toughness test (*KCU*), may be allowed.

2.2.2.3 The electric-welded pipes used for other process piping of the oil-and-gas equipment, except for the piping used for liquefied gases at a pressure more than 1,6 MPa, combustible and hardly ignitable liquids at a pressure more than 2,5 MPa and with a working temperature above 300 °C, shall be in heat-treated condition and their welds shall be subjected to 100 per cent non-destructive testing and bending or impact toughness test.

2.2.2.4 The electric-welded pipes, which are in contact with the medium producing corrosion cracking of the metal, regardless of the pressure and wall thickness, shall be in heat-treated condition, and their welds shall be as strong as the base metal and subjected to 100 per cent non-destructive testing.

2.2.2.5 Flat welded flanges are used for the piping operating under a nominal pressure not more than 2,5 MPa and at a temperature of medium not higher than 300 °C. For the piping operating under a nominal pressure above 2,5 MPa, regardless of the temperature, as well as for the piping with a working temperature above 300 °C, regardless of the pressure, butt-welded flanges shall be used.

2.2.2.6 Welded branch pipes shall be used for the process piping:

with inside nominal diameter D_n of 150 – 400 mm at a pressure P_n not more than 6,3 MPa;

with inside nominal diameter D_n of 500 – 1400 mm at a pressure P_n not more than 2,5 MPa.

2.2.2.7 Steel concentric and eccentric reducers with inside nominal diameter D_n of 250 – 400 mm may be used for the process piping at a pressure P_n up to 4 MPa, and with D_n of 500 – 1400 mm at P_n up to 2,5 MPa. Reducer welds shall be subjected to 100 per cent non-destructive testing.

2.2.2.8 Welded four-way pipe unions may be used on the piping made of carbon steel at a working temperature not higher than 250 °C. Four-way pipe unions made of electric-welded pipes may be used at a

pressure P_n not more than 1,6 MPa; along with that, they shall be made of the pipes recommended for use at a pressure P_n not less than 2,5 MPa. Four-way pipe unions made of seamless pipes may be used at a pressure P_n not more than 2,5 MPa, provided they are made of the pipes recommended for use at a pressure P_n not less than 4 MPa.

2.2.2.9 For the process piping use shall be generally made of knuckle bends made of seamless and welded straight seamed pipes by hot stamping or drawing method, bent and built-up steel branches.

2.2.3 Pipelines with nominal pressure above 10,0 MPa.

2.2.3.1 For manufacture, mounting and repair of pipelines to be used at a pressure above 10,0 MPa and up to 320,0 MPa and at a temperature from – 50 up to 540 °C, use shall be made of steel pipes in compliance with the standards agreed with the Register. Conditions of using materials for corrosive media containing hydrogen, ammonia, carbon monoxide are determined in compliance with the technical documentation reviewed and approved by the Register.

2.2.3.2 Semi-finished products of steel pipes shall be subjected to impact test to be carried out on the specimens with notch of *KCU* type and *KCV* type at a temperature of 20 °C, as well as at sub-zero temperatures in case where pipes are operated under such conditions. The values of impact toughness for steel semi-finished products and pipes at all test temperatures for *KCU* shall not be less than 30 J/cm^2 and for *KCV* – not less than 25 J/cm^2.

2.2.3.3 Each pipe shall be subjected to hydraulic tests. The value of test pressure is specified in the normative and technical documentation for pipes. The pipes shall be delivered in heat-treated condition.

2.2.3.4 The pipes with inside diameter of 14 mm and more shall be subjected to non-destructive testing. The pipes with inside diameter less that 14 mm shall be subjected to magnetic particle or dye-penetrant testing.

2.2.3.5 The pipes made of corrosion-resistant steels shall be subjected to intergranular corrosion tests, when contemplated by the design.

2.2.3.6 During manufacture, mounting and repair it is necessary to perform incoming inspection of pipes, forgings, welded joint components and welding materials for the oil-and-gas equipment pipelines for compliance with the requirements of the present Rules, standards, specifications and technical documentation. The extent and methods of inspection shall be agreed with the Register and the tests shall include:

tensile test at 20 °C and working temperature;

impact test at 20 °C and sub-zero temperature;

micro structural analysis;

flattening test;

static bend test.

2.3 MECHANICAL, FLEXIBLE, EXPANSION JOINTS AND HOSES

2.3.1 Mechanical, flexible and expansion joints.

2.3.1.1 Type and design of the mechanical, flexible and expansion joints, which are used in the oil-and-gas equipment systems described in 1.1.1, shall be approved by the Register.

2.3.1.2 The requirements for the mechanical, flexible and expansion joints shall comply with 2.5.4, 2.5, Part VIII "Systems and Piping" of the Rules for the Classification and Construction of Sea-Going Ships and 8.5, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

2.3.1.3 During mounting of the oil-and-gas equipment flexible joints, instructions of Appendix to Section 8 Part V "Technical Supervision during Construction of Ships" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships (Instructions on the Installation of Flexible Joints) shall be carried out.

2.3.2 Hoses.

2.3.2.1 The hoses used for loading/offloading of well fluids shall comply with the requirements of Section 6, Part VIII "Systems and Piping" of the Rules for the Classification and Construction of Sea-Going Ships and 8.8, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

2.3.2.2 High pressure drilling hoses shall comply with the requirements of the standards recognized by the Register and the technical documentation approved by the Register.

2.4 FITTINGS

2.4.1 Design of the fittings with manual and remote control, their marking and arrangement shall comply with the requirements of Section 4, Part VIII "Systems and Piping" of the Rules for the Classification and Construction of Sea-Going Ships, unless otherwise specified in the present Section.

2.4.2 When the system is fitted with remote-controlled power driven valves, also arrangements for their manual control shall be provided.

2.4.3 When sealed, the shut-off pipe fittings shall provide leak-tightness according to the current standards. Leak-tightness classes for seals according to GOST 9544 shall be selected depending on the application of fittings:

class A for moderately hazardous toxic substances, combustible gases and readily ignitable liquids;

class B for combustible liquids, hardly ignitable and non-combustible substances with a pressure above 4 MPa;

class C for combustible liquids, hardly ignitable and non-combustible substances with a pressure less than 4 MPa.

2.4.4 Fittings made of carbon and alloyed steels may be used for media with corrosion rate not more than 0,5 mm/year.

2.4.5 The fittings made of grey cast iron are not allowed for use on the pipelines conveying toxic substances and fire and explosion dangerous substances. The fittings made of grey cast iron may be used on other pipelines at a design pressure not more than 1,0 MPa (for steam, not more than 0,3 MPa) operated at an environment temperature not lower than – 15 °C. In this case, the ultimate strength of grey cast iron shall not be less than 300 MPa.

2.4.6 The fittings made of ductile cast iron are not allowed for use on the pipelines conveying liquefied hydrocarbon gases and readily ignitable liquids with boiling point below 45 °C.

For moderately hazardous toxic substances, readily ignitable liquids (except those with boiling point below 45 °C) and combustible liquids, the fittings made of ferritic ductile cast iron may be used if the working temperature limits are not lower than – 15 °C and not higher than 150 °C at a working pressure up to 1,6 MPa. In this case, the malleable cast iron shall have elongation more than 12 per cent and for medium working pressures up to 1,0 MPa use shall be made of the fittings designed for pressure P_n not less than 1,6 MPa, and for working pressures above 1,0 MPa use shall be made of the fittings designed for a pressure not less than 2,5 MPa.

2.4.7 Scope of application of the fittings made of ferritic ductile cast iron with elongation less than 12 per cent shall comply with 2.4.5.

2.4.8 The fittings made of spheroidal or nodular graphite cast iron may be used for the pipelines conveying readily ignitable liquids when the elongation of that cast iron is not less than 12 per cent and the working temperature shall not exceed 300 °C. The impact toughness of the spheroidal or nodular graphite cast iron for the fittings used at a temperature lower than – 15 °C shall not be less than 20 J/cm^2.

2.4.9 At elongation less than 12 per cent, scope of application of the spheroidal or nodular graphite cast iron shall comply with 2.4.5.

2.4.10 Regardless of the medium, working pressure and temperature, the fittings made of grey and malleable cast iron shall not be used in the following cases:

on the pipelines exposed to vibrations and hydraulic impacts;

on the pipelines with medium temperatures above 220 °C;

on the pipelines operating under extreme alternating temperature conditions;

where a substantial cooling of the fittings due to Joule-Thomson effect is possible;

on the pipelines conveying fire and explosion dangerous substances containing water or other freezing liquids at the pipe wall temperature below 0 °C, regardless of pressure;

in pump unit manifolding system on open areas;

on piping of tanks and vessels for storing fire and explosion dangerous and toxic substances.

2.4.11 On the pipelines operating at an environment temperature lower than – 40 °C use shall be made of fittings made of the appropriate alloyed steels, special alloys or non-ferrous metals, with an impact toughness of the metal (*KCV*) not less than 20 J/cm^2 at the minimum possible casing temperature.

2.4.12 For the pipelines with working pressure above 35,0 MPa cast fittings shall not be used.

2.4.13 The fittings with flat face flanges shall not be used in the pipelines with a working pressure above 10,0 MPa.

2.5 PIPING LAYING

2.5.1 Piping shall be laid in compliance with Section 5, Part VIII "Systems and Piping" of the Rules for the Classification and Construction of Sea-Going Ships.

2.5.2 Systems and piping conveying safe media shall be separated from the piping, which may contain explosive and inflammable media.

Cross-connection may be allowed by the Register in case when measures are taken to preclude potential contamination of the piping containing safe medium.

2.5.3 Where the pipelines pass through watertight bulkheads, decks and other watertight structures, there shall be used appropriate bulkhead sockets, welded pads and other details to ensure the integrity of the structure concerned.

Sockets attached by welding to watertight decks and bulkheads shall have the wall thickness, as a minimum, 1,5 mm greater than that of pipes connected to the sockets.

2.5.4 Where the pipelines pass through fire-resisting bulkheads, the requirements of 2.1.3, Part VI "Fire Protection" of the Rules for the Classification and Construction of Sea-Going Ships shall be met.

2.6 SURVEYS OF PIPING SYSTEMS DURING CONSTRUCTION OF FPU/MODU/FOP

2.6.1 Surveys of the piping systems during construction of FPU/MODU/FOP shall be carried out in compliance with Section 9, Part I "General Regulations

for Technical Supervision".

2.6.2 Mounting of the piping systems shall be performed in compliance with the technical documentation approved by the Register.

2.7 SURVEYS OF PIPING SYSTEMS OF FPU/MODU/FOP IN SERVICE

2.7.1 Initial surveys.

2.7.1.1 The piping systems of oil-and-gas equipment of FPU/MODU/FOP manufactured without the Register technical supervision, as well as in cases mentioned in 10.2.2, Part I "General Regulations for Technical Supervision" shall be submitted to the initial survey.

2.7.1.2 During initial survey the construction, arrangement and installation of the piping systems of the FPU/MODU/FOP oil-and-gas equipment shall be checked for compliance with the requirements of the Rules. Extent of examinations, tests, measurements and operational testing is specified by the Register with due regard to the technical condition of the piping systems and availability of certificates or permissions issued by other classification or supervisory body. The dates of the subsequent surveys are counted from the dates stated in the certificate with regard to subsequent concurrency with periodical surveys.

2.7.2 Periodical surveys.

2.7.2.1 Survey of the pipelines with nominal pressure up to 10,0 MPa.

2.7.2.1.1 Survey of pipelines of the FPU/MODU/FOP oil-and-gas equipment with nominal pressure up to 10,0 MPa shall be carried out in compliance with the requirements of Section 10 and Table 10.2.7, Part I "General Regulations for Technical Supervision".

2.7.2.1.2 Dates of surveys (examinations with access, opening-up or dismantling and thickness measurements being provided, where necessary) shall comply with Table 10.2.7, Part I "General Regulations for Technical Supervision". When setting dates, it is necessary to take into consideration the rate of corrosive-erosive wear, operational conditions and results of the preceding surveys of the pipelines.

2.7.2.1.3 During surveys of the piping systems it is necessary:

to carry out external examination of the pipeline;

to measure thickness of the pipeline wall and welded flange connection using non-destructive testing equipment;

to carry out internal survey of the pipeline after dismantling (disassembly) of the section operating under the most unfavourable conditions;

where necessary, to perform non-destructive testing of welds, metallographic and mechanical tests.

2.7.2.1.4 The wall thickness shall be measured on sections operating under the most complicated conditions (bends, T-joints, incuts, places of pipe contraction, upstream and downstream of fittings, places of accumulation of moisture and fluids causing corrosion, in stagnant pockets, drainages), as well as on straight piping sections on agreement with the Register.

Along with that, the straight sections of interblock pipelines shall be subjected to wall thickness measurement in at least three places. In all cases, wall thickness shall be checked in 3 to 4 diameter points and on the branch pipes – in at least 4 to 6 points on the convex and concave parts.

2.7.2.1.5 Survey of the welded flange connection shall be carried out by means of internal survey (with the pipeline being disassembled) or thickness measurements by non-destructive testing in at least three points around the circumference of the flange collar.

2.7.2.1.6 The pipeline sections, which were subjected to disassembly, cutting and welding in the process of survey, after assembly shall be tested for strength and tightness. In well-grounded cases, during disassembly of the flanged connections associated with replacement of gaskets, fittings or individual components, only tightness tests may be permitted. In this case, the newly installed fittings or pipeline components shall be previously tested for strength by a test pressure in accordance with 2.7.4, 2.7.5.

2.7.2.1.7 Upon expiry of the designed service life, the pipeline, regardless of its technical condition, shall be subjected to an overall inspection in order to determine possibility and time period of further operation.

2.7.2.2 Survey of the pipelines with nominal pressure above 10,0 MPa.

2.7.2.2.1 Survey of pipelines of the FPU/MODU/FOP oil-and-gas equipment with a nominal pressure above 10,0 MPa shall be carried out in compliance with the requirements of Section 10 and Table 10.2.7, Part I "General Regulations for Technical Supervision".

2.7.2.2.2 Dates of surveys (examinations with access, opening-up or dismantling and thickness measurements being provided, where necessary) shall comply with Table 10.2.7, Part I "General Regulations for Technical Supervision".

2.7.2.2.3 Dates of surveys of the pipelines with a pressure above 10,0 MPa shall be set proceeding from the operational conditions but not less than once in four years. The first survey shall be carried out not later than in 2 years after the pipeline was commissioned.

2.7.2.2.4 Scope of survey of the pipelines with a pressure above 10,0 MPa shall cover:

at least two sections of the pipelines of each process block, regardless of the medium temperature;

at least one section of each collector or interblock pipelines, regardless of the medium temperature.

Selection of the test sections shall be agreed with the Register.

2.7.2.2.5 During survey of the test section of the pipeline with a pressure above 10,0 MPa it is necessary:

to carry out external examination;

when union or flange joints are used, to disassembly them and thereafter to carry out internal survey;

to measure thicknesses of the pipe walls and other components of the test section;

when during examination defects are detected in welds (in the near weld zone) or their quality is doubtful, to carry out non-destructive testing;

when the metal quality is doubtful, to check its mechanical properties and chemical composition;

to check condition of couplings, flanges, gaskets, fastenings, as well as the pipe formed components and fittings, where provided on the test section.

2.7.2.2.6 Upon unsatisfactory survey results of the test sections of the pipeline with a pressure above 10,0 MPa, on agreement with the Register, an overall survey shall be carried out with complete dismantling of the pipeline and check of the condition of pipe assemblies and components, as well as fittings installed on the pipeline.

2.7.2.2.7 All pipelines and/or their sections, which during survey were subjected to disassembly, cutting and welding, after assembly shall be tested for strength and tightness.

2.7.2.2.8 Upon expiry of the designed service life, the pipeline, regardless of its technical condition, shall be subjected to an overall inspection in order to determine possibility and time period of further operation.

2.7.3 Survey of the piping fittings.

2.7.3.1 Examination and repair of the piping fittings, including non-return valves, as well as the driving gear (electric, pneumatic, hydraulic, mechanical drive), as a rule, shall be carried out during survey of the pipeline.

2.7.3.2 During survey of the fittings, including non-return valves, the following operations shall be performed:

external examination;

disassembly and examination of condition of individual parts;

examination of inner surface and, where necessary, non-destructive testing;

lapping-in of sealing surfaces (where necessary);

assembly, operational testing and strength and tightness tests.

2.7.4 Testing of piping.

2.7.4.1 The piping shall be hydraulically tested for strength and tightness:

after completion of mounting of the oil-and-gas equipment or on the Register demand during the initial surveys;

in service, in due dates set by the Rules (refer to Section 10 and Table 10.2.7, Part I "General Regulations for Technical Supervision").

2.7.4.2 Value of the test pressure p_t, in MPa, for the cases mentioned in 2.7.4.1 during strength tests (except the injection pipelines and their fittings, refer to 2.8.2.8, Part II "Drilling Systems and Equipment") shall not be less than

$$p_t = 1{,}5p\,\frac{\sigma_{20}}{\sigma_t} \qquad (2.7.4.2)$$

where p = the design pressure of the pipeline, in MPa;

σ_{20} = the allowable stress for the pipeline material at 20 °C, in MPa;

σ_t = the allowable stress for the pipeline material at the maximum above-zero design temperature, in MPa.

In all cases, the value of the test pressure shall be such that the equivalent stress in the pipeline wall does not exceed 90 per cent of the yield strength at the test temperature.

2.7.4.3 The test pressure in the pipeline specified in 2.7.4.2 shall be maintained for 10 min (strength test) and then it shall be reduced down to the working pressure, at which a thorough examination of welds shall be carried out (tightness test).

After completion of examination, the pressure shall be increased up to the test pressure and maintained for 5 min more, after that the pressure shall be again reduced down to the working pressure and the pipeline shall be subjected to a thorough examination for the second time.

Duration of the tightness test depends on duration of the pipeline examination and leakage test of the detachable joints.

2.7.4.4 The test of the pipelines with a nominal pressure up to 10,0 MPa for strength and tightness may be hydraulic or air test. Generally, hydraulic test shall be conducted. On agreement with the Register, hydraulic test may be replaced by air test.

2.7.4.5 The pipelines designed for a nominal pressure above 10,0 MPa shall be hydraulically tested. In technically grounded cases, on agreement with the Register, hydraulic test of these pipelines may be replaced by air test, provided that this test is monitored by an acoustic emission method (only if the ambient air temperature is above zero).

2.7.4.6 Results of the hydraulic test for strength and tightness are considered satisfactory if during the test no breaking, visible deformations, pressure drops according to pressure gauge occurred and no leakage and sweating were detected in the base metal, welds, fitting bodies, detachable joints and in all incuts.

2.7.4.7 All pipelines for toxic substances, combustible gases and readily ignitable liquids, besides routine tests for strength and tightness shall be subjected to additional leakage test with determination of pressure drop during the test. Pipelines in the process equipment piping system shall be tested together with this equipment.

2.7.4.8 The additional leakage test at the pressure equal to the working one shall be carried out with the use of air or inert gas after the strength and tightness tests, flushing and purging. Duration of the additional test shall not be less than 24 hours for installed pipelines of the FPU/MODU/FOP oil-and-gas equipment and shall be stated in the technical documentation for each pipeline to be approved by the Register.

During periodical tests, as well as after repair involving welding and disassembly of the pipeline, the

duration of test shall not be less than 4 hours.

2.7.4.9 Results of the additional air leakage test of the installed process pipelines, which have been subjected to repair involving disassembly or welding, shall be considered satisfactory if the pressure drop rate does not exceed 0,1 per cent an hour for the pipelines conveying toxic substances and 0,2 per cent an hour for the pipelines conveying combustible gases and readily ignitable liquids.

2.7.5 Testing of fittings.

2.7.5.1 The fittings installed on the pipelines shall be subjected to hydraulic tests by the pressure in compliance with 21.1, Part VIII "Systems and Piping" of the Rules for the Classification and Construction of Sea-Going Ships.

2.7.5.2 After assembly, the fittings shall be tested for leakage by a hydraulic pressure equal to the design pressure.

3 REQUIREMENTS FOR THE SPECIAL PURPOSE SYSTEMS AND PIPING

3.1 SYSTEM FOR GATHERING OF WELL FLUIDS

3.1.1 Detachable connections of the underwater standpipe (riser) shall be arranged on the FPU/MODU/FOP in such a way that in the event of their possible leakage ingress of oil and gas into the spaces is prevented.

3.1.2 Manifolds and piping with shut-off control and safety fittings shall be designed for the wellhead static pressure at the starting of a field development.

3.1.3 Non-return valves shall be installed on the well flowlines upstream of the manifolds.

3.1.4 The pipelines leading from the wellheads to inlet manifolds shall be laid in one tier.

3.1.5 The pipelines leading from the wellheads to the process plants shall be laid in one tier and designed for 1,5 times the working pressure. Well number and flow direction shall be marked by paint at the beginning and end of the pipeline.

3.1.6 Standpipes of the flowlines and air lines shall be secured to the FPU/MODU/FOP metal structures by clamps. The air lines and flowlines shall be arranged in such a way as not to cross gangways, working floors and other passageways.

3.1.7 Pipelines of the systems for gathering of well fluids shall comply with the requirements of 2.1, Part III "Systems for Production, Gathering, Treatment and Transportation of Well Fluids".

3.2 SYSTEMS FOR TREATMENT OF WELL FLUIDS

3.2.1 Passage of pipelines with combustible gases, readily ignitable and combustible liquids through accommodation, administrative and domestic and service spaces, control stations, as well as through air ducts and ventilating trunks is prohibited.

3.2.2 Use of pipelines to reduce overall resistance of antistatic earth conductors is prohibited.

3.2.3 Flange joints on the process pipelines may be permitted only in places where fittings are installed or the pipelines are connected to apparatus, as well as in those sections where periodical disassembly is required to carry out cleaning and repair of the pipelines.

3.2.4 Within hazardous zones the oil-and-gas pipelines shall be laid without coupling flanges.

3.2.5 Flange joints shall be arranged in places open and accessible for visual examination, maintenance, disassembly, repair and mounting. Flange joints of the pipelines with combustible gases, readily ignitable and combustible liquids shall not be arranged above the places intended for passage of people and above the working platforms.

3.2.6 Manual- and remote-controlled fittings used on the process equipment handling combustible gases, readily ignitable and combustible liquids shall have leak-tightness class for seals not lower than B according to GOST 9544.

3.2.7 When laying pipelines with hazardous media, pipes with readily ignitable liquids shall be located below the gas pipes.

3.2.8 Pipelines of the systems for treatment of well fluids shall comply with the requirements of 2.4, Part III "Systems for Production, Gathering, Treatment and Transportation of Well Fluids".

3.3 GAS WITHDRAWAL SYSTEM

3.3.1 The pipelines of gas withdrawal system shall be of the minimum length and shall be laid with the minimum number of bends and detachable joints.

3.3.2 The pipelines of gas withdrawal system shall comply with the requirements of 2.6.4, 2.6.5 and 2.6.7, Part III "Systems for Production, Gathering, Treatment and Transportation of Well Fluids".

3.4 SYSTEM FOR TRANSPORTATION OF WELL FLUIDS

3.4.1 The pipelines for transportation of oil, gas and condensate shall be provided with pig launchers.

3.4.2 The pipelines leading to production standpipes for transportation of well fluids from the FPU/MODU/FOP shall be equipped with the remote-controlled valves, which are actuated automatically by the ESD system and provide shutdown of the relevant pipelines.

3.4.3 The pipelines for transportation of well fluids shall comply with the requirements of 2.12, Part III "Systems for Production, Gathering, Treatment and Transportation of Well Fluids".

PART VI. CARGO-HANDLING GEAR

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part apply to the following:

cargo-handling gear installed on the FPU/MODU/FOP and designed for loading, unloading, moving of loads essential for operation of the FPU/MODU/FOP from one position to another and also conveyance of the personnel;

process cargo handling gear.

1.1.2 Cargo-handling gear mentioned in 1.1.1 shall also meet the requirements of the Rules for the Cargo Handling Gear of Sea-Going Ships, to the extent as applicable.

1.2 GENERAL REQUIREMENTS

1.2.1 General provisions relating to the procedure of technical supervision of the cargo-handling gear mentioned in 1.1.1 of the FPU/MODU/FOP during their manufacture, mounting and operation, as well as the requirements for the amount of technical documentation submitted to the Register for review and approval shall comply with the requirements of Sections 3 to 10, Part I "General Regulations for Technical Supervision".

1.2.2 Cargo-handling gear not regulated by the Rules for the Cargo Handling Gear of Sea-Going Ships or the gear designed for operation under specific conditions not stipulated by the Rules for the Cargo Handling Gear of Sea-Going Ships shall be subject to special consideration by the Register.

2 REQUIREMENTS FOR SPECIAL PURPOSE HOISTING CRANES

2.1 The cranes used for moving loads or conveyance of the personnel on the FPU/MODU/FOP shall meet the requirements of this Section and the requirements of the international standards.

2.2 Load lifting (lowering) speed V, in m/s, shall not be less than

$$V = 0{,}1(H_{1/3} + 1) \qquad (2.2)$$

where $H_{1/3}$ = the significant wave height, in m (with 13 per cent probability), in compliance with the FPU/MODU/FOP design approved by the Register.

2.3 For a special purpose cargo crane the dynamic factor for calculation of the crane foundation (base) shall be assumed at least 1,3 times greater than the dynamic factor used for calculation of an ordinary ship's crane.

2.4 The crane used for conveyance of the personnel shall satisfy the following requirements:

winches of the crane used for conveyance of the personnel shall be provided with two braking systems, one of which shall be manually operated;

safe working load of the crane shall be at least twice the design load incorporating weight of all the appliances (stage, loose gear), as well as the weight of the personnel being conveyed;

if the load lowering speed is more than 0,3 m/s, the control and monitoring system shall provide soft landing of the stage;

in the event of emergency failure of the crane drive, the crane shall be automatically brought in a position to provide lowering of the stage with the personnel, and the safe lowering of the stage shall be provided.

2.5 The special purpose crane shall be provided with the following:

permanent wireline tension system, if the safe working load of the hook is less than 25 t;

wireline slack detector;

load indicator or load moment indicator;

visual and sound alarm system activated when the load or capsizing moment comprises 90 per cent of the safe working load.

2.6 For the cranes designed for loading/unloading of the supply vessels in seaway, a system for emergency release of the cargo hook shall be provided, which permits the discharge of the wireline in the event of unexpected overloading of the crane due to the hook or load catching at the supply vessel.

2.7 The permanent tension system (movement compensator) shall maintain the tension of not higher than 1,5 t.

2.8 Winch drums shall be provided with a wireline slack detector, which shall be activated automatically when the wireline is slackened in the process of lowering.

2.9 The cabin of the special purpose crane shall meet the following requirements:

the cabin shall provide an operator with a sufficient view of the working zone, including the hook and its position;

the cabin shall be provided with anti-freezing and anti-fog means;

the cabin shall be provided with windscreen wipers;

the cabin shall be provided with heaters, fan and air conditioner;

the cabin shall be of fire-proof design;

the cabin shall be provided with an arrangement for emergency evacuation of the operator.

2.10 Each crane, after assembly at the manufacturer's, shall be subjected to functional tests according to the program approved by the Register. The tests shall be witnessed by the surveyor to the Register.

A copy of the approved program of functional tests shall be kept in the crane's operating manual.

2.11 After installation on the platform, the crane shall be subjected to full-scale tests under operational conditions according to the program agreed by the customer, approved by the Register and in the presence of the surveyor to the Register and a representative of the customer. The program of functional tests and also the program of tests after installation on the FPU/MODU/FOP shall be developed by the crane supplier and approved by the Register.

2.12 In the process of operation the crane shall be subjected to full-scale tests under operational conditions with the following frequency:

after initial installation on the FPU/MODU/FOP;

after any significant re-equipment, as well as after repair or replacement of the basic load-bearing structures (supports, boom, framework).

2.13 The program of the tests conducted in the process of crane operation shall be agreed with the Register.

2.14 Periodical tests shall be conducted not less than once in five years.

2.15 To perform repair and cargo-handling operations in the working spaces of the drilling rig and the systems for production, treatment and transportation of well fluids of the FPU/MODU/FOP, process cargo-handling gear with required safe working load shall be provided.

3 REQUIREMENTS FOR SPECIAL PURPOSE CARGO-HANDLING GEAR

3.1 BLOCK-AND-TACKLE UNIT

3.1.1 Casings of the equipment forming a part of the block-and-tackle system (crown block, block-and-tackle unit, hook) shall be marked with the allowable safe working load.

3.1.2 Threaded connection of the hook shank with the thrust nut shall be fitted with a device preventing spontaneous unscrewing of the nut.

3.1.3 The main hook arm shall have a self-closing device to prevent the swivel link from going out of the mouth. The device shall be provided with an arrangement for its forced opening.

3.1.4 Design of the hook shall prevent spontaneous falling-out of the elevator links from the side arms.

3.1.5 The hook shank shall be provided with an arrangement to stop the hook rotation when required by the process.

3.1.6 Design of the hook and block-and-tackle unit shall provide the uniform load distribution on the links suspended thereon.

3.1.7 Clearances between the housing and pulley flanges of the block-and-tackle system shall be not more than 0,25 of the wireline diameter.

3.1.8 To ensure stability of the block-and-tackle unit with the hook or automatic elevator when travelling without load, its center of gravity shall be located below the wireline pulley axis.

3.1.9 Design of the fitting device and pass-by of the fixed end of the wireline shall:

provide the possibility of pass-by and replacing of the wireline without throwing the coils off the drum (except for mobile drilling units);

prevent overlapping of the wireline coils on the drum in case of the wireline slack.

3.2 BLOCK-HOOK AND SWIVEL

3.2.1 The block-hook is designed for suspension, by means of bails with elevator, of the drill strings and swivel in the process of drilling and round-trip operations, to hold aweigh a casing string for running it into the well, as well as during hook-up and commissioning. The safe working load of the block-hook shall correspond to that of the crane.

3.2.2 The hook shank shall be provided with an arrangement to stop the hook rotation when required by the process.

3.2.3 The main hook arm shall have a self-closing device to prevent the swivel link from going out of the mouth. The device shall be provided with an arrange-

ment for its forced opening. Design of the hook shall prevent spontaneous falling-out of the elevator links from the side arms.

3.2.4 Turning of the swivel link shall be limited within the range of 25 – 50° towards the side opposite the swivel gooseneck.

3.2.5 Design of the swivel shall provide safe replacement of the washpipe seals on the drilling derrick (without disconnection of branch pipe and drilling mud hose).

3.2.6 Sealing elements in the swivel hydraulic section shall be designed for the pressure equal to 1,5 times the system working pressure.

3.2.7 Connecting thread of the swivel stem shall be of left-handed type.

PART VII. HEAT EXCHANGERS AND PRESSURE VESSELS

1 APPLICATION

1.1 The requirements of the present Part apply to the heat exchangers and pressure vessels incorporated in the FPU/MODU/FOP oil-and-gas equipment.

1.1.1 Separators:
of drilling mud;
of oil treatment systems;
of gas/condensate treatment systems.

1.1.2 Multiphase separators.

1.1.3 Electric dehydrators.

1.1.4 Desalters.

1.1.5 Mass exchanger columns.

1.1.6 Pig launchers/receivers.

1.1.7 Heat exchangers:
plate-type heat exchangers;
shell-and-tube heat exchangers;
capacitive heat exchangers.

1.1.8 Process water treatment plants.

1.2 The requirements of the Rules do not apply to thermal fluid boilers, pressure vessels for compressed air and inert gases (nitrogen) of various, including process, application, which shall comply with the requirements of Part IX "Boilers, Heat Exchangers and Pressure Vessels" of the MODU/FOP Rules.

2 GENERAL

2.1 General provisions relating to the procedure of technical supervision over heat exchangers and pressure vessels of the oil-and-gas equipment of FPU/MODU/FOP during their manufacture, mounting and operation, as well as the requirements for the amount of technical documentation submitted to the Register for review and approval shall comply with the requirements of Sections 3 to 10, Part I "General Regulations for Technical Supervision".

2.2 In compliance with 8.3 Part I "General Regulations for Technical Supervision", to be recognized by the Register are the manufacturers producing the following materials and oil-and-gas equipment:

.1 steel rolled products for heat exchangers and pressure vessels operating at a pressure above 0,07 MPa or a temperature by 10 °C above the saturation point of working liquid at the atmospheric pressure;

.2 steel pipes and piping parts for heat exchangers, pressure vessels and piping operating at a pressure above 0,07 MPa or a temperature by 10 °C above the saturation point of working liquid at the atmospheric pressure;

.3 steel semi-finished products (forgings, castings, billets) if they are produced for heat exchangers, pressure vessels and piping at works other than a rolling mill;

.4 heat exchangers operating at a pressure above 0,07 MPa or a temperature by 10 °C above the saturation point of working liquid at the atmospheric pressure;

.5 pressure vessels operating at a pressure above 0,07 MPa or a temperature by 10 °C above the saturation point of working liquid at the atmospheric pressure.

2.3 Subject to the Register technical supervision are the heat exchangers and pressure vessels specified in 1.1 with a working pressure of 0,07 MPa and above, capacity of 0,025 m^3 and above, which product of pressure value, in MPa, by capacity, in m^3, is equal to 0,02 and more.

2.4 Scope of technical supervision, materials used, strength of structural elements, welding and heat treatment, as well as the extent of tests of the heat exchangers and pressure vessels specified in 1.1 shall comply with the requirements of Sections 1, 2 and 6, Part X "Boilers, Heat Exchangers and Pressure Vessels" of the Rules for the Classification and Construction of Sea-Going Ships, unless otherwise specified in the Sections given below.

2.5 Strength calculations for the heat exchangers and pressure vessels shall be made in compliance with the requirements of Section 2, Part X "Boilers, Heat Exchangers and Pressure Vessels" of the Rules for the Classification and Construction of Sea-Going Ships, the standards recognized by the Register or the technical documentation approved by the Register.

3 GENERAL REQUIREMENTS FOR HEAT EXCHANGERS AND PRESSURE VESSELS

3.1 MATERIALS

3.1.1 General.

3.1.1.1 The materials intended for manufacture of assemblies and parts of the heat exchangers and pressure vessels shall comply with the requirements of the standards recognized by the Register and the technical documentation approved by the Register.

3.1.1.2 The chemical composition of steel shall be in accordance with standards or specifications agreed with the Register proceeding from the required mechanical properties, including those at elevated design temperature, at that the content of base elements shall not exceed the values given in 3.3, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships.

3.1.1.3 The steel shall be killed. Using of rimming steel is not permitted, and semi-killed steel is permitted on agreement with the Register. On agreement with the Register, the steel may be treated with grain-refining elements.

3.1.1.4 Using of cladding and deposited metals may be permitted for manufacture of heat exchangers and pressure vessels, provided that the materials of the base material, cladding metal and deposited metals are manufactured in compliance with the standards/specifications agreed with the Register.

3.1.1.5 Use of the electric-welded pipes with longitudinal or spiral weld may be permitted in compliance with the standards/specifications agreed with the Register, provided that the weld is subjected to non-destructive testing throughout the length.

Seamless or welded pipes shall be subjected to hydraulic tests in compliance with the standards/specifications agreed with the Register. The hydraulic tests of the seamless pipes may be omitted if the pipes are subjected to non-destructive testing over their whole surface.

3.1.1.6 Cladding and deposited plates and forgings with deposits shall be subjected to ultrasonic testing or testing by other methods which make it possible to reveal separation of the cladding (deposited) metal from the base metal, as well as discontinuities and delaminations of the forging metal. Scope of quality assessment is established in compliance with the standards/specifications agreed with the Register. Bimetal plates of more than 25 mm in thickness, intended for manufacture of the vessels operating under a pressure above 4,0 MPa shall be subjected to complete ultrasonic testing or testing by the equivalent methods.

3.1.1.7 Carbon and low-alloyed steel plate of more than 60 mm in thickness intended for manufacture of the vessels operating under a pressure above 10,0 MPa shall be subjected to ultrasonic testing or testing by the equivalent methods.

3.1.1.8 Carbon, low-alloyed and alloyed steel forgings intended for operation under a pressure in above 6,3 MPa and having one of the overall dimensions more than 200 mm and a thickness more than 50 mm shall be subjected to ultrasonic testing or testing by the equivalent method.

3.1.1.9 Use of grey and ductile cast iron for manufacture of components and shells of the heat exchangers and pressure vessels is not permitted. Parts and fittings of the heat exchangers and pressure vessels of up to 1000 mm in diameter and working pressure up to 1,0 MPa may be manufactured of spheroidal or nodular graphite cast iron of ferrite structure in compliance with Table 3.9.3.1, Part XIII "Materials" of the Rules for Classification and Construction of Sea-Going Ships.

3.1.2 Mechanical properties.

3.1.2.1 The mechanical properties at room and design temperatures shall comply with the standards/specifications.

3.1.2.2 The steel properties shall be confirmed by the following tests:

tensile test with determination of tensile strength, yield stress and elongation;

bend test;

impact test (*KCU* or *KCV*);

At the request of the Register, other types of tests may be carried out to confirm the possibility of using steel under specified operational conditions.

3.1.2.3 Sampling and extent of tests shall comply with the requirements of 3.3, Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships.

3.1.3 Materials for fittings of heat exchangers and pressure vessels.

3.1.3.1 The fittings of heat exchangers and pressure vessels shall be manufactured in compliance with the standards/specifications approved by the Register.

3.1.3.2 Use of copper alloys for the fittings of heat exchangers and pressure vessels is allowed at design medium temperature up to 250 ºC and working pressure up to 1,6 MPa.

3.2 SURVEYS OF HEAT EXCHANGERS AND PRESSURE VESSELS DURING MANUFACTURE

3.2.1 General.

3.2.1.1 The heat exchangers and pressure vessels specified in 1.1 and listed in the Register Nomenclature

(refer to Section 7, Part I "General Regulations for Technical Supervision") shall be fabricated at the manufacturers recognized by the Register.

3.2.1.2 The heat exchangers and pressure vessels shall be fabricated at the manufacturers' under the Register technical supervision with issue of the relevant documents listed in the Register Nomenclature.

3.2.2 Technical supervision of the Register at the manufacturers'.

3.2.2.1 General provisions relating to the procedure of technical supervision of the heat exchangers and pressure vessels of the FPU/MODU/FOP oil-and-gas equipment shall comply with Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

3.2.2.2 The heat exchangers and pressure vessels shall be manufactured and the process operations shall be carried out under the Register supervision in compliance with the approved technical documentation, which is enlisted in 1.3.4, Part X "Boilers, Heat Exchangers and Pressure Vessels" of the Rules for the Classification and Construction of Sea-Going Ships.

3.2.2.3 Scope of surveys under the established production conditions for manufacture of parts, assemblies and products as a whole involves checks of the following:

.1 documentation for materials and their visual examination;

.2 machining of parts;

.3 welding operations;

.4 manufacture of parts and assemblies;

.5 assembly of products;

.6 hydraulic tests.

The necessity of carrying out surveys specified in 3.2.2.3.2 to 3.2.2.3.4 is subject to special consideration by the Register.

3.2.2.4 Welded shells, bottoms and casings of the heat exchangers and pressure vessels shall be manufactured in compliance with the procedure developed by the manufacturer and approved by the Register.

3.2.2.5 The parts and units shall be assembled within the tolerances for clearances between the components in compliance with the technical documentation approved by the Register. The attainment of the required conjunction between the components of a product through excessive interference being applied by the assembling fixtures is not permitted.

Where necessary, the components may be fitted by heating on the agreement with the Register.

3.2.2.6 After manufacture or assembly, all the components of the heat exchangers and pressure vessels shall be subjected to hydraulic tests in compliance with the requirements of 1.7, Part X "Boilers, Heat Exchangers and Pressure Vessels" of the Rules for the Classification and Construction of Sea-Going Ships. The value of the test pressure shall be such that the equivalent stress in the pipeline wall at the test pressure does not exceed 90 per cent of the yield stress of the material at the test temperature.

3.2.2.7 The vessels, which manufacture is completed at the installation site and which are transported to the installation site in parts shall be subjected to hydraulic test at that site. The hydraulic test of the vessels to be vertically installed may be carried out with the vessels in horizontal position, provided that the strength of the vessels shell is ensured, for which purpose the strength calculation shall be made by the vessel designer with due regard to the vessel position adopted in the process of the hydraulic test.

3.2.2.8 Time of the vessel exposure to test pressure shall be set in the technical documentation approved by the Register. The time of exposure to test pressure shall not be less than:

10 min for wall thicknesses up to 50 mm;

20 min for wall thicknesses above 50 and up to 100 mm;

30 min for wall thicknesses above 100 mm.

3.3 SURVEYS OF HEAT EXCHANGERS AND PRESSURE VESSELS DURING CONSTRUCTION OF FPU/MODU/FOP

3.3.1 General.

3.3.1.1 Survey of the piping systems during construction of FPU/MODU/FOP shall be carried out in compliance with Section 9, Part 1 "General Regulations for Technical Supervision".

3.3.2 The Register technical supervision at the manufacturer's during construction of FPU/MODU/FOP.

3.3.2.1 The heat exchangers and pressure vessels shall be mounted under the Register supervision in compliance with the technical documentation approved by the Register.

3.3.2.2 The Register surveys during mounting of the heat exchangers and pressure vessels shall generally involve:

.1 for heat exchangers:

checking of installation on foundation and securing;

operational testing;

.2 for pressure vessels:

checking of installation on foundation and securing;

internal survey;

operational testing.

3.3.2.3 Internal survey of the heat exchangers and pressure vessels shall be carried out prior to their preparation for operational testing to confirm that all their components are in proper technical condition in compliance with the approved technical documentation.

3.3.2.4 The heat exchangers and pressure vessels shall be operationally tested according to the program approved by the Register. The heat exchangers shall be

operationally tested together with the support systems, pipelines and devices.

At that the following shall be tested: mounting quality, operation with specified parameters of the working medium, operation of fittings, instrumentation and regulating devices, adjustment of safety devices.

3.3.2.5 Operational testing of the pressure vessels involves checking of their installation quality and performance reliability.

At that the following shall be tested: operability of fittings and regulating devices, as well as capacity and adjustment of safety devices.

3.4 SURVEYS OF HEAT EXCHANGERS AND PRESSURE VESSELS OF FPU/MODU/FOP IN SERVICE

3.4.1 Initial surveys.

3.4.1.1 Heat exchangers and pressure vessels of the oil-and-gas equipment of the FPU/MODU/FOP constructed without the Register technical supervision, as well as during surveys stated in 10.2.2, Part I "General Regulations for Technical Supervision" shall be submitted to the initial survey.

3.4.1.2 During initial survey, the heat exchangers and pressure vessels shall be subjected to internal survey, hydraulic test and external examination.

3.4.1.3 The surveys specified in 3.4.1.2 may be credited within the intervals specified when certificates or permissions of other classification or supervisory body are issued. In this case the dates of subsequent surveys and tests shall be counted from the dates stated in the certificates with due regard to subsequent concurrency with periodical surveys.

3.4.2 Periodical surveys.

3.4.2.1 Scope of periodical surveys of the heat exchangers and pressure vessels of the FPU/MODU/FOP oil-and-gas equipment shall comply with the requirements of Section 10 and Table 10.2.7, Part I "General Regulations for Technical Supervision".

3.4.2.2 The heat exchangers and pressure vessels operating with the medium, which causes material corrosion at a rate not more than 0,1 mm/year, shall be subjected to external examination and internal survey not less than once in two years and to hydraulic test by a test pressure once in eight years.

3.4.2.3 When the corrosion rate of the heat exchanger and pressure vessel material exceeds 0,1 mm/year, annual external examinations and internal surveys shall be carried out.

3.4.2.4 Hydraulic tests of the heat exchangers and pressure vessels shall be carried out at a test pressure p_t, in MPa, equal to

$$p_t = 1{,}25p\,\frac{\sigma_{20}}{\sigma_t} \qquad (3.4.2.4)$$

where p = design pressure, in MPa;
σ_{20} = the allowable material stress at 20 °C, in MPa;
σ_t = the allowable material stress at the maximum above-zero design temperature, in MPa.

For the heat exchangers and pressure vessels inaccessible for the overall internal survey, as well as after major repair, the test pressure shall be assumed to be equal to $1{,}5p$.

PART VIII. MATERIALS AND WELDING

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part apply to the materials and welding used in manufacture, mounting and repair of the FPU/MODU/FOP oil-and-gas equipment accessories being the items of the Register technical supervision, except those specified in 1.1.2.

1.1.2 The requirements for the materials and welding of the FPU/MODU/FOP drilling derrick structures and derrick substructures shall comply with 2.1.2.1 and 2.1.2.2, Part II "Drilling Systems and Equipment".

1.2 GENERAL REQUIREMENTS

1.2.1 The materials used for manufacture of the systems, arrangements and mechanisms of the FPU/MODU/FOP oil-and-gas equipment shall comply with the requirements in Part XIII "Materials" of the Rules for the Classification and Construction of Sea-Going Ships, Part XII "Materials" of the MODU/FOP Rules, Part XIII "Materials" of the FPU Rules and Parts V, VII of the present Rules, to the extent as applicable.

1.2.2 During manufacture of the materials and products for the FPU/MODU/FOP oil-and-gas equipment, the Register may permit the use of the normative and technical documents of foreign classification societies, other recognized national and international standards, rules and regulations.

1.2.3 General provisions relating to the procedure of technical supervision of materials and welding for oil-and-gas equipment of the FPU/MODU/FOP during their manufacture, mounting and operation shall comply with the requirements of Sections 3 to 10, Part I "General Regulations for Technical Supervision".

1.2.4 The materials and products used for manufacture of the pipelines of systems, heat exchangers and pressure vessels forming part of the FPU/MODU/FOP oil-and-gas equipment and listed in the Register Nomenclature (refer to Table 7.1) shall be certified by the Register.

1.2.5 In compliance with the Register Nomenclature (refer to Table 7.1), to be recognized by the Register are the manufacturers producing the following materials:

.1 steel rolled products for heat exchangers and pressure vessels operating at a pressure above 0,07 MPa or a temperature by 10 °C above the saturation point of working liquid at the atmospheric pressure;

.2 steel pipes and piping parts for heat exchangers, pressure vessels and piping operating at a pressure above 0,07 MPa or a temperature by 10 °C above the saturation point of working liquid at the atmospheric pressure;

.3 steel semi-finished products (forgings, castings, billets) if they are produced for heat exchangers, pressure vessels and piping at works other than a rolling mill.

Procedure for recognition of the manufacturers of materials for the FPU/MODU/FOP oil-and-gas equipment shall comply with 8.3, Part I "General Regulations for Technical Supervision".

1.2.6 The materials used for manufacture of the oil-and-gas equipment systems, arrangements and mechanisms shall provide the reliable operation of that equipment within its design service life with regard to the specified operational conditions (design loading, the minimum and maximum design temperature, rate and frequency of loading variations, fatigue strength), a composition and nature of a medium (corrosiveness, toxicity, etc.), and also the effect of the environment and other factors.

1.2.7 For manufacture, mounting and repair of the systems, mechanisms and arrangements for the FPU/MODU/FOP oil-and-gas equipment, the materials, which are specified in the Register-approved project and comply with the current normative documents, shall be used.

1.2.8 When performing welding operations during manufacture, mounting and repair of the FPU/MODU/FOP oil-and-gas equipment, the requirements in Part XIV "Welding" of the Rules for the Classification and Construction of Sea-Going Ships, Part XIII "Welding" of the MODU/FOP Rules and Part XIV "Welding" of the FPU Rules shall be met.

1.2.9 Welding consumables used in welding operations during manufacture, mounting and repair of the FPU/MODU/FOP oil-and-gas equipment shall be approved by the Register (refer to 8.2.5, Part I "General Regulations for Technical Supervision") in compliance with the requirements in Section 4, Part XIV "Welding" of the Rules for the Classification and Construction of Sea-Going Ships.

1.2.10 Welding processes used during manufacture, mounting and repair of the FPU/MODU/FOP oil-and-gas equipment (refer to 8.2.6, Part I "General Regulations for Technical Supervision") shall be approved in compliance with the requirements in Section 6, Part XIV "Welding" of the Rules for the Classification and Construction of Sea-Going Ships.

1.2.11 Welders approved by the Register for welding operations during manufacture, mounting and repair of the FPU/MODU/FOP oil-and-gas equipment shall be certified in compliance with the requirements in Section 5, Part XIV "Welding" of the Rules for the Classification and Construction of Sea-Going Ships.

2 REQUIREMENTS FOR OIL-AND-GAS EQUIPMENT MATERIALS AND WELDING

2.1 REQUIREMENTS FOR MATERIALS IN CONTACT WITH CORROSIVE MEDIA

2.1.1 The equipment of a drilling mud system, systems for production and treatment of the FPU/MODU/FOP well fluids during operations on a sea shelf in the fields, containing hydrogen sulphide and other corrosive media, shall be manufactured of the materials, which provide serviceability and durability in these media or shall be provided with a reliable inhibitor or special protection.

2.1.2 Materials for an ordinary or resistant to sulphide corrosion cracking design shall be selected with regard to the process parameters and corrosive media characteristics.

2.1.3 Materials resistant to sulphide corrosion cracking shall be used at the corrosive media parameters specified in 1.3, Part V "Systems and Piping".

2.1.4 The oil-and-gas equipment materials resistant to sulphide corrosion cracking shall comply with the technical documentation approved by the Register and/or the standards recognized by the Register.

2.1.5 Resistance of materials to corrosive media shall be tested in compliance with the provisions in 4.3.9.5 of the Rules for the Classification and Construction of Subsea Pipelines.

2.2 REQUIREMENTS FOR INSPECTION OF MATERIALS AND PRODUCTS

2.2.1 Procedures and extent of inspection of the materials and semi-finished products shall be determined on the basis of the technical documentation approved by the Register and/or the standards recognized by the Register.

2.2.2 Cladding and deposited plates, as well as forgings shall be subjected to ultrasonic testing or other methods of non-destructive testing, which provide detection of the delaminations of a cladding (deposited) metal from the base metal, as well as discontinuities and disintegrations of a forging metal. In this case the extent of quality assessment is established by the technical specifications approved by the Register for cladding or deposited plates and forgings, or by the standards recognized by the Register.

2.2.3 Carbon and low-alloy steel of over 60 mm in thickness used during manufacture of load-bearing elements for mechanisms and arrangements shall be subject to plate-by-plate ultrasonic testing or another equivalent method of testing for defects. The methods and standards of inspection shall comply with the requirements of the standards recognized by the Register.

2.2.4 Carbon, low-alloy and intermediate-alloy forgings intended for manufacture of high-loaded load-bearing elements and having one of its overall dimensions exceeding 200 mm and a thickness over 50 mm shall be subjected to a single ultrasonic testing or another equivalent method. Not less than 50 per cent of the test forging is subjected to testing for defects. Procedure and standards of inspection shall comply with the normative documentation. Where necessary, the percentage of inspection may be increased up to 100 per cent.

2.3 REQUIREMENTS FOR MATERIALS OF PIPELINE SYSTEMS

2.3.1 Requirements for materials of the steel pipelines of the FPU/MODU/FOP oil-and-gas equipment shall comply with the provisions of 2.2, Part V "Systems and Piping".

2.3.2 Requirements for materials of the pipeline fittings of the FPU/MODU/FOP oil-and-gas equipment shall comply with the provisions of 2.4, Part V "Systems and Piping".

2.4 REQUIREMENTS FOR MATERIALS OF HEAT EXCHANGERS AND PRESSURE VESSELS

2.4.1 Requirements for materials of the heat exchangers and pressure vessels forming part of the FPU/MODU/FOP oil-and-gas equipment shall comply with the provisions of 3.1, Part VII "Heat Exchangers and Pressure Vessels".

PART IX. SPECIAL REQUIREMENTS FOR ENSURING EXPLOSION AND FIRE SAFETY

1 ELECTRICAL EQUIPMENT

1.1 GENERAL

1.1.1 The requirements of this Section apply to the electrical equipment of the drilling rig and process system, which shall comply with the requirements in Part X "Electrical Equipment" of the MODU/FOP Rules to the extent as applicable.

1.1.2 Hazardous areas are divided into zones wherein the equipment, arrangements, process vessels and pipelines of the systems of the FPU/MODU/FOP process system and drilling rig are installed, shall be established in compliance with the requirements in 2.9 – 2.11 of Part X "Electrical Equipment" of the MODU/FOP Rules, as well as with the requirements of the national supervisory bodies.

1.1.3 The electrical equipment, instrumentation and automated control systems, lighting, alarm and communication facilities of the drilling rig and process system designed for use in hazardous areas shall be certified in terms of explosion hazard and be provided with relevant certificates, which confirm an explosion protection type, issued by a special competent national or international body, which documents (certificates) are recognized by the Register.

1.2 CLASSIFICATION OF HAZARDOUS AREAS

1.2.1 Depending on the frequency and duration of the explosive mixture presence, the FPU/MODU/FOP hazardous areas are divided into the following zones:

zone "0": in which an explosive gas atmosphere is continuously present or present for long periods;

zone "1": in which an explosive gas atmosphere is likely to occur in normal operation;

zone "2": in which an explosive gas atmosphere is not likely to occur, and if it occurs as a result of accident or damage of the process equipment, it will exist for a short time.

1.2.2 Other spaces are considered non-hazardous areas. Zones shall be spaces, which enclose one-type explosion protection equipment. One or another type of equipment in the particular hazardous zone shall be arranged in compliance with the requirements in 2.4, 2.11 of Part X "Electrical Equipment" of the MODU/FOP Rules, as well as with the requirements of the national supervisory bodies.

1.3 FPU/MODU/FOP HAZARDOUS AREAS

1.3.1 The boundaries of hazardous areas are defined by the physical properties of explosive mixtures, parameters of the drilling rig and process system equipment and of the locations and spaces wherein oil and gas equipment is installed (refer also to 2.9, Part X "Electrical Equipment" of the MODU/FOP Rules).

1.3.2 The FPU/MODU/FOP locations and spaces, wherein explosive gas/air mixtures appear or may penetrate, shall be referred to one or another zone of a hazardous area according to Table 1.3.1.

1.3.3 All the enclosed spaces of the FPU/MODU/FOP, where the explosive mixtures of combustible gases or flammable liquid vapours may originate or penetrate therein, shall be provided with mechanical plenum-exhaust ventilation ensuring an air change in compliance with the requirements in 3.3.1, Part VIII "Systems and Piping" of the MODU/FOP Rules and the requirements of the national supervisory bodies.

Table 1.3.1

Nos.	Locations and spaces	Hazardous area zone
1	1.1 Internal spaces of closed tanks and pipelines relating to process arrangements of the gas-saturated (active) drilling mud, i.e. the mud between a wellhead and a final degassing discharge, system, internal spaces of hydrocarbon product tanks and pipelines	**0**
	1.2 Internal spaces of open process arrangements 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	

Nos.	Locations and spaces	Hazardous area zone
2[1]	2.1 Enclosed spaces wherein open process equipment and arrangements for oil and drilling mud are installed, which contain oil and petroleum gasesz	**0**
	2.2 Internal spaces of trunks, ducts, chutes and other similar arrangements wherein combustible gases and oil vapours cannot spread	
	2.3 Spaces for storage of cargo hoses for transfer of inflammable liquids with a flash point of 60 °C and less	
	2.4 Paint lockers, stores for paints, solvents, 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 an open trough	**1**
	3.2 Enclosed or semi-enclosed spaces 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 that are below the drill floor	
	3.4 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 open or semi-enclosed spaces, except for closed and semi-closed spaces below the drill floor and also the area within 1,5 m from exhaust ventilation outlets of zone "1" spaces or from any other opening for access to zone "1"	
	3.5 Ducts, pits and other similar structures in spaces which would otherwise be zone "2", but the removal of accumulated vapours and gases from them is impossible	
4[1]	4.1 Enclosed spaces with closed process units and arrangements, equipment, apparatus, piping, components of shutdown and regulating devices for inflammable liquids and combustible gases	
	4.2 Spaces of pump rooms for pumping of oil and waste waters with oil content above 150 mg/l	
	4.3 Open areas within 5 m around open process arrangements, equipment, apparatus containing oil and petroleum gases or inflammable liquids	
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 Open spaces within the boundaries of the drilling derrick up to a height of 3 m above the drill floor	
	5.3 Semi-enclosed spaces 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 open spaces below the drill floor and within a radius of 3 m from a potential source of oil-gas-air mixture release such as the top of a drilling nipple	
	5.5 Spaces within 1,5 m beyond the zone "1" areas specified in 3.2 and 3.4	
	5.6 Spherical open 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 higher	
	5.8 Air-closed spaces (locks) between zone "1" and non-hazardous areas	
6[1]	6.1 Open spaces within 3 m around closed process arrangements, equipment, apparatus and well components	
	6.2 Semi-enclosed spaces with process arrangements, equipment, apparatus; spaces within 15 m around a well axis from the lower structures of the platform to the entire height of a drilling derrick	
	6.3 Semi-enclosed spaces below the derrick working platform within the enclosure containing oil and petroleum gases or inflammable liquids	
	6.4 Semi-enclosed spaces wherein the well components is installed within the enclosure	

Table 1.3.1 - continued

Nos.	Locations and spaces	Hazardous area zone
	6.5 Semi-enclosed spaces for storage of cargo hoses for transfer of inflammable liquids	
	6.6 Spaces within 3 m in horizontal and vertical directions from the breathing pipes and safety hoses, as well as the arrangements for air discharge from the exhaust ventilation of the spaces with hazardous areas	
	6.7 Spaces within 0,5 m in horizontal and vertical directions from any openings (doorways, window openings) leading from the spaces with hazardous areas	
[1] The locations and spaces specified in items 2, 4 and 6 are the constituents of hazardous areas only on condition that the FPU/MODU/FOP complies with the requirements of the RF supervisory bodies.		

1.3.4 The gas detection and alarm system shall comply with the requirements in 7.9, Part X "Electrical Equipment" of the MODU/FOP Rules and the present Rules.

1.3.5 Arrangement of hazardous areas and spaces of the FPU/MODU/FOP shall be approved by the Register and the national supervisory bodies.

1.3.6 Division into relevant hazardous areas of the spaces not mentioned in Table 1.3.1, which may be hazardous under certain conditions, is subject to special consideration by the Register in each case.

1.3.7 Where doors or other openings are provided between the spaces mentioned in Table 1.3.1, the explosion hazard of any space with such openings is determined in accordance with 2.10, Part X "Electrical Equipment" of the MODU/FOP Rules.

1.3.8 The spaces with non-flanged pipelines for inflammable and combustible liquids are referred to the non-hazardous spaces, provided the pipes penetrate bulkheads/decks through the welded sockets and sleeves with non-flammable sealing preventing the ingress of explosive mixtures into the spaces.

1.3.9 The section of a transport pipeline (riser) for inflammable or combustible liquids located on the FPU/MODU/FOP outside hazardous areas is recommended to provide with a protective casing to prevent liquid spreading in the event of the pipeline depressurization. In addition, provision shall be made for an alarm interlocked with the ESD system to warn about the presence of an explosive mixture within the space protected by the above casing. The flammable liquid in the casing enclosure shall be discharged into an open-cut hazardous drainage system.

1.4 CLASSIFICATION OF EXPLOSION-PROOF ELECTRICAL EQUIPMENT[1]

1.4.1 Explosion-proof electrical equipment is classified according to the levels and types of explosion protection, groups and temperature classes.

1.4.2 Explosion-proof electrical equipment according to the levels of explosion protection is divided into the following types:

.1 particularly explosion-proof electrical equipment (level 0);

.2 explosion-proof electrical equipment (level 1);

.3 high robustness explosion-proof electrical equipment (level 2).

1.4.3 Particularly explosion-proof electrical equipment means explosion-protected electrical equipment provided with additional means of explosion protection.

1.4.4 Explosion-proof electrical equipment provides explosion protection both under the normal operating conditions of electrical equipment and when damaged, except the damages to the means of explosion protection. High robustness explosion-proof electrical equipment provides explosion protection only under the normal operating conditions of electrical equipment (in the absence of accidents and damages).

1.4.5 Explosion-proof electrical equipment according to the type of explosion protection is divided into the equipment, which is provided with the following:

.1 flameproof enclosure (d);

.2 protective gas-pressurized enclosure (p);

.3 intrinsically safe electric circuit (i);

.4 quartz-filled enclosure with live parts (q);

.5 oil-filled enclosure with live parts (o);

.6 special protection type due to item particulars (s);

.7 any other type of protection (e).

1.4.6 Explosion-proof electrical equipment in terms of its admissibility for use in the zones shall comply with the requirements imposed upon the equipment associated with industrial gases and vapours (group II and subgroups IIA, IIB and IIC).

1.4.7 Depending on the maximum allowable temperature of a surface, the explosion-proof electrical

[1] The requirements of Federal Law No. 123-ФЗ "Technical Regulations on Fire Safety Requirements" dated 22 July 2008 have been taken into consideration.

equipment of group II is subdivided into the following temperature classes:

.1 T1 (450 °C);

.2 T2 (300 °C);

.3 T3 (200 °C);

.4 T4 (135 °C);

.5 T5 (100 °C);

.6 T6 (85 °C).

1.4.8 Explosion-proof electrical equipment shall be marked according to the sequence below:

.1 mark of the level of electrical equipment explosion protection (2, 1, 0);

.2 mark classing electrical equipment as explosion-proof (Ex);

.3 mark of the type of explosion protection (d, p, i, q, o, s, e);

.4 mark of the group or subgroup of electrical equipment (I, II, IIA, IIB, IIC);

.5 mark of the temperature class of electrical equipment (T1, T2, T3, T4, T5, T6).

1.4.9 Methods of testing explosion-proof electrical equipment for its belonging to the relevant level, type, group (subgroup), temperature class are prescribed by the international or national standards.

1.5 ARRANGEMENT OF MACHINERY AND ELECTRICAL EQUIPMENT IN WORKING SPACES

1.5.1 Accommodation and public spaces shall be arranged at the maximum distance away from the hazardous areas considering a prevailing wind direction. Provisions shall be also made for structural arrangements to protect working and accommodation spaces against a potential effect of explosions and fires.

1.5.2 The spaces within zone 2, as well as explosion-protected machinery spaces for process purposes shall not communicate with the hazardous spaces. Where the passages are available, it shall be provided with tambur-gateway being air-pressurized by mechanical supply ventilation.

1.5.3 On the FPU/MODU/FOP of 28 m high and over provided with lifts, the wells having no air-pressurized locks at their exit shall be provided with a system to pressurize the lift trunk in the event of an accident.

1.5.4 Hazardous spaces for process purposes shall have at least two exits, one of which shall lead directly to the open deck.

1.5.5 Escape routes for the FPU/MODU/FOP personnel to be used in the event of an accident shall lead from the hazardous areas to a temporary shelter, embarkation stations and a helicopter deck.

1.5.6 The spaces of main, emergency and back-up sources of electrical power shall be separated from the spaces in the hazardous areas by "A-60" class fire bulkheads and divisions having fire-resistance of 1 hour on the unexposed side.

1.5.7 Installation of diesel-generators/gas turbine generators in the spaces of the hazardous areas is prohibited.

1.5.8 The exterior "A-60" class bulkheads of the accommodation module shall endure fire exposure within at least an hour.

1.5.9 The exterior bulkheads of the accommodation module on the side of zones with oil and gas equipment shall have no scuttles and air inlets of ventilation and air-conditioning systems, and shall have a fire-resistant coating, and also shall be fitted with arrangements for producing water screens.

1.5.10 Switchboards shall comply with the requirements in 4.5, Part X "Electrical Equipment" of the MODU/FOP Rules.

1.5.11 Cables, wires and procedures for their laying and anchoring shall comply with the requirements in Section 16, Part X "Electrical Equipment" of the MODU/FOP Rules.

1.5.12 The lighting fixtures of emergency lighting, which are supplied from an independent source of electrical power, lengthwise of escape routes shall be provided with devices to check their operability in simulating the switching-off of the main source of electrical power. The life time of the independent source of electrical power shall be sufficient to supply emergency lighting on the escape routes during estimated time for the evacuation of people to a safe area.

1.5.13 The estimated time shall correspond to the time of supplying the lighting fixtures of emergency lighting, provided they are supplied from the emergency source of electrical power in compliance with the requirement in 9.3, Part X "Electrical Equipment" of the MODU/FOP Rules.

1.5.14 Radio stations, the control stations (panels) of fire-extinguishing units and fire alarm shall be located in the main machinery control room, and the stand-by means of control and communication, at the main control station and in a temporary shelter.

1.5.15 The enclosed spaces of the objects used for production, gathering, treatment and transportation of oil, gas and condensate shall be separated by "A-60" class fire bulkheads from the spaces containing main, emergency and stand-by sources of electrical power and shall be provided with emergency ventilation with the output to the main machinery control room and main control station of the main process parameters and the indications of air condition at the items, and with the activation of an audible and visual alarm and the ESD system.

1.5.16 The rules for application of the electrical equipment depending on the degree of its explosion and fire hazard, and also the indicators of this hazard and procedures for their determination are established by the national and international standards.

2 AUTOMATION

2.1 GENERAL

2.1.1 The requirements of this Section apply to the automated process control systems of the oil-and-gas equipment and ESD system.

2.1.2 The automated process control system and ESD system may be combined into a common system.

2.1.3 The automated process control system is subject to the Register technical supervision irrespective of the automation mark in the FPU/MODU/FOP class notation (refer to 2.4, Part I "Classification" of the MODU/FOP Rules and 2.2, Part I "Classification" of the FPU Rules).

2.1.4 Items of the Register technical supervision in the automated process control system and ESD system are given in the Register Nomenclature in Section 7, Part I "General Regulations for Technical Supervision".

2.2 SCOPE OF TECHNICAL SUPERVISION

2.2.1 General provisions relating to the procedure of technical supervision of the automated process control system and ESD system, as well as the requirements for the amount of technical documentation submitted to the Register for review and approval shall comply with the requirements of Sections 3 to 10, Part I "General Regulations for Technical Supervision".

2.2.2 The execution of monitoring and control functions with regard to the systems providing drilling and production of hydrocarbons, treatment and transportation of well fluids shall be provided by the automated process control system. Design of the automated process control system may include various options of the number of disconnection levels depending on the system design, set of the equipment installed and the process details of well fluid production on the FPU/MODU/FOP.

2.2.3 The ESD system provides manual emergency shutdown or emergency shutdown via the automated process control system of the electrical equipment of the process system and the drilling rig (refer to 9.2, Part XI "Electrical Equipment" of the FPU Rules).

2.2.4 The requirements for the monitoring and control system of an electrical power plant are given in Part VII "Machinery Installations and Machinery", Part X "Electrical Equipment" and Part XIV "Automation" of the MODU/FOP Rules. The requirements for fire protection and fire and hazardous gases detection systems are set forth in Part VI "Fire Protection" and Part X "Electrical Equipment" of the MODU/FOP Rules.

2.3 MONITORING AND CONTROL FACILITIES

2.3.1 Depending on the FPU/MODU/FOP purpose, the automated process control system shall execute the functions of the following subsystems:

.1 process control system to monitor and control the process system and drilling rig;

.2 ESD system providing: shutdown of fuel oil and lubricating oil pumps, of the equipment, which uses air for burning/compression, of a drilling rig/process system, power-off of the electrical equipment of the drilling rig/process system with the expansion of hazardous areas (refer to 2.2.3, 2.2.4);

.3 maintenance system providing: submission of information on the condition of production systems to the management, production process reports for transmitting ashore, for communication with shore-based services via a satellite station. The maintenance system is designed only for the engineering data mining from the automated process control system; any control via maintenance system shall be prohibited.

2.3.2 Information and control connections of the automated process control system shall be based on microprocessor technology and shall be carried out via a high-performance reserved data network using a standard noise immune interface.

2.3.3 Alarm facilities shall provide electrical and information compatibility with each other and also with other facilities interacting with them.

2.3.4 The communication lines between alarm/fire alarm facilities shall be designed considering their functioning in fire within the time period required for detecting the fire, giving an alarm on evacuation, the time needed for people evacuation, as well as the time required to control other facilities.

2.3.5 Alarm facilities shall be resistant to electromagnetic interference with the maximum allowable values of interference level typical for the object to be protected. At that these facilities shall be electromagnetic interference-free with regard to other facilities installed on the object being protected.

2.3.6 Alarm facilities shall provide electrical safety.

2.3.7 The automated process control system shall include UPS intended for the most essential apparatus of the system during and after power-off of the main and emergency electrical power plants (refer to 2.4.2).

2.3.8 The automated process control system shall provide:

protection against unauthorized access;

protection against wrong actions of the personnel;

protection against damages to information and programs;

automatic and routine monitoring of apparatus and device serviceability with the information output to the operator panel.

2.3.9 Operability of alarm devices and gas detection devices shall be checked at least once in a month.

2.3.10 Calibration and verification of instrumentation, automation devices and also interlocking and alarm systems shall be carried out according to the schedules agreed with a territorial supervisory body, company metrological service and approved by a company technical manager.

2.3.11 The following instrumentation shall not be installed and used:

without a brand or with an overdue brand;

without certificates;

with expired life time;

damaged, and requiring repairs and special verification.

2.3.12 Air supplied to the pneumatic automation system shall be preliminary purified and dried. The air purification and drying efficiency shall comply with the requirements of the recognized standards.

2.3.13 The pneumatic automation air system shall be provided with a receiver of the compressed air capacity sufficient for operation of instrumentation and automatic devices during at least an hour.

2.3.14 All the instrumentation and switchboards shall be antistatically earthed irrespective of the voltage applied.

2.3.15 The monitoring and control facilities forming ESD system shall have 100 per cent redundancy.

2.4 INSTRUMENTATION AND AUTOMATION DEVICES

2.4.1 Equipment, instrumentation and automated control systems, lighting, alarm and communication facilities for use in hazardous areas shall have an explosion-proof enclosure and the protection level, corresponding to the hazardous area zone, and the type of explosion protection, corresponding to the categories and groups of explosive mixtures.

2.4.2 Provision shall be made for an UPS, as an emergency transitional source of power, to supply the monitoring and control devices of blowout equipment to ensure control in emergency de-energization. The UPS operational time shall correspond to that of the automated process control system but not less than 30 minutes (refer also to 9.3, Part XI "Electrical Equipment" of the Rules for the Classification and Construction of Sea-Going Ships).

2.4.3 The fixed gas analyzers of the gas detection system shall be of a dual-limit type activated when the hydrocarbon concentration in the air reaches 20 per cent and 50 per cent of lower flame limit and shall provide the signal shaping for the automated process control system.

2.4.4 The measurement limit of a working pressure shall be within the second third of the scale of a pressure gauge. The dial of the latter shall be marked with a red line or fitted with a red plate on the glass of the pressure gauge after a scale division corresponding to the allowed working pressure. The pressure gauge fitted 2 m to 5 m above the platform, from which it may be seen, shall be at least 160 mm in diameter.

2.4.5 The requirements for fire, hazardous and toxic gas detection systems are given in Section 4, Part VI "Fire Protection" and in 7.9, Part X "Electrical Equipment" of the MODU/FOP Rules.

2.4.6 Instrumentation located in the main machinery control room and at the main control station shall have inscriptions indicating the parameters to be determined.

2.5 AUTOMATED SYSTEM FOR MONITORING, CONTROL AND EMERGENCY PROTECTION OF DRILLING RIG AND PROCESS SYSTEM EQUIPMENT (AUTOMATED PROCESS CONTROL SYSTEM AND ESD SYSTEM)

2.5.1 The following conditions shall be observed during operation of FPU/MODU/FOP:

flowing wells shall be provided with automatic downhole and wellhead surface controlled subsurface safety valves (SCSSV) and also with well components fitted with remote-controlled gate valves;

gas-lift wells shall be provided with wellhead and line SCSSV.

2.5.2 Production tubing and annulus space pressure in running wells shall be continuously monitored.

2.5.3 Purging and unloading of wells, pipelines, separators, etc. shall be carried out through purging and unloading units.

2.5.4 The ESD system of the automated process control system shall be so designed in such a way that it may be checked with no effect on the functioning of other systems. Provision shall be made for a possibility to periodically check the automated process control system activation by simulating the initiation of the situations specified in 2.6 and 2.7.

2.5.5 Measures shall be taken to provide electromagnetic compatibility of automated process control system equipment (refer to 2.2, Part X "Electrical Equipment" of the MODU/FOP Rules).

2.5.6 The ESD system of the automated process control system is designed for shutdown of the equipment installed for carrying out the processes of well drilling, treatment and transportation of well fluids, discharge to the flare, and also for pressure relief and draining through the specially provided systems to prevent hazard for the platform in whole.

2.5.7 Provisions shall be made for manual start of the ESD system of the automated process control system from the following locations: the main machinery control

room, main control station, area of wellhead SCSSV, temporary shelter, helicopter platform and the personnel embarkation stations.

2.5.8 The requirements in Section 9 of Part X "Electrical Equipment" of the MODU/FOP Rules, 9.2.4 of Part XI "Electrical Equipment" of the FPU Rules, as well as Part XIV "Automation" of the MODU/FOP Rules shall be taken into account, to the extent as applicable.

2.6 PARTIAL SHUTDOWNS OF PROCESSES

2.6.1 In the event of emergency situation associated with any well or equipment unit, provision shall be made for an opportunity to partially shut down a process or a well.

2.6.2 The ESD system of the automated process control system shall provide the following sequence of operations:

closing of wellhead valves and gate valves (including those at the assembly of underwater blowout equipment) associated with the given process;

total shutdown of the assembly of the process of hydrocarbon raw production and treatment, and of the associated equipment and systems.

2.6.3 The number of emergency shutdown levels and the sequence of shutdown operations are designed for each ESD system project of the specific automated process control system for the FPU/MODU/FOP (refer also to Section 2, Part III "Systems for Production, Gathering, Treatment and Transportation of Well Fluids").

2.6.4 Procedure for closing (opening) of shut-off valves, switching-on/switching-off of the equipment, list of potential failures with regard to the processes and troubleshooting, list of parameter values, at which the processes are partially or totally shutdown shall be determined in the course of identification during the risk analysis (refer to 2.4, Part X "Safety Assessment") and described in the appropriate sections of a technological routine, operational manuals for the FPU/MODU/FOP equipment.

2.6.5 In the event of the ESD system failure, the automated process control system shall provide manual intervention of the operator and a possibility to continue operation in a manual mode.

2.6.6 When the concentration of hydrocarbons in air of hazardous areas (zones 0, 1, 2) reaches 20 per cent of lower flame limit, the alarm (visible and audible) shall be activated and emergency exhaust ventilation shall be started.

2.6.7 When the concentration of hydrocarbons rises up to 50 per cent of lower flame limit and above, in case of a power supply failure, fire, a high/low pressure in the pipeline for delivery of a well fluid, all the processes in systems of oil and gas gathering and treatment shall be shutdown, including emergency exhaust ventilation.

2.6.8 The emergency shutdown procedure for the processes of drilling, production and treatment of hydrocarbons at any block or module shall not result in an emergency situation at other FPU/MODU/FOP blocks and modules.

2.7 TOTAL SHUTDOWN OF PROCESS EQUIPMENT AND ALL PRODUCTION PROCESSES

2.7.1 In the event of emergency situations like an uncontrolled blowout, depressurization of systems containing hydrocarbons resulting in expansion of hazardous areas (Table 1.3.1); activation of the fire alarm system, the ESD system of the automated process control system shall provide the total shutdown of all drilling and process equipment and all production processes automatically or by the operator command in a manual mode using emergency stop buttons in the main machinery control room or other control stations (refer to 2.5.7).

In all other respects, the ESD system shall comply with the requirements in 9.6, Part X "Electrical Equipment" of the MODU/FOP Rules.

2.7.2 Depending on the potential consequences of an emergency situation, the ESD system of the automated process control system shall provide the following (refer also to Section 2, Part III "Systems for Production, Gathering, Treatment and Transportation of Well Fluids"):

shutdown of the single units and systems of an installation with and without the well fluid emptying;

total shutdown of a process of raw production and treatment, inhibitor injection system, reconditioning installation and other systems with and without the well fluid emptying;

total shutdown of all the platform process equipment (except the emergency life support systems), closing of gate valves (valves) at the wellheads and pipelines connecting the FPU/MODU/FOP to other objects of field construction or support vessels, pressure releasing and emptying of process equipment and pipelines by means of the systems provided.

2.7.3 The sequence of machinery and equipment shutdown, specified in 2.7.1 and 2.7.2, may be changed, depending on the specific emergency situations. The recommended sequence of shutdowns shall be included in a special instruction on actions in emergency situations.

2.7.4 Signal shaping to activate the ESD system shall be provided in automatic mode:

by a signal of gas detection system sensors;

at actuation of the fire alarm;

at power supply failure;

at the faulty operation of process systems affecting safety and environmental pollution;

at getting of vessels foul of the FPU/MODU/FOP when mooring and manoeuvring;

at buckling of the FOP structures;

at structure failure or helicopter fall on the FPU/MODU/FOP top structure.

2.8 CONTROL STATIONS

2.8.1 To control the FPU/MODU/FOP facilities the following control stations shall be provided:

the main machinery control room and consolidated operator room of the drilling rig/process system;

the main control station and consolidated reserve station.

2.8.2 In addition, the following control stations shall be provided on the FPU/MODU/FOP:

driller's cabin;

drilling foreman's office;

geo-technological monitoring station;

helicopter control center;

fire-extinguishing stations;

local control stations.

2.8.3 The control and monitoring of the FPU/MODU/FOP facilities under normal operational conditions shall be carried out from the main machinery control room. In emergency situations associated with heavy fire and uncontrollable blowouts of hazardous gases resulting in the expansion of hazardous areas, provision shall be made for duplicating control and monitoring from the main control station enclosed within a temporary shelter. All control stations shall be provided with necessary communication means, warning and alarm facilities.

2.9 MAIN MACHINERY CONTROL ROOM

2.9.1 The main machinery control room is intended to provide reliable and failure-free operation of technical facilities of the drilling rig and/or process system.

2.9.2 To be provided from the main machinery control room are:

.1 centralized monitoring and remote automated control of the following:

electrical power plant and support systems;

main, emergency and back-up sources of electrical power;

personnel life support systems;

main and auxiliary equipment of the drilling rig and process system;

systems associated with the drilling rig and process system operation;

.2 air monitoring in spaces;

.3 control of fire-fighting means;

.4 emergency shutdown of the drilling rig and process system;

.5 emergency shutdown of ventilation, fuel oil and lubricating oil pumps, equipment, which uses compressed air for burning/compression;

.6 monitoring of non-explosion-proof equipment in the event of fire, oil and gas shows, and expansion of hazardous areas;

.7 execution of arrangements on ecological monitoring;

.8 radio communications, video surveillance within the areas of arrangement of the production system facilities;

.9 preparation of reports and summaries on process progress and material consumption for administrative purposes.

2.10 MAIN CONTROL STATION

2.10.1 The main control station is intended for general management of production processes, personnel safety and environment protection.

2.10.2 Where necessary, the main control station, in terms of its objectives and tasks, shall function as the main machinery control room.

2.10.3 To be also provided from the main control station are:

monitoring of a navigational situation;

monitoring of hydro meteorological conditions;

control of navigational light and sound signal means;

radio communications with the shore and ships;

management of production and process systems, as well as ecological monitoring;

submission of information on the condition of structures and equipment related to the FPU/MODU/FOP systems.

2.11 DRILLER'S CABIN

2.11.1 The driller's cabin is intended for direct control of a well drilling process and shall be arranged on the drilling floor.

2.11.2 To be ensured from the driller's cabin are:

monitoring and control of drilling equipment:

monitoring of parameters of hole drilling processes;

monitoring of hazardous gas blowouts and initiation of ignition sources in the drilling rig spaces;

monitoring and control of blowout equipment;

video surveillance of the condition of rotating and cargo-handling equipment, mechanisms for setting the drill pipe stands;

emergency shutdown of drilling equipment at the expansion of hazardous areas.

2.12 DRILLING FOREMAN'S OFFICE

2.12.1 The drilling foreman's office is intended for management of a well drilling process and shall be located outside the hazardous areas.

2.12.2 To be ensured from the drilling foreman's office are:

technical management of works on hole drilling;

monitoring of parameters of well drilling and cementing processes;

monitoring of parameters of the drilling rig auxiliary systems;

monitoring of parameters of equipment and systems providing the drilling rig operation;

monitoring of hazardous gas blowouts, initiation of ignition sources, condition of explosion and fire protection means in the drilling rig locations and spaces;

warning the main machinery control room of emergency situations and measures taken for their elimination, management of works on eliminating oil-gas-water shows at the well and emergency well killing;

video surveillance of the areas of the drilling equipment arrangement;

preparation of summaries on the hole drilling progress, tool and material consumption.

2.13 GEO-TECHNOLOGICAL MONITORING STATION

2.13.1 The geo-technological monitoring station shall be used for execution of the following functions:

monitoring of the drilling process parameters;

computation and automated monitoring of the process parameter derivatives;

laboratory research of the core and drilling mud samples;

automated and laboratory monitoring of gases;

well cementing and hydraulic calculations;

geological definitions for the well;

research on the well productivity, development of recommendations on the optimization of hole drilling processes;

early prediction of gas shows and development of recommendations on the accident prevention.

2.14 AUTOMATIC FIRE EXTINGUISHING INSTALLATIONS[1]

2.14.1 Automatic water-based and foam fire extinguishing installations.

Automatic water-based and foam extinguishing installations shall provide:

.1 timely detection of fire and start of the automatic fire extinguishing installation;

.2 water supply from the sprinklers of automatic water-based fire extinguishing installations with a water supply rate as required;

.3 foam supply from the foam generators of automatic foam fire extinguishing installations with a foam expansion ratio and supply rate as required.

2.14.2 Automatic gas fire extinguishing installations.

Automatic gas fire extinguishing installations shall provide:

.1 timely detection of fire with an automatic alarm system being part of the automatic gas fire extinguishing installation;

.2 a possibility to delay the supply of a fire extinguishing medium within the time period needed for evacuating people from a protected space;

.3 making of the fire extinguishing concentration of a fire extinguishing gas in the protected space or above the surface of a burning material within the time needed for fire extinguishing.

2.14.3 Automatic dry powder extinguishing installations.

Automatic dry powder extinguishing installations shall provide:

.1 timely detection of fire with an automatic alarm system being part of the automatic dry powder extinguishing installation;

.2 powder supply from the sprayers of automatic dry powder extinguishing installations with a powder supply rate as required.

2.14.4 Automatic aerosol extinguishing installations.

Automatic aerosol extinguishing installations shall provide:

.1 timely detection of fire with an automatic alarm system being part of the automatic aerosol extinguishing installation;

.2 a possibility to delay the supply of a fire extinguishing aerosol within the time period needed for evacuating people from a protected space;

.3 making of the fire extinguishing concentration of a fire extinguishing aerosol in the protected space within the time needed for fire extinguishing;

[1] The requirements of Federal Law No. 123-ФЗ "Technical Regulations on Fire Safety Requirements" dated 22 July 2008 have been taken into consideration.

.4 prevention of any opportunity for people and combustible materials to contact the high-temperature parts of the generator surface and the jet of a fire extinguishing aerosol.

2.14.5 Automatic combined fire extinguishing installations.

Automatic combined fire extinguishing installations shall comply with the requirements imposed on the automatic fire extinguishing installations they consist of.

2.14.6 Robotic fire extinguishing installations.

Robotic fire extinguishing installations shall provide:

.1 detection and elimination or limitation of the fire spread beyond a seat of fire without the presence of personnel within the operational area of the installation;

.2 a possibility to remotely control the installation and to transmit information from the location where the installation is used;

.3 a possibility of the installation to execute its functions when exposed to the hazardous factors like a fire or an explosion, radiant, chemical or other hazardous effects on people and the environment.

2.14.7 Automatic installations for fire inhibition.

Automatic installations for fire inhibition shall provide reduction of fire expansion rate and initiation of associated hazardous factors in the following cases:

.1 automatic installations for fire inhibition shall be used in the spaces where the application of other automatic fire extinguishing installations is unreasonable or impracticable;

.2 type of a fire extinguishing medium used in the automatic installations for fire inhibition is defined by the features of the object to be protected and by the type and location of fire.

2.14.8 The technical requirements for structural fire protection and the equipment of the FPU/MODU/FOP fire protection systems are given in Part VI "Fire Protection" of the MODU/FOP Rules.

2.15 HELICOPTER CONTROL CENTER

2.15.1 The helicopter control center is intended to provide the helicopter launching and landing.

2.15.2 To be provided from the helicopter control center are:

field of view of helicopter flights;

control of helicopter system lighting;

provision of the helicopter crew with meteorological data;

helicopter homing, radio and radiotelephone communications with the helicopter crew;

recording the helicopter crew talks with a flying control officer and the internal talks.

2.16 LOCAL CONTROL STATIONS

2.16.1 Local control stations are intended to control production system facilities at their locations.

2.16.2 Local control stations shall be provided with all the instrumentation and automated control systems, communication means and alarms as required.

2.16.3 List of parameters from the local control stations displayed in the main machinery control room and main control station, shall comply with the requirements of design documentation.

2.17 MONITORING AND CONTROL OF EXPLOSION AND FIRE PROTECTION FACILITIES

2.17.1 When the concentration of hazardous gases reaches 20 per cent of lower flame limit, the automated process control system shall provide:

activation of visible and audible alarms in the main machinery control room, at the main control station, in the driller's cabin, drilling foreman's office and also at the relevant local control stations;

indication in the main machinery control room, at the main control station of the hazardous gas concentration;

automatic start of the back-up fans of a process ventilation system in the relevant spaces of zones 0 and 1, closing of fire ventilation gate valves on air inlets of the relevant explosion-proof spaces.

2.17.2 When the concentration of hazardous gases reaches 50 per cent of the lower flame limit, the automated process control system shall provide:

shutdown of the equipment consuming air for burning/compression;

shutdown of welding equipment;

shutdown of drilling equipment;

emergency shutdown of the process system;

shutdown of non-explosion-proof electrical equipment in open spaces and within the spaces outside the boundaries of a temporary shelter;

emergency shutdown of ventilation;

activation of alarm in the main machinery control room and at the main control station indicating the open doors around the temporary shelter boundaries when hazardous gases are detected in the open spaces and air inlets;

when the signals on detection of hazardous gases are not accepted (acknowledged) by a watch officer within 120 s, provision shall be made for a signal to actuate the automatic start of a public address system and general alarm system.

2.17.3 To execute the above functions, detectors shall give high reliability signals acknowledged by at least two sections.

2.17.4 At any location of the object being protected, where people shall be warned of an accident, the loudness level generated by the audible and vocal annunciators shall be higher than the permissible noise level. The vocal annunciators shall be located in such a way that at any point of the object being protected, where people shall be warned of an accident, the intelligibility of the voice information transmitted is provided. Light annunciators shall provide the contrasting perception of information within the range representative for the object being protected.

2.17.5 Where the FPU/MODU/FOP is subdivided into alerting zones to warn the personnel of an accident, the special order of priority in warning the people in various spaces of the FPU/MODU/FOP shall be established.

2.17.6 An alerting system to warn people of an accident and a people evacuation control system shall function during the time needed for the personnel evacuation.

2.17.7 The sound signals of the alerting system to warn people of an accident shall have a tonality different from other signals.

2.17.8 Audible and vocal annunciators shall have no releasable connections, possibility of volume control and shall be connected to the electric mains and also to other communication facilities. The communications of the systems used for warning people of an accident and for control of the people evacuation may be combined with the FPU/MODU/FOP broadcasting network.

2.17.9 The alerting system and people evacuation control system shall be provided with the UPS.

2.17.10 The information transmitted by the alerting system and the people evacuation control system shall comply with the information in the developed plans for people evacuation, which shall be placed on each deck of the FPU/MODU/FOP.

2.18 EMERGENCY SHUTDOWN OF VENTILATION

2.18.1 The emergency shutdown of ventilation is carried out by its sections:

shutdown of an adjacent ventilation section shall not result in the forced stop of the equipment located in the spaces covered by other sections;

shutdown of an adjacent ventilation section shall not result in the escape of hazardous gases outside the boundaries of process spaces within a dangerous area and in the penetration of these gases into safe spaces.

2.18.2 The emergency shutdown of ventilation and closing of fire ventilation gate valves shall be controlled:

remotely: from the main machinery control room and the main control station;

remotely: at escape routes from the spaces of the relevant ventilation section;

automatically: at activation of the fire smothering gas system, detection of hazardous gases with a concentration of 50 per cent of lower flame limit at the air intakes of explosion-proof spaces.

2.19 EMERGENCY SHUTDOWN OF FUEL OIL AND LUBRICATING OIL PUMPS

2.19.1 Emergency shutdown of the fuel oil and lubricating oil pumps, pumps for transfer of inflammable and combustible liquids shall be controlled:

remotely: from the main machinery control room and the main control station;

remotely: at the escape routes;

automatically: at activation of the fire smothering gas system, detection of hazardous gases with a concentration of 50 per cent of lower flame limit at the air intakes of explosion-proof spaces.

2.20 EMERGENCY SHUTDOWN OF WELDING EQUIPMENT

2.20.1 Emergency shutdown of the welding equipment shall be controlled:

remotely: from the main machinery control room and the main control station;

automatically: at activation of the fire smothering gas system, detection of hazardous gases with a concentration of 50 per cent of lower flame limit at the air intakes of explosion-proof spaces.

2.21 AUTOMATION SYSTEMS OF DRILLING RIG AND PROCESS SYSTEM

2.21.1 Automation of monitoring, control and safety systems of the drilling rig and process system shall also comply with the requirements in 9.6, Part X "Electrical Equipment" and also Part XIV "Automation" of the MODU/FOP Rules, to the extent as applicable.

2.21.2 The manifold monitoring and control system shall provide:

alarm to the main machinery control room on the position (open/closed) of the pneumatically controlled valves distributing well fluids from the well to the manifolds.

remote control from the main machinery control room of opening and closing of the valves distributing the well fluids from the well to the high- and low-pressure manifolds;

2.21.3 The monitoring and control system of the well fluid measuring unit shall provide in the main machinery control room the indication of the following:

multi-phase flow pressure;

multi-phase flow temperature;

multi-phase flow discharge (content of oil, water and gas) for each well and its recording.

2.21.4 The separator monitoring and control system shall provide:

automatic regulation of a gas pressure and a liquid level in the separator;

indication in the main machinery control room of a gas and oil flow at the separator outlet;

alarm in the main machinery control room indicating the position of oil supply valves (open/closed) at the separator inlet and outlet, and the valves for gas discharge from the separator to the flare, on a high and low gas pressure and oil level in the separator, the extremely high and low gas pressure and the oil level in the separator;

emergency control of closing of the valves installed on the pipelines supplying the well fluids to the separator, diverter valves for oil and water delivery from the separator, opening of the valve for gas discharge from the separator to the flare.

2.21.5 The crude oil heater monitoring and control system shall provide the automatic regulation of the crude oil temperature at the heater outlet.

2.21.6 The monitoring and control system of the gas compressor coolers shall provide:

automatic regulation of gas temperature at the cooler outlet;

indication in the main machinery control room of gas temperature at the cooler inlet and outlet.

2.21.7 The booster pump monitoring and control system shall provide:

remote control of the pump start and shutdown from the main machinery control room;

automatic flow regulation;

alarm in the main machinery control room indicating the pump overloads and malfunctions;

emergency shutdown of the pumps.

2.21.8 The dehydrator monitoring and control system shall provide:

remote control of the dehydrator start and shutdown from the main machinery control room;

automatic regulation of the oil flow at the dehydrator inlet and of the oil level in the dehydrator;

indication in the main machinery control room of the oil level in the dehydrator and a pressure differential at the inlet valve;

alarm in the main machinery control room indicating the high/low oil level and extremely high/low oil level in the dehydrator, and on its malfunctions;

emergency shutdown of the dehydrator, closing of the crude oil supply and diverter valves and water diverter valves.

2.21.9 The crude oil desalter monitoring and control system shall provide:

remote control of the desalter start and shutdown from the main machinery control room;

automatic regulation of the oil flow at the desalter inlet and of the oil level in the desalter;

indication in the main machinery control room of the oil level in the desalter and a pressure differential at its inlet valve;

alarm in the main machinery control room indicating the high/low oil level and extremely high/low oil level in the desalter, and on its malfunctions;

emergency shutdown of the desalter, closing of the crude oil and flushing water supply and diverter valves.

2.21.10 The monitoring and control system of oil offloading pumps shall provide:

remote control of the pump start and shutdown from the main machinery control room;

automatic flow regulation at the 4th stage separator and measuring unit;

alarm in the main machinery control room indicating the high/low values of oil supply at the pump suction, pump overload and malfunctions;

emergency shutdown of the pumps.

2.21.11 The monitoring and control system of the measuring unit at offloading pipeline shall provide:

remote control from the main machinery control room of opening and closing of the valves on the main and back-up measuring lines;

indication in the main machinery control room of the crude oil flow, temperature, pressure and watering;

recording in the main machinery control room of the crude oil (gas) flow;

alarm in the main machinery control room indicating the high watering of crude oil (gas humidity).

2.21.12 The monitoring and control system of the pig lancher/receiver at an offloading pipeline shall provide:

remote control from the main machinery control room of opening and closing of the valves on the lines of oil suction and delivery to the pipeline;

indication in the main machinery control room of the pressure in the pig lancher/receiver and in the bypass line;

alarm in the main machinery control room indicating the closed/open position of the valves on the lines of oil suction and delivery to the pipeline/cover of the pig lancher/receiver, high pressure in the pig lancher/receiver, high/low pressure in the bypass line, the extremely high and low pressure in the bypass line of the gas measuring unit at offloading pipeline.

PART X. SAFETY ASSESSMENT

1 DEFINITIONS AND ABBREVIATIONS

1.1 DEFINITIONS

1.1.1 For the purpose of this Part the following terms and definitions not given in 1.1, Part I "General Regulations for Technical Supervision" are used.

Accident means a failure of structures and/or technical devices installed on a hazardous production object (FPU/MODU/FOP), uncontrolled explosion and/or a blowout of hazardous substances.

Accident risk analysis means a process of hazards identification and FPU/MODU/FOP accident risk assessment with regard to individuals or groups of persons, property or environment.

Accident hazard identification means a process of identifying and recognizing an existing hazard on the FPU/MODU/FOP, as well as definition of hazard characteristics.

Hazardous substances mean flammable, oxidizing, combustible, explosive, toxic substances and those posing hazard to the environment.

Accident hazard means a threat, potential damage to the people, property and/or the environment due to an accident on the FPU/MODU/FOP. Accident hazards are associated with a potential failure of structures and/or technical devices, an explosion and/or a blowout of hazardous substances with a resultant damage.

Accident risk assessment means a process used for determination of probability (or frequency) and severity of consequences for health, property and/or the environment after the accident. The process includes estimation of probability (or frequency) and assessment of consequences and their combinations.

Accident risk means measure of danger featuring the probability of potential accident on the FPU/MODU/FOP and the severity of the accident consequences. The key indices of the accident risk are the following:

technical risk means the probability of a technical device failure with certain level (class) consequences for a certain period of the FPU/MODU/FOP operation; technical risk indices are determined by the relevant methods of the reliability theory and mathematical simulation;

individual risk means a frequency of individual injury as a result of the factors of danger under consideration;

potential territorial risk means a frequency of the materialization of hazardous effects at the certain point of a territory;

potential loss of life means an expected number of people injured as a result of potential accidents during a certain period of time;

societal risk or FN curve means a relation between the frequency of events F where at the specified degree not less than number of people N has been injured. It defines severity of the potential accident consequences.

expected damage means the mathematical expectation of a damage value due to a potential accident during a certain period of time.

Industrial safety requirements mean the conditions, bans, restrictions and other mandatory requirements in the federal laws and other normative legal acts of the Russian Federation, as well as in the normative and technical documents, which are adopted in accordance with the established procedure and which observance provides industrial safety.

1.2 ABBREVIATIONS

IMO means the International Maritime Organization.

HPO means a hazardous production object.

2 RISK ANALYSIS AND ASSESSMENT

2.1 GENERAL

2.1.1 The present Part has been developed on the basis of the guidance materials of IMO and Russian supervisory bodies.

The general part of a system of the FPU/MODU/FOP safety measures is the procedures for identification and valuation of risk of origination and progress of the accident situations. Identification of hazards shall be based on the development of a concept of accident scenarios analysis and on the substantiation of procedures for assessment of the accident situations. The risk valuation is based on the development of the criteria of the sufficient equipment safety, which depends on the qualitative and quantitative assessments of risks and on risk management. The requirements for identification and valuation of risks for the FPU/MODU/FOP provided with the equipment for drilling, production, gathering, treatment, storage and transportation of well fluids shall comply with the recognized guidance materials of an authorized supervisory body (Russian Federal Service for Environmental, Technological and Nuclear Supervision (Rostekhnadzor), EMERCOM State Fire Control Service), and also with the requirements of Part XV "MODU and FOP Safety Assessment" of the MODU/FOP Rules.

2.1.2 Calculations on risk assessment are the integral part of a declaration on industrial safety at the objects, for which it shall be developed in compliance with the RF legislation.

2.1.3 The accident situation analysis is divided into two main trends.

The first trend is associated with the analysis of accident situations for compliance with standards.

The second trend is associated with the analysis of accident situations for poorly studied scenarios or for the scenarios of a higher hazard.

2.1.4 The analysis of accident situations is resulted in the development of the arrangements aimed at minimization of a probability and severity of the accident consequences for the FPU/MODU/FOP provided with the equipment for drilling, production, gathering, treatment, storage and transportation of well fluids.

2.2 RISK ANALYSIS OF ACCIDENT SITUATIONS

2.2.1 Basic principles.

2.2.1.1 The analysis of accident situations shall be performed to identify, assess and management of potential accident situations.

Taken alone, the analysis of accident situations does not provide a proper safety level. It is part of an integrated safety assessment system. Other areas associated with this system are labour protection, personnel training and organizational arrangements in connection with the accident.

Risk analysis of accident situations is carried out at all pre-project operations, at all design stages starting with a design concept, at commissioning and decommissioning, in service, at re-equipment, conservation and utilization of the FPU/MODU/FOP designed for production, gathering, treatment, storage and transportation of well fluids. In this case all the design operational modes shall be considered, i.e. normal operational and extraordinary modes, emergency and extreme scenarios.

2.2.1.2 The purpose of risk analysis at the stage of investments and pre-project works performance or at the design stage of the drilling rig, systems for production, gathering, treatment and transportation of well fluids, is the following:

identification of hazards and the prior quantitative and qualitative risk assessment, considering hazard exposure on the personnel, population, property and the natural environment;

taking into account the results during analysis of acceptability of the decisions proposed and selection of the optimum alternatives of arrangement of the facilities and equipment, including arrangement of other objects and cost efficiency;

information support for development of a process schedule, plan of the project quality control, instructions and plans on elimination (localization) of spills and accident situations;

assessment of alternative proposals.

2.2.1.3 During commissioning (decommissioning) of the FPU/MODU/FOP, the risk analysis may be aimed at the following:

identification of hazards and assessment of accident consequences, improvement of risk assessment derived from the experience of functioning of hazardous production objects (HPO)[1];

verification of operational conditions compliance with the requirements of industrial safety and the Register;

development and improvement of commissioning (decommissioning) instructions.

2.2.1.4 At stage of operation, re-equipment, conservation and utilization of FPU/MODU/FOP, the risk analysis may be aimed at the following:

[1] Rostekhnadzor considers FPU/MODU/FOP as HPO.

verification of operational conditions compliance with the requirements of industrial safety and the Register;

refinement of information on main hazards and risks (during declaration of the HPO industrial safety as well);

development of recommendations on improvement of activities of the technical supervisory bodies;

improvement of a process schedule, operating instructions and a maintenance manual, plans on elimination (localization) of spills and accident situations, plans for managing risks on the FPU/MODU/FOP;

assessment of the effect relating to changes in organizational structures and procedures for practical work and maintenance relevant to improvement of the industrial safety management systems and the Register technical supervision.

2.2.1.5 Analysis of potential accident situations shall be reviewed and approved by the Register and shall include:

initial data for analysis, starting with the description of conditions at initiation of the accident situation;

particulars of analysis techniques;

physical, analytical and statistical models;

description of the scenario of the accident progress, including performance of the required calculations;

output data, including description of arrangements on the accident prevention with indication of the equipment and systems to be used for prevention of accidents and neutralization of the accident consequences;

measures on protection of the personnel and persons being on the FPU/MODU/FOP at the accident.

2.3 CRITERIA OF SUFFICIENT SAFETY

2.3.1 The most widespread potential accicdent situations are the following:

blowout;

spill/release;

leakage;

structural damage;

capsize;

foundering;

explosions;

fires;

collisions, etc.

The criteria of sufficient safety or risk acceptability during analysis of potential accident situations are determined by the matrix "probability-severity of consequences" (refer to Table 2.3.1-1).

During analysis three groups of the objects, which may be affected due to the accident, are determined:

personnel;

environment;

tangible objects.

The concept "individual risk", which means a frequency of individual injury as a result of the factors of danger under consideration, is used as the characteristic of risk indices for the personnel.

Table 2.3.1-1

Risk assessment matrix

Frequency of accident occurrence during service life (frequency of materialization of a certain type accident)	Levels of accident severity degree[1]			
	Catastrophic	Major and more than major	Minor	Insignificant
	Exposure on personnel			
	multiple human losses	single human losses	long disability	insignificant effect
Practically inevitable $V > 1$/year or more	A	A	A	C
Probable 1/year $> V > 10^{-2}$/year or once per 1 — 100 years	A	A	B	C
Unlikely 10^{-2}/year $> V > 10^{-4}$/year or once per 100 — 10000 years	A	B	B	C
Rarely 10^{-4}/year $> V > 10^{-6}$/year or once per 10000 — 1000000 years	A	B	C	D
Practically impossible $V < 10^{-6}$ /year or more than once per 1000000 years	B	C	C	D

[1] Refer to Table 2.3.1-2.

Note. V – accident frequency/probability.

Table 2.3.1-2

Levels of accident severity degree

Levels of accident severity degree	Characteristic of accident consequences
I Insignificant	No effect on population health and safety, no injuries at the object, no damages to the object, no effect on natural resources
II Minor	No serious injuries and human losses, slight damages to the object, no time-out, slight short-term effect on natural resources
III Major	Potential serious injuries and human losses at the object, but no threats to population health and life; major, negative, but eventually reversible effect on some natural resources
IV More than major	Injuries and some human losses of population or injuries and many human losses among the object personnel, major damages to objects, major and long-term damage to two or more natural resources
V Catastrophic	Many human losses among population, extraordinary widespread damage to many natural resources

2.3.2 Characteristics of risk analysis procedures, depending on the accident category:

A – quantitative risk analysis is recommended or special safety measures are required;

B – quantitative risk analysis or certain safety measures are required;

C – qualitative risk analysis or some safety measures are recommended;

D – no risk analysis and special additional safety measures are required.

2.3.3 Table 2.3.3 presents correspondence of the hazard level classification according to the Safety Rules of the RF Rostekhnadzor and the MODU/FOP Rules of the Register.

Table 2.3.3

Correspondance of hazard level classification

Rostekhnadzor classification	A			B	C		D
Register classification	1	2	3	4	5	6	7

The identification of hazards and analysis of consequence of their materialization allow preliminarily determination of the hazard and risk priority. According to the matrix, all hazards are distributed over three risk levels:

tolerable;

as low as reasonably practicable;

intolerable.

Intolerable hazards are those in respect of which the risk that cannot be justified under any circumstances, excepting force majeure. Referred to such hazards are the consequences considered as catastrophic. This risk level is denoted by "A" in the risk matrix.

Tolerable hazards are those in respect of which the risk is acceptable and justified reasoning from social and economic considerations. The risk associated with the object operation is acceptable if the society is ready to take this risk for the benefit due to the object operation. These levels are denoted by "C" and "D" in the risk matrix.

The "As Low As Reasonably Practicable" (ALARP) level falls between the tolerable and intolerable risk levels and is denoted by "B" in the risk matrix.

2.3.4 In compliance with the Register requirements, in order to assess the damage suffered by personnel, annual individual risks (AIR) are adopted as safety criteria:

unacceptable risk level: $> 10^{-3}$ fatalities per year;

negligible risk level: $< 10^{-6}$ fatalities per year;

The range within 10^{-6} to 10^{-3} is the ALARP region.

The individual risk criteria are intended to protect the personnel against an excessive risk effect. The individual risks do not depend on the number of working people running a risk and therefore are comparable for various situations. It means that the individual risk criteria developed for the shore-based workers may be also used for offshore installations. Based on this conclusion, the figures taken from the Rostekhnadzor Safety Rules are used in the risk assessment matrix.

2.3.5 The individual risk criteria are the following:

maximum tolerable risk: 10^{-3} per man per year;

maximum tolerable societal risk: 10^{-4} per man per year;

broadly acceptable risk: 10^{-6} per man per year.

2.3.6 Criteria for a societal risk ($\geqslant 10$ deaths):

risk $> 10^{-3}$ – unacceptable risk zone;

risk $< 10^{-3}$, but $> 10^{-5}$ – tight risk control zone (intermediate risk values);

risk $< 10^{-5}$ – unconditionally acceptable risk zone.

The societal risk specifies the extent and probability (frequency) of accidents and is defined by a distribution function of losses (damage) generally referred to as the *FN* curve (Farmer's curve).

2.3.7 For reference it should be noted that the Health and Safety Executive (HSE) of Great Britain holds to the following principles in assessing safety at sea: "The persons, who follow legal regulations, shall set up the criteria of their own for the acceptability and tolerance of an individual risk. However, the maximum level of an individual risk associated with a fatality shall be generally assumed equal to 1 out of 1000 (10^{-3}) per year, and of the broadly acceptable level of an individual risk, within 1 out of 10000 (10^{-4}) — 1 out of a million per year (10^{-6})" (also refer to Table 4.4.4).

As a tentative criterion to evaluate a risk during design, the individual risk value computed on the basis of reliable statistics on fatalities in various incidents on the objects associated with the construction of the world continental shelf may be used. Such statistics is available in electronic databases (e.g. WOAD – World Offshore Accident Data) for North Sea sectors of Great Britain and Norway, and of the Gulf of Mexico as well.

2.3.8 Table 2.3.8 presents an exemplary list of the FPU/MODU/FOP items, which generally feature high risks, to protect the personnel on the main types of shelf installations. These items in the HSE documents are termed as critical safety elements. The List is intended to identify the high risk items in order to prevent their missing in risk analysis. Nevertheless, the List cannot be taken as being comprehensive and cannot exclude considering additional items and risks in the analysis.

Table 2.3.8

Exemplary list of potentially high risk FPU/MODU/FOP items

List of potentially high risk items	MODU	FPU	FOP
Item structures			
Frame constructions and piles	—	—	X
Gravity structures	—	—	X
Jacking system of self-elevating MODU	X	—	—
Hull (including watertight closures)	X	X	—
Drilling derrick	X	—	X
Fresh fire fighting water tanks	X	X	X
Top structure, including a catwalk bridge and flare stack	—	—	X
Helicopter deck	X	X	X
Cargo-handling gear	X	X	X
Pedestal cranes	X	X	X
Foundations	X	X	X
Explosion protection with detonation wave removal (blast relief panels)	X	X	X
Protection of submersible items including underwater structures	X	X	X
Turret	—	X	—
Drilling and process equipment			
Drilling mud system	X	—	X
Blowout equipment	X	—	X
Well choke and kill lines (including emergency discharge)	X	—	X
Cementing system	X	—	X
Marine risers	X	—	X
Instrumentation of well control management systems	X	—	X
Divertor system	X	—	X
Electrical equipment			
Emergency (uninterruptible) power supply systems	X	X	X
Accumulators	X	X	X
Protective devices	X	X	X
Elements of ignition protection			
Protective earthing	X	X	X
Electrical equipment in hazardous areas	X	X	X
Protection of high temperature work surfaces	X	X	X
Natural ventilation	X	X	X
Explosion and fire safety			
Air composition control systems	X	X	X
Fire alarm systems	X	X	X
Water fire main linear system	X	X	X
Sprinkler system	X	X	X
Fire pumps	X	X	X
Fire circular main	X	X	X
Foam fire-extinguishing system	X	X	X
Carbon dioxide smothering system	X	X	X
Structural fire protection	X	X	X
Ventilation systems	X	X	X

List of potentially high risk items	MODU	FPU	FOP
Temporary shelter, escape routes and facilities			
Temporary shelters	X	X	X
Escape routes	X	X	X
Lighting equipment of a helicopter platform	X	X	X
Escape route lighting	X	X	X
Intercommunication and alarms	X	X	X
External communication	X	X	X
Lifeboats and lifejackets	X	X	X
Personal lifejackets, immersion suits, life-saving equipment of a helicopter deck	X	X	X
Life-saving appliances			
Life-saving systems (personal life-saving appliances, knotted ropes, nets)			
Ladders	X	X	X
Liferafts	X	X	X
Duty vessel with a fast lifeboat	X	X	X
Localization of hydrocarbon raw	X	X	X
Oil-and-gas equipment and piping (including shut-off fittings and instrumentation)			
Automatic emergency shutdown systems (automated process control system, ESD system)	—	X	X
Pressure relief systems	X	X	X
Quick-closing valves in engine room	X	X	X
Air holes	—	X	X
Underdrainage and open-cut drainage from hazardous areas	—	X	X
Marine risers with shut-off valves	X	X	X
Piping	—	X	X
Shut-off valves of a subsea pipeline	—	X	X
Sea component	—	X	X
Anchoring system for station-keeping including an anchor release device			
Navigational aids (including lights, fog gong, hydrometeorological observation system)	X	X	—
Early warning system radar	X	X	X
Ballast and drain systems. Object stability when both are used.	X	X	X
Inert gas system	X	X	—
Dynamic positioning system	X	X	X
Thrusters	X	X	—
Auxiliary equipment:	X	X	—
Gangways			
Gas cylinders	X	X	X
Electric generators	X	X	X
Public address system	X	X	X
Equipment for drill-holes survey	X	X	X
Storage for radioactive components	X	—	X
Storage for chemicals	X	X	X
Emergency schedule control system	X	—	X
	X	X	X

2.4 IDENTIFICATION OF HAZARDS FOR ALL FPU/MODU/FOP PROVIDED WITH EQUIPMENT FOR DRILLING, PRODUCTION, GATHERING, TREATMENT, STORAGE AND TRANSPORTATION OF WELL FLUIDS

2.4.1 Structural strength of the FPU/MODU/FOP hull.

2.4.1.1 The matters of structural strength shall be considered during design, construction and operation of FPU/MODU/FOP, and also during hull structure modernization.

Adequate structural strength is provided by redundancy and operational reliability.

2.4.1.2 During provision of adequate structural strength emphasis shall be made on the following:

special structural materials;

primary structural elements like the locations for ships' mooring, arrangement of tanks/reservoirs, process modules and blocks;

primary structural elements, which are critical for the structure strength in whole.

2.4.1.3 As a criterion an ultimate strength criterion shall be considered written by the formula

$$F \leqslant R \qquad (2.4.1.3\text{-}1)$$

where F = design value of a generalized force action;
R = design value of a generalized bearing capacity (structure design strength).

Calculation methods may be based on the analysis of the plastic response of structural elements.

The process of formation of the support vessel - FPU/MODU/FOP interaction force in collision is described by the formula

$$N = N_s + N_d \qquad (2.4.1.3\text{-}2)$$

where N = total effect;
N_s = static force (running aboard);
N_d = dynamic force (impact).

$$N_d = M\ddot{X} + B\dot{X} \quad (2.4.1.3\text{-}3)$$

where M and B = inertia and damping factors in collision with a ship;
$\ddot{X}$, $\dot{X}$ = acceleration and speed of a ship relative to the FPU/MODU/FOP recorded at the instant of collision.

An impact momentum, if the additional requirements are not specified, is determined by the formula

$$N_d \times \Delta t = M\dot{X} \quad (2.4.1.3\text{-}4)$$

where Δt = collision time that depends on the extent and effectiveness of collision object protection against an impact.

Two types of collisions shall be considered:

running aboard of a ship or floating object, i.e. any FPU/MODU/FOP contact with the ship or floating object at low speed, as a rule not more than 0,3 kn; the factors on the speed and inertia components of the impact are negligible (an impact momentum is nil), the effect may be considered as generated by the impressed force applied statically;

collision with a ship or floating object, i.e. the ship or floating object's impact on the FPU/MODU/FOP external surface; the factors on the speed and inertia components of the effect are sufficient to generate an impact momentum.

2.4.2 Recommendations on assessment of catastrophe risk after damage of the FPU/MODU/FOP structure.

2.4.2.1 These recommendations shall be considered as complementary to the risk analysis given in 2.6. To be considered are the accident events, which may result in catastrophic consequences. The recommendations may be used for analysis of the already happened events to accumulate experience in operation and during design of the FPU/MODU/FOP.

2.4.2.2 The catastrophe risk P_c may be determined by the formula

$$P_c = P_1 + (1 - P_1)P_2 \quad (2.4.2.2\text{-}1)$$

where P_1 = accident risk;
P_2 = accident consequence risk determined on the basis of the recommendations stated below.

In determination of quantitative catastrophe characteristics QAR_c and AIR_c (refer to 2.7.2.5, 2.8.1), it shall be assumed:

$$Q_{ik} = P_c. \quad (2.4.2.2\text{-}2)$$

2.4.2.3 The algorithm is constructed as follows: it is assumed that an accident has happened, a structure has suffered damage and further, the consequences of this damage are analyzed. The algorithm is based on structural inadequacy and the loss of the structure with fatalities and damage to the environment.

2.4.2.4 During assessment of damage consequences, the following problems are recommended for consideration.

2.4.2.4.1 Damage identification.

When settling the matter, it is recommended to answer the following questions.

Has the given damage been taken into account during the FPU/MODU/FOP design (i.e. to what extent it complies with the design damage)?

Which damage versions were considered and were the ultimate strength calculations of damaged structure performed during the FPU/MODU/FOP design?

Which margin of survivability (in terms of structural redundancy) has the structure?

2.4.2.4.2 The key question of technical condition assessment of the structure in whole: how much did the technical condition of a structure meet the requirements of normative documents prior to suffering a damage?

Answering the question, the following shall be known:

age of the FPU/MODU/FOP;

is an active system for assessment and monitoring of the structure behavior and condition available on the FPU/MODU/FOP (record of cracks, deformations, displacements, etc.)?

are the readings of vibroacoustic sensors of deformation monitored and what measures are taken by their readings?

when and by whom was the last survey or inspection for defects of the FPU/MODU/FOP hull carried out; survey (inspection for defects) results: residual thicknesses, residual deformations, cracks, fractures, presence of obviously weakened areas in the hull structure due to corrosion?

was any deviation from the requirements of normative documents allowed in assessment of residual thickness and deformation values (if so, how much are deviation data justified?);

was the repair of load-bearing structural elements conducted?

repair quality;

what time was the FPU/MODU/FOP service prolonged for after survey?

2.4.2.4.3 Assessment of environmental conditions.

The key question: will external loads (due to very rough sea, ice, wind, seismic loads) exceed or not exceed the design ones for the damaged FPU/MODU/FOP? The case in point is the potential service life of the FPU/MODU/FOP after the damage.

When settling the problem, it is reasonable to take into account the following:

availability of active system on the FPU/MODU/FOP for assessment of environmental conditions (wind, sea, ice, seismic activity, etc.);

period of the year when a damage has occurred because the probability to exceed the design load value changes within a year;

time period needed for taking measures on prevention of potential catastrophe development.

2.4.2.4.4 Assessment of the possibility of a failure for systems and arrangements such as: anchor and mooring lines, dynamic positioning system, power complex.

When settling the problem, it is reasonable to hold information on the following:

technical condition of life support systems and arrangements;

environmental conditions after the FPU/MODU/FOP structure damage;

assessment of the possibility of damage to other elements of the FPU/MODU/FOP hull.

2.4.2.4.5 The final materialization of the algorithm on assessment of damage consequences may be carried out by construction of the failure and event trees.

2.5 SPECIFIC ACCIDENT SITUATIONS

2.5.1 Depending on the FPU/MODU/FOP type and purpose, specific accident situations may be generated, which shall be subject to the risk analysis and assessment taking into account a specific character.

2.6 METHODS OF RISK ANALYSIS

2.6.1 General requirements.

When selecting and applying the methods of (qualitative/quantitative) risk assessment, the requirements below are recommended to be followed:

method shall be scientifically grounded and comply with the hazards under consideration;

method shall result in the form, which allows better understanding of the ways of hazard materialization and directing the ways of risk reduction;

method shall be repeatable and verifiable.

2.6.2 It is recommended to start the risk analysis with an algorithm development.

Fig. 2.6.2 presents the sequence of basic operations (stages) on the quantitative risk analysis of the most essential processes taking place on any FPU/MODU/FOP.

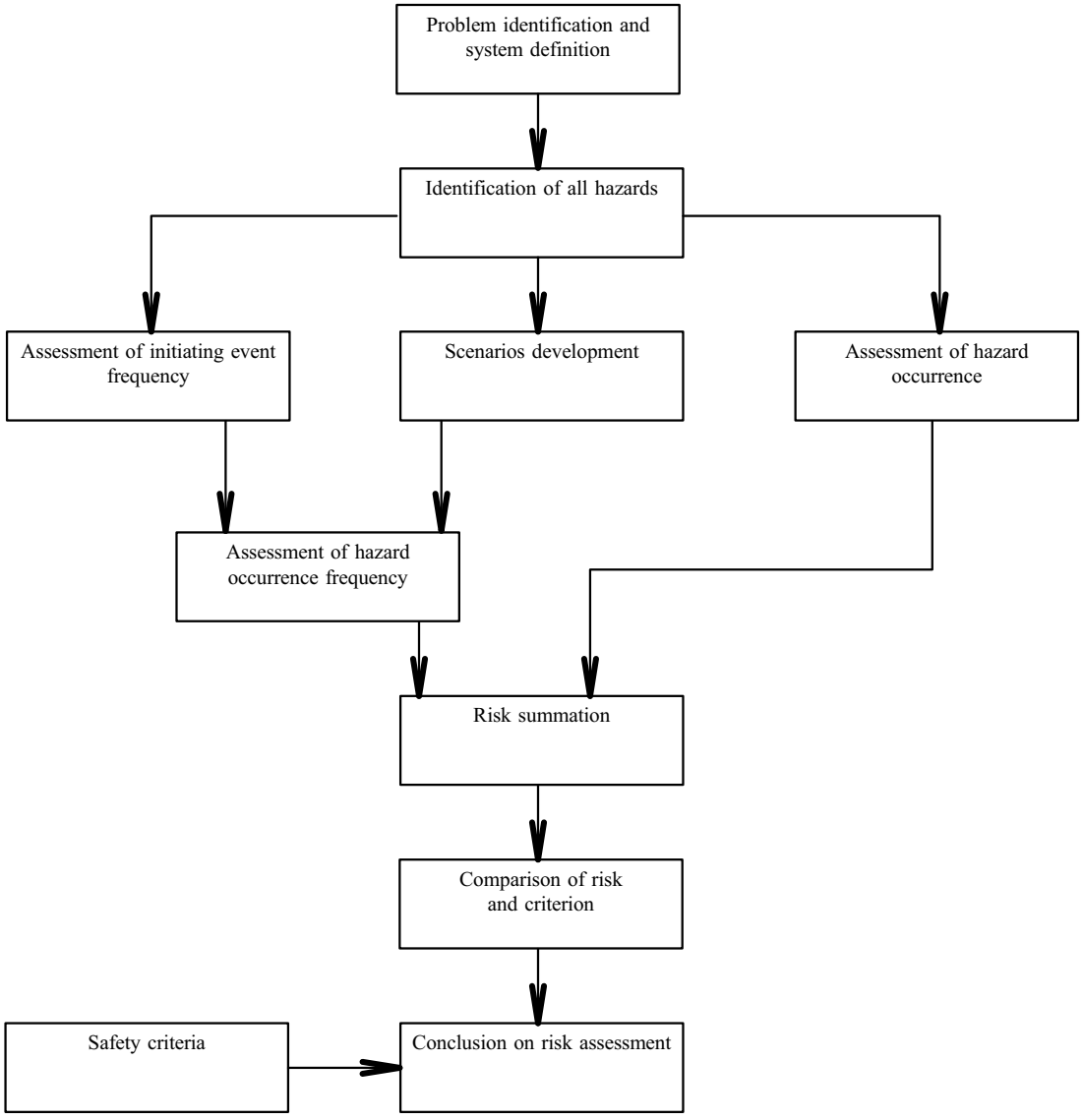


Fig. 2.6.2 Sequence of quantitative risk analysis

2.6.3 Qualitative methods of risk analysis.

2.6.3.1 Checklist.

Use of checklist is a usual method for identification of compliance with standards.

The checklist is simple for use and may find application for identification of hazards during the FPU/MODU/FOP design, construction, operation, conservation and utilization. The minimum acceptable level of hazard is determined with the help of the checklist.

Where necessary, checklists may be drawn up for specific situations and used for assessment of proper execution of standard process operations and for specifying the problems to be emphasized.

The checklist is the quickest method for analysis of accident situation at identification of hazards and is very effective in the management process of standard accident situations.

2.6.3.2 "What if ..." analysis.

This method is much like the one of checklists use.

The method is based on the questions, which begin with "What if ..." and considers the situation development after "What if…". The analysis compilers shall be adequately realistic to avoid improbable scenarios of events development.

The "What if ..." type analysis may be used for identification of hazards during the FPU/MODU/FOP design, modification, operation, conservation or utilization. It results in the list of problem locations potential for accidents materialization and provides the methods supposed to avoid risks and prevent accidents.

2.6.3.3 Hazard identification (HAZID) study.

A multidisciplinary team shall take part in these studies, which determines accident situations and FPU/MODU/FOP operability, using the structural form of the "What if ..." type analysis.

The structural solution of each component of a process scheme is analyzed in the form, in which it is presented in design documentation.

The HAZID method may be used at all the stages of the FPU/MODU/FOP design, modification and operation. The result of the analysis is the list of problems associated with potential accidents or reduction of the FPU/MODU/FOP operability, as well as the types of malfunctions/failures and the consequences of each malfunction/failure.

Practice shows that major accidents are characterized by a combination of accidental events generated with a various frequency at the various stages of the accident materialization and progress: equipment failures, human factor, off-design external effects, collapse, blowout, spills, dissemination of substances, ignition, explosion, intoxication, etc.

To identify cause-and-effect relations between those events, the logical-and-graphical methods of analysis, determined as "failure trees" and "event trees", are used.

2.6.3.4 Hazard and operability (HAZOP) study of FPU/MODU/FOP.

These studies result in the list of problems, which may cause a potential accident, or reduction of the FPU/MODU/FOP operability, as well as in the list of recommended changes, proposals or actions aimed at safety and operability improvement. Time and effectiveness of this method directly depend on the FPU/MODU/FOP size and complexity and on experience of specialists who define accident situations and the FPU/MODU/FOP operability, using the structural form of the "What if... " analysis.

2.6.3.5 Failure mode and effects analysis (FMEA).

2.6.3.5.1 This analysis is used in definition of individual types of failures, which may cause or contribute to accident materialization. The analysis of the type of failures and of their consequences may by used along with other quantitative methods of hazard identification.

The purpose of this analysis is definition of failure types and each failure consequences for the FPU/MODU/FOP. At the design stage, this method may be used for identification of needs in additional protective measures or in their reduction. The failure analysis during the FPU/MODU/FOP modification is used for definition of its impact on existing structures and equipment. This method is also used in operation for definition of individual failures that may result in significant consequences. So far as this method is subjective, at least two specialists competent in the FPU/MODU/FOP, processes and equipment are needed for its use.

Where each type of failures is included in the analysis of a criticality level, the method goes over into a critical analysis of types of failures and their consequences.

2.6.3.5.2 The detailed description of the methods recommended for risk analysis is given in Appendices 2 and 3 to the Rules for the Classification and Construction of Subsea Pipelines (hereinafter referred to as "the SP Rules").

2.7 QUANTITATIVE METHODS OF RISK ASSESSMENT (QRA)

2.7.1 Failure tree and event tree analysis.

The failure tree (error chain) analysis is a deductive method that focuses on a particular event resulting in an accident which is called the top event, and on the construction of the logic diagram of all the relationships that may cause this event. The error chain is a graphical and logical illustration of various structural errors, equipment failures, effect of environmental conditions and human factor, which may cause an accident.

The event tree analysis is an inductive method intended for study of the accident roots and identification of key errors that initiated the accident. It also provides

analysis with the base for determination of the accident risk degree.

The event tree analysis consists in constructing a sequence of events (tree branches) resulting in the top event (event at the top of a tree).

This method is used during the FPU/MODU/FOP design, operation, re-equipment and utilization. It is particularly useful in the analysis of new technologies, structural solutions and operational conditions, which have not passed evaluation test in practice yet. The method provides:

qualitative logical description of potential problems, including combinations of the potential event scenarios;

quantitative assessments of event frequency/probability (from 0 to 1) for each tree branch, which allow determining the contribution of each event to the assessment of the risk degree.

2.7.2 Statistical methods.

2.7.2.1 Risk assessment is aimed at focusing attention on the areas of the highest risk levels, and also at identifying the factors having an important effect on them.

2.7.2.2 Among accident situations under consideration shall be those, which allow identifying the various types of risks (for the personnel, environment, structures, equipment and technical devices).

2.7.2.3 Risk may be defined as a frequency or probability of event B initiation at event A occurrence (dimensionless value within the range of 0 – 1).

2.7.2.4 The quantitative assessment of contributions to risks is typically undertaken in three stages based on the accident statistics:

the levels of accidents are defined depending on their recurrence (frequency);

the severity of accident consequences stated in risk terms;

the distribution of combined characteristics across all the levels of accidents is defined in risk terms to provide a possibility of assessing the total risk contribution among the levels.

2.7.2.5 The QAR mathematical methods may comprise different statistical models, including Monte Carlo statistical method[1], composite probability formula and other adequate statisitical methods.

The composite probability formula in determination of QAR_k is written down as follows:

$$QAR_k = \sum_{i=1}^{i=n} Q_i Q_{ik} \qquad (2.7.2.5)$$

where Q_i = recurrence of the i-th situation (accident event) under consideration;

Q_{ik} = risk of an accident (e.g. a probability of materialization of the i-th branch of an event tree if the method specified in 2.7.1 is used);

n = number of scenarios (events) under consideration for the given type of an accident (or the number of event tree branches);

k = corresponds to the given type of an accident.

2.7.2.6 The statistical methods corresponding to description of the FPU/MODU/FOP responses to environmental effects (wind, sea, current, ice, seismic effects, etc.) shall comply with the procedures used in the Register normative documents.

2.7.3 Impact diagram.

The impact diagram is mostly used for comparing some versions of a solution. Emphasis shall be placed on the higher risk areas. In these cases, the diagram that materializes the proposal based on the risk matrix (refer to 2.3.1) may be applied. On the basis of the impact diagram may be obtained both quantitative and qualitative results (refer to 3.1.7, Part XV "MODU and FOP Safety Assessment" of the MODU/FOP Rules).

2.7.4 The risk assessment results in the following:

identification of high risk areas;

identification of factors radically affecting the risk level in a managed mode;

re-evaluation of risks for each version of risk control and management.

2.8 ASSESSMENT OF INDIVIDUAL AND SOCIETAL RISKS

2.8.1 During the analysis of accident situations, the individual risks featuring the frequency of emergence of striking effects of a certain kind are determined.

The value of an annual individual risk (AIR) at any effect or an accident event is determined by the formula

$$AIR_k = \sum_{i=1}^{i=n} Q_i Q_{ik} Q_{ik}^p \qquad (2.8.1)$$

where Q_i = recurrence of the i-th situation (accident event) under consideration;

Q_{ik} = risk of an accident (e.g. a probability of materialization of the i-th branch of an event tree if the method specified in 2.7.1 is used);

n = number of scenarios (events) under consideration for the given type of an accident (or the number of event tree branches);

Q_{ik}^p = conditional probability to affect people in materialization of the i-th branch of an event tree.

2.8.2 The value of the total annual individual risk (AIR_Σ) at various effects (e.g. due to earthquakes, fire, explosions, dropped objects, etc.) is determined as the sum of AIR for separate effects, i.e.:

$$AIR_\Sigma = \sum_{i=1}^{k=m} AIR_k \qquad (2.8.2)$$

where m = number of potential striking factors taken into account.

[1] The common name of a group of numerical methods based on numerous "experiments", among which are selected those with successful outcomes and their probability is estimated.

2.8.3 Societal risk is determined with the use of *FN* curves connecting the level of an accident frequency (*F*) with the number of fatalities in the accident (*N*).

The societal risk assesses the magnitude of potential catastrophes. It is an integral characteristic of materialization of certain risk consequences. The value of societal risk (i.e. fatality risk) at $N = 1$ is used for determination of the annual individual risk (AIR).

2.9 EXPERT ANALYSIS METHODS

2.9.1 Delphi method[1].

Using the Delphi method:

an "informed intuitive judgement" is materialized and a problem is formulated for this purpose;

a team of experts who can comprehensively cover the formulated problem is selected;

the conditions enabling the most effective teamwork are created, and for this purpose the team is headed by an experienced analyst who is well aware of the Delphi technique;

all the team members are provided with the information available on the problem under consideration.

The sequence of conditions in use of the Delphi method, in terms of organization and procedure, is presented as follows:

.1 a leading analyst or someone else on his behalf prepares the initial information on the problem, which is presented to the team of selected experts in writing or verbally, or in both ways, where necessary;

.2 the experts submit their judgement assessed either by ranking the versions proposed (if quantitative assessment is impracticable) or by the quantitative assessment of the event under consideration, where possible;

.3 the opinions received from the individual experts guided by the analyst are compared and comments of each expert are discussed;

.4 the experts re-assess their initial judgements when, from their standpoint, this is justified;

.5 the final result of assessment is drawn up.

2.9.2 Coefficient of concordance.

Within the framework of the Delphi method, the extent of experts' team consent is assessed using a coefficient of concordance *W*:

$$W = \frac{12 \sum_{i=1}^{i=n} \{ \sum_{j=1}^{j=n} x_{ji} - (1/2)m(n-1) \}}{m^2(n^3 - n)} \qquad (2.9.2\text{-}1)$$

[1] Analitic method of a problem assessment by experts to verify the concordance of the expert opinions, analyze the results and develop recommendations.

where m = number of experts;
n = number of objects.

The coefficient *W* varies from 0 to 1. $W = 0$ means that no linkage exists between experts' rankings, while $W = 1$ means that all the experts rank the objects for a given attribute in the same way.

The significance of the concordance coefficient is assessed using a parameter *Z*:

$$Z = \frac{1}{2} \cdot \ln \frac{(m-1)W}{1-W} \qquad (2.9.2\text{-}2)$$

which has the Fisher distribution with degrees of freedom $\nu_1 = n - 1 - 2/m$ and $\nu_2 = (m - 1)\nu_1$.

The Pearson χ^2 criterion may be used for the quantity $n > 7$. The quantity $m(n - 1)W$ has a χ^2 distribution with $\nu = n - 1$ degrees of freedom.

The acceptable value of the coefficient of concordance *W* is within the range of 0,5 – 0,7; $W = 0{,}995$ at a confidence level of probability.

2.9.3 Coefficient of pair correlation.

Within the framework of the Delphi method, in solving problems associated with processing of information having qualitative and comparative nature, rank correlation method are used.

In classifying qualitative information, the so-called ranking is used, which implies the arrangement of n objects in an ascending or descending order of some quantitatively non-measurable attribute *X*. A rank x_i indicates the place which the *i*-th object occupies among other n objects ranked according to the attribute *X*.

A coefficient of rank correlation ρ presents statistics of the ranked objects linkage. This coefficient assesses the linkage between qualitative attributes of separate objects, which are not subject to precise quantitative assessment:

$$\rho = 1 - \frac{6S(d^2)}{n(n^2-1)} \qquad (2.9.3\text{-}1)$$

where n = number of objects;

$$S(d^2) = \sum_{i=1}^{n} (x_i - y_i)^2 \qquad (2.9.3\text{-}2)$$

where x_i, y_i = properties under consideration.

2.9.4 Properties of the coefficient of rank correlation.

$$-1 \leqslant \rho \leqslant +1.$$

$\rho = 0$ means that the attributes *X* and *Y* for n objects are independent by ranking these objects for the attribute *Y*.

$\rho = -1$ means that the ranking of objects for the attributes *X* and *Y* is fully opposite.

If x_i and y_i are random variables, the coefficient of rank correlation turns into an ordinary coefficient of pair correlation:

$$\rho = \frac{cov(XY)}{\sigma(X)\sigma(Y)} \qquad (2.9.4)$$

where $\sigma(X)$ and $\sigma(Y)$ = *X* and *Y* standard deviations;
$cov(XY)$ = *X* and *Y* covariation.

2.9.5 The risk analysis methods may be used separately or may complement each other, qualitative analysis methods may include quantitative risk criteria (for the most part, according to expert analysis with the use of the "probability - severity of consequences" matrix for hazards ranking). Where possible, the complete quantitative risk analysis shall use the results of the qualitative analysis of hazards (refer to Table 2.9.5).

Table 2.9.5

Recommendtions on selecting risk analysis methods

Method	Type of activity				
	Siting (pre-project works)	Design	Commissioning or decommissioning	Operation	Re-equipment/ conservation /utilization
"What if ..." analysis	0	+	++	++	+
Checklist analysis	0	+	+	++	+
Hazard and operability analysis	0	++	+	+	++
Analysis of failures and consequences	0	++	+	+	++
"Failure tree and event tree" analysis	0	++	+	+	++
Quantitative risk analysis	++	++	0	+	++

"0" — least acceptable method of analysis;
"+" — recommended method;
"++" — the most appropriate method.

3 SELECTION OF RISK CONTROL AND MANAGEMENT VERSION AT ENVIRONMENTAL EFFECTS

3.1 GENERAL

3.1.1 At the design stage of the FPU/MODU/FOP, a concept of safety to prevent collisions shall be created that comprises the three-stage control of risk, for which purpose are introduced:

safety echelons around the FPU/MODU/FOP;

effective protection of a hull structure against a collision;

limitations of damage parameters.

3.1.2 In settling problems associated with the FPU/MODU/FOP safety at environmental effects, all their unfavourable combinations shall be considered.

3.1.3 The FPU/MODU/FOP shall be provided with instrumentation to monitor the environment and FPU/MODU/FOP key responses to intensive environmental effects (wind, very rough sea, ice, seismic effects, enc.).

3.2 ECHELONING OF SAFETY ZONES AROUND FPU/MODU/FOP

The most efficient and effective means of risk management is the arrangement of safety echelons around the FPU/MODU/FOP (refer to 4.1.3, Part XV "MODU and FOP Safety Assessment" of the MODU/FOP Rules).

3.2.1 The FPU/MODU/FOP safety echelons include two types:

The external echelon (2 to 6 mile-zone around the FPU/MODU/FOP) with limitations on ships' speed and routing. The extent of limitations depends on:

ship's type, displacement and draught;

ship's maneuverability (CPP, thrusters, rotary propellers, active station-keeping and positioning system).

The internal echelon (0,5 to 2 mile-zone around the FPU/MODU/FOP) with strict limitations on ships' presence; speed towards the FPU/MODU/FOP along the zone radius shall be not more than 2 – 4 knots, depending on the ship, its displacement, installed power, maneuverability and systems protecting against collision.

Any towing of poorly-controlled objects within the echelons is excluded.

The safety echelon radii may be corrected by a designer on agreement with supervisory bodies, the Register and customer depending on the FPU/MODU/FOP type.

Monitoring and prevention of ships' traffic and presence within the safety echelons shall be carried out from the FPU/MODU/FOP control station.

3.2.2 The effective structural protection of the FPU/MODU/FOP hull against collisions with ships shall include shock-absorbing and deformation protection of the hull.

The shock-absorbing protection of the FPU/MODU/FOP against ships being moored at sea shall be ensured with pneumatic fenders or other shock-absorbing means equivalent with respect to energy intensity and a specific contact force.

The deformation protection of the FPU/MODU/FOP shall be provided with the structures being crumpled and scattering the impact energy during their deformation, and dampening the contact force down to the value that the shock-absorbing protection may take up.

It is allowed to use the first type of protection on the FPU/MODU/FOP, and the second one, on ships.

The effective structural protection of the FPU/MODU/FOP hull shall be provided in compliance with Part II "Hull" of the MODU/FOP Rules and shall provide mooring of the special purpose ships at sea state up to 6 inclusive.

The FPU/MODU/FOP shall also be provided with the special structural protection being an integral part of a mooring/offloading system, which shall be agreed by a designer with supervisory bodies and the Register in compliance with the established procedure.

3.3 ANALYSIS OF POTENTIAL ACCIDENT SITUATIONS AT UNCONTROLLED WELL FLOWING AND BLOWOUTS

3.3.1 Description of accident process.

Uncontrolled flowing is generally preceded by gas, oil and water shows and spring formations, which are the most severe types of accidents during drilling and operation of oil and gas wells, up to the FPU/MODU/FOP potential loss.

Drilling, especially drilling-in, may cause fluid ingress into the well during drilling after cementation and in the course of the well operation. The further development of gas, oil and water shows may result in a blowout of well fluids or drilling mud/flushing water and emergency flowing, which may initiate an explosion and fire situation.

3.3.2 Uncontrolled flowing is regarded as an uncontrolled outflow of well fluids through a wellhead due to the absence, failure or leakage of shut-off facilities, or due to spring formation.

Reasons of transition of gas, oil and water shows and blowouts into an emergency condition during drilling, well workover and servicing, and also during the well perforation are determined as the following:

untimely detection of gas, oil and water shows;

lack of drill crew members' training on the prevention and control of potential gas, oil and water shows;

lack of measures on the wellhead sealing;

improper actions on the wellhead sealing;

inconsistency between the well design and geological conditions (attitude of bed, reservoir pressure and temperatures, depth of layers subjected to hydraulic fracturing, etc. are ignored);

poor workmanship in cementing conductors, intermediate and production tubing;

leakage of threaded joints and integrity damage of casing strings, as well as defects of the wellhead assembly;

lack of monitoring of blowout equipment at the wellhead and non-compliance of its technical parameters to operational conditions at the well;

failure and improper operation of blowout equipment (BOPs);

lack of equipment (non-return valves, ball valves, cut-off valves) for prevention of a blowout through the drill pipes;

lack of the necessary reserve of drilling mud of proper quality at the well;

poor labour discipline.

3.3.3 The reasons of uncontrolled flowing and blowouts occurrence during the well operation are divided into three groups.

3.3.3.1 The first group is referred to a damage or failure of the wellhead equipment, namely:

mechanical damages caused by transport and cargo-handling appliances, water head, ice pressure, storms, etc.;

failures due to the poor quality of equipment components produced by the manufacturers;

failures at low temperatures;

failures due to violation of repair and maintenance procedures with regard to a casing head and well components;

failures due to exposure of aggressive environment and high pressures (equipment components generally fail in the wells, which production contains carbon dioxide, hydrogen sulphide and reservoir water);

failures and damages due to explosion in communications that arise at formation of an explosive mixture of petroleum gases and air, self-ignition at oxidizing pyrophorus deposits, electrostatic discharge, heating of oil-gas-air mixture when emerged from a slot, shock wave action.

3.3.3.2 The second group is referred to initiation of uncontrolled flowing associated with the failure of the well itself, which happens at an intrawell explosion, leakage of flow string and tubing-casing annulus, and improper well design.

3.3.3.3 The third group is referred to organizational reasons, i.e. uncontrolled operation of wells, non-fulfilment of timely works on monitoring, repairs and maintenance of the wellhead and bottom-hole equipment.

3.3.4 During construction of an event tree to assess a "blowout" hazard, the parameters below shall be taken into account:

location of a well fluid show during blowout;

well fluid flow;

blowout direction;

details of measures undertaken to regain control of the well operation;

blowout duration;

probability of blowout ignition and delays before the ignition;

signs of a forthcoming blowout.

At that it shall be taken into account that the blowout duration depends on the way of regaining the well control and the efficiency of its application, and also on a liquid ingress into the well.

3.4 STATISTICAL DATA ON WELL FLOWING AND BLOWOUTS

3.4.1 The blowout frequencies may be estimated relying on the analysis of accident statistics.

The statistical data given in this Chapter are based on the data on frequency of the similar accident situations and may be used by a designer taking into account the application of the recognized extrapolation methods.

When new technologies are used, like drilling of horizontal and deviated wells, the above data may be overestimated.

Table 3.4-1 contains comparative data on estimation of blowout probabilities received on the basis of the International Association of Oil & Gas Producers (OGP) data. They combine the information of different countries of the world over 1980 – 1992. The information was prepared for creation of a database on frequency of leakages and ignition probabilities for assessment of risks for the FPU/MODU/FOP in service. The Scandpower project is based on the similar data over world countries, but the data processing procedure is somewhat different.

The OGP data are used by the oil industry of western countries as a basis for predicting a failure frequency. In this connection the OGP Forum data are used for risk assessment. They subdivide blowouts into controlled and uncontrolled (Table 3.4-2) and by a probability of their ignition (Table 3.4-3).

The OGP Forum data also allow determining frequency of blowouts during simultaneous drilling and producing operations in the FPU/MODU/FOP areas (Table 3.4-4).

Table 3.4-1

Comparative data on blowout probability

Stage	Frequency per year	
	OGP	Scandpower
Drilling (per each drilled well)	$2{,}3 \times 10^{-3}$	$3{,}3 \times 10^{-3}$
Completion (per each well being completed)	$7{,}0 \times 10^{-4}$	$1{,}0 \times 10^{-3}$
Production (per well per year)	$4{,}6 \times 10^{-5}$	$5{,}0 \times 10^{-5}$
Workover and maintenance (per each operation)	$4{,}0 \times 10^{-4}$	$8{,}0 \times 10^{-3}$

Table 3.4-2

OGP data on probability of blowouts per year

Stage	Total	Controlled blowouts	Uncontrolled blowouts
Drilling (per each drilled well)	$2{,}3 \times 10^{-3}$	$0{,}7 \times 10^{-4}$	$1{,}6 \times 10^{-3}$
Completion (per each well being completed)	$7{,}0 \times 10^{-4}$	$1{,}6 \times 10^{-4}$	$5{,}4 \times 10^{-4}$
Production (per well per year)	$4{,}6 \times 10^{-5}$	0	$4{,}6 \times 10^{-5}$
Workover and maintenance (per each operation)	$4{,}0 \times 10^{-4}$	0	$4{,}0 \times 10^{-4}$

Table 3.4-3

Probability of blowout ignition

Number of blowouts	Number of ignitions	Fast ignition (within 5 min)	Slow ignition (within 2 hours)	Very slow ignition (after 2 hours)
112 100 %	93 83 %	7 6,3 %	3 2,7 %	9 8 %

Table 3.4-4

Probable locations of blowouts and their percentage

Area	Drilling	Comp-letion	Produc-tion	Repairs and maintenance
Drilling derrick deck	69	10	—	64
Load-bearing deck	—	—	17	—
Wellhead zone	9	10	61	29
Underwater const-ruction	22	80	22	7

3.5 ANALYSIS OF POTENTIAL ACCIDENT SITUATIONS IN THE EVENT OF FIRE DURING PROCESS EQUIPMENT OPERATION

3.5.1 Fire classification[1].

Fires are classified under the following classes in terms of types of combustible substances and materials:

.1 fires of solid combustible substances and materials (class A);

.2 fires of combustible liquids or melting solid substances and materials (class B);

.3 fires of gases (class C);

.4 fires of metals (class D);

.5 fires of combustible substances and materials of live electrical power units (class E);

.6 fires of nuclear materials, radioactive wastes and radioactive substances (class F).

[1] The requirements of Federal Law No. 123-ФЗ "Technical Regulations on Fire Safety Requirements" dated 22 July 2008 have been taken into consideration.

3.5.2 Hazardous fire factors.

Hazardous fire factors affecting people and property are the following:

.1 flame and sparks;

.2 heat flow;

.3 elevated environment temperature;

.4 high concentration of toxic combustion and thermal decomposition products;

.5 low oxygen concentration;

.6 reduced visibility a-smoke.

3.5.3 The hazardous fire factors are associated with the following:

.1 fragments, parts of the failed structures, process installations, equipment, units, arrangements and other property;

.2 radioactive and toxic substances and materials from the failed process installations, equipment, units, arrangements and other property which enter the environment;

.3 high voltage on the current-conducting parts of process installations, equipment, units, arrangements and other property;

.4 hazardous factors of an explosion due to fire;

.5 effect of extinguishing media.

3.5.4 Explosion-and-fire hazardous properties of hydrocarbon mixtures are characterized by the following indices:

concentration limits for propagation of flame;

ignition temperature;

ignition temperature limits;

flash point.

The explosion-and-fire hazard indices are stipulated by the normative documents on fire safety and are used for establishment of the requirements for use of substances and materials, and for computing a fire risk.

3.5.5 Calculations for estimation of a fire risk are the integral part of a formal safety assessment (FSA) being part of an industrial safety declaration at the objects, for which it shall be developed in compliance with the RF legislation.

3.5.6 The procedure for calculation of a fire risk assessment is established by the RF normative legal documents.

3.5.7 During operation of the process equipment the following types of fire are possible:

fire characterized by combustion in a gas-vapour phase;

fire characterized by spray combustion.

The explosion hazard of process installations is defined not only by the physical and chemical properties of hydrocarbons and their mixtures, but process parameters as well. The higher the process temperature and pressure, the more favourable conditions for generation of a hazardous cloud formed due to equipment depressurization and process medium discharge into the air.

It is assumed that the discharge will not ignite at once, but after a delay, and will result in an explosion rather than in spray combustion. Therefore, the probability of a jet fire is ignored. The explosion probability and individual risk as a result of explosion are calculated according to 2.7 – 2.9.

Fire in a gas-vapour phase may develop in any location, where inflammable liquids are available, and it is characterized by a small or zero kinetic energy due to necessity to generate inflammable vapours, and by a relatively a low level of heat flows.

Fire size in a gas-vapour phase is determined on the basis of a balance between a leakage rate and combustion rate, and depends on the quantitative parameters of the liquid in the equipment under consideration and on the structural design of the latter.

Inflammable liquid volumes for calculation of fire parameters in spaces are assumed for the most unfavourable version of fire spread (at start, stop, loading, unloading, storage, repairs, normal operation and failure of apparatus or process equipment) when the maximum amount of substances and materials, being the most hazardous with regard to ignition, penetrates (or is permanently available) in the space.

3.5.8 The ignition of an accident blowout with static discharges is a consequence of some reasons based on the following phenomena:

triboelectric effect, which occurs at the mutual friction of moving flow particles and fixed structures with the resultant change of an aggregative state of a flowing substance;

dispersion of a liquid phase within a jet;

deformation of a flowing medium at an impact in a solid obstruction.

3.5.9 The factors increasing the probability of a flowing ignition due to static discharges are: increased rate of flowing (increased flowing production rate); occurrence of solid and liquid foreign components within a jet; mechanical effect on the flowing jet with the resultant change of its shape; a jet strike against the free surface of a liquid (e.g. oil or condensate spilled at the wellhead).

3.5.10 At fires of gas-and-oil flowing all the oil is generally burnt up in the air, while at fires of oil flowing some oil spilled around continues burning on the FPU/MODU/FOP decks and a water surface.

3.5.11 Measures on management of the risks associated with explosions, dropping and flying objects may be integrated into two groups by the attribute of their effect on the various stages of a accident:

measures affecting the potential source of an accident situation and providing a lower probability of accident situation occurrence;

measures affecting the accident development and providing mitigation of the accident consequences.

The first group measures refer only to the potential sources of explosions and dropping (flying) objects on the FPU/MODU/FOP.

3.5.11.1 The basic measures of the first group are the following:

conservative approach at design stage based on a wide use of design experience regarding provision of safety;

at arrangement of process blocks with regard to hazards, determination by the method of hierarchy analysis of the most hazardous apparatus (block centre) in the process block in order to construct event/failure trees;

performance of periodical surveys of the equipment and other potential sources of explosion and dropping (flying) objects in service;

monitoring of certain conditions, which may indicate failure initiation, e.g. readings of vibration and acoustic sensor systems installed on large equipment provided with rotating units;

the whole complex of organizational fire safety measures.

3.5.11.2 The basic measures of the second group are the following:

arrangement and proper layout of equipment (refer to 4.1);

backing-up of the systems, which can affect a process of the accident development and an extent of the accident consequences;

physical separation of the back-up safety systems;

application of special structural protection systems;

development of special design for the standard structures to be used as the protective barriers;

organizational support of the least hazardous, regarding the consequences of the accident development and propagation of striking factors.

3.5.11.3 To provide the necessary level of safety (as low as reasonably practicable), the whole complex of the first and second group measures shall be materialized.

3.5.12 The main external and internal sources associated with an effect of explosions, dropping and flying objects (fragments) on the FPU/MODU/FOP are the following:

accidents on transport vessels-shuttles nearby the FPU/MODU/FOP, which result in explosions and/or in occurrence of dropping/flying objects due to the accident;

vessels (tanks) and pipelines pressurized and containing gas or liquid hazardous substances;

structures and equipment having significant kinetic energy.

The degree of the striking factor of a flying (dropping) object is primarily characterized by its mass and impact velocity. In addition, the striking effect of the flying object also depends on its shape and an angle between a velocity vector and an impact plane.

The explosion effect on the object is caused by the quick change of an excess air pressure in the form of an air shock wave. The level of an explosion hazard depends on the value of the maximum excess pressure. To assess the object response to an explosion effect, the time of excess pressure rise and drop shall be determined. The failure of some potential explosion sources may be accompanied by the formation of an excess air pressure and simultaneous generation of flying objects (fragments). For instance, it is typical for the explosion failure of the pressure vessels.

The potential primary factors associated with an explosion and dropping (flying) objects are the following:

deformation, damage, structure and equipment failures;

injuries and fatalities of the personnel;

displacement (shaking) of structures;

generation of flying objects;

emergence of caustic, toxic gases, vapours and aerosols;

initiation of fire.

The primary factors may initiate a set of secondary factors. For instance, shaking of structures may result in damages to equipment, a drop of loose objects, injuries of the personnel, etc.

3.5.13 The Register establishes three levels of hazard due to explosion and a flying (dropping) object (refer to Table 2.3.1):

I – features the maximum possible values of striking factor parameters and characteristics for a given source;

II – features the values of striking factor parameters and characteristics not relating to levels I and III;

III – features the values of striking factor parameters and characteristics, which cause no appreciable consequences for the FPU/MODU/FOP structures, equipment, personnel and for the environment.

Where the values of striking factor parameters and characteristics for a given source cannot be determined with an adequate degree of reliability, a conservative approach for safety assessment shall be used assuming that the level I hazard is materialized.

The level III hazard is defined by the maximum tolerable levels of regular loads on structures, equipment and personnel.

Regarding an effect on a person, to be considered are the following striking factors: direct fire effect, excess pressure, thermal radiation, gas contamination and air toxicity.

The following loading levels on the personnel may be accepted as tolerable:

tolerable levels of accelerations (for sitting and standing positions) – 0,9*g* (along all the coordinate axes);

at the impact of a head against an obstacle, the collision velocity shall not exceed 2,3 m/s;

at impacts by the objects having a mass of 1, 2, 3, 4 and 5 kg, the impact velocity shall not exceed 5; 3,7; 3; 2,5 and 2,2 m/s, respectively;

the value of an excess pressure of a shock wave shall not exceed 35 kPa.

3.5.14 Fires on FPU/MODU/FOP are in principle divided into two categories:

fires on the exposed decks;

fires in internal spaces.

3.5.14.1 A fire on the exposed decks caused by a gas blowout from a drainage system or by the pipeline/tank/apparatus breaking shall be classified as the most hazardous. The particular hazard of this fire is that firstly the liquid phase spread covers a large area and a large vapour cloud is formed; secondly, the inflammable liquid and/or gas influx is rather large and practically uncontrollable, especially at the initial stage of fire; thirdly, a gas-vapour combustible mixture, which consists of air, gases and vapours coming from the drainage systems and ruptures, is formed in the air above the unit. The sources of such mixture ignition may be:

faulty deck lighting;

open flame;

sparks of any origin (welding operations);

power equipment exhaust gases;

combustible parts of equipment.

During assessment of hazard "fires caused by the leakages of produced well fluids from process systems", the following potential sources of hydrocarbon leakage in the process system shall be considered:

swivels;

turrets;

risers;

separators;

piping;

manifold and system fittings;

flexible hoses;

tanks for storage of hydrocarbons and combustible gases.

In order to define a possible mode of equipment failures and the conditions of process liquid leakages, the FPU/MODU/FOP components shall be grouped by the categories, such as "pressure vessels", "pumps/compressors" and "storage tanks".

During construction of a logical-and-graphical diagram of fire propagation (failure/event trees), the following shall be considered:

level of the equipment hazard;

chemical composition of potentially ignitable substance;

environmental conditions of an operational area (primarily, wind direction and velocity);

actual capabilities of shutting off the source of ignitable substance (oil, natural gas or liquefied natural gas);

presence of other vessels or structures close to the FPU/MODU/FOP;

opportunity of the follow-up explosion(s);

technical condition of the FPU/MODU/FOP hull;

effectiveness of fire protection operation, etc.

It shall be also considered that the given fire may result in an oil spill fire on the water surface, fire ball and vortex.

3.5.14.2 Fires in the FPU/MODU/FOP internal spaces are divided into three main groups:

fires in machinery spaces, energy compartments (except purely electrical and technical compartments and spaces), control stations and corridors;

fires of electrical equipment;

fires in process, service, domestic and accommodation spaces.

The main reasons of fire emergence in the internal spaces are the following:

violation of operating conditions and rules for the equipment and device operation;

accidents and failures of the equipment, machines, machinery and devices, as well as of their service systems.

The source of fire emergence in the internal spaces may be the following:

sparks of any origin;

open flame;

surfaces heated up to a temperature of ignition point of fuels and lubricants (uninsulated parts of diesel-generator gas exhaust, overheated bearings, electrical equipment);

faulty electric wiring.

3.5.15 All the technical requirements on the FPU/MODU/FOP fire protection are given in Part VI "Fire Protection" of the MODU/FOP Rules.

3.6 STATISTICAL DATA ON WELL FLUID LEAKAGES

3.6.1 One of the basic reasons of initiating fires and explosions on offshore objects of the oil-and-gas producing industry is well fluid leakages. The statistical data on the accident situations recorded on the offshore objects of the British sector of the North Sea given below are based on the HSE annual reports containing information on the frequency of the accident situation occurrence, and may be used by a designer taking into account the recognized extrapolation methods.

The analysis of a probability of initiating accident situations associated with hydrocarbon release (fire, explosion) is carried out on the base of statistical data of the OGP "Database on Hydrocarbon Leakages" and the Oil&Gas UK "Statistics on Hydrocarbon Releases on Offshore Installations".

The scenarios of fire emergence are based on hydrocarbon leakages (blowouts) from the equipment and pipelines of process systems. According to the data given in Tables 3.6.1-1 to 3.6.1-3, leakages most commonly originate in connections and due to the failures of fittings.

Moreover, as a result of corrosion the holes of a various diameter appear in the pipeline and vessel walls, which visual detection is impeded due to the presence of thermal insulation. Nevertheless, according to statistical data in the Oil&Gas UK report, out of 643 leakages identified on the platforms in the British sector of the North Sea within the period from 1 October 1992 to 31 March 1997, 506 leakages were just visually detected.

Table 3.6.1-1

Relationship between leakages and their location on the FPU/ MODU/FOP equipment in the British sector of the North Sea

Leakage location	Fraction of total number, %	
	2002	2001
Flanged pipe connection	13	8
Welded pipe connection	13	6
Pipe body	6	13
Open pipe	4	16
Valve stem	8,5	4
Valve body	8,5	5
Valve flange	0	1
Open valve	4	3
Tank body	2	3
Tank flange	2	3
Open tank	2	1
Small hole on pipe	6	8
Small hole in connection	4	7
Connections of automation system equipment	15	3
Pump/compressor flange	0	2
Pump/compressor sealing	6	3
Body of flexible pipeline	0	4
Swivel pipe	0	1
Other sealings in equipment	4	7

Table 3.6.1-2

Relationship between leakages and specific reasons on offshore installations in the British sector of the North Sea

Direct reason	Fraction of total number of reasons, %	
	2002	2001
Internal corrosion	4	5
External corrosion	0	7
Erosion	9	6
Fatigue/vibration	21	11
Improper assembly	21	12
Operator's fault	4	11
Change of material properties due to ageing	28	27
Procedural violations	6	4
Inadequate insulation	2	4
Interlocking	0	2
Inadequate procedures	4	8
Equipment defects	0	6

Table 3.6.1-3

Relationship between leakages and basic reasons on offshore installations in the British sector of the North Sea

Basic reason	Fraction of total number of reasons, %	
	2002	2001
Incorrect monitoring	11	10
Inadequate risk assessment	13	8
Inadequate structural design	30	29
Inadequate procedure	23	9
Inadequate competence	8,5	12
Inadequate supervision	8,5	5
Improper selection/use of material	13	8
Inadequate description of a problem	0	2
Excess loading	4	2
Outdated information/data	0	1
Improper assembly	15	7
Inadequate maintenance	8,5	—
Inadequate communications	2	2
Inadequate monitoring/control conditions	32	28

Table 3.6.1-4

List of the special safety measures, which non-performance results in failures of equipment and systems

Locked valve
Work approval and permit
Insulating
Change of monitoring
Revision of procedures
Revision of design solutions (including HAZOP)
Competent support
Inspection/monitoring conditions
Corrosion/erosion monitoring
Building/acceptance inspection
Special check (for installations, which service life has expired)

Table 3.6.1-5

Statistical data on leakage parameters within 2001-2002 on the fixed offshore platforms in the British sector of the North Sea

Kind of hydrocarbon	Importance	System	Amount of hydro-carbon leakage, kg/s	Duration of leakage, min	Equivalent hole dimension, mm
Gas	Minor	Gas vent	2,30	3,00	0,9
Gas	Minor	Well	0,90	1,00	0,9
Non-process	Minor	Luboil, diesel	6,00	3,00	1,76
Non-process	Minor	Gas compressor	3,43	6,00	4,00
Non-process	Minor	Luboil, heat exchange	0,80	5,00	2,12
Non-process	Minor	Luboil, diesel	0,50	6,00	0,85
Non-process	Minor	Luboil, gas turbogenerator	3,75	6,00	0,50
Non-process	Minor	Luboil, gas turbogenerator	3,75	1,00	2,06
Non-process	Minor	Luboil, gas turbogenerator	1,00	1,00	0,9
Non-process	Minor	Luboil, heat exchange			
Non-process	Minor	Luboil, diesel	1,00 0,80	1,00	0,38

Table 3.6.1-6

Example of leakage frequency calculation

$(d/D)'$	P'	P	$D = 400$ mm			
			d, mm	d/D	Q_f	$Q_y = Q_f \cdot P$
0	0,65	0,65	10	0,025	$4{,}5 \times 10^{-4}$	$2{,}93 \times 10^{-4}$
0,05	0,88	0,23	25	0,0625		$2{,}93 \times 10^{-5}$
0,1	0,94	0,06	50	0,125		$1{,}04 \times 10^{-5}$
0,2	1		100	0,25		$2{,}7 \times 10^{-5}$
1			1	400		$2{,}7 \times 10^{-5}$

P' = distribution value for $(d/D)'$;
P = difference between a subsequent and preceding distribution value;
d = diameter of a leakage hole;
d/D = d to D ratio;
Q_f = frequency of a valve leakage (e.g. according to HSE data);
Q_y = frequency of a valve leakage for various diameters of a leakage hole.

Table 3.6.1-7

Frequency of flange and valve leakages

Equipment	Diameter (D), mm	Leakage frequency per year of operation
Flanges	$D < 75$	$4{,}04 \times 10^{-5}$
	$75 < D < 275$	$5{,}46 \times 10^{-5}$
	$D > 275$	$1{,}18 \times 10^{-4}$
Valves	$D < 75$	$7{,}18 \times 10^{-5}$
	$75 < D < 275$	$1{,}02 \times 10^{-4}$
	$D > 275$	$4{,}50 \times 10^{-4}$

Table 3.6.1-8

Distribution of flange and valve holes by size[1]

Ratio of leakage hole diameter to inner pipeline diameter	Distribution of leakage holes by size	
	Flange	Valve
0,05	—	0,65
0,10	0,96	0,88
0,20	—	0,94
1,00	1	1

Table 3.6.1-9

Frequency of flange leakages for holes of various size

Diameter, mm	Hole size, mm								
	Full section	300	250	200	150	100	50	25	10
400	$4{,}72 \times 10^{-6}$	$4{,}72 \times 10^{-6}$	$4{,}72 \times 10^{-6}$	$4{,}72 \times 10^{-6}$	$4{,}72 \times 10^{-6}$	$4{,}72 \times 10^{-6}$	$1{,}13 \times 10^{-4}$	$1{,}13 \times 10^{-4}$	$1{,}13 \times 10^{-4}$
300	$4{,}72 \times 10^{-6}$	$4{,}72 \times 10^{-6}$	$4{,}72 \times 10^{-6}$	$4{,}72 \times 10^{-6}$	$4{,}72 \times 10^{-6}$	$4{,}72 \times 10^{-6}$	$1{,}13 \times 10^{-4}$	$1{,}13 \times 10^{-4}$	$1{,}13 \times 10^{-4}$
250	$2{,}18 \times 10^{-6}$	—	—	$2{,}18 \times 10^{-6}$	$2{,}18 \times 10^{-6}$	$2{,}18 \times 10^{-6}$	$2{,}18 \times 10^{-6}$	$5{,}24 \times 10^{-5}$	$5{,}24 \times 10^{-5}$
200	$2{,}18 \times 10^{-6}$	—	—	—	$2{,}18 \times 10^{-6}$	$2{,}18 \times 10^{-6}$	$2{,}18 \times 10^{-6}$	$5{,}24 \times 10^{-5}$	$5{,}24 \times 10^{-5}$
150	$2{,}18 \times 10^{-6}$	—	—	—	—	$2{,}18 \times 10^{-6}$	$2{,}18 \times 10^{-6}$	$2{,}18 \times 10^{-6}$	$5{,}24 \times 10^{-5}$
100	$2{,}18 \times 10^{-6}$	—	—	—	—	—	$2{,}18 \times 10^{-6}$	$2{,}18 \times 10^{-6}$	$5{,}24 \times 10^{-5}$
50	$1{,}62 \times 10^{-6}$	—	—	—	—	—	—	$1{,}62 \times 10^{-6}$	$1{,}62 \times 10^{-6}$
25	$1{,}62 \times 10^{-6}$	—	—	—	—	—	—	—	$1{,}62 \times 10^{-6}$

An example of calculation of the leakage frequency is given in Table 3.6.1-6. As an example the valve fitted on a pipeline of 400 mm in diameter (D) is taken.

Frequency calculation of leakages through the holes of various diameter in the pipelines of various diameter is given in Table 3.6.1-13.

[1] Although a distribution by size is constant, for hole calculation discrete values are used that is reasonably justified as most of the holes are small and the difference in the leakage consequences between various holes of a small diameter is minor. From the above it might be assumed that frequency of the different diameter flange (Table 3.6.1-9) and valve (Table 3.6.1-10) leakages are calculated by rounded values for hole sizes.

Table 3.6.1-10

Frequency of valve leakages for holes of various size

Diameter, mm	Hole size, mm								
	Full section	300	250	200	150	100	50	25	10
400	$2{,}70 \times 10^{-5}$	$2{,}70 \times 10^{-5}$	$2{,}70 \times 10^{-5}$	$2{,}70 \times 10^{-5}$	$2{,}70 \times 10^{-5}$	$2{,}70 \times 10^{-5}$	$1{,}04 \times 10^{-4}$	$2{,}93 \times 10^{-4}$	$2{,}93 \times 10^{-4}$
300	$2{,}70 \times 10^{-5}$	—	$2{,}70 \times 10^{-5}$	$2{,}70 \times 10^{-5}$	$2{,}70 \times 10^{-5}$	$2{,}70 \times 10^{-5}$	$2{,}70 \times 10^{-5}$	$1{,}04 \times 10^{-4}$	$2{,}93 \times 10^{-4}$
250	$6{,}12 \times 10^{-6}$	—	—	$6{,}12 \times 10^{-6}$	$6{,}12 \times 10^{-6}$	$6{,}12 \times 10^{-6}$	$6{,}12 \times 10^{-6}$	$2{,}35 \times 10^{-5}$	$6{,}63 \times 10^{-5}$
200	$6{,}12 \times 10^{-6}$	—	—	—	$6{,}12 \times 10^{-6}$	$6{,}12 \times 10^{-6}$	$6{,}12 \times 10^{-6}$	$2{,}35 \times 10^{-5}$	$6{,}63 \times 10^{-5}$
150	$6{,}12 \times 10^{-6}$	—	—	—	—	$6{,}12 \times 10^{-6}$	$6{,}12 \times 10^{-6}$	$6{,}12 \times 10^{-6}$	$2{,}35 \times 10^{-5}$
100	$1{,}22 \times 10^{-5}$	—	—	—	—	—	$6{,}12 \times 10^{-6}$	$6{,}12 \times 10^{-6}$	$2{,}35 \times 10^{-5}$
50	$4{,}31 \times 10^{-6}$	—	—	—	—	—	—	$4{,}31 \times 10^{-6}$	$1{,}65 \times 10^{-5}$
25	$4{,}31 \times 10^{-6}$	—	—	—	—	—	—	—	$1{,}65 \times 10^{-5}$

Table 3.6.1-11

Frequency of pipeline leakages

Equipment	Diameter, mm	Leakage frequency per year of functioning
Pipeline	$D < 75$	$1{,}93 \times 10^{-4}$
	$75 < D < 275$	$6{,}78 \times 10^{-5}$
	$D > 300$	$5{,}12 \times 10^{-5}$

Table 3.6.1-12

Distribution of pipeline hole sizes

Ratio of leakage hole diameter to inner pipeline diameter	Distribution of leakage holes by size
0,05	0,6
0,22	0,85
0,45	0,95
1,00	1,00

Table 3.6.1-13

Frequency of pipeline leakages for holes of various size

Diameter, mm	Hole size, mm								
	Full section	300	250	200	150	100	50	25	10
400	$2{,}56 \times 10^{-6}$	$2{,}56 \times 10^{-6}$	$2{,}56 \times 10^{-6}$	$5{,}12 \times 10^{-6}$	$5{,}12 \times 10^{-6}$	$1{,}28 \times 10^{-5}$	$1{,}28 \times 10^{-5}$	$3{,}07 \times 10^{-5}$	$3{,}07 \times 10^{-5}$
300	$2{,}56 \times 10^{-6}$	—	$2{,}56 \times 10^{-6}$	$2{,}56 \times 10^{-6}$	$5{,}12 \times 10^{-6}$	$6{,}78 \times 10^{-6}$	$1{,}28 \times 10^{-5}$	$3{,}07 \times 10^{-5}$	$3{,}07 \times 10^{-5}$
250	$2{,}56 \times 10^{-6}$	—	—	$3{,}39 \times 10^{-6}$	$3{,}39 \times 10^{-6}$	$6{,}78 \times 10^{-6}$	$1{,}70 \times 10^{-5}$	$1{,}70 \times 10^{-5}$	$4{,}07 \times 10^{-5}$
200	$3{,}39 \times 10^{-6}$	—	—	—	$3{,}39 \times 10^{-6}$	$6{,}78 \times 10^{-6}$	$1{,}70 \times 10^{-5}$	$1{,}70 \times 10^{-5}$	$4{,}07 \times 10^{-5}$
150	$3{,}39 \times 10^{-6}$	—	—	—	—	$3{,}39 \times 10^{-6}$	$6{,}78 \times 10^{-6}$	$1{,}70 \times 10^{-5}$	$4{,}07 \times 10^{-5}$
100	$3{,}39 \times 10^{-6}$	—	—	—	—	—	$6{,}78 \times 10^{-6}$	$1{,}70 \times 10^{-5}$	$4{,}07 \times 10^{-5}$
50	$9{,}65 \times 10^{-6}$	—	—	—	—	—	—	$1{,}93 \times 10^{-5}$	$1{,}64 \times 10^{-4}$
25	$9{,}65 \times 10^{-6}$	—	—	—	—	—	—	—	$1{,}93 \times 10^{-5}$

Table 3.6.1-14

Distribution of instrumentation hole sizes

Ratio of leakage hole diameter to inner pipeline diameter	Distribution of leakage holes by size
0,10	0,13
0,20	0,2
1,0	1
N o t e. All values are given per year.	

Table 3.6.2-1

Distribution of dimensions for compressor holes

Diameter of leakage hole, mm	Distribution of leakage holes by size
10	0,62
25	0,15
50	0,08
100	0,8
150	0,08

3.6.2 Compressor leakages.

Compressor leakages make up $1{,}44 \times 10^{-3}$ per year.

3.6.3 Tank leakages.

Tank leakages make up $2{,}64 \times 10^{-3}$ per year.

Frequency calculation of leakages through the holes of various diameter from the valves of various diameter is given in Table 3.6.3-2.

Table 3.6.2-2

Frequency of compressor leakages for holes of various size

Diameter, mm	Hole size, mm					
	Total cross-section	150	100	50	25	10
400	$1{,}44 \times 10^{-3}$	$1{,}44 \times 10^{-3}$	$1{,}44 \times 10^{-3}$	$1{,}44 \times 10^{-3}$	$2{,}07 \times 10^{-3}$	$1{,}12 \times 10^{-2}$
300	$1{,}44 \times 10^{-3}$	$1{,}44 \times 10^{-3}$	$1{,}44 \times 10^{-3}$	$1{,}44 \times 10^{-3}$	$2{,}07 \times 10^{-3}$	$1{,}12 \times 10^{-2}$
250	$1{,}44 \times 10^{-3}$	$1{,}44 \times 10^{-3}$	$1{,}44 \times 10^{-3}$	$1{,}44 \times 10^{-3}$	$2{,}07 \times 10^{-3}$	$1{,}12 \times 10^{-2}$
200	$1{,}44 \times 10^{-3}$	$1{,}44 \times 10^{-3}$	$1{,}44 \times 10^{-3}$	$1{,}44 \times 10^{-3}$	$2{,}07 \times 10^{-3}$	$1{,}12 \times 10^{-2}$
150	$1{,}44 \times 10^{-3}$	—	$1{,}44 \times 10^{-3}$	$1{,}44 \times 10^{-3}$	$2{,}07 \times 10^{-3}$	$1{,}12 \times 10^{-2}$
100	$2{,}88 \times 10^{-3}$	—	—	$1{,}44 \times 10^{-3}$	$2{,}07 \times 10^{-3}$	$1{,}12 \times 10^{-2}$
50	$4{,}32 \times 10^{-3}$	—	—	—	$2{,}07 \times 10^{-3}$	$1{,}12 \times 10^{-2}$
25	$7{,}02 \times 10^{-3}$	—	—	—	—	$1{,}12 \times 10^{-2}$

Table 3.6.3-1

Distribution of hole sizes in tanks

Diameter of leakage hole, mm	Distribution of leakage holes by size
25	0,54
50	0,89
150	0,96

Table 3.6.3-2

Frequency of tank leakages for holes of various size

Diameter, mm	Hole size, mm			
	Total cross-section	150	100	50
400	$1{,}06 \times 10^{-4}$	$1{,}85 \times 10^{-4}$	$9{,}24 \times 10^{-4}$	$1{,}43 \times 10^{-3}$
300	$1{,}06 \times 10^{-4}$	$1{,}85 \times 10^{-4}$	$9{,}24 \times 10^{-4}$	$1{,}43 \times 10^{-3}$
250	$1{,}06 \times 10^{-4}$	$1{,}85 \times 10^{-4}$	$9{,}24 \times 10^{-4}$	$1{,}43 \times 10^{-3}$
200	$1{,}06 \times 10^{-4}$	$1{,}85 \times 10^{-4}$	$9{,}24 \times 10^{-4}$	$1{,}43 \times 10^{-3}$
150	$2{,}90 \times 10^{-4}$	—	$9{,}24 \times 10^{-4}$	$1{,}43 \times 10^{-3}$
100	$2{,}90 \times 10^{-4}$	—	$9{,}24 \times 10^{-4}$	$1{,}43 \times 10^{-3}$
50	$1{,}21 \times 10^{-3}$	—	—	$1{,}43 \times 10^{-3}$
25	$2{,}64 \times 10^{-3}$	—	—	—

N o t e. Hole size values are rounded to the nearest 50 mm; leakage frequency is given per year.

3.7 QUANTITATIVE ASSESSMENT OF FIRE RISK IN GAS-VAPOUR PHASE

3.7.1 A probability of fire emergence in gas-vapour phase is determined as follows:

$$QAR_{gvp} = Q_{ig} \cdot Q_l \qquad (3.7.1\text{-}1)$$

where QAR_{gvp} = quantitative assessment of a fire emergence risk;
Q_{ig} = probability of gas-vapour fraction ignition;
Q_l = leakage frequency.

The ignition probability is determined by the formula

$$\lg Q = 0{,}3929(\lg Q_{liq} + 1) - 2{,}376 \qquad (3.7.1\text{-}2)$$

where Q_{liq} = rate of liquid leakage, in kg/s.

Rate of liquid leakage is determined by the formula

$$Q_{liq} = C_d A \sqrt{2\rho(P - P_d)} \qquad (3.7.1\text{-}3)$$

where Q_{liq} = rate of liquid leakage, in kg/s;
C_d = flow/discharge coefficient (0,6 for round holes);
A = area of leaking hole, in m^2;
ρ = liquid density;
P = leakage pressure, in Pa;
P_d = environmental pressure, $1{,}01 \times 10_5$ Pa.

Quantitative assessment of a fire risk is determined by the formula

$$QAR_n = (Q_l^s \cdot m + Q_l^t \cdot n + Q_l^i \cdot l) Q_{ig} \qquad (3.7.1\text{-}4)$$

where Q_l^s, Q_l^t, Q_l^i = frequency of leakage during operation of separators, tanks and instrumentation, correspondingly (assumed according to 3.6);
m, n, l = number of separators, tanks and instrumentation, correspondingly.

Calculation is made for the following:

the most probable size in case of an emergency (10 mm);

the maximum size in case of an emergency.

A value of Q_{ig} for the most probable size in case of an emergency is equal to $2{,}3 \times 10^{-2}$, and for the maximum size in case of an emergency a probability of liquid ignition is assumed equal to

$8{,}0 \times 10^{-2}$ as for the leakage with a large mass flow (> 50 kg/s). The calculation results are given in Table 3.7.

Table 3.7.1

PCalculation results of quantitative assessment of a fire risk

Leakage value	QAR_n
The most probable size in case of an emergency	$8{,}9 \times 10^{-5}$
The maximum size in case of an emergency	$3{,}1 \times 10^{-4}$

4 RISK MANAGEMENT

4.1 SELECTION OF RISK CONTROL AND MANAGEMENT VERSION

4.1.1 The purpose of risk management is to propose the effective and practical risk control and management version, which includes three principal stages:

focusing on risk areas, which need management;

identification of potential check risk levels;

structuring of check risk levels into the practically managed versions of scenarios.

4.1.2 At all the stages of the FPU/MODU/FOP design, a procedure for selection of the risk control and management version shall be created, which is acceptable for existing accident situations and for the accident situations caused by new technologies or new methods of operation. At the first stage, the QAR results are classified so that main efforts are focused on the areas, which mostly need control. The main aspects to be considered in this case are the following:

accidents with an unacceptable risk level are considered first;

in construction of failure and event trees, the risks mostly contributing to the outcome are identified.

4.1.3 The selection of a risk degree control level is associated with specific measures on risk management. In establishing measures to control the risk degree, it is recommended to construct a detailed causal chain: hazard → accident situation → accident → consequences.

Management methods shall be aimed at:

reducing the frequency of errors at: designing, enginering, proper organizational policy, personnel training;

neutralizing the effect of non-conformities to prevent the accidents;

excluding circumstances, under which non-conformities may occur;

mitigating the severity of accident consequences.

4.1.4 Two feasible approaches to group management methods are recommended:

"general approach", which provides risk management by assessment of the accident initiation probability and development of actions to prevent sequence of development of several different accidents;

"differentiated approach", which provides management of the risks of accidents escalation along with a possibility to affect the later stages of other accidents escalation with regard to reducing the risks not directly associated with the previous accidents.

4.1.5 On the basis of the selected version of risk management, a Risk Management Plan is drawn up for its materializing within a Quality Control Plan during design and operation of the particular type of the FPU/MODU/FOP.

4.2 RECOMMENDATIONS ON REDUCING BLOWOUT AND FIRE RISKS

4.2.1 Fire-fighting measures on the FPU/MODU/FOP are reasonably to divide into four groups.

4.2.1.1 The first group deals with the measures of organizational character, namely:

development and formal drawing up of instructions for performance of all the works carried out on the FPU/MODU/FOP;

development of duty regulations for the FPU/MODU/FOP entire personnel;

strict observance of the safety standards and requirements during performance of any works on the unit, implementation of a permittance system for conducting fire-hazardous works;

development and formal drawing up of a Process Procedure, the Fire Plans and an Accident Elimination Plan containing clear instructions on the personnel actions in fire extinguishing;

development and implementation of a training system concerning the works on the FPU/MODU/FOP with regular check of the personnel knowledge and drill exercises.

4.2.1.2 The second group includes the measures of technical character aimed at prevention of possibility of fire initiation on the FPU/MODU/FOP. The most essential measures are the following:

use of explosion- and fire-proof equipment, machines, machinery, devices and systems in fire-hazardous areas and spaces of the FPU/MODU/FOP;

installation of a special system on the FPU/MODU/FOP, which prevents natural gas blowouts;

use on the FPU/MODU/FOP of the systems for transfer of inflammable liquids where the possibility of leakage is kept to a minimum;

provision of the air composition required in the FPU/MODU/FOP spaces by ventilation and installation of gas detection systems;

limitations on the use of combustible materials in service, general purpose and accommodation spaces.

4.2.1.3 The measures on structural protection against fire aimed at prevention of its propagation on the FPU/MODU/FOP (Part VI "Fire Protection" of the MODU/FOP Rules) form the third group of fire-fighting measures. In terms of risk control, the following measures among them shall be considered as crucial:

block-module design of the FPU/MODU/FOP according to a process principle;

tier arrangement of process equipment;

separation of one block/module from another with relevant spaces, as well as of one fire-hazardous space from another with gas-tight fire-resistant bulkheads and specially ventilated cofferdams and airlocks;

implementation of special measures for ensuring safe evacuation of the personnel from any service, general purpose or accommodation spaces through passageways, corridors, airlocks, trunks provided with fire protection means;

arrangement on the FPU/MODU/FOP of a special space - temporary shelter wherein the personnel may be in safety within a certain period of time required for fire extinguishing or evacuation of people from the FPU/MODU/FOP, but not less than an hour.

4.2.1.4 The fourth group includes active measures on fire fighting. It comprises fire extinguishing systems, which use various physical and chemical principles of operation (refer to Section 3, Part VI "Fire Protection" of the Rules for the Classification and Construction of Sea-Going Ships).

4.3 RECOMMENDATIONS FOR DECISION MAKING ON ACCIDENT RISK REDUCTION

4.3.1 The recommendations shall be based on acceptability levels of risks and their underlying causes, on the comparison of risk control and management alternatives and shall be followed to provide reduction of risks down to the most possible level at all the stages of the FPU/MODU/FOP design and operation.

The objective comparison of alternatives shall be provided based on the potential reduction of a risk level and cost effectiveness of risk control and management alternatives. The recommendations shall correspond to the IMO and IACS recommendations, and shall comply with the requirements of the RF Rostekhnadzor normative documents.

4.3.2 All the decisions made for the accident risk reduction shall comply with the current regulations of supervisory bodies, as well as of the Register, and the operational standards specified in the process regulations for the FPU/MODU/FOP and in the relevant operating instructions approved by the Register.

Operational standards are used everywhere during the entire life cycle of the FPU/MODU/FOP. It is vital that they be related to the systems and processes, which facilitate the reduction of the total risk. At that the number of operational standards therewith shall improve the safety management.

The operational standards relate to the particular types of FPU/MODU/FOP and they are recommended to be formed at three levels:

operational standards based on risk assessment, which specify quantitative parameters;

operational scenario standards, which may include qualitative or quantitative risk assessments specifying a particular objective for managing risks when a specific hazard or a group of hazards occur;

operational system standards, which specify the FPU/MODU/FOP safety level that shall be provided by all systems to provide the tolerable total level of risks.

4.3.3 The statistical data given in 3.4 and 3.6 allow developing the recommendations on reduction of fire risks being the most probable scenarios of escalating hazardous situations on the FPU/MODU/FOP, as the analysis of these statistical data and their extrapolation provide a designer with a possibility to correctly assess and exclude existing potential risks.

4.3.4 Examples of the practical quantitative assessment of separate types of risks are given in Appendices 2 – 4 of Part XV "MODU and FOP Safety Assessment" of the MODU/FOP Rules.

4.4 AS LOW AS REASONABLY PRACTICABLE (ALARP) PRINCIPLE

4.4.1 As low as reasonably practicable (ALARP) principle with regard to safety is carried out as follows.

4.4.1.1 The identification of hazards and consequence analysis of their materialization allow preliminarily definition of the hazard priority. For this purpose a risk matrix is used (Table 2.3.1), according to which all the hazards are distributed over three levels: intolerable, as low as reasonably practicable and tolerable.

Intolerable hazards are those in respect of which the risk cannot be justified except force majeure circumstances. Such hazards are associated with catastrophic consequences.

Tolerable hazards are those, which materialization is remote, and their consequences are insignificant. In respect of these hazards no measures are required and they may be excluded from further consideration.

4.4.1.2 The ALARP level falls between the "tolerable" and "intolerable" levels and is determined by HAZOP (Hazard and Operability Study) method, analyzing the effect of the process parameter deviations (physical and chemical properties, pressures, temperatures, etc.) from the specified values in terms of a hazard initiation.

4.4.1.3 The risk matrix (refer to Tables 3.1.7 and 5.2.1, Part XV "MODU and FOP Safety Assessment" of the MODU/FOP Rules) is materialized by identification and comparison of specific potential risks in the areas of high risk using the impact diagram (3.1.7 and 5.2, Part XV "MODU and FOP Safety Assessment" of the MODU/FOP Rules). Following the objective definition, a working group of experts performing examination within the framework of the FSA methodology, is formed. The work is recommended to be conducted in three stages: preparation (work planning and organization), risk identification, processing and documenting.

Where risk cannot be quantified, the qualitative qualification of accident circumstances and the qualitative risk assessment are permitted.

4.4.1.4 As guidance in development of the arrangements for materialization of the ALARP principle given in Fig. 4.4.4 is a process of undertaking corrective actions (IACS Recommendation "Guidance on Managing Maintenance and Repairs") proposed for review, and Table 4.4.4 contains the oriented values of quantitative risk assessment of separate accident occurrence.

Process of corrective actions performance

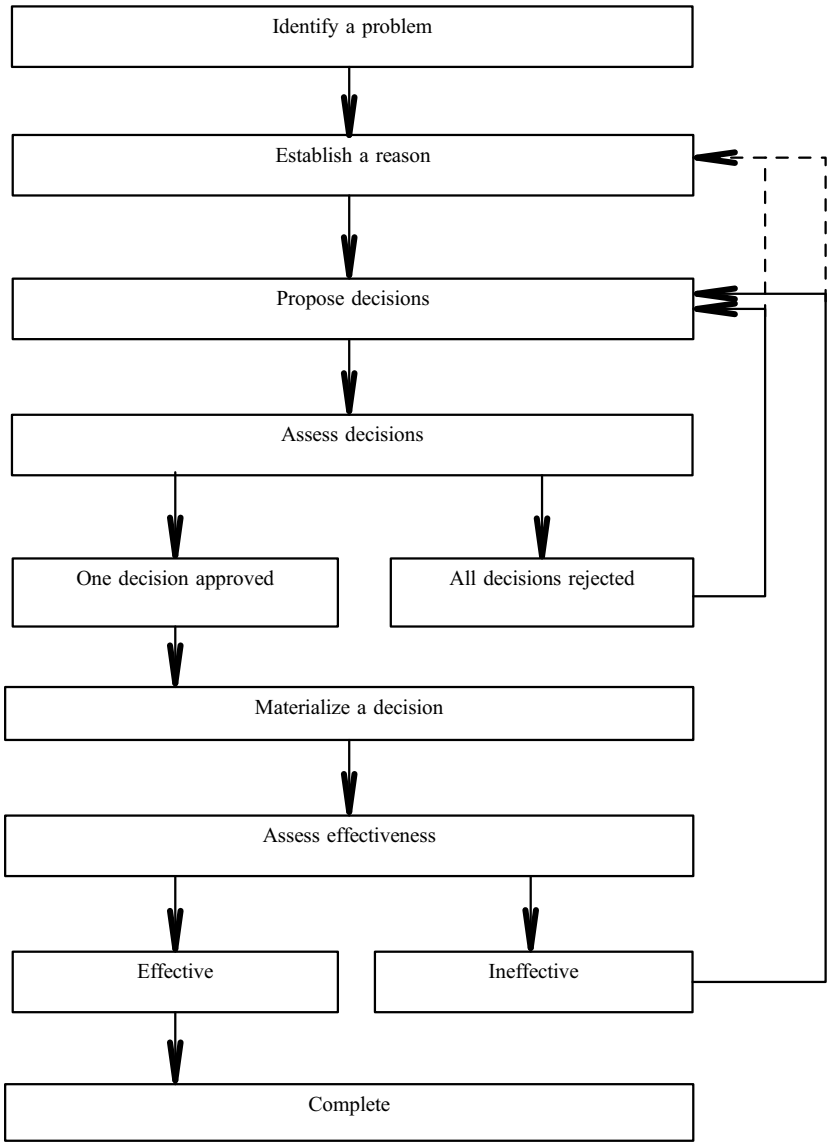


Fig. 4.4.4

Table 4.4.4

Values of risk assessment criteria

Type of hazard	Values of risk assessment criteria (fatality frequency from a category "FPU/MODU/FOP personnel" per year)
Well blowouts	5×10^{-5}
Fires due to leakages of produced well fluids from process systems	3×10^{-4}
Fires due to leakages of diesel fuel oil and lubricating oil from support systems	1×10^{-5}
Industrial hazards	7×10^{-4}
Destructive wave/wind loads	1×10^{-7}
Destructive ice loads	1×10^{-7}
Destructive seismic vibrations	1×10^{-7}
Fall of helicopters when carrying the personnel	1×10^{-5}
Accident with a transport/support vessel	1×10^{-5}
Fatalities among the personnel working on the FPU/MODU/FOP at the fall of helicopters on the FPU/MODU/FOP	5×10^{-7}
Accidents of general purpose/life support systems	3×10^{-5}
Failures of structures due to the ships' collisions with/docking impacts on the FPU/MODU/FOP	2×10^{-6}
Dropping/flying objects	1×10^{-6}
Fatalities among the personnel during evacuation	7×10^{-5}

5 SUBSTANTIATION AND EFFECTIVENESS ASSESSMENT OF THE DECISIONS ON RISK LEVEL REDUCTION

5.1 A cost assessment consists of the following stages:

consideration of the above assessed risks in terms of frequency/probability and consequences to define the base cause;

classification of the risk control and assessment versions defined in 3.1 and 3.2 to understand cost rates resulting from application of one or another risk control version;

assessment and comparative effectiveness of each version depending on a relative cost.

5.2 Cost shall cover: initial cycle, all design stages, operation, repairs, modernization, utilization, personnel training, verification and validation (inspection, certification, etc.), losses due to environment pollution, indemnity for the third party and personnel liabilities.

Cost estimation shall be performed on the basis of various recognized techniques and procedures.

Cost is determined in relation to the personnel, organization, company, coastal zone population, etc. who is directly or indirectly affected by the accident.

5.3 At this stage the effectiveness of proposals is determined:

cost of each risk control and management version mentioned above is estimated;

cost of the measures mostly affecting the result is estimated.

5.4 The cost effectiveness of the measure selected is recommended to determine either working out a probability-optimization problem or minimizing a *P*-type effectiveness function:

$$P = S + p\overline{u} \tag{5.4-1}$$

or on the basis of the method of increments:

$$I = S\Delta - \overline{u}\delta p \tag{5.4-2}$$

where I = measure benefit;
S = initial cost of the structure, equipment, FPU/MODU/FOP;
$\overline{u}$ = probability-average loss in case of a failure;
p = failure probability (risk value) referred to the entire life time of the structure, equipment, FPU/MODU/FOP;
Δ and δ = relevant increments.

5.5 Risk assessment may be used for substantiation of insurance rates in case of the damage liability insurance with regard to environment, personnel, population, third parties and for development of safety measures.

6 REQUIREMENTS FOR DRAWING UP THE RESULTS OF SAFETY ASSESSMENT

6.1 The results of risk assessment at all design stages shall be considered, justified and drawn up in such a way that the specialists who did not take part in an initial assessment may check and repeat the calculations and conclusions made.

6.2 The process of risk assessment shall be documented. The amount and form of a report containing the assessment results depend on the objectives of the risk assessment performed. Recommended for including into the report (unless otherwise specified in normative and legal documents, e.g. in the documents on drawing up declarations on industrial safety) is the following:

title page;

list of performers with indication of their posts, academic status and organization name;

abstract;

table of contents;

tasks and objectives of the risk assessment performed;

description of the hazardous industrial object being assessed;

assessment technique, initial assumptions and limitations, which define the range of risk assessment;

description of the assessment procedures, models of accident processes and substantiation of their application;

initial data and their sources, including accident rate data and reliability of equipment and technical systems[1];

results of hazards identification;

results of risk assessment;

analysis of the uncertainties of the risk assessment results;

generalization of risk assessments with the most "weak" points specified;

recommendations on risk reduction;

conclusion;

list of the information sources used, normative and technical, normative and legal base.

[1] Depending on the analysis objectives, the technical system is regarded both as a combination of technical devices and equipment (e.g. automated process control system) and as a single technical devices or their components.

APPENDIX 1

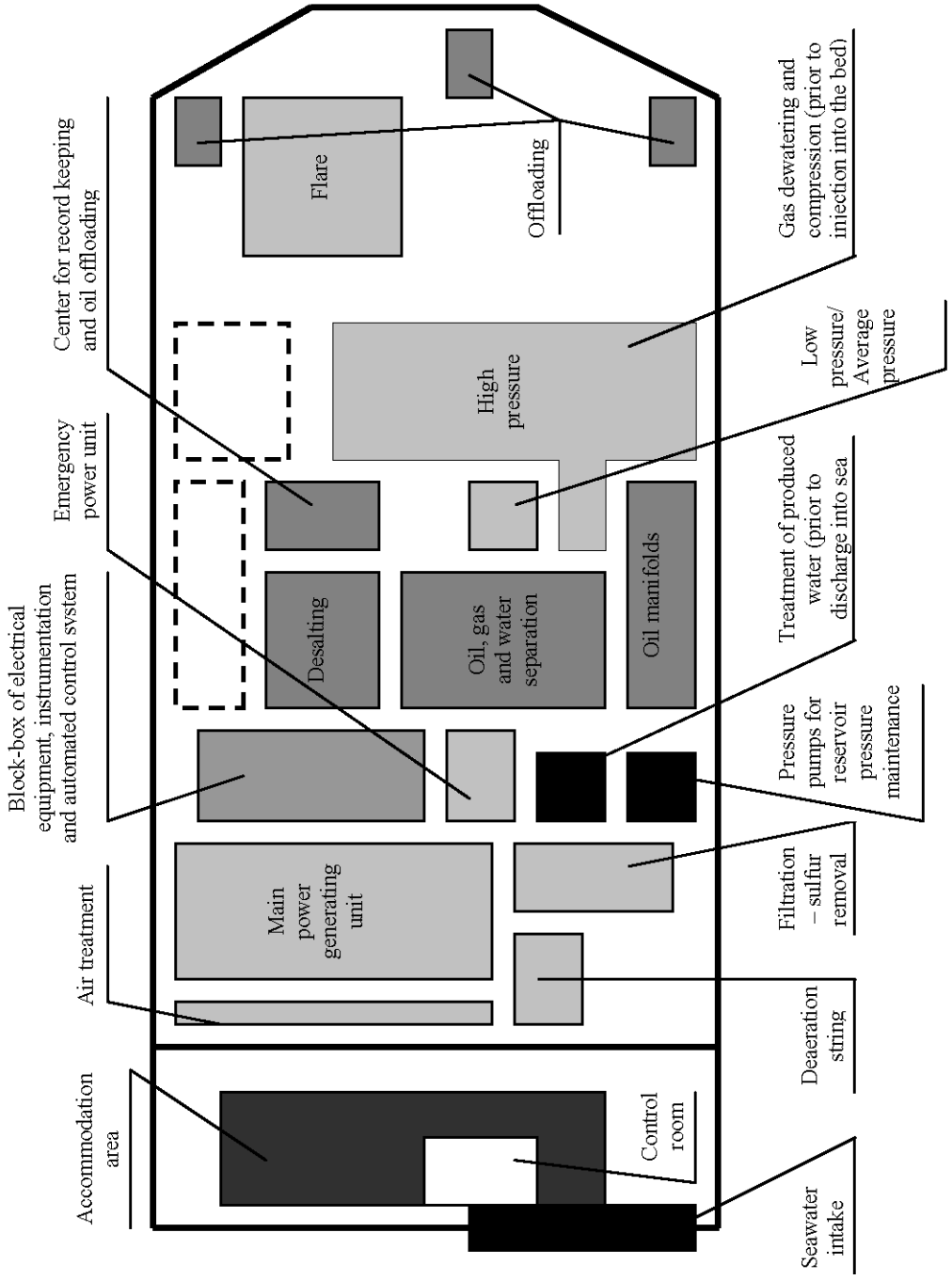
ABBREVIATIONS USED IN INTERNATIONAL PRACTICE

AAV = Annulus access valve.
ABS = American Bureau of Shipping.
ADS = Atmospheric diving system.
AIV = Annulus isolation valve.
AMV = Annulus master valve.
ANSI = American National Standards Institute.
API = American Petroleum Institute.
ASV = Annulus swab valve.
AUV = Autonomous underwater vehicle.
BOP = Blowout preventer.
CAA = Civil aviation authority.
CALM = Catenary anchor leg mooring.
CRA = Corrosion-resistant alloy.
CSON = Continental shelf operations notice.
C/WO = Completion/Workover.
DFI = Design, fabrication, installation.
DHPTT = Downhole pressure/Temperature transmitter.
DIN = Deutsches Institut fur Normung.
DNV = Det Norske Veritas.
DP = Dynamic positioning.
DSV = Diving support vessel.
EDP = Emergency disconnect package.
EER = Escape, evacuation, rescue.
EPS = Emergency power supply.
ESD = Emergency shutdown.
ESP = Electrical submersible pump.
FAT = Factory acceptance test.
FEA = Fire and explosion analysis.
FMEA = Failure mode and effects analysis.
FPS = Floating production system.
FPU = Floating production unit.
GA = General alarm.
GBS = Gravity base structure.
HAZID = Hazard identification.
HAZOP = Hazards in operation analysis.
HIPS = High integrity protection system.
HP = High pressure.
HPU = Hydraulic power unit.
HVAC = Heating, ventilating and air conditioning.
HXT = Horizontal X-tree.
ID = Internal diameter.
IPU = Integrated pipeline umbilical.
ISO = International Organization for Standardization.
LCV = Level control valve.
LMRP = Lower marine riser package (for drilling).
LNG = Liquefied natural gas.
LP = Low pressure.
LPG = Liquefied petroleum gas.
LPMV = Lower production master valve.
LRFD = Load and resistance factored design.
LRP = Lower riser package (for workover).
LWI = Light well intervention.
MAWP = Maximum working pressure.
MLSS = Mudline suspension system.
MLSV = Mudline safety valve.
MODU = Mobile offshore drilling unit.
MPFM = Multiphase flowmeter.
MPP = Multiphase pump.
MWD = Measuring while drilling.
NB = Nominal bore.
NRV = Non-return valve.
OWS = Oily water separator.
PCS = Production control system.
PFD = Process flow diagram/data.
PGB = Permanent guide base.
PIV = Production isolation valve.
PLEM = Pipeline end manifold.
PLET = Pipeline end termination.
PMV = Production master valve.
PSD = Production shutdown.
PSW = Production swab valve.
PWV = Production wing valve.
QRA = Quantitative risk analysis.
QRS = Quantitative risk assessment.
ROT = Remotely operated tool.
ROV = Remotely operated vehicle.
RTJ = Ring type joint.
SALM = Single anchor leg mooring.
SAS = Safety and automation system.
SBM = Single buoy mooring.
SCM = Subsea control module.
SCSSV = Surface-controlled subsurface safety valve.
SITHP = Shut-in tubing head pressure.
SPS = Surface process shutdown.
SSIV = Subsea isolation valve.
SSP = Subsea processing.
SUDU = Subsea umbilical distribution unit.
SUT = Subsea umbilical termination.
SXT = Surface X-tree.
TB = Tubing hanger.
TFL = Through-flowline system.
TGB = Temporary guide base.
THRT = Tubing hanger running tool.
TLP = Tension leg platform.
TLQ = Temporary living quarters.
TPS = Total platform shutdown.
TRT = Tree running tool.
ULS = Ultimate limit state.
UNS = Unified numbering system.

UPMV = Upper production master valve.
UPS = Uninterrupted power supply.
VXT = Vertical X-tree.
WAT = Wax appearance temperature.
WHP = Wellhead pressure.
WOCS = Workover control system.
WOR = Workover riser.
XOV = Cross-over valve.
XT = X-tree.

APPENDIX 2

TYPICAL DIAGRAM OF OIL-AND-GAS EQUIPMENT ARRANGEMENT ON FPU



APPENDIX 3

LIST OF RECOGNIZED NORMATIVE AND TECHNICAL DOCUMENTS

Nos.	Code name	Designation
1.	GOST 12.0.002:1980	Occupational safety standards system. Terms and definitions
2.	GOST R 12.0.007:2009	Occupational safety standards system. Labour protection management systems in organizations. Guidelines requirements on development, implementation, audit and improvement
3.	GOST R 12.0.230:2007	Occupational safety standards system. Occupational safety and health management systems. General requirements
4.	GOST R 12.1.030-1981	Occupational safety standards system. Electric safety. Protective condactive earth, neutralling
5.	GOST 12.1.044-89	Occupational safety standards system. Fire and explosion hazard of substances and materials. Nomenclature of indices and methods of their determination
6.	GOST 12.2.032 -78	Occupational safety standards system. Operator's location in a sitting position. General ergonomic requirements
7.	GOST R 12.2.141 -99	Occupational safety standards system. Surface drilling equipment. Safety requirements
8.	GOST 12.3.033 -78	Occupational safety standards system. Constructing machines. General requirements of safety
9.	GOST 12.4.040 -78	Occupational safety standards system. Control elements of manufacturing equipment. Notations
10.	GOST 24.104-85	Unified system of standards of computer control systems. Computer control systems. General requirements
11.	GOST R 22.0.02-94	Safety in emergencies. Basic terms and definitions
12.	GOST R 22.0.05-94	Safety in emergencies. Technogenic emergencies. Terms and definitions
13.	GOST 6286-73	High-pressure rubber hoses with metal braids without fittings. Specifications
14.	GOST R 9544-2005	Pipeline gate valves. Classes and rates of gates sealibility
15.	GOST 13862-90	Blowout prevention equipment. Standard schemes, basic parameters and technical design requirements
16.	GOST R 14254-96	Degrees of protection provided by enclosures (IP Code)
17.	GOST 16293-89	Complete drilling rigs for development and deep exploratory drilling. Basic parameters
18.	GOST 16853-88	Steel tackle ropes for operational and deep probe boring. Specifications
19.	GOST 23611-79	Electromagnetic compatibility of radio-electronic equipment. Terms and definitions
20.	GOST 23872-79.	Electromagnetic compatibility of radio-electronic equipment. Nomenclature of parameters and technical data classification
21.	GOST 25452-90	High-pressure rubber hoses, spiral wire reinforced without assembly. Specifications
22.	GOST 28618-90	Rubber hoses and hose assemblies for rotary drilling and vibration applications. Specifications
23.	GOST R 51330.0-99:	Electrical apparatus for explosive gas atmospheres. Part 0: General requirements
24.	GOST R 51330.1-99:	Electrical apparatus for explosive gas atmospheres. Part 1: Construction and verification test of flameproof enclosures of electrical apparatus
25.	GOST R51330.2-99	Electrical apparatus for explosive gas atmospheres. Part 1. Construction and verification test of flameproof enclosures of electrical apparatus. First supplement. Appendix D. Method of test for ascertainment of maximum experimental safe gap
26.	GOST R 51330.3-99	Explosion protected electrical equipment. Part 2. Filling or purging of the pressurized enclosure "p"
27.	GOST R 51330.4-99	Electrical apparatus for explosive gas atmospheres. Part 3. Spark-test apparatus for intrinsically-safe circuits
28.	GOST R 51330.5-99	Explosion protected electrical apparatus. Part 4. Method of test for ignition temperature
29.	GOST R 51330.6-99	Electrical apparatus for explosive gas atmospheres. Part 5. Powder filling *q*
30.	GOST R 51330.7-99	Explosion proof electrical apparatus. Part 6. Oil-filled enclosures *o*
31.	GOST R 51330.8-99	Explosion proof electrical apparatus. Part 7. Type of protection *e*

Nos.	Code name	Designation
32.	GOST R 51330.9-99	Electrical apparatus for explosive gas atmospheres. Part 10: Classification of the hazardous areas
33.	GOST R 51330.10-99	Electrical apparatus for explosive gas atmospheres. Part 11: Intrinsic safety "i" – Ex ia, Ex ib, Ex ic
34.	GOST R 51330.11-99:	Electrical apparatus for explosive gas atmospheres Part 12: Classification of mixtures of gas and vapors with air according to their maximum experimental safe gaps (MESG) and minimum ignition currents (MIC)
35.	GOST R 51330.12-99:	Electrical apparatus for explosive gas atmospheres. Part 13: Construction and use of rooms or buildings protected by pressurization
36.	GOST R 51330.13-99:	Electrical apparatus for explosive gas atmospheres. Part 14: Electrical installations in hazardous areas (other then mines)
37.	GOST R 51330.14-99	Electrical apparatus for explosive gas atmospheres. Part 15: Type of protection "n" – Ex n
38.	GOST R 51330.15-99	Electrical apparatus for explosive gas atmospheres. Part 16: Artificial ventilation for the protection of analyzer(s) houses
39.	GOST R 51330.16-99	Electrical apparatus for explosive gas atmospheres. Part 17: Inspection and maintenance of electrical installations in hazardous areas (other than mines)
40.	GOST R 51330.17-99	Electrical apparatus for explosive atmospheres. Part 18: Encapsulation "m" – Ex m
41.	GOST R 51330.18-99:	Electrical apparatus for explosive gas atmospheres. Part 19: Repair and overhaul for apparatus used in explosive atmospheres (other than mines or explosives)
42.	GOST R 51330.19-99	Electrical apparatus for explosive gas atmospheres. Part 20: Data for flammable gases and vapours, relating to the use of electrical apparatus
43.	PB 03-540-03	General rules for explosion safety of explosion and fire hazardous chemical, oil chemical and oil refining facilities
44.	PB 03-585-03	Rules for design and safe operation of process pipelines
45.	PB 03-576-03	Rules for design and safe operation of pressure vessels
46.	PB 03-591-03	Rules for design and safe operation of flare systems
47.	PB 08-623-03	The safety regulations for exploration and development of oil and gas deposits on the continental shelf
48.	PB 08-624-03	Safety rules in oil and gas industry
49.	PD 03-418-01	Procedural guidelines for risk analysis of hazardous production objects
50.	NORSOK STANDART P-100	Process systems
51.	ISO 17020:2004	General criteria for the operation of various types of bodies performing inspection
52.	ISO 9001:2008	Quality management systems – Requirements
53.	ISO 9004:2000	Quality management systems – Guidelines for performance improvements
54.	ISO 14001	Environmental management systems – Requirements with guidance for use
55.	OHSAS 18001:1999	Occupational health and safety management systems. Specification
56.	ISO 29001:2003	Petroleum, petrochemical and natural gas industries – Sector-specific quality management systems – Requirements for product and service supply organizations
57.	ISO 19900:2002	Petroleum and natural gas industries – General requirements for offshore structures
58.	ISO 10423:2004	Petroleum and natural gas industries. Drilling and production equipment. Wellhead and Christmas tree equipment
59.	IS013503-1 : 2003	Petroleum and natural gas industries – Completion fluids and materials – Part 1: Measurement of viscous properties of completion fluids
60.	ISO 13533 : 2001	Petroleum and natural gas industries – Drilling and production equipment – Drill-through equipment
61.	ISO13534 : 2000	Petroleum and natural gas industries – Drilling and production equipment – Inspection, maintenance, repair and remanufacture of hoisting equipment. – 2nd edition.

Nos.	Code name	Designation
62.	ISO 13535 : 2000	Petroleum and natural gas industries – Drilling and production equipment – Hoisting equipment
63.	ISO 13623 : 2000	Petroleum and natural gas industries – Pipeline transportation systems
64.	ISO 13626 : 2003	Petroleum and natural gas industries – Drilling and production equipment – Drilling and well-servicing structures
65.	ISO 13703 : 2002	Petroleum and natural gas industries – Design and installation of piping systems on offshore production platforms
66.	9th Edition TEMA Standards	Ninth Edition of the Standards of the Tubular Exchanger Manufacturers Association
67.	ASME B16.10	Face-to-face and end-to-end dimensions of valves
68.	ASME B16.5	Pipe flanges and flanged fittings
69.	ASME B16.5a	Addition to ASME B16.5
70.	ASME B31.1	Power piping
71.	ASME B31.3	Process piping
72.	ASME B31.4	Pipeline transportation systems for liquid hydrocarbons and other liquids
73.	ASME B31.8	Gas transmission and distribution piping systems
74.	ASME-BPVC	Boiler and Pressure Vessel Code
75.	ASTM A6M	Specification for general requirements for rolled structural steel bars, plates, shapes and sheet piling
76.	ASTM A435	Specification for straight-beam ultrasonic examination of steel plates
77.	ASTM A770	Specification for through-thickness tension testing of steel plates for special applications
78.	ASTM E23	Test methods for notched bar impact testing of metallic materials
79.	ASTM E208	Test method for conducting drop-weight test to determine nil-ductility transition temperature of ferritic steels
80.		Guidelines for Formal Safety Assessment (FSA), IMO
81.		MSC/Circ.1023. Guidelines for Formal Safety Assessment (FSA) for use in the IMO rule-making process

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