Polski Rejestr Statków

RULES

PUBLICATION NO. 105/P

MARINE UNITS

FIXED OFFSHORE PLATFORMS AND EQUIPMENT

RULES FOR THE CONSTRUCTION AND SURVEY

August
2018

This Publication P (Rule) – MARINE UNITS. FIXED OFFSHORE PLATFORMS AND EQUIPMENT. RULES FOR THE CONSTRUCTION AND SURVEY developed by Polski Rejestr Statków S.A consist of the following Parts:

I	–	Survey Regulations
II	–	Structure, Materials, Marine Equipment
III	–	Positioning the Unit on Sea Bed
IV	–	Machinery Equipment and Systems
V	–	Fire and Anti-explosion Protection
VI	–	Electrical Installations and Control Systems
VII	–	Hydrocarbon Processing Systems
VIII	–	Radio, navigation, signalling, life-saving, environment protection equipment and lifting appliances
IX	–	Requirements for the issue of Safety Operation Certificate
X	–	Helideck

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The Publication replaces the Publication No. 105/P, rev. 2018.

This Publication is extended and supplemented by the below documents of the Polish Register of Shipping:

Supervision Activity Regulations
Rules for the Classification and Construction of Sea-going Ships
Rules for Statutory Survey of Sea-going Ships

Publication No. 2/P	–	Alternative Survey Arrangements for Machinery,
Publication No. 9/P	–	Requirements for Computer Based Systems
Publication No. 51/P	–	Procedural Requirements for Service Suppliers,
Publication No. 52/P	–	Underwater Inspection of Mobile Offshore Drilling Units in Lieu of Drydocking
Publication No. 54/P	–	Alternative Hull Survey Arrangements.
Publication No. 2/I	–	Prevention of Vibration in Ships
Publication No. 18/I	–	Guidelines for Non-destructive Testing of Underwater Part of the Mobile Offshore Drilling Units,
Publication No. 28/I	–	Guidelines for Safe Entry to Confined Spaces *(from 2019 replaced by Publication No. 123/P)*,

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CONTENTS

PART I

Survey Regulations

1 GENERAL

1.1 Survey according to this Publication

1.1.1 The subject of the survey carried out in accordance with the present *Rules for the Construction and Survey of Fixed Offshore Platforms*, further referred to as *the Publication* are marine units defined in 1.2.1 ~~export offshore pipeline systems associated with the *units*, self-elevating mobile offshore units~~, intended for exploitation and processing of hydrocarbons, floating or positioned temporarily or permanently on the sea bed, or designated for such positioning, further referred to as *units* or platforms. The subject of survey are also subsea export pipeline systems associated with units positioned on the sea bed.

The Publication applies also to fixed drilling offshore platforms as specified in the act of 18 August 2011 on marine safety (Journal of Laws 2011 No. 228 item 1368), as further amended.

Detailed definitions of the above terms are given in 1.2.1.

1.1.2 This *Publication* may be respectively used for other than in 1.1.1 types of the offshore hydrocarbon production, processing and transportation *units* and equipment and offshore pipeline systems.

1.1.3 In terms of the Regulation of the Minister of Economy of 25 April 2014 on detailed requirements for operation of mining plants excavating by drilling holes (Journal of Laws 2014 item 812 of 23 June 2014), chapter 13, §367 item 1, the rules apply to offshore units, referred to in subparagraphs (b), (c) (f) and (g), excluding drilling units and equipment.

1.1.4 The requirements of the Publication apply to designing, construction/conversion of the *unit*, the *unit* in afloat condition, in transition condition and the *unit* positioned on sea bed, as well as to the *unit* withdrawn from service and utilized.

1.1.5 The *units* permanently positioned on sea bed shall comply with applicable requirements of the Polish building law[1], as well as Polish geological and mining law.

1.1.6 This *Publication* specifies principles of technical survey, performed by Polski Rejestr Statków. The *Publication* also informs on the survey duties of the survey Orderer.

1.1.7 The purpose of the PRS survey is to ensure safe operation of the *unit* by checking and confirmation of the *unit* structure and technical condition compliance with technical requirements contained in this *Publication* ~~and requirements of the Act on Building Law of 7 July 1994 applicable to marine hydrotechnical structures,~~ as well as applicable legal ~~the~~ requirements referred to in 1.1.4. ~~of respective regulations of the Ministers of the Republic of Poland.~~

1.1.8 Part I of the *Publication* defines the survey methods and proceedings. Technical requirements, being the basis of the survey are specified in Parts II to VIII and Part X.

1.1.9 This *Publication* specifies the requirements, the fulfilment of which constitutes the basis for the issue of appropriate certificates of compliance by PRS to the *unit* or its equipment.

1.1.10 The survey of Polski Rejestr Statków covers the whole (steel) structure of the *unit*, which consists of the platform and its legs.

1.1.11 The survey of Polski Rejestr Statków over the *unit* covers, if not specified otherwise, the *unit* platform equipment within the area bound by:
– production manifold (inclusive),
– the valve installed on the exported oil outlet (inclusive),
– the valve installed on the exported gas outlet (inclusive),

[1] All entries in this Publication, which refer to building law, geological and mining law, as well as to other legal acts referred to in 1.2.1 of Part III, concern exclusively the activity carried out ~~in the areas the mentioned legal regulations apply to, i.e.~~ in the Polish maritime areas as defined in the Act of 21 March 1991, ~~Journal of Laws 2013, item 934,~~ with further amendments, on the Polish maritime areas and Maritime Administration.

– the valve installed on the outlet of the lines of water injection to deposit,
– immersed pumps of cooling and fire fighting sea water (inclusive)
– valves on the inlets of service media periodically supplied to the platform (e.g. liquid fuel) – inclusive,
– drilling derrick (where applicable) – excluded, except obstacle marking and lighting, according to Part X and pipings of blow-down system and torch (if installed on the derrick).

1.1.12 Principles of PRS survey of subsea pipeline systems are presented in Appendix A.

1.1.13 PRS may perform safety assessment of the *unit* with the use of risk analysis and assessment, by methods adopted for offshore industry, or perform an independent verification according to art. 17 of Directive 2013/30/EU of the European Parliament and of the Council of 12 June 2013 on safety of offshore oil and gas operations and amending Directive 2004/35/EC (Official Journal of the European Union L.2013.178.66).

1.2 Definitions, Abbreviations

1.2.1 Definitions and Abbreviations

Accommodation spaces – public spaces, corridors, lavatories, crew cabins, offices, hospitals, cinemas, game and hobby rooms, pantries containing no cooking appliances and other similar enclosed spaces.

Building law – the Act of 7 July 1994 – Building law (Journal of Laws 2018, item 1202, of 22 Jun 2018, as further amended).

Certificate of Helideck Equipment Compliance – Certificate of Conformity issued for the structure of the *unit* helideck, together with associated technical appliances.

Certificate of MODU – a permanent or temporary C*ertificate of the fixed offshore unit* or permanent or temporary *Certificate of self-elevating offshore unit*.

Certification cycle – cyclical period starting from the date of completion of the Initial Survey to accept the *unit* for PRS survey or from the date of Certificate Renewal Survey completion, equal to certificate validity period (in general 5 years) and covering all due Periodical Surveys.

~~Class – for the purpose of this Publication – means that the unit holds a certificate of class, issued by a Classification Society – a member of IACS.~~

Conversion of the *unit* – activities aimed at the change of the *unit* scantlings or/and its purpose.

CS – IACS Classification Society

Enclosed space – a space delineated by floors, bulkheads and/or decks, which may have doors and/or windows.

ESD system – emergency shutdown system – a system intended for shutdown (isolating) the whole of production installations and ignition sources as well as shutdown of specified machinery in case of serious hazard.

Examinations:
– External examinations – a visual inspection of structure, machinery or equipment, without dismantling, to provide a general assessment of their condition and to determine, where necessary, the scope of an additional close-up examination.
– Internal examinations – a visual examination of structure, machinery or equipment in dismantled condition (partially or wholly) or a visual examination of an arrangement (boilers, pressure vessels) from the inside, aimed at the assessment of their condition and determination, where necessary, the scope of an additional close-up examination.
– Close-up examination – a survey where the details of structure, machinery or equipment are subject to close visual inspection by the Surveyor, i.e. normally within the Surveyor's hand reach and possible hammer, magnifying glass, etc. testing.

Exceptional circumstances – unavailability of dry docking facilities or repair facilities; unavailability of essential materials, equipment or spare parts; delays incurred by action taken to avoid severe weather conditions.

FAULT TREE – fault tree analysis – a method applied at risk analysis.

Fixed offshore platform - the unit intended for hydrocarbons excavation and processing, permanently positioned on the ground, which is marine engineering structure – see unit, marine unit, stationary unit.

Fixing the Unit – the process of unit transition from the unit afloat mode to unit fixed on sea bed mode.

FMEA – Failure Mode and Effects Analysis – a method applied at risk analysis.

FMECA – Failure Mode, Effect and Criticality Analysis – a method applied at risk analysis.

FOP – Fixed Offshore Platform.

Geological and Mining Law – the Act of 9 June 2011 – Geological and Mining Law (Journal of Laws 2017, item 2126, of 17 November 2017, as further amended).

Group of Offshore *Units* – operationally associated group of *units* equipped with machinery and systems for extracting liquid or gas minerals, their initial storage, their preparation for being received at sea or on land, as well as equipped with crew accommodation spaces.

Hard coating – coating that remains hard, usually epoxy or equivalent.

Hazardous zone – an area in which an explosive gas/air mixture arising from the excavating operations may occur.
Detailed definitions of hazardous areas are given in 1.2.2.

IACS – International Association of Classification Societies.

Initial survey – a complete set of surveys of a *unit*, after completion of which PRS issues the first permanent *Certificate for the Fixed Offshore Unit*.

Inspection – inspection of marine structure according to § 62 of the Regulation of the Minister of Maritime Affairs of 23 October 2006 ~~(Journal of Laws, No. 206, of 2006, item 1516)~~;. The inspection is effected during survey.
§ 62.1 of the Regulation of the Minister of Maritime Affairs on the technical conditions of use and the detailed scope of control of marine engineering structures of 23 October 2006 (Journal of Laws, No. 206, of 2006, item 1516) reads: - *Control of marine structure is carried out, taking into account art. 62(4) of the act (the act on building law of 7 July 1994, Journal of Laws 2018, item 1202 of 22.06.2018, as further amended), by the owner or operator of the construction. The control shall cover the whole marine structure including its systems, installations, machinery and other production equipment, with the exception of technical equipment.*

Jacking machinery – installations and machinery used to move the *unit* legs – drives of toothed wheels, toothed gears, locking and shock absorbing devices, associated electrical machinery.

Jetting – sinking unit footings by water jet washing out.

LCS – local control station – local station for local control and monitoring of particular system or appliance.

Machinery spaces – spaces containing combustion engines, gas turbines, oil fuel units, boilers, compressors, pumps, incinerators, generators and essential electrical machinery, ventilation machinery, oil filling stations and other similar spaces.

Main dimensions of the *unit* fixed on the sea ground:
– H_c – height a.m.s.l. (a.m.s.l. means height above mean sea level) of the tallest element of the *unit*,
– H_d – height a.m.s.l. of main deck of the unit pontoon,
– H_h – height a.m.s.l. of helideck,

– *S* – space (also air gap) – height a.m.s.l. of the unit pontoon bottom.

Main dimensions as for ship: *L*, *B*, *H*, apply also to pontoon.

Maritime Administration – for the purpose of this *Publication* – competent regional unit of the Polish Maritime Administration – the Maritime Office.

Marine structure – in the meaning of building law, the *unit* positioned permanently on the sea bed, marine hydrotechnical structure.

MCS – Main control station – enclosed space or part thereof accommodating means of control of essential systems and functions, not associated with oil and gas processing such as: navigational lighting, ballast system, jacking system, *unit* evacuation;

Mining Office – District Mining Office in Gdańsk (acc. to art. 168(2) of the Act “Geological and Mining Law” of 9 June 2011 (Journal of Laws 2017, 2126, uniform text of 17.11.2017, as further amended), in respect of designing and executing building works and maintaining building objects within mining plant premises, the Mining Office bodies perform tasks within the scope of Architecture and Building Administration and Building Supervision).

Mode of operation – a condition in which a *unit* operates at the given time (it may be afloat or positioned on the sea bed). For the purpose of the present *Publication*, the following modes of operation have been distinguished:

– *unit* afloat – a condition when the *unit* floats on the water,
– *unit* fixed – mode of operation when the *unit* is positioned on the legs on the sea bed and its hull is above the sea water level at the prescribed height. Temporary fixing means fixing on the sea bed for a defined time-period, which ends with transition of the *unit* to afloat mode. Permanent fixing means fixing for an indefinite time-period, which is, however, restricted by *unit* structure degradation and demand of preservation of environment protection requirements. Permanent fixing shall end with liquidation or neutralization of the platform.
– transient conditions – the *unit* is being fixed on the sea bed or elevated,
– severe storm conditions – a condition wherein a *unit* may be subjected to the most severe environmental loadings for which it is designed. It is assumed that process operations shall be discontinued due to the severity of the environmental conditions.

Mobile unit – brief definition of a mobile offshore drilling unit (MODU Code), or other offshore platform of self-elevating type, intended for reconstruction to production platform.

Operator – operator of the *unit*, acc. to art. 2 of Directive 2013/30/EU of 12 June 2013, also the owner or operator of the marine structure acc. to the Regulation of the Minister of Maritime Affairs on the technical conditions of use and the detailed scope of control of marine engineering structure of 23 October 2006 (Journal of Laws, No. 206, of 2006, item 1516).

PCS – Process control station – enclosed space or part thereof accommodating the means of control of hydrocarbons extraction and processing systems, as well as the means of control of the process-associated auxiliary systems (including power supply systems);

Pre-loading – transitional increase of the *unit* weight by means of ballasting, used during the *unit* positioning on sea bed.

Process medium – a medium gained from the sea deposit, subject to technological process, and subsequently exported from the *unit* and/or utilized for the *unit* power supply in the form of liquid or gas.

Process operations – any activities associated with the exploitation, processing and exporting hydrocarbons from the platform.

Protective coatings – coating materials applied to provide protection against corrosion, usually epoxy or equivalent. Other coating systems may be considered acceptable as alternatives, provided they are applied and maintained in accordance with the manufacturer’s specifications.

P S D s y s t e m – process shutdown system – a safety system intended for shutdown (isolating) one or many component installations of production process by closing of specified valves and immobilizing machinery.

P u b l i c s p a c e s – halls, dining rooms and other similar spaces.

~~S a f e t y o p e r a t i o n c e r t i f i c a t e – *Safety structure operation certificate of the fixed offshore unit*, a *Safety installation operation certificate of the fixed offshore unit*.~~

S c o u r i n g – washing out the footing substract by sea water stream.

S e l f - e l e v a t i n g o f f s h o r e p l a t f o r m – platform having hull with sufficient buoyancy for its safe transit, fitted with movable legs capable of raising the hull above the sea level and being supported on, or stuck into, sea bed.

S e m i - e n c l o s e d s p a c e – a location where natural conditions of ventilation are notably different from those on open decks due to the presence of structures such as roofs, windbreaks and bulkheads and which are so arranged that dispersion of gas may not occur.

S e m i h a r d c o a t i n g – a coating that dries and converts in such a way that it stays flexible and has the ability to prevent corrosion for at least three years.

S e r v i c e s p a c e s – galleys, pantries containing cooking appliances, lockers, store-rooms, workshops other than those forming part of the machinery spaces, as well as similar spaces and trunks to such spaces.

S p l a s h i n g z o n e – a zone where the structure of platform legs is periodically flooded and/or splashed with water and exposed, due to waves motion and changes of sea level.

S o f t p r o t e c t i v e c o a t i n g s – coating that remains soft so that it wears off at low mechanical impact, when walked, touched, due to erosion, etc. Soft protective coating is based on lanolin, vegetable oil or other organic, as well as non-organic substances.

S t a t i o n a r y *U n i t* – the unit permanently positioned on the ground.

S u b s t a n t i a l c o r r o s i o n – an extent of corrosion such that assessment of corrosion pattern indicates wastage in excess of 75% of allowable margins, but within acceptable limits.

S u r v e y – a set of inspection and control activities executed by PRS in the specified time realized through checking compliance with technical documentation, as well as carrying out appropriate examinations, measurements and tests. It is assumed, as a principle, that within the framework of a survey an inspection is performed in accordance with § 62.1 of the Regulation of the Minister of Maritime Affairs on the technical conditions of use and the detailed scope of control of marine engineering structures of 23 October 2006 (Journal of Laws, No. 206, of 2006, item 1516).

U n i t , M a r i n e U n i t – for the purpose of this Publication, a fixed offshore or self-elevating platform, used for hydrocarbons extraction (drilling platform) and processing (production platform), intended to be positioned permanently or temporarily on sea bed. The *unit* consists of a pontoon and supporting legs. The pontoon consists of a hull and equipment. The hull together with supporting legs is defined as structure. The supporting leg consists of a leg and a footing. In terms of geological and mining law, the *unit* positioned on sea bed for deposit extraction is a construction object in terms of building law. In terms of the Polish building law, the *unit* positioned permanently on sea bed is a marine structure. The *unit* conventional boundaries have been defined in 1.1.11.

U n i t p o s i t i o n i n g – the whole of the issues and technical processes related to permanent fixing the *unit* on the sea bed.

U n i t r e c o n s t r u c t i o n – works of wide extent aimed at extending the *unit* operational period.

1.2.2 Hazardous Zones[1]

1.2.2.1 Definitions

Hazardous zones – areas in which explosive gases, vapours or mists exist, or may exist, in the amounts sufficient to arise explosive or flammable mixtures.

Zone 0 – zone in which explosive or flammable mixture of gases, vapours or mists exists continuously or for long periods in normal operation, approximately for more than 1000 hours within a year.

Zone 1 – zone in which explosive or flammable mixture of gases, vapours or mists is likely to occur in normal operation or during repair or maintenance activities, or after damage/failure of system equipment, approximately from 10 to 1000 hours within a year.

Zone 2 – zone in which explosive or flammable mixture of gases, vapours or mists is not likely to occur at normal operational conditions; such explosive or flammable mixture may exist only for a short time, approximately from 1 to 10 hours within a year.

Zone 2 includes also spaces where flammable volatile liquids, gases or mists are stored and/or processed or used, however, they remain inside closed tanks and/or pipings, and they may leak outside only in result of damage to these tanks or pipings.

The zone 2 includes also spaces where explosive or flammable mixtures do not arise due to ventilation, however, where explosion hazard may arise in result of the ventilation system failure or inoperativeness.

1.2.2.2 Examples of places belonging to particular zones:

Zone 0 includes the internal spaces of closed tanks, production machinery and pipes for active process mud, including gas outlets

Zone 1 includes:

- **.1** outdoor and semi-enclosed locations – the areas within 1.5 m from any ventilation outlets of zone 1, or any access to Z1 spaces;
- **.2** pits, ducts or similar structures in locations which would otherwise be Z2 but which are so arranged that dispersion of gas may not occur.

Zone 2 includes:

- **.1** areas within 1.5 m off the space of zone 1 referred to in 1.2.2.7;
- **.2** outdoor areas within 1.5 m of the boundaries of any ventilation outlet from or access to Z2 space, except cases specified in paragraph 1.2.2.5;
- **.3** air locks between zone 1 and a non-hazardous area.

1.2.2.3 Examples of additional places counted in particular zones: onboard the *unit* maintaining active well intervention equipment

Zone 0 includes inter alia the internal spaces of ~~closed tanks and~~ gas outlet pipe for active process mud between the well and the final depressurizing discharge.

Zone 1 includes:

- **.1** enclosed spaces containing any part of the mud circulating system that has opening into the spaces and is between the well and the final depressurizing discharge ;
- **.2** in outdoor and semi-enclosed locations – the areas within 1.5 m from the boundaries of any openings to equipment which is part of the mud system as specified in .1, any ventilation outlets of zone 1, or any access to Z1 spaces;
- **.3** enclosed spaces or semi-enclosed locations that are below the drill floor and contain a possible source of explosion mixture release such as the top of a drilling nipple;

[1] Arrangement and sizes of hazardous zones shall be determined according to a recognized standard. E.g. API RP 505. Information in 1.2.2 are given for information.

.4 enclosed spaces that are on the drill floor and which are not separated by a solid floor from the spaces specified in .3.

Zone 2 includes:

.5 enclosed spaces which contain open sections of the mud circulating system from the final depressurizing discharge to the mud pump suction connection at the mud pit;

.6 outdoor locations within the boundaries of the drilling derrick up to a height of 3 m above the drill floor;

.7 semi-enclosed derricks to the extent of their enclosure above the drill floor or to a height of 3 m above the drill floor, whichever is the greater;

.8 semi-enclosed locations below and contiguous to the drill floor and to the boundaries of the derrick or to the extent of any enclosure which is liable to trap gases.

.9 outdoor locations below the drill floor and within a radius of 3 m from a possible source of explosion mixture release such as the top of a drilling nipple.

1.2.2.4 Communication between the Zones

Where, for operational reasons, access doors or other openings are required between a non-hazardous space and the adjacent Zone 1 or Zone 2, any non-hazardous space and lower hazard space shall be treated as a space of higher hazard the same as the location the opening leads to, except that

.1 an enclosed space with direct access to any Zone 1 location can be considered as Zone 2 if
- the access to Zone 2 is fitted with a gastight door opening into this space, and
- ventilation is such that the air flow with the door open is from Zone 2 space into Zone 1 location, and
- loss of ventilation is alarmed at a permanently manned station;

.2 an enclosed space with direct access to any Zone 2 location is not considered hazardous if:
- the access is fitted with a self-closing gastight door that opens into the non-hazardous location, and
- ventilation is such that the air flow with the door open is from the non-hazardous space into Zone 2 location, and
- loss of ventilation is alarmed at a permanently manned station;

.3 an enclosed space with direct access to any Zone 1 location is not considered hazardous if:
- the access is fitted with self-closing gastight double doors forming an airlock, and
- the space has ventilation overpressure in relation to the hazardous space, and
- loss of ventilation is alarmed at a permanently manned station.

Where ventilation arrangements of the intended safe space are considered sufficient by PRS to prevent any ingress of gas from Zone 1 location, the two self-closing double doors forming an airlock may be replaced by a single self-closing gastight door which opens into the non-hazardous location and has no hold-back device

1.2.2.5 Devices which shall be taken into account at considering hazardous spaces [1] (examples).

.1 Pressure vessels containing hydrocarbons
.2 Valves, valve servo-motors, flange and threaded connections
.3 Inlet production manifold
.4 Boilers, piston engines and turbines
.5 Cleaning pig handling devices
.6 Deposit water installations
.7 Compressors and pumps of volatile, flammable and explosive media
.8 Measuring instruments containing hydrocarbons
.9 Drip trays
.10 Sewage wells
.11 Sewage pipes ends
.12 Control panels and switchboards.

[1] Typical equipment located onboard production platform in the area defined in 1.1.11.

2 SCOPE OF SURVEY

PRS' classification survey, based on the principles and requirements specified in the present *Publication*, covers:

.1 materials and welding applied in the construction, conversion and repair of the structure and equipment of a *unit*,
.2 structure strength,
.3 *unit* jacking machinery,
.4 intact and damage stability of the *unit* towed to permanent location,
.5 watertight and weathertight integrity of the *unit*,
.6 hull equipment of the *unit* towed to permanent location,
.7 *unit* positioning on sea bed
.8 measuring devices used for control of position and signalling changes of technical condition of the *unit* positioned on sea bed,
.9 process machinery and installations located above sea level (including pressure vessels, separators, heat exchangers, compressors, pumps, electrical machinery):
- above-water systems supporting deposit exploitation (water conditioning and forcing, chemicals proportioning);
- crude oil processing and export systems,
- gas compression and export systems,

.10 power supply machinery and systems (including internal combustion engines and electric motors, generators and distributing arrangements, boilers, pressure vessels, heat exchangers, compressors and pumps):
- power supply,
- liquid and gas fuel systems, gas fuel conditioning,
- compressed air systems,
- steam systems,
- compressors,
- pumps,

.11 ventilation systems,
.12 fire alarms and protection,
.13 explosion alarms and protection,
.14 radio, navigational and signalling systems and equipment,
.15 life-saving systems and equipment, escape routes,
.16 environment protection systems and equipment,
.17 lifting appliances,
.18 helideck facilities.

3 PRS DOCUMENTS ISSUED FOR THE *UNIT*

3.1 General

After completion, with positive result, appropriate surveys and carrying out respective tests of the *unit*, including inspections and examinations prescribed in building law, PRS issues appropriate certificates and documents to be transferred to Maritime Administrations.

In paragraphs 3.2, 3.3, 3.4, general principles applicable at the issue of the above mentioned documents have been presented, using the newly constructed, converted or reconstructed *units* as an example. Information concerning the issue of documents to existing units, not subject to conversion or reconstruction, are presented in Chapter 4.

3.2 Documents Issued After Completion of Shipyard Acceptance Tests of the *Unit*

3.2.1 Temporary Certificate of Fixed Offshore Unit (1)

The *Temporary Certificate of Fixed Offshore Unit* confirms compliance of the *unit* structure and equipment, necessary for safe transport to the permanent location and for the *unit* positioning, with the requirements of Parts II, III, IV, V, VI and VII of this *Publication* and with an approved technical documentation.

The certificate confirms fitness of the *unit* structure and equipment for the safe transport to the permanent location and for the unit positioning on the sea bed according to an agreed project and technology. The certificate is enclosed with the Application for building permit (the unit fixing on the sea bed), to be submitted to the building supervision body.

The certificate is issued for a limited time, needed for the safe transport of the *unit* to permanent location and for the *unit* positioning activities. In a justified case, e.g. due to change of technical condition of the unit structure and/or equipment, PRS may change the validity date of the already issued certificate. The certificate ceases its validity automatically after issue of the document in accordance with 3.3~~.1~~.

3.2.2 Temporary Certificate of Self-elevating Offshore Unit (1)

For the unit positioned on the deposit, instead of the certificate acc. to 3.2.1, *Temporary certificate of self-elevating offshore unit* (1) may be issued according to 3.2.1. The issue of such certificate is conditioned by confirmation by PRS of the unit ability to elevate from the place of positioning and transition to afloat mode. The certificate automatically ceases to be valid after the issue of the document in accordance with 3.3.

3.2.3 Temporary Documents for Maritime Administrations

.1 Survey report on radio, navigational and signalling equipment,
.2 Survey report on life-saving equipment,
.3 List of equipment – environment pollution prevention,
.4 Compliance certificate - environment pollution prevention.

The requirements concerning issuing the above documents are specified in Part VIII.

3.3 Documents Issued to the *Unit* Positioned on the Sea Bed

3.3.1 Temporary Certificate of Fixed Offshore Unit (2)

The *Temporary Certificate of Fixed Offshore Unit* confirms compliance of the *unit* structure and equipment, necessary for safe operational testing on the given location, with the requirements of Parts II, III, IV, V, VI and VII of this *Publication* and with an approved technical documentation.

The certificate confirms fitness of the *unit* structure and equipment for the safe operational testing on the given deposit and permanent location. The certificate is enclosed with the Application for permit to temporary use the *unit* with the purpose of carrying out operational testing, to be submitted to the building supervision body.

The certificate is issued for a limited time, necessary for operational testing. In a justified case, e.g. due to change of technical condition of the *unit* structure and/or equipment, PRS may change the validity date of the already issued certificate. The certificate ceases to be valid automatically after issue of the document in accordance with 3.4.1.

3.3.2 Temporary certificate of self-elevating offshore unit (2)

For the unit positioned on the deposit, instead of the certificate acc. to 3.3.1, *Temporary Certificate of Self-elevating Offshore Unit* (2) may be issued according to 3.3.1. The condition for the issue of such certificate is confirmation by PRS of the unit ability to elevate from the place of positioning and transition to afloat mode.

3.3.3 Temporary certificate of self-elevating offshore unit (3)

The Temporary Certificate of Self-elevating Offshore Unit confirms compliance of the *unit* structure and equipment, necessary for safe elevating from the place of positioning, transition to afloat mode and transport by sea, with the requirements of Parts II, III, IV, V, VI and VII of this *Publication* and with an approved technical documentation.

The certificate is issued for a limited time, necessary for the *unit* elevating and safe transport. In a justified case, e.g. due to change of technical condition of the *unit* structure and/or equipment, PRS may change the validity date of the already issued certificate.

3.3.4 Temporary Documents for Maritime Administration

Documents as in 3.2.3, issued for the unit positioned or elevated and to be transported by sea.

3.4 Permanent Documents – Issued After Positive Completion of Operational Testing

3.4.1 Certificate of Fixed Offshore Unit

The Certificate of Fixed Offshore Unit confirms compliance of the *unit* structure and equipment with the requirements of Parts II, III, IV, V, VI and VII of this *Publication* and with an approved technical documentation.

The certificate confirms fitness of the *unit* structure and equipment for the safe operation on the given oilfield and location. The certificate is enclosed with the Application for permit to operate the *unit*, to be submitted to the building supervision body.

The Certificate is issued on the date of initial survey completion. Certificate validity period is 5 years, provided surveys required by this *Publication* will be performed and recommendations executed positively at due terms. In a justified case, due to change of technical condition of the unit structure and/or equipment, the Certificate may be issued with shorter validity. In the above case, PRS may also shorten the validity of the previously issued Certificate.

PRS may suspend validity of the certificate or cancel it for reasons defined in Chapters 7 and 8 of this Part.

3.4.2 Certificate of Self-elevating Offshore Unit

For the unit positioned on the deposit, instead of the certificate acc. to 3.4.1, the *Certificate of Self-elevating Offshore Unit* (1) may be issued according to 3.4.1. The condition for the issue of such certificate is confirmation by PRS of the unit ability to elevate from the place of positioning and transition to afloat mode.

3.4.3 Documents for Maritime Administrations

.1 Survey report on radio, navigational and signalling equipment,
.2 Survey report on life-saving equipment,
.3 List of equipment – environment pollution prevention,
.4 Compliance certificate - environment pollution prevention.

Requirements for the issue of the above documents are specified in Part VIII.

~~3.4.4 Safety Structure Operation Certificate for the Fixed Offshore Unit~~

~~The *Safety Structure Operation Certificate for the Fixed Offshore Unit* is issued at the separate request of the *unit* Operator.~~

~~The Certificate confirms compliance with organizational and technical conditions ensuring safe structure operation of the *unit* having valid *Certificate of Fixed Offshore Unit*.~~

~~Requirements for the issue of the above Certificate are specified in Part IX.~~

~~The certificate validity period is 5 years, provided audits required by this *Publication* will be performed and recommendations executed positively at due terms. In a justified case, the Certificate may be issued with shorter validity. PRS may also shorten validity of the previously issued Certificate.~~

~~PRS may suspend validity of the certificate or cancel it for reasons defined in Part IX.~~

~~3.4.5 Safety Installation Operation Certificate for the Fixed Offshore Unit~~

~~The *Safety Installation Operation Certificate for the Fixed Offshore Unit* is issued at the separate request of the *unit* Operator.~~

~~The Certificate confirms compliance with organizational and technical conditions ensuring safe installation operation of the unit having valid *Certificate of Fixed Offshore Unit*.~~

~~Requirements for the issue of the above certificate are specified in Part IX.~~

~~The certificate may be issued for all installations or for a specified one/group of installations.~~

~~The certificate validity period is 5 years, provided audits required by this *Publication* will be performed and recommendations executed positively at due terms. In a justified case, the certificate may be issued with shorter validity. PRS may also shorten validity of the previously issued certificate.~~

~~PRS may suspend validity of the certificate or cancel it for reasons defined in Part IX.~~

3.4.4 Helideck Certificates

The temporary *Certificate of Helideck Equipment Compliance*, is issued at the request of the *unit* Operator, after completion of PRS initial survey of these facilities, in accordance with the requirements of Part X.

The *Certificate of Helideck Equipment Compliance*, called also *Helideck Certificate* is issued at the request of the *unit* Operator, after completion of air operation trials at the normal service conditions of the *unit*.

The Helideck Certificate confirms the helideck structure and equipment conformity with the requirements of Part X and an approved technical documentation, as well as compliance with technical conditions of safe performance of specified air operations and service activities for defined sizes and types of helicopters.

The certificate validity period is 5 years, provided surveys required by this *Publication* will be performed with positive result and recommendations executed ~~positively~~ at due terms. In a justified case, the certificate may be issued with shorter validity. PRS may also shorten the validity of the previously issued certificate.

PRS may suspend validity of the certificate or invalidate it for reasons defined in Part X.

3.5 Documents of Lifting Appliances

Conditions for the issuing documents for lifting appliances and making entries therein are shown in Part VIII.

3.6 Documents concerning the *unit* withdrawal from service

At the request of the Operator, PRS shall issue, according to the plan and adopted procedures for *units* withdrawal from positioning location and utilization (scrapping), documents confirming fulfilling the personnel, environment, and material resources safety conditions during realization of the above procedures. The scope of survey to be performed before the issue of the documents and the scope of possible supervision will be subject to separate consideration.

3.7 Other Documents

PRS may issue for the *unit* other documents, such as e.g. *Single Voyage Declaration* or technical certificates, in accordance with the *PRS Principles of Supervision Activity*, on the basis of technical requirements specified in this Publication.

4 UNIT ACCEPTANCE FOR PRS SURVEY

4.1 General

Certificates

4.1.1.1 The process of *unit* acceptance for PRS survey completes with the issue of permanent *Certificate of Fixed Offshore Unit* or permanent *Certificate of Self-elevating Offshore Unit.*

4.1.1.2 *Helideck Certificate* ~~and *Safety Operation Certificate*~~ may be issued to the *unit* having valid permanent PRS *Certificate of Fixed Offshore Unit* or *Certificate of Self-elevating Offshore Unit*, after confirmation of its compliance with the requirements of ~~Parts IX and~~ Part X.

4.1.2 Conditions of the *Unit* Acceptance for PRS Survey

According to this Publication requirements, the *unit* may be accepted for PRS survey after submitting by the Owner a written Application, required technical documentation and submitting the *unit* for an *Initial Survey*, as shown in Table 1.

According to the requirements of this *Publication*, PRS may cover with his survey:

.1 a new-built construction,

.2 a converted mobile offshore *unit*, having class certificate or an equivalent document issued by PRS or any other Class Society, or an equivalent safety document recognized by Maritime Administration and issued by appropriate body of shelf state administration.

.3 a converted mobile offshore *unit* whose class assigned by PRS or any other Class Society, or an equivalent safety document issued by appropriate body of shelf state administration, ceased to be valid,

.4 a converted mobile offshore *unit* which has never been granted before the relevant certificate of class nor any safety document issued by shelf state administration, or whose such certificate has never been submitted to Polski Rejestr Statków.

.5 a *unit* not subject to conversion, granted previously a PRS certificate of class or an equivalent document for a mobile offshore *unit*, positioned permanently in a specified location on sea bed or intended to be so positioned.

4.1.3 Initial Survey of the Offshore *Unit*

4.1.3.1 General

The result of the Initial Survey shall confirm that the *unit* technical condition is such that it can be operated safely within operation period declared by the Operator on the permanent location, on the condition that relevant periodical surveys will be carried out and PRS recommendations executed, including repairs possible to be performed on site.

In respect of the *unit* structure, a reserve of fatigue strength shall be considered, in accordance with the requirements of Part II.

4.1.3.2 Initial Survey of Bottom Parts of *Unit* Legs

The result of the survey of bottom parts of the *unit* legs, which are located below the sea bed level and are not accessible for inspection, shall indicate that their technical condition is such that the *unit* can be operated safely without periodical surveys of the said parts, for a time not shorter than the time of the *unit* exploitation on the permanent location, declared by the Operator and recorded in the *Certificate of Fixed Offshore Unit*.

In particular case, when the requirement of 4.1.3.2 may not be complied with, PRS may agree to application of requirement 4.1.3.3.

4.1.3.3 Initial Underwater Survey of *Unit* Legs Bottom Parts

PRS may accept surveys of bottom parts of the *unit* legs, which are below the sea bed level, performed under water if the Operator declares the possibility of such solution. In such case, appropriate declaration of the Operator, as well as decision on the terms of underwater surveys of the *unit* legs bottom parts shall be entered in the *Certificate of Fixed Offshore Unit.*

4.2 A *Unit* Newly Constructed under PRS Survey

4.2.1 Technical Documentation

4.2.1.1 General Technical Documentation

PRS shall receive the application for acceptance of the *unit* for survey, in accordance with this Publication, and main plans of the *unit* including technical description, general arrangement plan and environmental parameters. The documentation shall cover at least the below issues:

- the *unit* purpose, characteristics of crude oil and gas production process, characteristics of products export means;
- characteristics of sea bed in the *unit* permanent location over the oilfield;
- expected period of the drilling *unit* service in the location;
- method of the *unit* removal from the permanent location after exploitation completion and its utilization (scrapping);
- sea depth and sea bed characteristics in the *unit* permanent location over the deposit;
- wave heights and periods;
- expected maximum wind speed;
- expected speed and direction of sea current;
- minimum air and water temperature;
- other environmental factors;
- expected depth of sea bed penetration;
- minimum distance from the hull bottom to water surface;
- status of jacking machinery after the *unit* positioning on the oilfield:
  - maintaining legs jacking capability; or
  - maintaining only the capability of pontoon being statically supported on legs;
- description of technological process of the *unit* equipment (in a dock, in water, after being positioned);
- maximum mass of the *unit* during its transit to permanent location and after being positioned;
- number of permanent crew members.

4.2.1.2 Building Design

Documentation referred to in Subchapter 1.4 of Part III, approved by building supervision body appropriate for fixed offshore *units*, shall be submitted to Polski Rejestr Statków for review.

4.2.1.3 Documentation of the *Unit* Structure and Equipment

Documentation within the scope given in Parts II, IV, V, VI, VII and VIII of this Publication shall be submitted to PRS for consideration.

4.2.1.4 Workshop Documentation of the *Unit* Structure and Equipment

The workshop documentation shall be supplied prior to construction commencement, for agreement, to designated PRS field unit. The scope of the documentation shall be each time defined by this field unit.

4.2.1.5 Operating Booklet

Each *unit* shall be provided with an operating booklet. The booklet shall contain information for the operating personnel on the safe operation of the *unit* in both normal and emergency conditions. The documentation, prepared to the extent sufficient for operations of the *unit* covered by issued temporary or permanent *Certificate of Fixed Offshore* Unit, shall be agreed with PRS and submitted to the *unit* before final surveys are carried out for the issue of the above certificates.

The documentation shall include:

.1 a general description of the *unit*, indicating the lightweight data based on the results of an inclining test, as well as hydrostatic curves or equivalent data[1];

.2 pertinent data for each approved mode of operation, including design loads from waves and current, wind, minimum anticipated air and sea temperatures, assumed sea bed conditions, draught and other environmental factors;

.3 a general arrangement plan, including permissible deck loads and showing watertight compartments, closings, air vents and ventilation. If the unit has permanent ballast, its mass, distribution and material shall be clearly indicated;

.4 typical load conditions;

.5 *unit* stability booklet containing maximum KG-draught or displacement curve based upon compliance with the required intact and damage stability criteria;

.6 unit subdivision information;

.7 operational instructions, including precautions to be taken in adverse weather, changing mode of operations or any inherent limitations of operations;

.8 drawings and description of ballast system including instructions for ballasting;

.9 sounding tables;

.10 hazardous zones plan;

.11 fire control plan approved by Maritime Administration;

.12 diagram of main oil fuel system including oil fuel storage tanks;

.13 information on safety measures including arrangement of life-saving appliances and personnel evacuation proceedings;

.14 production systems descriptions and operational instructions;

.15 schemes and description of ESD and PSD systems operation;

.16 diagrams of main and emergency electric power supply, as well as diagrams of electric installation, details of emergency shut down procedures for electrical equipment;

.17 a set of drawings showing the exact location and extent of application of different grades and strength of structural materials, their technical characteristics being given;

.18 a description of the material and welding procedures employed, as well as any other relevant construction information;

.19 data relating to restrictions and prohibitions regarding repairs or modifications.

4.2.2 The Scope of Initial Survey

The Initial Survey covers:

.1 approval of documentation for the *unit* structure and equipment, within the scope ogiven in 4.2.1.3;

.2 agreement of workshop documentation acc. to 4.2.1.4;

.3 agreement of the operation booklet acc. to 4.2.1.5;

.4 supervision of the manufacture of machinery, electrical and other devices, equipment, materials and products referred to in particular Parts of this *Publication*;

.5 supervision of hull and legs construction;

.6 supervision of installation of machinery, equipment and systems mentioned in particular Parts of the *Publication*, onboard the *unit*,

.7 supervision of sea trials of the *unit*;

.8 supervision of the *unit* transport to the permanent location;

.9 supervision of the *unit* positioning on the sea bed and survey of legs after permanent positioning the unit on the sea bed[2],

.10 supervision of operational tests on the permanent location;

.11 periodical inspection, referred to in art. 62 item 1 para 2 of the Act of 7 July 1994 on Building Law, (Journal of Laws 2018.1202 uniform text of 22.06.2018, as further amended), taking into account

[1] Not applicable to the unit accepted for PRS survey according to 4.6.2.3

[2] During and after positioning the *unit* on the sea bed, legs and elevating equipment shall be surveyed. The scope of survey shall be determined considering the positioning process. The survey after positioning may cover examinations of the unit legs by a diver, examinations with the use of unmanned underwater vehicles, NDT examinations.

art. 62, item 1, para 4 of the said act and requirements of § 62, § 75 and § 76 of the Regulation of the Minister for Maritime Affairs of 23 October 2006 on the technical conditions of use and the detailed scope of control of marine engineering structures (Journal of Laws No. 206 of 2006, item 1516).

4.3 Converted Mobile Offshore *Unit* having *Class* Certificate

4.3.1 Technical Documentation

For the *unit* under conversion or reconstruction, granted previously certificate of PRS or of another Class Society or Maritime Administration recognized equivalent safety certificate, issued by relevant Foreign Shelf State Administration, documentation scope according to 4.2.1 applies. PRS may accept a specified document/ documents from own classification documentation as the basis for survey of the *unit*.

In particular case, PRS may accept as a basis for survey a specified document/ documents issued by another Classification Society or Maritime Administration recognized equivalent safety certificate, issued by relevant foreign Shelf State Administration.

4.3.2 The Scope of Initial Survey

The scope of Initial Survey covers:

.1 approval of documentation for the *unit* structure and equipment, within the scope given in 4.2.1.3, including the provisions of 4.3.1;
.2 agreement of workshop documentation acc. to 4.2.1.4;
.3 agreement of the operation booklet acc. to 4.1.2.5, including the provisions of 4.3.1;
.4 supervision of the manufacture of new machinery, electrical and other devices, equipment and materials and products referred to in particular Parts of this *Publication*;
.5 supervision of hull and legs reconstruction/conversion;
.6 supervision of installation of new machinery, equipment and systems mentioned in particular Parts of the *Publication*, onboard the *unit;*
.7 supervision of machinery and structures not subject to conversion – within the scope as for the renewal of the *Certificate* (acc. to 6.3). PRS may agree to survey performance to the scope of relevant periodical survey (6.1 or 6.2);
.8 supervision of sea trials of the *unit*;
.9 supervision of the *unit* transport to the permanent location;
.10 supervision of the *unit* positioning on the sea bed and survey of legs after permanent positioning the unit on the sea bed[1)];
.11 supervision of operational tests on the permanent location.
.12 periodical control, referred to in art. 62 item 1 para 2 of the Act of 7 July 1994 on Building Law (Journal of Laws 2018.1202 uniform text of 22.06.2018, as further amended), taking into account art. 62, item 1, para 4 of the said act and requirements of § 62, § 75 and § 76 of the Regulation of the Minister for Maritime Affairs of 23 October 2006 on the technical conditions of use and the detailed scope of control of marine engineering structures (Journal of Laws No. 206 of 2006, item 1516).

4.4 Converted Mobile Offshore Unit with Invalid Certificate

4.4.1 Technical Documentation

For the mobile offshore unit under conversion, whose certificate issued by PRS or by another Class Society or an equivalent safety certificate issued by relevant foreign Shelf State Administration became invalid, PRS makes a decision on application of requirement acc. to either 4.2.1 or 4.3.1.

4.4.2 The Scope of Initial Survey

[1)] During and after positioning the *unit* on the sea bed, legs and elevating equipment shall be surveyed. The scope of survey shall be determined considering the positioning process. The survey after positioning may cover examinations of the unit legs by a diver, examinations with the use of unmanned underwater vehicles, NDT examinations

PRS makes a decision on application of requirement acc. to either 4.2.2 or 4.3.2 in respect of all or selected survey objects.

4.5 Converted Mobile Offshore *Unit* with no Certificate Issued Before

4.5.1 Technical Documentation

For the mobile offshore unit under conversion which has never been issued with appropriate certificate nor a safety document of foreign Shelf State Administration, or whose such certificate has never been submitted, PRS shall require submission of technical documentation according to 4.2.1. In particular cases, PRS may consider reducing the scope of documentation, if it does not affect the unit, people and environment safety.

4.5.2 The Scope of Initial Survey

PRS shall determine the scope of the Initial Survey of the unit structure and equipment.

4.6 The Unit not subject to Conversion Issued with Certificate

4.6.1 Technical Documentation

For the *unit* not subject to conversion having previously been granted a certificate or an equivalent PRS document issued for a mobile offshore unit, permanently positioned in a defined location on sea bed or intended to be so positioned, documentation scope as per 4.2.1 applies. PRS may accept a specified document/documents from its own classification documentation of the unit as a basis for survey.

In the case the *unit* is permanently positioned on sea bed and will remain there, the scope of technical construction documentation referred to in 3 of Part III may be limited if it is accepted by a building supervision body.

4.6.2 The Scope of Initial Survey

4.6.2.1. Initial Survey Carried out Partly during *Unit* Repair in a Shipyard

The scope of Initial Survey covers:

.1 audit of classification documentation of the *unit* structure and equipment, to the scope acc. to 4.2.1.1, 4.2.1.2, 4.2.1.3, 4.2.1.5;

.2 consideration of documentation of repairs and minor structural changes, approval and/or agreement of alterations made in the *unit* documentation;

.3 supervision of the manufacture of new machinery, electrical and other devices, equipment and materials and products referred to in particular Parts of this *Publication*;

.4 supervision of the installation of new machinery, equipment and systems mentioned in particular Parts of the *Publication*, onboard the *unit*;

.5 supervision of hull and legs, including inspection in a dock;

.6 supervision of sea trials of the *unit*,

.7 supervision of the *unit* transport to the permanent location,

.8 supervision of the *unit* positioning on the sea bed and survey of legs after permanent positioning the unit on the sea bed,

.9 supervision of operational tests on the permanent location,

.10 periodical control, referred to in art. 62 item 1 para 2 of the Act of 7 July 1994 on Building Law, (Journal of Laws 2018.1202 uniform text of 22.06.2018, as further amended), taking into account art. 62, item 1, para 4 of the said act and requirements of § 62, § 75 and § 76 of the Regulation of the Minister for Maritime Affairs of 23 October 2006 on the technical conditions of use and the detailed scope of control of marine engineering structures (Journal of Laws No. 206 of 2006, item 1516).

The proceedings of 4.6.2.1 may be applied, provided that new machinery and changes referred to above in enumerations .2, .3 and .4 are introduced in non-significant scope and the *unit* purpose does not change. Otherwise a complete procedure acc. to 4.3 applies.

4.6.2.2. Initial Survey Performed upon Special Decision of PRS without Dock Survey

Proceeding according to 4.6.2.1 applies; the hull survey shall be carried out in part in the *unit* positioned condition, and the legs survey in the *unit* afloat condition.

4.6.2.3. Initial Survey Performed upon Special Decision of PRS at the *Unit* Permanent Location

Proceeding according to 4.6.2.1 applies, excluding enumeration 5 (dock survey) and enumerations 6, 7 and 8.

The survey of hull and legs, including the part of legs situated below the sea bed level, is performed in the *unit* positioned condition. The condition for such a survey is ensuring by Operator the possibility of technical condition assessment of the bottom parts of legs, situated below the sea bed level, see the requirement of 4.1.3.3.

Table 1

Procedure of the *unit* Initial Survey, stages					
Unit acc. to	Structure and equipment survey, dock survey, *unit* tests in afloat condition	Structure and equipment survey, *unit* tests in afloat condition	Survey of the *unit* positioned on sea bed	Survey/ operational tests	Conditions to be fulfilled for particular type of Initial Survey
	After completion of the stage, PRS issues a document acc. to				
4.1.2.1	3.2.1, 3.2.2	-	3.3.1	3.4.1, 3.4.2	
4.1.2.2	3.2.1, 3.2.2	-	3.3.1	3.4.1, 3.4.2	
4.1.2.2	-	3.2.1, 3.2.2	3.3.1	3.4.1, 3.4.2	Acceptance for the validity of hull and legs dock survey performed by the previous Class Society
4.1.2.3	3.2.1, 3.2.2	-	3.3.1	3.4.1, 3.4.2	
4.1.2.4	3.2.1, 3.2.2	-	3.3.1	3.4.1, 3.4.2	
4.1.2.5	3.2.1, 3.2.2	-	3.3.1	3.4.1, 3.4.2	
4.1.2.5	-	3.2.1, 3.2.2	3.3.1	3.4.1, 3.4.2	Upon special PRS decision – hull survey partly in the *unit* elevated condition, legs survey in the *unit* afloat condition
4.1.2.5	-	-	3.3.1	3.4.1, 3.4.2	Upon special PRS decision – hull and legs survey in the *unit* positioned condition,

5 MAINTAINING THE CERTIFICATE VALIDITY – SURVEYS

5.1 General

5.1.1 The conditions for maintaining the *Certificate of Fixed Offshore Unit* are:
- maintaining the *unit* – its structure, machinery and equipment – in a satisfactory technical condition,
- operation of the *unit* in accordance with conditions specified in the *Certificate of Fixed Offshore Unit*, the manufacturer's instructions and the principles of good seamanship,
- carrying out due Periodical Surveys, including inspections performed according to § 62 of the Regulation of the Minister of Maritime Affairs of 23 October 2006 on the technical conditions of use and the detailed scope of control of marine engineering structures (Journal of Laws No. 206 of 2006, item 1516), at scheduled dates,
- carrying out recommendations at scheduled dates,
- carrying out the required Occasional Surveys/special inspections
- timely payment of fees for survey services.

5.1.2 PRS informs the Owner on the dates of due Periodical Surveys by the *unit's* survey status. Non-receipt of the information does not absolve the Owner from an obligation to submit the *unit* for survey at the dates specified in the *Publication.*

5.1.3 The Operator is obliged to prepare properly a *unit* for each survey. The Surveyor may refrain from a performing a survey if he considers that the *unit* has not been properly prepared for the survey or threat to life or health exists.

If, during the survey, entering a confined space is necessary, the requirements contained in Publication *No. 28/I Guidelines for Safe Entry to Confined Spaces (from 2019 replaced by Publication No. 123/P)* shall be complied with.

5.1.4 Survey for the Certificate Renewal shall ascertain that the *unit* technical condition complies with the requirements of this *Publication* and that the *unit* is fit for the intended purpose for the subsequent 5-year period – subject to proper maintenance and operation.

5.1.5 The Annual and Intermediate Survey, through examination of the structure and operation test of particular machinery, arrangements and installations, shall ascertain that the *unit* meets, in a satisfactory degree, *Certificate* validity maintenance conditions.

5.1.6 The Annual Survey, Intermediate Survey or Survey for the Certificate Renewal may be considered complete if an appropriate survey of the *unit* has been held within the scope specified in respective paragraphs of sub-chapter 5.2. PRS may extend the scope of surveys, depending on the *unit* age, technical condition, as well as the type of equipment and structure.

5.1.7 After completion of Periodical or Intermediate Survey, designated PRS Field Office endorses the Certificate.

5.1.8 After completion of the Survey for the Certificate Renewal, PRS Head Office issues a new Certificate for the *unit* on the basis of verified survey reports.

5.1.9 Intervals between Periodical Surveys of a *unit* will date from the commencement of the first classification cycle.

5.1.10 PRS may shorten the intervals between examinations, structure items thickness measurements and/or tests of the *unit* particular machinery, arrangements, systems and equipment if it is found necessary due to their technical condition or service conditions.

5.1.11 In well-justified cases, PRS' Surveyor may dispense with a survey of particular items of machinery in dismantled condition or limit the scope of survey if external examinations, measurements and operation tests prove that the machinery item is in a good and efficient condition.

5.1.12 Where, during survey, damage to the *unit* structure (buckling, grooving, detachment, fracture, etc.) over the allowable limits or corrosive wastage of surfaces, spaces or structure elements exceeding allowable limits, significant corrosion or other defects, which, in the opinion of the Surveyor, may affect the *unit* structural integrity and tightness, are found, they shall be promptly and thoroughly repaired, before the *unit* is accepted for further service.

5.1.13 Thickness measurements of the *unit* structural elements, if not carried out by PRS itself, shall be witnessed by PRS' Surveyor to the extent necessary to control the process. A meeting, prior to the commencement of the survey ~~thickness measurements~~, shall be attended by PRS' Surveyor, the Operator's representative and the representative of the thickness measurement firm. During the meeting, communication between parties involved in the survey/thickness measurements shall be agreed.

Thickness measurements of the *unit* structural members required for *Certificate* renewal shall be carried out, where practicable, well in advance, but not before the Annual Survey preceding Survey for Certificate Renewal

5.1.14 Remote inspection techniques may be used to facilitate the required internal examinations, including close-up examinations and gauging required with close-up examinations.

Proposals for use of remote inspection techniques shall be submitted to PRS' for approval before the survey.

Where such techniques are applied, confirmatory close-up examinations are carried out by PRS' Surveyor at selected locations.

The use of remote inspection techniques may be restricted or limited where there is an indication of abnormal deterioration or damage to structure.

5.1.15 Services, which constitute the basis for the *unit* technical condition assessment by PRS, such as:
- examination of the *unit* underwater part by a diver;
- thickness measurements of the *unit* structural members;
- non-destructive and destructive tests (see *Publication No. 18/I – Guidelines for Non-Destructive Tests of the Underwater Part of Mobile Offshore Drilling Units (Polish version only))*;
- surveys and tests of fire-fighting systems as well as all repairs which affect the *unit*, such as:
  - the *unit* structure repairs;
  - renovations of machinery and equipment (combustion engines and turbines, main and emergency generating sets, boilers and pressure vessels, heat exchangers, separators, process air compressors, production medium, bilge and ballast pumps, main and emergency switchboards);
  - repairs with use of special processes and procedures (welding, laminating, pulverization, Metalock repair, filling with chemosetting products);

shall be performed by service suppliers approved by PRS (see *Publication No. 51/P – Procedural Requirements for Service Suppliers*).

In justified cases, PRS' Surveyor may, at the Operator's request, agree on performance of services by a service supplier not holding PRS' approval – on a single approval basis, after verifying the service supplier's ability to perform such services.

All above-mentioned activities, performed by a service supplier, shall be verified by PRS' Surveyor.

Thickness measurements of the *unit* structural members and examination of the underwater part shall be performed in the presence of PRS' Surveyor.

5.1.16 Where repairs of the unit structure, machinery or essential equipment are to be carried out during its operation, they shall be performed only upon consent of PRS. In such cases, the Operator is obliged to submit to PRS, for acceptance, the Repairs Programme.

The Operator who plans such repairs is obliged to submit, to PRS, the Repairs Programme determining the object of repair, the repair extent and technology, and the repair performer, as well as to agree the date and scope of the survey after repairs.

In justified cases, PRS Surveyor's attendance, during repairs, may be required.

An agreement is not required in the case of maintenance and routine service ~~to hull, machinery and equipment~~ in accordance with the manufacturer's recommended procedures and established marine practice.

In addition, any not planned repairs, made during operation, which affect or may affect the *unit* safety and technical condition, shall be noted in the pertinent documents of the *unit* and submitted, as soon as possible, to PRS for the purpose of determining the scope of subsequent periodical survey.

5.1.17 In the case of repairs to the coating in ballast tanks, holds and on the *unit* underwater part plating, the Operator is obliged to submit, to PRS, a document confirming that the coating was applied in accordance with the manufacturer's recommendations. In the case of routine maintenance work carried out by the *unit* crew, submission of an Operator's report is required.

5.1.18 Each measurement constituting the basis for the assessment of the structure, machinery or equipment technical condition shall be carried out with measuring devices calibrated to recognized national or international standards. Each measuring device shall have valid calibration certificate. The Surveyor may accept, without confirmation of calibration:
– simple measuring equipment (e.g. rulers, measuring tapes, weld gauges, micrometers, etc.), provided they are of standard commercial design, properly maintained and periodically verified by the user;
– the equipment fitted on board the *unit* and used for checking pressure, temperature or rpm, etc., provided their readings are compared with other similar instruments.

5.1.19 For the unit, to which PRS issued the *Certificate of Self-elevating Offshore Unit,* general principles of certificate validity maintenance given in paragraphs 5.1.1 to 5.1.18 apply, excluding the obligation of carrying out control according to § 62 of the Regulation of the Minister of Maritime Affairs of 23 October 2006 on the technical conditions of use and the detailed scope of control of marine engineering structures (Journal of Laws No. 206 of 2006, item 1516).

5.2 Periodical Surveys

5.2.1 Types of Periodical Surveys

.1 The unit issued with PRS *Certificate of Fixed Offshore Unit*, during each classification cycle, is subject to Periodical Surveys, including also inspections according to § 62 of the Regulation of the Minister for Maritime Affairs of 23 October 2006 on the technical conditions of use and the detailed scope of control of marine engineering structures (Journal of Laws No. 206 of 2006, item 1516):
– Annual Surveys,
– Intermediate Surveys,
– 5-year Surveys for Certificate Renewal.

.2 Periodical Surveys of drilling *units* may be performed by PRS on Continuous Survey basis or other alternative survey systems, described in sub-chapter 5.3.

.3 Machinery and systems referred to in Parts VII and VIII may undergo surveys within a specific cycle.

.4 The *unit* issued with PRS *Certificate of Self-elevating Offshore Unit* is subject to surveys described in 5.2.1 to 5.2.3, except the obligation of carrying out inspection in accordance with § 62 of the Regulation of the Minister for Maritime Affairs of 23 October 2006 on the technical conditions of use and the detailed scope of control of marine engineering structures (Journal of Laws No. 206 of 2006, item 1516).

5.2.2 Intervals between Periodical Surveys

.1 Intervals between PRS Periodical Surveys of a *unit* will date from the issue, by PRS, of the first permanent certificate for the *unit*.

.2 The Annual Survey shall be held within 3 months, before and after each anniversary of the issue of the first permanent certificate for the *unit* or the last certificate renewal.

.3 The Intermediate Survey shall, as a rule, be held at either the second or third Annual Survey.
Examinations and tests, which are additional to the requirements of the Annual Survey, may be performed either at or between the second and third Annual Survey

.4 The Survey for Certificate Renewal shall be held within the *unit* class validity period, i.e. at 5-yearly intervals. In exceptional cases, upon PRS' agreement, a maximum 3-month extension of certificate beyond the 5th year may be granted.

Where the Survey for Certificate Renewal is completed within 3 months before and after the expiry date of certificate validity, the period of validity of the new certificate shall not exceed 5 years from the expiry date of the existing certificate. Where the Survey for Certificate Renewal is completed more than 3 months before the expiry date of certificate validity, the period of validity of the new certificate will start from the survey completion date

In such case, the number and dates of Annual Surveys carried out for certificate confirmation shall be determined counting back annual periods from the date of completion of the new certificate validity. If the so determined nearest Annual Survey falls within 3 months from the date of issue of the *Temporary Certificate*, the survey may be neglected.

The Survey for Certificate Renewal may be commenced at the fourth Annual Survey and be progressed so as to be completed by the expiry date of the certificate.

Where the Survey for Certificate Renewal is commenced before the fourth Annual Survey, the entire survey shall be completed within 15 months. The period of validity of the new certificate will start from the survey completion date.

.5 Survey of the underwater part of *units* may be carried out by divers (see *Publication No. 52/P – Underwater Inspection of Mobile Offshore Drilling Units in Lieu of Drydocking Survey).* Alternatively, the survey, within the scope agreed with PRS, may be performed with the use of PRS accepted certified technical appliance and by a PRS approved procedure.

The survey of the underwater part shall be conducted twice within each classification cycle: during Intermediate Survey and the Survey for Certificate Renewal. The intervals between consecutive surveys shall not exceed 3 years; in exceptional circumstances, as defined in 1.2, PRS may accept an extension to a maximum of 3 months. The Operator may decide that the survey of the underwater part is to be carried out in several stages.

.6 PRS may shorten the intervals between consecutive surveys of the unit underwater part, as well as the intervals between examinations, measurements or tests of particular items of machinery, installations and equipment if it is found necessary due to their technical condition.

New due dates of the survey of the *unit* underwater part shall be, in general, concurrent with Periodical Surveys of the whole *unit*

.7 Survey of all types of boilers shall be carried out during the *unit* Periodical Survey. The following boilers are subject to Periodical Survey:

– steam boilers used for production purposes,
– all other steam boilers having working pressure exceeding 0.35 MPa or a heating surface exceeding 4.5 m^2,
– thermal oil boilers.

The following shall apply:

.1 an external survey of all types of boilers is performed at annual intervals, at the time of the Periodical Survey of the *unit*. The external survey shall be carried out after internal survey and tightness test, if performed;

.2 an internal survey of the steam and thermal boilers shall be carried out at the time of Periodical Survey of the *unit*, twice within 5-year classification cycle; however, the intervals between successive internal surveys shall not exceed 3 years;

.3 the thermal oil boilers are subject, during the Survey for *Certificate* Renewal, to hydraulic test with a pressure equal to 1.25 the working pressure.

.8 If surveys of particular items, required at the Survey for Certificate Renewal, have been carried out, in the required scope, within 12 months before the due Renewal Survey, such surveys will be credited for Survey for Certificate Renewal. The subsequent survey of such items, in the next 5-year classification cycle, may be carried out appropriately earlier.

5.3 Continuous Surveys and other Alternative Survey ~~Systems~~ Schemes

At the written request of the Operator, instead of direct survey, PRS may accept Continuous Survey or other alternative survey ~~system~~ scheme for specified items of the ship’s hull, machinery, automatic systems, in accordance with *PRS Publication No. 2/P* or *54/P*.

5.4 Other Surveys

5.4.1 Occasional Surveys

Occasional Surveys of a *unit* or the *unit* machinery, arrangements, installations or equipment are held upon request in all cases not covered by Initial Surveys for Class Assignment, Periodical Surveys or surveys resulting from Continuous Survey. Occasional Survey may be held at the Owner's or Underwriter's request or may be consequent upon PRS, Flag State or Mining Office verification of the correctness of the performed classification activities.

The scope of Occasional Surveys and their procedure will be determined by PRS, depending on the purpose of the survey, age and technical condition of the *unit*.

5.4.2 After Damage Survey

An offshore *unit* shall be submitted to Survey After Damage in the case of damage sustained by the *unit* structure, machinery, arrangements, installations, equipment or outfit covered by the requirements of this *Publication* and subject to PRS' survey.

The aim of the survey is to assess the extent of damage, to specify the scope of work required to eliminate the consequences of damage and to determine the possibility and conditions for maintenance, or reinstatement, of the *unit Certificate*.

The Owner is obliged to report damage to PRS as soon as possible.

5.4.3 Survey after Exceeding the Environmental Design Conditions

A *unit* shall be subjected to Occasional Survey if the most severe environmental design conditions have been exceeded (see 1.2.1 "severe storm condition").

5.4.4 Special Inspection

Surveys according to 5.4.1, 5.4.2 and 5.4.3 shall be performed onboard the *unit* issued with PRS *Certificate of the Fixed Offshore Unit* in accordance with the provisions of § 81 of the Regulation of the Minister for Maritime Affairs of 23 October 2006 on the technical conditions of use and the detailed scope of control of marine engineering structures (Journal of Laws No. 206 of 2006, item 1516)

5.5 Audits

Onboard the *units* issued with the *Certificate of the Fixed Offshore Unit*, audits may be required to be carried out, by a competent body, to determine compliance of the processes, performed by PRS, with the requirements.

At PRS' request, the Operator should to submit the offshore *unit* for auditing, within the scope, at a date agreed with PRS.

6 SCOPE OF PERIODICAL SURVEYS

6.1 Annual Survey

6.1.1 Control

Within Annual Survey the *unit* issued with PRS *Certificate of the Fixed Offshore Unit* is subject to periodical inspections referred to art. 62 item 1 para 1 of the act of 7 July 1994 on building law (Journal of Laws 2018, item 1202, uniform text of 22.06.2018, as further amended), taking into account art. 62, item 1, para 4 of the said act and requirements of § 62, item 1, paragraph 4, § 68 and § 69 of the Regulation of the Minister for Maritime Affairs of 23 October 2006 on the technical conditions of use and the detailed scope of control of marine engineering structures (Journal of Laws No. 206 of 2006, item 1516).

6.1.2 Structure Elements and Deck Equipment:

– examination of the above-water part of *unit* legs, particularly including splashing zone;
– external examination of the bottom, side and open deck plating (the unit hull in the elevated working position), with particular attention given to the hull and legs connections;
– examination of production equipment load-bearing and supporting structures;
– examination of all coamings, railings, hawse pipes, bollards, ventilation and air heads on above waterline decks;
– examination of fittings attachment to the outer shell;
– examination of closing appliances of openings on open decks;
– examination and operation tests of external doors, side scuttles, closing appliances of hatches, skylights, manholes and emergency exits, as well as the doors in boundaries enclosing particular hazardous spaces;
– external examination and operation tests of ~~anchoring,~~ mooring and towing equipment, where applicable;

6.1.3 Internal Combustion Engines:

– examination and operation tests of engine safety system;
– examination of high pressure fuel pipelines;
– operation tests of starting arrangements.

6.1.4 Pumps:

Bilge, ballast, general use, lubricating oil, fuel, heating and cooling medium pumps:
– external examination;
– operation tests;

Process fluid pumps:
– external examination;
– service records checking, operation tests of selected pumps.

6.1.5 Compressors and Pressure Vessels: of Air, Process Fluid and Gas Fuel

– external examination;
– operation tests of compressors;
– operation test of safety valves.

For pressure vessels transferring combustible and/or explosive media subject to erosion or accelerated corrosion, PRS may require thickness measurements of walls and/or pressure test to be carried out.

6.1.6 Pinions, Racks, Locking and Shock-absorbing Devices of Hull Jacking Arrangements:

– external examination;
– operation tests[1].

[1] Only when the legs elevating capability is maintained – see 3.4.2.

6.1.7 Pipelines, Including Fittings:

Bilge, ballast, lubricating oil, fuel , compressed air, steam pipelines

- external examination;
- operation tests of valves, with particular consideration given to remotely closed valves; if during survey such tests are not feasible, the Operator is obliged to agree with PRS the date of conducting such tests.

Process fluid pipelines, including fittings:

- external examination ~~(within the scope agreed with the Owner)~~;
- service records checking;
- examination and operation tests of pipelines safety system;

For pressure vessels subject to erosion or accelerated corrosion, transferring combustible and/or explosive media, PRS may require thickness measurements of walls and/or pressure test to be carried out.

6.1.8 Steam Boilers and Thermal Oil Boilers

.1 The external survey of steam boiler covers:

- examination of the boiler fastenings,
- examination of the boiler casing and insulation,
- external examination of the boiler fittings,
- functional test while in operation.

.2 During the functional test, operation of the following shall be checked:

- boiler and steam super-heater safety valves[1]
- boiler supply and circulating water system,
- boiler blow-off and skimming system,
- water level indicators,
- pressure gauges,
- remote control of the main steam valve and safety valves,
- fuel supply system,
- boiler automatic system,
- boiler safety system,
- boiler alarm system.

.3 The external survey of thermal oil heater covers:

- external examination,
- operation tests of safety valves,
- checking the operation of alarm and safety systems of limit temperature of thermal oil and exhaust gases,
- checking the correctness of pressure gauges indications,
- operation tests of the valves remote control,
- operation tests of the arrangements for emergency discharge of thermal oil from installation,
- remote stopping the circulating pumps

.4 Internal survey of steam boiler and thermal oil boiler

For the purpose of the internal survey (see 5.2.2.7), both sides, water and combustion, of the boiler shall be sufficiently clean to enable a proper assessment of the examined parts (water and steam drums, boiler furnace, combustion chambers and furnaces, tubes, stays and stay-bolts, steam super-heaters and economizers).

At the boiler survey, examination of the boiler mountings, in dismantled condition, shall be carried out.

If upon examination, there is any doubt as to the technical condition of the boiler, PRS may require that additional thickness measurements of boiler parts, partial or complete removing of insulation or hydraulic test should be carried out.

[1] Where the setting of safety valves can be done during a break in service only and provision for such a break, during the survey, has not been made, PRS' Surveyor may authorize the ship's Chief Engineer to set and seal utilization boiler safety valves, as well as to enter appropriate record in the engineer's log book. The record shall be presented to PRS' Surveyor at the nearest survey.

The internal survey of thermal oil heater is carried out within the scope of the applicable requirements concerning steam boiler internal survey.

.5 If, during the Periodical Survey or Occasional Survey, damages that require repair of the boiler are detected, the repair shall be performed under the PRS Surveyor's supervision according to the repair procedure approved by PRS. After repair, hydraulic test to a pressure 1.25 the working pressure shall be carried out.

On repair of the boiler mountings, hydraulic test to a pressure specified in the *Rules for the Classification and Construction of Sea-going Ships*, *Part VI – Machinery Installations and Refrigerating Plants* shall be carried out.

6.1.9 Fire and Explosion Protection

A detailed list of requirements and acceptance criteria for the surveys of fire and explosion protection equipment are included in Part V, Chapter 8.

6.1.10 Electrical equipment and automation

.1 The main sources of electric power:
- test load;
- parallel test run, including the test of reverse current or reverse power protection;
- checking the settings of overload and short circuit protection of generators.

.2 Emergency sources of electric power:
- operation test of emergency generating set;
- test of emergency accumulators.

.3 Distributing devices – main and emergency switchboards, navigation lights switchboard, battery charging facilities, together with battery room ventilation, control and monitoring consoles, shore connection installations, section and terminal switchboards:
- examinations.

.4 Electric power converting installations supplying essential consumers:
- operation tests.

.5 Electric drives of essential machinery (including control and monitoring devices) of: pumps, air compressors, unit jacking system, mooring and towing winches, fans, watertight doors, doors separating hazardous areas:
- operation tests

.6 Main lighting and emergency lighting of compartments and places important from the point of view of the safety of the *unit* and persons on board:
- visual examinations;
- operation tests.

.7 Internal communication and electrical signalling arrangements (service telephone communication, general alarm system):
- operation tests.

.8 Generating sets automatic control system:
- operation tests.

.9 Safety system of engines driving generating sets:
- operation tests.

.10 Automation systems of pumps, compressors, boilers, process machinery, including safety systems:
- operation tests.

.11 Independent ventilation system of hazardous areas, including warning and alarm system:
- operation tests;
- visual examinations.

.12 Explosion-proof equipment and installations:
- visual examinations.

6.2 Intermediate Survey

6.2.1 Scope of Intermediate Survey

The Intermediate Survey covers the requirements of Annual Survey and additionally:

.1 Structure examination of:
- superstructures and deckhouses,
- machinery and production spaces with casings,
- selected hull integral tanks,

.2 survey of underwater part of the unit, according to 6.3.5 – in the second and subsequent certification cycles, based on the assessment of technical condition of the unit legs, PRS may agree to the survey performance only at the Survey for Certificate Renewal.

6.2.2 Inspection

Within the first Intermediate Survey a periodical inspection is carried out, referred to in art. 62 item 1 para 2 of the act of 7 July 1994 on building law (Journal of Laws 2018, item 1202, uniform text of 22.06.2018, as further amended), taking into account art. 62, item 1, para 4 of the said act and requirements of § 62, § 75 and § 76 of the Regulation of the Minister for Maritime Affairs of 23 October 2006 on the technical conditions of use and the detailed scope of control of marine engineering structures (Journal of Laws No. 206 of 2006, item 1516).

6.3 Survey for the Renewal of the *Certificate of Fixed Offshore Unit*

6.3.1 General

6.3.1.1 Prior to the commencement of the Survey for Certificate Renewal:
- the 5-year examination cycle within Continuous Survey or other alternative survey schemes, if applied, shall be completed (see 5.3);
- examination of arrangements due for surveys within the four first years of certification cycle shall be completed.

6.3.1.2 The Survey for the Renewal of the Certificate covers activities of the Intermediate Survey (including Annual Survey) and additionally:
- inspection, acc. to 6.3.2;
- survey of machinery and electrical equipment, acc. to 6.3.3;
- survey of fire and explosion protection equipment, acc. to 6.3.4;
- survey of underwater part of the unit, acc. to 6.3.5.

6.3.2 Inspection

Within the Survey for Certificate Renewal, an inspection control is carried out, referred to in art. 62 item 1 para 2 of the act of 7 July 1994 on building law (Journal of Laws 2018, item 1202, uniform text of 22.06.2018, as further amended), taking into account art. 62, item 1, para 4 of the said act and requirements of § 62, § 75 and § 76 of the Regulation of the Minister for Maritime Affairs of 23 October 2006 on the technical conditions of use and the detailed scope of control of marine engineering structures (Journal of Laws No. 206 of 2006, item 1516).

6.3.3 Machinery and Electrical Equipment

.1 measurement of crankshaft deflection of internal combustion engines driving main generators;

.2 internal examination of appliances in the case of unsatisfactory operation or where required by the manufacturer's operating manual. This applies to: gas turbines and their gears, internal combustion engines, pumps (listed in 6.1.4), compressors (listed in 6.1.5), as well as the *unit* jacking and deck systems;

.3 tightness tests of bilge, overflow, air and sounding pipes;

.4 operation tests of ballast, cooling water, steam, compressed air, fuel oil, lubricating oil and hydraulic systems - if there is any doubt as to the technical condition of the pipes; PRS may require the hydraulic test or wall thickness measurement to be carried out;
.5 internal examination of air receivers and fittings;
.6 hydraulic tests of pipes passing through fuel oil tanks, liquid cargo tanks and storage spaces;
.7 hydraulic tests of heating coils in tanks not subject to examination. In tanks subject to examination, the heating coils shall be tested depending on their technical condition;
.8 examination of ventilation ducts passing through watertight bulkheads and fire-resisting bulkheads;
.9 examination of tanks not forming structural part of the *unit*;
.10 examination and hydraulic test of heat exchangers, if required, depending on the result of examination and after repair;
.11 operation test of process fluid system, including PSD and ESD systems, and of their manual control. If there is any doubt as to the technical condition of the pipes, PRS may require the hydraulic test and/or wall thickness measurement to be carried out;
.12 operation tests of generator overload and under voltage protection;
.13 operation tests of electrical heating appliances;
.14 examination of cables and the cable penetrations in watertight and fire-resisting bulkheads;
.15 examination of lightning and earthing protection;
.16 checking the set point value of sensors of essential machinery automatic systems;
.17 operation tests of control systems parameters vital for the *unit* operation;
.18 examination and checking correctness of indications of measuring and control instruments and gauges agreed with the Operator and indicated by the Surveyor. (This applies, in particular, to the systems: compressed gases, steam and hazardous media systems).

6.3.4 Fire and Explosion Protection

A detailed list of requirements and acceptance criteria for the surveys of fire and explosion protection equipment are included in Part V, Chapter 8:

6.3.5 Survey of Underwater Part of the Offshore *Unit*

.1 The survey of the *unit* underwater part shall be carried out in accordance with a programme, prepared well in advance and agreed with PRS, specifying procedures for the survey, the scope of survey and test methods. The programme should include information gained from examinations carried out during the previous survey. See also *Publication No.52/P – Underwater Inspection of Mobile Offshore Drilling Units in Lieu of Drydocking Survey*.
.2 The survey of the *unit* underwater part by divers may be accepted, provided that:
- the in-water survey programme, agreed with PRS, contains a lay-out of areas to be surveyed. These areas shall be properly named and marked to ensure correct description and identification of the areas to be surveyed;
- the survey is carried out by suitably qualified and equipped divers or divers being Surveyors to PRS. Alternatively, the survey, to the scope agreed with PRS, may be carried out with the use of PRS accepted certified technical means and according to PRS accepted procedure. The survey shall be documented by video tapes and underwater photographs; in the case of divers who are not PRS' Surveyors, the survey shall be carried out using close-circuit television and two-way communication between the diver and the attending PRS' Surveyor;
- the areas to be surveyed are sufficiently clean;
- the sea water is clear enough to afford good visibility;

.3 The in-water survey documentation (the survey programme, reports, photographs, tapes, etc.) shall be available on board the *unit* for reference at the subsequent survey.
.4 The scope of the underwater survey of the *units* covers:
- examination of the underwater part of *unit* legs;
- examination of all sea valves in the pontoon underwater part plating, including sea chests[1];
- examination of bracing members connecting columns and other underwater parts;

[1] Where the elevating capability by the legs elevating arrangements is maintained

- tightness tests of tanks indicated by PRS' Surveyor and spaces inside the underwater parts;
- thickness measurements of plating of underwater parts, as well as their bracing members, within the scope agreed with PRS' Surveyor. At the third and subsequent 5-year surveys, such measurements are obligatory.

7 CERTIFICATE SUSPENSION

7.1 Automatic Suspension of the *Certificate of Fixed Offshore Unit*

The certificate is automatically suspended if:

.1 the validity of certificate has expired before completion of Survey for Certificate Renewal.
In exceptional circumstances, PRS may grant an extension of class not exceeding, however, 3 months;

.2 recommendations issued by PRS have not been carried out in the due time or certificate issue conditions have not been complied with. In such case PRS may extend the validity of certificate until a new date assigned for recommendations execution or certificate issue conditions compliance;

.3 damage to structure, machinery, installations or equipment, covered by the requirements of this *Publication,* has been found;

.4 changes have taken place that affect entries in the certificate (e.g. change of the Operator);

.5 the design and service conditions, specified in classification documents, have been transgressed;

.6 the *unit* has not been subjected to Periodical Survey within 3 months of the due date of the survey.

7.2 Intent to Suspend the Certificate

If the Owner has not paid PRS for services connected with the offshore *unit*, its certificate, by the PRS Head Office decision, will be suspended. The Owner will be notified, well in advance, in writing, of PRS' intent to suspend the certificate.

7.3 Duration of Certificate Suspension

The *unit* certificate will be invalid from the date of its suspension until the date of validity reinstatement. Certificate suspension period should not last longer than 3 months. If certificate suspension period exceeds 6 months, the drilling unit certificate is no more valid.

At the Operator's request, PRS may grant a longer suspension period when the *unit* is not operating as in the event of awaiting PRS' decision in case of a casualty or attendance for certificate reinstatement.

7.4 Certificate Reinstatement

The *unit* certificate will be reinstated subject to satisfactory completion of Occasional Survey (see 5.4.1) carried out by PRS.

Exception to this is the situation, referred to in 7.2, in which case the *unit* certificate will be reinstated if the reasons for its suspension have been eliminated.

7.5 Notification to Operator, Flag States and Mining Office

PRS will confirm the suspension and reinstatement of the *unit* certificate by separate letters to the Owner, the Flag State and the Mining Office.

8 CERTIFICATE WITHDRAWAL

The *Certificate of Fixed Offshore Unit* is withdrawn in the case of circumstances which cannot be eliminated or involve a long lasting repair and which render certificate maintenance impossible.

The certificate is withdrawn in the following cases:

– after alterations to hull, superstructures, machinery, equipment and installations affecting the unit's safety and covered by the requirements of this *Publication* have been introduced without prior agreement with PRS,

– after the unit removal from positioning location;

– after the *unit* has been sunk (scuttled) or transmitted for utilization (scrapping), at the written request of the Operator.

At the Operator request, the *unit* the class of which has been withdrawn may be subjected to a survey for certificate validity reinstatement. The scope of the survey will be specified by PRS in each particular case.

9 LAY-UP, WITHDRAWAL FROM SERVICE AND UTILIZATION OF THE *UNIT*

9.1 At the Operator request, a *unit* may be laid-up, while maintaining its certificate. The request shall include:
– the planned *unit* lay-up period;
– a list of machinery (e.g. boilers, generating sets, bilge pumps, etc.) that will be kept in service during the *unit's* lay-up period;
– a list of the *unit's* crew during lay-up period.

9.2 A *unit* is laid-up upon carrying out survey within the scope agreed with PRS in each particular case.

9.3 During the laying-out period, the machinery listed in 9.1 shall be annually surveyed at the time of Periodical Surveys.

9.4 For a laid-up *unit*, other Periodical Surveys, specified in 5.2.1, are automatically postponed until the survey for the unit's recommissioning.

9.5 A *unit* is recommissioned at the ~~Owner's~~ Operator request, upon carrying out a survey within the scope specified by PRS in each particular case. The survey shall cover at least all due and overdue Periodical Surveys and recommendations.

Depending on the length of the laying-up period, tests of particular installations or their parts may be required.

9.6 At the request of *unit* Operator, PRS may supervise the process of unit's withdrawal from its positioning location, transfer to the place of utilization and the utilization process itself (see 3.6).

PART II

Structure, Materials, Marine Equipment

1 GENERAL

1.1 Application

1.1.1 Part II of the *Publication* applies to supporting structures of self-elevating offshore units subject to conversion into stationary units, i.e. units fixed permanently on the sea bed.

The term *supporting structures* covers unit legs with footings, hull supported on legs (including deckhouses) and components strengthening the unit legs, if applied (stay ropes, additional supports, etc.) The supporting structures are generally made of steel, however, some of their parts may be made of aluminium. Pipes being components of unit legs may be strengthened by filling with special hardening compound (concrete).

The requirements of Part II apply also to hull equipment as well as to the unit stability and subdivision in towed condition.

1.1.2 In this Part, reference is made to the requirements formulated in: *API RECOMMENDED PRACTICE 2A-WSD (RP 2A-WSD) – Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms – Working Stress Design, Twenty First Edition, December 2000* and in subsequent supplements to the document. Reference to documents listed in items [2] to [9] of paragraph 1.2.3 can also be met.

1.2 Terms, Definitions, Standards

1.2.1 Terms and definitions

In this Part II ~~*Publication* (Ch. II)~~ the below definitions concerning the unit structure components as well as loads acting thereon and structure therein, apply.

Structure Parts:

– unit supporting structure – structure of footings and legs (together with their additional strengthenings in the form of stay ropes, supports, etc. where applied);

– footings (spud cans) – massive plated structures constituting the lower end of unit legs, positioned freely on the sea bed;

– stiffener – a structure member directly supporting the plating;

– primary supporting member – structure member supporting the stiffeners;

Structure stresses:

– nominal stresses – stresses determined with the use of bar and beam structure item models or FEM models with use of plate/membrane finite elements of relatively big size; they can include normal, shear or equivalent stresses;

– geometric stresses (hot spot stress) – nominal stresses multiplied by stress concentration factor or the FEM stresses calculated with the use of appropriate finite elements mesh and special FEM calculated stresses interpretation procedure;

– theoretical critical stresses – stresses that cause buckling of items of „ideal” structures, i.e. ideally rectilinear, linear in elastic structures at any stress level (material with boundless high value of yield point) and without so called residual stresses, which in the real structures are caused by e.g. welding;

– critical stresses – stresses that cause buckling of real structure item, i.e. the one which does not comply with the assumptions given in the definition of theoretical critical stresses.

Loads:

– short - term loads – loads due to sea waves action within time period in which the load can be considered stationary, i.e. when the significant wave height does not change;

– l o n g - t e r m l o a d s – loads within longer time period, when they cannot be considered stationary;
– l o a d r e t u r n p e r i o d – a period of time between two consecutive indications of the assumed load value;

Other terms:

– a m p l i t u d e o f s t r e s s e s – a half of the value of stresses range;
– c h a r a c t e r i s t i c w i n d s p e e d , v_w – mean wind speed within the time period of 1 minute, at the level of 10 m above still water surface, with 100 years or 1 year return period, [m/s];
– s t r e s s c y c l e – stresses varying within time period between their consecutive mean values;
– r e g u l a r w a v e – sinusoidal wave on water surface;
– i r r e g u l a r w a v e s – real wave motions of random nature;
– w a v e s p e c t r u m f u n c t i o n ($S(\omega)$) – function of waves circular frequency ω, being a measure of the share of regular waves of frequency ω, which when summed up make irregular waves;
– s t r e s s s p e c t r u m ($S_\sigma(\omega)$) – function similar to the wave spectrum function, however, it applies to stress amplitudes σ;
– P a l m g r e n - M i n e r h y p o t h e s i s – assumptions regarding fatigue strength of structure items, upon which the accumulation of fatigue effects is a result of direct combining fatigue effects due to stress cycles of various stress range values;
– m e a n w a v e p e r i o d – mean value of time period between water zero level values in specified point of still water surface;
– S - N c u r v e – relation between the value of stress range and the number of stress cycles causing sample (or structure item) damage in result of fatigue cracking;
– s t r e s s r a n g e – difference between the maximum and the minimum value of stresses within stress cycle;
– s i g n i f i c a n t w a v e h e i g h t (H_s) – expected value of the one third highest waves.

1.2.2 Symbols and abbreviations

Essential symbols used in this *Publication* (Part II) have the following meaning:

g – standard acceleration of gravity (9.81 m/s$^{2)}$;
k – material factor, depending on the yield point R_e;
R_e – material yield point, MPa;
$S(\omega)$ – wave spectrum;
$S_\sigma(\omega)$ – stress spectrum;
ρ – water density (1.025 kg/m^3);
ρ_p – air density (1.222 kg/m^3);
σ – normal stresses, MPa;
τ – shear stresses, MPa;
σ_e – equivalent stresses, calculated using Mises-Huber hypothesis, MPa;
$\Delta\sigma$ – stresses range that means a difference between the maximum and the minimum value of geometric stresses within a stress cycle, MPa.

1.2.3 Normative and Rule References

This Publication refers directly to the regulations/standards listed below. Upon separate consideration, PRS may accept the unit structure designed with the use of other rules.

[1] *API RECOMMENDED PRACTICE 2A-WSD (RP 2A-WSD) – Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms – Working Stress Design, Twenty First Edition, December 2000*.
[2] Polski Rejestr Statków, *Rules for the Classification and Construction of Sea-Going Ships – Part IX – Materials and Welding.*

[3] Polski Rejestr Statków, *Rules for the Classification and Construction of Sea-Going Ships – Part II – Hull.*
[4] Polski Rejestr Statków, *Publication No. 21/P – Testing of the Hull Structures.*
[5] Polski Rejestr Statków, *Publication Nr 49/P – Requirements Concerning Mobile Offshore Drilling Units, 2007.*
[6] *Design of steel structures,* NORSOK STANDARD N- 004, Rev.3, February 2013.
[7] Polski Rejestr Statków, *Publication No. 45/P – Fatigue Strength Analysis of Steel Hull Structure, 1998* .
[8] IACS, *Common Structural Rules for Bulk Carriers and Oil Tankers*, 2013.
[9] Polski Rejestr Statków, *Rules for Statutory Survey of Sea-Going Ships, Part VI – Lifting Appliances, 2004.*
[10] Polski Rejestr Statków, *Publication No. 40/P – Non-metallic Materials.*
[11]`Polski Rejestr Statków – *Publication 55/P – Survey of Corrosion Protection and Anti-fouling Systems*, 2012.
[12] Norsok Standard M-501 *Surface preparation and protective coating*.

1.3 Scope of Survey

1.3.1 General principles of survey of a unit under conversion (adaptation to a stationary unit) and surveys of units in service are specified in *Part I – Survey Regulations*.

1.3.2 Survey of the unit under conversion covers its whole supporting structure:
– unit legs together with special strengthenings, if applied (such as stay ropes, supporting bars, piles, etc.);
– leg footings or bottom mats;
– unit pontoon structure including strengthenings (foundations) under the unit equipment items (power generators, cranes, oil/gas process machinery, etc.);
– superstructures and deckhouses;
– a helideck.

1.3.3 Structures referred to in 1.3.2, under the unit construction or modernization, are subject to inspection as regards:
– conformity with an approved technical documentation;
– compliance with the present *Publication* ~~within the scope~~ for items not indicated in the technical documentation;
– compliance with applicable requirements of the *Rules for the Classification and Construction of Sea-Going Ships – Part IX – Materials and Welding*.

1.3.4 The pontoon of the unit adapted to a stationary offshore unit, shall be subjected to tightness tests with the use of the requirements of document [4] (see 1.2.3), within the scope applicable to offshore units.

1.3.5 The hull vibration issues are subject to PRS survey according to *Publication 2/I – Prevention of Vibration in Ships*.

1.3.6 The whole documentation of the corrosion prevention system shall be submitted for approval, and scantlings of structure primary members with and without corrosion additions shall be given in construction drawings.

1.4 Technical Documentation of the Unit

1.4.1 PRS Approved Documentation

1.4.1.1 Drawings

The following drawings shall be submitted to PRS for approval. The drawings shall show parts of original structure that remain onboard the unit (original structure is the structure before the adaptation of the unit to stationary platform) and new or modified structure parts, after adaptation:

- structural drawings of platform legs;
- footings and bottom mat drawings;
- platform pontoon drawings (midship section, longitudinal section, decks, bottom, sides, bulkheads and divisions, pillars, etc);
- pontoon structure in the vicinity of legs (details of strengthenings under the legs elevating/lowering mechanism used for the platform positioning on the sea bed as well as mode of legs – pontoon connection in the stationary platform shall be shown);
- structure of platform strengthenings (e.g. system of used stay ropes, piles, anchors, etc.);
- structure of superstructures and deckhouses;
- a helideck;
- foundations and strengthenings under the components of platform equipment (deck cranes and boom derricks, oil and gas exploitation system, energy generators, drilling equipment (if provided), etc.);
- hatch covers.

1.4.1.2 Other Documents

The following documents shall be submitted to PRS for approval:

- plan of access means for the performance of structure periodical surveys;
- plan of mooring appliances;
- welding procedures;
- plan of structure corrosion protection;
- methods and scope of non-destructive examinations during the platform adaptation;
- procedure for the platform positioning on the sea bed.

1.4.1.3 Platform Service Limitations

Documents containing information on essential limitations of the platform service shall be approved by PRS.

In particular, the following documents shall be submitted for approval:

- weather limitations for the time of the platform positioning on the sea bed;
- weather limitations during the process of drilling of crude oil/gas extraction;
- procedure for transition from drilling or crude oil/gas extraction process to the extreme weather survival;
- loads of decks, drilling equipment, crude oil/gas extraction process equipment, cranes safe working load, etc.

1.4.2 Documentation submitted to PRS for information

The following documents shall be submitted to PRS for information:

- general arrangement plan of the original platform (before its adaptation to stationary unit);
- general arrangement plan of the stationary platform (after adaptation; assumed position of the pontoon bottom over water surface shall be shown);
- plan of communication equipment;
- plan of tanks (tanks volumes, the maximum density of liquids in tanks, volumetric centres coordinates shall be given);
- allowable deck loads;
- platform dead weight distribution and information on variable weight values and distribution;
- stability calculations for platform positioning (acc. to requirements of 6.4);
- report on original platform structure items thickness measurements;
- report on platform strength analysis (strength of legs, pontoon, legs – pontoon structure connections);
- report on fatigue strength analysis of platform legs, connections of legs with footings and pontoon structure in the region adjacent to legs;
- stability calculations for platform transit to its positioning location.

2 MATERIALS AND CORROSION PROTECTION

2.1 General

2.1.1 The requirements of this Chapter (II-2) apply to the selection of materials (steel, aluminium and others) used for the platform supporting structure adaptation to stationary platform. Materials used for original structure items which remain as the items of the platform adapted for stationary one, shall be considered by PRS separately.

2.1.2 Detailed requirements for materials used for the platform supporting structure adaptation to stationary platform are specified in document [2] (see p. 1.2.3), within the scope applicable to platforms.

2.1.3 Steel for platform structures is selected per steel grades, depending on the item influence on the platform safety (so called strength class), on the structure design temperature and item thickness.

2.2 Certification of Materials

2.2.1 Steel or aluminium rolled, extruded or cast components used for the platform structure adaptation to stationary one, which belong to structural elements of special or primary class (see 2.3.1.3), shall have PRS Survey Certificate (3.2). Other structural elements shall have at least Survey Certificate (3.1).

Materials used for original structure components, which are parts of the platform adapted for stationary one, will be considered by PRS separately.

2.3 Structural Steel

2.3.1 Normal, Higher and High Strength Steel

2.3.1.1 Normal, higher and high strength hull steel shall be used for adaptation of the platform structure to stationary one.

2.3.1.2 Notations of steels referred to in 2.3.1.1, division into grades, values of yield point R_e and material factor k (used to determine the values of allowable stresses) are given in table 2.3.1.2.

Table 2.3.1.2 Steel notations

Designation	Steel notation (grade)	*Re* [MPa]	*k*
Normal strength steels	A B D E	235	1.0
Higher strength steels	AH32 DH32 EH32 FH32	315	1.31
	AH36 DH36 EH36 FH36	355	1.48
	AH40 DH40 EH40 FH40	390	1.63
High strength steels	A420 D420 E420 F420	420	1.75
	A460 D460 E460 F460	460	1.92
	A500 D500 E500 F500	500	2.08
	A550 D550 E550 F550	550	2.29
	A620 D620 E620 F620	620	2.58
	A690 D690 E690 F690	690	2.88

2.3.1.3 Strength classes of the platform supporting structure components

Selection of steel grade to particular components of the platform supporting structure depends on so called strength class of the component (special class, primary class, secondary class).

Particular items of self-elevating platform structures adapted to stationary platforms belong to the below classes:

Special class:

– leg structure components directly connected to footings or bottom mat;
– pipe components of leg structures manufactured as a three-dimensional frame, in region of their connection to pipe components of other directions (taking into account use of connecting components made as castings, where such solution is applied);

– highly stressed components of cranes and other machinery foundations and platform pontoon structure in their vicinity.

Primary class:

– parts of bulkheads, deck, sides and bottom plating of the platform pontoon, being parts of the pontoon primary strength component system;
– monolithic structure legs plating (circular section columns);
– pipes being parts of legs structure in the form of a three-dimensional frame (beyond special class);
– pontoon structure components directly taking loads from the platform legs;
– footings or bottom mat structure components on the extension of platform legs structure;
– structure items supporting heavy superstructures or deckhouses, heavy items of platform equipment, a helideck, etc.;

Secondary class:

– parts of platform pontoon deck, sides and bottom plating, beyond primary class;
– pontoon internal bulkheads and divisions, beyond primary class, stiffeners and T-shaped primary supporting members within pontoon structure;
– divisions, primary supporting members and stiffeners in the structure of cylindrical platform legs;
– bulkheads and divisions, T-shaped primary supporting members and stiffeners in the structure of footings or bottom mats, beyond primary class.

2.3.2 Steel with Specified Through Thickness Properties

2.3.2.1 Where a plate or pipe structural element of the thickness 15 mm and more is exposed to considerable stresses perpendicular to its plane, PRS may require application of steel “Z” for such element. Detailed requirements for steel “Z” are specified in document [2] (see 1.2.3).

2.3.3 Design Temperature of Structures

2.3.3.1 The design temperature of structure is one of parameters defining steel grades required for particular platform structure items. The method of determining the design temperature is given in 2.3.3.2 and 2.3.3.3.

2.3.3.2 The design temperature of structure for external and internal elements of stationary offshore platforms, situated above the sea level is the lowest mean daily average air temperature in the area of platform support.

2.3.3.3 The design temperature of structure for leg structure components located below the sea level and for components of footings and bottom mats shall be assumed as equal to 0° C.

2.3.4 Selection of Steel Grades

2.3.4.1 Required normal and higher strength steel grades, depending on the strength class of structure element, its thickness (together with corrosion addition acc to. 2.6) and the design temperature, are specified in table 2.3.4.1.

Table 2.3.4.1 Required normal and higher strength steel grades

Structure class	Minimum design temperature Steel grade	0°C	-10°C	-20°C	-30°C	-40°C	-50°C
1	2	3	4	5	6	7	8
Secondary	A	30	20	10	–	–	–
	B	40	30	20	10	–	–
	D	50	40	30	20	10	–
	E	50	50	50	50	45	35
	AH	40	30	20	10	–	–
	DH	50	50	45	35	25	15
	EH	50	50	50	50	45	35
Primary	A	20	10	–	–	–	–
	B	25	20	10	–	–	–
	D	35	25	20	10	–	–
	E	50	50	50	40	30	20
	AH	25	20	10	–	–	–
	DH	45	40	30	20	10	–
	EH	50	50	50	40	30	20
Special	A	–	–	–	–	–	–
	B	15	–	–	–	–	–
	D	20	10	–	–	–	–
	E	50	45	35	25	10	–
	AH	15	–	–	–	–	–
	DH	30	30	10	–	–	–
	EH	50	45	35	25	10	–

Note: for intermediate temperatures, the linear interpolation of thickness may be performed.

2.3.4.2 Applied steel grades of high strength steel will be considered by PRS separately.

2.3.4.3 In the case of structural elements, which always are subjected to compression or low tensile stresses, PRS may, upon separate consideration, agree to use of lower steel grade than specified in table 2.3.4.1.

2.4 Other Structural Materials

2.4.1 Aluminium Alloys

2.4.1.1 Aluminium alloys may be used for the structural items of superstructures, deckhouses, hatch covers, hatch coamings and other structure components, provided the strength of such structures is not lower than the strength of equivalent steel structures. Applied aluminium alloys shall comply with the requirements specified in document [2] (see 1.2.3).

2.4.1.2 Strength calculations of structures in areas of heat affected zones of rolled and extruded structural items welds shall employ the values of aluminium strength parameters in applied welding materials.

2.4.1.3 Material factor *k* for aluminium alloys shall be determined in accordance with the below formula:

$$\cancel{k =} \frac{R_e}{240} \quad k = \frac{R_{e\ 0,2}}{240} \qquad (2.4.1.3)$$

where:
R_e – yield point;
The value $R_{e\ 0.2}$ adopted for strength calculations shall be not less than $0.7R_m$;
(R_m means tensile strength of aluminium alloy in soft condition, i.e. recrystalized or hot rolled).

2.4.2 Other Structural Materials

Other materials than steel or aluminium alloys may be applied in platform structures provided that they comply with strength requirements, are non-flammable, prove adequate resistance to chemical environmental factors, etc. Their application is subject to separate consideration by PRS.
Non-metallic materials and products shall comply with the requirements specified in document [10] (see 1.2.3).

2.5 Corrosion Protection

2.5.1 The required corrosion protection system of steel structures depends on the location of structural elements in one of the below structure areas:

– weather affected areas – external structure surfaces (legs, hull, superstructures/deckhouses, etc.) above the below defined transition area;
– transition area – external structure items surfaces within the distance 5 metres off the waterline (the mean sea level);
– underwater area – external (legs) structure surface below the transition area;
– internal area – structure surfaces not directly subjected to weather and sea effect.

2.5.2 External structure surfaces within the weather affected area and transition area shall be anticorrosion coated, in accordance with paint manufacturer requirements.

2.5.3 External hull surfaces in underwater area shall be corrosion protected with the use of a protective coating with additional use of cathodic protection system. The cathodic protection system is subject to PRS approval.

2.5.4 Ballast tanks and crude oil/ crude oil products tanks shall have an efficient corrosion protection coating with possible use of cathodic protection system and/or corrosion additions.

The protection coatings shall comply with requirements given in documents [11] and [12] (see 1.2.3).

2.6 Corrosion Additions

2.6.1 If the tanks mentioned in 2.5.4 are not provided with an efficient cathodic protection system neither with paint coating, then thicknesses of structural items resulting from strength requirements (net thickness), for the planned 20 year period of platform service life, shall be increased by the following values t_k of corrosion additions:

a) in water ballast tanks:
   – one side corrosion protected plating: t_k = 1.5 mm;
   – plating without corrosion protection: t_k = 3.0 mm;
   – face plates and webs of internal stiffeners and primary supporting members and brackets: t_k= 3.0 mm;

b) in crude oil/ crude oil products tanks:
   – one side corrosion protected plating: t_k = 1.0 mm;
   – one side corrosion protected plating: t_k = 2.0 mm;
   – face plates and webs of internal stiffeners and primary supporting members and brackets: t_k= 2.0 mm.

2.6.2 For tanks protected against corrosion with use of paint or cathodic protection system or where assumed service life differs from 20 years, the required values of corrosion additions will be separately determined by PRS.

3 GENERAL REQUIREMENTS FOR STRUCTURE AND ITS STRENGTH

3.1 Platform Exploitation Phases. Bottom Clearance of a Pontoon

3.1.1 Sufficient strength of platform structure shall be ensured in the below phases of exploitation:
– unit transit to its location as a stationary platform;
– process of platform positioning on the sea bed;
– normal conditions of platform exploitation;
– extreme weather survival conditions.

3.1.2 After the platform has been positioned on the sea bed, sufficient clearance shall be ensured between the platform pontoon bottom and the average still water level. Expected sinking of platform legs in the sea bed shall be taken into account.

The platform pontoon bottom shall be, generally, at such level that its distance to the crest of a wave of 100 years return period, taking into account increase of water level due to astronomical and wind tides, shall be not less than 10% of the water level increase due to combined tide and wave amplitude effect, and not less than 1.2 m.

3.1.3 If the conditions defined in 3.1.2 are not fulfilled, the analysis of the platform supporting structure strength and its support stability shall include impact loads of pontoon due to sea wave motions.

3.2 Scope of Strength Analysis

3.2.1 The structure strength analysis shall include the below form of destruction/damage:
– material plasticization;
– buckling of structure elements;
– fatigue cracking.

3.2.2 The structure strength analysis consists in considering numerous load cases taking into account:
– loads due to dead weight of platform structure and equipment items;
– loads due to weight of stores, ballast and various cargo / materials kept onboard the platform;
– loads due to drilling system or crude oil/gas extraction system, cranes lifting the weights, etc.;
– variable environmental loads (sea current, sea wave motions, wind pressure, icing);
– accidental loads.

Combinations of the above loads which generate the greatest stresses in the structure shall be considered. Detailed requirements concerning the loads are given in Chapter 5.

Methods of the structure strength analysis and allowable values of parameters of response to loads are given in Chapters 6 to 9.

3.2.3 The platform Operator defines the allowable parameters of environmental loads for the normal operation of platform. The parameters are recorded in appropriate platform documentation (Platform operating manual, PRS certificates, etc.). Normal operation is interrupted when the environmental loads became higher than above mentioned and the platform passes into extreme weather survival condition.

The extreme weather conditions are defined on the basis of reliable statistic data available for the platform positioning region. Relevant detailed information is specified in Chapter 5.

3.3 Calculation Models for Platform Structure Strength Analysis

3.3.1 Structure Modeling

3.3.1.1 Applied calculation models shall sufficiently precisely reflect structure deformations and stresses, taking into account deformability of the ground under footings or bottom mat, effect of ropes/anchor chain cables or leg strengthenings – if such components are applied. The most precise representation of platform loads shall be applied. Use of calculation model based on finite element method (FEM) is recommended.

3.3.2 Methods of the Structure Strength Analysis

3.3.2.1 At determining deformations and stresses in platform structure, dynamic effects due to platform inertia shall be considered. With this purpose, alternatively:
- static analysis may be applied with horizontal loads (due to sea current, wave motions and wind pressure) increased by a multiplier referred to as dynamic amplification factor (DAF) (details are given in Chapter 6);
- analysis of platform dynamics may be used, consisting in the integration of platform movement equations, taking into account loads varying in time (details are given in Chapters 6 and 8).

3.3.2.2 The assessment of the structure resistance to plasticization is performed based on the nominal normal, shear and equivalent stresses level.

Where plate or shell models of structure parts have been used, the equivalent stresses are calculated from the below formula:

$$\sigma_{eq} = \sqrt{\sigma_x^2 + \sigma_y^2 - \sigma_x \sigma_y + 3\tau_{xy}^2} \qquad (3.3.2.2)$$

where:

σ_x, σ_y – normal stresses along x and y axes;
τ_{xy} – shear stresses.

Calculation of the required thickness of plating subjected to pressure is performed with the use of plate model.

Calculation of the required stiffener dimensions of plating subjected to pressure is performed with the use of beam model.

In some cases the beam model may be applied to the calculation of the required dimensions of the primary members supporting plating stiffeners.
Detailed information on the required calculation models and the strength criteria are given in Chapter 6.

3.3.2.3 In the case of plate structure items subject to compression or shear, or stiffeners of plating, pillars, platform legs structure items (pipes), etc. subject to compression, their buckling strength shall be assessed. The values of stresses calculated within the strength analysis are applied in the calculations, in accordance with Chapter 6.

The buckling strength analysis may apply directly a FEM model of platform structure used in calculations according to Chapter 6 or parametric formulae containing values of structure items dimensions, Young modulus and Poisson coefficient of the material, as well as the values of stresses in the structure item. Detailed requirements on such calculations have been specified in Chapter 7.

3.3.2.4 In accidental cases (such as ship collision with the platform leg, fall of the weight lifted by a crane), structure strength in region of accidental load is assessed by ultimate strength calculations. Relevant detailed requirements are specified in Chapter 6.

3.3.2.5 Fatigue strength of platform legs structure, legs connections with footings and pontoon structure in areas adjacent to legs shall be subject to verification. In calculations, of stress ranges in structure items due to sea wave motion loads variable in time and S-N curves shall be applied. Structure fatigue cracking strength is assessed with use of Palmgren-Miner hypothesis.

Detailed requirements for such calculations are given in Chapter 8.

3.4 General Requirements for Platform Structure

3.4.1 Damaged Structure Strength

3.4.1.1 Platform legs shall be so designed that in case of extensive plasticization of a single bracing connecting leg chord or its separation from the chord (in result of fatigue cracking), no further significant damages to the leg will occur. Therefore the platform legs shall fulfil the strength criteria for damaged structure, defined in Chapter 6.

3.4.2 Stress Concentration Issue

3.4.2.1 Platform structure modification, aimed at its adaptation from self-elevating unit to stationary one, shall be so performed to preclude excessive stress concentration in discontinuity regions.

Use of large openings in the pontoon primary supporting members, where increased stresses exist, shall be avoided.

3.4.3 Transmission of Plates Transverse Stresses

3.4.3.1 Where possible, transmission of normal stresses of considerable values, transversely to plates, shall be avoided. Otherwise, the plate shall be made of "Z" type steel. (see 2.3.2).

3.4.4 Structural Details of Pontoon, Superstructures/Deckhouses and Foundations

3.4.4.1 The below issues shall be resolved according to Chapter 3 of PRS Rules [3] (see 1.2.3), within the scope applicable to pontoon and superstructure/deckhouse structures:
- span and effective flange of plating and primary supporting members stiffeners;
- effective web section area of primary supporting member;
- arrangement of weld seams;
- connections of primary supporting member face plates;
- openings in structure items;
- primary supporting member structure (face plates, stiffeners, tripping brackets).

3.4.4.2 Design and dimensions of structure items of engine and auxiliary machinery foundations shall fulfil the requirements of Chapter 9.

3.4.5 Platform Leg Structure

3.4.5.1 The structure of platform legs, made of pipe sections, shall comply with general requirements for pipe element connections, specified in document [1] (see 1.2.3), taking into account a unique structure of chords usually containing toothed bars of the leg elevating/lowering system of the self-elevating unit.

3.4.5.2 The structure of additional strengthenings of legs, designed within the process of platform adaptation to stationary unit, or the structure of monolithic pipes (pipes of considerable diameter, with holes for pins of leg jacking/lowering system) shall be considered by PRS separately.

3.4.6 Structure of Footings

3.4.6.1 Platform leg columns shall be extended up to the footing bottom. The footing shall incorporate a system of densely fitted transverse bulkheads and divisions, arranged radially or circumferentially (or in mutually transverse directions). The extensions of leg columns shall have connections with bulkheads/divisions. The bulkheads/divisions shall be welded to the bottom and deck and to footing side walls. Bulkheads/divisions shall be so little spaced that appropriate local strength of footings bottom plates bent by the sea bed ground pressure and side wall and deck plates bent by water pressure (if the footing structure is tight), is ensured.

3.4.6.2 Design details of leg columns and bracing connections with the footing shall enable achievement of the required fatigue strength, in accordance with criteria specified in Chapter 8.

4 WELDED JOINTS

4.1 General

4.1.1 Requirements Application

4.1.1.1 The requirements of this Chapter apply to types and sizes of welds used in the structure of pontoon hull (including superstructures/deckhouses), platform legs and footings.

4.1.1.2 In the case of welding structure elements made of normal or higher strength steel or of aluminium, the requirements pertaining to welding materials, welding procedures, welders' qualifications, weld quality inspections and protection from weather conditions during welding, which have been specified in document [2] (see 1.2.3), shall be complied with.

Welding procedures for the elements made of high strength steel (R_e > 390 MPa) will be considered by PRS separately.

4.1.2 General Requirements pertaining to Plates Butt Joints

4.1.2.1 Where plates of equal thickness shall be connected with the use of a butt joint, edge preparation is required, as shown in Fig. 4.1.2.1.

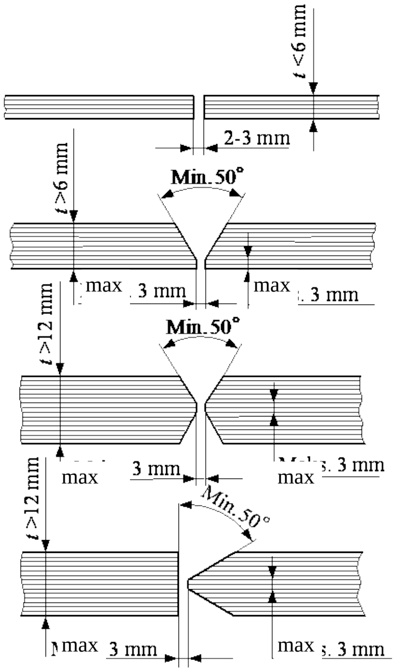
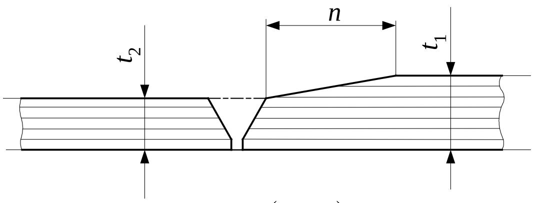


Fig. 4.1.2.1 Edge preparation for manual welding with butt joints

4.1.2.2 Where plates with thicknesses differing by more than 3 mm are butt joined, the thickness of the thicker plate shall be reduced by beveling, as shown in Fig. 4.1.2.2.



$$n_{\min} = 3(t_1 - t_2)$$

Fg. 4.2.1.2 Edge preparation for welding plates of different thicknesses

4.1.3 General Requirements for Fillet Weld Thickness

4.1.3.1 Applied types of fillet welds and the determination of the fillet weld thickness are shown in Fig. 4.1.3.1.

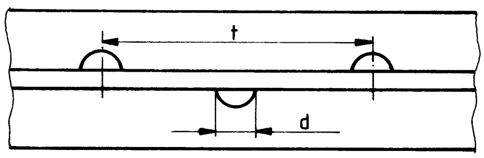
a) staggered weld

b) chain weld

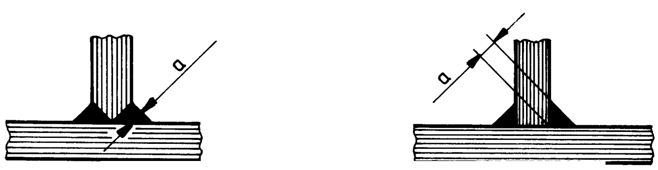
however, not more than 75 mm

c) scallop weld

d) single intermittent weld



e) staggered spot weld



f) thickness *a* of fillet weld

Fig. 4.1.3.1 Types of fillet welds and determination of weld thickness

4.1.3.2 Design thickness a of fillet welds shall be not less than that determined from the below formula:

$$a = \alpha\beta t + 0.5t_k \tag{4.1.3.2}$$

where:

α – coefficient depending on the type of connected structure items; required values of a are given in 4.2 and 4.3;
β – coefficient depending on the weld type; values of β are given in table 4.1.3.2;
t – lower value of joined items thicknesses, [mm].
t_k – the value of corrosion addition required for the items, [mm] (see 2.6).

The applied weld thickness shall not be less than:
2.5 mm – for t = 4 mm
3.0 mm – for 4 mm < $t \le$ 10 mm
3.5 mm – for 10 mm < $t \le$ 15 mm
0.25 t – for t > 15 mm.

Table 4.1.3.2

Item	Fillet weld type	β
1	Double intermittent weld	1.0
2	Staggered intermittent weld, chain weld, with scallops	t/l
3	Single continuous weld	2.0
4	Single intermittent weld	$2\ t/l$

t – weld pitch,
l – weld length.

4.1.4 Other Types of Welded Joints

4.1.4.1 Lap joints and slot welding may be used, upon separate consideration by PRS, only in areas of structures transmitting low stresses or where application of butt welds or fillet welds is not possible.

4.2 Types and Dimensions of Welds for the Unit Pontoon Hull

4.2.1 Deep Fusion Welding or Full Penetration Welding

4.2.1.1 PRS may require deep fusion welding or full penetration welding to be used for cruciform joints of plates in way of platform legs connections with pontoon and in heavily loaded areas of crane foundations – on the basis of stress analysis in these structure regions.

4.2.2 Fillet Joints

4.2.2.1 Cruciform joints of plates outside the regions mentioned in 4.2.1.1 and T-shaped joints of the pontoon structure may be performed by fillet joints. Double continuous welds are generally to be applied. The request concerning the use of single or intermittent welds will be considered by PRS separately.

4.2.2.2 Values of α (see 4.1.3.2) used for the determination of the required thickness of fillet welds in the platform pontoon structure are generally the following:

α = 0.60 – for heavily loaded cruciform joints, where full penetration welding should be used (upon special consideration by PRS);
α = 0.40 – for pontoon bulkhead/division connections with pontoon bottom and deck plating and for bulkhead/division mutual connections;
α = 0.35 – for connections of T-shaped primary supporting member webs of pontoon deck and bottom with plating, connections of T-shaped primary supporting member webs with the plating of the pontoon tank bulkheads and side walls.
α = 0.20 – for connections of plating stiffeners with the plating subject to transverse loads;
α = 0.15 – for stiffeners of division walls, primary supporting member webs, etc.

In some cases, PRS may, upon special consideration, agree to use of lower values of α than above given, on the basis of detailed structure strength analysis.

4.2.2.3 In the area of accommodation spaces located within the superstructures/deckhouses, the required types and dimensions of fillet welds shall comply with the provisions of document [3] (see 1.2.3).

Welds in regions of superstructures/deckhouses structure subject to considerable functional loads (store rooms, etc.) or supporting heavy or heavily loaded equipment items, shall be dimensioned acc. to the requirements of 4.2.1.1, 4.2.2.1 and 4.2.2.2.

4.3 Types and Dimensions of Welds in Footings

4.3.1 Elements extending the platform leg chords into footing structure shall be full penetration welded to the vertical footing divisions.

4.3.2 Bulkheads and divisions as well as side walls of a footing shall be full penetration or deep fusion welded to bottom plating, applying the coefficient $\alpha = 0.30$ (see 4.1.3.2).

4.3.3 Bulkheads and divisions as well as side walls of a footing shall be welded to the footing deck plating by continuous double fillet welds, applying the coefficient $\alpha = 0.40$ (see 4.1.3.2).

4.3.4 Mutual connections of bulkheads and divisions as well as footing side walls shall be welded by full penetration welds or deep fusion welds, applying the coefficient $\alpha = 0.30$ (see 4.1.3.2).

4.3.5 T-shaped primary supporting members or stiffeners of the footing bottom, side walls and deck (if applied) may be welded by continuous, double, fillet welds, applying the coefficient $\alpha = 0.30$ (see 4.1.3.2).

4.3.6 Stiffeners of footing bulkheads and divisions shall be welded by continuous, double, fillet welds, applying the coefficient $\alpha = 0.30$ (see 4.1.3.2).

4.4 Welds in Platform Leg Structure

4.4.1 Welded connections of pipe elements of leg structure (e.g. pipes of skew and horizontal braces welded to chords) shall be performed by full penetration welds. The requirements of document [1] (see 1.2.3) shall be fulfilled.

4.4.2 Where the pipe element connections in leg structure (e.g. pipes of skew and horizontal braces welded to chords) are additionally strengthened by brackets, pipe internal rings, etc., the welds to be used shall be considered by PRS separately.

5 LOADS FOR STRUCTURAL STRENGTH ANALYSIS

5.1 General

5.1.1 In this Chapter, a method of determination of platform loads applicable at the evaluation of unit structure strength, in normal service and accidental conditions, has been specified. Paragraphs 5.2 to 5.7 show the way of including environmental loads associated with:
- sea waves motions;
- sea currents;
- wind pressure;
- leg structure fouling;
- sea bed ground effect;
- deck icing or snow covering.

In paragraphs 5.8 and 5.9, requirements for determining design loads in service and emergency conditions have been given.

The environmental loads applicable in fatigue strength analysis of platform legs are dealt with in Chapter 8.

5.1.2 Methods of determining design load conditions, including the loads referred to in 5.1.1, are specified in 5.10.

5.2 Sea Waves Motions

5.2.1 Design Wave Parameters

5.2.1.1 Loads due to two-dimensional design waves assumed in the form of regular (sinusoidal) wave or Stokes wave of 5th order, respectively to the relation between the water area depth h_a and wave length L_f, shall be applied to the platform structure strength assessment according to criteria specified in Chapter 6. Where $h_a/L_f > 0.3$, the wave described by linear wave theory (regular, sinusoidal wave) may be assumed. Where $h_a/L_f \le 0.3$, a Stokes regular wave of 5th order shall be assumed.

5.2.1.2 In the structure strength analysis performed according to Chapter 6, the height of the wave of 100 year return period (H_{100}) or of 1 year return period (H_1) shall be applied.

Value H_{100} shall be determined based on statistic data pertaining to environmental conditions in the platform positioning area.

5.2.1.3 Wave period T_{100} of 100 year return period shall be determined from the below formula:

$$H_{100} = \left(\frac{T_{100} - 1}{4.1}\right)^{2.5} \qquad (5.2.1.3)$$

In the platform structure strength calculations, in accordance with Chapter 6, several regular waves of the period values within the range $(1 \pm 0.2)T_{100}$, shall be taken into account.

5.2.1.4 The wave height H_1 shall be related to H_{100}, as follows:

$$H_1 = 0.75 \cdot H_{100} \qquad (5.2.1.4\text{-}1)$$

The period T_1 of a wave of height H_1 shall be determined from the formula:

$$\frac{H_{100}}{T_{100}^2} = \frac{H_1}{T_1^2} \qquad (5.2.1.4\text{-}2)$$

In strength calculations of the platform structure according to Chapter 6, several regular waves of the period values within the range $(1 \pm 0.2)T_1$, shall be taken into account.

5.2.1.5 In the strength analysis made according to Chapter 6, it is to be assumed that waves of parameters such as in 5.2.1.3 and 5.2.1.4 may move in any direction.

5.2.2 Structure Load due to Wave Motions

5.2.2.1 The load due to wave motion of platform legs manufactured as single vertical pipes or as a three-dimensional frame made of pipes or other shapes, shall be determined from Morison equation:

$$F = 0.5\rho DU|U|C_d + \rho VaC_m \text{, [kN/m]} \tag{5.2.2.1}$$

where:
F – force applied related to the unit of pipe length [kN/m],
$\rho = 1.025$ t/m^3 – sea water density,
D – diameter of the element projection onto the plane perpendicular to U (in case of pipe elements, D is the pipe diameter), [m],
U – water particles velocity vector coordinate on the axis perpendicular to the element axis, [m] (see 5.2.2.2);
V – volume of the structure element related to a running metre of its length (for circular shape pipe elements: $V = \frac{\pi D^2}{4}$), [m^2],
a – water particles acceleration vector coordinate on the axis perpendicular to the element axis, [m/s^2] (see 5.2.2.2);

C_d and C_m – numerical coefficients (see 5.2.2.4).

5.2.2.2 The values of U and a shall be determined based on appropriate formulae resulting from the applied wave theory (see 5.2.1.1).

In region of wave crest, the values of U and a above the still water surface shall be taken the same as those for the still water surface.

In region of wave trough, the values of U and a shall be taken as if the still water surface is shifted downwards, to the momentary level of waved water.

5.2.2.3 In the structure strength analysis according to Chapter 6, the velocity U used in formula 5.2.2.1 is an algebraic sum of water particles velocities resulting from wave motions and sea current. It shall be assumed that the wave motion direction is collinear with the direction of water particles motion due to sea current.

In the fatigue strength analysis performed according to Chapter 8 requirements, the current speed shall be neglected.

5.2.2.4 For circular shape pipes, values of C_d and C_m to be used in the strength analysis, shall be taken as follows:
– for smooth surfaces of pipes (not fouled – see 5.5):

$$C_d = 0.65 \quad C_m = 1.6 \tag{5.2.2.4-1}$$

– for fouled pipe surfaces (see 5.5):

$$C_d = 1.05 \quad C_m = 1.2 \tag{5.2.2.4-2}$$

For pipe structure elements of non-circular section, values C_d and C_m used in the strength analysis, shall be considered by PRS separately.

In the case of leg columns forming smooth pipes of diameter D, with two toothed bars situated oppositely (along column pipe axis), the value of C_d shall be determined from the below formula:

$$C_d = C_d^{'} + 4e\cos\alpha / D \tag{5.2.2.4-3}$$

where:
$C_d^{'}$ – value of C_d , acc. to formula 5.5.5.4-1,
e – distance from column pipe surface to the middle-height of bar teeth.
α – angle between the water particles velocity vector and the column pipe symmetry plane, perpendicular to bar tooth height direction,
D – column pipe diameter.

For the fouled columns as above (with toothed bars), value C_d used in strength calculations shall be considered by PRS separately.

Values C_d and C_m used in fatigue strength analysis are given in Chapter 8. .

5.3 Sea Current

5.3.1 Sea Current Speed

5.3.1.1 The sea current velocity shall be determined on the basis of statistical data pertaining to the platform positioning location, taking into account wind effect.

Where no sufficient data are available, the current velocity v_c, depending on vertical coordinate z, may be assumed as in the formula:

$$v_c = v_{tc} + 0.017 v_w (1 - z/50), \text{ [m/s]} \tag{5.3.1.1}$$

where:

v_{tc} – reference tidal current velocity, [m/s],
v_w – reference wind velocity, [m/s] (see 5.4.3.1),
z – distance to still water free surface, [m]; $z < 50$ m shall be assumed.

5.3.1.2 Sea current velocity at wave crest shall be taken as equal to the value calculated according to formula 5.3.1.1, for $z = 0$.

5.3.1.3 The platform leg load taking into account current velocity shall be determined according to 5.2.2.3.

5.4 Wind

5.4.1 Wind Velocity

5.4.1.1 The following values of characteristic wind velocity v_w shall be applied on the basis of reliable statistical data from the place of the platform positioning. Where statistical data are not available, the below values of v_w for unrestricted operation area of the platform shall be applied:

v_w = 36 m/s – characteristic wind speed at 1 year return period, used in load case D (see 5.10.1);
v_w = 51.5 m/s – characteristic wind speed at 100 year return period, used in load case B (see 5.10.1).

5.4.1.2 Wind pressure onto the above-water parts of platform, determined according to 5.4.2.1, shall be applied in the shear strength analysis of the platform structure (load cases B and D, according to 5.10.1). It is to be assumed that the wind loads the platform simultaneously with wave motions and sea current action and in the same direction.

5.4.1.3 In the local strength analysis of the above-water parts of platform structure and parts of its equipment, the load due to wind gusts (waves and sea current effect on the bottom parts of the platform structure disregarded), calculated acc. to 5.4.2.1 for characteristic wind speed at 100 years return period, increased by 13%, shall be considered. Strength criteria determined in 6.1.2 for load case B shall be applied.

5.4.2 Load due to Wind

5.4.2.1 Wind forces acting on particular components of the above-water elements of the platform shall be calculated from the below formula:

$$F = 0.5 \rho_p C_s C_H A V^2, \text{ [N]} \tag{5.4.2.1}$$

where:

ρ_p = 1.222 kg/m^3 – air density,
C_s – non-dimensional coefficient of values depending on the shape of the element, given in table 5.4.2.1-1,
C_H – non-dimensional coefficient of values depending on the distance to still water surface, given in table 5.4.1.1-2,
A – area of projection of the structure element onto the plane perpendicular to wind direction, [m^2],
V – wind velocity equal to characteristic wind velocity v_w acc. to 5.4.1.1 or wind gust velocity acc. to 5.4.1.3, [m/s].

Table 5.4.2.1-1 Values of C_s coefficient

Shape	C_s
spherical	0.4
cylindrical	0.5
large flat surfaces	1.0
drilling davit	1.25
ropes	1.2
isolated primary supporting members and underdeck members	1.3
minor structural items	1.4
cranes, girders, etc.	1.5
deckhouses of module construction,, etc.	1.1

Table 5.4.2.1-2 Values of C_H coefficient

Height over the water level, [m]	C_H
0 – 15.3	1.00
15.3 – 30.5	1.10
30.5 – 46.0	1.20
46.0 – 61.0	1.30
61.0 – 76.0	1.37
76.0 – 91.5	1.43
91.5 – 106.5	1.48
106.5 – 122.0	1.52
122.0 – 137.0	1.56

5.5 Fouled Unit Legs

5.5.1 Parameters of Leg Fouling

5.5.1.1 In the platform structure strength analysis, fouling of leg structure components and its effect on platform leg loads from wave motions and sea current shall be considered (see 5.2.2).

In order to determine such fouling parameters as:

– depth of fouled leg sections;
– fouling thickness;
– fouling density (kg/m^3),

information on the operation of similar platforms in the sea conditions similar to those existing in the location of planned positioning of the unit, shall be used.

The method of determining the above parameters shall be sufficiently documented and accepted by PRS.

5.5.1.2 If during platform operation a periodical removal of fouling from the leg structure is expected, the value of fouling thickness to be taken for calculations shall be equal to the anticipated maximum thickness of fouling layer, accumulated between removal operations..

The value shall be specified in the PRS approved platform documentation.

If documented information of anticipated fouling of legs is not available (see 5.5.1.1), the value of fouling density not less than 100 mm, for the whole legs length – from the footings level up to 0.5H_{100} above the still water level (H_{100} is defined in 5.2.1.2), shall be taken for calculations of platform loads.

5.6 Sea Bed Ground Effect

5.6.1 Ground Parameters

5.6.1.1 Before the platform positioning on the sea bed, physical parameters of sea bed ground, to be used in structure strength analysis, shall be examined. Detailed requirements concerning this aspect are given in Chapter III.

If the platform is to be strengthened by a system of ropes or supports fixed to piles anchored to sea bed, the above values of ground parameters shall be applied in pile strength calculations.

5.6.1.2 On the basis of examined ground elasticity, the platform legs fixity for rotation shall be determined, as it significantly influences the distribution of internal bending moments in the legs and dynamical loads resulting from oscillating platform movements exerted by sea waves motions. Relevant calculations shall be presented to PRS for approval.

5.7 Icing

5.7.1 Platforms located in south regions of the Baltic Sea may suffer icing and snow covering of the pontoon deck and superstructure/deckhouse deck.

The strength analysis of platform structure shall be performed taking into account the weight of ice and snow gathered on decks, taking values given in 5.7.2.

5.7.2 It shall be assumed that the amount of load from ice and snow gathered on decks is not less than 0.25 t/m^2 (pressure of 2.5 kPa).

5.8 Functional Loads

5.8.1 Definition of Functional Loads

5.8.1.1 The term *functional loads* means loads which result from the unit operation in the most favourable weather conditions, i.e. when the sea is calm (no sea waves and sea current, no wind and icing exist nor fouling on the underwater elements of the supporting structure).

5.8.2 Loads Treated as Functional Loads

5.8.2.1 The functional loads include, in particular:
– a dead weight of the platform structure;
– the weight of the platform equipment elements;
– the weight of stores, water ballast, extracted crude oil collected in tanks, etc.;
– response forces from operating cranes, production equipment, etc.;
– buoyancy forces acting on underwater elements of platform structure;
– ground reactions to leg footings, forces due to action of ropes (if applied), forces due to additional leg columns (if applied), etc.

5.8.2.2 Loads due to liquids in tanks, bulk cargo stores, materials and general cargo and containers placed on decks and due to heavy items of equipment, shall be determined according to requirements of Chapter 16 of the PRS Rules, document [3] (see 1.2.3), taking zero values of accelerations a_v, a_T and a_l in respective formulae.

5.8.2.3 Deck loads (pressure) assumed in the platform structure strength analysis shall not be less than:
– for regions where operational loads are not expected to be transmitted: 2.5 kPa,
– crew spaces, communication corridors, etc.: 4.5 kPa,
– working areas on decks: 9.0 kPa,
– storage spaces: 13.0 kPa.

5.8.2.4 Loads due to liquids in tanks shall be taken according to requirements given in document [3] (see 1.2.3) assuming vertical acceleration $a_v = 0$.

5.9 Accidental Loads

5.9.1 The following cases of accidental loads shall be considered in the platform design process:
– collision with leg structure or pontoon of the ship mooring at the platform;
– fall of the weight lifted by a crane onto platform deck;
– explosion of hydrocarbon vapours;
– a fire.

5.9.2 Load due to the Ship Collision with the Platform Supporting Structure

5.9.2.1 It is the platform operator who makes a proposal in respect of the dimensions of the greatest ship to moor alongside the platform and permissible sea condition for such operation. It is recommended, however, that the assumed mass of the ship should be not less than 5000 tons and the permissible speed of the ship side, bow or transom collision with the leg structure should be not less than 2 m/s.

5.9.2.2 The measure of intensity of ship collision with the platform structure is the assumed value of kinetic energy E_k of the ship of mass m_s and associated water mass m_w, colliding with the platform with the speed V_s:

$$E_k = \frac{1}{2}(m_s + m_w)V_s^2 \qquad (5.9.2.2)$$

Values m_w shall be taken not less than:
$m_w = 0.4\ m_s$ – at collision with the ship side,
$m_w = 0.1\ m_s$ – at collision with the ship bow or side.
It may be assumed that $V_s = 0.5H_s$, [m/s], where H_s is the value of significant wave height, [m], adopted as permissible at ship mooring conditions.

5.9.2.3 The value of kinetic energy of ship colliding with the platform structure, calculated according to formula 5.9.2.2 for assumed values of m_s and V_s, is entered in the PRS issued platform certificates.

5.9.2.4 The platform structure elements which can contact ship side, superstructure, bow or transom shall be determined on the basis of ship dimensions (draught, depth, etc.), taking into account possible ship motions on waves and platform dimensions (height of pontoon bottom over water, distance from legs to pontoon sides, etc.).

5.9.3 Loads due to Dropped Objects

5.9.3.1 In the platform structure strength analysis, the possibility of accidental fall of an object lifted by a crane on a pontoon deck or superstructure/deckhouse decks, shall be considered.

5.9.3.2 The maximum values of the dropped object weight and the drop height result from allowable crane loads and the crane radius. The load measure is the value of potential energy E_p:

$$E_p = mgh \qquad (5.9.3.2)$$

where:
m – dropped object mass,
h – dropped object height.

5.9.3.3 It shall be assumed that the centre of gravity of dropped object may displace horizontally so that it will fall inside a cone whose top is at crane hook and whose generatrices are inclined 5 degrees to vertical. In the analysis of damages to structure caused by dropped object and in calculations of damaged structure strength, in accordance with Chapter 6, drop in regions whose damage will result in the greatest increase of stresses in non-damaged parts of platform structure, shall be assumed..

5.9.4 Fire

5.9.4.1 Increase of platform structure temperature due to fire results in reducing the value of Young's modulus and the material yield point, and creating so called temperature stresses in the platform supporting structure.

5.9.4.2 Temperature load of structure due to fire depends on the location of fire source in relation to structure, flames distribution in the space and the generated heat power per a unit of the area covered by flames ([kW/m^2]). The above parameters are recommended to be determined during analysis of fire risk performed with the use of FMEA/FMECA and EVENT TREE methods.

5.9.4.3 Temperature loads defined in 5.9.4.2 shall be applied together with functional loads determined in 5.8.2.

5.9.5 Load from Explosions

5.9.5.1 Consideration of a load due to explosion of hydrocarbon vapours in the platform compartments where extracted crude oil/ gas are stored or transferred by pipelines shall result from the analysis of explosion risk performed by FMEA/FMECA and EVENT TREE methods.

5.9.5.2 The load due to explosion is a short duration pressure of high values. In result of explosion, the air flow of high speed may also be generated. The explosion may result in extended plastic deformations or breaking of structure element connections in the region of explosion and in damage to platform equipment items attachments.

5.9.5.3 Explosion pressure as a function of time may be assessed on the basis of subject literature. Recommendations given in [1] (see 1.2.3) may be applied.

5.10 Design Load Cases

5.10.1 Each supporting structure item of the platform shall comply with the strength criteria defined in Chapters 6 and 7 for the below load cases:

A. Functional load (acc. to 5.8).
B. Maximum environmental loads (acc. to 5.2 to 5.7) acting simultaneously with functional loads (acc. to 5.8).
C. Accidental loads (each of cases acc. to 5.9.2 to 5.9.4) acting simultaneously with functional loads (acc. to 5.8).
D. Environmental loads of 1 year return period (acc. to 5.2. to 5.7) acting simultaneously with functional loads (acc. to 5.8), in the case of structure with damaged elements, due to accidental loads.

6 STRENGTH OF STRUCTURE

6.1 Strength of Pontoon and Superstructures

6.1.1 General

6.1.1.1 In this Chapter, required scope and methods of supporting structure strength analysis of platform pontoon and superstructures/ deckhouses hull are defined and allowable stress values are given. The analysis covers normal service conditions taking into account environmental loads, accidental conditions and the cases of structure damaged by accidental loads.

6.1.2 Allowable Stresses at Service and Accidental Conditions

6.1.2.1 The requirements of 6.1.2 apply to allowable stresses in the structure items of hull and superstructures/deckhouses, associated with global response to loads. They are equivalent stresses (see 3.3.2.2) determined for membrane components of nominal stresses in bottom plating, deck(s), sides, pontoon bulkheads/divisions, T-shaped primary supporting members, pillars. The requirements apply only to service conditions of the platform considered in 6.1.4 and accidental conditions, dealt with in 6.1.5 to 6.1.8.

The values of allowable stresses given in 6.1.2.3 apply only to pontoon and superstructure/ deckhouse structures outside the region adjacent to locations of platform leg support on the pontoon, for which the values of allowable stresses are specified in 6.3.

The values of allowable stresses applied at dimensioning of the plating, stiffeners of plating and primary supporting members subjected to bending by transverse loads, have been specified in 6.1.4.2 to 6.1.4.5,

6.1.2.2 In calculations of structures subjected to accidental loads and in the strength analysis of the structure damaged due to failure (see 6.1.5. to 6.1.8 and load cases C and D of loads in 5.10), the values of allowable stresses given in 6.1.2.3 apply to structure areas not adjacent to damaged area. In the close vicinity to damaged area and locally outside this area, transgression of allowable stresses is allowed, however, redistribution of stresses due to plasticization or breaking of local item connections, or buckling of structure components shall be considered in the calculation model.

6.1.2.3 Values of allowable stresses in the load cases defined in 5.10 are given in table 6.1.2.3, where η means the value of $\frac{\sigma_{eq}}{R_e}$.

Stresses σ_{eq} shall be calculated in accordance with 3.3.2.2.

Table 6.1.2.3 Allowable stresses

Load case	A	B	C	D
η	0.60	0.80	0.80	1.0

6.1.3 Platform Towing Conditions

6.1.3.1 Platform towing with the pontoon supported by buoyancy force, as a rule, takes place with limited weather conditions (limited allowable value of significant wave height).

6.1.3.2 The strength analysis of platform pontoon performed for towing conditions shall use calculation methods and criteria contained in document [3] (see 1.2.3), within the scope applicable to platforms. Structure strength in the region of platform legs support will be considered by PRS separately.

Dynamic action of legs, according to requirements of 6.2.10 and 6.3, and dynamic loads (water pressure and platform movements acceleration) shall be considered in the above analysis.

It is recommended that the dynamic loads exerted in the assumed permissible waving conditions should be determined by direct calculations, i.e. by solving platform motion equations, on irregular wave in the assumed allowable sea state.

6.1.3.3 Dynamic action of legs, according to 6.2 and 6.3, shall be considered.

Alternatively, simplified calculations may be applied (quasi-statistical model), with the use of loads in the form of sea water pressure onto the pontoon bottom and sides, structure dead weight, weight of platform equipment items, cargo, water ballast, etc. and dynamic loads from legs due to platform motions on waves (heel) and wind pressure (see 6.2.10). The loads shall be such as to ensure approximate equilibrium of the whole platform and ensure estimation of stresses at safe side. The strength analysis shall include various cases of ballast distribution in pontoon tanks and of deck work load, or precisely defined distribution of these loads, given in the platform towing manual.

6.1.3.4 The FEM model applied in the analysis shall generally meet the requirements concerning hull, defined in 6.1.4.1.1 and the requirements on legs modeling specified in 6.2.6.1, as well as the requirements for legs – pontoon hull connections, specified in 6.3. Influence of sea pressure may be simulated by distribution of respectively significant number of springs under strong structure elements of pontoon bottom.

6.1.3.5 Report on calculations shall be submitted to PRS for information.

6.1.4 Service Conditions

6.1.4.1 Stress Calculation Method

6.1.4.1.1 Stresses in the structure of pontoon and superstructures/deckhouses, evaluated according to criteria defined in 6.1.2, shall be generally calculated using the shell and beam FEM model of the whole supporting structure – to consider the platform legs effect on pontoon structure. At developing such FEM model, general requirements of Chapter 14 of the document [3] (see 1.2.3) shall be applied within the scope applicable to platform structure. The platform legs shall be modelled according to principles given in 6.2.

In FEM model, net thicknesses of structure items shall be used, i.e. actual values of thickness (design thicknesses in case of designed new structure parts or thicknesses measured for existing structure items) shall be reduced by corrosion additions specified in 2.6.

Load cases A and B (see 5.10) shall be applied in FEM model.

Boundary conditions apply to legs supporting and they have been defined in 6.2.8.

Application of more simplified calculation models will be considered by PRS separately.

6.1.4.2 Plating Thickness

6.1.4.2.1 Thickness of plates of pontoon structure and superstructures/deckhouses subject to pressure of liquid in tanks, service pressure of decks, etc. shall be verified in the load case A (see 5.10). For plating adjacent to platform legs, PRS may also require load case B to be considered. Plate thickness shall be not less than calculated from the formula:

$$t = 18 k_a s \sqrt{\frac{p}{\sigma}} + t_k \text{, [mm]} \qquad (6.1.4.2.1\text{-}1)$$

where:

s – length of the shorter plate side, [m],

l – length of the longer plate side, [m],

$k_a = \left(1 - 0.27\frac{s}{l}\right)^2$, the adopted value need not be higher than 0.88,

σ – allowable stresses determined according to the requirements of. 6.1.4.2.2, [MPa].

The applied plate thickness shall not be less than:

$$t = \frac{t_0}{\sqrt{R_e / 235}} + t_k \text{, [mm]} \qquad (6.1.4.2.1\text{-}2)$$

where:

t_0 = 7 mm – for plates of special and primary class elements,

t_0 = 5 mm – for plates of secondary class elements (see 2.3.1.3),
t_k – corrosion addition (see 2.6).

6.1.4.2.2 For plates which do not transmit membrane stresses due to bending of pontoon supported by platform legs, the allowable stress values are as below:

$$\sigma = \frac{2}{3} R_e \text{, [MPa]} \tag{6.1.4.2.2-1}$$

In case of plates which transmit stresses due to bending of pontoon supported by platform legs, the allowable stress values are as below:

$$\sigma = \sqrt{\left(\frac{2}{3} R_e\right)^2 - 0.19\sigma_2^2} - 0.25|\sigma_2| - 0.5|\sigma_1| \text{, [MPa]} \tag{6.1.4.2.2-2}$$

where:
σ_1 – value of membrane stresses due to bending of pontoon, in direction of plate side of length *s*, [MPa],
σ_2 – value of membrane stresses due to bending of pontoon, in direction of plate side of length *l*, [MPa].
Stresses σ_1 and σ_2 shall be determined on the basis of calculations required in 6.1.4.1.

6.1.4.3 Plating Stiffeners

6.1.4.3.1 Strength of plating stiffeners of the structure of pontoon and superstructures/deckhouses, subject to the pressure of liquid in tanks, deck service pressure, etc. shall be verified for the load case A (see 5.10). For plate stiffeners in region of platform legs, PRS may require the load case B to be considered.

The plating stiffener section modulus, together with effective flange, shall be not less than defined from the below formula:

$$W = \frac{1000 psl^2}{m\sigma} w_k \text{, [cm}^3\text{]} \tag{6.1.4.3.1}$$

where:
p – design pressure, [kPa],
s – stiffener spacing, [m],
l – stiffener span, [m],
m – non-dimensional coefficient depending on the fixity of the end cross-sections :
  m = 12 – for continuous stiffeners of pontoon deck, bottom, sides or bulkheads composed of many spans,
  m = 10 – for stiffeners which are non-continuous (e.g. vertical stiffeners);
  m = 8 – for stiffeners with simply supported ends.
σ – value of allowable stresses, determined acc. to 6.1.4.3.2,
w_k – coefficient taking into account corrosion addition, determined acc. to 6.1.4.3.3.

6.1.4.3.2 The value of allowable stresses shall be calculated from the formula:

$$\sigma = \frac{2}{3} R_e - \sigma_1 \tag{6.1.4.3.2}$$

where:
σ_1 – value of membrane stresses due to pontoon bending, acting along the stiffener axis, [MPa].
Stresses σ_1 shall be determined based on the calculations required in 6.1.4.1.

6.1.4.3.3 The values of coefficient w_k shall be calculated from the formula:
– for angle stiffeners:

$$w_k = 1 + 0.1 t_k \tag{6.1.4.3.3-1}$$

– for other stiffeners:

$$w_k = 1 + 0.06 t_k \tag{6.1.4.3.3-2}$$

where:
t_k – the value of corrosion addition, required for the stiffened plating, [mm], determined according to 2.6.1.

6.1.4.4 Stiffener Brackets

Dimensions of stiffener brackets shall be determined according to the requirements of Chapter 13 of document [3] (see 1.2.3).

6.1.4.5 Primary Supporting Members and Pillars

6.1.4.5.1 Primary supporting members and pillars shall be taken into account in the structure FEM model required in 6.1.4.1. Effect of openings in webs on the values of shear and equivalent stresses shall be considered. To that purpose, the openings need not be modeled directly in FEM model but in their vicinity a reduced thickness of web plate may be applied, according to requirements of 6.1.4.1.

6.1.4.5.2 Allowable values of equivalent (nominal) stresses defined in 6.1.2 are obligatory.

6.1.5 Accidental Conditions – Dropped Objects

6.1.5.1 Permanent deformations of structure parts or their separation from the neighbouring elements are usual results of the dropped object of parameters defined in 5.9.3 on the deck of pontoon or superstructure/deckhouse of platform.

6.1.5.2 The analysis of dropped object consequences may be performed with the use of advanced calculation models (non-linear FEM analysis). Alternatively, simplified estimating calculations, based on values of energy dispersed in the structures subject to plastic strain, may be applied. With this purpose, information included in document [6] (see 1.2.3), which enable to assess the maximum deformations of plating plates, stiffeners and primary supporting members (including plastic strain) and the strength of plating stiffeners and primary supporting members attachments to adjacent structure items, may be applied. The functional loads determined according to the requirements of 5.8.2 shall be considered, that means that the load case C shall be applied in the calculations (see 5.10).

6.1.5.3 The strength of the structure damaged in result of dropped object shall be evaluated. Permanent deflections of plating, plating stiffeners and primary supporting members shall be considered in the calculation model, or it is to be assumed that such elements do not exist within the structure. Elements having ends separated from other structure components shall be neglected. If in such structure model, subjected to functional loads, defined in 5.8.2, and environmental loads of 1 year return period (waves, wind, load case D acc. to 5.10), the nominal stresses in structure elements do not exceed the level defined in table 6.1.2.3 and the structure elements are not subject to buckling, then the structure is considered resistant to the fall of weight of the assumed parameters.

6.1.6 Accidental Conditions – Collision with a Ship

6.1.6.1 It is recommended that the platform supporting structure and the elements of crude oil/gas extraction system should be protected by appropriate fender guard system, which shall ensure dispersion of ship kinetic energy of parameters specified in 5.9.2, without damage to supporting structure.

6.1.6.2 If the requirements of 6.1.6.1 are not complied with and the parameters of the ship mooring along the platform allow for its accidental collision with pontoon structure or superstructure wall, consequences of such collision for the platform supporting structure shall be evaluated.

6.1.6.3 The analysis of structure damage due to ship collision with platform may be performed using advanced calculation models (non-linear FEM analysis), according to general requirements given in the document [1] or [6] (see 1.2.3). Alternatively, simplified estimating calculations, based on values of energy dispersed in the structures of platform and ship, due to elastic and plastic strain, using values of force values needed for achieving assumed elastic and plastic strain of plating plate or beam (plating stiffeners, primary supporting members), may be applied. With this purpose , information included in document [6] (see 1.2.3), which enable to estimate the maximum deformations of plating plates, stiffeners and primary supporting members (including plastic strain) and the strength of plating stiffeners and primary supporting members attachments to adjacent structure items, may be applied. Functional loads, determined according to 5.8.2, shall be considered together with loads from collision with ship, that means the load case C shall be applied in calculations (see 5.10).

6.1.6.4 The strength of the structure damaged in result of ship colliding the platform shall be evaluated. Permanent deflections of plating, plating stiffeners and primary supporting members shall be considered in the calculation model, or it is to be assumed that such elements do not exist within the structure. Elements having ends separated from other structure components shall be neglected. If in such structure model, subjected to functional loads, defined in 5.8.2, and environmental loads of 1 year return period (waves, wind, load case D acc. to 5.10), the nominal stresses in structure elements do not exceed the values given in table 6.1.2.3 and the structure elements are not subject to buckling, then the structure is considered resistant to the collision with a ship of the assumed size and speed.

6.1.7 Accidental Conditions – Fire

6.1.7.1 During the structure design, measures shall be taken for the maximum restriction of fire effect on the platform structure by the following arrangements:

- division of pontoon, superstructure/deckhouse space into flame-proof compartments of the possibly smallest volume;
- use of fire-proof insulation of walls, decks;
- use of automatic fire detection and extinguishing systems.

Based on the analysis of such arrangements, PRS may waive the structure strength analysis according to requirements of 6.1.7.2 to 6.1.7.5.

6.1.7.2 For fire conditions, the structure strength calculations consist in estimation of temperature value in structure elements, in time function, on the basis of the analysis of heat flow from fire source into the structure, in the form of radiation, convection and conduction – for a fire of characteristics defined according to 5.9.4.2. The loads defined in 5.9.4.3 are considered at once.

6.1.7.3 The strength analysis of structure subjected to high temperature may be performed with use of advanced calculation models (non-linear FEM analysis) described in [1] or in [6] (see 1.2.3). Reduction of Young's modulus value and yield point for steel associated with the temperature rise and material plastic flow resulting in permanent deformations of some structure items, is considered in calculations. The supporting structure maintaining its rigidity during the fire and after its end (after the high temperatures cease), is considered resistant to fire of an assumed characteristics..

6.1.7.4 An alternative analysis may be applied in relation to that described in 6.1.7.3 and permissible temperature values may be determined for particular structure components, at which maximum stresses in these components do not exceed the yield point at elevated temperature. This level of stresses is considered acceptable in accidental (fire) conditions. Such calculations are performed by a method described in document [6] (see 1.2.3).

On the basis of so determined temperatures, fire characteristics safe for the structure may be estimated (see 5.9.4).

6.1.7.5 After the platform structure strength analysis, PRS may agree to a simplified strength analysis of structure fire resistance. In such analysis, it may be assumed that all vertical and horizontal divisions directly encompassing the fire source (walls, decks) do not support adjacent structure regions (it may be assumed in the analysis that the divisions do not exist within the structure). If in such structure model, neglecting temperature stresses, including functional loads referred to in 5.8.2 and environmental loads of 1 year return period (waves, wind, load case D acc. to 5.10), the nominal stresses in the structure items do not exceed the values given in table 6.1.2.3 and the structure items are not subject to buckling, the structure is considered fire-proof in the given space.

6.1.8 Accidental Conditions – Explosion

6.1.8.1 During the structure design, measures shall be taken for the maximum restriction of explosion effect on the platform structure by using the following arrangements:
– appropriate division of pontoon, superstructure/deckhouse space;
– use of special shields for supporting structure parts or platform equipment;
– use of protective measures in the form of flaps opened automatically at sudden pressure buildup;
– use of appropriate spaces ventilation system.

Based on the analysis of such arrangements, PRS may waive the structure strength analysis according to requirements of 6.1.8.2 and 6.1.8.3.

6.1.8.2 The strength analysis of structure subjected to explosion pressure load may be performed using advanced calculation models (non-linear FEM analysis), according to general requirements given in the document [1] or [6] (see 1.2.3). Alternatively, simplified estimating calculations, based on a system with one degree of freedom, may be applied. With this purpose, information included in document [6] (see 1.2.3), which enable to estimate the maximum deformations of plating plates, stiffeners and primary supporting members (including plastic strain) and the strength of plating stiffeners and primary supporting members attachments to adjacent structure items, may be applied. Functional loads, determined according to 5.8.2, shall be considered together with explosion pressure load, that means the load case C (see 5.10) shall be applied in calculations.

6.1.8.3 The strength of the structure damaged in result of explosion shall be evaluated. Permanent deflections of plating, plating stiffeners and primary supporting members shall be considered in the calculation model, or it is to be assumed that such elements do not exist within the structure. Elements having ends separated from other structure components shall be neglected. If in such structure model, subjected to functional loads, defined in 5.8.2, and environmental loads of 1 year return period (waves, wind, load case D acc. to 5.10), the nominal stresses in structure elements do not exceed the values given in table 6.1.2.3 and the structure elements are not subject to buckling, then the structure is considered resistant to explosion of the assumed characteristics in the given structure region.

6.2 Strength of Legs and Footings

6.2.1 General

6.2.1.1 It is assumed that the conversion of self-elevating platform into the one permanently positioned on the sea bed may need the platform legs to be modified as below:
a) use of legs typical for self-elevating platforms, i.e structures in the form of a three-dimensional frame made of pipes; the structures may be new or the self-elevating platform legs may be strengthened with additional pipe elements;
b) legs as in case (a) provided with additional strengthenings in the form of special ropes or supports attached to legs and anchored to piles in the sea bed, etc.;
c) replacement of original self-elevating platform legs with those in the form of circular section columns made using thick-wall pipes.

6.2.1.2 In this paragraph 6.2, the method of verifying the legs strength has been defined for the below conditions:
a) normal service conditions of the platform permanently positioned on the sea bed;
b) sea transit of the platform, if expected (platform pontoon is floating and its legs are elevated above the pontoon);
c) legs lowering (legs collision with the sea bed);
d) legs forcing into the sea bed ground by appropriate loading the pontoon (e.g. with water ballast);
e) ship collision with the platform leg.

6.2.1.3 Paragraphs 6.2.2 to 6.2.5 define the method of determining some parameters of the whole platform or its legs, which are used for determining loads in quasi-statistical calculation model, defined in 6.2.9, or for the evaluation of the level of stresses in the platform leg structure components.

6.2.2 Dynamic Amplification Factor for Pontoon Space

6.2.2.1 The dynamic amplification factor of pontoon spaces (*DAF*) takes into account increase in displacement and internal forces and stresses in platform legs, in relation to the values calculated with the assumption of static action of the legs load due to wave motions. It is an effect of platform inertia. The value of *DAF* factor is applied at determining additional horizontal load of the platform pontoon, used in a simplified analysis of the platform response to the load, using the calculation model described in 6.2.9.2.

6.2.2.2 The value of *DAF* factor shall be calculated from the below formula:

$$DAF = \frac{1}{\sqrt{\left(1-\left(\frac{T_0}{T}\right)^2\right)^2+\left(2\xi\frac{T_0}{T}\right)^2}} \qquad (6.2.2.2)$$

where:
T_0 – platform free vibration period, calculated acc. to 6.2.2.3,
T – period of regular wave used in platform strength calculations (see 5.2.1),
ξ – damping coefficient (see 6.2.2.4).

6.2.2.3 In order to calculate T_0, a FEM model of the platform, developed according to principles given in 6.1.4.1.1, may be used and the vibration analysis may be performed. The mass of legs fouling and the added mass of water of the platform leg structure components situated below the average level of still water, shall be considered in the calculation model. For leg components built from pipe elements, as a three-dimensional frame, or legs in the form of columns made of single pipes, the values of added mass of water coefficients have the value of ρVC_m factor from the formula 5.2.2.1.

In FEM model, legs bending rigidity shall be reduced in order to include the effect of leg compressive forces on their deflection. For FEM calculations, the value of Young modulus of leg structure elements shall be divided by α coefficient calculated in accordance with 6.2.3.2.

The value of T_0 taken in FEM analysis, acc. to 6.2.9, shall be equal to the values of basic free vibration period when all legs are bent in the same direction (approximately) and the pontoon motion direction is the least inclined to the waves motion direction, assumed for the given case of FEM platform structure strength calculations.

6.2.2.4 Coefficient ξ takes into account vibration damping in result of energy dispersion in the structure (mainly in leg connections with hull), in water resisting movements of leg structure components and in the ground supporting leg footings. The coefficient value taken for calculations shall not exceed 0.07.

6.2.3 Effect of Legs Compression on Their Bending

6.2.3.1 In result of leg compression by a vertical force (action of pontoon on the leg) when the leg axis is deflected from vertical, additional bending moment is generated therein. If in the adaptation of the self-elevating unit to a stationary unit, strengthenings leading to significant increase in legs transverse rigidity are not provided, the above bending moment shall be taken into account in the leg strength analysis. Its value shall be assessed on the basis of the value u_0 of leg end deflection from vertical (Fig. 6.2.3.1) and the value u_f of pontoon horizontal displacement due to wave motions, sea current and wind pressure.

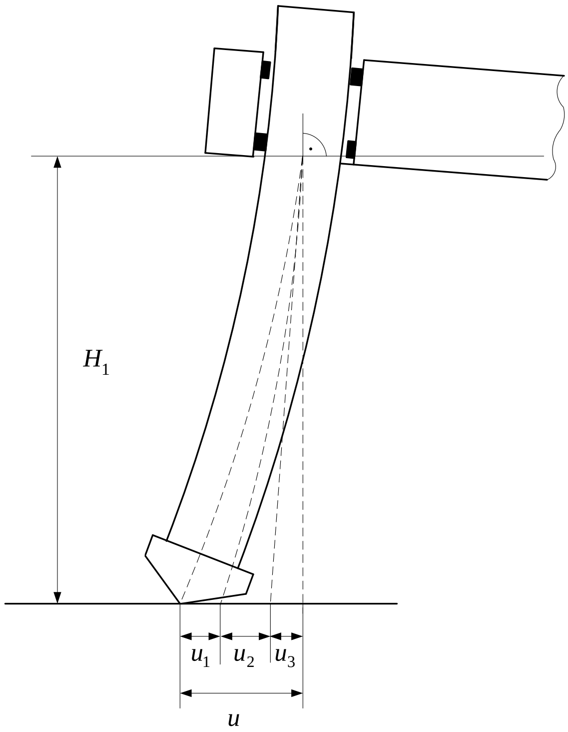


Fig. 6.2.3.1 Leg end deflection from vertical

The deflection u_0 is a sum of three components (Fig. 6.2.3.1):

$$u_0 = u_1 + u_2 + u_3 \tag{6.2.3.1}$$

where:
u_1 – leg axis deflection (technological) from straight line;
u_2 – leg axis deflection due to clearances in leg casing in the pontoon;
u_3 – leg axis deflection due to whole platform heel.

The u_o value taken for platform strength evaluation is determined by the platform designer, it shall, however, be not less than $H_1/200$ (H_1 – see Fig. 6.2.3.1).

The u_f value shall be calculated by solving linear FEM model of platform described in 6.2.9, taking into account the load including dynamic overloads (see 6.2.9.2.2), however, without considering the effect of u_0.

6.2.3.2 The value of total displacement of platform pontoon Δ used for consideration of the effect of leg compression on the increase of leg bending moment, shall be calculated from the below formula:

$$\Delta = \alpha(u_0 + u_f) \tag{6.2.3.2-1}$$

where:
u_0, u_f – see 6.2.3.1;

$$\alpha = \frac{1}{\left(1 - \frac{P}{P_E}\right)} \tag{6.2.3.2-2}$$

P – arithmetic mean value of platform leg compressive forces, from work loads (case A in 5.10);
P_E – value of theoretical critical force of the leg under compression, calculated according to 6.2.4.

6.2.3.3 Consideration of the effect of non-axial compression of platform legs on leg structure stresses may be done by applying horizontal load of resultant value equal to F_H force, to platform pontoon (see Fig. 6.2.3.3 and paragraph 6.2.9.2.2):

$$F_H = \frac{Q_p \Delta}{H} \tag{6.2.3.3}$$

where:

Q_p – platform weight, excluding the weight of leg sections below their pontoon attachments;

Δ – displacement calculated according to formula 6.2.3.2-1;

H – dimension defined in Fig. 6.2.3.3.

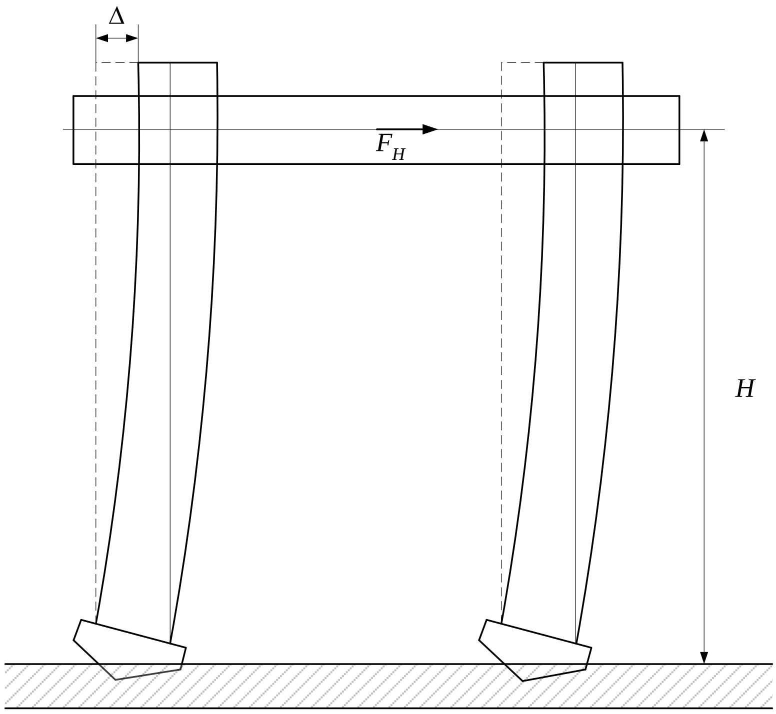


Fig 6.2.3.3 Load of pontoon by force F_H

6.2.4 Theoretical Value of Critical Force of a Leg under Compression

6.2.4.1 The force P_E (see 6.2.3.2) may be determined by using FEM model of the platform, described in 6.2.9, to determine so called eigen values. The model shall take account only of the platform weight.

6.2.4.2 Alternatively, the force P_E may be determined with use of the model of a beam structure adequate to leg structure. The beam is elastically supported for the rotation on the lower end (ground effect – see 6.2.8) and is able to displace transversely within its section at lower pontoon attachments and has zero value of transverse section rotation angle in this place. At calculation of the moment of inertia of such beam, only the transverse sections of chords, shall be considered.

6.2.5 Critical Stresses of Platform Leg Structure Components

6.2.5.1 The values of critical stresses of platform leg items at local buckling (buckling of bracing sections between chords, chords' sections between bracing attachments, etc.) are needed for the strength analysis of the structure elements subject to simultaneous compression and bending, according to the requirements of Chapter 7.

6.2.5.2 The values of critical stresses σ_c of leg structure items made from pipes or pipes with attached elements (e.g. column toothed bars) shall be calculated from the formula:

$$\sigma_c = R_e \quad \text{when} \quad \lambda \le \lambda_0$$

$$\sigma_c = R_e \frac{1+\mu+\lambda^2-\sqrt{(1+\mu+\lambda^2)^2-4\lambda^2}}{2\lambda^2} \quad \text{when} \quad \lambda > \lambda_0 \tag{6.2.5.2-1}$$

where:

$$\mu = 0.2(\lambda - \lambda_0) \qquad (6.2.5.2\text{-}2)$$

$$\lambda = \sqrt{\frac{R_e}{\sigma_E}} = \frac{\lambda_k}{\pi}\sqrt{\frac{\sigma_E}{E}} \qquad (6.2.5.2\text{-}3)$$

$\sigma_E = \dfrac{\pi^2 E}{\lambda_k^2}$ – theoretical critical stresses (6.2.5.2-4)

$\lambda_k = \dfrac{l_e}{i}$ – element slenderness coefficient (6.2.5.2-5)

$l_e = Kl$ – element effective length (6.2.5.2-6)

l – element length;
K – numerical factor with values depending on fixation of element ends

$i = \sqrt{\dfrac{I}{A}}$ – radius of inertia (6.2.5.2-7)

I – moment of inertia of the cross-section;
A – cross-section area.

In the case of chord sections, K = 1.0 shall be assumed.
In the case of leg bracings, K = 0.8 shall be assumed, unless lower values may be taken upon detailed analysis.

6.2.6 FEM model of Platform Legs

6.2.6.1 In case of legs made as several vertical chords connected by horizontal and skew braces, it is sufficient to use the calculation model in the form of three-dimensional frame, i.e. apply beam finite elements.

Model of legs–pontoon hull interaction shall be performed in accordance with 6.3.

Pipes that constitute leg structure shall be connected with FEM model of a footing, complying with the requirements of 6.2.7.

Requirements for FEM model of pontoon hull and superstructures/deckhouses have been specified in 6.1.4.1.1

Model of legs–ground interaction shall be performed in accordance with 6.2.8.

6.2.6.2 FEM model of additional strengthenings of platform structure connected with legs or with pontoon will be considered by PRS separately, depending on proposed detailed design solutions.

6.2.6.3 For platforms with legs being massive columns in the form of single vertical pipes, a model of legs in the form of beam elements may be used, but in regions of leg – footing connection and leg – pontoon hull connection, use of shell or volume finite elements is recommended.

6.2.7 FEM Model for Footings

6.2.7.1 The footings shall be modeled with the use of shell finite elements. Particular attention shall be given to modeling footing bottom plates, side walls, transverse bulkheads and divisions system and footing deck plate. Footing bottom plate stiffeners, if applied, may be modeled by beam finite elements.

Regions of leg structure components connections with footing structure elements shall be modeled with particular care.

6.2.8 Effect of Sea Bed Ground

6.2.8.1 Before permanent positioning the platform on the sea bed, geological examinations of ground shall be performed, to assess its bearing capacity and estimate depth of sinking the footings transmitting leg loads in the ground.

Elastic deformability of the ground essentially affects the load of leg and pontoon structure parts adjacent to their contact area. Ground deformability influences also the frequency of platform free vibrations, what affects indirectly the rate of leg structure fatigue degradation.

6.2.8.2 In the FEM analysis, the ground effect onto the platform may be simulated by distribution of vertical spring system under bottom plates and horizontal spring system connected with footings side surface. The rigidity of each spring is adequate to elastic compressibility of the ground and to supported area of bottom or side area of the footing.

6.2.8.3 The system of springs, referred to in 6.2.8.2, is the only platform support (if additional strengthenings fitted to the sea bed by means of piles, anchors, etc., have not been applied).

6.2.9 Legs Strength for Platform Service Conditions

6.2.9.1 FEM Direct Analysis – Platform Dynamics

6.2.9.1.1 Structure stresses may be determined as a function of time, by applying an advanced calculation method consisting in direct integration of the platform structure model motion equations. The motion equations are created for the FEM model of the whole platform (see the requirements for FEM model given in 6.1.4.1.1 and 6.2.6 to 6.2.8). The motion equation solutions (displacement of FEM model nodes and stresses in finite elements) are determined within the assumed time intervals. Variable loads due to moving regular wave of parameters given in 5.2.1, are considered. Alternatively, the analysis may apply an irregular wave, generated based on the wave spectrum, corresponding to significant wave height H_s of the following value:

$$H_s = 0.55H \qquad (6.2.9.1.1)$$

where:
$H = H_{100}$ or $H = H_1$ – depending on the load case (see 5.10 and 5.2.1).

FEM model includes so called geometrical nonlinearities, aimed at considering the effect of leg compressive forces on the platform pontoon displacement.

Application of the above calculation model and calculation results will be considered by PRS separately.

Practically, use of a simplified calculation model described in 6.2.9.2 is sufficient.

6.2.9.2 Simplified analysis – Quasi-statistical model

6.2.9.2.1 In calculations, a FEM model complying with the requirements of 6.1.4.1.1 and 6.2.6 to 6.2.8 is applied. It is assumed that the load from the design regular wave of characteristics specified in 5.2.1, constitutes a static load of the structure. Not less than 20 momentary wave positions in relation to platform, covering the wave period values with regular time steps, are taken into account. It is assumed that the sea current and wind directions are the same as waves direction. Calculations shall be made for at least 8 directions, covering the whole range of 360 degrees with interval of 45 degrees, unless the preliminary analysis of structure configuration proves that the above number of considered wave directions may be reduced.

Various methods of distribution of variable work loads in a pontoon and in superstructures/deckhouses shall be considered in calculations, provided such cases can be met during platform service.

6.2.9.2.2 Dynamic overloads associated with load, variable in time, due to design (regular) wave, are considered in calculations by a simplified method. With this purpose, a static load equivalent to horizontal force F acting in the wave direction and passing through the gravity centre of the whole platform mass, shall be applied to the pontoon, taking into account the added mass of water in legs (the force F acts similarly to force F_h shown in Fig 6.2.3.3):

$$F = R_h(DAF - 1) \qquad (6.2.9.2.2)$$

where:

R_h – the amplitude of total ground horizontal reaction force for all platform legs, calculated as a half of difference between the maximum and minimum ground reaction force, when legs are loaded from wave motion, sea current and wind pressure (static action assumed); The maximum and the minimum response values are determined for time period equal to wave period; *DAF* – determined in 6.2.2.2.

6.2.9.2.3 Effect of non-linear compression of legs on their bending shall be taken into account in the FEM model according to the requirements of 6.2.3.3.

6.2.9.2.4 The effect of the sea bed ground on footings shall be considered according to 6.2.8.

It is, however, recommended that the platform legs and their attachments to hull and footings should additionally fulfil the strength criteria for the below footing support cases:

- the bottom of each footing is simply (non-displaceably) supported in the leg axis;
- all nodes of the FEM model of a leg, located at its bottom, are non-displaceably supported (leg fixed at its bottom end).

6.2.9.2.5 For pipe components of leg structure (or leg chords containing toothed bars) subjected to tension or compression with simultaneous bending, the tensile stresses σ_n (normal) in external fibres shall comply with the criteria defined in table 6.1.2.3, where the following shall be taken:

$$\eta = \frac{|\sigma_n|}{R_e} \tag{6.2.9.2.5}$$

6.2.9.2.6 For pipe components of leg structures (or leg chords containing toothed bars) subjected to tension or compression, a criterium of buckling strength given in 7.2.4.2 shall be fulfilled. Stresses σ_c applied in criteria of 7.2.4.2 shall be determined in accordance with 6.2.5.2.

6.2.9.2.7 The strength of connections of horizontal and skew braces with leg chords shall be verified using formulae used for allowable values of axial forces and bending moments and equations checking strength under combined action of the above loads, given in [1] (see 1.2.3). Safety factor related to loads damaging connections, of values η given in table 6.1.2.3, shall be applied.

In case of connections of design not considered in document [1] (e.g. used additional strengthenings inside chord pipes, brackets connecting bracing pipes to chords, etc.), checking the strength of the connections is recommended, with the use of appropriate FEM models or engineering estimates using bearing capacity estimation methods which, however, give conservative results. Results of such calculations will be considered by PRS separately.

6.2.10 Platform Towing

6.2.10.1 During platform towing, its legs are elevated high over the pontoon and their displacement against the pontoon is restrained. Legs dead weight, inertia forces resulting from pontoon motions in waves and wind force are essential components of leg loads.

The greatest stresses occur in region of leg connections with pontoon.

6.2.10.2 Leg structure stresses shall be determined with use of FEM model described in 6.1.3.4.

6.2.10.3 Dynamical loads of legs result from platform motions in waves and they may be determined on the basis of direct calculation of platform dynamics on waves (acc. to 6.1.3.3) or based on alternative simplified calculations. Leg structure components have tangential accelerations, depending on angular accelerations of pontoon rotary movement in waving conditions (pitch or roll) and vertical accelerations associated with platform heave motions. Extreme values of these accelerations are accompanied by extreme values of pontoon angle of heel. Calculations of such loads shall be submitted to PRS for information.

6.2.10.4 Leg loads due to their weight and inertia forces, used in the strength analysis, shall be not less than leg weight increased by 20% (vertical load) and than the loads corresponding to tangential accelerations in the harmonic rotary movement of pontoon with a period of 10 seconds and amplitude of 15 degrees. The loads shall be applied to pontoon inclined by 15 degrees. The pontoon rotation axis shall be assumed as a longitudinal or transverse axis, in the pontoon waterplane, penetrating the geometrical centre of platform leg axles system.

6.2.10.5 Leg loads due to wind pressure shall be determined according to general methods defined in 5.4. Values of wind velocity appropriate for the assumed environmental limitations for the time of platform towing, shall be used.

6.2.10.6 The values of permissible stresses in leg structure components shall fulfil the requirements of 6.2.9.2.5 and 6.2.9.2.7 and the requirements of 6.2.9.2.6 for structure components stability shall also be complied with, taking $\eta = 0.8$.

6.2.11 Leg Collision with the Ground

6.2.11.1 If lowering platform legs aimed at its positioning on the sea bed is performed in waving conditions, the bottom end of the leg may collide the sea bed and in result overload of leg structure and of the elements connecting the leg with pontoon may occur.

6.2.11.2 The acceptable sea state for the platform leg lowering may be estimated on the basis of the values of forces acting on platform leg after its collision with sea bed, determined according to requirements of 6.2.11.4.

6.2.11.3 Leg collision with the sea bed may be caused by platform pitching or rolling, due to sea waves motions. It may be assumed in the platform structure strength analysis that the platform collision with the sea bed occurs with one leg, only.

Values of horizontal and vertical components of the force of ground acting on the leg footing may be estimated from the below formulae:

$$P_h = \frac{2\pi}{T}\phi\sqrt{\frac{I_m K_h}{1+\frac{K_v}{K_h}\left(\frac{e}{h}\right)^2}} \tag{6.2.11.3-1}$$

$$P_v = \frac{2\pi}{T}\phi\sqrt{\frac{I_m K_v}{1+\frac{K_h}{K_v}\left(\frac{h}{e}\right)^2}} \tag{6.2.11.3-2}$$

where:

P_h – horizontal force, taken in the middle-height of footing, of the sense opposite to the leg end movements forced by platform rolling;

P_v – vertical force, taken in the leg axis;

ϕ – rolling amplitude (in radians) or pitching amplitude of the platform, estimated for the assumed sea state;

T – rolling period, estimated as above;

I_m – platform moment of inertia, taking into account the mass of added water, in relation to rolling axis;

K_h – rigidity of a leg loaded in direction of the force P_h (ratio of the force to deflection value, including deformability of leg attachments to pontoon);

K_v – rigidity of a leg loaded in vertical direction (ratio of the force to displacement value, including deformability of leg attachments to pontoon);

e – horizontal distance from the pontoon rotation axis at rolling to the leg axis, perpendicularly to rotation axis;

h – water depth.

6.2.11.4 Permissible values of P_h and P_v forces, and based on them, acceptable waving conditions, may be defined from the condition that stresses in the platform structure and in leg connections to pontoon are not greater than permissible stresses for $\eta = 1.0$ (such as in 6.2.10.6).

6.2.12 Forcing Legs into the Ground

6.2.12.1 Shortly after initial positioning of platform on the sea bed, platform legs shall be successively subjected to increased values of compressive forces by filling with ballast and then emptying successive ballast tanks in pontoon.

6.2.12.2 The values of the leg compressive forces may be estimated by using the FEM model and calculation method given in 6.1.4.1.1.

6.2.12.3 For each leg, it is recommended that the successive values of compressive force should be not less than the force that exerts vertical load at the footing bottom on the ground of mean value equal to the maximum pressure met in service conditions (in moderate part of footing bottom), at environmental load with waving of 100 years return period. The value of the pressure may be estimated on the basis of calculations using FEM model required for the strength analysis in service conditions (acc. to 6.1.4.1.1).

If stresses in the leg structure or in region of leg connections with pontoon prove to be greater than the values assumed for $\eta = 1.0$ (compare.6.2.10.6), the value of the compressive force of the leg being forced into the ground shall be respectively reduced.

6.2.12.4 During scheduling the process of legs forcing into the ground, the possibility of sudden increase in leg sinking depth due to non-homogeneous ground structure shall be precluded. This ground structure shall be previously examined (see 6.2.8.1).

6.2.13 Ship Collision with the Platform Leg

6.2.13.1 The issue of ship collision with platform leg shall be analyzed similarly to the issue of collision with the pontoon hull (see 6.1.6). For the platform of a design similar to self-elevating unit (i.e. platform without strengthenings in the form of additional leg supports, ropes, etc.), the force of ship effect on the leg depends essentially on the global rigidity of platform (it applies to transverse displacements of pontoon due to horizontal force acting on platform leg) and on local rigidity of the leg (it applies to leg deflections in relation to the line joining footing axis and leg casing axis, at the level of leg lower contact region with to the hull). Platform mass reduced to the collision spot, ship mass and its structure rigidity in point of contact with platform leg considerably affect the maximum value of the above force.

The value of the force of contact between the ship and the platform leg may be estimated on the basis of dynamics of collision of two points having masses of the ship and of the platform, connected by a system of springs of the above given rigidity.

6.2.13.2 The effects of the collision (permanent local indents of structure elements or their global deformations, broken connections between structure components, etc.) may be estimated similarly to the case of ship collision with the pontoon hull (see 6.1.6).

6.2.13.3 A collision with the ship may result in serious damage to leg chord. Internal forces in the so damaged leg (shear force and bending moment) are distributed as in the beam with a hinge (in the place of column damage). The rigidity of the damaged leg, taking into account loads transverse to its axis, is considerably reduced. In consequence, the values of internal forces and stresses in non-damaged legs will increase.

The strength analysis of damaged structure shall be performed, considering the environmental loads of 1 year return period. The method of analysis and strength criteria are similar to those given in 6.1.6.4, for damaged pontoon strength.

6.3 Strength of Leg Connections with Pontoon

6.3.1 Strength Model for Leg Connections with Pontoon

6.3.1.1 In the FEM model of the platform, the elements connecting legs with platform pontoon shall be reflected, respectively to the used leg restraining system. The FEM model shall include the deformability of connecting elements and clearances between leg columns and the hull in the case when the essential part of the bending moment in the leg, at pontoon bottom, is balanced by horizontal hull reaction forces, in places where leg chord guides are situated.

The above connections may be considered in FEM model by the use of the system consisting of beam elements connected with beam elements of chords, having axles transverse to leg axis, and springs simulating deformability of blocking mechanisms.

The applied modeling method will be considered by PRS separately.

6.3.1.2 In way of leg connections with hull, local great pressures onto leg chord bar teeth (or pressure by locking pins onto edges of cuts in monolithic legs, made as single pipes) and pressure in the area of leg contact with surfaces of guides in the hull, exist. As a result, additional local bending of leg chords occurs between their connections with horizontal/skew bracings or local bending of the shell of monolithic legs. Resulting stresses shall be taken into account in the strength evaluation of the structure of legs, pontoon hull and connecting elements.

The value of equivalent stresses, as a rule, shall not exceed the level of $\eta = 1.0$ (see 6.1.2.3) for load case B (see 5.10).

Where notches exist, stresses may locally exceed the level of $\eta = 1.0$ – depending on the used mesh of finite elements. Such cases will be considered by PRS separately.

6.4 Stability of Platform Positioning

6.4.1 Preliminary Remarks

6.4.1.1 Platform positioning on the sea bed shall ensure stability of its position.

In case of platform of a design similar to the self-elevating unit (i.e. the platform supported on respectively strong legs, without additional leg supports in the form of supporting bars, etc), its supporting stability may be verified by a method defined in 6.4.2, with the use of criteria given in 6.4.3.

6.4.1.2 For the platform previously operating as a self-elevating unit, where additional strengthenings of platform legs, made as skew bars, stay ropes, etc. shall be applied, the structure stability will be considered by PRS separately.

6.4.2 Stability Analysis Method

The evaluation of stability of platform positioning on the sea bed may be performed on the basis of results of solving the FEM model for the whole platform, defined in 6.1.4.1.1, taking into account effect of platform inertia (*DAF* factor, acc. to 6.2.2.2) and effect of pontoon transverse displacements on leg bending (coefficient α defined in 6.2.3.2). The evaluation consists in determining the values of vertical components of platform leg reaction forces in the load case B (see 5.10). Assumptions concerning waves directions, sea current and wind pressure, given in 6.2.9.2.1, shall be obligatorily applied.

Many realistic distributions of ballast and stores weight in pontoon and on its deck, expected during the unit service, shall be included in the calculations.

6.4.3 Stability Criterium

Platform positioning is considered stable when the minimum value of vertical compression force in each leg, at any moment (i.e. at any wave position against the platform) is not less than 10% of the response force, at conditions without wind, waving and sea current. Results of the analysis shall be submitted to confirm that effect of wind, waves and sea current on the platform shall not cause horizontal displacement of leg footings.

7 BUCKLING STRENGTH OF STRUCTURE ELEMENTS

7.1 Method of Calculations

7.1.1 Calculation of Thoretical Critical Stresses

7.1.1.1 For structure components of pontoon hull and superstructures/deckhouses, buckling strength evaluation covers plating of bottom, decks and internal bulkheads, webs of T-shaped primary supporting members.

Theoretical critical stresses of plating shall be determined according to formulae given in Chapter 13 of document [3] (see 1.2.3).

If among the plate stresses, the value of compression in one direction or shearing prevails, the theoretical critical stresses σ_E or τ_E shall be determined according to 13.4.3.4 or 13.4.3.5 in document [3].

In case of plates subjected to compression in two directions and/or shear stresses, the value of theoretical equivalent critical stress shall be calculated according to 13.4.3.7 in document [3].

The effect of openings in plate fields on the value of theoretical critical stresses shall be considered according to the requirements of 13.4.3.8 and 13.4.3.9 in document [3].

7.1.1.2 Compressed stiffeners of pontoon plating and pillars are subject to buckling strength evaluation in one-directional compression conditions. The value of theoretical critical stresses σ_E in lateral buckling conditions shall be calculated, according to 13.5.3.2 in document [3] and in torsional buckling conditions, according to 13.5.3.3 in document [3] (see 1.2.3).

7.1.1.3 For components of pipes forming platform legs designed as a three-dimensional frame, the value of theoretical critical stresses at components local buckling, shall be determined according to 6.2.5.2.

7.1.1.4 The value of theoretical critical stresses at global buckling of compressed platform legs designed as a three-dimensional frame is recommended to be determined with the use of global FEM model of the platform developed according to 6.1.4.1.1, environmental loads due to wave motions, sea current and wind pressure being neglected. It is recommended that simple axial leg support, at the level of footing bottom, should be assumed.

7.1.1.5 In case of platform structural components in the form of pipes of circular cross-section without internal stiffeners or stiffened with internal rings (single platform legs, bars of circular transverse cross-sections used as leg strengthenings, etc.), theoretical critical stresses shall be determined for local buckling of pipe wall (FEM calculations or formulae given in the literature to be applied). Such calculations are not required, when the below condition is fulfilled:

$$\frac{D}{t} \leq \frac{E}{9R_e} \tag{7.1.1.5}$$

where:
D – pipe diameter;
t – pipe wall thickness.

7.1.2 Calculation of Critical Stresses

7.1.2.1 Critical stresses σ_c, τ_c and σ_{ec} of pontoon and superstructures/deckhouses structure components shall be determined respectively to stresses σ_E, τ_E and σ_{zE}, defined in 7.1.1, using appropriate formulae given in 13.3.2.2, 13.3.2.4 and 13.3.2.6 in document [3] (see 1.2.3). Similarly, critical stresses at local buckling of pipe walls (see 7.1.1.5) and stresses σ_c at global buckling of legs (see 7.1.1.4) shall be determined.

7.1.2.2 In case of pipe components forming platform legs as a three-dimensional frame, the value of critical stresses shall be defined according to 6.2.5.2.

7.2 Buckling Strength Criteria

7.2.1 Plates and Stiffeners in the Pontoon and Superstructures/Deckhouses Structure

7.2.1.1 In case of plates subjected to compression along one direction, shear or complex state of stresses, the below criteria shall be fulfilled:

$$\frac{|\sigma|}{\sigma_c} \le \eta_0 \eta \tag{7.2.1.1-1}$$

$$\frac{|\tau|}{\tau_c} \le \eta_0 \eta \tag{7.2.1.1-2}$$

$$\frac{\sigma_e}{\sigma_{ec}} \le \eta_0 \eta \tag{7.2.1.1-3}$$

Where :
σ – compressive stresses;
τ – shear stresses;
σ_e – equivalent stresses (see 13.3.2.9 in [3]);
η – coefficient of values given in table 6.1.2.3;
η_0 = 1.1 (except the web plates of primary supporting members, where η_0 = 1.0 shall be assumed).

7.2.1.2 In the case of compressed plating stiffeners, a criterium in the form of equation 7.2.1.1-1 applies, where the values η as in 7.2.1.1 and η_0 = 1.0 shall be assumed.

7.2.1.3 In the case of plating stiffeners subjected to axial compression and local bending, the below criterium shall be fulfilled:

$$\frac{|\sigma|}{\sigma_{0c}} + \frac{|\sigma_b|}{\sigma_{bc}} \le 1.0 \tag{7.2.1.3}$$

where:
σ – compressive stresses (normal stresses along the neutral axis of bending);
σ_b – bending stresses in extreme fibres of transverse cross-section of stiffener;
$\sigma_{bc} = \eta\,\sigma_c$ – when σ_b are compressive stresses;
$\sigma_{bc} = \eta\,\mathrm{Re}$ – when σ_b are tensile stresses;
σ_c – critical stresses calculated according to 7.1.2.1;
η – defined in 7.2.1.2;
$\sigma_{0c} = \eta\sigma_c(1 - 0.13\lambda/\lambda_0)$ – if $\lambda < \lambda_0$;
$\sigma_{0c} = 0.87\eta\sigma_E$ – if $\lambda \ge \lambda_0$;
σ_E – theoretical critical stresses, calculated according to 7.1.1.2;
$\lambda_0 = \sqrt{2\pi^2 E / R_e}$
$\lambda = \frac{Kl}{r}$
Kl – buckling length of stiffener (K = 1.0 – in case of a simple support of ends);
r – transverse section inertia radius (see 6.2.5.2).

7.2.2 Compressed Pillars in the Pontoon and Superstructures/Deckhouses Structure

7.2.2.1 In the case of compressed pillars, critical stresses σ_c calculated according to requirements of 7.1.1.2 and 7.1.2.1 shall be not less than the stresses calculated from the formula:

$$\sigma = \frac{10P}{Ak_1}, \text{ [MPa]} \qquad (7.2.2.1)$$

where:

P – compressive force calculated when performing strength analysis of platform, according to requirements of Chapter 6 [kN];

A – transverse cross-sectional area of pillar, [cm^2];

$$k_1 = \frac{k_2}{1 + \frac{l}{i}}$$

$k_2 = 0.6$ – for pontoon pillars;

$k_2 = 0.7$ – for superstructure/deckhouse pillars;

l – pillars length, [m];

r – inertia radius of the pillar cross-section, [cm] (see 6.2.5.2).

7.2.3 Critical Rigidity of Stiffeners and Primary Supporting Members in the Pontoon and Superstructures/Deckhouses Structure

7.2.3.1 The moment of inertia of transverse section (including plating effective flange) of stiffeners supporting plating elements subjected in their planes to compression perpendicular to stiffeners axles, shall be of values not less than the required in 13.5.3.6 in document [3].

7.2.3.2 The moment of inertia of transverse section (including plating effective flange) of the primary members supporting the stiffeners subjected to axial compression, shall be of values not less than required in 13.6.4.3 in document [3].

7.2.4 Global and Local Buckling of Platform Legs

7.2.4.1 Mean compressive stresses σ in the platform legs constructed of pipe elements, as a three-dimensional frame, or in legs in the form of monolithic columns, shall, in any load case (see 5.10) comply with the below condition:

$$\frac{|\sigma|}{\sigma_c} \le \eta \qquad (7.2.4.1\text{-}1)$$

where:

η – coefficient of values given in table 6.1.2.3;

$$\sigma = \frac{P_m}{A} \qquad (7.2.4.1\text{-}2)$$

P_m – maximum value of leg compressive force, calculated from FEM model of platform, described in 6.1.4.1.1;

A – total cross-sectional area of leg chords;

σ_c – critical stresses calculated from the below formula:

$$\sigma_c = \sigma_E \text{ – if } \sigma_E \le 0.5R_e \qquad (7.2.4.1\text{-}3)$$

$$\sigma_c = R_e\left(1 - \frac{R_e}{4\sigma_E}\right) \text{ – if } \sigma_E > 0.5R_e \qquad (7.2.4.1\text{-}4)$$

$$\sigma_E = \frac{P_E}{A} \qquad (7.2.4.1\text{-}5)$$

P_E – a force determined in accordance with 6.2.4.

7.2.4.2 In the case of horizontal and skew leg bracings, the stresses σ and σ_b (see definitions in 7.2.1.3) shall comply with criteria defined by formulae 7.2.1.1-1 (η = 1.0 shall be assumed) and 7.2.1.3.

7.2.4.3 Platform legs in the form of monolithic pipes or chords of platform legs constructed as a three-dimensional frame, shall meet the below criterium:

$$\frac{|\sigma|}{\sigma_c} + \frac{|\sigma_b|}{\sigma_c} \le \eta \qquad (7.2.4.3)$$

where:

σ – axial (compressive) stresses;

σ_b – bending stresses, determined taking into account dynamical overload and effect of pontoon horizontal displacements on leg bending moments; stresses σ_b contain the component due to local bending chords by transverse load;

σ_c – critical stresses at local buckling of monolithic column plating or buckling of chord segment between bracing attachments (calculated according to 6.2.5.2);

η – coefficient of values given in table 6.1.2.3.

8 FATIGUE STRENGTH

8.1 Method of Analysis. Fatigue Strength Criterium

8.1.1 General

8.1.1.1 The fatigue strength evaluation covers welded connections within the platform leg structure and their additional strengthenings in the form of e.g. bars or ropes. PRS may also require fatigue strength analysis of pontoon structure items in way of the connections with platform legs to be performed, depending on the connections design and the level of stresses range in these regions. The required method of platform legs stresses determination has been defined in 8.2. The criteria for fatigue strength are given in 8.1.3.

8.1.1.2 In the fatigue strength calculations, variable in time platform leg loads due to sea waving shall be considered. Loads from sea current and wind pressure and variable work loads of platform pontoon may be neglected.

8.1.1.3 In the fatigue strength analysis of modernized platform leg structure, adapted for stationary unit, cumulative fatigue effect in these parts of leg structure which remained from the original platform structure, i.e were subject to stress oscillation in the past during self-elevating platform service, shall be considered.

8.1.1.4 In the case of self-elevating platform converted into stationary one, it is generally impossible to comply with fatigue strength criteria, formally required for fixed units (see 8.1.3). In such case, PRS may provisionally accept operation of the platform having fatigue strength lower than required for fixed unit, provided that the platform complies with the requirements of 8.1.3.1.

8.1.2 Method of Calculation of Fatigue Strength of Platform Legs

8.1.2.1 Calculations of structure items fatigue strength are based on determining distribution function for geometric stress ranges $\Delta\sigma$ in way of welds joining platform structure components, in stationary sea conditions (see 8.3.1.2). With this purpose, a FEM model of platform structure shall be developed (see 8.3.5) and statistical data on waving conditions in platform positioning region shall be used (relevant detailed information has been given in 8.3.2). Load due to sea waves motion is applied to FEM model as described in 8.2.

So called deterministic or stochastic method of determining $\Delta\sigma$ may be used (see 8.3.3 and 8.3.4). In the deterministic method and in two applicable variants of the stochastic method, the FEM model is subject to the load from regular wave effect on platform leg structure. The range of stresses $\Delta\sigma$ in the chosen structure point is determined as a difference between the maximum and the minimum value of stresses σ in this point, for the time period equal to regular wave period.

8.1.2.2 For the calculations, actual range of the values of stresses (from zero to the maximum value, i.e. the one with probability, e.g. of circa 10^{-5}), shall be substituted with a packet of values $\Delta\sigma_i$ (i = 1, 2, ..., i_{max}), uniformly distributed along the above range, whereas the number i_{max} shall not be less than 20.

8.1.2.3 The measure of fatigue degradation of structure components is so called fatigue damage parameter D, calculated on the basis of so called Palmgren-Miner hypothesis, from the below formula:

$$D = \sum_{i=1}^{i_{\max}} \frac{n_i}{N_i} \qquad (8.1.2.3\text{-}1)$$

where:
i_{max} – defined in 8.1.2.2;
n_i – number of stress cycles with stress range value $\Delta\sigma_i$ (see 8.1.2.2), calculated as defined in 8.3.1.2;
N_i – number of stress cycles calculated based on S-N curve:

$$N_i = \frac{K}{\Delta\sigma_i^m} \tag{8.1.2.3-2}$$

where:
K, m – parameters of S-N curve(see 8.4.3);
$\Delta\sigma_i$ – stress range, [MPa] (see 8.1.2.2).

At calculation of D, platform operation until its conversion to a fixed unit shall be considered (it applies to platform structure parts that remained from the original structure) and corrosive conditions shall be considered, by appropriate selection of values of K and m (see 8.4).

8.1.3 Fatigue Strength Criteria

8.1.3.1 Fatigue strength of platform structure shall fulfil the criterium:

$$D \le D_{dop} = \frac{1}{C_f} \tag{8.1.3.1}$$

where:
D – defined in 8.1.2.3;
C_f – safety factor of values specified in table 8.1.3.1.

Values C_f given in table 8.1.3.1, concerning the self-elevating platform converted into stationary unit, are coherent with the values required in document [6] (see 1.2.3) for fixed platforms.

Table 8.1.3.1

Values of C_f for fixed platforms

Item.	Structure item	C_f
1	Structure items inaccessible for inspection: – welded connections of leg chords and bracings to be sunk in the ground;. – connections of leg chords and bracings with footings; – welded joints within the footing structure, directly adjacent to leg columns; – connections of leg strengthenings with piles and piles positioned in sea bed; – brackets, plate straps and other elements welded to leg supporting structure aimed at supporting elements of process system, corrosion protection system, etc., sunk in the ground.	10.0
2	Welded connections in footing structures, outside the region mentioned in item 1	3.0
3	Welded connections of leg structure components and additional leg strengthenings (if applied) in the area between the highest instantaneous water level (wave crest level) and the ground level, if they are to be subjected to regular underwater surveys.	3.0
4	Any welded connections in leg structure (except welds joining chord segments), above the region defined in item 3 and welded connections in pontoon structure, directly adjacent to legs, if they are to be subjected to regular surveys and are accessible for repair.	1.0
5	Welds joining chord segments, item 4 does not apply to.	2.0

8.1.3.2 For parts of the self-elevating platform legs which remained in the structure of the unit converted into stationary one, the values of C_f given in table 8.1.3.1 will generally not possible to be achieved. In such situation PRS shall require replacement of lower parts of leg structure and leg connections to footings, which will be sunk in the sea bed and will be inaccessible for inspection, in order to achieve $C_f \ge 10.0$, for such parts.

8.1.3.3 For parts of platform leg structure situated above the sea bed (above the footings and leg parts sunk into the ground) and for pontoon structure, at the request of the stationary platform user, PRS may agree to application of the value $C_f = 1.0$, provided the below conditions are complied with:

a) the analysis of the fatigue degradation process of leg structure will be performed, fatigue cracking of PRS selected structure items being assumed, which prove the minimum design value of fatigue strength;
b) structure surveys procedure will be developed (underwater surveys – in case of leg structure), with short intervals between surveys, respectively to the results of fatigue strength calculations of original structure and of the structures with assumed ineffective elements, due to fatigue cracking (see (a));
c) the procedure for platform modification or service interrupting and crew evacuating (in extreme case), after fatigue cracks have been found at periodical survey of structure, has been developed. With this purpose, calculation of the process of further growth of detected fatigue crack will be needed, with the use of fracture mechanics method.

8.1.3.4 The platform user, when applying for acceptance for service of a platform whose structure complies with fatigue strength criteria defined in the formula 8.1.3.1, using the value $C_f = 1.0$, shall consider economic effects of the platform shut-down after detection of fatigue cracks in supporting structure and repair of damaged structure.

8.2 Loads of Platform Legs

8.2.1 Method of Consideration of Environmental Loads

8.2.1.1 In calculations of fatigue strength, the linear wave theory shall be applied (sinusoidal waves).

8.2.1.2 The effect of sea current and wind pressure on the stresses in platform structure is neglected in calculations. It is assumed that variable stresses in platform supporting structure are caused only by sea waves action on the platform legs. At determination of loads, items of leg supporting structure and process system elements attached thereto, corrosion protection system, etc, shall be considered.

8.2.2 Calculation of Leg Loads

8.2.2.1 Loads of platform legs shall be determined in accordance with formula 5.2.2.1. For the structure items in the form of circular section pipes, the below values of coefficients C_d and C_m are assumed (in accordance with API Regulations, see document [1] in 1.2.3):

– for elements of smooth surface: $C_d = 0.5$, $C_m = 2.0$;
– for fouled elements: $C_d = 0.8$, $C_m = 2.0$.

8.2.2.2 For leg structure items under fouling hazard, the fouling layer thickness equal to 50% of the thickness applied in strength calculations (see 5.5.1) shall be taken in calculations.

8.2.2.3 For the items of leg structure and their strengthenings of transverse section other than circular, the values of C_d and C_m coefficients will be considered by PRS separately.

8.3 Stress Ranges. Stress Concentration Factors

8.3.1 General

8.3.1.1 In the fatigue strength analysis of platform supporting structure items, ranges of geometric stresses $\Delta\sigma$ are applied. The values of $\Delta\sigma$ are calculated as a product of nominal stresses range and the stress concentration factor (see 8.3.6) or with the use of precise FEM model of structure adjacent to the area subject to fatigue strength evaluation. The requirements for FEM models are given in 8.3.5.

8.3.1.2 The values of $\Delta\sigma$ are of stochastic nature, being the result of sea waves action on the platform leg and their additional strengthenings (where applied) structure. Description of waving conditions made in accordance with 8.3.2, shall be utilized in calculations. Loads due to wave motions, $\Delta\sigma$ and number of stress cycles may be determined by a deterministic method (see 8.3.3) or stochastic method (see 8.3.4), which is recommended for use as more advanced one.

8.3.1.3 The values of $\Delta\sigma$ determined according to requirements of 8.3.1.2 shall be corrected acc. to requirements of 8.3.7. The corrected values are used in calculations of parameters D according to 8.1.2.3.

8.3.2 Description of Waving Conditions

8.3.2.1 The waving conditions in the area of platform positioning, used in design calculations, shall be confirmed by reliable statistic data.

8.3.2.2 It is recommended that the statistic data on waving conditions should contain information on the probability of occurrence of the waving with significant wave height within the range $(H_s - 0.5{\cdot}\Delta H_s; H_s + 0.5{\cdot}\Delta H_s]$ and the mean wave period from the range $(T_1 - 0.5{\cdot}\Delta T_1; T_1 + 0.5{\cdot}\Delta T_1]$. The waving of parameters from the ranges as above is replaced with representative waving of significant wave height H_s and mean period T_1, and of assumed wave motion direction against north-south direction.

Application of a simplified description is acceptable, where 8 waving directions are assumed, which divide the 360 degrees angle to sectors of 45 degrees each.

8.3.2.3 Statistic data on the waving shall also contain recommendations on the type of wave spectrum function $S(\omega, \Theta)$ (ω means the wave angular frequency; Θ is an angle defining deflection from the main direction of wave motion), i.e. the formula for determining $S(\omega, \Theta)$ in function of H_s and T_1 , as well as on additional numerical parameters.

8.3.2.4 A simplification may generally be used, that the wave spectrum function can be described as $S(\omega)$, that means the waving is taken as two-dimensional.

8.3.3 Deterministic Method of Calculation $\Delta\sigma$

8.3.3.1 The deterministic method consists in substituting the actual sea waving with a finite number of regular (sinusoidal) waves of defined height and period. Values of the above wave parameters, their directions against north-south line and the time of particular waves effect on the platform (number of cycles of structure stresses due to waving), is determined based on the analysis of statistic data on waving, in accordance with 8.3.2, and the assumed period of platform exploitation. The applied number of regular waves moving along each of considered directions shall be not less than 12.

The method of determining the above data for calculation of platform structure fatigue strength shall be sufficiently documented and submitted to PRS for verification.

8.3.3.2 Determination of values $\Delta\sigma$ in selected structure points is performed as described in 8.3.4.2.3.

8.3.4 Stochastic Method of Calculation $\Delta\sigma$

8.3.4.1 The stochastic method of calculations is based on determining the stress spectrum $S_\sigma(\omega)$, for stress amplitude $\sigma = 0.5{\cdot}\Delta\sigma$, at selected points of structure, in sea conditions defined in 8.3.2.2, at the assumed wave motion direction (see formula 8.3.4.2.4-2). The calculations may consist in determining $\Delta\sigma$, for many regular waves, and applying quasi-statistical calculation method (as in 6.2.9.2), with the use of FEM model described in 8.3.5. Requirements for such calculation method are given in 8.3.4.2.

Alternatively, more complex methods, described in 8.3.4.3 and 8.3.4.4, may be used. The methods conform to recommendations given in document [1] (see 1.2.3).

8.3.4.2 Determination of $\Delta\sigma$ with use of Quasi-statistical Method

8.3.4.2.1 Basic phase of calculations is determining the ranges of stresses $\Delta\sigma$ at selected points of structure, in result of effect of respectively high number of regular (sinusoidal) waves of various angular frequency ω, on the platform legs, for each of at least 8 considered waving directions (angular interval of 45 degrees).

8.3.4.2.2 For each of considered wave motion directions, not less than 10 to 20 frequencies ω shall be considered, whose differences $\Delta\omega$ shall be reduced close to the base natural frequency of global platform vibration. The waves parameters shall be so chosen that values h_w/L_f (h_w means wave height and L_f – wave length) are constant. For the Baltic Sea, it is recommended to take $h_w/L_f \approx 0.05$. Values h_w are recommended to be within the range from 0.5 metre to $0.5H_{100}$ (H_{100} is defined in 5.2.1.2).

8.3.4.2.3 Use of instantaneous load from regular (sinusoidal) wave, taking approximately into account dynamic overloads, is required to be used in calculations made with the use of FEM model. The load shall be determined in accordance with the requirements of 8.2, for at least 16 values of time uniformly distributed along the wave period, that means successive representative wave positions in relation to platform shall be considered, during wave motion. For each of the above wave positions, the value of hot spot stresses σ shall be determined for the chosen structure point, and the value $\Delta\sigma$ calculated as a difference between the maximum and the minimum value σ within the time period equal to wave period.

8.3.4.2.4 The wave load transfer function for stress amplitude $\sigma = 0.5\Delta\sigma$ is determined

$$H_\alpha(\omega) = \frac{\sigma}{0.5 \cdot h_w} \tag{8.3.4.2.4-1}$$

where:
α – assumed direction of wave motion;
h_w – wave height.

Subsequently, the stress spectrum shall be determined:

$$S_{\sigma,\alpha}(\omega) = \left|H_\alpha(\omega)^2\right| \cdot S_\alpha(\omega) \tag{8.3.4.2.4-2}$$

where:
$S_\alpha(\omega)$ means the function $S(\omega)$ defined in 8.3.2.4 for the considered wave motion direction, defined as α.

Notes:
a) use of the above two formulae means that load of the platform leg structure items, see formula 5.2.2.1, is subject to linearization against the wave height, i.e. the value of term $0.5\rho DU|U|C_d$ in formula 5.2.2.1, is assumed directly proportional to the wave height;
b) if $S(\omega, \Theta)$ (see 8.3.2.3) has been considered, instead of $S_\alpha(\omega)$ (see 8.3.2.3), the formula 8.3.4.2.4-2 shall be modified appropriately.

8.3.4.2.5 It can be assumed that stress amplitudes at defined sea condition and at assumed direction of wave motion are subject to Rayleigh distribution. Upon this assumption and the assumed time period of platform exploitation and based on statistic data on waving (see 8.3.2.2), the number of stress cycles n_i of stress range equal to $\Delta\sigma_I$ and then parameter D (see 8.1.2.3) shall be calculated.

8.3.4.3 The Method based on Calculation of Wave Load Transfer Function for Stress Amplitude in Frequency Domain

8.3.4.3.1 Calculations make use of a linear FEM model of platform, for its vibrations analysis. The linearization covers loading platform legs in the form of equation 5.2.2.1. In this formula, velocity U shall be substituted with the difference of water particles velocities due to waving and the velocity of leg structure items displacement, due to structure vibrations. Similarly, acceleration a shall be replaced.

8.3.4.3.2 It is assumed in linearized equations of platform motions that the values of displacements, velocity and accelerations of FEM model nodes are harmonic, with angular frequency ω equal to frequency of regular wave, which loads the platform legs. Leg load due to regular wave is also harmonic, in result of performed linearization. In consequence, a system of algebraic equations is created with unknown values of displacements of FEM model nodes. The displacements constitute the solution of this equation system. Subsequently, conventionally for FEM model, stress amplitudes σ in selected structure spots, as well as function $H_\alpha(\omega)$ (acc. to formula 8.3.4.2.4-1, are determined.

8.3.4.3.3 A set of regular waves for calculations according to 8.3.4.3.2 is chosen similarly as for calculations in 8.3.4.2. After determining $H_\alpha(\omega)$ according to 8.3.4.3.2, the further calculations proceed as in the method described in 8.3.4.2.

8.3.4.4 Method based on Direct Integration of Equations of Platform FEM Model Motion in Time Domain

8.3.4.4.1 It is the most advanced form of a stochastic method. It consists in direct integration of equations of FEM model motion of the platform whose legs are loaded by irregular wave action. The wave is generated conventionally as a superposition of finite number of regular waves having various amplitudes and frequencies, with random values of phase angle. Amplitudes of component waves result from the wave spectrum.

8.3.4.4.2 Calculations acc. to 8.3.4.4.1, in appropriately long time period, are performed for some number of actual sea wave spectra. Based on the calculations, stress amplitudes σ are determined in time function, in points where fatigue strength is analyzed. On the basis of calculated σ as functions of time transfer function, the spectral concentration function $S_{\sigma,\alpha}(\omega)$ is determined, and subsequently the stress amplitude transmission function $H_\alpha(\omega)$ is calculated, using the formula 8.3.4.2.4-2. The advantage of the method is considering non-linear effects of wave motions on the platform leg structure. The non-linear effects result from the formula 5.2.2.1 and alterations in time function of the actual structure area wetted by waving.

8.3.4.4.3 Representative functions $H_\alpha(\omega)$, determined as described in 8.3.4.4.2, are used for determining $S_{\sigma,\alpha}(\omega)$ according to formula 8.3.4.2.4-2 – for other considered waving conditions defined by functions $S_\alpha(\omega)$.

8.3.4.4.4 Calculations proceed further according to requirements of 8.3.4.2.5.

8.3.5 FEM Model of Platform

8.3.5.1 In calculations of platform response to legs loading from regular (sinusoidal) waves, a FEM model complying with the requirements specified in 6.1.4.1.1, 6.2.6, 6.2.7, 6.2.8 and 9.2, is applied. At determining horizontal force F according to requirements of 6.2.9.2.2, the force R_h, shall be applied which is an instantaneous value of horizontal resultant load of all platform legs, due to wave motions. Loads due to waves shall be applied as specified in 8.3.4.2.3. The effect of leg compression on their additional bending, which is considered in strength calculations according to 6.2.3, may be neglected in fatigue strength calculations.

8.3.5.2 Elasticity of the ground under footings shall be reflected with the greatest possible precision in the FEM model (see 6.2.8), as it essentially influences the value of a period T_0 of basic free vibrations and the dynamic amplification factor *DAF* (see 6.2.2). The above parameters have essential impact on the value of calculated fatigue strength.

8.3.6 Stress Concentration Factors

8.3.6.1 Definition of Stress Concentration Factor

8.3.6.1.1 In calculations of fatigue strength of platform structure components welded joints, usually the ranges $\Delta\sigma$ of hot spot stresses are used. Hot spot stresses have intermediate values between nominal stresses and actual stresses at the weld, where fatigue crack occurs. The stresses are determined considering stress concentration factors (see 8.3.6.1.2, 8.3.6.2 and 8.3.6.3), or with use of special procedure for processing FEM calculation results (see 8.3.6.3.1). Nominal stresses are stresses calculated by methods for Strength of Materials analysis (e.g. a beam longitudinal force divided by its cross-sectional area, bending moment divided by section modulus value, etc.) or FEM calculated stresses in the vicinity of notches but using coarse mesh of finite elements.

8.3.6.1.2 The stress concentration factor (*SCF*) is a result of dividing hot spot stresses σ by nominal stresses σ_n:

$$SCF = \frac{|\sigma|}{|\sigma_n|} \tag{8.3.6.1.2}$$

8.3.6.2 Welded Joints of Chords and Bracings in the Platform Leg Structure

8.3.6.2.1 Connections of pipes forming the structure of platform legs are, as a rule, performed by one-side welding. In the region of weld face stress concentration is found bigger than at weld root and in consequence fatigue cracking will generally occur earlier in the region of weld face.

8.3.6.2.2 In calculations of fatigue strength, the values of stress concentration factors (*SCF*) for typical pipe connections (i.e. connections without additional brackets, rings, etc.) given in document [1] (see 1.2.3) may be applied. The values are determined according to formulae given in this document, depending on basic parameters, such as diameters and thicknesses of connected pipe walls, etc. They pertain to the region of weld face and differ along the weld perimeter. For fatigue strength calculations of the region of one-side weld root, the value of *SCF* may be initially taken by 2.0 lesser than the value for the region of weld face, and calculated from properly selected S-N curve, according to recommendations in document [1].

8.3.6.2.3 Guidelines given in document [1], for determining *SCF* with use of parametrical formulae for pipe connections additionally strengthened by brackets and rings and for pipe connections strengthened by filling with cement mortar, may be applied.

8.3.6.2.4 In the case of leg structure nodes of the values of geometrical parameters exceeding the applicability range of *SCF* calculation formulae, referred to in 8.3.6.2.2, or nodes of unique structure, as well as nodes in the form of steel castings, the SCF values may be determined using the recommendations given in 8.3.6.3.

8.3.6.2.5 Where a platform legs FEM model using beam elements forming a three-dimensional frame has been applied, hot spot stresses in selected points of weld face are calculated as a sum of axial nominal stresses and pipe bending stresses, multiplied by respective *SCF* values. Hot spot stresses are recommended to be so determined for at least 8 points on the weld perimeter and fatigue strength calculations performed for these points.

8.3.6.3 FEM Calculations and Structure Nodes other than for Leg Structure

8.3.6.3.1 In cases mentioned in 8.3.6.2.4, the values of *SCF* may be determined with the use of FEM model of leg structure part. In such case, application of volume 20-nodes finite elements is recommended. It is sufficient to use one row of finite elements towards the pipe wall thickness. In way of the point where the *SCF* value shall be determined, the side lengths of finite elements shall be equal to pipe thickness. The weld shall be directly modeled, by volume elements. The hot spot stresses are determined by extrapolation of finite elements stress values towards the weld edge, adjacent to the weld. More precise guidelines concerning the procedure for determining the hot spot stresses with use of FEM model have been given in document [1] (see 1.2.3).

8.3.6.3.2 If the hot spot stresses for fatigue strength analysis shall be calculated by FEM method, the FEM model of the structure part composed of volume finite elements, constructed according to principles defined in 8.3.6.3.1, may be a part of FEM model of the whole platform leg, where generally beam finite elements are applied. In such cases, hot spot stresses are calculated directly.

8.3.6.3.3 In the case of fatigue strength calculations for welded connections in leg structure in the form of monolithic columns, footings and pontoon hull, the requirements of documents [7] or [8] (see 1.2.3) may be applied in the scope applicable to platform structure. It concerns, in particular, the issues such as S-N curve and method of FEM calculation of hot spot stresses. The number of stress cycles shall be determined on the basis of the analysis of structure response to leg loads due to wave motions, respectively to requirements of 8.3.3 and 8.3.4. In doubtful cases, the calculation method shall be agreed with PRS.

8.3.7 Correction $\Delta\sigma$

8.3.7.1 In the case of connections of relatively thick pipes, correction of stress ranges $\Delta\sigma$ calculated according to requirements defined above in 8.3, is required.

A substitute value of $\Delta\sigma_z$ calculated from the below formula is applied to calculations with use of S-N curves:

$$\Delta\sigma_z = \Delta\sigma\left(\frac{t}{t_{ref}}\right)^c \tag{8.3.7.1}$$

where:
t_{ref} = 16.0 mm;
t – wall thickness of pipe where fatigue crack will occur, [mm];
c = 0.25.
The formula 8.3.7.1 shall be used for $t > t_{ref}$.

8.3.7.2 In case of an improved shape of weld face, in result of grinding (as defined in 11.1.3(d) in document [1]), c = 0.20 may be used.

8.3.7.3 If only the region of weld edge has been ground or weld face has been shot blasted/ hammered, c = 0.15 may be used.

8.3.7.4 In case of steel cast elements, t_{ref} = 38.0 mm and c = 0.25 shall be assumed.

8.4 S-N Curves

8.4.1 General

8.4.1.1 S-N curves applicable in fatigue strength calculations correspond to the below formula:

$$N = \frac{K}{\Delta\sigma^m} \tag{8.4.1.1}$$

where:
N – number of stress cycles needed for fatigue crack to occur;
K, m– numerical factors of values given in 8.4.2 to 8.4.4;
$\Delta\sigma$ – stress range, [MPa].

8.4.1.2 The values of parameters K and m depend on the type of structure components and their corrosion protection.

8.4.1.3 S-N curves, defined in 8.4.2 and 8.4.3, are applicable to hot spot stress ranges $\Delta\sigma$ determined according to principles given in 8.3.

8.4.2 S-N curves for Welded Connections of Steel Pipe Elements

8.4.2.1 In the case of welded connections of structure items in the form of pipes, efficiently corrosion protected by paint coating (when immersed in water or above water surface), S-N curve shall be applied in the form of formula 8.4.1.1, using the below parameter values (conforming to API Regulations, see document [1] in 1.2.3):
$K = 10^{12.48}$, m = 3.0 – for $N < 10^7$;
$K = 10^{16.13}$, m = 5.0 – for $N \geq 10^7$

8.4.2.2 For welded connections of structure elements in the form of pipes which are not corrosion protected by paint coating, but by an efficient cathodic protection system, S-N curve shall be applied in the form of formula 8.4.1.1, using the below parameter values (in accordance with API Regulations, see document [1] in 1.2.3):
$K = 0.5 \times 10^{12.48}$, m = 3.0 – for $N < 1.8 \times 10^7$;
$K = 10^{16.13}$, m = 5.0 – for $N \geq 1.8 \times 10^7$.

8.4.2.3 S-N curves defined in 8.4.2.1 and 8.4.2.2, may be applied also to leg structure nodes in the form of one-side welded pipes, additionally strengthened by internal rings or brackets.

8.4.2.4 S-N curves defined in 8.4.2.1 to 8.4.2.3, may be applied to structure nodes complying with standards for workshop tolerances of welded pipe structure nodes, for the preparation of plate edges and weld face shape at one-side welding and for the quality control of welding, as specified in Chapter 11 of API Regulations (document [1], see 1.2.3).

8.4.3 S-N curves for Cast Connections of Leg Structure Elements

8.4.3.1 In the case of pipe connections of leg structure elements by means of steel castings, S-N curve shall be applied in the form of the formula 8.4.1.1, using the below parameter values (in accordance with API Regulations, see document [1] in 1.2.3:
$K = 10^{15.17}$, $m = 4.0$ – for $N < 10^7$;
$K = 10^{17.21}$, $m = 5.0$ – for $N \geq 10^7$.
The diagram is applicable to hot spot stress ranges $\Delta\sigma$.

8.4.4 S-N curves for Other Steel Structure Nodes

8.4.4.1 For platform structure nodes other than those referred to in 8.4.2 and 8.4.3 (legs in the form of monolithic columns, additional elements welded to pipes forming leg supporting structure, associated with platform process system, etc. and welded nodes of platform pontoon structure), S-N curves, recommended in PRS Publication (document [7], see 1.2.3), shall be applied as a rule.

8.4.5 Increase of Fatigue Strength by Weld Treatment

8.4.5.1 Treatment increasing fatigue strength of structure elements welded connections such as: weld grinding, shot-blasting or hammering may be applied, however, in general, such technological processes should not be considered at the evaluation of structure fatigue strength according to criteria specified in 8.1.3, except the effect of these processes on correction of stress ranges due to thickness of connected elements – as specified in 8.3.7. Upon special consideration, PRS may agree to additional consideration of positive effect of improving weld shape on fatigue strength, by grinding, according to requirements of document [1] (see 1.2.3).

8.5 Fatigue Strength of Strengthenings of the Legs Piled into the Sea Bed and Structure Nodes Strengthened by Cement Mortars

8.5.1 The fatigue strength of the connections of leg strengthenings in the form of e.g. special bars connected to piles positioned in the sea bed by means of special cement mortars, may be evaluated according to requirements of document [6] (see 1.2.3).

8.5.2 In the case of connections of pipes in platform leg structures, strengthened by cement mortars, information on determining the values of stress concentration factors (*SCF*) given in document [1] (see 1.2.3), may be used.

9 SUPPORTING OF PONTOON EQUIPMENT ITEMS

9.1 Application

9.1.1 The requirements of Chapter 9 apply to supporting structures (foundations) of heavy items of platform equipment, such as boilers, energy generators, deck machinery, cranes, etc.

9.2 Structure of Foundations

9.2.1 The structure of foundations shall comply with general requirements given in *PRS Rules*, document [3] (see 1.2.3), within the scope applicable to the structure of platform pontoon and superstructures/deckhouses.

9.2.2 The structure of foundations of deck cranes shall comply with the requirements of *PRS Rules*, document [9], (see 1.2.3).

9.3 Foundations' Dimensions and Strength

9.3.1 At determining the dimensions of foundations supporting generating sets or boilers, the requirements of *PRS Rules* shall be applied (document [3], see 1.2.3).

9.3.2 The structure of foundations and adjacent pontoon or superstructure/deckhouse structure elements, are subject to strength analysis, according to the requirements of *PRS Rules* (document [3], see 1.2.3).

10 STABILITY AND SUBDIVISION DURING TOWING

10.1 Application

10.1.1 This Chapter applies to the *units* defined in Chapter 1 of this *Publication*.
The scope of this Chapter requirements may also cover obligatory regulations of the state of the unit registration or the state of its operation.
PRS may consider compliance with administration regulations equivalent to fulfilling the requirements of this Chapter

10.2 General

10.2.1 All *units* in towing conditions shall comply with applicable requirements contained in this Chapter being a condition for achieving PRS certificate.

10.2.2 Requirements concerning *unit* stability are specified in 10.7.

10.2.3 Requirements concerning *unit* subdivision are specified in 10.8.

10.2.4 Requirements concerning *unit* freeboard are specified in 10.9.

10.3 Definitions

Definitions and terms contained in *Part IV – Stability and Subdivision* of the *Rules for the Classification and Construction of Sea-Going Ship*s refer also, in appropriate scope, to offshore *units*. To this Chapter the below definition applies:

The least favourable axis of the unit – longitudinal, transverse or other axis, in relation to which the righting lever curves and of heeling lever curves are the least favorable.

10.4 General Requirements

10.4.1 During towing, *the unit* shall comply with the stability and damage stability requirements for displacement conditions contained in this *Publication*, within the scope of draughts corresponding to towing conditions.

10.4.2 Stability verification shall be performed for the least favorable axis of the *unit*.

10.4.3 The heeling moment due to wind pressure shall be determined for the wind pressure calculated in accordance with 10.7.2, acting on the lever equal to vertical distance between the centre of projection of underwater body or (where possible) the centre of lateral resistance of the underwater body and the centre of windage area pressure.

10.4.4 The heeling moment curve shall be calculated for a sufficient number of heeling angles to define the curve. The heeling moment curve may be assumed to vary as the cosine function of the *unit* heel.

10.4.5 In stability calculations, the angles of platform flooding through the lowest opening, with non-weathertight closures, shall be taken into account.

10.4.6 In stability calculations, forces due to anchoring in the platform service location and its mooring shall not be considered, with the exception where the forces have a negative effect on the *unit* stability.

10.4.7 A PRS approved Stability Booklet shall be available onboard each *unit*. The Booklet shall contain the following data:
– stability data for towing conditions;
– instructions on service and environmental limitations necessary for the *unit* protection against capsizing.

10.4.8 Upon completion of construction/conversion, the *unit* shall be subjected, in the presence of PRS Surveyor, to the inclining test, for the determination of its centre of mass and lightweight mass at the towing load conditions.

10.4.9 The position of the centre of mass of *units* of the series or *units* having identical hull and insignificantly changed mass and distribution of machinery and equipment, may be determined by calculations, if the displacement lightweight measurement of a *unit* will confirm the calculation result.

10.5 Windage Area Calculations

10.5.1 The windage area of the *unit* shall comprise projections of all surfaces exposed to wind onto a vertical plane being in line with the *unit* least favorable axis.

10.5.2 Areas of projections of all structures exposed to wind in result of *unit* heel or trim shall be included in the unit windage area, with use of appropriate flow coefficient.

10.5.3 The above surfaces projections shall be included in the windage area after their multiplying by the shape coefficient C_s (taking into account surface shape), assuming the following values of this coefficient:
0.40 – for spherical shapes,
0.50 – for cylindrical shapes,
1.00 – for large flat surfaces (hull, deckhouses),
1.25 – for drilling derricks,
1.20 – for wires,
1.30 – for exposed underdeck members (beams and girders),
1.40 – for small parts,
1.50 – for isolated girders and shapes,
1.10 – for clustered deckhouses or similar structures.

10.5.4 For shapes or shape combinations not defined above, the shape coefficients C_s will be considered separately by PRS.

10.5.5 The windage area of trussed structures of drilling towers, jibs and masts may be approximately determined by taking 0.3 of the structure contour projection area, each side of structure in direction of the projection being considered and appropriate shape coefficient applied.

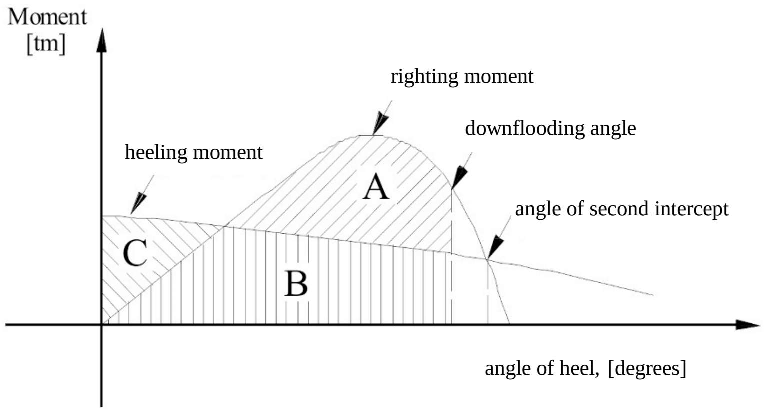
10.6 Load Conditions

10.6.1 Stability during towing shall be verified for the below loading conditions:
- **.1** platform with maximally raised legs, with 100% of stores;
- **.2** as in .1, with only 10% of stores,
- **.3** platform with legs lowered to 30% of their length, with 100% of stores.

10.6.2 If during towing other loading conditions are expected, less favourable for stability than those provided in 10.6.1, the platform stability shall be verified also for each of these conditions.

10.7 Intact Stability

10.7.1 During towing, the *unit* shall comply with the below stability criteria:
- **.1** metacentric height of the *unit* in all service conditions shall be not less than 0.3 m, taking into account correction for free liquid surfaces;
- **.2** the area under the righting moment curve to the second intercept of the righting moment curve and the heeling moment curve due to wind or the angle of downflooding, whichever is less, shall be at least by 40% in excess of the area under the of wind heeling moment curve to the same limiting angle (see Fig.10.7.1);



Area (A+B) > 1.4 of the area (B+C)

Fig.10.7.1

The conditions shall be verified for the downflooding angle or for the angle of second intercept of static stability arms with static heeling moment, taking the lesser angle;

.3 In all cases, the righting moment curve shall be positive over the entire range from upright to the second intercept with the heeling moment curve, as shown in Fig. 10.7.1.

10.7.2 The wind force F,[N] shall be determined from the below formula:

$$F = 0.5 C_S C_H \rho V^2 A$$

where:

ρ_P – the air mass density, (1.222 kg/m^3);
C_S – non-dimensional coefficient of values depending on the component shape, given in Table 5.4.2.1-1,
C_H – the height coefficient, depending on the height of the pressure centre of the unit windage area above the waterline, taken from table 10.7.2;
A – windage area, [m^2], defined according to 10.5,
V – wind velocity, [m/s], to be taken;
36.0 (70 knots), for towing in all meteorological conditions,
25.8 (50 knots) – for limited towing conditions,

Table 10.7.2

Height coefficient

Height above sea level, [m]	C_H
0 – 15.3	1.00
15.3 – 30.5	1.10
30.5 – 46.0	1.20
46.0 – 61.0	1.30
61.0 – 76.0	1.37
76.0 – 91.5	1.43
91.5 – 106.5	1.48
106.5 – 122.0	1.52
122.0 – 137.0	1.56
137.0 – 152.5	1,60
152.5 – 167.5	1.63
167.5 – 183.0	1.67
183.0 – 198.0	1.70
198.0 – 213.5	1.72
213.5 – 228.5	1.75

228.5 – 244.0	1.77
244.0 – 259.0	1.79
over 259.0	1.80

10.8 Damage Stability and Subdivision

10.8.1 Operational conditions for which the *unit* damage is considered, shall correspond to the intact stability calculation conditions.

10.8.2 *The unit* shall have sufficient freeboard and shall be so subdivided by means of bulkheads and watertight decks, to provide sufficient buoyancy and stability in particular loading conditions after damage and downflooding of any compartment, assuming damages given in 10.8.3, the below requirements being fulfilled:

.1 the offshore unit shall remain afloat in a condition of equilibrium, under a heeling moment due to permanent wind force acting towards the heel with velocity of 25,8 m/s (50 knots);

.2 the angle of heel in the final stage of unsymmetrical flooding, shall not exceed 17°.

.3 after flooding of a single compartment (wind action not considered), static stability range *GZ* shall be not less than;

$$RoS = \varphi_z - \varphi_s \geq Max\{(7^\circ + 1.5\varphi_s), 10^\circ\}$$

where:

~~*RoS* – range of stability *GZ*, (degrees),~~

φ_z – maximum angle of static stability range *GZ*, (degrees),

φ_s – static angle of heel after damage, (degrees),

The maximum angle of static stability range *GZ* shall be determined without reference to the angle of flooding (Fig. 10.8.2).

.4 in the final stage of flooding, the maximum static stability lever within the *RoS* range of *GZ* curve, shall be not less than 0.10 m;

.5 after flooding a compartment, the final waterline shall be at least 0.3 m below the lower edge of opening, through which platform may be flooded;

.6 the metacentric height of damaged *unit* shall be not less than 0.1 m.

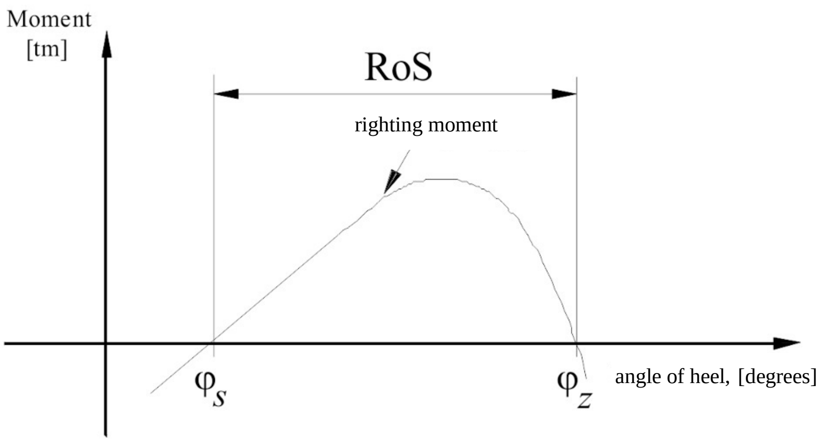


Fig. 10.8.2

10.8.3 **Damage Extent**

.1 transverse extent (damage depth) – 1.5 m, measured horizontally in depth from the unit plating.

.2 vertical extent – from the base line upwards, without limit,

.3 longitudinal extent – it is assumed that it occurs within one compartment, and no watertight division bulkheads are assumed to be damaged. If bulkheads are spaced less than 3 meters, one of them shall be disregarded.

10.8.4 Actual permeabilities shall be taken for calculation of compartments flooding. For void spaces, the permeability μ = 0.98 is assumed, while for machinery compartments, pump rooms and similar compartments, where machinery is installed, the permeability μ = 0.85 is taken.

10.8.5 Any pipings, ventilation systems and other trunks within the extent of damage shall be assumed to be damaged. Positive means of closure shall be provided at the pipings and trunks to preclude the progressive flooding of other spaces which are assumed intact.

10.9 Freeboard

10.9.1 General

10.9.1.1 *Units* shall have clearly placed and visible freeboard mark or the maximum draught mark in floating condition, determined in accordance with the below requirements.

10.9.1.2 *Units* which have been exempted from the requirements of the *International Convention on Load Lines, 1966*, upon decision of Maritime Administration of the state where they will be registered or in the waters of which will be operated, shall have placed maximum draught mark in floating condition. Position of this mark shall be determined on the basis of design, stability and subdivision requirements.

10.9.1.3 For the unit positioned on the sea bed or being elevated and lowered, the freeboard mark or the maximum draught mark is not applicable.

10.9.2 Determination of Freeboard

10.9.2.1 The offshore *unit* in floating or transit condition shall comply with the requirements of *International Convention on Load Lines – 1966*, except as exempted specifically. The freeboard shall be calculated in accordance with the said *Convention*.

10.9.2.2 At calculation of the block coefficient, volumes of drilling shafts and wells located inside hull shall be deducted from the hull volume.

10.9.2.3 The *unit* freeboard calculated according to the *Convention*, shall be increased by the value received by dividing the shaft or well volume by the waterplane area.

10.9.2.4 Provisions of 10.9.2.2 and 10.9.2.3 apply also to narrow recesses in way of stern.

10.9.2.5 Narrow wing extensions at the stern shall be regarded as hull appendages. The dimensions of these structures shall be excluded for the determination of the *unit* length and disregarded in freeboard calculations.

10.9.2.6 If the *unit* shape is such that freeboard calculations are not possible to be performed in accordance with the *Convention*, the freeboard shall be determined on the basis of intact and damaged stability requirements and design requirements.

11 HULL EQUIPMENT

11.1 Mooring Equipment

11.1.1 General

Stationary offshore unit need not be provided with the mooring equipment. Generally, vessels are not moored directly to the platform, and the offshore units to the sea- or land-based structures. If the Owner, however, makes a decision on the use of such equipment, its design shall comply with the requirements of 11.1.2 to 11.1.10.

For this *Publication*, anchors and associated appliances are not considered as the mooring equipment.

11.1.2 Mooring ropes shall be selected by calculating a non-dimensional equipment number *EN* from the below formula:

$$EN = h(\Delta / h)^{\frac{2}{3}} + 2S_{CZ} + 0.1S_B \qquad (11.1.2)$$

where:

h – the number of platform hulls or pontoons[1]

Δ – design displacement, [t], for a draught during towing;

S_{CZ} – total front windage area, [m^2], for a draught during towing;

S_B – total lateral windage area, [m^2], for a draught during towing;

S_{CZ} and S_B shall be calculated according to formula:

$\Sigma q C_k C_w A_b$;

q = 1.0 , for hull, superstructures and deckhouses

= 0.3 , for other surfaces exposed to wind action;

C_K – shape factor:

C_K = 0.5 for spherical and cylindrical shapes,

= 1.0 for hull, superstructures and deckhouses,

= 1.5 for other shapes;

C_w – height factor, depending on the vertical distance H between the waterline during towing and the centre of the given area,

C_w = 1.00 for $H < 50$ m;

= 1.10 for 50 m $\le H <$ 100 m

= 1.20 for 100 m $\le H <$ 150 m

= 1.30 for 150 m $\le H <$ 200 m

= 1.37 for 200 m $\le H <$ 250 m

= 1.43 for 250 m $\le H <$ 300 m; to be considered individually for greater values of H, however not above 1.80

A_w – area of front projection of each large element of the platform exposed to wind action, [m^2] (including columns, superstructures, big cranes, hull parts above the draught level during towing, etc.);

A_b – area of lateral projection of each large element of the platform exposed to wind action, [m^2] (including columns, superstructures, big cranes, hull parts above the draught level during towing, etc.)

The following conditions shall be considered at the calculation of windage areas:

11.1.3 Tiers of superstructures or deckhouses of width not greater than 0.25 B, at any place, where B is a moulded breadth of platform, need not be considered, provided the area of their projection is less than 1% of the total area of platform projection;

11.1.4 Guard rails and bulwarks higher than 1.5 m shall be taken into account;

[1] PRS shall separately consider design of bollards, hawse pipes and fairleads of the platform without buoyancy part, which are used for mooring vessels alongside it.

11.1.5 For platforms with columns, the area of projection of all columns shall be considered (that means the surfaces non-exposed to wind shall not be deducted). However, the shape factor for cylindrical surfaces of columns equal to 0.5, may be considered;

11.1.6 Use of combined projection area of a group of deckhouses instead of calculation of each individual deckhouse area is possible;

11.1.7 The calculations of large isolated structures, such as cranes and derricks, shall be performed individually, with the use of the above given shape factors;

11.1.8 Small isolated structures of projection area less than 1% of the total projection area of platform may be disregarded in calculations.

11.1.9 Lattice structures commonly used in derrick towers, booms and some types of masts, may be calculated approximately by taking 30% of combined areas of the front and rear side projections (i.e. 60% of combined projection area of one side for double-sided lattices). The shape factor shall be assumed as in formula 11.1.2.

11.1.10 Calculated value of the equipment number shall be applied in table 4.1.2, *Part III – Hull Equipment* of the *Rules for the Classification and Construction of Sea-Going Ships.*

11.1.11 Steel wire ropes or synthetic fibre ropes complying with 4.2.1.2 and 4.2.1.4, *Part III – Hull Equipment* of the *Rules for the Classification and Construction of Sea-Going Ships*, may be used as mooring ropes.

11.1.12 The design of mooring appliances shall generally comply with the requirements of 4.2.2.2 to 4.2.2.7, *Part III – Hull Equipment* of the *Rules for the Classification and Construction of Sea-Going Ships.*

11.1.13 The safe working load shall not exceed 80% of design load determined acc. to 4.2.2.4, *Part III – Hull Equipment* of the *Rules for the Classification and Construction of Sea-Going Ships.*

This requirement pertains to a single equipment component, assuming no more than one turn of one rope.

The safe working load shall be marked permanently on each equipment item, e.g. by welding.

11.1.14 The number and type of mooring winches are left to the Owner's and designer's discretion, provided that the nominal pull of the winches is not less than 0.22 and not more than 0.33 times the breaking strength of the mooring rope and that the winches comply with the requirements of Chapter 6.4, *Part VII – Machinery, Boilers and Pressure Vessels* of the *Rules for the Classification and Construction of Sea-Going Ships*.

11.1.15 The part of platform structure subjected to direct action of forces applied to the platform attached equipment, shall comply with the requirements of 4.2.3.2 and 4.2.3.5 of *Part III – Hull Equipment* of the *Rules for the Classification and Construction of Sea-Going Ships*

11.1.16 The type of survey over the mooring equipment has been defined in Part I of this *Publication* (see 4.2.2, 4.6.2 and 6.1.2).

11.1.17 The mooring equipment, structure of its foundations and their supporting items, are subject to general examinations during periodical surveys, for verifying their corrosion or wear level.

11.1.18 Mooring ropes shall be subjected to examinations as regards:

.1 their excessive wear,
.2 wires corrosion,
.3 cracked wires,

Ropes with damaged wires in the amount of over 10% their total number over the length of 8 diameters shall be recommended for replacement. Condition of winches foundations, fairleads and mooring bollards (especially those over 10 years of age) shall be examined.

11.1.19 Detailed scope and kind of any repair activities is left to the attending PRS Surveyor decision.

11.2 Towing Arrangements

11.2.1 General

A stationary platform need not be obligatorily provided with the towing arrangements. Their provision is at the discretion of the Owner and depends on adopted method of platform transit to positioning location. The towing arrangements comprise bollards, chocks, fairleads and towing ropes. If the platform is provided with towing arrangements, their use for platform towing is acceptable if they comply with strength requirements.

11.2.2 The drawing of towing arrangements shall be furnished to PRS for information either as a separate plan of towing arrangements or as a part of a common plan of mooring and towing equipment.

11.2.3 The design and arrangement of shipboard towing devices shall take into account both standard and accidental situations.

11.2.4 The towing rope shall be selected using the selection principles given in 11.1.2, 11.1.3 and 11.1.4. Diameter of towing ropes made from natural and synthetic fibres shall not be less than 20 mm.

11.2.5 Towing bollards shall comply with the requirements of 4.2.2.6 and 4.2.2.7 of *Part III – Hull Equipment* of the *Rules for the Classification and Construction of Sea-Going Ships.*

11.2.6 The number and position of towing bollards and other items of towing system shall be determined on the basis of the structure particulars and general arrangement of the platform. Shipboard fittings for towing shall be located on the deck stiffeners so as to facilitate efficient distribution of towing loads.

11.2.7 Where the shipboard equipment is not selected in accordance with a recognized industry standard, the load used to assess its strength shall comply with the requirements of 5.2.2.4 and 5.2.2.5, *Part III – Hull Equipment* of the *Rules for the Classification and Construction of Sea-Going Ships.*

11.2.8 For each shipboard fitting and equipment item, safe working load, taking into account strength of fitting connection with unit structure, shall be durably marked.

11.2.9 It is assumed that the towing arrangements will be used once, therefore their survey is limited to initial survey scope in accordance with Part I of this *Publication*.

11.3 Hull Access Means

11.3.1 General

Particular parts of the platform shall be easily and safely accessible for persons onboard. Gangways and means of overboard falling protection, such as guard railings, are used for this purpose.

Particular attention shall be given to appropriate protection of helicopter landing area.

11.3.2 Guard Railings

11.3.2.1 All exposed parts of platform decks shall be provided with guards in the form of railings. The height of railings shall generally be not less than 1 metre above the deck. Where this height would interfere with the normal operation in this region of the platform, PRS may agree for lesser height, provided adequate additional protection of people is ensured.

11.3.2.2 Railings design shall generally comply with the requirements of 9.2.3 to 9.2.5, Part III – Hull Equipment of the Rules for the Classification and Construction of Sea-Going Ships.

11.3.3 Gangways

11.3.3.1 Where the use of permanent gangways is necessary, they shall be:

– so located as not hinder easy access across the working areas of the deck and operation of platform machinery;

– constructed of fire resistant and non-slip material;
– provided with a continuous platform at least 0.6 m in width;
– fitted with guard rails extending on each side throughout its length, complying with the requirements of 11.3.2.2.

11.3.3.2 Steel wire ropes may be accepted on gangways instead of fixed guard rails, provided the requirements of 9.3.5, *Part III – Hull Equipment* of the *Rules for the Classification and Construction of Sea-Going Ships* are complied with.

11.3.4 During periodical surveys, conforming to the requirements of Part I of this *Publication*, particular attention shall be given to corrosion diminutions of railing stanchions bottom parts.

PART III

Positioning the Unit on Sea Bed

0

1 GENERAL

1.1 Application

The requirements of Part III apply to production platforms of self-elevating type, permanently positioned on sea bed, considered a marine structure subjected to building law.

Part III specifies requirements concerning geological examinations, design documentation and supervision and control of platform positioning.

1.2 Acts, Regulations and Standards

1.2.1 Acts and Regulations

.1 Act of 9 June 2011 – Geological and Mining Law, (Journal of Laws, 2017, item 2126, as further amended);

.2 Act of 7 July 1994 – Building Law, (Journal of Laws, 2018, item 1202, uniform text of 22.06.2018, as further amended);

.3 Act of 21 March 1991 on the Republic of Poland sea areas and maritime administration (Journal of Laws 2017, item 2205 uniform text of 29.11.2017 r., as further amended);

.4 Regulation of the Minister of Transport and Maritime Economy of 1 June 1998 on technical conditions to be met by hydro-engineering structures and their location (Journal of Laws, 1998, No 101, item 645);

.5 Regulation of the Minister of Environment of 20 December 2011 on detailed requirements concerning designs of geological works, including works the performance of which requires obtaining a license (Journal of Laws, 2011, No.288, item 1696);

.6 Regulation of the Minister of Transportation, Construction and Maritime Economy of 25 April 2012 on detailed scope and form of the building design (Journal of Laws, 2012, item 462, as further amended);

.7 Regulation of the Minister of Environment of 18 November 2016 on hydrogeological documentation and geological-engineering documentation (Journal of Laws, 2016, item 2033);

.8 Regulation of the Minister of Infrastructure of 2 September 2004 on the detailed scope and form of design documentation, technical specifications and implementation and acceptance of construction works, and the functional utility program (Journal of Laws, 2013, item 1129);

.9 Regulation of the Minister of Maritime Affairs of 23 October 2006 on the technical conditions of use and the detailed scope of control of marine hydro-engineering structures (Journal of Laws, 2006, No. 206, item 1516);

.10 Regulation of the Minister of Transport, Construction and Maritime Economy of 25 April 2012 on the determination of geotechnical conditions for positioning building objects (Journal of Laws, 2012, item 463);

.11 Regulation of the Minister of Economy of 25 April 2014 on detailed requirements concerning operation of mining plants excavating minerals by bore holes, (Journal of Laws, 2014, item 812).

.12 Regulation of the Minister of Environment of 8 December 2017 on the operational plans of mining plants (Journal of Laws, 2017, item 2293)

1.2.2 Standards

.1 EN ISO 19900:2013 – Petroleum and natural gas industries – General requirements for offshore structures.

.2 EN ISO 19901-1:2015 – Petroleum and natural gas industries – Specific requirements for offshore structures. Part 1: Metocean design and operating considerations.

.3 EN ISO 19901-2:2005 – Petroleum and natural gas industries – Specific requirements for offshore structures – Part 2: Seismic design procedures and criteria.

.4 EN ISO 19901-4:2006 – Petroleum and natural gas industries. Specific requirements for offshore structures. Part 4: Geotechnical and foundation design considerations.

.5 EN ISO 19901-5:2006 – Petroleum and natural gas industries – Specific requirements for offshore structures – Part 5: Weight control during engineering and construction.

.6 EN 1997-1:2008/A1:2014-05P Eurocode 7 – Geotechnical design – Part 1: General rules.
.7 EN 1997-2:2007/A1:2010P Eurocode 7 – Geotechnical design – Part 2: Ground investigation and testing.

.8 EN ISO 22475-1:2006 – Geotechnical investigation and testing. Sampling methods and groundwater measurements. Part 1: Technical principles for execution**.**

2 SCOPE OF SUPERVISION

.1 Verification of positioning design and technology;
.2 Acceptance of materials to be built-in during the unit positioning on sea bed;
.3 Inspection of documents from setting out the location of unit positioning on sea bed;
.4 Supervision of unit positioning works,
.5 Control of required examinations and verifications;
.6 Verification of performed activities quality and their conformity with design, building permit, rules and state-of-the-art principles;
.7 Participation in final acceptance activities and the object commissioning;
.8 Verification of as built documentation;
.9 Performance of periodical inspections acc. to Part I – Survey Regulations.

3 TECHNICAL DOCUMENTATION

3.1 Design of Geological Works

The Regulation of the Minister of Environment of 20 December 2011 on detailed requirements concerning designs of geological works, including works the performance of which requires obtaining a license (Journal of Laws, 2011, No. 288, item 1696), defines the principles of preparation of the design of geological works to document marine structure positioning. This regulation mentions elements to be contained in a descriptive and graphical part of the design. The design of works shall take into account the scope and conditions of examinations of the sea subsoil, given in the Regulation of the Minister of Transport and Maritime Economy of 1 June 1998 on technical conditions to be met by hydro-engineering structures and their location (Journal of Laws, 1998, No 101, item 645). The design is signed by a person having confirmed appropriate competences for executing, supervising and managing geological works. Prepared design of geological works (where license is not required) shall be submitted to appropriate geological authority for approval. In case of works carried out within the sea area of the Republic of Poland, such appropriate body is the Minister relevant for environment affairs acting in agreement with the Minister relevant for maritime economy affairs (Act of 9 June 2011 – Geological and Mining Law, (Journal of Laws, 2017, item 2126, uniform text of 17.11.2017, as further amended)).

3.2 Geological Documentation

Results of geological works, together with their interpretation, the degree of achieving the assumed objective and justification thereof, are presented in the geological documentation (Art. 88 of the Act – Geological and Mining Law (Journal of Laws, 2017, item 2126, uniform text of 17.11.2017, as further amended)). For determining geological and engineering conditions of building objects positioning, the geological-engineering documentation is prepared (art. 91 of the above Act). The documentation shall be prepared in accordance with the Regulation of the Minister of Environment of 8 May 2014 on hydrogeological documentation and geological-engineering documentation (Journal of Laws 2014, item 596); The geological documentation is approved by decision of appropriate geological authority.

The basis governing the principles of documenting geological-engineering conditions of building objects positioning, including offshore areas, is the act of 9 June 2011 – Geological and Mining Law (Journal of Laws, 2017, item 2126, uniform text of 17.11.2017, as further amended), and resulting regulations, in particular:

.1 Regulation of the Minister of Environment of 8 May 2011 on hydrogeological documentation and geological-engineering documentation (Journal of Laws, 2014, item 596);
.2 Regulation of the Minister of Environment of 15 December 2011 on detailed requirements concerning other geological documentations (Journal of Laws, 2011, No.282, item 1656);

.3 Regulation of the Minister of Environment of 20 December 2011 on the use of geological information for remuneration (Journal of Laws 2011, No. 292, item 1724);

.4 Regulation of the Minister of Environment of 19 December 2001 on the method and scope of performing the duty by the contractor operating geological works to make available and to transfer information and samples to geological administration authorities (Journal of Laws, 2001, No. 153, item 1781);

.5 Regulation of the Minister of Environment of 15 December 2011 on collecting and making available geological information (Journal of Laws, 2011, No.282, item 1657);

.6 Regulation of the Minister of Environment of 20 December 2011 on *detailed requirements concerning designs* of *geological works, including works* the performance of which *requires* obtaining a *license* (Journal of Laws, 2011, No. 288, item 1696).

3.3 Building Design (Projekt budowlany)

For such marine construction as a self-elevating stationary unit, a building design (projekt budowlany) shall be developed and approved, in accordance with the Act on Building Law of 7 July 1994 (Journal of Laws, 2018, item 1202, uniform text of 22.06.2018, as further amended). The design scope and form shall be in accordance with the regulation of the Minister of Transport, Construction and Maritime Economy of 25 April 2012 on detailed scope and form of the building design (Journal of Laws 2012 item 462). Design conditions for such building objects are defined in the Regulation of the Minister of Transport and Maritime Economy of 1 June 1998 on technical conditions to be met by hydro-engineering structures and their location (Journal of Laws, 1998, No 101, item 645);

3.4 Detailed Design (Projekt wykonawczy)

Technical documentation may also include a detailed design to cover, among the others, procedure for execution of particular positioning works and technical specifications for works execution and acceptance, prepared in accordance with the Regulation of the Minister of Infrastructure of 2 September 2004 on the detailed scope and form of design documentation, technical specifications and implementation and acceptance of construction works, and the functional utility (Journal of Laws, 2013, item 1129).

3.5 As-built Documentation (Dokumentacja powykonawcza)

According to the Act on Building Law, the scope of the as-built documentation is the building documentation, including the building permit together with enclosed building design, building site book, records on partial and final acceptance, if needed, drawings and descriptions useful in the object realization, geodetic statements and measurements book, and for objects executed by assembly also the assembly book, with entered changes made in the progress of works execution and geodetic as-built measurements.

3.6 Operation and Maintenance Documentation

Geological works with other purpose than searching and recognition of mineral beds, executed with the use of mining shot materials or performed at the depth more than 100 m, or those performed on the mining area used for mining activity by underground works or with use of bore holes, are covered respectively with the regulations for mining plants and its operation and for mine rescue (art. 86 of the act of 9 June 2011 – Geological and mining law, (Journal of Laws, 2017, item 2126, uniform text of 11.11.2017, as further amended).

The operation of a mining plant is executed in accordance with legal regulations, in particular on the basis of mining plant operational plan, and according to the principles of mining technique. The operational plan, respectively to performed activity, shall be prepared in accordance with the Regulation of the Minister of Environment of 8 December 2017 on mining plant operational plans (Journal of Laws, 2017, item 2293).

Detailed requirements on operations of mining plants excavating minerals by bore holes result from the Regulation of the Minister of Economy of 25 April 2014 on detailed requirements concerning operation of mining plants excavating minerals by bore holes (Journal of Laws, 2014, item 812). The rules of the Regulation apply respectively to geological works and to performance of bore holes in operation of mining plants.

The above provisions apply inter alia to geological works associated with positioning of building objects and to the construction of building objects of a mining plant.

4 REQUIREMENTS

4.1 General Requirements

General requirements pertaining to offshore structures are contained in PN-EN ISO 19900:2014-03 Standard. The PN-EN ISO 19901-4:2006 Standard covers engineering geology issues, such as description of the area, characteristics of subsoil, design and installation of foundations on sea bed.

The requirements for the offshore structure positioning conditions are defined in:

.1 The Regulation of the Minister of Transport, Construction and Maritime Economy of 25 April 2012 on the determination of geotechnical conditions for positioning of building objects (Journal of Laws, 2012, item 463);

.2 The Regulation of the Minister of Transport and Maritime Economy of 1 June 1998 on technical conditions to be met by hydro-engineering structures and their location (Journal of Laws, 1998, No 101, item 645);

.3 The Regulation of the Minister of Maritime Affairs of 23 October 2006 on the technical conditions of use and the detailed scope of control of marine hydro-engineering structures (Journal of Laws, 2006, No. 206, item 1516);

4.2 Geological Examinations of Sea Bed

The geological and engineering examinations shall result in providing solutions to the following aspects: structure subsidence, cyclic displacements, boundary bearing capacity and dynamics, distribution of loads under foundation, sea bed scouring and erosion, subsoil liquefaction, pile foundation, cut through hard layer.

Current guidelines as regards conditions of examination of subsoil for the positioning marine structures are contained in the Regulation of the Minister of Transport and Maritime Economy of 1 June 1998 on technical conditions to be met by hydro-engineering structures and their location (Journal of Laws, 1998, No 101, item 645, Chapter 4, paragraphs 36-41).

Prior to detailed examinations of subsoil, a design of geological works shall be prepared.

Preliminary examinations include bathymetric measurements, aimed at preparation of detailed topographic maps of sea bed and localization of sea bed obstructions, such as large boulders or ship wrecks.

Detailed geological and engineering examinations of sea bed for the building object positioning are performed by means of drillings and depth penetration soundings. The examinations shall give answers to the following questions:

.1 what is the pattern of subsoil layers at the designed structure location?

.2 what is the subsoil characteristics?

.3 what is the characteristics of particular subsoil layers, affected by the designed structure?

.4 what can be the structure construction consequences and whether and how the harmful consequences can be avoided?

4.3 Positioning the Unit on Sea Bed

4.3.1 Positioning, anchoring, towing or moving the unit is carried out under supervision of persons having relevant marine competences.

4.3.2 Procedure for carrying out works of the unit positioning on sea bed shall be in accordance with an approved detailed design, developed on the basis of the unit manufacturer's instructions.

4.3.3 The detailed design shall be prepared taking into account requirements of Part II of this *Publication*, in particular the requirements of 6.2.8, 6.2.11, 6.2.12, 6.4.

4.3.4 The design shall define:

– footings sea bed immersion depth (determined on the basis of the subsoil bearing capacity);
– the rate and time of each pillar pre-loading, to achieve proper immersion in sea bed.

4.3.5 The design shall include:

– checking whether the minimum distance from pontoon to water surface is maintained at the maximum footing immersion in sea bed;
– considering if one pillar is capable of cutting through the hard layer and how it would affect the capsizing and stabilizing moments – checking the safety as regards unit capsizing.
– considering the possibility of footings immersion in sea bed by their scouring.
– determining permissible values of structural items vertical deflection after the unit positioning and anchoring on the sea bed.

PART IV
Machinery Equipment and Systems

1 GENERAL

1.1 Application

The requirements of this *Part IV Machinery Equipment and Systems* apply to machinery and systems installed on fixed offshore platforms, further referred to as *units*, defined in 1.2.1 of Part I as *units* and marine units. They do not apply to machinery and systems used for hydrocarbons extraction and processing.

1.1.1 The machinery requirements concern:

.1 piston engines and turbines of generating sets, complete generating sets,
.2 gears, disengaging and flexible couplings,
.3 auxiliary and deck machinery,
.4 pump aggregates with combustion engines included in systems covered with requirements of *Part V – Fire and Anti-Explosion Protection,*
.5 hydraulic and pneumatic propulsion systems,
.6 air and refrigerating compressors,
.7 steam boilers and waste-heat boilers of working pressure $p \geq 0.07$ MPa,
.8 water boilers of water temperature above 115 °C,
.9 boiler water economizers of working pressure $p \geq 0.07$ MPa,
.10 liquid and gas fuel firing equipment of boilers,
.11 condensers and deaerators;
.12 pressure vessels and heat exchangers filled in service condition, in part or completely, with gas or steam of working pressure $p \geq 0.07$, for which the product of pressure [MPa] and volume [dm^3] amounts to 30 or more,
.13 air coolers and air heaters of working pressure in the air space $p \geq 0.07$ MPa,
.14 non-classed cooling equipment,
.15 platform jacking machinery.

1.1.2 The requirements for systems concern:

.1 bilge system,
.2 ballast, heel and trim equalizing systems,
.3 air, overflow and sounding systems,
.4 exhaust gas system,
.5 ventilation system,
.6 liquid fuel system,
.7 gas fuel system,
.8 lubrication oil system,
.9 compressed air system,
.10 cooling water system,
.11 boiler feed water, steam and condensate system.

1.2 Terms, Definitions, Standards

Applicable terms are given in *Part I – Survey Regulations*.

1.3 Scope of Survey

1.3.1 Scope of Machinery Manufacture Survey

1.3.1.1 General provisions concerning survey of the manufacture of engines, turbines, compressors, boilers, pressure vessels, heat exchangers and auxiliary machinery covered with requirements of this Part are given in *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships*.

1.3.1.2 The following equipment is subject to PRS survey during manufacture:

.1 internal combustion engines – they are surveyed according to principles given in PRS *Publication No. 4/P – Inspection of Mass Produced Internal Combustion Engines*,
.2 gears, disengaging and flexible couplings,
.3 air and refrigerant compressors,
.4 pumps, blowers, fans (complying with explosion-proof requirements),
.5 windlasses and mooring winches,
.6 power hydraulics components: pumps, actuators and batteries,
.7 fuel and oil separators,
.8 steam boilers, exhaust gas boilers, economizers, condensers,
.9 pressure vessels, boiler water deaerators and heat exchangers,
.10 gas turbines.

1.3.1.3 Survey of new equipment shall be carried out according to procedures contained in *Part VII* of the *PRS Rules for the Classification and Construction of Sea-Going Ships.*

1.3.1.4 In well justified cases PRS may agree to installation onboard the units of machinery manufactured and tested according to approved international standards, without PRS supervision of manufacture.

1.3.2 Scope of Systems Survey

Fitting the mechanical equipment in machinery spaces, as well as fitting and testing the below listed plants forming a part of machinery listed in 1.1.2, are subject to PRS survey:
.1 generating sets,
.2 air compressors,
.3 high capacity pumps,
.4 boilers, pressure vessels, heat exchangers and boiler water deaerators,
.5 fans, oil and fuel separators,
.6 refrigerating plants,
.7 control systems, control and signalization of machinery.

1.3.3 PRS survey covers vibrations related problems of the machinery and electrical systems and appliances in accordance with the principles set out in *Publication No. 2/I – Prevention of Vibrations in Ships*.

1.3.4 PRS accepts only these measurements of vibration and other physical values, which were performed by measuring laboratories approved by PRS.

1.3.5 Manufacturing of pipes, valves and fittings intended for piping systems of classes I and II, as well as other valves and fittings, including those remotely controlled, is subject to PRS survey. Classification and survey of pipings are covered by *Part VI* of the PRS *Rules for the Classification and Construction of Sea-Going Ships*.

The above mentioned components shall have PRS survey certificates: *Test Certificate or Product Certificates* or *Type Approval Certificates*.

1.3.6 Installation of refrigerating plant and systems of output above 100 kW is subject to PRS survey. The survey covers the following manufacturing stages:
.1 manufacture and testing of separate components of the refrigerating plant at the manufacturer's works,
.2 fitting of machinery, apparatus and vessels,
.3 fitting of refrigerant system,
.4 fitting of coolant, cooling air and cooling water systems,
.5 fitting of main and emergency ventilation,
.6 fitting of insulation of refrigerated chambers, freezers, apparatus, vessels and refrigerant piping,
.7 fitting of control, monitoring, alarm and safety systems of the refrigerating plant.

1.3.7 After the plants, equipment and systems subject to PRS survey have been fitted on board the *unit*, they shall be subjected to tests in accordance with the programmes agreed with PRS.

1.4 Technical Documentation of Machinery

1.4.1 General

Prior to the commencement of the machinery construction, the below listed technical documentation shall be submitted, in triplicate, to PRS Head Office for consideration and approval.

1.4.2 Documentation for I.C. Engines

1.4.2.1 Type approval of such engine requires the documentation specified in *PRS Publication 4/P – Inspection of Mass Produced Internal Combustion Engines* to be submitted to PRS.

1.4.2.2 An updated type documentation is the basis for PRS survey of the engine manufacture.

1.4.2.3 If the engine is manufactured upon licence and the manufacturer is not a holder of the engine *Type Approval Certificate*, the documentation within the scope defined in *PRS Publication 4/P – Inspection of Mass Produced Internal Combustion Engines,* specifying design alterations introduced to the given type, shall be submitted to PRS. PRS may demand that these alterations should be confirmed by the licence holder – who is in possession of the relevant *Type Approval Certificate.*

1.4.2.4 If the engine is granted type approval by another class society, the documentation to the scope agreed with PRS, is required to be submitted to PRS.

1.4.3 Documentation for Approval of Gas Turbines

1.4.3.1 The below type approval documentation shall be submitted to PRS:

.1	Technical description and basic technical specification, including diagram of power and rotations versus inlet air temperature	**A**
.2	Assembly drawings and sectional drawings with mounting dimensions	**A**
.3	Drawings of bodies, casings, rotors, vanes and vane seals, attachments, bearings, burners and combustion chambers, heat exchangers integral with the turbine, together with specification of the materials	**A**
.4	Specification of mechanical properties and chemical composition of the materials used. For materials working in temperature over 400 ºC, the detailed temperature related mechanical, creep and corrosion specification shall be provided	**R**
.5	Drawings of thermal insulation	**A**
.6	Foundation and attachment drawings	**A**
.7	Diagram of temperature distribution in the turbine at rated nominal power and at the maximum allowable short time power	**R**
.8	Torsional vibration analysis and if applicable vanes vibration calculations	**A**
.9	Diagrams of rotation speed control system, alarm and safety system	**A**
.10	Detailed information regarding speed governors and safety controller	**A**
.11	Diagrams of lubrication and fuel system	**A**
.12	Rotor balancing procedure	**R**
.13	Failure analysis and analysis of safety system effectiveness	**R**
.14	Turbine Type Test Program[1)]	**A**
.15	Turbine Test Program[1)]	**A**
.16	Operation Manual including Manual for Emergency Situation Measures	**R**
.17	Instruction for Preventive Maintenance	**R**

References:

[1)] Test program shall have acceptance criteria defined.

Notes:

1 The documentation with code **A** shall be approved by PRS.

2 The documentation with code **R** shall be submitted for reference but it may be subject of certain requirements by PRS.
3 In case of turbines with a power below 100kW and for turbines dedicated for auxiliary purposes, the scope of the required documentation for approval may be lowered after agreeing it with PRS.

1.4.3.2 Documentation for heat exchangers associated with turbine, see 1.4.4.

1.4.3.3 The basis for PRS manufacture supervision is an updated documentation of the Turbine Type and Torsional Vibration Calculations for the particular propulsion system.

1.4.3.4 If the turbine is being built under licence and turbine manufacturer does not hold *Type Approval Certificate* for the turbine, he ought to submit the documentation to a scope given in 1.4.3.1 with detailed listing of all introduced design alterations in relation to the approved type. PRS may request confirmation of presented alterations by the licence holder – who is in possession of the *Type Approval Certificate*.

1.4.3.5 If the turbine is granted type approval by another class society, the documentation specified in 1.4.3.1, to the scope agreed with PRS, is required to be submitted to PRS.

1.4.4 Technical Documentation for Boilers, Pressure Vessels, Heat Exchangers, Condensers and Deaerators

Technical documentation for boilers, pressure vessels, heat exchangers, condensers and deaerators shall be in accordance with 1.3.5, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships.*

1.4.5 Technical Documentation for Non-classified Refrigerating Plants

Technical documentation for non-classified refrigerating plant shall be in accordance with 1.3.4, *Part VI* of the PRS *Rules for the Classification and Construction of Sea-Going Ships.*

1.4.6 Technical Documentation for other Machinery

Documentation for machinery not mentioned above in 1.4, including gears, clutches and deck machinery, shall be in accordance with 1.3.4, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships*

1.5 Technical Documentation for Machinery Systems

1.5.1 General

Prior to commencement of the system construction, technical documentation within the scope in 1.5.2 and 1.5.3 shall be submitted, in triplicate, to PRS for consideration and approval.

1.5.2 Plans, specifications, descriptive documents

Technical documentation for machinery systems shall include:

.1 arrangement plan of machinery in machinery spaces, as well as in the spaces of emergency power sources, including the means of escape plan;
.2 characteristics of machinery systems, including the data necessary for the required calculations;
.3 diagram and specification of remote control of main machinery, including the data of fitting remote control stations with control devices, instrumentation, warning devices, means of communication and other equipment.

1.5.3 Piping Diagrams

.1 diagram of gravity overboard drain system,
.2 diagram of bilge system,
.3 diagram of spaces and tanks drainage system,
.4 diagram of ballast and equalizing systems,
.5 diagrams of air, overflow and sounding pipes,
.6 diagram of exhaust gas system including drawings of silencers and spark arresters,

.7 diagrams of ventilation and air conditioning systems (showing arrangement of watertight bulkheads, fire divisions, closing devices of ventilation ducts and openings),
.8 diagrams of fuel oil systems,
.9 diagrams of gas fuel systems,
.10 diagrams of lubricating oil systems,
.11 diagrams of cooling water systems,
.12 diagram of compressed air system,
.13 diagrams of boiler feed water and condensate system,
.14 diagram of steam system,
.15 diagram of oily water system,
.16 diagram of sanitary system,
.17 diagrams of hydraulic systems driving machinery and equipment.

2 MACHINERY EQUIPMENT

2.1 General

General provisions of *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply, with the exception of requirements for main propulsion and technical documentation.

2.2 Internal Combustion Engines

The I.C. engines shall comply with the requirements of Chapter 2, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* and Publication No. 88/P *Guidelines on Safety for Natural Gas-fuelled Engine Installations in Ships* applicable to four-stroke engines driving generating sets, supplied with fuel oil, gas or dual fuel.

2.3 Gas and Dual Fuel Turbines

Gas turbines shall comply with 3.3, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* applicable to oil, gas or dual fuel turbines driving generating sets.

2.4 Reduction Gears

Requirements of 4.2, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply, except for the requirements for the ship main propulsion.

2.5 Disengaging and Flexible Couuplings

Requirements of 4.3, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply, except for the requirements for the ship main propulsion.

2.6 Auxiliary Machinery

2.6.1 The auxiliary machinery shall comply with the requirements of Chapter 5, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships*, and in particular:
– air compressors shall comply with 5.1.1 and applicable requirements of 5.1.2,
– pumps shall comply with 5.2, including additional requirements for flammable liquid pumps contained in 5.2.2,
– fuel and oil separators, the requirements of 5.4,
– ventilators, the requirements of 5.3.1.

2.6.2 Requirements for ventilators in hazardous spaces

2.6.2.1 The air gap between the casing and rotor shall not be less than 0.1 of the rotor shaft bearing journal diameter and not less than 2 mm, but it is not required that the air gap be greater than 13 mm.

2.6.2.2 Terminals of ventilation ducts shall be protected against the entry of foreign matter into the fan casings by means of wire net, with square net mesh of the side length not exceeding 13 mm.

2.6.2.3 Ventilation fans shall be of non-sparking design. The fan is not sparking if in any conditions there is no risk of sparks generation. Casing and rotating parts of fan shall be made of such materials, which do not cause electric charge accumulation, and the fans installed shall be properly earthed to the hull of ship in accordance with the requirements of chapter 18 of *Part VI* of the present Publication.

2.6.2.4 Except the cases specified in paragraph 2.6.2.5, rotors and fan casings in way of rotor shall be made of such materials which do not generate sparks, as confirmed by appropriate tests.

2.6.2.5 The tests mentioned in paragraph 2.6.2.4 may be waived for the fans made of the following combinations of materials

.1 rotor and/or casing made of non-metallic materials with anti-electrostatic properties,

.2 rotor and casing made of non-ferrous metal alloys,

.3 rotor made of aluminium or magnesium alloy and steel casing (including stainless austenitic steel), where a ring made of non-ferrous material of adequate thickness is used inside the casing in way of rotor,

.4 any combination of steel rotor and casing (including stainless austenitic steel) provided that the radial clearance between them is not less than 13 mm.

.5 rotor and casing made of stainless austenitic steel.

2.6.2.6 Rotors and fan casings made of the following materials are considered as sparking and their application is not permitted

.1 rotor made of an aluminium or magnesium alloy and steel casing, irrespective of the radial clearance value,

.2 casing made of an aluminium or magnesium alloy and steel rotor, irrespective of the radial clearance value,

.3 any combination of rotor and casing made of steel with the design radial clearance less than 13 mm.

2.7 Deck Machinery

The deck machinery shall comply with the requirements of 6.1, 6.3 and 6.4, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships*, in relation to windlasses and mooring winches.

The above requirements pertain to windlasses and mooring winches, which are not commonly used, mostly during platform transit and positioning at support location.

2.8 Boilers and Pressure Vessels – General Requirements

Requirements of 8.1 and 8.2, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply.

2.8.1 Boilers

2.8.1.1 Oil fueled Boilers and Utilization Boilers

The requirements for oil fueled boilers and utilization boilers are contained in Chapter 9, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships*.

2.8.1.2 Gas and Dual Fuel Boilers

For gas and dual fuel boilers, the below requirements apply in addition to the requirements mentioned in 2.9.1:

2.8.1.2.1 The boiler shall be so designed that collecting the non-burned gas in any part of boiler and exhaust gas system is not possible. Fitting fans in the exhaust gas system is permitted. The fans shall be of explosion-proof design.

2.8.1.2.2 Each boiler shall have its individual exhaust duct.

2.8.1.2.3 Gas and dual fuel burners shall be of design ensuring stable and complete combustion of supplied fuel in any boiler service conditions.

2.8.1.2.4 The combustion chamber shall be equipped with flame monitoring system. The system shall automatically close fuel supply to the burner upon detection of flame loss.

2.8.1.3 Control, Safety and Alarm Systems of Boilers

Requirements of Chapter 10, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* and of Chapter 16 of *IGC Code* apply.

2.8.1.4 Oil and Gas Fuel Installations of Boilers

Requirements of Chapter 11, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* and of Chapter 16 of *IGC Code* apply.

2.8.2 Pressure Vessels, Condensers, Deaerators and Heat Exchangers

Requirements of Chapter 12, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply, within the scope of machinery used on fixed offshore platforms.

2.9 Hydraulic Systems Driving Machinery and Equipment

Requirements of Chapter 7, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply.

3 SYSTEMS

3.1 General

General provisions contained in *Part VI* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply.

3.2 Bilge System

3.2.1 Scope of Requirements

Requirements of 3.2.2 of this Part apply to the units under construction and units being afloat during towing or during supporting on, or self-elevating from, the sea-bed. The requirements are also obligatory for the unit issued with the Certificate of Self-elevating Offshore Unit, according to 3.4.2 of Part I.

Requirements of 3.2.3 of this Publication apply to the units founded on the sea-bed.

3.2.2 Bilge System of the Unit Afloat

3.2.2.1 An efficient bilge pumping system shall be provided on the *unit*, capable of pumping from and draining watertight compartments other than spaces permanently appropriated for the carriage of fresh water, water ballast, oil fuel or liquid cargo (for which other efficient means of draining are provided), under all conditions whether the unit is upright or inclined.

3.2.2.2 Additional suctions shall be provided in large compartments or compartments of unusual form.

3.2.2.3 Compartments not provided with a bilge suction may be drained to other spaces provided with such suction ends.

3.2.2.4 Means shall be provided to detect the presence of water in such compartments which are adjacent to tanks containing liquids and adjacent to void compartments through which pass pipes conveying liquids. If PRS is satisfied that the safety of the *unit* is not impaired, the means to detect the presence of water may be dispensed with in particular compartments.

3.2.2.5 At least two independent self-priming power pumps, or two pump units complying with 3.3.2.8, connected to each bilge main shall be provided. Sanitary, ballast and general service pumps may be accepted as independent self-priming power bilge pumps if they are fitted with connections to the bilge pumping system.

3.2.2.6 One of the bilge pumps may be a bilge ejector, provided that there is a separate pump delivering sufficient water for operating the ejector.

3.2.2.7 Where the capacity of one pump is less than required, the deficiency may be made up for by the other pump. The capacity of the smaller pump, however, is not to be less than one third of the combined pumping capacity.

3.2.2.8 Each pump unit may consist of one or more pumps connected to the main bilge line, provided their combined capacity is sufficiently large to ensure proper flow.

3.2.2.9 Considering the method and circumstances of sea transport of the unit to its foundation site, PRS may accept other arrangements to those provided in 3.3.2.5.

3.2.2.10 All bilge pipes shall be made of steel or other suitable material of appropriate properties, approved by PRS.

3.2.2.11 All distribution boxes and manually operated valves shall be in positions which are accessible under ordinary circumstances.

3.2.2.12 Bilge system shall enable oily bilge water, the water contaminated by chemicals and clean bilge water to be transported by means of separate pumps and piping.

3.2.2.13 A means to indicate whether a valve is open or closed shall be provided at each location from which the valve can be controlled. The indicator should rely on movement of the valve spindle.

3.2.2.14 Drainage of hazardous areas shall be given special consideration having regard to explosion risk.

3.2.2.15 It is recommended that the internal diameter of branch bilge suctions from each compartment shall not be less than given by the following formula, rounded to the nearest 5 mm:

$$d = 2.15\sqrt{A} + 25 \text{ [mm]}$$

where *A* [m^2] is wetted surface of the compartment when the compartment is half way filled with water. The internal diameter of any branch bilge line is not to be less than 50 mm. For irregularly shaped compartments *A* will be specially considered

3.2.2.16 The cross-sectional area of the main (collective) bilge lines is not to be less than the combined area of the two largest branch suctions.

3.2.2.17 The capacity of each pump or pump unit referred to in 3.3.2.5, shall be sufficient, at normal service conditions, to ensure water flow rate at least 2 m/s in a pipeline of diameter given in 3.3.2.16.

3.2.3 Bilge System of the *Unit* Founded on the Sea Bed

3.2.3.1 The bilge system shall be capable of pumping from and draining compartments referred to in 3.3.2.1, including draining fire-extinguishing water:
– through a fixed bilge system,
– directly overboard (environmental requirements being complied with),
– to lower spaces,
– thorough a portable installation.

3.2.3.2 The fixed arrangements referred to in 3.3.2 may be dismantled only upon agreement with PRS.

3.3 Ballast System

3.3.1 Scope of Requirements

Requirements of 3.3 apply to the units under construction and units being afloat during towing or during supporting on, or self-elevating from, the sea-bed.

For the unit founded on the sea bed, upon PRS acceptance, the ballast system may be partly or completely taken out of service and PRS survey.

3.3.2 Requirements

3.3.2.1 Requirements contained in Chapter 8, *Part VI* of the PRS *Rules for the Classification and Construction of Sea-Going Ships*, applicable to stationary production platforms, apply.

3.3.2.2 The ballast system shall be capable of filling up and emptying each ballast tank with use of at least one of two independent power pumps or by controlled free water drainage.

3.4 Air, Overflow and Sounding Piping Systems

Requirements of Chapter 9, *Part VI* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply.

3.5 Exhaust Gas System

Requirements of Chapter 10, *Part VI* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply.

3.6 Ventilation System

3.6.1 Requirements for all Ventilation Systems

3.6.1.1 Requirements contained in Chapter 19, *Part VI* of the PRS *Rules for the Classification and Construction of Sea-Going Ships*, applicable to stationary production platforms, apply.

Where the unit's process fluid pumps are installed in an enclosed space, the requirements of 22.5.1.4, of the above mentioned *Part* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply.

3.6.1.2 Inlets to ventilation system shall be located far away from outlets of cold blowdown of emergency disposal system, to prevent suction of released gas.

3.6.1.3 Air inlets leading to machinery space with combustion engines shall be clear at least 3 m from the hazardous areas boundaries.

3.6.1.4 Requirements of paragraph 2.9, *Part V* and paragraph 5.6, *Part VI* of this *Publication*, apply.

3.6.2 Additional Requirements for the Ventilation of Hazardous Spaces

3.6.2.1 Requirements of Chapter 18, *Part VI* of this *Publication*, apply.

3.6.2.2 Gas concentration detection and alarm system shall be installed:
– in mechanical ventilation outlets of hazardous areas,
– in ventilation inlets.

For equipment and systems, where potential gas leak sources are concentrated on a small area, gas concentration detectors may be omitted in the inlets to mechanical ventilation system, provided the ventilation system is automatically disconnected in the case of gas detection in any place of zone 1 or 2. External air inlets to accommodation spaces ventilation shall always be equipped with gas detectors.

3.6.2.3 Ventilation of hazardous areas shall be independent of the ventilation of non-hazardous spaces.

3.6.2.4 Hazardous enclosed spaces shall be ventilated with under-pressure in relation to adjacent less hazardous locations. Fans shall be interlocked to ensure outlet fan is engaged prior to inlet fan, and ventilation failure shall initiate alarm at a manned location. Fans shall comply with the requirements of 2.6.2.

3.6.2.5 Inlets and outlets of ventilation system shall be so distributed that an efficient ventilation is ensured, taking account of potential gas leak sources such as appliances and systems located in the ventilated area.

3.6.2.6 Ventilation inlet ducts passing through a more hazardous area than the ventilated space shall be operated at overpressure in relation to the hazardous area.

3.6.2.7 The outlet air from hazardous spaces shall be routed through separate ducts to outdoor area which, in the absence of the considered exhaust, is of the same or lesser hazard than the ventilated space. The internal spaces of such ducts belong to the same zone as the inlet space.

3.6.2.8 The outlet ducts and the area in vicinity of the discharge point shall have the same area classification as the ventilated space. The dimension of the hazardous zone at outlet shall not be less than the zone dimensions in open air for the largest single source within the enclosed space.

3.6.3 Requirements for Overpressure Ventilation of Enclosed Spaces

The ventilation system shall be suitable to::
– maintain at least 50 Pa overpressure with respect to the external hazardous area when all penetrations are closed,
– maintain an outward air flow through all openings of the enclosed space.

3.7 Oil Fuel System

Requirements of Chapter 12, *Part VI* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply.

3.8 Gas Fuel System

Requirements of 2.12.9, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply.

3.9 Lubricating Oil System

Requirements of Chapter 13, *Part VI* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply.

3.10 Cooling Water System

Requirements of Chapter 15, *Part VI* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply.

3.11 Compressed Air System

Requirements of Chapter 16, *Part VI* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply.

3.12 Boiler Feed Water, Steam and Condensate System

Requirements of Chapters 17 and 18, *Part VI* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply.

3.13 Oily Water System

Requirements contained in Part VIII of this *Publication* apply.

3.14 Sanitary System

Requirements contained in Part VIII of this *Publication* apply.

3.15 Hydraulic Drive System

Requirements of Chapter 7, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply.

4 PLATFORM JACKING MACHINERY

4.1 Application

4.1.1 Requirements of Chapter 4 apply to jacking machinery of the platforms under conversion and intended to be permanently supported on sea bed, where the above equipment is under conversion or technical assessment.

4.1.2 Requirements of Chapter 4 apply to driving gears, climbing pinions, racks, leg locking systems and flexible mounts. The requirements for jack house frame and for welded connections between rack and platform leg structure have been specified in 4.4, Part II of this *Publication.*

4.2 General Requirements

4.2.1 Structure design evaluation for platform jacking machinery requires defining the characteristics of the system service loads. With this purpose, the following service conditions of jacking machinery shall be considered:
– leg jacking,
– leg lowering,
– pontoon jacking,
– pontoon lowering,
– accidental conditions (e.g. one or more jacking appliances has failed),
– pre-loading,
– unfavourable atmospheric conditions (stormy weather)
– overload of propulsion engines of platform jacking machinery.

4.2.2 All platform jacking machinery shall be designed taking into consideration loads exerted in service conditions as described in 4.2.1. The values of design safety factors shall be the same for all anticipated service conditions of jacking machinery.

4.2.3 At determining the load distribution of platform jacking machinery items, the following shall be taken into account:
– friction in platform leg guides,
– effect of *unit* gravity centre displacement.

If the available documentation contains no information on the friction force acting in the platform leg guides, 10% of value of vertical forces acting in normal service conditions of the platform jacking machinery may be taken as design friction force. Where the platform is deflected from vertical when elevated (e.g. in result of unequal sinking of legs in the ground during loading down), a greater value of friction force acting in leg guides shall be taken.

4.2.4 Jacking machinery (including a pinion-rack) shall be so designed that damage due to overload should affect first the easily accessible places. It means that e.g. in case of overload of driving engines or jacking of platform with locked legs, a deformation (damage) shall be noticeable first on the easily accessible elements, such as pinion or (preferably) a rack. The damages shall be noticeable before damage occurs at enclosed gear, where it is less able to be visually identified.

4.2.5 The jacking machinery shall be so designed that self-locking of legs at platform lowering is avoided.

4.3 Arrangement of Jacking Machinery

4.3.1 The platform jacking units shall be so arranged to enable individual dismantling of particular subassemblies (e.g. for maintenance).

4.3.2 The platform jacking units shall be fitted to jack-house frame so as to avoid negative effect of deflection of the elastic pads mounted between the jack-house frame and platform pontoon on the operation of gear wheel/rack system.

4.3.3 Elastic rubber pads shall be protected by oil based coating.

4.3.4 Driving engines shafts shall be capable of being rotated manually (e.g. by provision of a tetragonal pin for mounting a crank on the end of engine shaft).

4.3.5 Use of engine operation locking is required (supply shutdown) when the leg locked.

4.4 Reduction Gears

Requirements specified in Chapter 4.2, *Part VI* of the PRS *Rules for the Classification and Construction of Sea-Going Ships* apply to reduction gears.

4.5 Pinion and Rack

The design of pinions, together with bearings, and racks is subject to special consideration by PRS.

4.6 Gear Bodies and Bearing Casings

4.6.1 Bodies and bearing casings shall be so designed as to eliminate deformations that may be harmful for gear wheel operation.

4.6.2 The design of gear body shall be such as to enable inspection of gear wheels and slide bearings. For gears with parallel shafts inspection covers shall be used, while for planetary gear openings for boroscope inspection shall be provided.

4.7 Propeller Shafts and their Couplings

4.7.1 Requirements concerning shaft couplings in the form of shrink fit, flange, keyed and other connections are presented in Chapter 4, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships*.

4.7.2 Propeller shafts shall be so designed as to maintain the shaft strength in accordance with requirements of 4.2.1. Complexity of stresses due to simultaneous torsion and bending shall be considered. Stress concentration factors may be taken on the basis of relevant literature or the requirements of Chapter 4, *Part VII* of the PRS *Rules for the Classification and Construction of Sea-Going Ships.*

4.8 Bearings

4.8.1 The minimum durability of rolling bearings (ball and roller bearings) shall be L_{10a} (ISO 281), and that should match the time period between planned overhauls. At determining bearing durability, quality of lubrication may be considered, provided that necessary requirements, mainly those concerning lubricant purity, are complied with.

4.8.2 Stresses of the designed active surfaces of slide bearings under maximum load, shall not exceed 50% of yield strength of bearing material. The bearing and lubricating system shall be so designed as to avoid bearing wear resulting in clearances inacceptable for proper gear wheel operation.

4.9 Propulsion Unit Brakes

4.9.1 Power units of the platform jacking machinery shall be provided with propulsion shaft brakes. The brakes shall activate automatically after failure to electric supply of jacking machinery.

4.9.2 The value of brake static friction moment shall be not less than 1.3 of the maximum moment noted when the break shall be activated.

4.10 Flexible Joimts

Flexible joints of platform jacking unit shall be subject to special PRS consideration.

4.11 Control Equipment

4.11.1 The following monitoring and control equipment of platform jacking unit is required:

– remote signalling and alarm system of platform leg position locking and propulsion unit brake, activated in case of engine start at brake/lock activated. The alarm shall be activated by an independent mechanical sensor;
– remote signalling and alarm system of motor overheating;
– permanent remote signalling of loads at jacking /lowering. Monitoring of platform leg loads, acting during platform jacking /lowering, shall be ensured. The system shall generate alarm if the maximum permitted load is exceeded.

4.12 Tests of Jacking Machinery

4.12.1 The jacking machinery shall be tested in accordance with a PRS approved test programme.

4.12.2 Within the scope of jacking machinery tests performed onboard the *unit*, position of the pinion wheel and the rack shall be inspected~~, both along the rack longitudinal axis and for the tooth clearance~~.

4.12.3 Motion tests of the jacking machinery of the platform under construction or conversion shall be carried out at the maximum design loads acting at platform jacking and lowering. As a minimum, testing shall cover one working cycle of the system at jacking or lowering.

4.12.4 Tests shall cover the control of operation of propulsion unit brake (see 4.9).

PART V
Fire and Anti-explosion Protection

1 GENERAL

1.1 Application

1.1.1 *Part V – Fire and Anti-explosion Protection* applies to the structural fire-protection, fire-entinguishing systems, fire alarm systems and fire-fighting equipment used on stationary production platforms, hereinafter referred to as *units,* defined in 1.2.1 of Part I as *units* and *marine units*.
Alternative/innovatory installation design and arrangements for fire protection are permitted onboard the *unit* and they may deviate from the requirements specified in this *Part V*, provided that installations and arrangements meet the fire safety objectives and the functional requirements which is subject to verification by the documentation approval and relevant tests or examinations.

1.2 Definitions

General terminology definitions used in this *Publication* are specified in *Part I – Survey Regulations*.
For the purposes of this *Part V*, the following additional definitions have been adopted:

1. Gastight door – solid close-fitting door designed to resist the passage of gas under normal atmospheric conditions.

2. Lower flammable /explosive limit – minimum concentration of vapour-to-air (or vapour-to-another oxidant) below which propagation of a flame will not occure in the presence of an ignition source or above which a flame will spontaneously spread in the mixture.

3. Upper flammable/explosive limit – maximum vapour-to-air (or vapour-to-another oxidant) concentration above which propagation of a flame will not occure.

4. MED – *Council Directive 96/98/EC of 20 December 1996 on Marine Equipment*, as amended, which, in respect of the fire protection, sets the requirements and certification scope for the equipment used on board the ships who are subject to *SOLAS 74/78,* as amended, and are flying the EU Member State flag.

5. Group of fire – fires' classification by the types of fuel they burn and burning process. Fires are classified as follows:
- Group A – fires that involve common solid combustibles, usually of organic origin, such as wood, paper, cloth, coal, etc. whose burning process normally produces glowing coal;
- Group B – fires are fueled by flammable or combustible liquids, which include oil, petrol, alcohols, etc. and solid materials which melt when heated such as fat, tar, etc.;
- Group C – fires of such gases as: methane, acetylene, hydrogen, etc.;
- Group D – fires that involve such light metals and their alloys as magnesium, sodium, aluminium, etc.;
- Group F or K – fires that involve cooking oils, grease or animal fat in cooking appliances.

6. *FSS Code* – the *International Code for Fire Safety Systems* adopted by IMO Resolution MSC.98(73), as amended.

7. *FTP Code* – the *International Code for Application of Fire Test Procedures* adopted by IMO Resolution MSC.61(67) , as amended.

8. *MODU Code* – the Code for Construction and Equipment of Mobile Offshore Drilling Units adopted by IMO Resolution A.1023(23).

9. Helideck – purpose-built helicopter landing platform located on a offshore unit.

10. Non-combustible material – material which neither burns nor gives off flammable vapours in sufficient quantity for self-ignition when heated to approximately 750°C, this being determined in accordance with Annex 1, Part 1 of the *FTP Code*. Another material is considered as combustible material.

11. Steel equivalent material – any non-combustible material which, by itself or due to insulation provided, has structural integrity properties equivalent to steel at the end of the applicable exposure to the standard fire test (e.g. aluminium alloy or composite material with appropriate insulation). Composite material equivalent to steel is subject to tests in accordance with the guidelines contained in IMO MSC/Circ.732.

12. Accommodation spaces – those used for public spaces, corridors, lavatories, cabins, offices, hospitals, cinemas, games and hobbies rooms, pantries containing no cooking appliances and similar spaces. Public spaces are those portions of the accommodation which are used for halls, dining rooms, lounges and similar permanently enclosed spaces.

13. Working spaces – those open or enclosed spaces containing equipment and processes, associated with production operations, which are not included in hazardous areas and machinery spaces.

14. Service spaces – those used for galleys, pantries containing cooking appliances, lockers and store-rooms, workshops other than those forming part of the machinery spaces, and similar spaces and trunks to such spaces.

15. Enclosed spaces – spaces delineated by floors, bulkheads and/or decks which may have doors or windows.

16. Control stations – those spaces where the *unit's* radio or main navigating equipment or the emergency source of power is located or where the fire recording or fire control equipment or where a fire-extinguishing system serving various locations is situated and the main control station (MCS) and process control station (PCS) are located. The space where the emergency source of power is located is not considered as being a control station.

17. Machinery spaces – all machinery spaces of category A and all other spaces containing propelling machinery, boilers and other fired processes, internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, ventilation and air-conditioning machinery and similar spaces as well as trunks to such spaces.

18. Machinery spaces of category A – all spaces which contain internal combustion-type machinery used either:

– for main propulsion; or
– for other purposes, where such machinery has in the aggregate a total power of not less than 375 kW,

or which contain any oil-fired boiler and trunks to such spaces.

19. A Class fire divisions – those divisions formed by bulkheads and decks which fulfil the following criteria:

.1 they are constructed of steel or an equivalent material;

.2 they are suitably stiffened;

.3 they are insulated with approved non-combustible materials such that the average temperature of the unexposed side will not rise more than 140°C above the original temperature, nor will the temperature, at any one point, including any joint, rise more than 180°C above the original temperature, within the time listed below:

A-60 Class – 60 min;
A-30 Class – 30 min;
A-15 Class – 15 min;
A-0 Class – 0 min,

.4 they are so constructed as to be capable of preventing the passage of smoke and flame to the end of the one-hour standard fire test; and

.5 the prototype bulkhead or deck tests performed in accordance with Part 3 of Annex 1 to *FTP Code* demonstrated that such a bulkhead or deck fulfils the above requirements for integrity and temperature rise.

20. B Class fire divisions – those divisions formed by bulkheads, decks, ceilings or linings which fulfil the following criteria:

.1 they are constructed of approved non-combustible materials, and all materials used in the construction and erection of B Class divisions are non-combustible, with the exception that combustible coatings and veneers may be permitted provided they have low flame-spread characteristics;

.2 they have an insulation value such that the average temperature of the unexposed side will not rise more than 140°C above the original temperature, nor will the temperature at any one

point, including any joint, rise more than 225°C above the original temperature, within the time listed below:
B-15 Class – 15 min;
B-0 Class – 0 min,

.3 they are so constructed as to be capable of preventing the passage of flame to the end of the first half hour of the standard fire test; and

.4 the prototype division tests performed in accordance with Part 3 of Annex 1 to *FTP Code* demonstrated that such a bulkhead or deck fulfils the above requirements for integrity and temperature rise.

21. C Class fire divisions – divisions constructed of approved non-combustible materials. They need meet neither requirements relative to the passage of smoke and flame nor limitations relative to the temperature rise. Combustible veneers are permitted, provided they meet the requirements of this *Part V*.

22. Hazardous areas – all those areas where, due to the possible presence of a flammable atmosphere, the use without proper consideration of machinery or electrical equipment may lead to fire hazard or explosion.

23. Standard fire test – test in which specimens of the relevant bulkheads or decks are exposed in a test furnace to temperatures corresponding approximately to the standard time-temperature curve, in accordance with the test method specified in Part 3 of Annex 1 to *FTP Code*.

24. Continuous B Class ceilings or linings – those B Class ceilings or linings which terminate only at an A or B Class division.

25. Low flame-spread – this means, with respect to materials used in the structural fire protection, that the surface thus described will adequately restrict the spread of flame, this being determined through testing in accordance with Part 5 of Annex 1 to *FTP Code*.

1.3 Standards and IMO documents related to this *Part V*:

.1 EN ISO 13702: Petroleum and natural gas industries – Control and mitigation of fires and explosions on offshore production installations – Requirements and guidelines

.2 Res. A.951(23): Improved guidelines for marine portable fire extinguishers.

.3 Res. A.952(23): Graphical symbols for shipboard fire control plans..

.4 MSC.1/Circ.1312/Corr.1: Revised guidelines for the performance and testing criteria, and surveys of foam concentrates for fixed fire-extinguishing systems.

.5 MSC.1/Circ.1318: Guidelines for the maintenance and inspections of fixed carbon dioxide fire-extinguishing systems.

.6 MSC.1/Circ.1432: Revised guidelines for the maintenance and inspection of fire protection systems and appliances.

1.4 Scope of Survey

1.4.1 General principles on survey performance during the survey of construction and further surveys in respect of the structural fire protection, fire-extinguishing systems and fire alarm systems are specified in *Part I – Survey Regulations.*

1.4.2 Subject to the survey to be exercised by PRS in the process of unit construction or conversion are fire protection structures, fire-extinguishing systems, fire alarm and detection systems, gas detection systems as well as other systems and solutions associated with the fire protection whose documentation is subject to consideration and approval and so are the equipment and systems posing fire hazard.

1.4.3 The following constructions/equipment components are subject to the certification for compliance with the relevant provisions applied in the fire protection:

.1 construction of A, B and C Class fire divisions,
.2 fire doors,
.3 fire door control system components,
.4 A and B Class windows and scuttles,
.5 non-combustible materials,
.6 primary deck coverings,
.7 low flame-spread materials used for the lining of divisions, ceilings and floors,
.8 fire dampers (ventilation),
.9 penetrations through A and B Class fire divisions for: electric cable transits, pipe, ducts, etc.,
.10 components of fixed pressure water spraying fire extinguishing systems: control valves, nozzles, monitors,
.11 carbon dioxide (CO_2) system components: cylinders, distribution valves, control cabinets, flexible pipe assemblies, discharge nozzles,
.12 gas fire-extinguishing systems, with a clean fire-extinguishing agent used as halon replacement,
.13 components of fixed foam fire-extinguishing systems: foam proportioners, control valves, foam monitors, foam concentrates,
.14 fire detection and alarm systems,
.15 flammable and toxic gas detection systems,
.16 portable instruments for measuring flammable vapour and oxygen concentrations,
.17 hydrant valves and fire hoses,
.18 fire hose nozzles,
.19 portable and mobile fire-extinguishers as well as fire-extinguishing units,
.20 the fire-fighter's outfits,
.21 emergency escape breathing devices.

1.4.4 Product certification procedure is confirmed by the PRS *Type-approval Certificate* for the use in marine environment. For the above mentioned equipment, *MED Conformity Certificate* is accepted as equivalent to the *Type-approval Certificate*.

1.4.5 In an individual case PRS may permit the installation on the *unit* of particular fire protection construction, material, product or system for which type-approval is required. In that case PRS issues the *Test Certificate* following the positive results of the tests performed in accordance with the previously agreed test and acceptance procedure.

1.4.6 Fire pumps, pumps supplying water-spraying fire-extinguishing systems, pumps supplying water and foam concentrate to foam application systems are subject to factory acceptance and operation tests, in accordance with the approved programme, to be witnessed by PRS surveyor.

1.4.7 Pressure vessels and cylinders in gas fire-extinguishing systems as well as their components subjected to high-pressure, e.g. CO_2 manifold, are subject to factory acceptance and pressure tests, in accordance with the approved programme, to be witnessed by PRS surveyor.

1.4.8 During the *unit* service, fire-extinguishing systems and fire protection equipment as well as the equipment posing extra fire hazard are subject to periodical technical surveys and confirmation.

1.4.9 Surveys, maintenance and repairs to fixed fire-extinguishing systems, fire detecting systems and combustible gas detecting systems, fire-fighting equipment (fire-extinguishers and portable foam applicators), breathing apparatus and low-location lighting as well as laboratory tests of foam concentrates may be performed only by service suppliers approved by PRS.

1.4.10 Service suppliers seeking PRS approval shall fulfil the requirements specified in *Publication No. 51/P – Procedural Requirements for Service Suppliers*.

1.5 Technical Documentation of Fire Protection

1.5.1 Survey Documentation

Prior to the commencement of unit construction/conversion the following documentation shall be submitted to the construction supervising body (PRS):

A. Structural Fire Protection:

.1 plan of structural fire protection indicating, names and fire hazard categories of the spaces, including:
- arrangement of A, B and C Class fire divisions including closures of openings in such divisions,
- draught stops' arrangement,
- details of construction for fire divisions,
- marking of escape routes,
- design solutions for typical penetrations through fire divisions for electric cable transits, pipe, ducts,

.2 arrangement of doors, including the fire door controls,
.3 arrangement of windows and scuttles,
.4 spaces' insulation plan,
.5 deck linings' plan,
.6 plan of unit spaces outfitting, including,
- partitions' lining and ceilings',
- floor lining,
- list of upholstered furniture, suspended textile materials and bedding components,

.7 conservation and painting plan,
.8 calculations of fire load (total quantity of combustible materials used in accommodation and service spaces as well as control stations),
.9 ventilation and air-conditioning plan for spaces, including the arrangement of ventilation ducts, air inlets and outlets as well as fire dampers,
.10 plan of the means of escape and assembly stations,
.11 list of the required certificates for the materials/components/structures used for fire divisions.

B. Active Fire Protection:

.1 fire protection concept of the *unit*,
.2 fire-fighting systems and equipment layout,
.3 fire main system plan,
.4 fixed water-spraying system plan,
.5 water screen system plan,
.6 plan of the system for extinguishing fire inside the exhaust ducts from galley range and the plan of deep-fat cooking equipment fire-extinguishing system,
.7 foam fire extinguishing system plan,
.8 plan of gas fire-extinguishing systems for machinery spaces,
.9 fire detection and alarm system plan,
.10 flammable and toxic gas detection system plan,
.11 fire-fighting equipment arrangement plan,
.12 fire-extinguishing system plan for paint lockers and flammable liquid lockers,
.13 list of the required certificates for the applied fire-fighting equipment/outfit and their components.

C. Equipment and Appliances Posing Extra Fire Hazard:

.1 plan of helicopter facilities, including fire-extinguishing systems and helideck arrangements,
.2 technical (welding) gas system plan,
.3 plan of gas fuel system for domestic purposes.

The documentation shall contain, respectively, the calculations, material specifications, summary lists of the equipment and system components as well as all the information necessary to assess whether the constructions/equipment/installations fulfil the requirements of this *Publication*.

1.5.2 Fire Control Plan

1.5.2.1 On the *unit*, the *Fire Control Plan* shall be available prepared on the basis of the general arrangement plan and showing the arrangement of:

.1 control stations (PCS and MCS),
.2 fire zones and fire divisions,
.3 fire detectors, manually operated call points and control panel,
.4 flammable gas detectors,
.5 hydrogen sulfide detectors,
.6 respiratory ducts' protective apparatus
.7 general alarm buttons,
.8 fire-extinguishing system/equipment and fire-extinguishers,
.9 fire-fighter's outfit,
.10 helicopter rescue kit,
.11 water-spray nozzles,
.12 automatic shut-off station (fuel supply shut-off, shut-down of engines, etc), ESD buttons,
.13 ventilation systems, including fire damper locations and fan control positions with identification numbers for fans serving each section,
.14 fire/watertight doors and their remote control positions,
.15 blow-out preventer control positions,
.16 primary and secondary escape routes and escape directions from all the unit areas and spaces to the open deck, to life-boat and life-raft embarkation stations as well as the means of access to spaces,
.17 assembly stations and life saving equipment.

Additionally, other fire-protection systems and equipment, if installed, shall be indicated *on the Fire Control Plan*, taking into account *unit* size, purpose and process systems.

The *unit* profile shall be included in the *Fire Control Plan*, with deck levels indicated, showing the arrangement of main vertical and horizontal fire divisions as well as the primary and secondary escape routes.

The required number of fire-fighting equipment components and other countable means applicable to fire protection shall be broken down in a table form.

1.5.2.2 Graphical symbols used in the *Fire Control Plan* shall comply with those specified in IMO Resolution A.952(23) and any description shall be in the official language of the maritime administration of competent jurisdiction over the unit.

1.5.2.3 In *Fire Control Plans* for the units constructed before 1 January 2004, symbols specified in IMO Resolution A.654(16) may be used.

1.5.2.4 *Fire Control Plan* shall be permanently exhibited in visible positions in halls and mess room and shall also be available in the fire control stations (MCS and PCS).

1.5.2.5 *Fire Control Plan* shall be kept up to date and any amendments shall be currently entered by the officer responsible for the unit fire protection.

1.5.2.6 *Fire Control Plan* shall be approved by the Maritime Administration or an authorized body.

1.5.3 Maintenance and Safety Documentation

1.5.3.1 The following documentation shall be available on the unit:

.1 *Fire Protection Systems' and Appliances' Maintenance Plan*;
.2 *Fire Training Manual*.

1.5.3.2 *Fire Protection Systems' and Appliances' Maintenance Plan* shall contain information on the maintenance, tests and inspections to be performed by the personnel for fire-extinguishing systems as well as fire-fighting equipment and outfits in the following scope:

.1 fire mains, fire pumps and hydrants including hoses, nozzles and international shore connections;
.2 fixed fire detection and fire alarm systems;
.3 fixed fire-extinguishing systems and other fire-extinguishing appliances;
.4 ventilation systems including fire and smoke dampers, fans and their controls;
.5 fuel supply emergency shut-down;
.6 fire doors including their controls;
.7 general alarm systems;
.8 emergency escape breathing devices;
.9 fire extinguishers, including spare extinguishers;
.10 portable flammable gas and oxygen monitoring devices;
.11 gas detection and alarm systems; and
.12 fire-fighter's outfit.

Fire Protection Systems' and Appliances' Maintenance Plan shall take into account the recommendations specified in IMO MSC.1/Circ.1318 and MSC.1/Circ.1432.

Fire Protection Systems' and Appliances' Maintenance Plan may be provided in an electronic version.

1.5.3.3 *Fire Training Manual* shall contain the detailed code of practice in the event of fire as well as fire training and drills in the following scope:

.1 general fire safety practice and precautions related to the dangers of smoking, electrical hazards, use of flammable liquids and similar hazards common on the *unit*;
.2 general instructions on fire-fighting activities and fire-fighting procedures including procedures for notification of a fire and use of manually operated call points;
.3 instructions on the duties assigned to individual personnel members;
.4 organization of teams responsible for fire-fighting and rescue actions;
.5 meanings of the alarms applicable to the unit;
.6 operation and use of fire-fighting systems and appliances;
.7 operation and use of fire doors;
.8 operation and service of fire and smoke dampers; and;
.9 escape systems and appliances.

Fire Training Manual shall be written in the working language of the unit and shall also be available in each mess room and recreation room or in each personnel cabin.

Fire Training Manual may be provided in the audio-visual form.

1.6 Operational Readiness and Maintenance

1.6.1 During the unit service, the following functional requirements shall be fulfilled:

.1 gas detection systems, fire protection systems and fire-fighting systems and appliances shall be maintained ready for use; and
.2 gas detection systems, fire protection systems and fire-fighting systems and appliances shall be properly tested and periodically inspected.

1.6.2 At all times while the *unit* is in service, the provisions of paragraph 1.6.1 above shall be fulfilled. A *unit* is not in service when:

.1 it is in repair or lay up (either at anchor or in port) or in dry-dock;
.2 it is declared not in service by the owner or the owner's representative.

1.6.3 Operational Readiness

.1 The following fire protection systems and gas detection systems shall be kept in good order so as to ensure their intended performance in the event of fire:

.1 structural fire protection including fire-resisting divisions and protection of openings and penetrations in these divisions,

.2 fire detection and fire alarm systems,

.3 gas detection and alarm systems, and

.4 systems and means of escape.

.2 Fire-fighting systems and appliances, portable gas detection means shall be kept in good working order and readily available for immediate use. Portable extinguishers which have been discharged shall be immediately recharged or replaced with an equivalent device.

1.6.4 Maintenance, testing and periodical inspections shall be performed in accordance with the *Fire Protection Systems' and Appliances' Maintenance Plan* developed in accordance with 1.5.2 and in a manner having due regard to ensuring the reliability of fire-fighting systems and appliances.

1.6.5 *Fire Protection Systems' and Appliances' Maintenance Plan* shall be kept on board the *unit* and be available for inspection whenever required by an authorized body.

2 STRUCTURAL FIRE PROTECTION

2.1 Requirements for Unit Construction

2.1.1 The requirements of this *Publication* apply to *units* having their hull superstructure, structural bulkheads, decks and deckhouses constructed of steel.

2.1.2 Exterior boundaries of superstructures and deckhouses enclosing accommodation and including any overhanging decks which support such accommodation which face the turret or process equipment deck area, shall be constructed of steel and insulated to A-60 standard for the whole of the portions which face the drilling derrick or deck with processing installations and on the outward sides for a distance of 3 m from the end boundary facing such a deck.

2.1.3 Windows and sidescuttles in external walls of superstructures which are required to meet A-60 standard[1)] which face the turret or process equipment deck area shall be:

.1 constructed to an A-60 standard; or
.2 protected by a water curtain; or
.3 fitted with shutters of steel or an equivalent material.

2.1.4 Windows and sidescuttles, with the exception of MCS and PCS windows, shall be of the non-opening type. PCS and MCS windows may be of the opening type provided the design of such windows permits rapid closure. Outside hazardous areas, windows and sidescuttles of the opening type are permitted.

2.2 Fire Integrity of Bulkheads and Decks

2.2.1 In addition to complying with the specific provisions for fire integrity of bulkheads and decks contained in sub-chapter 2.3, the minimum fire integrity of vertical divisions (bulkheads and partitions), separating adjacent spaces, shall be as specified in table 2.2-1, while for horizontal divisions (decks), as specified in table 2.2-2.

2.2.2 The following provisions shall govern application of the tables:

.1 if only one value is specified in the below tables for determining the fire integrity standard for the particular division separating adjacent spaces, such a value shall be applied in all cases;
.2 dash means that no special requirements apply to the material or fire integrity standard of the particular division;
.3 for determining the appropriate fire integrity standards to be applied to divisions between adjacent spaces, such spaces are broken down into categories according to their fire risk. The title of each category is intended to be typical rather than restrictive.

Spaces are broken down into the following 11 categories:

(1) **Control stations** – as defined in 1.2.
(2) **Corridors –** corridors and lobbies.
(3) **Accommodation spaces** – as defined in 1.2, excluding corridors, lavatories and pantries containing no cooking appliances.
(4) **Stairways** – interior stairways, lifts and escalators (other than those wholly contained within the machinery spaces) and enclosures thereto. In this connection a stairway which is enclosed only at one level shall be regarded as part of the space from which it is not separated by a fire door.
(5) **Service spaces** (**low fire risk**) – lockers, store-rooms and working spaces in which flammable materials are not stored, drying rooms and laundries.
(6) **Machinery spaces of category A** – as defined in 1.2.
(7) **Other machinery spaces** – as defined in 1.2, other than machinery spaces of category A.
(8) **Hazardous areas** – as defined in 1.2.

[1)] A-0 class bulkhead, protected by a water screen system, ensuring water delivery rate of 6 *l*/min per a square metre of exposed bulkhead surface, may be considered equivalent to A-60 standard. Intumescent coatings are acceptable as A class structure, provided they have low flame spread properties, low smoke development and low heat generation. Additionally, they shall be tested for fire gases toxicity.

(9) **Service spaces** (**high fire risk**) – lockers, store-rooms and working spaces in which flammable materials are stored, galleys, pantries containing cooking appliances, paint rooms and workshops other than those forming part of the machinery space, spaces for garbage collection and treatment.
(10) **Open decks** – open deck spaces, excluding hazardous areas.
(11) **Sanitary and similar spaces** – communal sanitary facilities such as showers, baths, lavatories, etc., and isolated pantries containing no cooking appliances. Sanitary facilities which serve a space and with access only from that space shall be considered a portion of the space in which they are located.

Table 2.2-1
Fire integrity of vertical divisions separating adjacent spaces

Spaces		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Control stations	(1)	A-0[d]	A-0	A-60	A-0	A-15	A-60	A-15	A-60	A-60	*	A-0
Corridors	(2)		C	B-0	B-0 A-0[b]	B-0	A-60	A-0	A-0	A-0	*	B-0
Accommodation spaces	(3)			C	B-0 A-0[b]	B-0	A-60	A-0	A-0	A-0	*	C
Stairways	(4)				B-0 A-0[b]	B-0 A-0[b]	A-60	A-0	A-0	A-0	*	B-0 A-0[b]
Service spaces (low fire risk)	(5)					C	A-60	A-0	A-0	A-0	*	B-0
Machinery spaces of category A	(6)						* [a]	A-0 [a]	A-60	A-60	*	A-0
Other machinery spaces	(7)							A-0[a][c]	A-0	A-0	*	A-0
Hazardous areas	(8)								–	A-0	–	A-0
Service spaces (high fire risk)	(9)									A-0[c]	*	A-0
Open decks	(10)										–	*
Sanitary and similar spaces	(11)											C

Table 2.2-2
Fire integrity of horizontal divisions separating adjacent spaces

Space above → Space below ↓		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Control stations	(1)	A-0	A-0	A-0	A-0	A-0	A-60	A-0	A-0	A-0	*	A-0
Corridors	(2)	A-0	*	*	A-0	*	A-60	A-0	A-0	A-0	*	*
Accommodation spaces	(3)	A-60	A-0	*	A-0	*	A-60	A-0	A-0	A-0	*	*
Stairways	(4)	A-0	A-0	A-0	*	A-0	A-60	A-0	A-0	A-0	*	A-0
Service spaces (low fire risk)	(5)	A-15	A-0	A-0	A-0	*	A-60	A-0	A-0	A-0	*	A-0
Machinery spaces of category A	(6)	A-60	A-60	A-60	A-60	A-60	* [a]	A-60	A-60	A-60	*	A-0
Other machinery spaces	(7)	A-15	A-0	A-0	A-0	A-0	A-0[a]	* [a]	A-0	A-0	*	A-0
Hazardous areas	(8)	A-60[e]	A-0[e]	A-0[e]	A-0[e]	A-0	A-60	A-0	–	A-0	–	A-0
Service spaces (high fire risk)	(9)	A-60	A-0	A-0	A-0	A-0	A-0	A-0	A-0	A-0[c]	*	A-0
Open decks	(10)	*	*	*	*	*	*	*	–	*	–	*
Sanitary and similar spaces	(11)	A-0	A-0	*	A-0	*	A-0	A-0	A-0	A-0	*	*

Notes to tables 2.2-1 and 2.2-2:

[a] Where the space contains an emergency power source or components of an emergency power source adjoining a space containing a ship's main power source or the components of a ship's service generator, the boundary bulkhead or deck between those spaces shall be an A-60 Class division.

[b] For clarification as to which note applies see paragraphs2.3.1 and 2.3.2.

[c] Where spaces are of the same numerical category, a bulkhead or deck of the rating shown in the tables is only required when the adjacent spaces are for a different purpose, e.g., in category (9), a galley next to an other galley does not require a bulkhead but a galley next to a paint room requires an A-0 bulkhead.

[d] Bulkheads separating the navigating bridge, chartroom and radio room from each other may be of B-0 rating.

[e] Engineering evaluation of fire hazard shall be conducted in accordance with paragraph 2.3.1.1. In no case shall the bulkhead or deck rating be less than the value indicated in the tables.

* the division shall be of steel or equivalent material, but need not be of A Class standard. However, where a deck is penetrated for the passage of electric cables, pipes and vent ducts, such penetrations shall be made tight to prevent the passage of flame and smoke.

2.2.3 Continuous B Class ceilings or linings in association with the relevant decks or bulkheads are permitted as contributing wholly or in part to the required insulation and integrity of a division.

2.2.4 In approving of fire structure components, there shall be considered the risk of heat transmission at intersections and terminal points of required thermal barriers. The insulation of a deck or bulkhead considered as A class fire divisions, shall be carried past the penetration, intersection or terminal point for a distance of at least 0,45 m in the case of steel and aluminium structures. If a space is divided with a deck or a bulkhead of A Class standard having insulation of different values, the insulation with the higher value shall continue on the deck or bulkhead with the insulation of the lesser value for a distance of at least 0,45 m.

2.2.5 The fire resistance of doors shall, as far as practicable, be equivalent to that of the division in which they are fitted. External doors in superstructures and deckhouses shall be constructed to at least A-0 Class standard and be self-closing, where practicable.

2.2.6 Doors required to be self-closing shall not be fitted with hold-back hooks. However, hold-back arrangements fitted with remote release hooks or other interlocking arrangements capable of automatic release in the event of remote release control failure or voltage decay, may be used.

2.3 Structure of Accommodation Spaces, Service Spaces and Control Stations

2.3.1 General

2.3.1.1 Accommodation spaces, service spaces and control stations shall not be located adjacent to hazardous areas. However, where this is not practicable, engineering evaluation of fire hazard/fire load analysis shall be performed to ensure that the level of fire protection and blast resistance of the bulkheads and decks separating these spaces from the hazardous areas are adequate for the likely hazard.

2.3.1.2 All bulkheads that are to be A Class divisions shall extend from deck to deck and to the deckhouse side or other boundaries.

2.3.1.3 All bulkheads forming B Class divisions shall extend from deck to deck and to the deckhouse side or other boundaries, unless continuous B Class ceilings or linings are fitted on both sides of the bulkhead, in which case the bulkhead may terminate at the continuous ceiling or lining.

2.3.1.4 In corridor bulkheads, ventilation openings are permitted only in and under the doors of cabins, public spaces, as well as in B class doors of lavatories, offices, pantries and lockers. The openings are permitted only in the lower half of the door. The total net area of any such opening or openings shall not exceed 0.05 m^2. Such an opening shall be fitted with a grille made of non-combustible material. Such openings shall not be provided in a door in a division forming a stairway enclosure.

2.3.1.5 Stairways shall be made of steel or an equivalent material.

2.3.2 Divisions Enclosing Stairways and Lift Trunks

2.3.2.1 Stairways which penetrate only a single deck shall be protected at least at one level by A or B Class divisions with self-closing doors so as to limit the rapid spread of fire from one deck to another. Personnel lift trunks shall be protected by A Class divisions.

2.3.2.2 Stairways and lift trunks which penetrate more than a single deck shall be surrounded by A Class divisions and protected by self-closing doors at all levels.

2.3.3 Draught Stops

2.3.3.1 Draught stops are tight barriers designed to prevent the spread of smoke and flame as well as prevent the feed of fire by the air intake in the air spaces behind the ceiling and bulkhead linings which are normally concealed during the *unit* service.

2.3.3.2 Accommodation and service spaces, control stations and corridors, shall be divided by draught stops in horizontal air spaces arranged not more than 14 metres apart.

2.3.3.3 In the vertical direction, such draught stops within stairways and lift trunks, shall be fitted at each deck level.

2.3.4 Ceilings and Linings

2.3.4.1 In accommodation and service spaces as well as control stations, all linings, ceilings, draught stops and their fixing shall be of non-combustible materials.

2.3.4.2 The framing of doors, including grounds and the joint pieces of bulkheads, shall be of non-combustible material.

2.4 Unit Outfitting Materials

2.4.1 Application of Non-combustible Materials

2.4.1.1 Insulating Materials and Details of Construction

Except for insulation in refrigerated compartments (provision stores), insulation materials of walls, floors and ceilings and of pipes and vent ducts passing the *unit* spaces shall be of non-combustible material.

Insulation of pipe fittings for cold service systems (refrigerating pipelines and cooling water pipes of air-conditioning systems) and vapour barriers and adhesives used in conjunction with insulation need not be non-combustible but they shall be kept to a minimum and their exposed surfaces shall have low-flame spread properties[1)].

In spaces where penetration of oil products is possible, the surfaces of the insulation shall be impervious to oil or oil vapours. Fire insulation in such spaces may be faced by metal sheets (not perforated) or glass-laminated plastic accurately sealed at joints.

Materials containing asbestos are not permitted to be used for insulation or details of construction, see circular MSC.1/Circ.1374.

Materials used for insulation or insulated details of construction such as ceiling panels, floor panels, wall plates, fire doors, etc. shall be delivered by the manufacturer together with the declaration that they are asbestos-free, taking account of the provisions of Annex 6 to *2015 Guidelines for Development of Inventory of Hazardous Materials* (IMO Resolution MEPC.269(68)).

2.4.2 Application of Combustible Materials

2.4.2.1 General

Non-combustible bulkheads, ceilings and linings fitted in accommodation and service spaces and in control stations may be faced with combustible materials, facings, mouldings, decorations and veneers, provided such spaces are bounded by non-combustible bulkheads, ceilings and linings in accordance with the provisions of paragraphs 2.4.2.2 to 2.4.2.4.

2.4.2.2 Maximum Calorific Value of Combustible Materials

Combustible materials used on the surfaces and linings specified in 2.2.2.1 shall have a calorific value[2)] Q not exceeding 45 MJ/m^2 of the area for the thickness used. This requirement does not apply to the surfaces of furniture fixed to linings or bulkheads.

The materials used for the facing of bulkheads, ceilings and linings shall be provided with the test certificate issued by an approved laboratory to confirm their calorific value.

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1) Refer to the *Recommendations on Improved Fire Procedures for Surface Flammability of Bulkhead, Ceiling and Deck Finish Materials* adopted by IMO Resolution A.653(16), in conjunction with the *Guidelines on Evaluation of Fire Hazard Properties of Materials* adopted by IMO Resolution A.166(ES.IV) as well as Annex 1 to Part 1 of the *International Code for Application of Fire Test Procedures (FTP Code).*

2) Refer to *PN-EN ISO 1716:2001 – Reaction to fire tests for building products – Determination of calorific potential*

2.4.2.3 Total Volumetric Capacity of Combustible Materials for Surface Facing

Where combustible materials are used for the facing of bulkheads, ceilings and linings in accordance with z 2.4.2.1, their volumetric capacity shall be limited as follows:

.1 the total volume of combustible facings, mouldings, decorations and veneers in accommodation and service spaces shall not exceed a volume equivalent to 2.5 mm veneer on the combined area of the walls and ceiling linings within any space other than corridors, stairway enclosures and control stations where the thickness shall not exceed 1.5 mm;

.2 in the case of *units* fitted with an automatic sprinkler system, the above volume may include some combustible material used for erection of C Class divisions.

2.4.2.4 Materials for Exposed Surface Facings in Enclosed Spaces

Materials used for facings of the following exposed surfaces shall have low flame-spread characteristics confirmed by tests performed in accordance with Part 5 of Annex 1 to the *FTP Code*:

.1 exposed surfaces in corridors and stairway enclosures;

.2 exposed surfaces of ceilings in accommodation and service spaces (saunas excluded) and control stations;

.3 surfaces and grounds in concealed or inaccessible spaces in accommodation and service spaces and control stations.

Materials used for facings in cabins, service spaces, public spaces and control stations need not have low flame-spread characteristics.

2.4.2.5 Paints, Varnishes and other Finishes

Paints, varnishes and other finishes used on exposed interior surfaces of accommodation, service spaces, control stations and in stairway enclosures shall not be capable of producing excessive quantities of smoke and toxic products, this being determined in accordance with Part 2 of Annex 1 to the *FTP Code*.

2.4.2.6 Primary Deck Coverings

Primary deck coverings, if applied within accommodation and service spaces and control stations, shall be of approved material which will neither readily ignite at an elevated temperature nor produce excessive quantities of smoke and toxic products nor pose the explosion hazard this being determined in accordance with Part 6 of Annex 1 to the *FTP Code*.

2.4.3 Waste Receptacles

Waste receptacles shall be constructed of non-combustible materials with closures and no openings in the sides or bottom.

Waste receptacles made of combustible materials are permitted in galleys, pantries, bars, spaces containing devices for garbage collection and processing as well as garbage incinerators, provided such receptacles are designed solely for the storage of wet wastes, glass bottles and cans and they are marked respectively.

2.5 Machinery Spaces

2.5.1 Machinery spaces shall be bounded by A Class steel bulkheads and decks of fire integrity required for fire divisions of the adjoining spaces. Penetrations for the passage of electric cables, pipes or vent ducts shall have fire integrity not less than A-0.

2.5.2 Floor panels normally used for walkways in machinery spaces shall be made of steel.

2.5.3 Materials used for floors, bulkhead, ceiling or deck facings in the machinery spaces and control stations shall be non-combustible. In spaces where penetration of oil products into the insulant structure is possible, the surfaces of such insulants shall be provided with a respective protective coating.

2.5.4 Doors installed in the divisions bounding machinery spaces shall be gastight and self-closing.

2.6 Paint Lockers and Flammable Liquid Lockers

2.6.1 Paint lockers and flammable liquid lockers shall be located away from accommodation spaces and such lockers shall be accessible from the open deck.

2.6.2 Paint lockers and flammable liquid lockers shall be classified as spaces of category (9) – service spaces (high fire risk). Bulkheads and decks bounding such lockers shall be made of steel and shall form A Class divisions having fire integrity as required for fire divisions depending on the category of the adjoining spaces.

2.6.3 Exits from the lockers shall have a direct access to the open deck or through the corridor or stairway specially designed for that purpose.

2.7 Welding Shops

2.7.1 Welding shops situated outside the machinery spaces shall be classified as spaces of category (9) – service spaces (high fire risk). Bulkheads and decks bounding such shops shall be made of steel and shall form A Class divisions having fire integrity as required for fire divisions depending on the category of the adjoining spaces.

2.7.2 Exits from the shops shall have a direct access to the open deck.

2.8 Galleys

2.8.1 Bulkheads and decks bounding galleys shall form A Class divisions having fire integrity as required for service spaces of high fire risk in accordance with the tables contained in sub-chapter 2.2 depending on the category of the adjoining spaces. Access doors shall be self-closing.
2.8.2 Floors, wall linings and false ceilings shall be made of non-combustible materials.

2.9 Ventilation Systems

2.9.1 Ventilation Ducts

2.9.1.1 Ventilation ducts, including ducts with single or double walls, shall be made of steel or steel equivalent material, except short flexible bellows of length not exceeding 600 mm, used for connecting ventilators to the ducts in air conditioning spaces. All other materials used in ducts structure, including insulation, except as given in 2.9.1.8, shall also be non-combustible. However, short ducts, not generally exceeding 2 m in length and with a free cross-sectional area not exceeding 0.02 m^2, need not be made of steel or equivalent material subject to the following conditions:

- **.1** the ducts are made of non-combustible material, which may be faced internally and externally with coatings having low flame-spread characteristics and, in each case, a calorific value not exceeding 45 MJ/m^2 of their surface area for the thickness used;
- **.2** the ducts are only used at the end of the ventilation device; and
- **.3** the ducts are not situated less than 600 mm, measured along the duct, from an opening in an A or B Class division including continuous B Class ceiling.

2.9.1.2 The ducts passing through A Class bulkheads shall comply with the below requirements:

- **.1** Where a thin plated duct with a free cross-sectional area equal to, or less than, 0.02 m^2 passes through A Class bulkhead or deck, the opening shall be lined with a steel sheet sleeve having a thickness of at least 3 mm and a length of at least 0.2 m, divided preferably into 0.1 m on each side of the bulkhead or, in the case of the deck, wholly laid on the lower side of the deck pierced.
- **.2** Where a duct with a cross-sectional area above 0.02 m^2 but equal or less than 0.075 m^2 passes through A Class bulkhead, the opening shall be lined with a steel sheet sleeve. The ducts or sleeves shall have a thickness of at least 3 mm and a length of at least 0.9 m. When passing through bulkheads, this length shall be divided preferably into 0.45 m on each side of the bulkhead. These ducts, or sleeves lining such ducts, shall be provided with fire insulation. The insulation shall have at least the same fire integrity as the bulkhead or deck through which the duct passes; and

.3 ducts with a cross-sectional area exceeding 0.075 m^2, passing through A Class bulkheads, shall be fitted with automatic fire dampers. Each fire damper shall be installed close to the bulkhead penetrated by the duct, and the duct between the damper and the bulkhead shall be made of steel, in accordance with the requirements of 2.9.1.3.5 and 2.9.1.3.6. The fire damper shall operate automatically but shall also be capable of being closed manually from both sides of the bulkhead. The damper shall be provided with an indicator which shows whether the damper is open or closed. Fire dampers are not required, however, where ducts pass through spaces surrounded by A Class divisions, without serving those spaces, provided those ducts have the same fire integrity as the divisions which they pierce. In order to avoid installing fire damper required where the cross-sectional area of the duct exceeds 0.075 m^2, the duct may not be divided into shorter lengths passing the A Class bulkhead and reconnected into original duct after the bulkhead.

2.9.1.3 In general, ventilation systems for machinery spaces of category A, galleys and hazardous areas shall be separated from each other and from the ventilation systems serving other spaces. Ducts serving hazardous areas shall not pass through accommodation spaces, service spaces, or control stations. Ducts provided for the ventilation of machinery spaces of category A and galleys shall not pass through accommodation spaces, control stations or service spaces unless:

.1 the ducts are constructed of steel having a thickness of at least 3 mm for ducts the free cross-sectional area of which is less than 0.075 m^2, at least 4 mm for ducts with free cross-sectional area between 0.075 m^2 and 0.045 m^2, and at least 5 mm for ducts with free cross-sectional area above 0.045 m^2;
.2 the ducts are suitably supported and stiffened;
.3 the ducts are fitted with automatic fire dampers close to the boundaries penetrated; and
.4 the ducts from the machinery spaces or galleys are insulated to A-60 Class standard to a point at least 5 m beyond each fire damper; or
.5 the ducts are constructed of steel in accordance with sub-paragraphs .1 and .2 above; and
.6 the ducts are insulated to A-60 Class standard throughout the accommodation spaces, service spaces or control stations.

2.9.1.4 Ducts provided for the ventilation of accommodation spaces, service spaces or control stations shall not pass through machinery spaces of category A, galleys or hazardous areas, unless the following criteria are fulfilled:

.1 the ducts where they pass through a machinery space of category A or a galley are constructed of steel in accordance with paragraphs 2.9.1.3.1 and 2.9.1.3.2;
.2 automatic fire dampers are fitted close to the boundaries penetrated; and
.3 the integrity of the machinery space or galley boundaries is maintained at the penetrations; or
.4 the ducts where they pass through a machinery space of category A or a galley are constructed of steel in accordance with paragraphs 2.9.1.3.1 and 2.9.1.3.2; and
.5 the ducts are insulated to A-60 standard within the machinery space or galley.

2.9.1.5 Ventilation ducts with a cross-sectional area exceeding 0.02 m^2 passing through B class bulkheads shall be lined with steel sheet sleeves of 0.9 mm in length divided into 0.45 m on each side of the bulkhead unless the duct is of steel for this length.

2.9.1.6 Where they pass through accommodation spaces or spaces containing combustible materials, the exhaust ducts from galley ranges shall have structure complying with the requirements of 2.9.1.3.1 and 2.9.3.1.2.

2.9.1.7 Each galley exhaust duct shall be fitted with:

.1 a grease trap readily removable for cleaning;
.2 a fire damper located in the lower end of the duct, at the connection between the duct and the galley fume collection hood, which is automatically and remotely operated and, in addition, a remotely operated fire damper located at the upper end of the duct, close to its outlet;
.3 arrangements, operable from within the galley, for shutting off the exhaust and air supply fans; and
.4 fixed means for extinguishing a fire within the duct[1)].

[1)] Refer to Publication ISO 15371:2009: Ships and marine technology - Fire-extinguishing systems for protection of galley cooking equipment.

2.9.1.8 Fire dampers shall be easily accessible. If they are placed beyond the ceiling or lining, the ceilings or linings shall have inspection openings provided with plates indicating fire damper identification number. The number shall also be placed on each remote control device.

2.9.1.9 The ventilation ducts shall be equipped with clearing holes for inspection and internal cleaning of the duct. The holes shall be located in the vicinity of fire dampers.

2.9.1.10 Gaskets made from combustible materials in flange connections are not allowed within 600 m from the openings in „A" or „B" Class bulkheads and in ducts, where „A" Class structure is required.

2.9.1.11 For the purpose of paragraphs 2.9.1.3.4 and 2.9.1.3.6, the ducts shall be insulated throughout the whole external surface. Ducts located beyond the space but in contact therewith by at least one surface shall be treated as passing through the space and insulated on the contact surface and beyond it at the length of 450 mm[1)].

2.9.1.12 All the fire dampers shall be capable of being manually operated. The dampers shall be capable of being directly power released or, alternatively, shall be electrically, hydraulically or pneumatically closed. All the dampers shall be accessible and manually operated from both sides of the bulkhead. Automatic fire dampers, including those capable of being remotely operated, shall have a safety device closing the damper in case of fire, even at the loss of power or reduction of hydraulic or pneumatic pressure. Remotely controlled fire dampers shall be capable of being reopened manually at place and optionally reopened remotely.

2.9.2 Ventilation Inlets and Outlets

2.9.2.1 The main inlets and outlets of all ventilation systems shall be capable of being closed from outside the spaces being ventilated. The closing devices shall be easily accessible, durably and permanently marked and their open-closed position shall be indicated.

2.9.2.2 The ventilation inlets of the accommodation spaces and control stations shall be so arranged as to prevent the ingress of flammable, toxic or noxious gases or smoke from surrounding areas.

2.9.2.3 Power ventilation of accommodation spaces, service spaces, control stations, machinery spaces and hazardous areas shall be capable of being stopped from an easily accessible position outside the space being served. The accessibility of this position in the event of fire in the spaces served shall be specially considered. The means provided for stopping the power ventilation serving machinery spaces or hazardous areas shall be entirely separate from the means provided for stopping ventilation of other spaces.

2.9.3 Spaces for Ventilators serving Machinery Spaces of Category A with Internal Combustion Engines

2.9.3.1 If there is no fire division between the ventilator space and machinery space with internal combustion engines, served by the ventilator space, then closing appliances of ventilating ducts or ducts serving the machinery space shall be located beyond both spaces.

2.9.3.2 If there is A-0 Class fire division between ventilator space and such machinery space or other space served by the ventilator space, including the passages, then the closing appliances of ventilating ducts or ducts serving the machinery space may be located in the ventilator space.

2.10 Means of Escape

2.10.1 General

2.10.1.1 The means of escape shall ensure that persons onboard can leave rooms/spaces and safely and swiftly escape to the lifeboat and liferaft embarkation deck. Such a deck shall be accessible from other open decks which are parts of the means of escape.

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1) Sketches of the insulation arrangements have been given in Interpretations to SOLAS Convention, Chapter II-2 (MSC.1/Circ.1276).

2.10.1.2 All normally attended areas of the unit shall be provided with at least two exits and escape routes located as far apart from each other as practicable so that at least one exit and the associated escape route be available in case of hazard. The means of escape shall be provided on both sides of the unit.

2.10.1.3 Escape routes shall be wide enough to enable the safe and swift passage of the maximum number of persons assumed to use such means of escape and also to enable easy passage of fire-fighting equipment and stretcher carrying. Typical main route of escape shall be at least 1 m in width while the secondary route of escape – 0.7 m.

The main escape routes and passages, including a sill, shall be not less than 2.2 m high, while the secondary escape routes – not less than 2.0 m high. In exceptional cases they may be, however, not less than 1.9 m of height.

2.10.1.4 The surfaces of decks, passages, landings, stairs, ladder rungs, etc. shall be non-slip and they shall facilitate water drainage as well as disposal of mud, oil and other impurities.

2.10.1.5 Means of escape are intended to enable the escape from and also access to spaces. Closing appliances of doors shall be so designed that they do not impede the achievement of these aims and that any doors included in the means of escape be capable of being open from both sides.

2.10.1.6 Lifts are not considered as forming one of the means of escape.

2.10.1.7 At least one escape route protected, as far as practicable, against radiation effects of fire shall be provided at the drill floor to allow ready means of escape to the open deck and superstructure stairways leading to the embarkation position and survival craft.

2.10.1.8 In working spaces, at least one escape route protected against radiation effects of fire shall be provided to allow ready means of escape to the open decks and embarkation positions and survival craft.

2.10.2 Means of Escape within Accommodation Spaces, Service Spaces and Control Stations

2.10.2.1 In every general area which is likely to be regularly manned or in which personnel are accommodated, at least two separate escape routes shall be provided, situated as far apart as practicable, to allow ready means of escape to the open decks and embarkation stations. Exceptionally, only one means of escape may be permitted, due regard being paid to the nature and location of spaces and to the number of persons who might normally be accommodated or employed there.

2.10.2.2 Stairways shall normally be used for means of vertical escape; however, a vertical ladder may be used for one of the means of escape when the installation of a stairway is shown to be impracticable.

2.10.2.3 Every escape route shall be readily accessible and unobstructed and all exit doors along the route shall be readily operable. Dead-end corridors exceeding 7 m in length are not permitted.

2.10.2.4 Stairways and corridors used as means of escape shall not be less than 0.7 m in clear width and shall have a handrail on one side. Stairways and corridors with a clear width of 1.8 m and over shall have handrails on both sides.

"Clear width" is considered the distance between the handrail and the bulkhead on the other side or between the handrails. The angle of inclination of stairways shall be, in general, 45°. In justified cases that angle may be increased to 50° and in machinery spaces and small spaces – up to 60°.

Doorways which give access to a stairway shall be of the same size as the stairway.

2.10.2.5 All stairways in accommodation and service spaces and control stations shall have frame construction of steel or other equivalent material.

2.10.2.6 In addition to the emergency lighting, the means of escape in accommodation areas, including stairways and exits, shall be marked by low- location lighting or photoluminescent strip indicators placed not more than 0.3 m above the deck at all points of the escape route, including angles and intersections. The marking shall enable personnel to identify the routes of escape and readily identify the escape exits. If electric illumination is used, it shall be supplied by the emergency source of power and it shall be so arranged that the failure of any single light or cut in a lighting strip will not result in the marking being ineffective. Additionally, escape route signs and fire equipment location markings shall be of photoluminescent material or marked by lighting. Such lighting or photoluminescent equipment shall be evaluated, tested and applied in accordance with the *FSS Code*.

2.10.2.7 External routes of escape from accommodation spaces to embarkation positions and survival craft shall be protected by water curtain in accordance with the requirements specified in 3.4.

2.10.3 Means of Escape from Machinery Spaces

2.10.3.1 Two means of escape shall be provided from each machinery space of category A. In particular, one of the following provisions shall be complied with:

- **.1** two sets of steel stairways or ladders, as widely separated as possible, leading to doors in the upper part of the space, similarly separated and from which access is provided to the open deck. One of these ladders or stairways shall be located within a protected enclosure that satisfies the requirements of 2.2.2 for stairways of category (4), from the lower part of the space it serves to a safe position outside the space. Self-closing fire doors of the same fire integrity standards shall be fitted in the enclosure. The ladder or stairway shall be so fixed that heat is not transferred into the enclosure through non-insulated fixing points. The enclosure shall have minimum internal dimensions of at least 0.8 m by 0.8 m, and the ladder may be situated in such enclosure. In the enclosure emergency lighting shall be provided; or
- **.2** one steel stairway or ladder leading to a door in the upper part of the machinery space from which access is provided to the open deck. Additionally, in the lower part of the space, in a position well separated from the ladder or stairway referred to, a steel door capable of being operated from each side shall be provided with access to a safe escape route from the lower part of the space to the open deck.

2.10.3.2 Stairways and ladders shall be constructed of steel or other equivalent material.

2.10.3.3 All inclined ladders/stairways with open steps in machinery spaces, which are a part or access to escape routes which are not located within a protected enclosure, shall be provided from below with a steel shelter from heat and fire.

2.10.3.4 All stairways and inclined escape ladders which are not located within a continuous fire enclosure shall be provided from below with a steel shelter from heat and fire.

2.10.3.5 From machinery spaces other than those of category A, two escape routes shall be provided except that a single escape route may be accepted for spaces that are entered only occasionally, and for spaces where the maximum travel distance to the door is 5 m or less.

3 FIRE-EXTINGUISHING SYSTEMS

Fire-extinguishing systems are intended for the extinguishing of fire in the enclosed unit spaces or on the open deck.

3.1 General

3.1.1 All fire-extinguishing systems shall be so constructed that during the normal service they are capable of being used immediately and ensure their reliable operation during the unit service.

3.1.2 Pumps other than fire main pumps necessary for the water supply to the fire-extinguishing systems required in this *Part*, their sources of power and controls shall be located outside the spaces protected by such systems and shall be so situated that a fire in the protected spaces will not render those systems ineffective.

3.1.3 The use of a fire-extinguishing medium which either by itself or under expected conditions of use gives off toxic gases, liquids and other substances in such quantities as to endanger persons and environment is not permitted.

3.1.4 In fire-extinguishing systems metal piping shall be used, except for aluminium pipes, of the respective minimum melting point required for the particular system. Steel pipes, except for those made of stainless steel, shall be protected against corrosion, preferably both internally and externally by galvanizing.

3.1.5 Permanently pressurized water piping which run outside the enclosed spaces or in not heated spaces shall be so arranged or protected as to preclude the possibility of freezing at minus temperatures.

3.1.6 Manual actuation of fire extinguishing systems shall be possible from the position outside the space protected by the particular system. The position shall be so situated that the personnel operating such a system is not exposed to thermal effects of the fire.

3.1.7 Fire extinguishing systems shall be so designed that their testing does not render them ineffective.

3.2 Water Fire Main System

3.2.1 General

3.2.1.1 The system shall consist of fire pumps, water supply piping, hydrant valves and fire hoses with nozzles so arranged that a fire in any location can be extinguished effectively.

3.2.1.2 The system shall be provided with at least one international type shore connection in accordance with requirements of the *FSS Code* to enable such a connection to be used on an y side of the unit.

3.2.2 Fire Pumps

3.2.2.1 At least two independently driven fire pumps shall be provided, each arranged to draw directly from the sea and discharge into a fixed fire main.

At least two sea suctions (sea valves, fittings, filters and suction pipes) shall be provided and so arranged that a failure of any means would not put all sea suctions out of action.

3.2.2.2 One of the fire pumps shall be considered as an emergency pump which shall be supplied from an emergency source of power or by an independent engine.

3.2.2.3 In fire main systems of high *units*, intermediate tanks are permitted. Such tanks shall have such a capacity and shall be so filled that at the lowest allowable water level the water supply of two fire houses be ensured from the uppermost hydrants at the pressure not less than 0.35 MPa for at least 15 min. The capacity of such tanks shall not be less than 40 m^3.

In the fire main systems with intermediate tanks the following shall be included:

– alarm system giving warning on the low level of water,
– two water replenishment pumps, one of which shall start automatically when the water level reaches the pre-set low level.

The system and intermediate tanks shall be effectively protected against freezing.

3.2.2.4 Fire pumps may be used for other purposes provided that one of them is dedicated for fire-fighting duties and be available for such duties at all times.

3.2.2.5 The pumps, their source of power, suctions and piping and valves shall be so arranged that a fire in any one compartment will not put all fire pumps out of action.

3.2.2.6 The capacity of the required pumps shall be appropriate to the fire-fighting services supplied from the fire main.

3.2.2.7 Each pump shall be capable of delivering at least one jet simultaneously from each of any two fire hydrants, hoses and 19 mm nozzles while maintaining a minimum pressure of 0.35 MPa at any hydrant. In addition, where a foam system is provided for the protection of helideck, the pump shall be capable of maintaining a pressure of 0.7 MPa at the foam installation. If the water consumption for any other fire protection or fire-fighting purpose exceeds the rate of the helideck foam installation, this consumption shall be the determining factor in calculating the required capacity of the fire pumps.

3.2.2.8 Where either of the required pumps is located in a space not normally manned or is relatively far removed from working areas, suitable provision shall be made for remote start-up of that pump and remote operation of associated suction and discharge valves.

3.2.2.9 Sanitary, ballast, bilge or general service pumps may be accepted as fire pumps, provided that they are not normally used for pumping oil products and other flammable liquids.

3.2.2.10 Every fire pump shall be fitted with shut-off valves on both suction and discharge sides as well as a pressure gauge. In the case of centrifugal pumps, not-return valves shall also be fitted to prevent the reverse flow of water.

3.2.2.11 Relief valves shall be provided in conjunction with all pumps connected to the fire main if the pumps are capable of developing a pressure exceeding the nominal pressure of the fire main. Such valves shall be so situated and adjusted as to prevent excessive pressure in no part of the fire main.

3.2.2.12 Fire pumps shall be operable from the position at each pump as well as from the PCS and MCS. In the starting position, pump operation indicator shall be provided (e.g. pressure gauge or indicator lamp).

3.2.3 Diesel Engine and Fuel Tank of Fire Pump

3.2.3.1 Fire pump which is considered as an emergency pump can be driven solely by a diesel engine. Any diesel driven power source for the pump shall be capable of being readily started in its cold condition down to the temperature of 0°C by hand (manual) cranking. Where this is impracticable, or if lower temperatures are likely to be encountered, or if the space with the driving engine is not heated, electric heating of the engine cooling water or lubricating oil system shall be provided. Where hand (manual) starting is impracticable, compressed air, electric power or other accumulated energy sources, including hydraulic energy or starting charges, are permitted. These means shall be such as to enable the diesel driven power source to be started at least six times within a period of 30 min and at least twice within the first 10 min.

3.2.3.2 In the machinery space containing the pump, there shall also be situated service fuel tank containing sufficient fuel to enable the pump to run on a full load for at least one hour.

3.2.3.3 Air inlet for the engine operation shall be independent of ventilation serving the space containing such an engine.

3.2.4 Fire Mains and Hydrants

3.2.4.1 The diameter of the fire main and water service pipes shall be sufficient for the effective distribution of the maximum required discharge from the required fire pumps operating simultaneously.

3.2.4.2 With the required fire pumps operating simultaneously, the pressure maintained in the fire mains shall be adequate for the safe and efficient operation of all equipment supplied therefrom.

3.2.4.3 The fire main shall, where practicable, be routed clear of hazardous areas and be so arranged as to make maximum use of any thermal shielding or physical protection afforded by the structure of the unit.

3.2.4.4 The fire main shall be provided with isolating valves so located as to permit optimum utilization in the event of physical damage to any part of the main.

The isolating valves shall be located in readily accessible positions and clearly marked. If such valves are remote-operated, they shall also be operable manually.

3.2.4.5 The fire main shall not have connections other than those necessary for fire-fighting purposes.

3.2.4.6 All practical precautions consistent with having water readily available shall be taken to protect the fire main against freezing.

3.2.4.7 Materials readily rendered ineffective by heat shall not be used for fire mains and hydrants unless adequately protected. The pipes and hydrants shall be so placed that the fire hoses may be easily coupled to them.

3.2.4.8 Hydrants shall be made of a material resistant to corrosion in sea environment. A coupling, complying with the requirements of national standards, or an isolating valve shall be fitted, to serve each fire hose so that any fire hose may be removed while the fire pumps are operating.

3.2.4.9 The number and position of the hydrants shall be such that at least two jets of water, not emanating from the same hydrant, one of which shall be from a single length of fire hose, may reach any part of the unit normally accessible to those on board while the unit is being navigated or is engaged in drilling operations. Each hydrant shall be provided with a fire hose.

3.2.4.10 Fire mains shall be provided with drain cocks fitted at the lowermost positions.

3.2.5 Fire Hoses and Nozzles

3.2.5.1 Fire hoses shall be made in accordance with the requirements of national standards and be sufficient in length to project a jet of water to any of the spaces in which they may be required to be used. Every fire hose shall be provided with a dual-purpose nozzle and the necessary couplings. Fire hoses, together with any necessary fittings and tools, shall be ready for use at any time and shall be kept in conspicuous positions near the water service hydrants or connections.

3.2.5.2 Fire hoses shall have a length of at least 10 m, but not more than:

.1 15 m in machinery spaces;

.2 20 m in other spaces and open decks; and

.3 25 m for open decks with a maximum breadth in excess of 30 m.

3.2.5.3 Nozzles shall be of dual purpose type (spray/jet type) and comply ith the following:

.1 standard nozzle sizes shall be 12 mm, 16 mm and 19 mm or as near thereto as possible. In justified cases larger diameter nozzles may be used;

.2 for accommodation and service spaces, a nozzle size greater than 12 mm need not be used; and

.3 for machinery spaces and exterior locations, the nozzle size shall be such as to obtain the maximum discharge possible from two jets at the pressure specified in paragraph 3.2.2.7 from the lowest capacity pump, provided that a nozzle size greater than 19 mm shall not be used.

3.2.5.4 In accommodation spaces, fire hoses (reel type) with nozzles shall be stored in fire hydrant boxes and connected to the hydrants at all times.

3.3 Water Spray Systems

3.3.1 Water spray system shall consist of water pump, water supply pipes and water distribution pipes which may be divided into sections with section shut-off valves and spray nozzles.

3.3.2 The pump capacity and discharge pressure shall be determined based on the required water output taking account of the characteristics and number of spray nozzles installed in the largest protected space/area.

3.3.3 The water discharge rate shall be assumed as follows:

1. 20 *l*/min per 1 m^2 of floor area – for the systems intended for the protection of wellhead or turret areas;

2. 20 *l*/min per 1 m^2 of floor area – for the systems intended for the protection of hydrocarbons' transport and processing facilities, pumps as well as compressors of the process medium;

3. 10 *l*/min per 1 m^2 of floor area – for the systems intended for the protection of production or processing systems, mud storage tanks and mud cleaning systems, as well as the facilities used for gas processing.

3.3.4 The water pressure in the system shall ensure an effective distribution of dispersed water in the protected space/ area.

3.3.5 The spraying nozzles shall be so arranged as to provide an uniform distribution of dispersed water in the protected space/area.

3.3.6 The system shall be provided with filters preventing the nozzles from becoming clogged by impurities in sea water or pipe corrosion chips.

3.3.7 Pipelines shall be led with a slope and shall be capable of being drained.

3.3.8 Shut-off (section) valves shall be fitted in safe and easily available places, which will not be cut off by a fire, or will be capable of being remotely controlled from the *unit* MCS.

3.3.9 Water supply pump activation points, system operation indicators (pressure reading/pump operation indicator) shall be provided in MCS or PCS.

3.4 Water Screen System

3.4.1 The water screen system is intended to be used in the following cases:

.1 for the protection/drenching walls of superstructure housing accommodation spaces;

.2 for the protection of external escape routes and *unit* assembly stations.

3.4.2 The water discharge rate of the water screen system shall be taken as follows:

.1 10 *l*/min per a square metre of vertical walls of superstructures housing accommodation spaces;

.2 4 *l*/min per a square metre of horizontal walls of superstructures housing accommodation spaces;

.3 15 *l*/min per a square metre of external escape routes and unit assembly stations;

.4 45 *l*/min per a running metre of wall of external escape routes and unit assembly stations.

3.4.3 The water screen system may be supplied from the water fire main system or from separate water supply pump.

3.4.4 The water screen system may be divided into sections by shut-off (section) valves which shall be fitted in safe and easily available places, which will not be cut off by a fire, or will be capable of being remotely controlled from the *unit* MCS.

3.4.5 Supply water pump activation points, system operation indicators (pressure reading/pump operation indicator) shall be provided in the MCS.

3.5 Fixed Deck Foam Fire-Extinguishing System

3.5.1 General

3.5.1.1 Fixed deck foam system shall consist of foam concentrate storage tank, water supply pump, foam concentrate pump and proportioner, water and foam concentrate distribution pipes, foam monitors and manual foam applicators.

The deck foam systems shall be designed for low-expansion foam. The low-expansion foam is a foam of expansion ratio up to 20 (generally about 10).

3.5.1.2 The foam generating arrangements shall be capable of delivering foam to the entire process systems deck area.

3.5.1.3 The fixed deck foam system shall be capable of simple and quick operation.

3.5.1.4 The deck foam system and the water fire main system can be supplied from the common line. However, operation of the deck foam system at its required output shall permit the simultaneous use of the minimum required jets of water at the required pressure from the fire main. A common line for the water fire main system and deck foam system can only be accepted if it can be demonstrated that the hose nozzles can be effectively controlled by one person when supplied from the common line at a pressure needed for operation of the monitors (not excessive).

3.5.1.5 The MCS for the system shall be suitably located outside the process system deck, in the vicinity of the accommodation spaces and shall be readily accessible and operable in the event of fire in the areas protected.

3.5.1.6 The major foam system equipment, such as the foam concentrate tanks and pumps shall be located outside the process system deck but may be located in the machinery space.

3.5.1.7 Means shall be provided for the personnel to safely check the quantity of foam concentrate in the tanks and taking the foam concentrate samples for the periodical checking of its quality. The minimum level/required quantity of foam concentrate shall be marked on the tank.

3.5.2 Foam Concentrate Requirements

3.5.2.1 Foam concentrate used in the foam fire-extinguishing system shall be type-approved in accordance with MSC/Circ. 1312/Corr.1 and shall be suitable for extinguishing the crude oil and its products.

3.5.2.2 The rate of supply of foam concentrate solution shall not be less than 0.6 *l*/min per a square metre of a deck where a fire of spilled oil fuel may occur, and not less than 6 *l*/min per a square metre of a deck with process systems.

3.5.2.3 Quantity of foam concentrate shall be sufficient to ensure foam generation for at least 15 min.

3.5.3 Monitors and Foam Applicators

3.5.3.1 Foam from the fixed deck foam system shall be delivered by means of monitors and manual foam applicators.

3.5.3.2 The number and position of monitors shall be such as to comply with the requirements specified in 3.5.1.2.

3.5.3.3 The distance from the monitor to the farthest extremity of the protected area forward of that monitor shall not be more than 75 % of the monitor throw in still air conditions.

3.5.3.4 The monitors and hose connections for a foam applicators shall be situated both port and starboard, at the front of, or above, the poop facing the process equipment deck.

3.5.3.5 Manual foam applicators shall be provided to ensure efficiency of fire fighting operations and to cover areas screened from the monitors.

3.5.3.6 The capacity of any applicator shall not be less than 400 *l*/min and the applicator throw in still air conditions shall not be less than 15 m.

3.5.3.7 Each *unit* shall be provided with at least four foam applicators. The number and arrangement of hose connections to foam concentrate pipeline shall be such that foam from at least two applicators can be directed onto any part of the process equipment deck area.

3.5.4 Isolating Valves

Valves shall be provided in the foam concentrate main and in the water fire main when this is an integral part of the deck foam system, immediately forward of any monitor position, to isolate damaged sections of those mains.

3.6 Fixed Gas Fire-Extinguishing Systems

3.6.1 General Requirements

3.6.1.1 Where the fire-extinguishing medium is required to protect more than one space, the quantity of medium available need not be more than the largest quantity required for any one space so protected, provided the spaces are separate.

3.6.1.2 Fixed gas fire-extinguishing system shall consist of container(s) for the storage of the fire-extinguishing medium, connected to a manifold, of pipes fitted with nozzles, conveying the medium into the protected spaces, as well as control devices and warning signalization. The systems shall be fitted with control (distribution) valves, normally closed, so that to enable delivering the medium to appropriate protected space.

3.6.1.3 Where compressed air receivers (e.g. diesel engine starting air receivers) are installed in a gas system protected space, the volume of the receivers converted to free air volume shall be added to the gross volume of the space when calculating the necessary quantity of the fire-extinguishing medium. The air volume in receivers may be neglected if the receivers safety valves discharges are led directly to atmosphere.

3.6.1.4 Means shall be provided for the personnel to safely check the quantity of the fire-extinguishing medium in the containers, without the necessity to move the containers completely from their fixing position.

3.6.1.5 Pressure containers/cylinders for the storage of fire-extinguishing medium and associated pressure components shall be designed to the relevant national standards, having regard to their locations and maximum ambient temperatures expected in service. The maximum ambient temperature 55ºC, expected in service, is assumed.

3.6.1.6 The piping for the distribution of fire-extinguishing medium shall be so arranged and discharge nozzles so positioned as to ensure a uniform distribution of the medium in the protected space.

3.6.1.7 Unless expressly provided otherwise, pressure containers/cylinders for the storage of fire-extinguishing medium shall be located outside protected spaces, in special fire-extinguishing stations complying with the requirements specified in 3.6.2.

3.6.1.8 All openings in boundaries and decks of spaces protected by a fixed gas fire-extinguishing system, which may admit air to or allow gas to escape from the space shall be capable of being closed from outside of the protected space.

These openings, being regarded as ventilation openings, shall be indicated by means of plate with the symbol used on *Fire Control Plan*.

3.6.1.9 All discharge pipings[1)], fittings and nozzles in the protected spaces shall be constructed of materials having a melting temperature which exceeds 925ºC. Where pipings, fittings or nozzles are constructed of components/materials for which the melting temperature is not specified, such components/materials shall be furnished with a document confirming their melting temperature.

The piping and the associated equipment shall be reliably fixed to the structure of the space.

3.6.1.10 Pipes distributing fire-extinguishing medium into protected spaces shall be fitted with a stub-pipe for connecting compressed air used for the piping passage test.

[1)] Gaskets used in pipings connections in protected spaces need not be made of materials of melting temperature higher than 925°C.

3.6.1.11 The pipes for conveying fire-extinguishing medium may pass through accommodation spaces, provided that they are of sufficient thickness over their whole length within these spaces, are joined only be welding without drains or other openings and that their tightness is verified with a pressure test, after their installation, at a pressure head not less than 5 MPa. The pipes for conveying fire-extinguishing medium shall not pass through refrigerated spaces.

3.6.1.12 At each entrance/manhole to the space protected by the gas fire-extinguishing system, a respective warning plate shall be placed.

3.6.2 Fire-Extinguishing Stations

3.6.2.1 Fire-extinguishing stations are spaces intended for the storage of fire-extinguishing medium and fire-extinguishing system equipment.

3.6.2.2 Fire-extinguishing station shall be located outside protected spaces, in a safe place and easily accessible from personnel accommodation spaces.

3.6.2.3 The boundaries and decks separating fire-extinguishing station from adjacent spaces shall have the same fire integrity as required for the stations.

3.6.2.4 Fire-extinguishing stations shall not be used for any other purposes than the storage of fire-extinguishing medium and fire-extinguishing system operation.

3.6.2.5 Fire-extinguishing station shall also fulfil the following requirements:

- **.1** it shall be located on the open deck and have direct access from the open deck or shall be located directly below the open deck with access from the deck – by means of stairways or permanently fixed steel ladder. Entrance to the station shall be independent of the protected space;
- **.2** it shall be separated from adjacent spaces by gastight bulkheads and decks. All means of closing any openings therein shall be gastight;
- **.3** station doors shall open outwards;
- **.4** it shall be provided with effective natural ventilation, with ventilation grates located in the lower and upper parts of the room.
- **.5** it shall be provided with fire-extinguishing system operating instructions, including pre-start safety procedures;
- **.6** the lighting of the station shall be supplied from the main and emergency source of electric power.

3.6.3 Control of the System, Warning Signalization and Time Delay

3.6.3.1 Fixed gas fire-extinguishing system shall be operated manually by means of distribution valves fitted on the pipes conveying fire-extinguishing media into the space. Automatic release of fire-extinguishing medium is not permitted.

3.6.3.2 In the case of systems intended for the protection of two or more spaces, the distribution valves on the pipes conveying fire-extinguishing medium into the protected spaces shall be so marked as to indicate clearly the spaces to which the pipes are led.

3.6.3.3 Suitable provision shall be made to prevent inadvertent release of fire-extinguishing medium into the protected space.

3.6.3.4 Fire-extinguishing system for the protection of machinery spaces shall be provided with manual remote controls (control cabinets/ panels) located outside the space, and if practicable, at the exit from the space.

3.6.3.5 Spaces protected by a gas fire-extinguishing system, accessible by doors or manholes, or other spaces in which the personnel is normally employed, shall be fitted with automatic visual and audible warning signalization – alerting of the release of fire-extinguishing medium.

3.6.3.6 The release of fire-extinguishing medium into a protected space shall be delayed by an automatic time-delay device for the length of time needed to evacuate the space, not shorter than 20 s and not longer than 45 s.

3.6.4 Carbon Dioxide (CO_2) Systems

3.6.4.1 Carbon dioxide fire-extinguishing system is intended for the protection of machinery spaces, boiler rooms and other spaces housing machinery and electrical equipment. The quantity of carbon dioxide, (G), for particular spaces, shall be calculated from the formula:

$$G = 1.79 \cdot V \cdot \varphi \text{, [kg]}$$

where:
V – design volume of the largest space to be protected – the gross volume of the space [m^3];
φ – filling factor;
φ = 0.35

3.6.4.2 The total quantity of CO_2 in the fire-extinguishing station on board shall be sufficient for the protection of the largest space.

3.6.4.3 For machinery spaces, the piping system shall be so designed that 85% of the required quantity of CO_2 can be discharged into the space within not longer than 2 min.

3.6.4.4 The system shall be operated manually by means of distribution valves fitted on the pipes conveying fire-extinguishing media into the space. Automatic release of fire-extinguishing medium is not permitted.

3.6.4.5 In the case of systems intended for the protection of two or more spaces, the distribution valves on the pipes conveying fire-extinguishing medium into the protected spaces shall be so marked as to indicate clearly the spaces to which the pipes are led.

3.6.4.6 Suitable provision shall be made to prevent inadvertent release of fire-extinguishing medium into the protected space.

3.6.4.7 Remote controls of carbon dioxide fire-extinguishing system intended for the protection of machinery spaces and other spaces in which the personnel normally work shall fulfil the following requirements:

1. two separate controls shall be provided for releasing carbon dioxide into a protected space and to ensure the activation of the warning signalization. One control shall be used for opening the distribution valve of the piping which conveys CO_2 into the protected space and the other control shall be used to open valves of storage containers/cylinders.
2. the two controls shall be located inside a release cabinet clearly identified for the particular space. If the cabinet is to be locked, the key to the cabinet shall be in a break-glass-type closure located adjacent to the cabinet.

3.6.4.8 After the system has been installed on board the *unit*, accepted and pressure tested, the following shall be performed:

.1 all CO_2 pipes and nozzles shall be blown through using compressed air or nitrogen;
.2 operation test of the warning signalization shall be performed.

3.6.5 Gas Equivalent Fire-extinguishing Systems for Machinery Spaces

The guidelines for the design, construction and type tests for the gas equivalent systems are given in PRS Publication No. 89/P

4 FIRE ALARM AND FLAMMABLE GAS DETECTION SYSTEMS

4.1 Fixed Fire Detection and Fire Alarm System

4.1.1 General Requirements

4.1.1.1 Any required fixed fire detection and fire alarm system shall consist of fire detectors, manually operated call points and the control panel. The system shall be capable of immediate operation at all times.

4.1.1.2 Where a fixed fire detection and fire alarm system is required for the protection of spaces other than stairways, corridors and escape routes, at least one detector shall be installed in each such space.

4.1.1.3 Fixed fire detection and fire alarm system shall be so designed and the detectors so arranged as to detect the onset of fire in any part of the protected spaces and under any normal conditions of operation of the machinery and variations of ventilation as required by the possible range of ambient temperatures.

4.1.1.4 Except in spaces of restricted height and where use of thermal detectors is particularly appropriate, detection and alarm systems using only thermal detectors are not permitted.

4.1.1.5 Smoke detectors shall be installed in all stairways, corridors and escape routes within accommodation spaces. It is recommended that special purpose smoke detectors be installed within ventilation ducting where smoke may occur as a factor indicative of incipient fire.

4.1.1.6 Manually operated call points shall be installed throughout the accommodation spaces, service spaces and control stations, but it is not required that they be fitted in an individual room within these spaces. One manually operated call point shall be located at each exit from the above spaces. Manually operated call points shall be located in the corridors of each deck at each exit (inside or outside) to the open deck and be readily accessible from the corridor such that no part of the corridor is more than 20 m from a manually operated call point.

4.1.1.7 Fixed fire detection and fire alarm system shall be so designed as to:

- **.1** control and monitor input signals from all the connected fire and smoke detectors and manually operated call points;
- **.2** provide output signals to the MCS and PCS to notify the personnel of fire and fault conditions of the system itself;
- **.3** monitor power supplies and circuits necessary for the operation of the system for loss of power and fault conditions of the system;

additionally :

- **.4** the system shall send signals to the *unit* ESD system.

4.1.1.8 Detectors and manually operated call points shall be connected to dedicated sections of the fire detection and fire alarm system. Other fire safety functions, such as alarm signals from the sprinkler valves, may be permitted to be connected if provided in separate sections.

4.1.1.9 Fixed fire detection and fire alarm system shall be so designed as to withstand supply voltage variation and transients, ambient temperature changes, vibration, humidity, shock, impact and corrosion normally encountered in platforms. All electrical and electronic equipment in the MCS or PCS or in their vicinity shall be tested for electromagnetic compatibility, in accordance with Res. A.813(19).

4.1.1.10 Fixed fire detection and fire alarm systems with an individual identification capability of fire detectors shall be so arranged that:

- **.1** means are provided to ensure that any fault (e.g. power break, short circuit, earth, etc.) occurring in the section will not render the other detectors in this section ineffective;
- **.2** all arrangements are applied to enable the initial configuration of the system to be restored in the event of failure (e.g. electrical, electronic, informatics, etc.);
- **.3** the first initiated fire alarm will not prevent any other detector from initiating further fire alarms;

.4 no loop will pass through a space twice. When this is not practicable (e.g. for large public spaces), the part of the loop which by necessity passes through the space for a second time shall be installed at the maximum possible distance from the other parts of the loop.

4.1.1.11 The fixed fire detection and fire alarm system shall be, as a minimum, capable of identifying each section.

4.1.2 Sources of Power Supply

4.1.2.1 There shall not be less than two sources of power supply for the electrical equipment used in the operation of the fixed fire detection and fire alarm system, one of which shall be an emergency source. The supply shall be provided by separate feeders reserved solely for that purpose. Such feeders shall run to an automatic changeover switch situated in or adjacent to the control panel for the fire detection system. The changeover switch shall be so designed that its failure will not cut off both sources of power supply. The main feeder (and the corresponding emergency feeder) shall run from the main switchboard (and the corresponding emergency switchboard) to the changeover switch avoiding another switchboard.

4.1.2.2 The operation of the automatic changeover switch or a failure of one of the power supply sources shall not cause loss of fire detection capability. Where a momentary loss of power would cause degradation of the system, a battery of adequate capacity shall be provided to ensure continuous operation during changeover.

4.1.2.3 Sufficient power supply shall be ensured to permit the continued operation of the system with all detectors activated, but not more than 100 if their total number exceeds this figure.

4.1.2.4 The emergency source of power specified in 4.1.2.1 shall be supplied by accumulator batteries or from the emergency switchboard. The source of power shall be sufficient to maintain the operation of the fire detection and fire alarm system for the periods of time required in *Part VI – Electrical Installations and Automation Systems*, and at the end of that period, shall be capable of operating all connected visual and audible fire alarm signals for a period of at least 30 min.

4.1.2.5 Where the fire detection system is supplied from accumulator batteries, the accumulator battery shall be located in or adjacent to the control panel for the fire detection system, or in another location suitable for use in an emergency. The rating of the battery charge unit shall be sufficient to maintain the normal output power supply to the fire detection system while recharging the batteries from a fully discharged condition.

4.1.3 Component Requirements

4.1.3.1 Detectors

4.1.3.1.1 Detectors shall be operated by heat, smoke or other products of combustion, flame, or any combination of these factors. Detectors operated by other factors indicative of incipient fires may be accepted, provided that they are not less sensitive than above detectors.

4.1.3.1.2 Smoke detectors required in all stairways, corridors and escape routes within accommodation spaces shall be certified to operate before the smoke density exceeds 12.5% obscuration per metre, but not until the smoke density exceeds 2% obscuration per metre, when tested according to EN 54:2001 and IEC 60092-504. Alternative national standards may be used. Smoke detectors to be installed in other spaces shall operate within sensitivity limits recommended by the manufacturer, having regard to the avoidance of detector insensitivity or oversensitivity.

4.1.3.1.3 Heat detectors shall be certified to operate before the temperature exceeds 78ºC but not until the temperature exceeds 54ºC, when the temperature is raised to those limits at a rate less than 1ºC per min, when tested according to EN 54:2001 and IEC 60092-504. Alternative national standards may be used. At higher rates of temperature rise, the heat detector shall operate within temperature limits recommended by the manufacturer, having regard to the avoidance of detector insensitivity or oversensitivity.

4.1.3.1.4 Operation temperature of heat detectors in drying rooms and similar spaces of a normal high ambient temperature may be up to 130 ºC, and to 140 ºC in saunas.

4.1.3.1.5 Flame detectors shall be tested in accordance with EN 54-10:2001 and IEC 60092-504. Alternative national standards are permitted to be applied.

4.1.3.1.6 All detectors shall be of a type such that they can be tested for correct operation and subsequently restored to normal surveillance without the renewal of any component.

4.1.3.1.7 Detectors fitted in hazardous areas, where there is a risk of explosion, shall be tested and type-approved for such service.

4.1.3.1.8 Detectors fitted in refrigerated spaces, such as refrigerated provision chambers, shall be tested in accordance with the relevant, for such spaces, procedures [1)].

4.1.3.2 Control Panel

The control panel for the fire detection and alarm system shall be tested in accordance with standards EN 54-2:1997, EN 54-4:1997 and IEC 60092-504:2001. Alternative national standards are permitted to be applied.

4.1.3.3 Cables

Cables used in the electrical circuits shall be flame-retardant in accordance with standard IEC 60332-1.

4.1.4 Installation Requirements

4.1.4.1 Detector Sections

4.1.4.1.1 Detectors and manually operated call points shall be grouped into sections.

4.1.4.1.2 The section of fire detectors which covers a control station, a service space or an accommodation space shall not include a machinery space of category A. For fixed fire detection and alarm systems with remotely and individually identifiable fire detectors, a section covering fire detectors in accommodation, service spaces and control stations shall not include fire detectors in machinery spaces of category A.

4.1.4.1.3 Where the fixed fire detection and fire alarm system does not include means of remotely identifying each detector individually, no section covering more than one deck within accommodation spaces, service spaces and control stations shall be normally permitted, except a section which covers an enclosed stairway. If the detection system is fitted with remotely and individually identifiable fire detectors, the sections may cover several decks and serve any number of enclosed spaces.

4.1.4.2 Arrangement of Detectors

4.1.4.2.1 Detectors shall be located for optimum performance. Positions near beams and ventilation ducts, or other positions where patterns of air flow could adversely affect performance, and positions where impact or physical damage is likely to occur, shall be avoided. Detectors shall be located on the overhead at a minimum distance of 0.5 m away from bulkheads, except in corridors, lockers and stairways.

4.1.4.2.2 The maximum spacing of detectors shall be in accordance with the below Table:

[1)] See the guidelines of the International Electrotechnical Commission, in particular Publication IEC60068-2-1 – Section one – Test Ab, *Environmental Testing – Part 2-1: Tests A: Cold*

Table 4.1.4.2.2
Spacing of detectors

Item	Detector type	Maximum floor area per detector [m^2]	Maximum distance apart between detector centres, [m]	Maximum distance from bulkheads, [m]
1	Heat detector	37	9	4.5
2	Smoke detector	74	11	5.5

Other spacings based upon test data which demonstrate the characteristics of the detectors are permitted.

4.1.4.2.3 Detectors in stairways shall be located at least at the top level of the stair and at every second level beneath.

4.1.4.2.4 When fire detectors are installed in freezers, drying rooms, saunas, parts of galleys used to heat food, laundries and other spaces where steam or fumes are created, heat detectors may be used.

4.1.4.2.5 Where a fixed fire detection and fire alarm system is required within accommodation spaces and service spaces, spaces having little or no fire risk need not be fitted with detectors. Such spaces include void spaces where combustibles are not stored, private bathrooms, public toilets, fire-extinguishing medium storage rooms (fire-extinguishing stations), cleaning gear lockers (in which flammable liquids are not stored), open deck spaces.

4.1.4.3 Arrangement of Cables

4.1.4.3.1 Cables which form part of the system shall be so arranged as to avoid galleys, machinery spaces of category A, and other enclosed spaces of high fire risk except where it is necessary to provide for fire detection or fire alarms in such spaces or to connect them to the appropriate power supply.

4.1.4.3.2 Section with individually identifiable capability shall be so arranged that it cannot be damaged at more than one point by a fire.

4.1.5 System Control Requirements

4.1.5.1 Visual and Audible Fire Detection Alarm Signals

4.1.5.1.1 Activation of any detector or manually operated call point shall initiate a visual and audible fire detection alarm signal at the control panel and indicating units. Alarm signals shall be in accordance with the *Code on Alerts and Indicators* – Res. A.1021(26). If the signals have not been acknowledged within 2 min., an audible fire alarm shall be automatically sounded throughout the personnel accommodation and service spaces, control stations and machinery spaces of category A. This alarm sounder system need not be an integral part of the detection system.

4.1.5.1.2 Control panel shall be located in the PCS or in the MCS (if continuously manned).

4.1.5.1.3 Power supplies and electric circuits necessary for the operation of the system shall be monitored for loss of power and fault conditions, as appropriate including:

.1 a single open or power break fault caused by a broken wire;
.2 a single ground fault caused by the contact of a wiring conductor with a metal component;
.3 a single wire to wire fault caused by the contact of two or more wiring conductors.

Occurrence of a fault condition shall initiate a visual and audible fault signal at the control panel which shall be distinct from a fire signal.

4.1.5.1.4 Means to manually acknowledge all alarm and fault signals shall be provided at the control panel. Audible alarm sounders on the control panel and indicating units may be manually silenced. The control panel shall clearly distinguish between normal, alarm, acknowledged alarm, fault and silenced conditions.

4.1.5.1.5 The system shall be so arranged as to automatically reset to the normal operating condition after alarm and fault conditions are cleared.

4.1.5.1.6 When the system is required to sound a local audible alarm within the cabins where the detectors are located, any means to silence the local audible alarms from the control panel are not permitted.

4.1.5.1.7 In general, audible alarm sound pressure levels at the sleeping positions in the cabins and 1 m from the sounder shall be at least 75 dB(A) and at least 10 dB(A) above ambient noise levels existing during normal equipment operation with the ship under way in moderate weather. The sound pressure level shall be in the 1/3 octave band about the fundamental frequency. Audible alarm signals shall not exceed 120 dB(A).

4.1.6 Installation Tests

4.1.6.1 The function of fixed fire detection and fire alarm systems shall be tested under varying conditions of ventilation after installation on board.

4.1.6.2 Suitable instructions, appropriate instruments for testing fire detectors, according to group of fire, as well as component spares for testing and maintenance shall be provided on board.

4.2 Fixed Hydrocarbon Gas Detection System (provided with sampling line)

4.2.1 General Requirements

4.2.1.1 The system shall consist of a central unit for gas measurement and analysis (detection device) and gas sampling pipes.

4.2.1.2 The system shall be designed, constructed and tested in accordance with guidelines given in MSC.1/Circ.1370.

4.2.2 Component Requirements

4.2.2.1 Gas Sampling Lines

4.2.2.1.1 Common sampling lines leading from different compartments to the detection equipment shall not be fitted, except the lines serving each pair of sampling points in one compartment.

4.2.2.1.2 The materials of construction and the dimensions of gas sampling lines shall be such as to prevent flow restriction. Where non-metallic materials are used, they shall be electrically conductive. The gas sampling lines shall not be made of aluminium.

4.2.2.2 Gas Analysing Unit

4.2.2.2.1 Gas analysing unit shall be located in a safe space and may be located in the MCS or the PCS (if permanently manned) and in addition in the other space, provided the following requirements are fulfilled:

- **.1** sampling lines shall not be led through gas-hazardous spaces, except where permitted under .5;
- **.2** hydrocarbon gas sampling pipes shall be equipped with flame arresters. Sample hydrocarbon gas shall be led to the atmosphere with outlets arranged in a safe location, far from a source of ignition and the accommodation area air intakes;
- **.3** manual isolating valve, which shall be easily accessible for operation and maintenance, shall be fitted in each of the sampling lines at the bulkhead on the gas-safe side;
- **.4** hydrocarbon gas detection equipment including sample piping, sample pumps, solenoids, analysing units etc., shall be located in a reasonably gastight cabinet (e.g. fully enclosed steel cabinet with a door with gaskets) which shall be monitored by its own sampling point. At a gas concentration above 30% of the lower flammable limit inside the steel enclosure, the entire gas analysing unit shall be automatically shut down, and
- **.5** where the enclosure cannot be arranged directly on the bulkhead, sample pipes shall be of steel or other steel equivalent material and without detachable connections, except for the connection points for isolating valves at the bulkhead and analysing unit, and shall be led on their shortest routes.

4.2.2.3 Gas Detection Equipment

4.2.2.3.1 Gas detection equipment shall be so designed as to sample and analyse gas from each sampling line of each protected space, sequentially at intervals not exceeding 30 min.

4.2.2.3.2 Means shall be provided to enable measurements with portable instruments, in case the fixed system is out of order or for system calibration. In case the system is out of order, procedures shall be in place to continue to monitor the atmosphere with portable instruments and to record the measurement results.

4.2.2.3.3 Audible and visual alarms shall be initiated in the MCS and the PCS and at the gas analysing unit when the vapour concentration in particular space reaches a pre-set value, which shall not be higher than the equivalent of 30% of the lower flammable limit (LFL).

4.2.2.3.4 Gas detection equipment shall be so designed that it may be readily tested and calibrated.

5 FIRE-FIGHTING EQUIPMENT, ESCAPE EQUIPMENT

5.1 General Requirements

5.1.1 Equipment shall be located in easily accessible and visible places on the *unit* and shall be fixed to bulkheads/linings/decks in a safe manner, allowing its immediate use.

5.1.2 The equipment shall be kept in good working condition and be available for immediate use at all times and shall be used exclusively for fire fighting, rescue operations and training purposes.

5.1.3 The location, on board the *unit*, of each equipment specified in the present Part (portable and mobile fire–extinguishers, portable foam applicator units, fire-fighter's outfit sets, water fog applicators, emergency escape breathing devices) shall be indicated by a plate with the symbol used on *Fire Control Plan.* The plates shall be made of photoluminescent material complying with the requirements specified in Res. A.752(18) or ISO 15370, or from other material and marked by lighting supplied from the emergency source of power.

Additionally, such plates shall be used to mark the following components of the fire-fighting appliances: manually operated call points, general alarm call points, fire detection control panel, emergency sources of electric power (aggregate, accumulator batteries), emergency switchboard, fire pumps, tanks/cylinders of gas fire-extinguishing systems, air compressor for breathing apparatus, controls for: remote operation of fixed fire-extinguishing systems, remote stopping of fuel and lubricating oil pumps, remote operation of fire pumps, remote operation of bilge pumps, remote closing of oil fuel/oil tank valves, remote stopping of fans and fire dampers in ventilation ducts, remote closing of fire dampers, closing appliances for ventilation openings in the *unit* spaces, as well as section valves and isolating valves of water and foam fire-extinguishing systems, fire hydrants and fire hose boxes.

5.1.4 Fire equipment protecting against the effect of fire, such as fire blankets, protective clothing and gloves shall be supplied by the manufacturer with asbestos free declaration taking account of Appendix 6 to the *2015 Guidelines for the Development of the Inventory of Hazardous Materials* (ResolutionMEPC.269(68)).

5.2 Portable and Mobile Fire-Extinguishers

5.2.1 Powder or carbon dioxide portable fire-extinguishers shall have a capacity of at least 5 kg; foam fire-extinguishers – a capacity of at least 9 *l* each. The total mass of a portable fire-extinguisher shall not exceed 20 kg.

Fire-extinguishers shall be of an approved type, based on the guidelines specified in Res. A.951(23).

5.2.2 Fire-extinguishers with fire-extinguishing capability equivalent to that of 9 *l* foam fire-extinguisher may be considered as equivalent.

Dry powder fire extinguishers having a capacity of at least 4 *kg* and water mist fire extinguishers having a capacity at least *6 l* are considered as equivalent means to fight fires of group A.

5.2.3 While selecting fire-extinguishers for particular spaces, a risk of the specific group of fire in that space shall be taken into account (see the definition of group of fires A, B, C, D, F or K given in 1.2). Fire-extinguishers shall be used as follows:

.1 accommodation spaces – group A;
.2 service spaces:
- drying rooms, pantries containing cooking appliances – group A or B;
- general lockers, deposit boxes – group B;
- galleys – group B, additionally group F or K;

.3 control stations – group A, with additional extinguishing medium for electrical equipment fires;
.4 machinery spaces – group B, with additional extinguishing medium for electrical equipment fires;
.5 workshops – group A or B;
.6 open decks – group B;
.7 helideck – group B.

5.2.4 Portable fire-extinguishers shall be situated ready for use at easily visible places, which can be reached quickly and easily at any time in the event of fire, and in such a way that their serviceability is not impaired by weather, vibration or other external factors. One of the portable fire-extinguishers intended for use in any space shall be stowed near the entrance to that space.

5.2.5 In accommodation and service spaces, in machinery spaces of category A and galleys, the minimum number of portable fire-extinguishers and their location shall be such that no point in the space is more than 10 m walking distance from an extinguisher. In external regions of crude oil and gas processing, the location of fire-extinguishers shall be such that no point in the space is more than 15 m walking distance from an extinguisher.

5.2.6 CO_2 fire-extinguishers shall not be situated in accommodation spaces or in explosion hazardous spaces.

5.2.7 In control stations and other spaces with electrical or electronic equipment, or machinery necessary for the unit safety, the portable extinguishers shall contain such extinguishing medium which is neither conductive nor harmful for such machinery and equipment.

5.2.8 On each *unit*, the number of spare fire-extinguishers shall be at least 50% of the total required number of fire-extinguishers.

5.3 Fire-Fighter's Outfit

5.3.1 Fire-fighter's outfit shall consist of the following:

.1 personal equipment, comprising:

- **.1.1** light type protective clothing made of material protecting the skin from the heat, radiating from the fire and from burns and scalding by flame or steam. The outer surface of the protective clothing shall be water-resistant;
- **.1.2** fire fighter's gloves;
- **.1.3** fire fighter's boots;
- **.1.4** fire-fighter's helmet;
- **.1.5** electric safety lamp of an approved type, with a minimum operation period of 3 h. Electric safety lamps used in hazardous areas shall be of an explosion-proof type, in accordance with Publication IEC 60079
- **.1.6** fireman's belt with snap fastener and fireman's axe in a sheath. The handle of the axe shall be provided with high-voltage insulation

.2 breathing apparatus, which shall be a self-contained, compressed-air operated breathing apparatus, the volume of air in the cylinders being at least 1200 *l* or other self-contained breathing apparatus capable of functioning for at least 30 min. All air cylinders shall be fitted with coupling of the same type to make them interchangeable.

5.3.2 Two spare charges shall be provided for each required breathing apparatus. *Units* equipped with suitably located means/compressors for fully recharging the air cylinders (fitted with filters preventing contamination) need to carry only one spare charge for each breathing apparatus.

5.3.3 For each breathing apparatus, a fireproof lifeline at least 30 m in length shall be provided. The lifeline shall be subjected to a strength test under static load of 3.5 kN for 5 min. The lifeline shall be capable of being attached by means of snaphook to the harness of the apparatus or to a separate belt in order to prevent the breathing apparatus from becoming detached when the lifeline is operated.

5.3.4 Fire-fighter's outfit shall be kept ready for use in an easily accessible location that is permanently and clearly marked. The fire-fighter's outfit shall be stored in two widely separated positions.

5.3.5 At least 2 sets of fire –fighter's outfit shall be available on each *unit*.

5.3.6 Onboard the *units* not equipped with suitably located means/compressors for fully recharging the air cylinders, in addition to the spare cylinders required in 5.3.2, sufficient number of spare cylinders shall be provided, intended for fire drills.

5.3.7 Onboard each unit, at least 2 two-channel portable radiotelephones for each fire-fighting team shall be provided, intended for firemen communication. Such portable radiotelephones shall be of explosion-proof type.

5.4 Apparatus/Compressor for Recharging Air Cylinders

5.4.1 The apparatus for recharging the air cylinders, if provided, should have its power supplied from the emergency source or be independently diesel-powered, or be so constructed or equipped that the air cylinders may be used immediately after recharging.

5.4.2 The apparatus/compressor should be suitably located in a sheltered space above main deck level on the *unit*.

5.4.3 Intakes for air compressors should draw from a source of clean air.

5.4.4 After compression, the air should be filtered to eliminate compressor contamination with oil.

5.4.5 The recharging capacity shall amount to at least 60 *l*/min for each required breathing apparatus, however, it does need to exceed 420 *l*/min.

5.4.6 Onboard the *units* equipped with means/compressors for recharging the air cylinders, at least one spare cylinder shall be provided intended for charging by the crew during periodical operation tests of the compressor.

5.5 Emergency Escape Breathing Devices (EEBD)

5.5.1 Emergency escape breathing device is an air or oxygen supplying device used only for escape from a compartment that has a hazardous atmosphere, dangerous to life and health.

5.5.2 Emergency escape breathing devices shall be designed and marked in accordance with Chapter 2, *FSS Code* and the guidelines contained in MSC/Circ.849.

5.5.3 In machinery spaces of category A containing internal combustion machinery, EEBDs should be positioned as follows:

- **.1** one (1) EEBD in the engine control room, if located within the machinery space;
- **.2** one (1) EEBD in workshop areas, being separate rooms within the machinery space. If there is, however, a direct access to an escape way from the workshop, an EEBD is not required.
- **.3** one (1) EEBD on each deck or platform level near the escape ladder or stairs constituting the second means of escape from the machinery space (other compartments provided with a machinery trunk or watertight door shall have additionally one EEBD at the lower level of the space, near the escape ladder or stairs).
- **.4** alternatively, a different number or location may be required, taking into consideration the layout and dimensions or the normal manning of the machinery space.

5.5.4 For machinery spaces of category A other than those containing internal combustion machinery, one (1) EEBD should, as a minimum, be provided on each deck or platform level near the escape ladder or stairs constituting the second means of escape from the space (other compartments provided with a machinery trunk or watertight door shall have additionally one EEBD at the lower level of the space, near the escape ladder or stairs).

5.5.5 For other machinery spaces, the number and location of EEBDs shall be determined individually, considering the space layout.

6 FIRE PROTECTION OF SPACES AND AREAS ON THE *UNIT*

6.1 Accommodation Spaces, Service or Working Spaces and Control Stations

6.1.1 Fixed Fire Detection and Fire Alarm Systems

6.1.1.1 Accommodation spaces, and service spaces shall be protected by an automatic fire detection and fire alarm system, complying with the requirements of 4.1. Accommodation spaces shall be fitted with smoke detectors, while galley spaces with heat detectors.

6.1.1.2 Manually operated call points shall be installed throughout the accommodation spaces, service and working spaces, in accordance with the requirements of 4.1.1.

6.1.1.3 Smoke detectors shall be installed in spaces containing electrical equipment and in control stations.

6.1.2 Air Supply and Smoke Extraction System in Control Stations

Control stations located outside machinery spaces shall be fitted with air supply and smoke extraction system to ensure that, in the event of fire, the machinery and equipment contained therein may continue to function effectively and the fire-extinguishing and rescue operations may be performed.

6.1.3 Portable Fire-Extinguishers

6.1.3.1 In public spaces, one portable fire-extinguisher shall be provided per 250 m^2 of deck area, or fraction thereof.

6.1.3.2 In corridors, the walking distance to fire-extinguishers shall not exceed 25 m within each deck.

6.1.3.3 Hospital shall be provided with at least one fire-extinguisher.

6.1.3.4 Laundry drying rooms and pantries containing cooking appliances shall be provided with at least one fire-extinguisher.

6.1.3.5 Control stations shall be provided with at least one fire-extinguisher.

6.1.3.6 Where the floor area of MCS or PCS is 50 m^2 and more, at least two fire-extinguishers shall be provided; where the floor area is less than 50 m^2 – only one extinguisher.

6.1.3.7 Lockers and store-rooms (having a deck area of 4 m^2 or more), workshops (not within machinery spaces) shall be provided with one extinguisher.

6.2 Galley Spaces

6.2.1 Deep-Fat Cooking Equipment

Deep-fat cooking equipment, installed in closed spaces or open decks, shall be fitted with the following:

.1 an automatic or manual fire-extinguishing system using fire-extinguishing medium suitable for extinction of burning fat, subject to tests in accordance with ISO 15371: 2009;

.2 a primary and backup thermostat with an alarm to alert the operator in the event of failure of either thermostat;

.3 arrangements for automatic shutting off the electrical power upon activation of the fire-extinguishing system;

.4 an alarm for indicating operation of the fire-extinguishing system in the galley where the equipment is installed; and

.5 controls for manual operation of the fire-extinguishing system, clearly labeled.

6.2.2 Portable Fire-Extinguishers

Galleys shall be provided with at least one group B fire-extinguisher; one additional group F or K fire-extinguisher shall be provided for galleys fitted with deep-fat cooking equipment.

6.3 Store-Rooms for Paints and Flammable Liquids

6.3.1 Spaces where paints or other flammable liquids, such as adhesives, grease and solvents, are stored, are regarded as store rooms for paints and flammable liquids.

6.3.2 Such store rooms shall be provided with one of the following fire-extinguishing systems:

.1 a carbon dioxide system, the quantity of CO_2 being calculated in accordance with 3.6.4.1, assuming filling factor $\varphi = 0.4$;

.2 a dry powder system designed for at least 0.5 kg powder/m^3;

.3 a water-spraying fire-extinguishing system or a sprinkler system, with the water discharge rate not less than 5 *l*/min per square metre of the floor. This system may be supplied from the water fire main;

.4 an other system providing equivalent protection.

In any case, the fire-extinguishing system shall be operable from outside the store-room
Additionally, such store-rooms shall be provided with one portable fire-extinguisher.

6.3.3 For lockers of a deck area less than 4 m^2, which do not give access to accommodation spaces, a portable carbon dioxide fire-extinguisher sized to provide the quantity of CO_2 not less than that calculated in accordance with 6.3.2 (1) may be accepted in lieu of a fixed system. A discharge port shall be arranged in the locker to allow the discharge of the extinguisher without having to enter into the protected space. The required portable fire-extinguisher shall be stowed adjacent to the port.

Alternatively, a port or hose connection may be provided to facilitate the use of the water fire main.

6.4 Machinery Spaces Containing Oil-fired Units

6.4.1 Fire Protection

6.4.1.1 Machinery spaces containing oil-fired main or auxiliary boilers, or other spaces containing heat treatment equipment, or fuel settling tanks, shall be provided with:

.1 one of the following fixed total flooding fire-extinguishing systems:

.1 a fixed gas fire-extinguishing system, e.g. carbon dioxide system, complying with the requirements specified in 3.6 or equivalent;

.2 a fixed water-spraying fire-extinguishing system, complying with the requirements of the *FSS Code*;

.3 a fixed high-expansion foam fire-extinguishing system complying with the requirements specified in the *FSS Code*.

6.4.1.2 Where the machinery space and spaces containing oil-fired machinery are not entirely separate, or if fuel oil can drain from the latter spaces into the machinery space, the combined machinery space and the room containing oil-fired machinery shall be considered as one compartment;

.1 at least two approved portable foam fire-extinguishers or equivalent, located in each room containing oil–fired machinery and in each room containing a part of the oil fuel system. Additionally, at least one 9 *l* foam extinguisher shall be provided for each burner, whereby the total capacity of additional extinguishers need not exceed 45 *l* for any one space;

.2 a receptacle containing sand, sawdust impregnated with soda, or other approved dry material, of capacity 0.1 m^3, located in the vicinity of boiler furnaces. A scoop for sand shall be provided near the receptacle. One portable 6 kg dry-powder extinguisher may be provided as an alternative.

6.4.1.3 Machinery spaces containing internal combustion engines of total output not less than 750 kW, shall be equipped with:

.1 one of the fixed fire-extinguishing systems mentioned in 6.4.1.1.1;

.2 one approved type mobile foam extinguisher of capacity 45 *l* or equivalent[1)] in each machinery space and one approved portable foam extinguisher or equivalent for each 750 kW of engine power output or part thereof. The total number of portable extinguishers so supplied should be not less than two and need not exceed six, for one compartment.

[1)] Mobile 25 kg dry powder extinguisher or mobile 20 kg CO_2 extinguisher are considered equivalent.

6.4.1.4 Additional, efficient fire-extinguishing arrangements shall be provided in machinery spaces not fitted with fixed fire-extinguishing installations containing steam turbines which are separated from boiler rooms by watertight bulkheads.

6.4.1.5 Where a fire hazard exists in any machinery space for which no specific provisions for fire-extinguishing appliances are prescribed in the above paragraphs, there should be provided in that space a number of approved portable fire extinguishers or other efficient means of fire extinction.

6.4.1.6 Machinery spaces of category A and, where deemed necessary, other machinery spaces shall be provided with arrangements permitting the release of smoke, in the event of fire.

6.4.2 Means of Control in Machinery Spaces and Working Spaces

6.4.2.1 Means should be provided for stopping ventilating fans serving machinery and working spaces and for closing all doorways, vents, annular spaces around funnels and other openings to such spaces. These means should be capable of being operated from outside such spaces in case of fire.

6.4.2.2 Machinery driving forced and induced draught fans, oil fuel transfer pumps and other similar fuel pumps should be fitted with remote controls situated outside the space concerned so that they may be stopped in the event of a fire arising in the space in which they are located.

6.4.2.3 Every oil fuel suction pipe from a storage, settling or daily service tank situated above the double bottom, shall be fitted with a cock or valve capable of being closed from outside the space concerned in the event of a fire arising in the space in which such tanks are situated.

6.5 Machinery Spaces and Boiler Rooms containing Crude-oil or Gas Fired Machinery

6.5.1 Machinery spaces and boiler rooms containing crude-oil or gas fired auxiliary boilers, combustion engines or turbines shall be equipped with additional gas fire extinguishing systems. The systems shall be so fitted that the approved fire-extinguishing medium can be directly supplied to the air inlet of the engine or gas turbine, to the burner part of the boiler or fuel drip tray. The use of the fire-extinguishing medium shall cause an automatic shut-down of the boiler draught fan.

6.5.2 In each machinery space/ boiler room, the below portable fire-fighting equipment shall be placed:

.1 mobile foam-extinguisher of at least 135 *l* capacity or equivalent [2)], with hoses on reels suitable for reaching any part of the space. In the case of domestic boilers of less than 175 kW, such foam-extinguisher is not required.

.2 at least two portable foam extinguishers – located in each firing space and in each space in which a part of the oil fuel installation is situated.

.3 a portable foam applicator unit, complying with the requirements of the *FSS Code*. The applicator may be located in the machinery space or at an entrance, outside of the space.

6.6 A Deck with Production or Processing Areas

6.6.1 A deck with production or processing areas shall be protected by a fixed deck foam fire-extinguishing system, complying with the requirements of 3.5, delivering foam to all installed machinery and systems.

6.6.2 The hydrocarbon transport and processing equipment, process fluid pumps and compressors installed on the deck with processing areas shall be protected by a fixed water-spraying system, complying with the requirements of 3.3.

6.6.3 At least two water monitors with dual purpose (jet/spray) nozzles so arranged that they can cover the whole protected area may be used for the protection of the deck with processing area, instead of the fixed water-spraying system. Each monitor shall be of capacity at least 100 m^3/h. The monitors shall be remotely controlled from the PCS or the *unit* MCS or from local easily accessible, sheltered from fire, position.

2) Mobile 50 kg dry powder extinguisher or mobile 45 kg CO_2 extinguisher are considered equivalent.

6.6.4 Rooms containing mud storage tanks and mud processing and cleaning systems shall be protected by a fixed water spraying system and foam system.

6.6.5 The machinery used in gas processing and located on deck with processing area, shall be protected by a fixed water-spraying system. Additionally, a dry-powder fire-extinguishing system shall be installed for extinguishing fires of burning gas. Such system shall comprise the powder container, powder conveying pipes and powder nozzle with fire hose or a powder monitors.

6.7 Wellhead and Drilling Derrick Areas

6.7.1 The wellhead and turret area shall be protected by a fixed foam fire-extinguishing system and fixed water-spraying fire-extinguishing system.

6.7.2 The escape routes from wellhead and turret areas leading to a safe place on weather deck shall be protected by water screen system fulfilling the requirements of 3.4.

6.7.3 Flammable and toxic gas detection and alarm detectors shall be fitted in the wellhead and turret area.

6.8 Fire Detection and Alarm

6.8.1 A fixed fire detection and alarm system including detectors and manual call points shall be installed in all machinery spaces, production and processing areas, and in each room containing equipment for the storage, processing and transport of oil products and other flammable products.

6.8.2 The fire detection and alarm system including detectors shall be installed in the room containing emergency generating unit.

6.9 Hydrocarbon Gas Detection and Alarm

6.9.1 A fixed automatic hydrocarbon gas detection and alarm system shall be installed and so arranged as to monitor continuously all enclosed areas of the *unit* in which an accumulation of flammable gas may be expected and it shall be capable of indicating at the main control point by aural and visual means the presence and location of gas accumulation.

6.9.2 Gas detectors shall be located in the following positions:

- **.1** hazardous areas, except in area 0 and mechanically ventilated areas;
- **.2** ventilation outlets from hazardous areas having mechanical ventilation;
- **.3** all intakes for ventilation, including:
  - **.1** ventilation intakes of enclosed machinery spaces contiguous to hazardous areas and containing internal combustion engines and boilers, and;
  - **.2** ventilation intakes and other openings of accommodation spaces;

6.9.3 Gas detectors shall be connected to sound and visual alarm system, which shall emit signals in the MCS and the PCS. The alarm system shall be capable of clear indicating the place of gas accumulation and gas concentration. Alarms shall be initiated when the gas concentration in a particular space reaches a pre-set value, which shall not be higher than the equivalent of 25% and 60% of the lower flammable limit (LFL).

6.9.4 Hydrocarbon gas detection system, provided with air sample line, complying with the requirements of 4.2, shall be installed in the *unit* hull tanks, where flammable gas may be expected to accumulate.

6.9.5 At least two portable gas detecting devices should be provided, each capable of accurately measuring a concentration of flammable gas.

6.10 Toxic Gas Detection and Alarm

6.10.1 A fixed automatic toxic (hydrogen sulphide) gas detection and alarm system shall be provided so arranged as to monitor continuously the turret area of the *unit* and capable of giving audible and visual alarm in the MCS and PCSs.

6.10.2 The alarm system shall be capable of clear indicating the toxic gas detection. The lower pre-set value of the alarm shall be 10 ppm, while the upper value not higher than 300 ppm, Reaching the upper pre-set value shall activate an escape alarm. If the alarm at the MCS is not acknowledged within 2 min, the toxic gas (hydrogen sulphide) alarm shall be automatically activated on helideck.

6.10.3 At least two portable hydrogen sulphide gas monitoring devices should be provided on the *unit*.

7 EQUIPMENT AND SYSTEMS POSING FIRE AND EXPLOSION RISK

7.1 Helicopter Landing Facilities

7.1.1 Helideck Fire Protection

7.1.1.1 Helideck shall be fitted with a fixed foam system complying with the requirements specified in 7.1.4.

7.1.1.2 The helideck area shall be provided with a least 2 fire hydrants and 2 dual type (jet/spray) nozzles, with a fire hose capable of supplying water to each part of the helideck.

7.1.1.3 In the close proximity of the helideck, the following fire-fighting appliances shall be provided:

.1 at least two mobile dry powder extinguishers having a total capacity not less than 45 kg;

.2 carbon dioxide extinguishers of a total capacity not less than 18 kg or equivalent. At least one of the extinguishers shall have a nozzle with a stiffened grip of a length that enables fighting the fire of helicopter engine from the helideck. The extinguishers shall be located in another place than the dry powder extinguishers referred to in .1.

.3 two sets of fire-fighter's outfits in accordance with the requirements specified in 5.3.1, in addition to those required in 5.3.5;

.4 at least one rescue kit, stored in a manner that provides for its immediate use and protection against weather conditions, consisting of:

- **.4.1** adjustable wrench,
- **.4.2** fire resistant blanket,
- **.4.3** metal cutters, bolt of length 60 cm,
- **.4.4** hook,
- **.4.5** hacksaw, for cutting metal structures, complete with 6 spare blades,
- **.4.6** ladder,
- **.4.7** lifeline of 5 mm in diameter and 15 m in length,
- **.4.8** pliers,
- **.4.9** set of assorted screwdrivers,
- **.4.10** harness knife complete with sheath,
- **.4.11** crowbar.
- **.4.12** hydraulic cutters, for cutting the helicopter structure[1]

7.1.2 Foam Fire-Extinguishing System for the Helideck

7.1.2.1 For helideck, the foam system shall contain at least two fixed foam monitors or deck integrated foam nozzles.

7.1.2.2 In addition, at least two hose reels fitted with foam-making branch pipe and non-collapsible hose of length sufficient to reach any part of the helideck shall be provided in the vicinity of the helideck.

7.1.2.3 Depending on helicopter category, the minimum foam system discharge rate shall be determined by multiplying the area of the circle of diameter *D*, given in Table 7.1.2.3, by 6 l/min/m^2.

Table 7.1.2.3

Helicopter category	Helicopter overall length *D*	Discharge rate of foam concentrate solution [*l*/min]
H1	$D < 15$ m	250
H2	15 m $\leq D <$ 24 m	500
H3	24 m $\leq D <$ 35 m	800

[1] Required for a helideck adapted for helicopters of H3 category

The *D* value is the greatest dimension of the helicopter under rotation, measured from the most extreme forward element of the main rotor blade to the most extreme backward element of the tail rotor blade.

7.1.2.4 The minimum foam system discharge rate for deck integrated foam nozzle system shall be determined by multiplying the overall helideck area by 6 *l*/min/m^2.

7.1.2.5 The foam concentrate shall be of an approved type and be demonstrated effective for extinguishing aviation fuel spill fires and shall be in accordance with performance standards not inferior to those specified in MSC.1/Circ.1312/Corr.1. Where the foam concentrate storage tank is on the exposed deck, freeze protected foam concentrates shall be used, if appropriate, for the temperatures of the *unit* operation area.

7.1.2.6 The quantity of foam concentrate shall be adequate to allow operation of all connected discharge devices for at least 5 min.

7.1.2.7 Means shall be provided for the personnel to safely check the quantity of foam concentrate in the tanks and taking the foam concentrate samples for the periodical checking of its quality. The minimum level/minimum required quantity of foam concentrate shall be marked on the tank.

7.1.2.8 Each monitor shall be capable of supplying at least 50% of the minimum foam system discharge rate, but not less than 500 *l*/min. The minimum discharge rate of each hose reel shall be at least 400 *l*/min.

7.1.2.9 The foam system shall be capable of manual release, and may be arranged for automatic release.

7.1.2.10 The distance from the monitor to the farthest extremity of the protected area shall not exceed 75% of the monitor throw in still air conditions.

7.1.2.11 Manual release station necessary for starting pumps and opening required valves, including the fire main system, if used for water supply, shall be located at each monitor and hose reel. In addition, a central release station shall be provided at a protected location. The foam system shall be designed to discharge foam with nominal flow and at design pressure from any connected discharge devices within 30 s of activation.

7.1.2.12 Activation of any manual release station shall initiate the flow of foam concentrate solution to all connected hose reels, monitors and deck integrated foam nozzles.

7.1.2.13 The system and its components shall be designed to withstand ambient temperature changes, vibration, humidity, shock impact and corrosion normally encountered on the open deck.

7.1.2.14 A minimum nozzle throw of at least 15 m shall be provided with all hose reels and monitors discharging foam simultaneously. The discharge pressure, flow rate and discharge pattern of deck integrated foam nozzles shall be so selected as to ensure capability to extinguish fires involving the largest size helicopter for which the helideck is designed.

7.1.2.15 Monitors, foam making branch pipes, deck integrated foam nozzles and couplings shall be constructed of brass, bronze or stainless steel. Pipings, fittings and related components, except gaskets, shall be designed to withstand a temperature of 925°C.

7.1.2.16 All manual release stations, foam monitors and hose reels shall be provided with a means of access that does not require travel across the helicopter landing area.

7.1.2.17 Oscillating monitors, if used, shall be preset to discharge foam in spray pattern and have a means of disengaging the oscillating mechanism to allow rapid conversion to manual operation.

7.1.2.18 If foam monitors with flow rate up to 1000 *l*/min are installed, they shall be equipped with air-aspirating nozzles. If a deck integrated nozzle system is installed, then the additionally installed hose reel shall be equipped with an air aspirating nozzle. The use of non air-aspirating foam nozzles (on both: monitors and the additional hose reel nozzles) is permitted only where foam monitors with a flow rate above 1000 *l*/min are installed. Where only portable foam applicators or hose reel foam stations[1)] have been installed, they shall be equipped with air suction nozzles (air foam nozzles).

7.1.3 Helicopter Refuelling Facilities

7.1.3.1 If the *unit* is provided with helicopter refueling facilities, the requirements specified in this sub-chapter shall be fulfilled.

7.1.3.2 Designated enclosed area shall be provided for the storage of fuel tanks which shall be:

- **.1** as remote as is practicable from accommodation spaces, escape routes and lifeboat embarkation stations; and
- **.2** isolated from areas containing a potential source of flammable vapours ignition

7.1.3.3 Fuel storage area shall be provided with arrangements whereby fuel spillage may be collected and drained to a safe location.

7.1.3.4 Fuel storage tanks shall be constructed of metal, be fitted with fuel level indicator, fuel filling and refueling pipe connector with a filter, fuel contamination drain cover, fuel samples cock and ventilating pipes fitted with vent heads of an approved type with spark arresters. Tanks and associated equipment should be protected against physical damage and from a fire in an adjacent space or area.

7.1.3.5 Portable fuel storage tanks shall be of appropriate design and be suitably installed, protected against damage and earthed.

7.1.3.6 Storage tank fuel pumps shall be provided with means which permit their shutdown from a safe remote location in the event of a fire. Where a gravity fuelling system is installed, equivalent closing arrangements shall be provided to remotely isolate the fuel source.

7.1.3.7 Fuel pumping unit shall be connected to one tank at a time. The piping between the tank and the pumping unit shall be of steel or equivalent material, as short as possible, and protected against damage.

7.1.3.8 Electrical fuel pumping units and associated control equipment shall be of an explosion-proof type.

7.1.3.9 Fuel pumping units shall incorporate a device which will prevent over-pressurization of the delivery or filling hose.

7.1.3.10 Equipment used in refueling operations shall be provided with terminals for connecting the earth conductor and connections ensuring equalization of electric potential between connected equipment items.

7.2 Cylinders Containing Technical (Welding) Gases (Oxygen or Acetylene)

7.2.1 General Requirements

7.2.1.1 Where more than one cylinder of oxygen and more than one cylinder of acetylene are used simultaneously, such cylinders and technical gas system shall be arranged in accordance with the requirements of this subchapter.

7.2.1.2 The cylinders shall be fitted with cylinder valve caps.

7.2.1.3 The storage of cylinders containing oxygen or acetylene in machinery spaces is prohibited.

7.2.2 Compartments for the Storage of Cylinders

7.2.2.1 Where two or more cylinders of each gas are to be kept in enclosed spaces, separate dedicated storage rooms should be provided for each gas.

[1)] Hose reel foam station – a rigid hose reel equipped with air-foam nozzles, together with a fixed proportioner and foam concentrate storage tank, fitted on the common frame

7.2.2.2 The compartment for the storage of cylinders shall comply with the below requirements:

.1 access to such a compartment shall be provided from the open deck and the door shall be key locked
.2 the compartment shall be enclosed by A-0 Class divisions and shall be separated from the fire-hazardous adjacent spaces by A-60 Class fire divisions;
.3 except as necessary for service within the room, electrical wiring and appliances are not permitted within the compartment. Where such electrical appliances are installed, they shall be of an explosion-proof type.
.4 the compartment shall not be used for other purposes than storage of gas cylinders;
.5 the compartment shall be provided with effective ventilation system;
.6 "**NO SMOKING**" and "**EXPLOSION HAZARD. NO NAKED LIGHT**" notices shall be displayed on the entrance to such compartment.
.7 the compartment shall be provided with safety manual containing the following information:
  .1 on completion of work, all cylinder valves shall be kept in closed position;
  .2 flammable materials (especially oil or fat) shall not be kept in the vicinity of oxygen cylinders;
  .3 cylinder valves shall not be handled with oily or greasy hands.

7.2.2.3 Cylinders containing technical (welding) gases, including empty cylinders shall be stored in an upright position and properly secured so as to ensure their quick removal. The cylinders shall have a clearly legible identification of the name and chemical formula of their contents.

7.2.2.4 Cylinders shall be stored on a base made from wood or other similar material in such a way as not to be in direct contact with deck surface.

7.2.2.5 At least one fire-extinguisher for extinguishing C group fires, shall be placed in this compartment.

7.2.3 Storage of the Cylinders on Open Deck

Cylinders containing technical (welding) gases – not more than two such cylinders – may be stored on open decks in designated positions which shall fulfil the following requirements:
.1 they shall be at a distance of at least 10 m from accommodation and control stations and at least 4 m from the compartments where flammable materials are stored;
.2 they shall be protected against excessive heating and weather effect, as well as against mechanical damage;
.3 "**NO SMOKING**" and "**EXPLOSION HAZARD. NO NAKED LIGHT**" notices shall be displayed in the vicinity of the cylinders.

7.2.4 Technical (Welding) Gases Installation

7.2.4.1 The pipes supplying oxygen and acetylene to a welding shop shall be made of steel, be connected by welded pipe coupling or flanges.

7.2.4.2 Each pipeline shall be fitted with pressure reducing valve and cut-off valve.

7.2.4.3 Where two or more cylinders are connected to a manifold, the supply pipe, between cylinders, shall be fitted with non-return valves.

7.2.4.4 The cylinders shall be connected to the manifold by flexible pipes of an approved type.

7.2.4.5 The manifold shall be fitted with a safety valve. The outlet from the safety valve shall be led to the open deck, in a place which will not pose fire hazard.

7.2.4.6 After installation on board the unit, the technical (welding) gas system is subject to acceptance and tests in accordance with the approved documentation. The pipes are subject to strength and tightness tests, with a test pressure equal at least 1.5 of oxygen and acetylene working pressure.

7.3 Gas Fuel System for Domestic Purposes

7.3.1 Gas fuel system for domestic purposes shall fulfil the relevant national standards of the *unit* Administration.

7.3.2 Cylinders containing liquefied gas for domestic purposes shall be stored on the open deck or in a well ventilated space which opens only to the open deck.

7.3.3 After installation on board the *unit*, the system is subject to acceptance and tests in accordance with an approved documentation. The pipes are subject to strength and tightness tests, with a test pressure equal at least 1.5 of working pressure.

7.4 Heating of Spaces

7.4.1 Electric heating appliances shall fulfil the requirements specified in Chapter 15, *Part VI – Electrical Equipment and Automation Systems*.

7.4.2 All heaters shall be so constructed and positioned as to preclude the possibility of ignition of window curtains or space furnishings, as well as the luggage and clothing left by the persons using the space concerned.

8 PERIODICAL SURVEYS OF FIRE PROTECTION AND ANTI-EXPLOSION EQUIPMENT

8.1 Annual Survey

8.1.1 General

.1 checking the operational readiness and maintenance of fixed fire–extinguishing systems, fire alarm systems and fire protection appliances. The surveyor shall check the records in *unit* documents relating to the required periodic surveys and appliances/systems maintenance performed by personnel;

.2 checking the required reports on periodic surveys/ operation tests of fire-extinguishing systems and appliances, performed by approved service stations, issued before the inspection;

.3 checking if all valves/controls /other elements of fire-extinguishing systems activation and associated components, such as stopping ventilation fans, closing devices for openings leading to spaces protected by gas fire-extinguishing system, closing the valves on engine/boilers fuel supply pipelines, stopping fuel/oil transport pumps, etc. are clearly marked by appropriate signs/plates, for their identification and are indicated by plates with the symbol applied in the *Fire Control Plan*;

.4 checking if operation manuals are provided at the fire-extinguishing systems control positions;

.5 checking if signs/plates used for essential appliances/controls, systems operating manuals and warning signs are provided in the working language of the *unit*;

.6 checking the required spare parts for fire-extinguishing systems/ appliances, for compliance with manufacturer's recommendations;

.7 checking that unnecessary flammable wastes/ garbage are not accumulated within accommodation area and that baskets/receptacles for combustible wastes are made of non-combustible materials, have no holes and have tight cover.

8.1.2 Fire Protection Documentation

.1 verification if the *Fire Control Plan* is up-to-date, approved by the Flag State Administration and exhibited in an easily accessible place;

.2 checking the maintenance and safety operation documentation: *Fire Protection Systems and Appliances Maintenance Plan*, *Fire Training Manual*. Checking whether the *Fire Protection Systems and Appliances Maintenance Plan* complies with the guidelines given in MSC.1/Circ.1432 and MSC.1/Circ.1318.

8.1.3 Fire Divisions and Structures

.1 external examination of A and B Class fire divisions – checking the condition of insulation, pipings penetrations tightness, condition of ventilation and cable ducts, tightness of closing appliances of openings in the divisions fitted in :

– accommodation, service spaces and in control stations,

– machinery spaces.

.2 external examination of fire structures, including stair and lift enclosures, ventilation systems, windows and skylights, and use of flammable materials, to confirm that no structural changes have been made;

.3 external examination of draught stops.

8.1.4 Fire Doors

.1 external examination of all fire doors;

.2 operation test of all self-closing (hinged and sliding) fire doors;

.3 operation test of remote release of all fire doors designed to be permanently kept open from control station and their release from a position at both sides of the door;

.4 operation test of indication at the fire door indicator panel in control station;

.5 operation test of the door release mechanism, allowing to automatically close the door in the event of disruption of the control system or central power supply.

8.1.5 Escape Routes

.1 examination of internal and external escape routes leading to life-saving appliances embarkation stations – verification that ladders/steps/ handrails/ floor plates within the escape routes are made of steel and are properly secured and that escape routes are not obstructed by furniture, cleaning equipment and other obstacles:
– in accommodation and service spaces and in control stations,
– in machinery spaces,
– on the open decks;

.2 examination of marking and lighting (supplied from emergency source of power) of escape routes, emergency exits and assembly stations;

.3 examination of deck hatches being a part of escape routes – checking whether the hatch can be opened from both sides;

.4 examination of trunks and cabins of personal lifts – checking the possibility of evacuation when the lift stops between decks in the event of power system failure. Checking whether the cabin is equipped with appropriate escape hatch and if the trunk is provided with an emergency escape ladder.

8.1.6 Fire Protection of Machinery Spaces

.1 examination of machinery spaces – checking if the spaces are clean and properly maintained (no evidence of contamination and leakages, etc. by flammable products, that can be the source of fire);

.2 operation test of closing devices of all openings leading to machinery spaces, such as: doors, manholes, vent heads and louvres;

.3 operation test of remote stopping inlet and exhaust ventilation fans;

.4 operation test of remote closing of: boiler supply fans, fuel transport pumps, lubricating oil, thermal oil pumps and oil fuel separators.

.5 operation test of remote closing of quick closing valves on oil fuel pipelines of the storage, settling and daily service tanks, situated in machinery space above the double bottom;

.6 inspection of fixed fire detection and alarm system;

.7 inspection of fixed total flooding fire-extinguishing system;

.8 checking the arrangement of the required fire-fighting equipment (portable and mobile fire-extinguishers, portable foam applicator units, emergency escape breathing devices);

.9 checking if the insulation materials in machinery spaces (sides, walls, ceilings, trunks, ventilation ducts, pipings, etc.) are properly coated to protect them against crude oil product vapours.

8.1.7 Fire Protection of Galleys and Pantries

.1 internal examination (through inspection dampers) to confirm that overhead spaces in galley spaces are free from grease and contamination;

.2 operation test of stopping mechanical ventilation in a galley space;

.3 checking if at least one fire-extinguisher to fight fires of B group is provided in the galley space;

.4 checking if a galley space fitted with deep-fat cooking equipment is provided with at least one portable fire-extinguisher to fight fires of F or K group.

8.1.8 Fire Protection of Store Rooms for Paints and Flammable Liquids

.1 examination of the room – checking that the room is clean and properly maintained;

.2 operation test of means of closing of all openings;

.3 operation test of the room ventilation;

.4 operation test of fire-extinguishing system control;

.5 checking if the required portable extinguisher is provided in the store-room/ at the entrance thereto.

8.1.9 Water Fire Main System

.1 external examination of the systems components, such as: fire pumps, isolating valves, pipings exposed to damage, hydrant valves, fire hose nozzles, fire hoses, hydrant boxes, hose reels, international shore connections, etc.

.2 operation test of all fire pumps – checking if required flow rate and pressure are maintained and checking that each fire pump, including the emergency fire pump, can be operated separately so that two jets of water are produced simultaneously from different hydrants at any part of the *unit* whilst the required pressure is maintained in the fire main.
.3 operation test of an emergency fire pump – checking the priming device (for the pump located above the water level), flow test of all fire pumps for proper pressure and capacity, checking the drive operation of the pump with combustion engine (operation of ventilation, fuel system, engine cooling system, exhaust system), checking the cold engine starting.
.4 checking if there is adequate fuel supply in emergency pump fuel tank;
.5 operation test of water supply to water fire mains by the emergency fire pump, after closing isolating valves in machinery space containing the main fire pump;
.6 checking the marking and accessibility of valves isolating pipelines sections;
.7 checking the relief valves of all fire pumps, for proper pressure setting;
.8 checking that all filters/strainers used in the system are free from debris and contamination;
.9 operation tests of all shut-off valves/isolating valves and all hydrant valves;
.10 checking that all fire hoses located inside the *unit* spaces are permanently connected to hydrant valves;
.11 test of remote starting fire pumps from the MCS;
.12 test of automatic start of fire pump, after opening hydrant valve and on reduction of pressure in the system – for continuously flooded systems;
.13 test of hydrophore tank maintaining system pressure, checking the water and compressed air amount (for permanently pressurized systems);
.14 checking the water head in the most unfavourably situated hydrant valves during the operation of the required fire pumps and water delivery by two nozzles;
.15 operation test of draining/ anti-freezing systems for the pipelines exposed to frost;
.16 operation test of selected water hose nozzles with fire hoses – at least 20% of the total number of the nozzles and fire hoses provided onboard the *unit* shall be tested;
.17 tightness test of selected fire hoses – at least 20% of the total number of fire hoses provided onboard the *unit* shall be tested, with the maximum pressure in the system, so that all the fire hoses are subjected to test within 5 years.

8.1.10 Fixed Local Water-spraying System and Water Screen System

.1 external examination of the system components, such as valves, pipings, discharge nozzles, etc;
.2 operation test of all shut-off valves;
.3 operation test (water delivery) of one of pipeline sections. The section selection shall be so arranged that during subsequent surveys successive sections can be inspected;
.4 operation test of draining/ anti-freezing systems for the pipelines exposed to frost;
.5 checking if all system controls are clearly marked;
.6 compressed air or nitrogen blowdown of pipelines and system nozzles.

8.1.11 Fixed Deck Foam Fire-extinguishing System

.1 external examination of the system components, such as foam concentrate tanks, foam monitors, foam applicators, water and foam concentrate pumps, foam proportioners, valves, pipings, nozzles, etc;
.2 operation test of water supply pumps and foam concentrate pumps – checking the flow and pressure;
.3 for the foam system supplied from the common pipeline with the water fire mains, operation test (with use of water) – checking if during operation of the foam system the water fire mains system may deliver the minimum required number of water jets, at the required pressure;
.4 checking that relief valves of all pumps are properly set;
.5 examination if all filters/strainers used in the system are free from debris and contamination;
.6 operation tests of all system shut-off valves;
.7 operation test of drainage/ anti-freezing systems for the pipelines exposed to frost;
.8 operation test of all water and foam monitors (with the use of water) – checking manual/remote control of monitors (test the horizontal and vertical rotation/ movement of monitor discharge nozzle, at the maximum discharge angles), checking the water throw extent;

.9 operation test of one water and foam monitor, using foam – visual examination of the generated foam quality;
.10 operation test of one foam nozzle – visual examination of the generated foam quality;
.11 tightness test of all fire hose nozzles available on the unit, with the maximum pressure in the system;
.12 checking the quantity of foam concentrate. The quantity of the foam concentrate shall be not less than that given in an approved documentation;
.13 checking the validity of periodical laboratory[1)] examination of the foam concentrate in accordance with MSC.1/Circ.1312 – for low-expansion foam or in accordance with MSC.1/Circ.798 – for medium-expansion foam. First examination shall be made 3 years after delivery of the concentrate to the *unit*, each subsequent examination – at yearly intervals.

8.1.12 High-pressure CO_2 Fire-extinguishing System

.1 external examination of CO_2 station; checking of: key locking, thermal insulation of the room, ventilation openings/ mechanical ventilation operation, a thermometer, means for weighing carbon-dioxide cylinder, the system operating manual, informative plates on valves, etc;
.2 external examination of system components, such as: CO_2 cylinders, securing of cylinder, flexible hoses, control cabinets, main isolating valves/distribution valves, pipelines, discharge nozzles, etc. Cylinders with signs of leaking, corrosion, indents or buckling shall be replaced with new ones or subjected to hydraulic test;
.3 checking that all flexible hoses are in proper condition and are properly tightened;
.4 checking connections of all pilot lines for tightness;
.5 checking the safety valves on the manifold/ piping sections for proper pressure setting and safety valve outlet;
.6 checking the validity of hydraulic test of all system pressure vessels;
.7 blowdown with compressed air or nitrogen of all pipelines and discharge nozzles conveying CO_2 to each protected space, after connecting compressed air or nitrogen to manifold stub pipe. Checking passage of each nozzle in the protected space by putting a plastic bag over a nozzle outlet and checking if the bag has become inflated or checking the gas discharge by other suitable means;
.8 operation test of mechanical ventilation of fire-extinguishing station and operation test of the station lighting supplied from main and emergency source of power;
.9 measurement of CO_2 quantity in all CO_2 storage cylinders and in all pilot bottles (weighing/ measurement of liquid level). The permissible loss of CO_2 cannot exceed 10% of the required quantity. Cylinders with less than 90% of nominal quantity shall be re-filled to the required level. The total amount of CO_2 shall be sufficient for the protection of the largest protected space;
.10 checking that the CO_2 system used for the protection of machinery spaces is fitted with two separate controls: No.1 – for opening the main valve / distribution valves on the pipeline delivering CO_2 to protected space, No. 2 – for opening valves on CO_2 cylinders; checking if the two control elements are placed in the release cabinet clearly identified for the particular space;
.11 operation test of all CO_2 system remote release cabinets. During the test, automatic activation of warning signalization and stopping the ventilation in protected spaces shall be checked;
.12 operation test of servo-mechanisms for remote release of cylinder rows by means of actuating rods (after isolating the rods);
.13 checking that all release cabinets are provided with identification plates and operating manuals;
.14 operation test of all functions of the system control panel;
.15 operation test of main valve / all distribution valves on pipelines conveying CO_2 to protected spaces;
.16 checking the emergency activation of the system from CO_2 fire-extinguishing station (checking the possibility of manual opening of each cylinder and each distribution valve, as well as automatic activation of warning signalization and stopping the ventilation in the protected spaces);
.17 operation test of visual and sound warning signalization in all protected spaces in which personnel are normally employed. The sound signal shall be heard throughout the whole compartment at the maximum noise level and shall be distinct from other alarm signals;

[1)] The examination may be carried out only by an approved service station or laboratory. The scope of examination covers checking the following parameters of the foam concentrate: sedimentation, pH value, foam ratio, dropping time and unit weight.

.18 operation test of warning signalization power supply from the emergency source and test of automatic supply switchover or supply from an accumulator battery;

.19 operation test of closing appliances of all openings in the protected spaces (entrance doors and hatches, louvres and ventilation heads);

.20 examination for checking tightness of bulkheads/ decks enclosing all protected spaces (penetrations of pipes, cables, ventilation ducts) and checking if bulkheads/ decks contain holes which make fire-fighting ineffective;

.21 checking warning plates on all entrance doors/ hatches to the protected spaces;

.22 after survey completion, checking if all isolating/distribution valves and adjustable flanges are in proper position and if all isolated CO_2 cylinders and pilot cylinders are properly connected to pipelines. Checking that each remote control pilot line pipe is capable of opening such numbers of cylinders as is required for the protection of the given space. Checking that each pilot line pipe is capable of opening the proper distribution valve

Note: When conducting the tests, having regard to the safety of persons who may be present in the protected spaces, provision shall be made for blanking off the manifold with the connected CO_2 cylinders by means of adjustable flange (if fitted) or isolating the manifold from pipes conveying CO_2 to the spaces.

8.1.13 Fire-extinguishing Systems for Deep Fat Cooking Appliance

.1 external examinations of system items, such as: fire-extinguishing medium container, flexible hoses, control valves, pressure control devices, pipelines, discharge nozzles, etc.;

.2 operation test of automatic or manual control of the system and examining the system in accordance with manufacturer’s instructions;

.3 test of automatic shut-down of electric power supply after activating fire-extinguishing system;

.4 operation test of alarm signalization after activating of the fire-extinguishing system;

.5 checking the validity of laboratory test of the foam concentrate/softening agent used as an additive to enhance the system fire-extinguishing efficiency, where applicable;

.6 additional tests – in accordance with recommendations of system manufacturer.

8.1.14 Galley Exhaust Ducts

.1 external examinations of system items, such as: fire-extinguishing medium container, flexible hoses, control valves, fire dampers, pipelines, discharge nozzles;

.2 internal examinations of grease trap and exhaust ventilation duct (through inspection hatches) – checking that the duct walls are free of grease build-up;

.3 test of manual control of fire dampers in the lower and upper part of the duct;

.4 operation test of fire-extinguishing system control.

8.1.15 Fixed Fire Detection and Fire Alarm System

.1 external examinations of the system components, such as: fire detection panel, indicating units, manually operated call points, etc. and random examination of several fire detectors;

.2 external examinations of all fire detectors in spaces where the detectors are exposed to aggressive atmosphere, such as galleys, etc, and in spaces where the detectors are subject to mechanical damage, such as recreation spaces for personnel, etc.;

.3 operation test of the fire detection and alarm system:

- in accommodation and service spaces,
- in machinery spaces,
- based on the test of a few selected fire detectors, with the use of testing devices, i.e. devices producing hot air, smoke or dispersed particles or creating other phenomena simulating a fire to which detectors respond – checking control of input signal from a fire detector and operation of fire alarm on the fire control panel.

.4 operation test of several selected manually operated call points;

.5 operation test of visual and audible fire detection alarm signal at the control panel and operation test of all functions of the control panel (normal operation, alarm and alarm acknowledgement, fault and silenced conditions);

.6 for the system with section identification capability – operation test of the given section identification;

.7 for the system with individually identifiable fire detectors/ manually operated call points – operation test of identifying the given detector/ manually operated call point;

.8 operation test of all alarm indicating units and checking the automatic alarm switchover from indicating unit to general emergency alarm system, within 2 minutes.

.9 operation test of the system power supply from the emergency source and test of automatic power supply switchover;

.10 operation test of transmitting information on fire detection to other fire protection systems, such as: fire alarm systems, stopping fans, closing fire doors, closing smoke extraction systems, etc., if provided;

.11 checking the required number of spare fire detectors, in accordance with the system manufacturer recommendations.

8.1.16 Fixed Flammable Gas Detection System

.1 external examinations of system components, such as: gas analysing unit, isolating valves, pipelines, gas sampling points, etc.;

.2 operation test of the system, including: activating visual and sound alarm on the gas analysing unit, after discharge of hydrocarbon vapours to one of served compartments of the *unit*, or one of gas detector, after the required 10% or 30% of the lower flammability level of gas concentration has been exceeded.

.3 checking the automation of sequential operation of continuous monitoring and gas analysing from each gas sampling line, at intervals not exceeding 30 minutes or according to manufacturer's recommendations;

.4 operation test of all functions of gas analysing unit;

.5 operation test of automatic shut-down of the system, after the gas concentration inside the gas detection cabinet exceeded 30 % of the lower flammability level (LFL) / safe toxic gas concentration;

.6 operation test of isolating valves fitted on each gas sampling line;

.7 blowing through all gas sampling lines with compressed air or nitrogen.

8.1.17 Escape Routes Low-location Lighting System

.1 external examinations of photoluminescent strip indicators and marking on all escape routes leading to assembly stations, to verify their condition;

.2 operation test of low-location lighting supplied by electrical power – checking operation of each section of the lighting;

.3 checking the validity of low-location lighting system luminance, required every 5 years.

8.1.18 Ventilation Systems – Fire Dampers

.1 examinations and operation test of closing appliances of main external air inlets and outlets of all ventilation systems;

.2 operation test of remote stopping ventilation fans;

.3 external examinations of all accessible fire dampers in ventilation ducts;

.4 operation test of all ventilation control means connected with fire-extinguishing systems;

8.1.19 Fire Fighter's Outfit, Breathing Apparatus and Emergency Escape Breathing Devices (EEBDs)

.1 checking the number and arrangement of the required sets of fire fighter's outfit and emergency escape breathing devices, for compliance with an approved *Fire Control Plan*;

.2 checking the hydraulic test date of all air cylinders of breathing apparatus, emergency escape breathing devices and other air recharging cylinders, required every 5 years;

.3 checking the validity of inspection of breathing apparatus by an approved service station, in accordance with manufacturer's instructions, required every 12 months. During the inspection, checking the quantity of air is required. In case of air loss / pressure drop, cylinders shall be re-filled.

.4 inspection of emergency escape breathing devices (EEBDs) by an approved service station, in accordance with manufacturer's instructions and at manufacturer's recommended intervals;

.5 checking the validity of air quality examination for breathing apparatus cylinder, or air replacement, required every 2 years;

.6 operation test of the air cylinders recharging system (including compressor), for checking the air quality. The air quality examination may be performed by a laboratory approved based on ISO/IEC 17025:2005, in accordance with EN 12021 or an equivalent national standard;

.7 checking the condition of breathing apparatus face pieces and air control valves;

.8 checking if the fire fighter's outfit, i.e. protective clothing, fire-fighter's gloves and boots, helmets and belts, electric safety lamps, as well as breathing apparatus and emergency escape breathing devices are complete, are in proper condition and if all cylinders, including the spare charges, of each required breathing apparatus, are sufficiently charged;

.9 checking the number of spare breathing apparatus (double number of spare charges for each apparatus is required), unless the *unit* is provided with the system for air cylinders recharging.

8.1.20 Portable and Mobile Fire-extinguishers

.1 checking the number and arrangement of the required fire-extinguishers on the *unit*, for compliance with an approved *Fire Control Plan*;

.2 checking the validity of inspection of breathing apparatus by an approved service station, in accordance with the guidelines given in Resolution A.951(23) and manufacturer's instructions (inspection label), required every 12 months;

.3 during the inspection, checking the quantity of fire-extinguishing medium in fire-extinguishers and powder carrier cartridges is required. In case of medium loss of more than 10%, it shall be replenished;

.4 checking the condition of several fire-extinguishers, selected at random;

.5 for mobile fire-extinguishers external examinations of each extinguisher components, checking the validity of hydraulic test for each pressure vessel, and additionally for dry powder fire-extinguishers – turning the extinguisher upside-down to verify that the powder is not settled;

.6 checking if the extinguishers placed onboard the *unit* are identified by plates made from a photoluminescent material with symbols used on the *Fire Control Plan*;

.7 checking if the *unit* is provided with the required spare extinguishers.

8.1.21 Portable Instruments for Measuring Concentration of Flammable Gas and Oxygen

.1 external examinations of the instruments;

.2 checking the validity of calibration / verification of the instruments;

.3 checking the required set of spare parts;

.4 checking the possibility of measuring flammable gases concentration on open deck and in double hull compartments, in connection with fixed air sampling pipings.

8.1.22 Technical (Welding) Gas (Oxygen or Acetylene) Systems

.1 visual examinations of spaces for the storage of cylinders – checking closing appliances of the spaces, the condition of insulation, ventilation openings, safety manuals and warning plates;

.2 external examinations of the system components, such as: cylinders, pressure reducing valves, elastic pipes, cut-off valves, pipelines, etc;

.3 checking the validity of hydraulic test of all oxygen and acetylene cylinders;

.4 checking the safety valve fitted on manifold, for proper pressure setting;

.5 checking that the oxygen and acetylene intake filter is clean/filter exchange;

.6 tightness test of the oxygen and acetylene pipings passing through other spaces, with use of compressed nitrogen, to a pressure of at least 1.25 of working pressure;
.7 blowing through the oxygen and acetylene pipings with compressed nitrogen;
.8 operation test of cut-off valves on the oxygen and acetylene pipings;
.9 visual examinations of welding shop (if provided) – checking closing appliances of the space, checking bulkheads/ fire divisions separating the welding shop from engine room and other spaces for the absence of unnecessary openings, checking the safety manual;
.10 operation test of welding shop ventilation.

8.1.23 Helideck Rescue Kit

.1 checking the kit completeness;
.2 examinations and checking conditions of particular items of the kit.

8.2 Five-Year Survey

8.2.1 General Requirements

The 5-year survey shall cover the scope of the Annual Survey and additionally the activities specified in this subchapter.

8.2.2 Fire Divisions

.1 close-up examinations of several selected class A and B fire divisions – checking the condition and securing of insulation, checking the insulation adhesion to bulkheads, ceilings and ventilation ducts, checking the condition of division surface materials;
– in accommodation spaces, service spaces, and control stations,
– in machinery spaces.
.2 close-up examinations of several selected draught stops in the accommodation area – checking the condition and securing of insulation, visual examination of the draught stop integrity.

8.2.3 Water Fire Main System

.1 hydraulic test of the system pipelines passing through hull tanks, with test pressure of at least 1.25 of working pressure;
.2 tightness test of the system pipings at the maximum pressure of the main fire pump;
.3 hydraulic test of pressure tank (for wet pipings), to a pressure of at least 1.25 of working pressure, required every 10 years;
.4 hydraulic test of all fire hoses, to the maximum working pressure (1.2 MPa), in accordance with PN-EN 671-3 Standard, required every 5 years. The test may be performed by an approved service station;

8.2.4 Fixed Deck Foam System

.1 internal examinations of control valves /isolating valves fitted on water supply pipelines and foam concentrate pipelines;
.2 tightness test of water and foam concentrate pipings at the maximum supply pump pressure;
.3 operation test of all foam proportioners and other foam mixing devices – checking the foam mixing ratio (it shall be within +30% to –10% of the nominal mixing ratio for the system);
.4 operation test of one of foam monitors may be carried out instead of operation test of foam proportioners – checking foam generation and supply to the *unit* deck and assessment of the foam quality;
.5 after completion of the tests, flushing all the foam concentrate pipings with fresh water, draining the pipes and purging with compressed air.

8.2.5 High-pressure Carbon Dioxide Fire-extinguishing System

.1 internal examinations of all control valves/ isolating valves of the system;
.2 internal examinations and hydraulic test of at least 10% of the number of CO_2 cylinders placed onboard the *unit*, to a pressure of 22.5 MPa – for cylinder with filling ratio 0.75 kg/*l* and 19.0 MPa –

for cylinders of filling ratio 0.67 kg/*l*, required every 10 years for cylinders of age up to 20 years of age and every 5 years for older cylinders, and after each repair (irrespective of age). Cylinders with the worst technical condition shall be subjected to the test. If one or more cylinders fail the test, a total of 50% of the onboard cylinders shall be tested. If further cylinders fail the test, all cylinders shall be tested;

.3 internal examinations and hydraulic test of all pilot CO_2 cylinders, to test pressure and at intervals as specified above;

.4 hydraulic test of pipelines/ manifold from the cylinder to isolating/distribution valves, to a pressure of 19.0 MPa;

.5 hydraulic test of all CO_2 pipelines from isolating/distribution valves to the protected spaces, and pipelines from safety valves passing through accommodation and service spaces, to a pressure of 5.0 MPa;

.6 after completion of hydraulic tests, blowing through the pipings with compressed air to a pressure of at least 2.0 MPa, to remove contamination and dry the pipes;

.7 pressure test of all pipelines of remote control pilot lines, from pilot cylinders to distribution valves/cylinder valves, with use of compressed nitrogen, to a pressure of 1.3 of working pressure;

.8 checking if all flexible hoses used for connecting cylinders have been replaced at intervals recommended by the manufacturer, however, not exceeding 10 years;

.9 operation test of servomechanisms for remote opening of CO_2 cylinders;

.10 operation test of each time-delay mechanism. During the test, the time of delay of CO_2 discharge into the protected space shall be checked. The time shall be 20–45 s, from the opening of the release cabinet until opening the cylinder valves;

.11 operation test of remote opening the main valve/distribution valves after discharging extinguishing medium of required working pressure through pilot lines from each fire-extinguishing station, after opening control valve No. 1 in the release cabinet;

.12 operation test of all heads for remote opening of CO_2 cylinders, after they are dismantled from cylinder valves and after discharging the extinguishing medium of required working pressure through pilot lines, from each fire-extinguishing station, after opening control valve No. 2 in release cabinet;

.13 test of manual opening the main valve/ distribution valves at the maximum CO_2 pressure acting on the valve;

.14 for the systems with remote opening CO_2 cylinders with the use of actuating rods – operation test of all actuating rods and rollers;

.15 after survey completion checking if all isolating valves/distribution valves and adjustable flanges are in proper position and if all CO_2 cylinders and pilot cylinders are properly connected to the pipelines. Checking if each pilot line is reset to open the required number of cylinders required for the protection of the given space. Checking if each pilot line pipeline is reset to open the correct distribution valve.

8.2.6 Fire-fighting System for Galleys provided with Deep Fat Cooking Appliances

.1 hydraulic test of the pressure vessel of the fire-extinguishing system, to a pressure of 1.5 of working pressure, required every 10 years.

8.2.7 Exhaust Ventilation Duct from Galley Range

.1 hydraulic test of the system extinguishing medium container, to a pressure of 1.5 of working pressure, required every 10 years;

.2 hydraulic test of the fire-extinguishing system pipelines, to a pressure of 1.25 of working pressure, required every 10 years.

8.2.8 Fixed Fire Detection and Fire Alarm System

.1 close-up examinations of the fire detection panel after removal of front plate. Checking the contacts and internal components for the signs of burns, blackening and corrosion;

.2 operation test of each detector and each manually operated call point – checking the alarm inputs on the fire control panel (for the system not capable of identifying each detector);

.3 operation test of detector failure alarm (for the system capable of identifying each detector);

.4 checking the alarm of main and emergency power supply loss;
.5 checking the condition of emergency power supply batteries.

8.2.9 Fixed Systems of Hydrocarbon Gas and Toxic Gas Detection

.1 close-up examinations of the gas analysis unit after removal of the front panel. Checking the contacts and internal components for the signs of burns, blackening and corrosion;
.2 calibration of the setting of the gas analysis unit, corresponding to 10% or 30% of the lower flammability level for hydrocarbon gases/flammable gases, in accordance with manufacturer's recommendations.

8.2.10 Escape Routes Low-location Lighting Systems

.1 Checking the luminance of all low-location lighting systems – checking the lighting intensity in accordance with the guidelines contained in Res. A.752(18) and ISO 15370 Standard.

8.2.11 Ventilation Systems – Fire Dampers

.1 operation test of one of automatic fire dampers in fire divisions by simulation of exceeding the pre-set temperature value.

8.2.12 Fire-fighter's Outfit, Breathing Apparatus and Emergency Escape Breathing Devices (EEBDs)

.1 hydraulic test of all steel cylinders of breathing apparatus, emergency escape breathing devices and other air recharging cylinders, to a pressure of at least 1.5 of working pressure, required every 5 years. Cylinders made of aluminium and composite materials are subject to hydraulic test in accordance with the manufacturer's recommendations;
.2 internal examinations of regulating valves of compressed air cylinders of breathing apparatus and of control valves of air recharging systems, required every 5 years.

8.2.13 Portable and Mobile Fire-extinguishers

.1 for water, gas, powder and foam fire-extinguishers – the replacement of the whole amount of fire-extinguishing medium in extinguishers and powder carrier cartridges, required every 5 years;
.2 the replacement of the fire-extinguisher components, such as elastic hoses, discharge nozzles, control valves, required every 10 years;
.3 internal examinations and hydraulic test of all cylinders of fire-extinguishers (and powder carrier cartridges), to a pressure of at least 1.5 of working pressure, required every 10 years;
.4 for mobile fire-extinguishers close-up examinations of at least one extinguisher of each type manufactured in the same year, kept onboard the *unit*.

8.2.14 Technical (Welding) Gas System (Oxygen or Acetylene)

.1 hydraulic test of all cylinders with technical (welding) gases, to a pressure of at least 1.5 of working pressure, required every 5 years;
.2 hydraulic test of pipelines from cylinder to reducing valves, to a pressure of 1.5 of working pressure, required every 5 years;
.3 examination of gas pressure reducing valves.

8.2.15 Gas Fuel System for Domestic Purposes

.1 hydraulic test of all cylinders with liquid gas, to a pressure of at least 1.5 of working pressure, required every 5 years;
.2 strength test of pipelines from cylinders to reducing valves, to a pressure of at least 1.5 of working pressure, required every 5 years;
.3 examination of pressure reducing valves.

PART VI
Electrical Installations and Control Systems

1 GENERAL

1.1 Application

1.1.1 *Part VI – Electrical Installations and Control Systems* applies to electrical installations and automatic systems in ~~self elevating production~~ platforms ~~fixed to sea bed~~ hereinafter referred to as *units*, defined in 1.2.1 of Part I as Units and marine units.

1.2 Explanations , Definitions, Standards

1.2.1 Explanations and Definitions

Definitions relating to the general terminology for the purpose of this *Publication* are given in *Part I – Survey Regulations.*

For the purpose of the *Part VI,* the following additional definitions have been adopted:

Alarm system – the system intended to give warnings of conditions when deviations from the preset limits on the selected parameters or changes in normal working conditions occur.

Automated machinery – an engine, machinery, installation or other devices equipped with automatic or remote control systems.

Automatic control system – the system intended to control the machinery without human interference according to the specified control function.

Automatic system – a defined number of components, units and their connections forming structural and functional integrity, intended to perform control and monitoring functions.

Component of automatic system – the simplest and functionally self-dependent structural item used in automatic systems (e.g. relay, resistor, logic element, sensor, final control element).

Dead unit condition – a condition under which the main propulsion plant, boilers and auxiliaries are not in operation due to the absence of power. The absence of power means the starting battery discharge, the absence of starting air needed for restoring the operation of the main propulsion plant, boilers and auxiliaries.

Earthing – metallic connection of equipment terminal with the unit's metal hull.

Emergency condition – a condition under which any services needed for normal operational and habitable conditions are not in working order due to failure of the main source of electric power.

Emergency lighting – lighting of the *unit's* compartments and spaces by means of lighting fixtures fed from the emergency source of power or from the transitional source of emergency electric power.

Emergency source of electric power – a source of electric power intended to supply emergency switchboard for distribution of power to all the essential consumers on board the *unit* in the case of the loss of voltage in the main switchboard busbars.

Emergency switchboard – a switchboard which, in the case of the loss of voltage in the main switchboard busbars, is directly supplied from emergency source of electric power or from transitional source of emergency electric power and is intended to distribute power to consumers which are necessary for maintain safety of the *unit* during emergency.

Essential equipment and systems– equipment and systems which, under normal operation, ensures the continuity of the production operation, safety of unit and safety of human life on the board.

Fire-retardant insulating material – material satisfying the requirements specified in *Publication No. 11/P – Environmental Tests on Marine Equipment*.

Hazardous area – an area in which an explosive gas atmosphere is present, or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of electrical apparatus.

Indicating system – the system intended to indicate values of given physical quantities or significant states.

Lightning conductor – conductor which ensures connection of spike with earthing.

Lightning protection zone – zone protected against direct lightning stroke.

Main generating station – a space where the main source of electrical power is situated.

Main source of electric power – a source intended to supply electric power to the main switchboard for distribution to all services necessary for maintaining the *unit* in normal operational and habitable conditions.

Main switchboard – a switchboard, which is directly supplied by the main source of electric power and is intended to distribute electric energy to the unit's services.

MODU Code – Code for the Construction and Equipment of Mobile Offshore Drilling Units, 2009 (2009 MODU Code).

Monitoring systems – general term for alarm, safety and indicating systems.

Normal operational and habitable condition – a condition under which the unit as a whole, including machinery, process services, fire protection, internal and external communications and signals, means of escape, as well as the designed comfortable conditions of habitability are in working order and functioning normally.

Passive-EM equipment – electrical equipment which, when used as intended, does not create or produce any switching or oscillation of current or voltage and is not affected by electromagnetic disturbances, e.g. cables, cables accessories; equipment containing only resistive loads without any automatic switching device; batteries and accumulators.

Remote control system – the system intended to affect remotely the machinery in order to achieve control function given by the operator.

Safe voltage – any voltage not causing potential danger of electric shock or burn in normal conditions. This condition is considered to be satisfied if the windings of transformers, converters and other devices stepping down voltage are isolated electrically, and if the value of the stepped-down voltage across these devices or sources of electric power does not exceed:

– 50 V between conductors for direct current,
– 50 V between conductors or between the hull and the phase for alternating current.

Safety system – the system intended to intervene in a specific way upon the machinery controlled in order to prevent the failure of machinery or enlargement of its consequences.

SEEMP Plan – *Energy Efficiency Management Plan*

Signal lights and means – lights and sound means, referred to in Chapter 5 of Part VIII to this *Publication*.

Special electrical spaces – spaces or locations intended exclusively for electrical equipment and accessible only for authorized personnel.

Spike – the upper part of the lightning conductor designed for the direct receiving of lightning strokes.

Survey - technical supervision carried out by PRS in accordance with the requirements of this *Publication*.

Transitional source of emergency electric power – a source of electric power intended to supply all the essential consumers from the moment the loss of voltage occurs in the main switchboard busbars until the emergency generating set picks-up the load.

Uninterruptible Power System (UPS) – combination of converters, switches and energy storage means, e.g. batteries, constituting a power system for maintaining continuity of load power in case of input power failure.

Unit of automatic system – part of the automatic system consisting of a certain number of components forming structural and functional integrity.

1.2.2 Standards /Additional Publications

This *Publication* is extended and supplemented by the following documents:

PRS Rules	–	Rules for the Classification and Construction of Sea-Going Ships, *Part VIII – Electrical Installations and Control Systems*
IEC 60092	–	Electrical Installations in Ships.
IEC 61892	–	Mobile and Fixed Offshore Units Electrical Installations.

SOLAS 1974 – International Convention for the Safety of Life At Sea.
IMO MODU Code 1989 – Code for Construction and Equipment of Mobile Offshore Drilling Units

1.3 Scope of Survey

1.3.1 General

General principles of conducting supervision of the unit construction and equipment manufacture are given in *Part I – General Regulations* of this *Publication*. In relation to crude oil and gas production equipment, the requirements of *Part VII – Hydrocarbon Processing Systems* also apply.

1.3.2 Survey of Electrical Installation in Unit

1.3.2.1 The following equipment and systems are subject to PRS' survey during installation on board:

.1 main and emergency, including transitional, sources of electric power;
.2 power and lighting transformers and electric power converters used in equipment listed in 1.3.2.1;
.3 distribution gear and control and monitoring panels;
.4 electric drives for:
- operation process air compressors, starting air compressors and air compressors for sound signals,
- operation process, bilge and ballast pumps;
- watertight doors and fire doors,
- pumps and compressors of the smothering system,
- ventilating fans in machinery spaces, cofferdams, cargo holds and hazardous rooms and spaces;

.5 main and emergency lighting of spaces and locations of essential machinery and means of escape;
.6 navigation lights and signalling lamps;
.7 internal service communication;
.8 general alarm system;
.9 fire detection signalling and warning system indicating the release of the fire extinguishing medium;
.10 watertight door and fire door signals;
.11 electrical equipment in hazardous rooms and spaces;
.12 cabling;
.13 earthing devices;
.14 lightning conductors;
.15 electric drives of unit's elevating machinery;
.16 electric drives of refrigeration and air conditioning;
.17 electric heaters of medium process, fuel and lubricating oil,
.18 heating appliances and space heaters;
.19 generating sets automatic control system;
.20 safety system of engines driving generating sets;
.21 automatic system of pumps and medium process and air compressors;
.22 automatic system of oil and fuel separators;
.23 remote or automatic control system of bilge, ballast, and fuel transfer installations;
.24 machinery alarm system;
.25 control system of steam boilers;
.26 regulating system of production process parameters;
.27 other machinery and facilities not listed above, specified by PRS in each particular case.

1.3.2.2 PRS' classification survey on board the unit covers also all automatic systems which control or monitor machinery, equipment or installations subject to PRS' survey in accordance with the provisions of the present Chapter of the *Publication*.

1.3.2.3 Electrical equipment intended for domestic, living and technological application is to be surveyed by PRS within the following scope:

.1 influence of this equipment operation on the unit's electric network parameters;
.2 choice of cable types, cable sections and the ways of running the cables;
.3 means of protection, insulation and earthing.

1.3.3 Survey and Certification of Electrical Equipment during Manufacture

1.3.3.1 The following items of electrical equipment intended for systems and devices, specified in 1.3.2.1, are subject to PRS' survey during manufacture:
.1 generating sets;
.2 generators and electric motors of rating 50 kW (kVA) and above;
.3 transformers above 20 kVA rating;
.4 switchboards;
.5 control and monitoring panels;
.6 electric couplings and brakes;
.7 switchgear, protection and control devices;
.8 apparatus and devices of internal communication and signalling;
.9 rotary converters and power-electronic equipment;
.10 fuel and oil heaters;
.11 accumulators;
.12 cables;
.13 heating appliances and space heaters;
.14 photoluminescent materials and electrically powered lights of low-location lighting;
.15 lamps of additional emergency lighting;
.16 public address system and general alarm systems;
.17 computers and programmable logic controllers;
.18 sensors and transducers;
.19 automation system controllers;
.20 power operated valves;
.21 servo-motors;
.22 electric, hydraulic and pneumatic relays;
.23 data loggers (if they perform functions covered by the *Rules*);
.24 uninterruptible power system (UPS) units of 3 kVA and above;
.25 other items of electrical equipment not listed above, specified by PRS in each particular case.

1.3.3.2 Each explosion-proof electrical equipment is to be surveyed (with respect to its explosion proofness) by a special body recognized by PRS for this purpose, irrespective of whether or not this equipment is subject to survey according to the requirements specified in 1.3.3.1.

1.3.3.3 Test programme for electrical equipment will be specially considered by PRS in each particular case and the values of the relevant test parameters are given in Appendix 2 to *Part VIII*, *PRS Rules for the Classification and Construction of Sea-going Ships*.

1.4 Technical Documentation of a Unit

1.4.1 Documentation of a Unit under Construction

1.4.1.1 Prior to the commencement of *unit* construction, documentation listed in 1.4.1.2 and 1.4.1.3, is to be submitted to the PRS Head Office for consideration and approval.

1.4.1.2 Classification documentation of electrical equipment:
.1 principle diagrams of power generation and distribution circuits of the main and emergency electric power sources: power circuits, lighting circuits (up to branch circuit board) and navigation light circuits;
.2 specification of data on the circuits with indication of current values, the applied protective devices, as well as the types and cross-sectional areas of cables;

.3 principle diagrams and a general view of the main and emergency switchboards, unit's navigation control and monitoring console and other devices of non-standard design;
.4 calculation results of electric power plant output necessary to provide operation of the unit in conditions specified in 3.1.6, as well as the basis for the choice of the number and output of generators and the calculation of power of electric power emergency sources;
.5 principle or detailed diagrams of main, excitation, control, monitoring, signalization, protection and interlocking circuits of the unit's electric propulsion plant machines;
.6 calculation results of the unit's electric propulsion plant generators output necessary to provide operation in all conditions;
.7 calculation results of short-circuit currents on the main switchboard busbars and in the other points of electric network – as the basis for the choice of switching and protecting apparatus of generators and consumers, as well as for checking electrodynamic and thermal loads to which apparatus, wiring and busbars of main switchboard and other distribution equipment are to correspond – together with the selection of protective devices;
.8 results of calculation of illumination intensity for important compartments and open locations for information;
.9 diagrams of internal communication and signalling;
.10 principle diagrams of essential electric drives according to 1.3.2.1.4;
.11 diagrams of protective earthing;
.12 principle diagram of cable passages with indication of compartments through which they pass;
.13 results of capacity calculations of accumulator batteries supplying emergency lighting, navigation lights, general alarm and fire detection systems;
.14 data on electrical equipment in spaces where explosion hazard exists;
.15 diagrams of remote switching-off ventilation, fuel pumps and lubricating pumps;
.16 arrangement plans of main and emergency generators, main and emergency switchboards, accumulator batteries, equipment of explosion-proof execution.

1.4.1.3 Classification documentation of automated machinery:
.1 functional diagrams of particular automatic systems with regard to the respective equipment, machinery and installations, giving information concerning: method of supply, functional features, structure, eventual connections with other systems as well as limit values of parameters covered by these systems;
.2 drawings of particular units of automatic systems such as desks, consoles, showing their elevation and arrangement of internal components, as well as their location on board the *unit*.

1.4.2 Documentation of a *unit* under Conversion or Reconstruction

For the *unit* under conversion or reconstruction, having previously class of PRS or another classification society or an equivalent document recognized by the Administration issued by a competent state administration of the shelf, the documentation specified in 1.4.1.2 shall be submitted to PRS. PRS may accept, as the basis of survey, certain document / documents of PRS from own documentation of the *unit* classification.

1.4.3 Workshop Documentation

The following workshop documentation is to be submitted to the relevant PRS field organizational unit for agreement:
.1 drawings of cabling and cable fastening;
.2 diagrams of final circuits of emergency switchboard and emergency lighting;
.3 diagrams of final circuits of lighting switchboards;
.4 test programme for *unit's* electrical equipment and automated machinery ;
.5 technical documentation of equipment

1.5 Technical Documentation of Equipment .

Prior to the commencement of survey the manufacture of electrical equipment, the following documentation is to be submitted to PRS for consideration:
.1 description of the principle of operation and the main characteristics;

.2 material specification which is to contain elements, instruments and materials used and their technical characteristics;
.3 assembly drawing with sections;
.4 circuit diagram;
.5 technical specifications and the test programme;
.6 the rotor shaft mechanical strength calculations, drawings of poles and commutator fastenings for machines of rating 50 kW (kVA) and above;
.7 for distribution switchboards – calculation of thermal and electrodynamic strength of busbars under short-circuit conditions and the choice of apparatus to fit these conditions where the current rating of a generator or generators running in parallel exceeds 1000 A;
.8 for generating sets – selection of output of internal combustion engine for generator, list of sensors and their limit values, as well as calculation of torsional vibrations;
.9 data on static or dynamic interference resistance, or the means of testing the electro-magnetic compatibility;
.10 definite means of interference damping.

Where necessary, PRS may require that additional documentation and data on reliability should be submitted.

2 GENERAL REQUIREMENTS

2.1 Operating Conditions

When designing, selecting and arranging electrical equipment, the operating conditions specified in 2.1.1 to 2.1.4 are to be taken into account.

2.1.1 Climatic Hazards

2.1.1.1 The temperature values, specified in Table 2.1.1.1, are to be taken as the rated ambient air and cooling water temperatures for electrical equipment. The use of electrical equipment for other temperature ranges is subject to special consideration by PRS in each particular case.

Table 2.1.1.1

Item	Location in the unit	Ambient air and cooling water temperature, [°C]			
		~~Unrestricted service~~ Tropics		Service outside the tropic	
		Air	Water	Air	Water
1	Machinery spaces, special electrical spaces, galleys	from 0 to 45	30	from 0 to 40	25
2	Open decks and spaces	from –25 to 45	–	from –25 to 40	–
3	Other spaces	from 0 to 40	–	from 0 to 40	–

Notes:
1) For electrical machines located in machinery space, maximum air temperature equal to +50 °C is to be taken.
2) Electronic equipment and components intended to be installed in switchboards, desks and enclosures are to be capable of correct operation at the ambient air temperature of up to 55°C. The temperature of up to 70°C should not cause damage to components, equipment and systems.

2.1.1.2 Electrical equipment is to be capable of correct operation at a relative air humidity of 75 ± 3 per cent and a temperature of + 45 ± 2°C or at a relative air humidity of 80 ± 3 per cent and a temperature of + 40 ± 2°C or at a relative air humidity of 95 ± 3 per cent and a temperature of + 25 ± 2°C.

2.1.1.3 The structural parts of electrical equipment are to be made of materials resistant to sea air or reliably protected against its effects.

2.1.2 Mechanical Hazards

2.1.2.1 Electrical equipment is to be capable of correct operation at vibrations with a frequency of 2 Hz to 100 Hz, as follows:
– at a frequency from 2 Hz to 13.2 Hz with displacement amplitude ± 1.0 mm;
– at a frequency from 13.2 Hz to 100 Hz with acceleration amplitude ± 0.7 g.

Electrical equipment intended to be installed in locations in which specific severe vibration conditions prevail (e.g. internal combustion engines, compressors) ~~or to be installed in the steering gear compartment~~ is to be capable of correct operation at vibrations with a frequency of 2 Hz to 100 Hz, as follows:
– at a frequency from 2 Hz to 25 Hz with displacement amplitude ± 1.6 mm;
– at a frequency from 25 Hz to 100 Hz with acceleration amplitude ± 4.0 g.

2.1.2.2 Electrical equipment is to have adequate mechanical strength and is to be so located that it is not exposed to a risk of mechanical damage.

2.1.3 Power Supply Parameters

2.1.3.1 Electrical equipment is to be so designed that it remains operative under steady conditions in all cases, at all deviations from the rated values of voltage and frequency specified in the Tables: Table 2.1.3.1-1 – for a.c. distribution systems, Table 2.1.3.1-2 – for d.c. distribution systems, Table 2.1.3.1-3 – for battery systems (see also 14.1.3.2 to 14.1.3.5).

Table 2.1.3.1-1

Voltage and frequency variations for a.c. distribution systems			
Parameters	Deviations from rated values		
	Prolonged	Transient	
		Value	Time
Voltage	+6%, –10%	±20%	1.5 sec
Frequency	±5%	±10%	5 sec

Table 2.1.3.1-2

Voltage variations for d.c. distribution systems	
Parameters	Variations
Voltage tolerance (continuous)	±10%
Voltage cyclic variation deviation	5%
Voltage ripple (a.c.r.m.s. over steady d.c. voltage)	10%

Table 2.1.3.1-3

Voltage variations for battery systems	
Systems	Variations
Components connected to the battery during charging (see Note)	+30%, –25%
Components not connected to the battery during charging	+20%, –25%
Note: Different voltage variations as determined by the charging/discharging characteristics, including ripple voltage from the charging device, may be considered.	

2.1.3.2 Where loads are supplied from a battery via an electronic converter or inverter, the maximum permitted d.c. voltage variations are to be taken as those on the load side of the converter or inverter. Where the d.c. is converted into a.c., the maximum variations are not to exceed those given in Table 2.1.3.1-1.

2.2 Design Requirements and Degrees of Enclosures Protection

2.2.1 General Requirements

2.2.1.1 Parts which may require replacement while in service are to be easily dismountable.

2.2.1.2 Where screw fastenings are employed, measures are to be taken to exclude self-loosening of screws and nuts or, where dismantling and opening are at frequent occurrence, loss of some.

2.2.1.3 Gaskets used in conjunction with electrical equipment components (such as doors, covers, sight holes, packing glands, etc.) are to be appropriate to the degree of enclosure protection of the equipment in question. Gaskets are to be secured to the covers or casings.

2.2.1.4 Enclosures, shields and covers of electrical equipment installed in places accessible to unauthorised persons, protecting against access to live parts, are to be opened only with the use of tools.

2.2.1.5 Water drainage arrangements are to be provided in electrical equipment where condensation is likely to occur. Channels are to be fitted inside the equipment to ensure condensate drainage from all equipment components. Windings and live parts are to be so arranged or protected that they are not exposed to the effect of condensate which may accumulate inside the equipment.

2.2.1.6 When oil, steam or water are led to the measuring instruments used in the control desk or in the switchboard, it is necessary to undertake the preventive measures in order not to allow oil, steam or water to penetrate the live parts of the electrical equipment in case of damage of the measuring instruments or pipes.

2.2.2 Insulation Clearances

2.2.2.1 Clearances between live parts of different potentials, or between live parts and earthed metal parts or an outer enclosure, both in the air and across the insulant surface, are to be in accordance with the operating voltage and operating conditions of the installation, the properties of the insulating materials used being taken into account.

2.2.3 Internal Connections

2.2.3.1 Stranded conductors are to be used for all the internal wiring in electrical equipment. The use of single-wire conductors is subject to special consideration by PRS in each particular case.

2.2.3.2 The conductors to be used for the internal wiring switchboards, control and monitoring desks and other distribution and switching gear are to have the cross-sectional area of not less than 1 mm^2. For control, protection, measurement of parameters, signalling and internal communication circuits, conductors with cross-sectional area of not less than 0.5 mm^2 may be used.

For electric and electronic circuits transforming and transmitting low-current signals, conductors with cross-sectional area of less than 0.5 mm^2 may be used, which will be specially considered by PRS in each particular case.

2.2.3.3 Current-carrying parts are to be so attached as not to transmit any additional mechanical stresses; such parts are not to be attached by means of screws fitted directly into insulating materials.

2.2.3.4 Stranded cores, cables and conductors are to have their ends fitted out to suit the type of terminal used, or are to be provided with lugs.

2.2.3.5 Insulated conductors are to be laid out and secured in such a manner that the method used for their attachment and arrangement does not lead to reduced insulation resistance and that they are not exposed to damage due to short-circuit electrodynamic loads or dynamic loads caused by vibrations or shocks.

2.2.3.6 The connection of insulated conductors to terminals and busbars is to be so effected that, under rated operating conditions, the insulation of conductors is not exposed to overheating.

2.2.4 Degrees of Enclosures Protection

2.2.4.1 Electrical equipment is to be provided with appropriate protective enclosures depending on their location or other suitable measures are to be taken to protect the equipment from a harmful effect of the environment and to protect the personnel from electric shock hazards.

2.2.4.2 The minimum degree of protection of electrical equipment installed in rooms and spaces of the unit is to be chosen in accordance with Table 2.2.4.2.

Table 2.2.4.2

Item	Electrical equipment location (examples)	Conditions in equipment location	Design according to degree of protection
1 2 3 4 5 6	Accumulator battery rooms Lamp rooms Paint rooms Stores for welding-gas bottles Holds classified as explosion-hazardous Tunnels for pipes containing oil with a flash-point of 60 °C or below	Danger of explosion	Certified safe-type
7 8	Dry accommodation spaces Dry control rooms	Danger of touching live parts	IP20
9 10 11 12 13 14	PCS and MCS spaces Engine and boiler rooms above floor Refrigerated machinery rooms, auxiliary machinery rooms General store-rooms Pantries Provision stores	Danger of dripping liquid and/or moderate mechanical damage	IP22
15	Bathrooms and showers	Increased danger of liquid occurrence and/or mechanical damage	IP34
16 17 18 19 20 21	Engine and boiler rooms below floor Closed fuel oil separator rooms Closed lubricating oil separator rooms Refrigerated rooms Galleys and laundries Machinery space area protected by local water-spraying fire-extinguishing system covering the areas A and B according to Fig. 2.2.4.2.	Increased danger of liquid occurrence and mechanical damage	IP44
22	Open decks	Danger of occurrence of liquids in large quantities	IP56

Notes:
1) Where the protection is not achieved by the equipment enclosure itself, other means or the location where it is installed shall ensure the degree of protection required in the Table.
2) The area protected by local water-spraying fire-extinguishing system is shown in Fig. 2.2.4.2.
   A – a protected area – an area which is required to be protected by local water-spraying fire-extinguishing system
   B – an area adjacent to a protected area, exposed to direct spray
   C – an adjacent area, other than A and B areas, where water may extend.

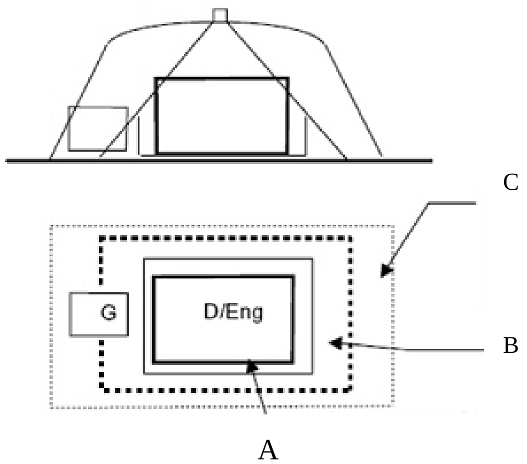

Fig. 2.2.4.2

3) In area C, according to Fig. 2.2.4.2, the electrical and electronic equipment may have a lower degree of protection than IP44, provided evidence of suitability for use in these areas is submitted, taking into account the design and equipment layout, e.g. the position of inlet ventilation openings. The cooling airflow for the equipment is to be ensured.

2.3 Protective Earthing

Metal enclosures of electrical equipment designed for higher voltage than the safety voltage, having no double or reinforced insulation, are to be fitted with an earth terminal marked with the symbol :

⏚

Depending on the purpose of the electrical equipment, provision is to be made for its earthing from inside or from outside.

2.3.1 Parts Subject to Earthing

2.3.1.1 The metal parts of electrical equipment which are likely to be touched under service conditions and which may become live in the event of damage to the insulation (except those mentioned in 2.3.1.2) are to have a reliable electric contact with a component fitted with an earth terminal (see also 2.3.3).

2.3.1.2 Protective earthing against electric shock hazard is not required for:

.1 electrical equipment supplied with current at safety voltage;
.2 electrical equipment provided with double or reinforced insulation;
.3 metal parts of electrical equipment fastened in an insulating material or passing through it and isolated from the earthed and live parts in such a manner that under normal operating conditions these parts cannot happen to be live or get in contact with the earthed parts;
.4 cages of specially insulated bearings;
.5 lamp bases, lamp holders and fasteners for luminescent lamps, lamp shades and reflectors, covers fastened to lamp holders or to lighting fixtures made of an insulating material or screwed into such a material;
.6 cable hangers and brackets;
.7 single sets of 250 V supplied by a separating transformer.

2.3.1.3 The screens and metal sheaths of cables are to be earthed.

2.3.1.4 The secondary windings of all measuring current and voltage transformers are to be earthed.

2.3.2 Earthing Terminals and Earthing Wires

2.3.2.1 Bolts for fastening the earthing wire to the unit's structure are to have a diameter not less than 6 mm; only for fastening wires with a cross-section of up to 2.5 mm^2 and wires with cross-section of up to 4 mm^2, bolts of 4 mm and 5 mm in diameter, respectively, may be used. These bolts are not to be used for other purposes than fastening the earthing wires. Bolts, which are screwed to a material (without nuts), are to be made of brass or other corrosion-resistant material.

The surface of the unit's structure to which the earthing wire is connected is to be metallically clean and adequately protected against corrosion.

2.3.2.2 Fixed electrical equipment is to be earthed by means of external earthing wires or an earthing conductor in the feeding cable. If earthing is made by means of one of the cores of the feeding cable, the core is to be connected to the earthed part of the equipment inside its enclosure. Special earthing need not be provided if the fastening of equipment ensures reliable electrical contact between the equipment enclosure and the *unit's* hull under all operating conditions.

For the purpose of earthing effected with an external earthing wire, copper wire is to be used. Wire of any other corrosion-resistant metal may also be used, provided the resistance of this wire does not exceed that of the required copper wire.
The cross-section of copper earthing wire is not to be less than that specified in Table 2.3.2.2.

Table 2.3.2.2

Cross-section of cable connected to appliance, [mm^2]	Minimum cross-section of external earthing conductor of fixed equipment, [mm^2]	
	Single-wire conductor	Multi-wire conductor
Up to 2.5	2.5	1.5
Over 2.5 to 120	Half the cross-section of a cable conductor connected, but not less than 4	
Over 120	70	

For the earthing effected with a special core in the feeding cable, the cross- section of this core is to be equal to the nominal section of the feeding cable core for cables up to 16 mm^2 and is to be equal to at least half the cross-section of the feeding cable core, but not less than 16 mm^2 for cables having a cross-section over 16 mm^2.

2.3.2.3 Earthing of the movable and portable appliances is to be effected through the earthed jack of a socket outlet or other earthed connecting elements and through the earthed copper core of the feeding cable. Cross-section of the earthing core is not to be less than the nominal cross-section of the core in the flexible feeding cable for cables up to 16 mm^2 and at least half the cross-section of the core in the flexible feeding cable, but not less than 16 mm^2 for cables over 16 mm^2.

2.3.2.4 Earthing wires or earthing conductors of cables in fixed equipment are not to be disconnected.

2.3.2.5 Earthing of screens and metal sheaths of cables is to be effected by one of the following methods:

.1 by a copper earthing wire having a cross-section not less than 1.5 mm^2 for cables with a cross-section up to 25 mm^2 and not less than 4 mm^2 for cables with a cross-section over 25 mm^2;

.2 by a suitable fastening of the metal sheath or armour of cables to the metal hull of the *unit*;

.3 by means of rings in the cable glands, provided they are corrosion-resistant, well conducting and resilient.

The earthing is to be effected at both ends of a cable, except cables in final sub-circuits which are permitted to be earthed on the supply end only. Where the methods specified above cause failures in the equipment operation, the screens, metal sheaths and armour of cables may be earthed by other approved means.

2.3.2.6 The external earthing wires are to be accessible for inspection and are to be protected against getting loose and against mechanical damage.

2.3.2.7 Cargo tanks and their process plant, including piping systems, are to have relevant connection with hull of the unit. Resistance between them and hull of the *unit* is not to be greater than 1 MΩ. In the case of lack of stable connection with the hull, bonding straps are to be used.

2.3.2.8 In the case of application of bonding straps, they are to be:
- clearly visible (in order to immediate verification of their failures);
- designed and installed in such way that they are protected against possible mechanical failures and corrosive atmosphere/products;
- easy for installation and replacement.

2.4 Lightning Protection

2.4.1 General Requirements

2.4.1.1 The *unit* is to be fitted with a lightning protection, the protection zone of which should comprise all arrangements that require protection against lightning.

When a *unit* is exposed to the risk of fire or explosion due to after-effects of lightnings, the earthing installation which would preclude secondary sparking is to be provided.

2.4.1.2 The lightning installation is to consist of a spike, lightning conductors and earthing. On metal masts, the lightning conductors need not be fitted if provision is made for a reliable electrical connection of the mast to the metal hull or to the earthing point.

2.4.2 Spike

2.4.2.1 If electrical equipment is installed on top of a metal mast, a lightning spike having a reliable connection with the mast is to be provided.

2.4.2.2 On each mast or topmast made of non-conducting material, a proper lightning installation is to be fitted.

2.4.2.3 Spikes are to be made of a rod of at least 12 mm in diameter. The rod may be of copper, copper alloys or steel suitably protected against corrosion; for aluminium masts, the spike may be made of an aluminium rod.

2.4.2.4 The spike is to be fitted to the mast in such a way as to project at least 300 mm above the top of the mast or above any equipment fitted on its top.

2.4.3 Lightning Conductor

2.4.3.1 The lightning conductor is to be made of a rod, flat bar or metal rope having a cross-section not less than 70 mm^2 for copper or its alloys and not less than 100 mm^2 for steel, the steel lightning conductors being suitably protected against corrosion.

2.4.3.2 Lightning conductors are to be run on the outer side of the mast and superstructures and as straight as possible with a minimum number of bends which should be smooth and have the largest possible radii.

2.4.3.3 Lightning conductors are not to pass through explosion-hazardous spaces.

2.4.4 Connections in the Lightning Installation

2.4.4.1 Connections in the lightning installation are to be welded, clamped, riveted or bolted with clamps.

2.4.4.2 The contact area of connections is to be at least 1000 mm^2.

Clamps and bolts are to be made of copper, copper alloys or steel suitably protected against corrosion.

2.4.5 Earthing Installation

2.4.5.1 Separate metal structures, movable joints, pipelines, screens of the cable network, as well as their inlets to the explosion-hazardous spaces are to be earthed.

2.4.5.2 Pipelines for crude oil products, as well as other pipelines related to the explosion-hazardous spaces and located on open decks or in spaces without electromagnetic shielding are to be earthed to the hull at distances not more than 10 m.

Pipelines located on the deck on which explosive gases may occur, but not related to the explosion-hazardous spaces, may be earthed to the *unit's* hull at every 30 m.

2.4.5.3 Metal parts located near the lightning conductors are to be earthed if they are not fixed on the earthed structures or if they are not metallically connected in any other way to the *unit's* hull.

Devices or metal parts located at a distance not more than 200 mm from the earthing conductors are to be connected to the latter in such a way as to preclude the possibility of secondary sparking.

2.4.5.4 All connections in the earthing installation are to be accessible for control and protected against mechanical damages.

3 MAIN SOURCE OF ELECTRIC POWER

3.1 General Requirements

3.1.1 Each *unit* is to be provided with main source of electric power of sufficient capacity to supply all essential services of the unit (not including the emergency power supply). The main source of electric power is to consist of at least two generators with an independent prime mover.

3.1.2 The number and the capacity of the generating sets and power converters composing the main source of electric power are to be such that in the event of any one generating set or power converter being stopped, it will still be possible to:

.1 supply the essential equipment and systems, maintaining the minimum comfortable conditions of habitability;

.2 start the electric motor with maximum starting current under the most severe starting conditions, with no such drop in voltage or frequency that might cause a fall out of synchronism or a stop of the generator prime mover, or switching off the running machines and apparatus.

3.1.3 The emergency source of electric power may be used for starting the engine-room machinery operation from a dead unit condition if its capability either alone or combined with that of any other source of electric power is sufficient to provide at the same time the services.

3.1.4 If only electric power is used for starting the main propulsion plant operation from a dead unit condition and if emergency source of electric power cannot be used for this purpose, then the generating set used for starting the main propulsion plant from a dead unit condition is to be provided with starting arrangements at least equivalent to those required for starting the emergency generating set.

3.1.5 The number and the capacity of the main source of electric power are to be determined with regard to the following operating conditions of the unit:

.1 in the event of fire or in other conditions having effect on the unit's safety;

.2 other – according to the unit's assignment.

3.1.6 Relevant parameters of sources and consumers of electrical power are to be presented in order to make necessary calculations for preparation of *Ship Energy Efficiency Management Plan* (SEEMP), if required.

3.2 Connection of Power Supply Sources

3.2.1 Where the electric power supply sources are not adapted for a prolonged operation in parallel to feed common busbars, the system of connections is to be so arranged as to provide possibility of their parallel operation during the time necessary for load transfer from one generator to another.

3.2.2 Where alternating-current generators are intended to operate in parallel, a synchronizer is to be installed in the main switchboard.

Where synchronizing is arranged to operate automatically, a stand-by manual synchronizer is to be provided.

Lamps for manual synchronizing are to be provided, irrespective of whether or not synchronoscopes have been fitted for manual or automatic synchronizing.

3.2.3 Where several direct-current generators are installed, a field initiating device is to be installed in the main switchboard. Such a device is also to be used in the case of a.c. synchronous generators if it is necessary for field initiation.

3.2.4 If provision has not been made for parallel operation between the shore electric power sources and those fitted on board, the connection system is to be provided with interlocking to prevent the connection of these sources for parallel operation.

3.2.5 Main switchboard busbars are to be subdivided into at least two parts, which should normally be connected by circuit breakers, switches, isolating switches or other means approved by PRS.

As far as practicable, generators and electrical power consumers which are duplicated are to be equally divided between the busbar parts.

4 DISTRIBUTION OF ELECTRIC POWER

4.1 Distribution Systems

4.1.1 The following systems of electric power distribution may be used in shipboard installations:

.1 for voltages up to 1000 V alternating current:

.1.1 three-phase three-wire insulated system;

.1.2 three-phase three-wire system with neutral earthed;

.2 in addition, for voltages up to 500 V alternating current:

.2.1 three-phase four-wire system with neutral earthed but without hull return;

.2.2 single-phase two-wire insulated system;

.2.3 single-phase two-wire system with one wire earthed;

.3 for direct current:

.3.1 two-wire insulated system;

.3.2 two-wire system with one pole earthed;

.3.3 three-wire system with neutral earthed.

The use of other systems is subject to special consideration by PRS in each particular case.

4.2 Power Supply from an External Source of Electric Power

4.2.1 If provision has been made for the *unit's* network to be supplied from an external source of electric power, a terminal for power supply from an external source of electric power is to be installed in the *unit*.

The external supply terminal is to be connected to the main switchboard by permanently fixed cables.

4.2.2 The terminal for power supply from an external source of electric power is to be provided with:

.1 suitable clamps to connect flexible cables;

.2 switchgear and protective devices for connection and protection of the cable supplying the main switchboard; where the length of the cable between the main switchboard and the terminal is less than 10 m, the terminal need not be provided with protection;

.3 a voltmeter or signal lamps to show the presence of voltage on terminals;

.4 a device or a possibility of connecting a device for checking the polarity and the phase sequence;

.5 clamps for earthing the neutral run from the external source;

.6 a plate indicating voltage level, kind of current and frequency;

.7 at the external supply terminal or nearby, a device for mechanical fastening of the flexible cable led to the terminal and cable hangers are to be provided.

5 ELECTRIC DRIVES FOR MACHINERY AND EQUIPMENT

5.1 General Requirements

5.1.1 Electrically driven machinery is to be provided with visual signal indicating that the device is in ”on” position.

5.1.2 The equipment provided with automatic remote and manual control is to be designed in such a manner that the automatic or remote control is switched off when changing over to the manual control. Manual control is to be independent of automatic or remote control.

5.2 Interlocking of Machinery Operation

5.2.1 The machinery provided with electric and manual drives is to be fitted with interlocking devices that will prevent the possible simultaneous operation of the drives.

5.2.2 If mutual dependence of machinery operation or machinery operation in a certain sequence is required, the appropriate interlocking device is to be used.

5.2.3 A device may be installed that will switch off the interlocking on condition that this device is protected from accidental switching off the interlocking. An informative inscription is to be placed in close proximity to this device indicating its application and forbidding using it by unauthorized personnel. Such device is not to be used for machinery specified in 5.2.1.

5.2.4 Starting of the machinery whose electric motors or switchgear require additional ventilation in normal operating conditions is to be possible only with ventilation in action.

5.3 Safety Switches

5.3.1 The control systems of electric drives, whose operation under certain conditions may endanger the human safety, are to be provided with safety switches that will ensure the disconnecting of the power supply from the electric drive.

The safety switches are to be painted red. An inscription indicating their purpose is to be placed near the switch.

These safety switches are to be protected from accidental, unintended use.

5.3.2 Safety switches are to be located in the control stations or in other places to ensure safe operation conditions.

5.3.3 Electric drives of the machinery and devices for which, in order to avoid damage or break-down, movement limits are required, are to be provided with limit switches that would ensure effective disconnecting of the electric motor.

5.4 Switchgear and Machine Control Gear

5.4.1 The switchgear which is not designed to break short-circuit currents is to withstand such maximum prospective short-circuit current that may flow at the point of its installation during the time required for operation of protection devices.

5.4.2 The machine control gear employed is to enable starting an electric motor only from the stop position.

5.4.3 Machine control gear is to be provided with an appropriate discharge protection device that would permit the disconnection of the shunt-field windings.

5.4.4 For each electric motor rated at 0.5 kW and more and its control gear, an appropriate device to disconnect the power supply is to be provided. If the control gear is mounted on the main switchboard or on any other switchboard in the same compartment and can be seen from the place of installation of the electric motor, then for this purpose it is permitted to use non-manoeuvring switches mounted on the switchboard.

If the requirements concerning the location of machine control gear stated above are not met, the following is to be provided:

.1 a device interlocking the switch on the switchboard in the ”off” position; or

.2 an additional disconnecting switch near the electric motor; or

.3 fuses in each pole or phase arranged in such a manner that they can be readily removed or replaced by the personnel.

5.5 Electric Drives for Pumps

5.5.1 The electric motors of fuel and lubricating oil transfer pumps, as well as of oil separators are to be provided with remote switching devices located outside the spaces in which these pumps are located and outside the machinery casing, but in direct vicinity of the exits from these spaces.

5.5.2 The electric motors of the pumps transferring the liquids outboard through the drain holes above the lightest waterline at locations where lifeboats or liferafts are lowered, are to be provided with non-manoeuvering switching devices located near the control stations of the driving machinery for lowering the relevant boats or rafts.

5.5.3 The electric motors of submersible bilge pumps and emergency fire pumps are to be provided with a remote starting device located above the bulkhead deck. The remote starting device is to be provided with the visual signal to indicate that the electric drive is switched on.

5.5.4 The local starting of fire and bilge pumps is to be possible even in case of failure in their remote control circuits.

5.6 Electric Drives for Fans

5.6.1 The electric motors for ventilation fans in machinery spaces are to be provided with at least two remote switching devices, one of which is to be located outside these spaces and their casings but in direct vicinity to the entries to these spaces.

5.6.2 The electric motors for ventilation fans serving cargo holds and galley fans are to be provided with switching devices at locations readily accessible from the main deck, but outside the machinery casings.

Electric motors of exhaust fans from the space above galley ranges are to be provided with additional switching devices located inside the galley room.

5.6.3 The supply and exhaust ventilation in spaces protected by a smothering system is to stop automatically when such a system is being put into operation.

5.6.4 The remote switching devices of electric motors for ventilation fans are to be grouped on board the unit so that all the electric motors may be remotely switched off from not more than three places.

6 LIGHTING

6.1 General Requirements

6.1.1 Lighting fixtures installed in rooms, locations and spaces where mechanical damage is possible to the hoods are to be provided with protection gratings or hoods made of material resistant to mechanical shocks.

6.1.2 Lighting fixtures are to be installed in such a manner as to prevent heating of cables and adjacent materials up to a temperature exceeding the permissible level.

6.1.3 In rooms and places illuminated with luminescent lamps where visible rotating parts of machinery are located, all measures are to be taken to prevent stroboscopic effect.

6.1.4 Outdoor lighting fixtures are to be installed in such a manner as not to dazzle the person handling any maneuvering and control station.

6.1.5 In rooms, locations and spaces lighted with discharge lamps which do not ensure the continuity of lighting at the voltage variations specified in *Part 2 (General Requirements),* lighting fixtures with incandescent lamps are to be provided.

6.1.6 Battery compartments and other explosion-hazardous spaces are to be illuminated with lighting fixtures located in adjacent safe spaces through gastight windows or with explosion-proof lighting fixtures installed inside such spaces .

6.1.7 The protections of the lighting final circuits of spaces are to be designed for the rated current not exceeding 16 A and the total circuit current is not to exceed 80 per cent of the rated current of the applied protection.

The number of lighting fixtures supplied from the lighting final circuits is not to exceed that specified in Table 6.1.7.

Table 6.1.7

Item	Voltage	Maximum number of lighting fixtures
1	up to 50 V	10
2	from 51 V to 120 V	14
3	from 121 V to 250 V	24

The cabin fans and other minor consumers may be supplied from the lighting final circuits.

6.1.8 Two-pole switches are to be used in lighting circuits. In dry accommodation and service spaces except PCS (Process control station) and MCS (Main control station) , single-pole switches may be used in circuits of individual and group lighting fixtures with a total power consumption of not more than 6 A, as well as in safety-voltage lighting fixtures.

6.2 Main lighting

6.2.1 In all rooms, spaces and locations of the unit where lighting is necessary to ensure the safety of navigation, operating of machinery and equipment, accommodation and evacuation of crew/ industrial personnel , stationary fixtures of the main lighting supplied from the main source of electric power are to be installed.

6.2.2 Lighting of corridors, stairways, machinery spaces and spaces in which the crew/industrial personnel can stay, is to be supplied by not less than two independent feeders. It should be ensured that in the event of failure of one of the above feeder at least 30% of luminaires remained in operation.

6.2.3 The main lighting system is to be so designed that a fire or other failure in the spaces containing the main source of electric power and/or the main lighting transformers does not cause the disconnection of the emergency lighting.

6.2.4 The main lighting switchboards are to be supplied by separate feeders solely intended for that purpose.

In addition to the lighting final sub-circuits, the main lighting switchboards may supply the electric drives of non-essential services rated up to 0.25 kW and individual space heaters rated up to 10 A.

6.3 Emergency Lighting

6.3.1 In all rooms, spaces and locations, mentioned in Chapt. 9 *(Emergency source of electrical power and energy distribution of the sources of emergency)* stationary fixtures of emergency lighting supplied from the emergency source of electrical energy should be permanently installed. In the absence of power from the primary source this lighting should be switched automatically. Only remote manual switching of MCS emergency outdoor lighting may be accepted.

6.3.2 The emergency lighting system is to be so designed that a fire or other casualty in the spaces containing the emergency source of electric power and/or emergency lighting transformers will not disconnect the main lighting system.

6.3.3 Permanently fixed, independent, automatically switched on lamps with built-in accumulator batteries and automatically recharged from the main lighting circuits may be used for the emergency lighting.

6.3.4 Each emergency lighting fixture is to be painted in red.

6.3.5 In the emergency lighting circuits, as a rule, no switches are to be fitted for the local disconnecting of fixtures. These switches may be used only in the circuits of emergency lighting lamps that, under normal conditions, are the lamps of the main lighting. In the emergency lighting circuits of the MCS and PCS, switches are to be installed.

6.4 Escape (temporary) lighting

6.4.1 In all rooms, spaces and locations, mentioned in Chapter 9 *(Emergency source of electrical power and energy distribution of the sources of emergency)*, stationary fixtures of escape (temporary) lighting supplied from the accumulator battery set should be permanently installed. Their capacity should provide the power for lighting by no less than 30 minutes. Accumulator batteries should be charged continuously with primary/emergency source of electricity. In the absence of power from the primary and the emergency source the lighting should be switched automatically.

6.5 Navigation Lights

6.5.1 Supply

6.5.1.1 The navigation lights required by Part VIII of *the Publication* should be powered from Navigation Lights Panel, in the MCS (Main Control Station). This Navigation Lights Panel should not be designed for any other purpose as supplying and control of navigation lights.

6.5.1.2 The Navigation Lights Panel is to be supplied by two circuits. One circuit from the main switchboard and the second circuit from the emergency switchboard . In the case of a power failure of one of these circuits the second circuit should be automatically switched while at the same time starting the alarm.

6.5.1.3 Navigation lights are to be connected to the network by flexible cables and plug connectors.

6.5.2 Requirements for the control / signalling circuits

6.5.2.1 Each feeding circuit of navigation lights is to be of two-wire type with a double-pole switch with visual indication of “ON/OFF” status.

6.5.2.2 Each navigation light feeding circuit is to be provided with protection in both wires and with visual signal of proper functioning of each navigation light.

6.5.2.3 For each navigation light visual and audible signals should be provided for acting in the case of failure any navigation light or damage to the circuit.

6.5.2.4 In case where doubled navigation lights ~~are~~ apply, each lamp should have a separate installation (circuit, protection, etc.), as required in this Chapter.

7 SIGNALLING AND INTERNAL COMMUNICATION

7.1 General Requirements

7.1.1 Signalling and internal communication systems, in addition to compliance with the applicable requirements of the present Chapter, are to comply, within the scope agreed with PRS, with the provisions of the *Code on Alerts and Indicators, 2009,* adopted by *IMO Resolution A.1021(26)*.

7.2 General Alarm System

7.2.1 Every unit are to be provided with a general alarm system. The system shall be should be well heard. The minimum sound pressure level for the alarm tone in open spaces is to be at least 80 dB(A) and at least 15 dB(9A) above the ambient noise level. In closed spaces the sound pressure level for the alarm tone is to be at least 75 dB(A) and at least 20 dB(A) above the ambient noise level. In no case shall the sound pressure level exceed 120 dB(A). Stations on which should be possible to launch a general alarm shall be agreed with the Administration. Required to have at least the following spaces: PCS, MCS, central fire station (if it is outside the PCS or MCS).

7.2.2 Signalling included in the general alarm system should be limited to: general emergency alarm, toxic gas (hydrogen sulfide), combustible gas, fire and unit abandon signals.

7.2.3 The general alarm system is to be supplied from the unit's network and from the emergency switchboard busbars.

The general alarm system may be supplied from the unit's network and from own accumulator battery, provided that automatic switch-over of supply circuit to accumulator battery is ensured.

7.2.4 The general alarm system is to be power supplied continuously, irrespective of the accumulator battery being set in position for charging or discharging.

7.2.5 When general alarm system is provided with its own accumulator battery, that battery may also be used for supplying other internal communication appliances, provided the battery capacity is sufficient for simultaneous supply of electric power to all appliances for sufficient time and these appliances are so designed that a damage to any circuit does not interfere with operation of other circuits.

7.2.6 Power supply circuits of general alarm system are to be provided only with short-circuit protection. Protection devices are to be fitted in both wires of supply circuit, as well as in circuits of each signalling device, if the system is not of self-controlled type.

One common protection for several signalling devices may be fitted if, in the space in which signalling devices are installed, good audibility of other signalling devices with independent protection is ensured.

7.2.7 Audible devices of general alarm system are to be so located that a signal is clearly heard against the noise in the given space. Audible devices installed in spaces with high intensity of noise are to be also fitted with visual signals.

The sound of the general alarm system is to be different from the sounds of all other signalling systems.

7.2.8 Signalling devices, switches and distribution boxes of the general alarm system are to be provided with readily visible distinctive marking.

7.2.9 Audible devices of general alarm system are to be divided at least in two circuits connected by one switch and so located that in large spaces (machinery spaces, boiler spaces) audible devices supplied from different circuits are installed.

7.2.10 The alarm should continue to operate until it is manually turned off or overridden by the public address system broadcast.

7.3 Public Address System

7.3.1 Every *unit* is to be fitted with public address system.

7.3.2 Public address system is to be one complete system consisting of a loudspeaker installation which enables simultaneous broadcast of messages from command microphone posts to all spaces available to the crew / industrial personnel and to alarm stations.

7.3.3 The public address system is to have command microphone posts installed on the following places:
– PCS;
– MCS;
– Fire detection control panels (if outside of the PCS or MCS);
– control station for emergency situations (if outside of the PCS or MCS).

7.3.4 Every command microphone post is to be fitted with light signalling which is to operate after the activation of the public address system.

7.3.5 The public address system, on full load and maximum amplification, is to ensure broadcasting service orders and emergency messages from command microphone posts to all required spaces, at the sound pressure level:
– 75 dB(A) and at least 20 dB(A) above the ambient noise level, in interior spaces;
– 80 dB(A) and at least 15 dB(A) above the ambient noise level, in exterior spaces.

7.3.6 The public address system is to be so arranged as to prevent feedback or other interference in broadcasting lines, e.g. in the case of short-circuit in loudspeakers' down-leads.

7.3.7 The public address system is to be supplied from the main source of electrical power, the emergency source of electrical power and transitional source of electrical power (continuous operation).

7.3.8 The public address system is to be protected against use by unauthorized persons .

7.4 Internal Communication

7.4.1 Effective means of internal communication for the purposes of communication between the spaces/rooms in which to take appropriate action necessary in emergency and danger situations are to be provided.

7.4.2 Service communication systems are to enable calling the subscriber and the clear voice communication in the conditions of specific noise in places where communication means are installed.

Where service telephone sets are located in spaces with a high noise level, noise suppressors are to be used or the sets are to be provided with additional headphones.

7.4.3 The communication means are to be provided with suitable sources of power, capable of ensuring the telephone operation even in the absence of power supply from the main sources of power.

7.4.4 A damage or disconnection of any telephone set is not to affect the working ability of the other sets.

7.4.5 The telephones for two-way communication between the PCS as well as MCS and local stations of controlling devices and operating essential equipment are to be provided with audible and visual calling signalization , both in the PCS as well as MCS and local stations.

8 PROTECTIVE DEVICES

8.1 General Requirements

8.1.1 With the exception of the power circuits of electric drives of fire pumps and emergency circuits, outgoing circuits of switchboards are to be protected against short-circuits and overloads by means of suitable devices installed at the beginning of each circuit.

Where circuit overload is not likely to occur, the circuit may be protected against short-circuits only.

8.1.2 Protective devices are to be so matched with the characteristics of the equipment under protection as to operate at all inadmissible overloads.

8.1.3 The protection system is to be discriminative both with regard to overload currents and to the prospective short-circuit currents.

Protection devices are to be so adjusted that the damage of non-essential consumers or their circuits does not affect harmfully the operation reliability of unit's generating plant and the continuity of supplying essential services.

Overload and short-circuits protection is not to operate under the effect of starting currents of the protected devices.

8.1.4 Overload protection is to be provided in:

.1 not less than one phase or positive pole in a two-wire system;
.2 not less than two phases in an insulated three-wire three-phase alternating- current system;
.3 all phases in a three-phase four-wire alternating-current system.

8.1.5 Short-circuit protection is to be fitted in each insulated pole of a direct-current system and in each phase of an alternating-current system.

Short-circuit current protective devices are to be set to operate at not less than 200 per cent of the rated current. Operation may be instantaneous or after a time-lag to allow for the proper discrimination.

To protect feeder cables and consumers against short-circuits, the same protective devices may be used.

8.1.6 Where, in any part of supply circuits, the cable cross-section is reduced, additional protection is to be provided unless the previous protective device is capable of protecting the cable of the reduced cross-section.

8.2 Protection of Generators

8.2.1 Generators not intended for parallel operation are to be provided with means of protection against overload and short-circuits. Fuses may be used as protective devices for generators rated under 50 kW (kVA), where installed with switches or contactors operating in all phases simultaneously.

8.2.2 Generators intended for parallel operation are to be at least provided with the following means of protection:

.1 against overloads;
.2 against short-circuits;
.3 against reverse current or reverse power;
.4 against under-voltage.

Generator protection system against overload is to be provided with visual and audible signals of overload operating with a time-lag of up to 15 minutes at overloads from 100 to 110 per cent of the rated current and be capable of disconnecting the generator after a time-lag corresponding to the generator thermal time constant at overloads within 110 to 150 per cent of the rated current of the generators.

For a setting of the protection to operate at 150 per cent of the rated current of generator, the time-lag is not to exceed 2 minutes for a.c. generator and 15 seconds for d.c. generator. At overloads exceeding 150 per cent of the rated current, the disconnection of the generator under such overload is to be instantaneous.

Overload protection setting and time delay values are to be selected to correspond to the overload characteristics of the generator prime mover so that the prime mover is capable of developing the necessary output within the time delay period adopted.

The protective devices used for generator overload protection are not to preclude the possibility of re-starting the generator immediately.

8.2.3 Means are to be provided to automatically and selectively disconnect the less essential services in the event of the generator being overloaded. This load shedding may be carried out in one or several stages, depending on the generator overload capacity.

The equipment for which the automatic load shedding is unconditionally allowed includes all services for habitability, e.g.: cooking, heating, domestic refrigeration, mechanical ventilation, air-conditioning, equipment of sanitary systems, etc.

The equipment for which the automatic load shedding is permissible includes, for example: windlass electric drives, refrigerating gear, cargo installation, mooring , lifeboat, ventilation and heating equipment switchboards, devices for charging the starting batteries and batteries powered essential equipment. The load shedding of other services is allowed unless their disconnection causes immediate disruption or prevents the systems required for the unit safety from being immediately available when the power supply is restored to normal operation conditions.

The equipment for which the automatic load shedding is not allowed includes, for example: electric drives of mechanisms ensuring the work of generating sets of the primary electric power source, switchboards of control and monitoring platform consoles.

The scope of the shed equipment is subject to special consideration by PRS in each particular case.

8.2.4 Reverse-power protection for generators intended to operate in parallel is to be selected to correspond to the prime mover characteristics. The respective protection settings are to be in accordance with those specified in Table 8.2.4.

Table 8.2.4

Kind of current	Limits of reverse-power protection settings related to generator prime mover	
	Turbine	Internal combustion engine
Alternating current	2-6 per cent of rated output of generator (kW)	8-15 per cent of rated output of generator (kW)

8.2.5 The under-voltage protection is to provide the possibility of connecting the generators to busbars at a voltage equal to 85 per cent or over of the rated value and to preclude their connecting to busbars at a voltage lower than 35 per cent of the rated value, as well as to disconnect generators when the voltage drops at their terminals to a value from 70 per cent to 35 per cent of the rated voltage.

8.2.6 The under-voltage protection is to operate with a time-lag necessary for disconnecting the generators from the busbars in the case of voltage drop and is to operate immediately during the attempt of connecting to busbars a generator, whose voltage has not reached the above-mentioned value.

8.2.7 Protection against internal faults and damage to connections between the generator and the circuit-breaker, causing de-energizing and immediate switching off the generator, is recommended for generators of rating 1500 kVA and above.

8.2.8 The short-circuit trips with a time-lag are to be so selected that in each case the expected short-circuit current in a protected circuit, after the lapse of the time-lag, is greater than the minimum return current of the trip.

8.2.9 Fuses may be applied as protection of semiconductors in the generator excitation circuits. Overload protection is to be in accordance with thermal characteristics of semiconductors.

8.2.10 Electronic or computerized protection devices for generators and consumers with load current higher than 30% of the rated current are to be provided with:
– arrangements to readily identify the final settings, if they are adjustable;
– facilities and instructions for testing on board the settings and functions.

8.3 Protection of Electric Motors

8.3.1 Outgoing feeders from switchboards supplying electric motors rated at over 0.5 kW are to be provided with means of protection against short-circuit currents and overloads, as well as with no-voltage protection if motors need not be automatically re-started.

It is admissible for overload and no-voltage protective devices to be installed in the motor starting apparatus.

8.3.2 The overload protective devices for continuously-loaded motors are to be set to disconnect the motor under protection in a range of 105 to 125 per cent of the rated current.

It is admissible for motor overload protective devices to be replaced by audible and visual signals subject to special consideration by PRS in each particular case.

8.3.3 The feeders of the electric drives of fire pumps are not to be fitted with overload protection operating on the thermal relay basis. Overload protection may be substituted with visual and audible signals.

8.4 Protection of Transformers

8.4.1 Short-circuit and overload protective devices are to be installed on the supply feeders of transformer primaries.

Transformers rated up to 6.3 kVA may be protected with fuses only.

Overload protection of transformers may be replaced by appropriate visual and audible signals subject to PRS' consent.

Overload protection or alarms need not be provided for voltage transformers and transformers supplying control circuits.

8.4.2 Transformers intended for parallel operation are to be provided with switches to disconnect their primary and secondary windings, but not necessarily at the same time.

8.4.3 If these transformers are supplied from different sections of the main switchboard, which may be disconnected during service, an interlocking device is to be provided to prevent their parallel operation when one of the sections, from which they are supplied, is disconnected.

8.4.4 The connection of current transformers is to be so arranged as to prevent the possibility of their secondary windings being opened during the switching of circuits.

8.5 Protection of Storage Batteries

8.5.1 Means of protection against short-circuit currents are to be provided for storage batteries other than those which are designed to start up internal combustion engines.

8.5.2 Each battery charging system is to be provided with a suitable protection against battery discharge due to a drop or loss of voltage at the outlet from the charger.

8.6 Protection of Pilot Lamps, Voltmeters, Capacitors and Voltage Coils of Apparatus

8.6.1 Pilot lamps, as well as measuring and recording instruments are to be provided with short-circuit protection or elements limiting short-circuit current.

Pilot lamps need not have such protective devices or elements limiting short-circuit current, provided that:

.1 the lamps are supplied through circuits inside the enclosure of the device;
.2 the protection of the device circuit is not exceeding 25 A;

.3 a fault in the lamp circuit is not liable to cause an interruption in the operation of an essential service.

Short-circuit protection and current limiting devices are to be located as close as practicable to the terminals on the supply side.

8.6.2 Radio interference suppression capacitors installed in the circuits of main and emergency switchboards, generators and essential electrical installations, are to be protected against short-circuit currents.

8.6.3 The voltage coils of apparatus and control or protective devices are to be protected against short-circuit current, but they need not have protection of their own, provided that:

.1 the coils are in the common enclosure of the device, they have common protective devices and they refer to the control system of one device;

.2 the coils are supplied through circuit of the device with protection not exceeding 25 A.

8.7 Protection of Power-electronic Equipment

8.7.1 Power-electronic semiconductor equipment is to be protected against internal and external overvoltage.

8.7.2 Blocks of semiconductor elements are to be protected against short-circuit. The protection of diodes and thyristors is to be independent of the load circuits protection.

8.7.3 If only one consumer is to be supplied by power-electronic equipment, the blocks of diodes and thyristors as well as load may have a common protection.

8.8 Protection of Emergency Circuits

8.8.1 The emergency sources of electric power are to be provided with a short-circuit protection only. Where the emergency source is a generator with an independent drive, visual and audible signals indicating the generator overload are to be fitted in the central control station.

8.8.2 Protection devices preventing immediate switching-on after operation of protection are not to be used in supply circuits of the emergency switchboard and emergency consumers.

9 EMERGENCY SOURCE OF ELECTRIC POWER AND DISTRIBUTION OF POWER FROM EMERGENCY SOURCES

9.1 General Requirements

9.1.1 Each unit is to be provided with the emergency source of electric power.

9.1.2 Generators with an independent drive or accumulator batteries (UPS- *Uninterruptible Power Supply*).

9.1.3 The capacity of the emergency source of electrical power is to be sufficient to supply power to all consumers, whose simultaneous operation is necessary to ensure safety in case of emergency.

Where electrical power is necessary to restore propulsion from a dead unit condition, the emergency source of electrical power is to have such capacity that the necessary propulsion starting energy is available within 30 min of blackout. Emergency generator stored starting energy is not to be directly used for starting the propulsion plant, the main source of electrical power and other essential auxiliaries (excluding emergency generator).

The dead unit condition is understood to mean a condition under which the main propulsion plant, together with generating sets are not in operation and devices intended for starting the main and auxiliary engines such as starting air vessels or starting batteries are discharged. Emergency generating set is not in operation but it is ready to use.

9.1.4 Means are to be provided to enable the inspection of all emergency electrical installations, including the automatic starting arrangement.

9.1.5 The central control station or the main switchboard is to be provided with a device indicating the discharge of an accumulator battery serving as the emergency or the transitional emergency source of power.

9.2 Spaces of Emergency Sources of Electric Power

9.2.1 The spaces of emergency sources of electric power, associated transforming equipment (if any), the transitional sources of electric power, the emergency switchboard and the emergency lighting switchboard are to be situated outside machinery casings.

The exits from these spaces are to be easily accessible and are to lead directly to the open deck.

9.2.2 The location of the emergency sources of electric power, associated transforming equipment (if any), the transitional sources of electric power, the emergency switchboard and the emergency lighting switchboard in relation to the main source of electric power, associated transforming equipment, and the main switchboard is to be such as to ensure that fire or other casualty in the space containing the main source of electric power, associated transforming equipment, the main switchboard or in any machinery space of Category A will not interfere with the supply, control and distribution of emergency electric power.

9.2.3 The spaces of emergency sources of electric power, associated transforming equipment, the transitional sources of power, the emergency switchboard and the emergency lighting switchboard are not to be adjoining, as far as practicable, to machinery and boiler compartments of Category A or spaces containing the main source of electric power, associated transforming equipment and the main switchboard.

Where such an arrangement is impracticable, decks and bulkheads separating the spaces are to comply with the requirements concerning control stations, set forth in *Part V – Fire and Anti-explosion Protection*.

9.2.4 The emergency switchboard is to be installed as near as practicable to the emergency source of electric power.

9.2.5 Where the emergency source of electric power is a generator with an independent drive, the emergency switchboard is to be located in the same space unless the operation of the emergency switchboard would thereby be impaired.

This space is to contain also all the starting, charging and energy storing devices intended for starting the emergency set.

9.2.6 The space of the emergency generating set is to be provided with heating arrangements to ensure appropriate temperature for ready starting of the set. The space is to be also ventilated in compliance with requirements in 11.3.3, *Part VI – Machinery Installations and Refrigerating Plants, PRS Rules for the Classification and Construction of Sea-going Ships*.

9.2.7 An accumulator battery which constitutes the emergency or transitional source of electric power, as well as the emergency switchboard are to be installed in separated spaces.

9.2.8 The battery room should comply with the requirements contained in the chapter on battery rooms.

9.3 Emergency Sources

9.3.1 The emergency sources of electric power are to have adequate capacity to supply simultaneously, for a period of 12 hours, electric power to the following consumers:

.1 emergency lighting of :
- **.1** all corridors, stairways and exits leading from accommodation and service spaces, personnel lift cars and their trunks,
- **.2** the machinery and generating sets spaces,
- **.3** all control stations, the main and the emergency switchboards,
- **.4** emergency generating set space,
- **.5** PSC,
- **.6** MCS and radio room,
- **.7** the stowage places for emergency and fire equipment, as well as the location of the manually operated call points,
- **.8** position at the fire pump, the sprinkler pump and at the starting positions of their motors,
- **.9** landing fields for helicopters,
- **.10** medical rooms.

.2 navigation lights and other lights required by Chapter 5 of Part VIII;

.3 internal communication equipment, command broadcast apparatus and general alarm system;

.4 navigation and radio equipment in accordance with the requirements of Part VIII;

.5 fire and hydrocarbon gas detection system;

.6 the daylight signalling lamp, audible devices (gongs, whistles, etc.), the manually operated calling signalization and all internal signalling systems required in an emergency;

.7 one of the fire pumps (if supplied by the emergency source of electric power) and the electric installations ensuring the operation of the foam generators specified in 3.5. of Part V ;

.8 other consumers, whose operation will be regarded by PRS necessary to ensure the safety of the *unit a*nd that of the people on board.

The consumers, specified in 9.3.1.3 to 9.3.1.6, may be supplied by their own accumulator batteries installed in accordance with 9.2 and having sufficient capacity to supply the services during 12 hours.

9.3.2 The emergency sources of electric power are to supply, for the period of 3 hours, the emergency lighting of places at lifeboats and liferafts, as well as the out-board spaces where the lifeboats and liferafts are brought down on water.

9.3.3 Where the emergency source of electric power is a generator with an independent prime mover, it is to be:

.1 driven by internal combustion engine (see para. 2.1.6, *Part VII – Machinery, Boilers and Pressure Vessels, PRS Rules for the Classification and Construction of Sea-going Ships*.) fitted with an alarm and safety system required by Chapter 19;

.2 capable of automatically starting in case of the loss of voltage in the main network and automatically connecting to the emergency switchboard busbars; the services required in 9.3.7 are to be automatically supplied from the emergency generator. The total time of starting and taking over the required load by the generator cannot exceed 45 seconds;

.3 provided with a transitional source of electric power if the time of the generator automatic starting and supplying the load, as required in .2, exceeds 45 seconds.

9.3.4 Where the emergency source of electric power is an accumulator battery, it is to:

.1 operate without recharging and with the voltage changes at its terminals within ± 12 per cent of the rated value throughout the discharge period;

.2 be capable of automatically connecting to the emergency switchboard busbars in the case of the loss of voltage in the main network and capable of immediately supplying at least those services specified in 9.3.7.

9.3.5 The accumulator battery is to be used as a transitional source of electric power required in 9.3.3.3. The capacity of the battery is to be sufficient to provide power supply without recharging and at the voltage changes at its terminals within ± 12 per cent of the rated value throughout the discharge period.

9.3.6 The capacity of the battery used as a transitional source of electric power is to be such as to ensure, for 30 minutes, power supply to the following consumers:

.1 lighting and navigation lights in accordance with 9.3.1.1, 9.3.1.2 and 9.3.2;

.2 all internal communication equipment and signals required in an emergency;

.3 fire detection and general alarm systems;

The consumers specified in .1, .2 and .3 are not required to be supplied by a transitional source of electric power, provided they have their own accumulator batteries of sufficient capacity for the required period of time.

9.3.7 During transition from the main to emergency power supply, services requiring continuous power supply are to be supplied from uninterruptible power system (UPS) complying with the requirements of sub-chapter 9.6.

9.3.8 Uninterruptible power systems used as battery or transitional emergency sources of power supply, required in 9.3.4 and 9.3.3.3, are to additionally comply with the requirements of sub-chapter 9.6.

9.3.9 Internal combustion engines driving emergency generators are to be fitted with an alarm and safety system designed:

.1 so that their parameters comply with the requirements of Chapter 2, *Part VII – Machinery, Boilers and Pressure Vessels, PRS Rules for the Classification and Construction of Sea-going Ships*;

.2 to be “fail safe”. The characteristics of the “fail safe” operation are to be evaluated on the basis of the system topology, its associated machinery, the complete installation and unit;

.3 such that regardless of the engine output, all shutdowns (except overspeed shutdown) are automatically overridden when the engine is in automatic or remote control mode during navigation;

.4 in which the alarm system functions in accordance with the requirements of the subchapter concerning the alarm system, with an additional requirement that emergency diesel engine group alarms are to be arranged on the PSC and MCS;

.5 with a local means of engine shutdown additional to the fuel oil control from outside the space;

.6 with a local indications of at least those parameters listed in .1 within the same space as the emergency diesel engines and remaining operational in the event of failure of the alarm and safety systems.

9.4 Distribution of Electric Power from Emergency Sources

9.4.1 The emergency switchboard is to be supplied during normal operation from the main switchboard by an interconnector feeder which is to be protected at the main switchboard against overload and short-circuit and which is to be disconnected automatically at the emergency switchboard in case of the loss of voltage in the main source of electric power. Where the system is arranged for feedback operation, the interconnector feeder is also to be protected at the emergency switchboard at least against short-circuit.

9.4.2 The emergency generating set may be used for short periods only, to supply consumers other than those specified in 9.3.1, 9.3.2, 9.3.3 in the following conditions:

.1 blackout condition;
.2 dead unit condition;
.3 routine use for testing;
.4 short-term parallel operation with the main source of electrical power for the purpose of load transfer.

9.4.3 Instructions are to be provided on board to ensure that when the unit is under way, all control devices (e.g. valves, switches) are in a correct position for the independent emergency operation of the emergency generating set and emergency switchboard.

These instructions are also to contain information on the required fuel oil tank level, ventilation openings, etc.

9.4.4 The consumers, listed in 9.3.1.1 are to be supplied with electric power by separate circuits directly from the busbars of the emergency switchboard fitted with suitable protection devices and switches. The consumers, listed in 9.3.1.2 to 9.3.1.6 may be supplied from the unit's navigation control and monitoring console located in the MSC and supplied in accordance with requirements for supplying the navigation control and monitoring console.

9.4.5 Where a transitional source of electric power is fitted, the consumers listed in 9.3.7 are to be supplied through a special switchboard. The circuits of the switchboard are not to be fitted with switches.

9.4.6 Cables supplying the emergency consumers are to be so run as to ensure the electric power supply to the remaining emergency consumers in case the emergency consumers located below the bulkhead deck are flooded.

9.4.7 The switchboards of the emergency consumers are to be located above the bulkhead deck.

9.5 Starting Arrangements of Emergency Generating Sets

9.5.1 The following devices with a continuously stored energy may be used as the starting arrangements of emergency generating sets:

.1 electrical starting system with its own accumulator battery and the charging system supplied from the emergency switchboard;
.2 hydraulic starting system supplied from the emergency switchboard;
.3 compressed air starting system supplied from the main or auxiliary air receivers through a non-return valve or by emergency air compressor supplied from the emergency switchboard.

9.5.2 Each emergency generating set arranged to be automatically started is to be equipped with a starting device of an approved type having the energy reserve sufficient for performing at least three consecutive starts. A source of the stored energy is to be protected against critical depletion by the automatic starting system, unless a second independent means of starting is provided. In addition, a second source of energy for additional three starts within 30 minutes or a manual starting device are to be provided.

9.5.3 Where automatic starting of the emergency generating set is not required, manual starting initiated by manual cranking, inertial starter, manually charged hydraulic accumulators may be applied, provided it can be demonstrated as being effective.

Where manual starting is not practicable, the starting devices are to comply with the requirements of 9.5.1 and 9.5.2, manual initiation of starting being permitted.

9.5.4 Where the emergency generating set is arranged to be started by means of electric starting system with its own accumulator battery only, a second accumulator battery serving as a reserve source of power with stored energy meeting the requirements of para. 9.5.2 is to be provided.

9.5.5 Emergency generating sets are to be capable of being readily started in their cold condition down to the temperature of 0°C. If this is impracticable or if lower temperatures are likely to occur, heating arrangements are to be provided so that ready starting of the generating sets is ensured.

9.6 Uninterruptible Power System (UPS) Units as Battery or Transitional Emergency Power Systems

9.6.1 Uninterruptible Power System units (hereinafter referred to as UPS units) are to be constructed in accordance with IEC Publication 62040 or the relevant national or international standards agreed with PRS. For the purpose of the present requirement, the following types of the UPS units can be distinguished:

- **.1** off-line UPS unit – an UPS unit where under normal operation the output load is powered from the bypass line (raw mains) and only transferred to the inverter if the bypass supply fails or goes outside, permitted by the *Publication*, preset limits. Permissible break in the load supply during transfer is to be not longer than 10 ms;
- **.2** line interactive UPS unit – an off-line UPS unit where the bypass line switches to the inverter when the input power goes outside, required by the *Publication*, voltage and frequency limits;
- **.3** on-line UPS unit – an UPS unit where under normal operation the output load is powered from the inverter, and will therefore continue to operate without break in the event of the supply input failing or going outside, permitted by the *Publication*, preset limits.

9.6.2 The operation of the UPS unit is not to depend upon external services.

9.6.3 The type of the UPS unit is to be appropriate to the power supply requirements of the connected load equipment.

9.6.4 An external bypass is to be provided.

9.6.5 The UPS unit is to be monitored and audible and visual alarm is to be given in a normally attended location for:

- **.1** power supply failure (voltage and frequency) to the connected load;
- **.2** earth fault;
- **.3** operation of battery protective device;
- **.4** when the battery is being discharged;
- **.5** when the battery bypass is in operation (applies to on-line UPS units, see 9.6.1.3).

9.6.6 The UPS unit is to be suitably located for use in an emergency. UPS units utilizing valve regulated sealed batteries may be located in compartments with normal electrical equipment, provided the ventilation arrangements are in accordance with the requirements of IEC Publication 62040 or the relevant national or international standards agreed with PRS.

9.6.7 The output power is to be maintained for at least the duration required for the connected equipment, as specified in 9.3 .

9.6.8 No additional services are to be connected to the UPS unit without verification that the UPS unit has adequate capacity. The UPS battery capacity is, at all times, to be capable of supplying the designated loads for the time specified in the requirements of the present Part of the *Publication* .

9.6.9 The rating parameters of the UPS charge unit are to be sufficient to recharge the batteries while maintaining the output supply to the UPS unit load equipment.

10 ELECTRIC MACHINES

10.1 General Requirements

10.1.1 The construction and operation of rotating machines shall comply with the requirements of IEC Publication 60092-301. The basic design of machinery should comply with the relevant parts of IEC Publication 60034.

10.1.2 Electric machines should be capable of continuous operation, unless otherwise specified their destination.

10.1.3 Electric machines, depending on where they are installed on the platform should be adapted to operate in the ambient air temperature specified in Table 10.1.3.

Table 10.1.3

No.	Location on platform	Temperature of the ambient air for continuous operation. [°C]	
		min.	max
1.	Machinery spaces, Locked special electrical spaces, galleys	0	45
2.	Open decks and spaces	–25	45
3.	Other spaces	0	40

10.1.4 Windings of electrical machines shall be resistant to moisture, sea air and vapor of oils.

10.1.5 Permissible temperature rises of electric machines at ambient temperature +45°C are specified in table 10.1.5. If the temperature of coolant is constantly below limits specified in Table 2.1.1.2, then temperature rises may be appropriately increased, however, by no more than 10 °C. If the temperature of coolant is above limits specified in Table 2.1.1.2, then temperature rises are to be appropriately decreased.

Table 10.1.5

Item	Parts of electrical machines	Classes of insulating material														
		A	E			B			F			H				
		Method of measurement, [°C]														
		Thermometer	Resistance	uilt-in sensors	Thermometer	Resistance	uilt-in sensors	Thermometer	Resistance	uilt-in sensors	Thermometer	Resistance	uilt-in sensors	Thermometer	Resistance	uilt-in sensors
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1
1	Windings of synchronous and asynchronous machines rated at 5000 kVA and over, or having a core length of 1 m and over	–	55	55	–	65	65	–	75	75	–	95	95	–	120	1
2	Windings of A.C. machines rated at under 5000 kVA and having a core length	45	55	–	60	70	–	65	75	–	80	95	–	100	120	–

	of less than 1 m. Field windings of D.C. and A.C. machines, D.C. excited, except such as are listed under 3, 4 and 5. Windings of rotors connected with commutator															
3	Field windings of D.C. excited non-salient-pole machines	–	60	–	–	75	–	–	85	–	–	105	–	–	120	–
4	Single-layer field windings with exposed surface	60	60	–	75	75	–	85	85	–	105	105	–	130	130	–
5	Low resistance field windings with more than one layer, as well as compensating windings	55	55	–	70	70	–	75	75	–	95	95	–	120	120	–
6	Permanently short-circuited windings, insulated	55	–	–	70	–	–	75	–	–	95	–	–	120	–	–
7	Permanently short-circuited windings, uninsulated	The temperature rises of such parts are not to reach values which can cause damage of insulation or other adjacent materials														
8	Steel cores and other parts out of contact with windings															
9	Steel cores and other parts in contact with windings	55	–	–	70	–	–	75	–	–	95	–	–	120	–	–
10	Commutators and unit rings open and enclosed	55	–	–	65	–	–	75	–	–	85	–	–	95	–	–

10.1.6 Generators are to be so designed that after reaching the steady-state temperature corresponding to the rated load they are capable of sustaining overcurrent such as specified in Table 10.1.6

Table 10.1.6

Item	Type of generator	Overcurrent, [%]	Duration of overcurrent, [sec.]
1	A.C. generator	50	120
2	D.C. generator	50	15

10.1.7 Electric motors are to be so designed as to be capable of developing, without stopping or sudden speed changes, increased torque such as specified in Table 10.1.7

Table 10.1.7

Item	Type of motor	Overload by torque, [%]	Duration of overload, [sec.]	Testing conditions
1	Polyphase synchronous motors, as well as squirrel-cage motors with starting current less than 4.5 times the rated current	50	15	Frequency, voltage and excitation to be maintained at rated levels

2	Polyphase induction motors for continuous and intermittent duties	60	15	Frequency and voltage to be maintained at rated levels
3	Motors as specified in 2, but for short-time and continuous duty with varying load	100	15	as above
4	Direct-current motors	50	15	Voltage to be maintained at rated level

10.1.8 Rotors of alternating and direct-current machines are to be capable of withstanding, for 2 minutes, without damage and permanent deformations, the following increased speed of rotation:

.1 generators, converters, electric couplings and brakes: 120 per cent of the rated speed, but not less than 3 per cent of the maximum number of revolutions in transient conditions;

.2 series-wound motors: 120 per cent of the permissible speed as indicated on the rating plate, but not less than 150 per cent of the rated speed;

.3 all motors other than those mentioned above: 120 per cent of the maximum no-load speed.

10.1.9 The requirements concerning electric machines testing are given in *Publication No. 42/P – Testing of Electric Machines.*

10.2 Rings, Commutators, Brushes, Bearings

10.2.1 Direct-current machines at 200 kW and above are to be provided with sight holes to permit observation of the commutator and brushes without removing the lids.

10.2.2 The permissible amount of wear of commutator segments or slip rings is to be indicated on their face side. It is to be taken equal to at least 20 per cent of the commutator segment or unit ring height.

10.2.3 For rotor of a mass of more than 1000 kg, possibility of reconditioning the commutator without removing the rotor from the machine is to be provided.

10.2.4 A flexible copper wire is to be used for drawing current from/to brushes. Brush holder springs are not to be used for this purpose.

10.2.5 The position of brushes in direct-current machines is to be clearly and indelibly marked.

Direct-current machines are to be so constructed as to be capable of working with fixed brush setting under all conditions.

10.2.6 Commutator type machines are to be capable of operating practically without sparking at any load from zero to the rated value.

No sparking is to be possible at the specified overloads, reversals or starts, to such an extent as to cause damage to brushes or commutators

10.2.7 Bearings are to be so designed as to avoid the possibility of oil splashing or leaking along the shaft and coming into contact with the machine windings or live parts.

10.2.8 Sliding bearings are to be fitted with overflow holes enabling outflow of oil excess and an oil level inspection lid. Oil level indicators are to be provided on machines rated at 100 kW (kVA) or more.

10.2.9 Pressure lubrication systems are to incorporate pressure indicators for oil supplied to a bearing.

10.2.10 Where reasonable, measures are to be taken to prevent flow of shaft stray currents through machinery bearings.

10.2.11 The bearings of generators driven by the main propulsion plant by means of belts or chains are to be designed with the transverse pull taken into account.

10.3 Electromagnetic Brakes

10.3.1 The brake is to operate when the brake operating coil becomes de-energized.

10.3.2 A 30 per cent voltage fall below the rated value is not to cause a hot brake to operate.

10.3.3 Electromagnetic brakes are to allow a manual release.

10.3.4 Electromagnetic brakes are to be fitted with at least two pressure springs.

10.3.5 The shunt windings of a compound-wound electromagnetic brake are to be capable of holding off the brake even when no current flows through the series winding.

10.3.6 The shunt windings of electromagnetic brakes are to be so constructed or protected that they can be safe from damage at overvoltages such as occur when they are disconnected.

10.4 Temperature Sensors

10.4.1 Stators of alternating-current machines rated at over 500 kVA or having an axial core length of more than 1000 mm, are to be provided with temperature sensors installed in places where the highest temperatures may be expected.

10.4.2 Embedded temperature sensors are recommended for short-time-rated and intermittent-rated electric motors.

10.4.3 It is recommended that embedded temperature sensors be used for the windlass drive electric motors. The sensors are to be so selected that the protection system disconnects the motor when the temperature rise limit for the insulation employed is exceeded by more than 30 per cent.

The terminals of sensors leads are to be so located as to be easily accessible.

10.5 Voltage Regulation

10.5.1 Alternating-current Generators

10.5.1.1 Each alternating-current generator is to have a separate independent system for automatic voltage regulation.

10.5.1.2 Damage to automatic voltage regulation of generators is not to result in inadmissible high voltages at the generator terminals.

10.5.1.3 Alternating-current generators are to have excitation margin sufficient to maintain for 2 minutes the rated voltage with a tolerance up to 10 per cent, with generator’s overload equal to 150 per cent of the rated current and power factor equal to 0.6.

10.5.1.4 Alternating-current generators rated at 50 kW (kVA) and above, together with their excitation and voltage regulation systems are to be so designed as to be capable of withstanding, at short-circuits, the effects of the three-fold rated current within 2 s.

10.5.1.5 Peak value of the three-phase short-circuit current of synchronous generators during operation at rated value is not to exceed 15-fold peak value of rated current.

10.5.1.6 Alternating-current generators are to have voltage regulation system so adjusted to the regulation characteristics of the prime movers that the rated voltage is maintained within ± 2.5 per cent (up to ± 3.5 per cent for emergency sets) at load changes from no-load to the rated load at rated power factor.

Main generators may have their voltage maintained within ± 3.5 per cent of the rated value at all power factor values from 0.6 to 0.9 except for the rated power factor.

The above requirement applies to a set operating at the rated speed and load of the generator.

10.5.1.7 A sudden change in the balanced load of a generator running at rated speed and rated voltage, under given current and power factor conditions, is not to cause a fall of voltage below 85 per cent of the rated value or a rise above 120 per cent.

Following such a change, the generator voltage is to be restored within not more than 1.5 seconds to the rated value with a tolerance of ± 3 per cent. For emergency sets, these values may be increased, respectively, to 5 seconds and ± 4 per cent of rated voltage.

Where no precise data are available on peak values of sudden load that may be connected additionally to the existing generator load, this may be taken equal to a load of 60 per cent of the rated current at a leading power factor of 0.4 or less, which is connected at idle speed and then disconnected.

11 TRANSFORMERS

11.1 General Requirements

11.1.1 In units where lighting and other essential services are powered through transformers, provision is to be made for not less than two transformers of such capacity that in case of failure of the largest unit, the remaining transformers will be capable of satisfying the complete demand for electric power under all operating conditions.

Where sectionalised busbars are used in the main switchboard, the transformers are to be connected to different sections of the busbars.

11.1.2 Dry transformers cooled by air are to be used. The use of transformers of other design (e.g. liquid-cooled) is subject to special consideration by PRS.

11.1.3 Transformers are to have electrically separated windings for primary and secondary voltages.

11.2 Overloads, Voltage Variations and Parallel Operation

11.2.1 Transformers are to be capable of withstanding 10 per cent overloads for 1 hour and 50 per cent overloads for 5 minutes.

11.2.2 Voltage variations at an active load between zero and rated load are not to exceed 5 per cent for transformers rated at up to 6.3 kVA and 2.5 per cent for transformers of higher rating.

11.2.3 Parallel-operating transformers are to have compatible vector groups, the same transformation ratios and their short-circuit voltages are to be such that the load on any transformer, at full load, does not depart from the corresponding proportional part of its power output by more than 10 per cent.

11.2.4 Where transformers are arranged to operate in parallel, the rated power output of the smallest transformer is not to be less than half the rated power output of the largest transformer.

12 POWER-ELECTRONIC EQUIPMENT

12.1 General Requirements

12.1.1 Power-electronic equipment is to be provided with silicon semi-conductor elements. The use of other types of elements is subject to special consideration by PRS.

12.1.2 Power-electronic equipment in which the power loss exceeds 500 W is to be provided with heating appliances to maintain the temperature of at least 3°C higher than the ambient temperature.

12.1.3 Power-electronic equipment is to be provided with air-cooling (natural or forced).The application of liquid-cooling is subject to special consideration by PRS.

12.1.4 In power-electronic equipment with forced ventilation, a protective device is to be provided to ensure reducing or switching off the load when the ventilation is switched off, as well as the actuating of the visual and audible signals when maximal permissible temperature inside equipment is exceeded.

12.1.5 Power-electronic equipment is to be provided with appropriate measuring instruments.

The maximum permissible values of parameters are to be marked on the scales of the measuring instruments. On the scales of the cooling air thermometers, in the case of forced air cooling, the maximum permissible temperature of the cooling air is to be clearly indicated.

12.2 Permissible Parameters of the Voltage Distortions

12.2.1 The voltage distortion factor, *K*, of the unit's network, caused by the operation of the power-electronic equipment is not to be greater than 10 per cent. The application of the power-electronic equipment causing the voltage distortions, exceeding the given tolerance range, is subject to special consideration by PRS.

The distortion factor is to be derived from the following formula:

$$K = \frac{1}{U_n}\sqrt{\sum_{v=2}^{n} U_v^2} \cdot 100\% \qquad (12.2.1)$$

where:

U_n – effective value of the network voltage;
U_v – effective value of voltage of *v*-number harmonic;
v – number of higher harmonic.

12.2.2 The factor u_w, determining the maximum relative deviation of the voltage instantaneous value from the first harmonic, is not to exceed 30 per cent.

The factor is to be derived from the following formula:

$$u_w = \frac{\Delta U_m}{\sqrt{2}\, U_1} \cdot 100\% \qquad (12.2.2)$$

where:

ΔU_m – the maximum value of the distorted voltage;
U_1 – the first harmonic effective value of voltage.

12.3 Design Requirements

12.3.1 Semiconductor' feeders should be made in accordance with IEC 60950-1 Standard. Converters for motor drives should be made in accordance with IEC 61800-5-1 Standard.

12.3.2 The ratings determine 100% of continuous load, and give the overload value and maximum duration of its existing.

12.3.3 Converters for motor drives (including systems for soft start) should withstand without overheating at least two starts following immediately after his stop or start in their cold condition .

12.3.4 Charge rectifiers, working as buffer with a storage battery set should have a sufficient power to cover all consumers connected to the network, and to charge the battery to 80% of rated capacity within 10 hours .

12.4 Control and Signalling Systems

12.4.1 Power-electronic equipment is to be provided with visual signals indicating the ”on” and “off” position of the power and control circuits.

12.4.2 The power circuits are to be electrically separated from the control circuit.

12.4.3 The prolonged difference between currents in parallel branches is not to be more than 10 per cent of the mean current value.

12.4.4 Failure of any of the rectifier valves is not to affect the operation of power-electronic equipment. An automatic control of load is to be provided to avoid exceeding the permissible loads for each of the rectifier valves. Failure of each of the rectifier valves is to be signaled by visual and audible alarms.

12.4.5 The asymmetry of control pulses of the converter control system ($\Delta\alpha$) is to be determined by the formula:

$$\Delta\alpha = \delta_k - \frac{360}{n} \tag{12.4.5}$$

where:
δ_k – distance between pulses of the adjacent ducts, in electric degrees;
n – number of control channels.
$\Delta\alpha$ is not to exceed ± 3 electric degrees at any point of the control range.

13 STORAGE BATTERIES

13.1 General Requirements

13.1.1 Storage batteries are to be so constructed that the loss of capacity of a fully charged battery due to self-discharge after 28 days out of operation at a temperature of 25 ± 5°C does not exceed 30 per cent of the rated capacity for acid batteries and 25 per cent for alkaline batteries.

13.1.2 Battery containers and closures for holes are to be so constructed and secured as to prevent spilling or splashing of the electrolyte when the container is inclined on any side to an angle of 40° from the vertical.

Closures are to be made of a durable material resistant to electrolyte. The closure design is to be such as to avoid the building up of excess gas pressure inside the battery.

13.1.3 The mastics used are not to change their properties or deteriorate at the ambient temperature changes within – 30°C to +60°C.

13.1.4 Materials used for fabrication of crates to house battery cells are to be resistant to electrolyte. Individual cells arranged within the crates are to be so secured as to preclude their relative movement.

13.2 Arrangement of Accumulator Batteries

13.2.1 Batteries having voltage exceeding the safety voltage, as well as batteries having a capacity of over 2 kW (computed from the maximum charging current and the rated voltage) are to be located in special battery compartments accessible from the deck or in appropriate boxes installed on the open deck. These spaces are to be special electrical spaces.

Batteries having capacity of up to 2 kW may be installed in boxes or cabinets located inside the unit.

Accumulator batteries intended for starting up internal combustion engines, except emergency sources of power, may be located in the engine room in special boxes or cabinets with suitable ventilation.

Accumulator batteries having a capacity of less than 0.2 kW are allowed to be installed in any space except accommodation spaces, provided that they are protected from the action of water and mechanical damage and do not harmfully affect the surrounding equipment.

13.2.2 The acid and alkaline batteries are not to be placed in one compartment or in one box.

The vessels and instruments intended for the batteries with different electrolytes are to be placed separately.

13.2.3 The inside part of battery compartment or box, as well as structural parts which may be subjected to harmful effect of electrolyte or gas are to be suitably protected.

13.2.4 The accumulator batteries, as well as the individual accumulator cells are to be properly secured in position. When they are placed on a stillage, the distance between the deck and the plugs of the upper tier of cells is not to exceed 1500 mm.

13.2.5 When installing the accumulator batteries or the individual accumulator cells, fitting linings and distance pieces between them are to be provided to ensure a clearance for circulation of air of not less than 15 mm.

13.2.6 Warning notices indicating the danger of explosion are to be provided on the doors leading to the battery compartment or near thereto, as well as on the boxes containing accumulators.

13.2.7 Accumulator batteries shall not be located in accommodation spaces except where the batteries are hermetically sealed. The location of hermetically sealed accumulator batteries in accommodation spaces is to be agreed with PRS in each particular case.

13.2.8 Except for explosion-proof lighting fixtures and cables led to accumulators and lighting fixtures, no other electrical equipment is to be installed in battery compartments.

13.3 Heating

13.3.1 The battery compartments in which temperature during operation may fall down below + 5°C, with the exception of battery boxes or cabinets installed on deck, are to be heated. The heating is allowed to be effected by the heat produced in adjacent spaces, as well as with water or steam radiators located inside the battery rooms.

13.3.2 The heating system valves are to be located outside the battery compartments.

13.3.3 The air conditioning system is not to be used for heating the battery compartments.

13.4 Ventilation

13.4.1 The battery compartments and boxes are to have sufficient ventilation that will prevent possible formation and accumulation of explosive mixtures.

The ventilation system is to meet the requirements given in sub-chapter 11.8, *Part VI – Machinery Installations and Refrigerating Plants* of the *PRS Rules for the Classification and Construction of Sea-going Ships*.

13.4.2 The battery compartments equipped with mechanical ventilation are to be provided with devices that will prevent possible charging of accumulator batteries before ventilation has been switched on. The charging cycle is to be automatically discontinued if the ventilators stop.

13.5 Charging the Storage Batteries

13.5.1 Equipment for charging the starter battery of emergency generator, emergency fire pump and batteries powered essential equipment should be separated and independent. They should be powered from busbars of the main switchboard.

13.5.2 Equipment for charging, working as buffer with a storage battery set should have a sufficient power to cover all consumers connected to the network, and to charge the battery to 80% of rated capacity within 10 hours .

13.5.3 The charging system should be able to measure the voltage at the battery clamps and measure the charging current, and for emergency energy sources **-** also measurement of the discharge current.

13.5.4 In units equipped with portable battery lamp or portable means of communication, devices for charging this equipment are to be provided.

13.6 Signalling and control of work of storage battery

13.6.1 Audible and visual alarm shall be given at the control station when a failure of the battery charging system, lowering the voltage on the battery or mechanical ventilation failure occurs..

13.7 Electric Starters for Internal Combustion Engines

13.7.1 In a unit equipped with electrically-started internal combustion engines, irrespective of the number of such engines, not less than two starter batteries are to be installed for starting the engines, or not less than two common batteries for starting all engines.

Permanent switching of the system is to be provided to ensure the possibility of using any battery for starting any of the engines in the group serviced by this battery. The arrangement is to be such that the batteries cannot be connected in parallel.

Where a single auxiliary engine is fitted, only one battery may be required.

13.7.2 The starting batteries are to be used for starting and the engine’s own monitoring purposes only. Arrangements are to be provided to maintain continuously the stored energy at all times.

13.8 Battery Characteristics

13.8.1 Each starter battery is to be designed to withstand the discharging current during starting that will correspond to the maximum current through the most powerful starting electric motor.

13.8.2 The capacity of each battery is to be sufficient for six starts of the engine in the ready-for-start condition; in the case of two or more engines – for not less than three starts of each engine.

13.8.3 When calculating battery capacity, the duration of each start is to be considered to be at least 5 seconds.

14 ELECTRICAL APPARATUS AND ACCESSORIES

14.1 Electrical Apparatus

14.1.1 The design of switchgear with renewable contacts is to be such that renewal of contacts is possible with the use of standard tools, without dismantling the switchgear or its basic components.

14.1.2 All non-maneuvering switches, except for cabin switches, are to be provided with mechanical or electrical contact position indicators.

14.1.3 Controllers and master controllers are to be provided with drums fixing the particular position of controls; location in the zero position is to be more perceptible than elsewhere. Controller and master controller drums are to be fitted with a scale and a position indicator.

14.1.4 Machine control gear, except that used for continuous regulation, is to be so constructed that the end and intermediate fixed positions are easy to feel at various control stages, while movement beyond the end positions is impossible.

14.2 Control system and measuring equipment

14.2.1 Control of necessary and important circuits should be separated from each other and should not be located in the same housing.

14.2.2 Control instruments of necessary and important equipment to be independent from each other and should be divided into two control stations or switchboards.

14.2.3 Control of the necessary and important equipment should not be dependent on any common controls such as emergency stop contactors .

14.2.4 A short circuit in indicator lights bulbs do not pose a threat to the control system.

14.2.5 Measuring instruments and transformers should have the class not lower than 2.5.
The upper scale limits of the instruments used are to be not less than:

.1 for voltmeters – 120 per cent of the rated voltage;
.2 for ammeters associated with generators not operated in parallel and with current consumers – 130 per cent of the rated current;
.3 for ammeters associated with parallel-operated generators – 130 per cent of the rated current for load-current scale;
.4 for wattmeters associated with generators not operated in parallel – 130 per cent of the rated output;
.5 for wattmeters associated with generators operated in parallel – 130 per cent for power scale and 15 per cent for reverse power scale;
.6 for frequency indicators – ± 10 per cent of the rated frequency.

14.3 Plug and Socket Connectors

14.3.1 Socket outlets and plugs with a rated current not exceeding 16 A shall be so constructed as to start and stop the rated current by inserting and removing the plug.

14.3.2 Socket outlets rated at over 16 A are to be provided with built-in switches. Such socket outlets are to be interlocked to prevent the possibility of inserting or withdrawing the plug when the socket switch is in the ”closed” position.

14.3.3 Socket outlets and plugs for voltage higher than the safety value are to have contacts for connecting the earth conductors of enclosures of the connected consumers.

14.3.4 Socket outlets and plugs are to be so designed that it is not possible to insert only one live contact pin into the socket outlet, or insert a live contact pin into the earthing contact. Besides, the design of the outlets intended for connecting the motors (or gear), the direction of rotation (or operation) of which depends on the change of the sequence of phases or poles connected, is to exclude the possibility of this change. When the plug is inserted into the socket outlet, the earthing part of the plug is to make contact with the earthing part of the socket outlet before connecting the live pins.

14.3.5 The design and dimensions of contacting parts of plugs are to be such as to exclude the possibility of connecting the plugs rated for one voltage with the socket outlet rated for another voltage.

15 HEATING APPLIANCES

15.1 General Requirements

15.1.1 Only heating appliances of stationary type are to be used.

15.1.2 Heating appliances are to be supplied from the main switchboard or section switchboard adopted for this purpose. Single heating appliances for interior spaces, supplied with current not more than 10A may be powered from lighting switchboards.

15.1.3 The supporting structural parts of heating appliances, as well as the internal surfaces of enclosures, are to be made entirely of non-combustible materials.

15.1.4 The permissible leakage current for hot heating appliances of stationary type is to be not more than 1 mA per 1 kW rated input of any separately connected heating element and not more than 10 mA for the appliance taken as a whole.

15.1.5 Heating appliances are to be so designed that the temperature of their components which are to be handled by the personnel or which can be touched accidentally does not exceed the values stated in Table 15.1.5.

Table 15.1.5

Item	Specification		Permissible temperature, [°C]
1	Control handles and other parts to be handled during substantial periods of time	metallic	55
		non-metallic	65
2	The same, but where short-time contact is possible	metallic	60
		non-metallic	70
3	Enclosures of electric space heating appliances at 20°C ambient temperature		80
4	Air coming out from space heaters		110

15.2 Space Heating Appliances

15.2.1 Electric heaters intended for space heating are to be of stationary type.
The electric heaters are to be provided with a suitable system to disconnect the supply source when the temperature rise exceeds the permissible limits for the heater enclosures.

15.2.2 The space heaters are to be installed in compliance with the requirements of para. 7.5, *Part V – Fire Protection, PRS Rules for Classification and Construction of Sea-going Ships*.

15.2.3 If built-in switches are not provided in the heating appliances, such switches are to be installed in the rooms in which these appliances are located. Switches are to disconnect power supply at all poles or phases.

15.2.4 The enclosures of electric heaters are to be so constructed as to prevent the possibility of placing any objects on them.

15.2.5 Stationary space heating appliances rated at 380 V and admitted for use in accordance with 4.2.2 are to be protected against access to live parts except with the aid of special tools. The enclosures are to have notices giving the voltage value.

15.3 Cooking Appliances

Heating appliances forming part of galley equipment are to be so constructed as to avoid the possibility of bringing cooking utensils into contact with live parts, and to prevent short-circuits or damage to insulation due to liquid spilling or leakage.

15.4 Oil and Fuel Heating Appliances

15.4.1 The electrical heating appliances may be used for heating oil and fuel having a flash point of vapour above 60 °C, provided that the requirements given in 15.4.2 and 15.4.3 are complied with.

15.4.2 The heating appliances of the oil and fuel pipelines are to be provided with temperature control devices, visual signal of operation conditions, as well as visual and audible alarms indicating a failure in the system or that the permissible temperature values have been exceeded.

15.4.3 As required in sub-chapter 12.3, *Part VI – Machinery Installations and Refrigerating Plants, PRS Rules for the Classification and Construction of Sea-going Ships,* the heating appliances for oil and fuel tanks are to be provided with temperature control devices for the heated medium, temperature indicators for surfaces of heating elements, minimum level sensors, as well as with means for the disconnection of power supply to the heating devices when the maximum permissible parameters have been reached.

Such appliances are to be provided with visual signal on operation conditions and with audible and visual signals indicating a failure in the system.

15.4.4 Where steam or electric heaters are provided in fuel or lubricating oil systems, they are to be fitted with at least high temperature alarm or low flow alarm in addition to a temperature control system. These alarms are not required where the temperature dangerous for ignition of the medium cannot be reached.

The safety switch with manual re-set is to be provided for disconnecting the supply voltage when temperature above 220 °C can be reached by a surface of the heating element. The safety switch is to be independent from the automatic control sensor.

Fuel and lubricating oil heaters are to be installed in accordance with the requirements specified in 12.2, *Part VI – Machinery Installations and Refrigerating Plants, PRS Rules for the Classification and Construction of Sea-going Ships*.

16 CABLES AND CONDUCTORS

16.1 General Requirements

16.1.1 Cables and conductors allowed for use in units are to be at least fire retardant and tested in accordance with IEC Publication 60332-1 or equivalent test procedures, meeting the requirements of the present Chapter or the relevant national and international standards agreed with PRS, including IEC Publications 60092-3, 60092-350, 60092-351, 60092-352, 60092-353, 60092-354, 60092-359, 60092-373, 60092-374, 60092-375 and 60092-376.

16.1.2 The telecommunication, telephone and coaxial cables are to comply with the requirements of IEC Publications: 60092-351, 60092-373, 60092-374, 60092-375, and 60331-25. Optical fibre cables are to comply with the requirements of IEC Publication 60331-25.

16.1.3 Where the use of fire-resistant cables is required, the cables are to comply with the requirements of IEC Publication 60331. Fire resistant cables are to be easily distinguishable.

16.1.4 The possibility of the use of other types of cables and wires is subject to special consideration by PRS in each particular case.

The requirements of the present Chapter do not apply to power cables for the voltage over 1000 V.

16.2 Conductors

16.2.1 Cable conductors intended for supplying essential services are to be of multi-wire type. Table 16.2.1 specifies the number of wires per conductor.

Table 16.2.1

Item	Nominal cross-sectional area of conductor, [mm^2]	Minimum number of wires per conductor	
		Circular non-compacted conductors	Compacted circular and shaped conductors
1	0.5 – 6	7	–
2	10 – 16	7	6
3	25 – 35	19	6
4	50 – 70	19	15
5	95	37	15
6	120 – 185	37	30
7	240 – 300	61	30

Note: The ratio of nominal diameters of any two wires of mechanically compacted conductors is not to exceed the value of 1:1.3 and that of shaped non-compacted conductors – 1:1.8.

16.2.2 Separate wires in multi-wire conductors are to be spliced in a reliable manner so as not to impair the mechanical or electrical properties of the wire and not to change the cross-section of the wire or that of the whole conductor. Splice-to-splice distances in separate wires along the length of conductor are not to be less than 500 mm.

16.2.3 Separate wires of rubber-insulated copper conductors are to be tinned or coated with a suitable alloy.

Tinning or other anticorrosive coating of external wiring or of all wires of a rubber-insulated conductor may be dispensed with if the manufacturer takes measures to guarantee that the rubber insulation does not affect adversely the metal of the conductor.

No tinning is required for conductors provided with other types of insulation.

16.3 Insulating Materials

16.3.1 The types of insulation that may be used for insulating current-carrying conductors in cables are listed in Table 16.3.1. The use of other types of insulation is subject to special consideration by PRS in each particular case.

Table 16.3.1

Designation of insulation	Standard types of insulating materials	Permissible working temperature[1], [°C]
PVC/A	Polyvinyl chloride compound – general purpose	60
V 75 PVC/D	Polyvinyl chloride compound – heat resistance quality	75
EPR	Ethylene-propylene rubber compound	85
XLPE	Cross-linked polyethylene compound	85
S 95	Silicone rubber compound	95
HF EPR	Halogen free ethylene propylene rubber	85
HF XLPE	Halogen free cross-linked polyethylene	85
HF S95	Halogen free silicon rubber	95
HF 85	Halogen free cross-linked polyolefin material	85

[1] Temperature of the conductor assumed for the calculation of current rating in continuous service of cables.

16.4 Cable Sheaths

16.4.1 Cable and conductor sheaths may be made of materials given in Table 16.4.1.

The use of other materials for cable sheaths is subject to special consideration by PRS in each particular case.

16.4.2 Sheaths are to be of uniform thickness, within permissible limits, throughout the manufacturing length of cable, and are to envelope the cable cores concentrically.

The sheaths are to form an impervious cover adhering to the protected cores.

Table 16.4.1

Designation	Type of tight non-metallic cable sheath	Maximum working temperature of cable in sheath, [°C]
ST1	Polyvinyl chloride compound – general purpose	60
ST2	Polyvinyl chloride compound – heat resistance quality	85
SE1	Polychloroprene rubber compound	85
SH	Chlorosulfonized polyethylene compound	85
SHF1	Halogen free thermoplastics material	85
SHF2	Halogen free thermosettings material	85

16.5 Protective Coverings

16.5.1 Metal screening braid is to be made of tinned copper wire. If plain copper wire is used, it is to be protected by suitable sheaths. Non-screening braids may be of galvanized steel wires. The braid is to be uniform and its density is to be such that its weight is at least equal to 90 per cent of the weight of the tube of an equal diameter, made of the same material and with a wall thickness equal to the braiding wire diameter.

16.5.2 Metal armour is to be made of annealed steel wire or tape, galvanized and wound helically, with a suitable pitch, over the cable sheath or an intermediate bedding over the sheath in such a way that a continuous cylindrical layer is formed to assure adequate protection and flexibility of the finished cable. On special demand, the armour may be made of non-magnetic metals, using the techniques described above.

16.5.3 Cable armour or braid made of steel tape or wire are to be painted for corrosion prevention.

16.5.4 Armour bedding is to be made of moisture resistant materials.

16.6 Marking

16.6.1 Rubber- or polyvinyl-chloride-insulated cables having a limiting temperature at core over 60°C are to be marked in such a manner as would permit their identification.

16.6.2 Cable conductors are to be marked in a way that would ensure the permanence of marking.
In multi-core cables, the cores of which are arranged in several concentric layers, at least two adjacent cores in each layer are to be marked with different colours.

16.7 Wiring

16.7.1 Insulated single-core conductors are to be used for internal wiring of switchboards and electrical devices (see also 2.3.3).

16.7.2 Non-insulated wires and busbars are permitted for use only for internal wiring of electrical devices. The external wiring with non-insulated wires or busbars is not allowed unless they are reliably guarded.

16.8 Cabling

16.8.1 General Requirements

16.8.1.1 Cables and conductors having multi-wire cores shall be used with the cross-sectional area not less than:

.1 1.0 mm^2 – for power, control and signalling circuits supplying the essential equipment and for power circuits supplying other equipment;
.2 0.75 mm^2 – for control and signalling circuits supplying non-essential equipment;
.3 0.5 mm^2 – for monitoring and indicating circuits and the circuits serving internal communication, with not less than 4 conductors in the cable.

In the case of circuits supplying non-essential equipment, it is permitted to use single-wire core conductors with a cross-sectional area of 1.5 mm^2 or less.

16.8.1.2 Maximum permissible temperature for the insulating material of the cable cores or conductors is to be at least 10°C higher than the maximum ambient temperature likely to exist in the space where the cable is installed.

16.8.1.3 In locations affected by the action of crude oil products and other aggressive media, the cables having a sheathing that will withstand the action of a given medium are to be used. Cables of other types may be installed in such locations, provided they are laid in metallic pipes (see 16.8.8).

16.8.1.4 In locations where cables may be subjected to mechanical damage, they are to have an appropriate armour, while other types of cables in such locations are to be protected with special reliable covers or are to be installed in ~~metallic~~ pipes (see 16.8.8).

16.8.1.5 Power and control cables for systems required to be operable under fire conditions, specified in 16.8.1.6, are to be fire- resistant if they pass through the casings of machinery spaces of Category A, galleys, drying rooms, boiler rooms and other high fire risk areas, other than those which they serve. Systems that are self-monitoring, fail safe or duplicated with cable runs as widely separated as practicable may be exempted from this requirement.

On the outer side of the above-mentioned compartments, the cables are to be run at a distance of not less than that specified in 16.8.4.2.

In units in which, due to their dimensions, the above requirement cannot be satisfied, measures are to be taken to ensure effective protection of the cables running through fire-hazardous spaces.

16.8.1.6 Systems required to be operable under fire conditions include: fire and general alarm system; fire-extinguishing systems and fire-extinguishing medium alarms; fire detection system; control and power systems to power-operated fire doors and status indication for all fire doors, control and power systems to power-operated watertight doors and status indication for all watertight doors, emergency lighting, low location lighting, public address system, remote emergency stop/shutdown systems for devices which may support the propagation of fire and/or explosion; emergency fire pump in accordance with the requirement specified in *Part V – Fire Protection, PRS Rules for the Classification and Construction of Sea-going Ships*.

In each particular case, the system means main and emergency power supply circuits, control, signalling circuits, as well as communication-circuits between the devices constituting part of the system.

The signalling and control cables are to be fire-resistant at least from the control/monitoring panel to the local distribution panel nearest to the relevant area or zone served. The power supply cables are to be fire-resistant at least from their distribution point, within the space containing the emergency source of electrical power, to the local distribution panel nearest to the relevant area or zone served.

16.8.2 Selection of Cables and Conductors for Loads Required

16.8.2.1 Permissible continuous loads on single-core cables and on conductors insulated by various materials are to comply with the values given in Table 16.8.2.1 (see also 16.8.2.6).

The values of loads given in the Table refer to the following cases of cable installation:

.1 not more than 6 cables installed in one bunch or one layer, adhering to one another;

.2 in two layers, irrespective of the number of cables in the layer, provided that there exists clearance for free circulation of the cooling air between the group or bunch of six cables.

The values of the permissible current ratings for the relevant cross-sectional areas specified in the Table are to be reduced by 15% (factor 0.85) in the case where more than 6 cables installed in one bunch may be simultaneously loaded by the rated current or where there is lack of clearance for the cooling air circulation.

Table 16.8.2.1
Permissible current ratings in continuous service of single-core cables and conductors with various insulation at the ambient temperature of 45 °C

Nominal cross-sectional area of conductor, [mm^2]	Permissible current rating in continuous service, A				
	Polyvinyl chloride	Polyvinyl chloride heat-resisting quality	Butyl rubber	Ethylene-propylene rubber, cross-linked polyethylene	Silicon rubber and mineral insulation
	+ 60*	+75*	+80*	+85*	+95*
1	8	13	15	16	20
1.5	12	17	19	20	24
2.5	17	24	26	28	32
4	22	32	35	38	42
6	29	41	45	48	55
10	40	57	63	67	75
16	54	76	84	90	100
25	71	100	110	120	135
35	87	125	140	145	165
50	105	150	165	180	200
70	135	190	215	225	255
95	165	230	260	275	310
120	190	270	300	320	360
150	220	310	340	365	410
185	250	350	390	415	470
240	290	415	460	490	–
300	335	475	530	560	–

* Maximum permissible temperature of conductor, [°C].

16.8.2.2 The values of permissible current ratings, *I*, for the cross-sectional areas specified in Table 16.8.2.1, as well as for any other cross-sectional areas are to be calculated from the formula:

$$I = \alpha S^{0.625} \text{ [A]} \qquad (16.8.2.2)$$

where:

α – factor depending on the maximum permissible operating temperature of the conductor, determined from Table 16.8.2.2;

S – nominal cross-section of conductor, [mm^2].

Table 16.8.2.2

Maximum temperature of conductor, [°C]		60	65	70	75	80	85	90
Values of factor α for the nominal cross-sectional area of conductor, *S*	≥ 2.5 mm^2	9.5	11	12	13.5	15	18	18
	< 2.5 mm^2	8	10	11.5	13	15	18	20

16.8.2.3 Permissible current ratings for two-, three- or four-core cables are to be reduced in relation to the values given in Table 16.8.2.1, using the following correction factors:

0.85 – for two-core cables;

0.70 – for three- and four-core cables.

16.8.2.4 Permissible current ratings for cables and conductors, installed in circuits with intermittent or short-time service, are to be determined by multiplying the value of current rating in continuous service of these cables, calculated in accordance with Table 16.8.2.1 or according to 16.8.2.3, by the correction factor taken from Table 16.8.2.4.

Table 16.8.2.4
Values of correction factors in relation to load

Nominal cross-sectional area of conductor, [mm^2]	Intermittent service, 40%		Short-time service, 30 min.		Short-time service, 60 min.	
	Cables and conductors					
	with metal coverings	without metal coverings	with metal coverings	without metal coverings	with metal coverings	without metal coverings
1	1.24	1.09	1.06	1.06	1.06	1.06
1.5	1.26	1.09	1.06	1.06	1.06	1.06
2.5	1.27	1.10	1.06	1.06	1.06	1.06
4	1.30	1.14	1.06	1.06	1.06	1.06
6	1.33	1.17	1.06	1.06	1.06	1.06
10	1.36	1.21	1.08	1.06	1.06	1.06
16	1.40	1.26	1.09	1.06	1.06	1.06
25	1.42	1.30	1.12	1.07	1.06	1.06
35	1.44	1.33	1.14	1.07	1.07	1.06
50	1.46	1.37	1.17	1.08	1.08	1.06
70	1.47	1.40	1.21	1.09	1.09	1.06
95	1.49	1.42	1.25	1.12	1.11	1.07
120	1.50	1.44	1.28	1.14	1.12	1.07
150	1.51	1.45	1.32	1.17	1.14	1.08
185	–	–	1.36	1.20	1.16	1.09
240	–	–	1.41	1.24	1.18	1.10
300	–	–	1.46	1.28	1.20	1.12

16.8.2.5 Permissible current ratings specified in Table 16.8.2.1 refer to the ambient temperature of + 45°C. For other ambient temperatures, permissible current ratings of cables and conductors are to be calculated using correction factors given in Table 16.8.2.5.

Table 16.8.2.5
Values of correction factors in relation to the ambient temperature

Maximum permissible temperature of conductor, [°C]	Ambient temperature, [°C]										
	35	40	45	50	55	60	65	70	75	80	85
60	1.29	1.15	1.00	0.82	–	–	–	–	–	–	–
65	1.22	1.12	1.00	0.87	0.71	–	–	–	–	–	–
70	1.18	1.10	1.00	0.89	0.77	0.63	–	–	–	–	–
75	1.15	1.08	1.00	0.91	0.82	0.71	0.58	–	–	–	–
80	1.13	1.07	1.00	0.93	0.85	0.76	0.65	0.53	–	–	–
85	1.12	1.06	1.00	0.94	0.87	0.79	0.71	0.61	0.50	–	–
90	1.10	1.05	1.00	0.94	0.88	0.82	0.74	0.67	0.58	0.47	–
95	1.10	1.05	1.00	0.95	0.89	0.84	0.77	0.71	0.63	0.55	0.45

16.8.2.6 Instead of making calculations resulting from 16.8.2.1 to 16.8.2.5, permissible current ratings for cables and conductors in relation to different maximum insulation temperature and different ambient temperatures in continuous, short-time and intermittent services may be selected according to *Publication No. 15/P – Current Rating Tables for Cables, Wires and Busbars in Marine Installations*.

16.8.2.7 When choosing cables for the final branch circuits of lighting or the heating appliances, neither correction nor demand factors are to be used.

16.8.2.8 Cables are to be so selected as to withstand the maximum short-circuit current. When choosing the cables, time-current characteristics of the applied protections, as well as the peak value of the anticipated short-circuit current in the first alternation, are to be also taken into account.

16.8.2.9 Cables installed in parallel for the same polarity or phase are to be of the same type, are to be run as close as possible to each other and are to have the same cross-sectional area of at least 10 mm^2 and the same length.

16.8.3 Selection of Cable Cross-sectional Areas for Permissible Voltage Drop

16.8.3.1 The voltage drop on the cables connecting the generators to the main switchboard or the emergency switchboard is not to exceed 1 per cent.

16.8.3.2 In normal operating conditions, the voltage drop on the cables between the busbars of the main or emergency switchboard and any electric consumers is not to exceed 6 per cent of the rated voltage. For the consumers supplied from accumulator batteries of the voltage not exceeding 50 V, the value may be increased to 10 per cent.

For navigation light circuits, the permissible voltage drop may be limited to smaller values so as to ensure the required lighting characteristics.

At short-time service, e.g. at starting the electric motors, a greater voltage drop is permissible, provided it does not adversely affect the work of the remaining electric consumers.

16.8.3.3 Cables used for supplying the directly-started alternating-current electric motors are to be so calculated that the total drop of voltage on motor terminals at starting does not exceed 25 per cent of the rated voltage.

The possibility of increasing the specified above voltage drop is subject to special consideration by PRS.

16.8.4 Installation of Cables

16.8.4.1 Cable runs are to be, as far as possible, straight and accessible and are to pass through locations where cables are not affected by any oil, fuel, water and excessive heating to which they are likely to be exposed. Cable runs are to be installed not closer than 100 mm to the sources of heat.

16.8.4.2 No cables are to be installed at a distance less than 50 mm from the double bottom and from the liquid fuel and lubrication oil tanks. The distance of cables from the shell plating, as well as from fire-resistant and watertight bulkheads and decks is to be not less than 20 mm.

16.8.4.3 Cables installed in bunches shall be in accordance with the requirements of IEC Publication 332-3[1)] regarding resistance of cable bunches to the spread of flame or the following means preventing the spread of flame are to be provided:

- **.1** fire stops, at least of B-0 Class (see sub-chapter 1.2, *Part V – Fire Protection*) are to be fitted on the cable bunches at the inlet to the main switchboard, emergency switchboard, switchboard supplying essential auxiliaries, monitoring and control panels and desks for control of machinery and the unit, as well as at each end of totally enclosed cable runs;
- **.2** in enclosed and semi-enclosed compartments and spaces, cable bunches installed in semi-enclosed and open cable runs are to be provided with:
  - – fire protection coating applied to the entire length of vertical runs and to the length of 1 m at every 14 m for horizontal runs, or
  - – fire stops of the B-0 Class, at least at every second deck or at every 6 m for vertical runs and at every 14 m for horizontal runs.

16.8.4.4 Cables having external metallic sheathing may be installed on structures of light alloys or be fastened in position with holders of such alloys only in cases where reliable anti-corrosive protection is provided.

16.8.4.5 In hazardous areas, in principle, passing cables are not to be installed. Applicability and detailed design solution of cables installation in these areas should be agreed with PRS.

16.8.4.6 No cables are recommended to be installed under the flooring of machinery spaces. If such an installation is required, cables are to be installed in metallic pipes or in closed ducts (see 16.8.8).

16.8.4.7 Cables installed across expansion joints in the hull structure are to be provided with expansion loops having a radius adequate for such a joint. The inside diameter of a loop is to be not less than 12 times the outside diameter of the cable.

16.8.4.8 Installation of cables having insulation intended to withstand different maximum permissible temperatures in the common cable runs is to be effected in such a manner that the cables are not heated above their permissible temperature.

16.8.4.9 Cables with different protective coverings, the less resistant of which may be subjected to damage, are not to be installed in one common pipe, one common duct or in other runs of unsupported common laying.

16.8.4.10 Multi-core cables shall not be used for supplying power to, and for control of, not mutually associated essential equipment. Multi-core cable is not to be used for both the safe voltage circuits and working voltage circuits greater than the safe voltage.

16.8.4.11 When equipment is supplied by two separate feeders, these feeders are to be installed in different runs as far apart as possible from one another, both in horizontal and in vertical direction.

[1)] Item 2.4 of PN-89/E-04160/55 Standard is considered equivalent.

16.8.4.12 Cables are not to be embedded in thermal or acoustic insulation if it is made of combustible materials. From such an insulation, cables are to be separated with plating of incombustible material or are to be located at a distance not less than 20 mm from it.

Where cables are installed in thermal or acoustic insulation made of incombustible materials, the cables are to be calculated with a corresponding load reduction.

16.8.4.13 Cables in refrigerating spaces are to be installed on perforated panels or bridges and are to be fastened in position in such a manner that a free space is reserved between the cables and the walls of the room.

Panels, bridges and cable clips are to be protected against corrosion.

If cables are to pass through the thermal insulation of a refrigerated space, they are to run at right angles to the insulation surface in an appropriate gland packed on both ends.

16.8.4.14 The minimum internal bending radii of the cables are not to be less than 6 times of external diameter of cable.

16.8.4.15 Cables and earthing conductors of equipment mounted on shock absorbers are to be installed in such a manner that they cannot be damaged in service.

16.8.5 Fastening of Cables

16.8.5.1 Cables are to be suitably fastened in position by means of clips, holders, hangers, etc. made of metal or other incombustible or low flame spread material.

The fastener surface is to be sufficiently wide and is to have no sharp edges.

The fasteners are to be selected in such a manner that the cables are fastened in position securely but without damage to their protective coverings.

16.8.5.2 Distances between the cable fastening points in the case of horizontal installation are not to exceed the values given in Table 16.8.5.2. For vertical runs of cables, these distances may be increased by 25 per cent.

Table 16.8.5.2

External diameter of cable, [mm]		Distance between fastening points for cables, [mm]		
Over	Up to	Without armour	With armour	With mineral insulation
–	8	200	250	300
8	13	250	300	370
13	20	300	350	450
20	30	350	400	450
30	–	400	450	450

16.8.5.3 Cables are to be fastened in such a manner that mechanical strains in cables are not transmitted to their inlet connections.

16.8.5.4 Cable runs and cables installed parallel to the shell plating are to be fastened to the hull structural members and not to the shell plating.

On watertight bulkheads and masts, cables are to be fastened by means of suitable structures, such as perforated tray plates or panels.

16.8.5.5 Cables running parallel to bulkheads subject to sweating are to be installed on bridges or on perforated panels in such a manner that a free space is reserved between cables and bulkheads.

16.8.5.6 Cable runs are to be installed with a minimum number of crossings. Bridges are to be used at places where cables cross each other. An air gap of not less than 5 mm is to be left between a bridge and the cable run crossing it over.

16.8.6 Cables Penetrating Decks, Bulkheads and Walls

16.8.6.1 Penetration of watertight, gas-tight and fire-resisting bulkheads and decks is to be made tight. Packing where cables penetrate the mentioned bulkheads and decks is not to reduce their tightness or resistance; no force resulting from elastic deformations of the unit is to be transmitted to the cables.

16.8.6.2 When installing the cables through non-watertight bulkheads or elements of the unit's structure not exceeding 6 mm in thickness, lining or bushings that will prevent damage to cables are to be provided.

Where bulkheads or the unit's structures are more than 6 mm thick, no lining or bushings are required, but the edges of the holes are to be rounded off.

16.8.6.3 Cables passing through decks are to be protected from mechanical damage up to a suitable height above the deck, and in locations where mechanical damage is less probable, up to a height of at least 200 mm. For single cables, the use of glands is permitted instead of filling with compound.

16.8.7 Cable Compounds and Packing

16.8.7.1 To fill the cable boxes in watertight bulkheads and decks, the use is to be made of packing compounds having good adhesion to the inside surfaces of cable boxes and cable sheathing, that will withstand the action of water and oil products, will not shrink and lose its tightness in continuous service.

16.8.7.2 Cable penetrations in watertight bulkheads and decks can also be made with modular penetrations an approved type.

16.8.7.3 Packing of cable penetrations through fire-resisting bulkheads is to be so made as to withstand standard fire test required for the given type of bulkhead, specified in sub-chapter 1.2, *Part V – Fire Protection*.

16.8.8 Installation of Cables in Pipes and Conduits

16.8.8.1 Pipes and conduits in which cables are installed are to be metallic and protected from corrosion on the inside and outside surface. The inside surface of pipes and conduits is to be even and smooth. Ends of pipes are to be machined or protected in such a manner that no damage is caused to the cables when they are being pulled in.

The application of cable trays and protective casings made of plastic materials is permitted, provided they meet the requirements specified in sub-chapter 16.8.9.

16.8.8.2 Pipe and conduit bending radius is not to be smaller than the permissible radius for cable of the largest diameter installed in this pipe.

16.8.8.3 The sum of the cross-sectional areas of all cables as measured on their outside diameters is not to exceed 40 per cent of the inside cross-sectional area of the pipe or conduit, in which the cables are put.

16.8.8.4 The pipes and conduits are to be mechanically and electrically continuous and are to be securely earthed if the method of their installation does not present in itself a reliable earthing.

16.8.8.5 The pipes and conduits are to be installed in such a manner that no water can accumulate in them. When required, ventilation holes are to be provided in the pipes, in the highest and lowest points possible, to ensure circulation of air and to prevent steam condensation. Holes in pipes are permissible only in places where they will not increase the danger of explosion or fire.

Pipes having open ends in a hazardous area are to be regarded as hazardous area. Enclosed spaces containing such pipes are to be regarded as extended hazardous area, unless provided with overpressure ventilation, with air inlets located in non-hazardous areas.

16.8.8.6 Cables running in vertical pipes and conduits are to be protected in such a way as not to be damaged due to tension caused by their own mass.

16.8.9 Cable Trays and Protective Casings Made of Plastic Materials

16.8.9.1 Cable trays and protective casings made of plastic materials are to be supplemented by metallic fixing and straps. Cable trays and protective casings made of plastics may not be used on open decks.

16.8.9.2 The support spacing is to be not greater than that specified in the manufacturer's recommendations for the maximum safe working load and is not to exceed 2 meters.

16.8.9.3 The sum of the cross-sectional areas of all cables passing through the protective casing is not to exceed the value specified in 16.8.8.3.

16.8.9.4 The selection and spacing of cable trays and protective casing supports are to take into account: the dimensions of cable trays and casings; mechanical and physical properties of the material; the mass of cable trays and protective casings, loads due to weight of cables, external forces, thrust forces and vibrations; maximum accelerations to which the system may be subjected; combination of loads.

16.8.10 Special Requirements for Installation of Single-core Alternating-current Cables

16.8.10.1 Single-core cables are not recommended for alternating-current installation. If installation of such cables is unavoidable, the cables rated in excess of 20 A are to meet the following requirements:

- **.1** cables are not to have coverings of magnetic material;
- **.2** cables which belong to one common circuit are to be installed in one run or in one pipe; installation of such cables in different pipes is permitted only when pipes of non-magnetic materials are used;
- **.3** cable fasteners other than those made of non-magnetic materials are to embrace all single-core cables in one circuit;
- **.4** distance between cables is not to be over one cable diameter.

16.8.10.2 When single-core cables are passed through bulkheads or decks, there is to be no magnetic material between the cables which belong to one common circuit. Distance between such cables and magnetic material is not to be less than 75 mm.

16.8.10.3 If single-core cables rated in excess of 250 A are installed parallel to steel structures, the distance between cables and these structures is to be not less than 50 mm.

16.8.10.4 When installing single-core cables with cross-sectional areas of over 185 mm^2, cables are to inter-cross not less than every 15 m. No cable inter-crossing is required in the case of cable length up to 30 m.

16.8.11 Connecting and Tapping of Cables

16.8.11.1 Ends of cables are to be packed in a manner that would prevent the entry of moisture inside the cable.

16.8.11.2 Protective covering of a cable led into a device from below should enter inside the device to not less than 10 mm from the inlet hole.

16.8.11.3 Connection of cables at places of tapping is to be effected in junction boxes by means of clamps.

16.8.11.4 If, during installation of cables, it is found necessary to make additional connections, they are to be effected in suitable junction boxes provided with clamps. The joint as a whole is to be protected from the influence of environmental conditions. Permission for the use of cable jointing and application of cable jointing method other than that mentioned above will be specially considered by PRS.

17 ADDITIONAL REQUIREMENTS FOR EQUIPMENT OF ABOVE 1000 V

17.1 General Requirements

17.1.1 The requirements of the present Chapter apply to electrical equipment with rated voltage above 1000 V up to 15 000 V alternating current and are supplementary to those specified in other Chapters of the present Part of the *Rules*.

Distribution systems with rated voltages above 15 000 V are subject to special consideration by PRS in each particular case.

17.1.2 Insulating materials used in electrical equipment of above 1000 V are to ensure, during the continuous service of the unit, the insulation resistance of at least 2000 Ω per V of rated voltage.

17.1.3 Warning notices indicating the value of voltage are to be placed at the entries to special electric spaces and on the enclosures of electric equipment located outside these spaces.

17.1.4 In junction boxes and sockets, as well as terminal boxes of electrical equipment with rated voltage above 1000 V, no joints are to be installed or connection of conductors effected if such joints or conductors are rated for lower voltages.

17.2 Power Distribution

17.2.1 Distribution Systems

17.2.1.1 The following systems of electric power distribution may be used in *units* installations:

.1 a three-core insulated system;

.2 a three-core system with the neutral point earthed directly to the unit's hull;

.3 a three-core system with the neutral point earthed to the hull through a low ohm resistance (value of resistance is to be so selected that the short-circuit earth current is within limits $0.2 \div 1.0$ of the rated load current of the largest generator);

.4 a three-core system with the neutral point earthed to the unit's hull through a high ohm resistance (value of resistance is to be equal to 1/3 value of the capacitive reactance between phase and an earth).

17.2.1.2 The total resistance of the neutral earthing is to be so selected that the short-circuit current passing through the hull is not greater than the rated current of the largest generator but not less than three times the minimum current required to operate any device protecting against short-circuit with the unit's hull.

It is permitted to connect all earthing resistors to a common earth bar which has connection with the hull at least in two places.

17.2.1.3 It is to be possible to split the main switchboard into at least two sections, each supplied by at least one generator, by means of circuit breakers, switches or switch disconnectors. Alternatively, at least two separate interconnected switchboards are to be provided. In that case, interconnecting cable is to be provided with a circuit-breaker at each end of the cable.

Services, which are duplicated, are to be divided between the sections of the main switchboard or between the interconnected switchboards. For the supply of auxiliary circuits, at least one independent source of electrical power for each section is to be provided.

17.2.1.4 The neutrals of generators operating in parallel may be connected in common before the common earthing resistor.

17.2.1.5 Generator neutrals are to be earthed through resistance in the main switchboard or directly on the generator.

17.2.1.6 For the purpose of maintenance or for the resistance measurements, the neutral conductor of each generator is to be provided with an isolating device so that the earthing connection of generator neutral can be isolated.

17.2.1.7 When using system with neutral earthed, measures are to be taken to preclude passage of short-circuit current from equipment or cable to the unit's hull in the hazardous zones.

17.2.2 Permissible Voltages

Rated voltages are not to exceed the values specified in Table 17.2.2.

Table 17.2.2

Inter-phase rated voltage, [kV]	Rated frequency, [Hz]
3/3.3	50 or 60
6/6.6	50 or 60
10/11	50 or 60
15	50 or 60

17.2.3 Power Supply from External Source of Electric Power

The power supply of the unit's network from an external source of electric power is permissible only for units permanently moored or founded on the sea bed.

Where external source of supply is necessary for auxiliary circuits, at least two external sources of supply are to be provided. Those external sources are to be so arranged that a failure or loss of one of them will not cause the loss of more than one generator set and/or set of the essential services.

Where necessary, one source of supply may be from the emergency source of electrical power for the start-up from dead unit condition.

17.3 Protective Devices

17.3.1 General Requirements

17.3.1.1 When different voltages are used in one device, precautions are to be taken to prevent the lower voltage systems from being charged by leakage from the higher voltage systems.

17.3.1.2 The overload protection is to be provided in all phases of the alternating-current system. No fuses are to be used in the overload protection.

17.3.1.3 Installations with rated voltage above 1 000 V are to be provided with audible and visual alarm giving a warning of short-circuit with the *unit's* hull.

17.3.2 Protection of Generators

17.3.2.1 Generators are to be provided with protection against short-circuit with the *unit's* hull and against phase-to-phase faults in the cable connecting the generator with the main switchboard.

17.3.2.2 The excitation systems of generators are to cause de-energizing of generators when any of the protective devices of the generator operates.

17.3.2.3 Generators are to be provided with protection against internal faults.

17.3.3 Protection of Transformers

17.3.3.1 Transformers are to be provided with overload and short-circuit protection.

17.3.3.2 The low voltage sides of the transformers are to be protected against overvoltages from higher voltage sides, which may be achieved by:
– direct earthing of the lower voltage system,
– appropriate neutral voltage limiters,

– earthed screen between the primary and secondary windings of the transformers.

17.3.3.3 Where transformers are connected in parallel, tripping of the protective devices at the primary side has to automatically trip the switch connected at the secondary side.

17.3.3.4 Voltage transformers are to be provided with overload and short-circuit protection on the secondary side.

17.4 Protective Earthing

17.4.1 Metallic enclosure of switchboards is to be provided with copper conductor situated along its total length, having at least two relevant terminals for connection with the unit's hull. One-second short-circuit earth current density in this conductor is not to exceed 150 A/mm^2, and the cross-section of conductor is not to be less than 30 mm^2. Casings of compartments and fields are to be connected to earthing conductor directly or by means of the metal parts of structure.

Welded and twisted connections assure proper continuity of earthing, but for twisted connections the surface of connection is to be protected against corrosion by usage of adequate anti-corrosion surfaces.

Depending on the method of the network neutral earthing and the time necessary for activation of the protection devices, maximum short-circuit current is to be taken into consideration for earthing connections.

17.4.2 Earthing of metal parts of withdrawable circuit-breakers or movable elements are to be effective in each fixed and intermediate position.

17.4.3 Doors of the high voltage compartments are to be connected to the earthed structure by means of copper conductor with a cross-section not less than 6 mm^2.

17.4.4 Metal enclosures of other high voltage equipment are to be earthed by means of flexible copper conductor of such cross-section that one-second short-circuit earth current density is not to exceed 150 A/mm^2, but not less than 16 mm^2.

17.4.5 The secondary windings of measuring current and voltage transformers are to be earthed by means of copper conductor with cross-section of not less than 4 mm^2.

17.4.6 The earthing conductors are to be suitably marked.

17.5 Arrangement and Protection Degree of Electrical Equipment

17.5.1 The electrical equipment is to be located in special electric spaces; the degree of protection of its enclosures is to be at least IP23 (see also 17.6).

The degree of protection of terminal boxes of electric rotating machines is to be at least IP44. The degree of protection of metal enclosed switchgear, control gear assemblies and static convertors is to be at least IP32.

In justified cases, such equipment may be placed outside the special electric spaces, provided the protection degree is at least IP4X and access to live parts is possible only when the voltage is off or with the use of special tools.

17.5.2 A easy-to-read diagram of the arrangement and the connections of electrical equipment is to be located in the special electric space.

17.5.3 Where equipment is not contained in an enclosure but a room forms the enclosure of the equipment, the access doors are to be so interlocked that they cannot be opened until the supply is isolated and the equipment earthed down.

17.6 Switchboards

17.6.1 The switchboards are to be provided with doors locked with a special key, other than those for switchboards and electrical equipment operating at lower voltages.

Opening of the door is to be possible only when the part of main circuit located in compartment or field of switchboard which becomes accessible is disconnected from supply.

17.6.2 Circuit-breakers used in switchboards are to be of a withdrawable type.

Circuit-breakers or movable elements with apparatus are to have mechanical devices fixing them in the operating position, in the testing position (control circuits are connected), as well as in switching-off position (main circuits are disconnected and furthermore, there is safe, insulating clearance in poles of main circuit).

Automatic shielding is to be provided, by means of insulating barriers, of fixed contacts of plug connections in live condition when circuit-breaker or movable element is withdrawn to the testing position, switched-off position or withdrawn totally from the switchboard.

Pulling out or pulling in of the circuit-breaker or movable element to the operating position is to be possible only when switchgear is in open condition.

If electrical or other energy is required for the operation of circuit breakers and switches, a store supply of such energy is to be provided for at least two operations of all the components.

However, the tripping due to overload, short-circuit or under-voltage is to be independent of any stored electrical energy sources.

17.6.3 For the purpose of short-circuiting the busbars and the outgoing switchboard circuits with each other and with the unit's hull, a device rated for the maximum short-circuit current is to be provided in the switchboard.

The possibility of using a portable short-circuiting device instead of a stationary one is subject to special consideration by PRS.

17.6.4 Along the free-standing switchboards a passageway is to be provided for inspection of the switchboard and the switchgear. The width of the passageway between the switchboard and the wall is not to be less than 800 mm and that between the parallel switchboard sections – not less than 1000 mm.

If such passageways are intended for maintenance of the switchboard, their width is to be increased to 1000 mm and 1200 mm, respectively.

Such passageway widths are required, irrespective of the type of the accidental touch protection applied.

17.6.5 The clearances between the live parts of electrical equipment and the protective barriers and enclosures are not to be less than those given in Table 17.6.5.

Table 17.6.5

Item	Rated voltage, [kV]	Minimum height of passageway, [mm]	Minimum protective clearances of live parts from barriers and enclosures consisting of:	
			tight doors and barriers [mm]	insulating handrails [mm]
1	3/3.3	2500	70	600
2	6/6.6	2500	100	600
3	10/11	2500	140	700
4	15	2500	180	700

In the case of smaller distances, appropriate voltage impulse test must be applied.

17.6.6 Switchboards are to be provided with devices intended for reduction of overpressure to ensure the mechanical strength of enclosure in case of internal short-circuit arcs.

Devices are to be so located that the influence of hot and ionized gases would not endanger personnel and compartment, in which they are located.

17.6.7 Switchboards are to be provided with devices which respond to the internal overpressure of compartments or radiation of electric arcs and which cause automatic switching-off of faulty circuit during short-circuit arcs.

17.7 Electric Machines

17.7.1 Electric generators and electric motors stator windings are to have all phase ends brought out to a separate terminal box.

17.7.2 Electric machines are to be provided with temperature detectors in their stator windings to actuate a visual and audible alarm in a normally attended position whenever temperature exceeds the permissible limit. If embedded temperature detectors are used, means are to be provided to protect the circuit against overvoltage.

17.7.3 Heating arrangements are to be provided to prevent the accumulation of moisture and condensation within the machines when they are stopped. It is recommended that such means are automatically switched on at stand-still and switched off at starting.

17.7.4 Heat exchangers of rotating machines are to be of the double tube type. In a normally attended position, a visual and audible alarm is to be given to monitor water cooler leakage.

17.7.5 In addition to the tests normally required for rotating machinery, a high frequency high voltage test is to be carried out on the individual coils in order to demonstrate a satisfactory withstand level of the inter-turn insulation to steep fronted switching surge. This test applies to coils for rotating machinery to be used either in earthed or insulated system and is to be considered as acceptance test.

It is recommended that the test be carried out as follows:

A sufficiently high frequency to develop the required voltage across the coil (e.g. by discharging a capacitor across the coil leads) is to be applied to the coil preferably after inserting the coils into the stator core and after bracing and wedging (if necessary with temporary wedges at the end of the core).

The peak value of the test voltage is given by the formula:

$$U_p = 2.45 \cdot U, \quad [\mathrm{V}] \tag{17.7.5}$$

where:
U – nominal voltage of the system.

Each coil is to be subjected to five impulses. If any coil fails during testing, it is to be replaced and the inter-turn test applied to the replaced coil and repeated on those coils disturbed during the replacement.

Alternative tests proposed by the manufacturer will be accepted, subject to PRS’ consent.

17.8 Transformers

17.8.1 Dry transformers having earthed screens between the windings of the high and low voltages are to be used.

The use of other types of transformers is to be agreed with PRS in each particular case.

17.8.2 The isolating of the transformer on the high voltage side is to cause the disconnection of the switch on the low voltage side.

17.8.3 If the voltage on the low voltage side of the transformer does not exceed 1000 V and the windings have the neutral insulated, a protective surge arrester is to be connected between the neutral of each transformer and the unit’s hull. Such a surge arrester is to be designed for operation at a voltage not exceeding 80% of the minimum proof voltage of the equipment supplied by the transformer in question.

17.8.4 Parallel to the surge arrester, insulation monitoring instruments or an insulation fault indicator in the lower voltage circuit supplied by the transformer in question may be connected. Such devices are not to interfere with the proper operation of the arrester.

17.9 Cabling

17.9.1 For three-phase alternating-current cabling, three-core cables with multi-wire cores are to be used.

17.9.2 The cross-sectional area of power cable conductor is not to be less than 10 mm^2.

17.9.3 Design, type and the permissible loads of the applied cables are subject to special consideration by PRS in each particular case.

17.9.4 The cables of the network of over 1000 V are to be installed separately from the network cables for voltages of up to 1000 V and are to be clearly marked.

17.9.5 When installing the cables, the following conditions are to be satisfied:

.1 the cables intended for distribution of electric power with various voltage values in the network may be installed in a common run, provided the insulation of all cables installed in the common run is rated for the highest voltage occurring in the run in question;

.2 the cables passing through the accommodation spaces are to be run in enclosed cable protective casings or pipes;

.3 the air clearances between high voltage cables of different voltage ratings are to comply with the distances specified in column 4 of Table 17.6.5;

.4 cables installed outside the special electric spaces are to be contained in earthed metallic pipes or ducts or are to be provided with earthed metallic sheaths.

Cables may be installed in the open when they are provided with a continuous metallic screens, sheaths or armour effectively bonded to earth.

17.9.6 It is not permitted to install connecting boxes nor any similar means for clearing the break in cables, damages or for extending the cables.

17.9.7 Rated voltages of cables are not to be less than the rated voltages of circuits, in which they are used. Rated voltages of cables are not to be less than the rated voltage between phases of circuit. This concerns systems with the earthed neutral point to the unit's hull through high ohm resistance, without automatic switching-off of the circuit with damaged insulation, as well as systems with insulated neutral point.

17.10 Voltage Tests of Main Circuits

Before being put into service, each system is to be tested by performing:

.1 an insulation resistance test,

.2 a direct current (d.c.) voltage-withstand test with the voltage meeting the following conditions:

$$U \geq 1.6\ (2.5\ U_0 + 2),\ [\text{kV}] \tag{17.10.1-1}$$

for cables of the rated voltage (U_0) up to and including 3.6 kV; or

$$U \geq 4.2\ U_0,\ [\text{kV}] \tag{17.10.1-2}$$

for cables of above 3.6 kV rated voltages

where:

U_0 – rated power-frequency voltage, between the conductor and earth or metallic screen, for which the cable is designed, [kV].

The test voltage is to be maintained for a minimum of 15 minutes. After completion of the test, the conductors are to be connected to earth for a period sufficient to remove any trapped electric charge.

.3 an insulation resistance re-testing (after the voltage test).

Alternatively, an a.c. voltage-withstand test may be carried out upon advice from high voltage cable manufacturer at a voltage not less than normal operating voltage of the cable and it is to be maintained for a minimum of 24 hours.

Tests according to IEC Publication 60502 are also permitted.

Table 17.10

System voltage, [kV]	Testing voltage 1 min *) ,[kV]		Impulse voltage, [kV]	
	to earth and between phases	safe pole clearance	to earth and between phases	safe pole clearance
3/3.3	10	12	40	46
6/6.6	20	23	60	70
10/11	28	32	75	85

*) For systems with insulated neutral point, testing voltage (1 minute) not less than 7.5 times the value of the rated voltage between phase and neutral point, is to be applied.

18 ELECTRICAL INSTALLATIONS IN EXPLOSION HAZARDOUS ZONES

18.1 General requirements and selection of equipment for specific zones

18.1.1 Electrical equipment installed in explosion hazardous zone 0 shall be certified for Ex-ia type of protection .

18.1.2 For explosion hazardous zone 0, the associated apparatus (e.g. protection devices) and safety barriers should have certificates confirming the possibility of their use in installations with Ex-ia type protection.

18.1.3 Electrical equipment installed into zone 1 shall be certified safe with respect to one of the following protection methods: Ex-i (intrinsic safe) category a or b, Ex-d (flameproof), Ex-e (increased safety), Ex-p (pressurised), Ex-m (moulded) Ex-s (special protection).

18.1.4 In principle, Ex-o (oil filled) and Ex-q (sand filled) are not accepted. However, small sand filled components as dry capacitors for Ex-e light fixtures are accepted.

18.1.5 Electrical equipment installed in explosion hazardous zone 2 should have a certificate accepted for zone 1 or zone 2 application or have a manufacturer's declaration of an Ex -n, or be documented by the manufacturer as suitable for installation in zone 2 (housing design with a minimum enclosure protection of IP44, maximum surface temperature corresponding to the space temperature class and the lack of emergence of ignition sources during normal operation).

18.1.6 Electrical equipment installed in paint stores, battery rooms, gas bottle stores, and in ventilation ducts serving such spaces shall be suitable for installation in zone 1 with the following requirements for gas group and ignition temperature:
– battery rooms: minimum gas group II C and temperature class T1
– paint stores: minimum gas group II B and temperature class T3
– gas bottle stores: minimum gas group II C and temperature class T2.

18.1.7 Cables routed through such spaces in explosion hazardous zone shall either be suitable for installation in hazardous area zone 1, or be installed in metallic conduit.

18.1.8 Spaces on open deck within 1 m of inlet and exhaust ventilation openings or within 3 m of exhaust outlets with mechanical ventilation are classified as explosion hazardous zone 2.

18.1.9 Enclosed spaces giving access to such spaces, referred to in 18.9.6, may be considered as non-hazardous, provided that:
– the door to the paint store is a gastight door with self-closing devices and without holding back arrangements,
– the paint store is provided with an acceptable, independent, natural ventilation system ventilated from a safe area,
– adjacent to the entrance to the paint store, warning notices stating that the store contains flammable liquids or gas, are mounted.

18.1.10 Battery rooms and boxes shall be regarded as explosion hazardous zone 2 with respect to access doors, covers(panels), etc.

18.1.11 The fan mounted inside extract ventilation ducts shall be of non-sparking type.

18.1.12 Lighting fixtures of explosion-proof construction are to be installed in such a manner that, except the fastening points, a free space of at least 100 mm is left around.

18.1.13 Fastening of electrical equipment to the walls of tanks intended for flammable liquids is not permitted. The distance between electrical equipment and the tank walls is in no case to be less than 75 mm.

18.2 Power supply, control and signalling systems

18.2.1 Electric motors certified Ex-e shall, when installed in zone 1, have an overload or thermal protection that disconnects the motor before the TE-time [from reaching operating temperature to the temperature specified in the Certificate of Ex (temperature class)]is exceeded in a situation with locked rotor

18.2.2 The frequency inverters with supported electric motors in Ex-e execution should be certified together (the relevant documents confirming the possibility of a joint application). Motors Ex-d must additionally be equipped with the winding temperature sensors for emergency stop of the motor in case of over temperature.

18.2.3 For electric motors Ex-n protected driven by frequency converters, a conformity declaration as described in 19.1.5 (including information about the type of converter that can be used) is required.

18.2.4 Ex-p protected equipment, for zone 1 installation, should have certificate of an independent institution.

18.2.5 Ex-p protected equipment, for zone 2 installation, may either be certified as for zone 1, or should have certificate of an independent institution.

18.2.6 Equipment Ex-p protected, for use in zone 1, should have automatically disconnected connection or isolation of the equipment inside the enclosure in the event of loss of adequate blood pressure. If the automatic disconnection creates a further risk, there should be other recognized methods of protection. For Ex-p protected, for use in zone 2, a suitable alarm at a manned control station for indication of loss of overpressure is accepted, instead of the automatic shutdown in the position permanently manned by crew/serviceman.

18.2.7 All intrinsic safe circuits shall have a safety barrier in form of a zener barrier or galvanic isolation certified safe for the application in front of the circuit part going into hazardous areas.

18.2.8 Enclosures Ex-d protected and its flameproof joints shall not be installed nearer to a bulkhead or solid object than 10 mm for gas group II A, 30 mm for II B, and 40 mm for II C.

18.2.9 Flameproof joints shall be protected against corrosion with suitable grease.

18.2.10 Degrees of protection of explosion-proof equipment should be in accordance with Table 2.3.4.2 described in Chapter 2, with the addition that the minimum IP degree of enclosures for Ex-n protected equipment is IP 44.

18.3 Cables and cabling net

18.3.1 In the hazardous spaces and areas cables intended for electrical equipment installed in these areas can only be installed.

Cables passing through these spaces and areas should be kept to a minimum and properly secured.

18.3.2 Cables installed in hazardous spaces and areas are to be sheathed with one of the following:

.1 metal armour or braid with non-metallic covering; or

.2 lead sheath plus further mechanical protection; or

.3 copper or stainless steel sheath (for mineral insulated cables only).

Cables passing through hazardous spaces and areas are to be protected against mechanical damage.

18.3.3 All metal sheaths and armour of the power supply cables of electric motors and lighting circuits passing through hazardous rooms and spaces, or supplying electrical equipment located in these rooms and spaces, are to be earthed at least at both ends.

18.3.4 Cables associated with intrinsically safe circuits are to be used for one device only and are to be separated from other cables.

18.3.5 No cables of portable electrical equipment are to pass through hazardous rooms and spaces, except cables associated with intrinsically safe circuits.

18.3.6 In zone 0 only wiring circuits Ex-ia protected is permitted .

18.3.7 In Zone 1 passage of cables through the spaces should be reduced to a minimum.

18.3.8 In Zone 2 passage of cables through the spaces is allowed.

18.3.9 Cable penetrations through decks and bulkheads in hazardous areas shall be gastight, type approved by the classification society.

18.3.10 In the case of direct entry of cable into an Ex-d enclosure, a gland shall be certified for explosion-proof type.

18.3.11 Unused openings for cable glands shall be blanked off by Ex type plugs.

18.3.12 Only one conductor is allowed to be connected into an Ex-e equipment.

18.3.13 Components inside an Ex-e equipment shall be certified safe with protection Ex-e, -d, -m or other approved method for zone 1 application.

18.3.14 Multicore cable screens should be connected to the protective terminal (earthing) in a safe area only at the circuit end where the barrier is installed.

19 AUTOMATION AND REMOTE CONTROL SYSTEMS

19.1 Design Requirements

19.1.1 General Requirements

19.1.1.1 Automated machinery provided with automatic or remote control system, as well as to the necessary extent with monitoring systems is, in addition, to be provided with means of local manual control.

In each case of failure in automatic or remote control system, the possibility of local control is to be maintained.

19.1.1.2 Where machinery or installation is remotely controlled, it should be possible for the operator to check, with sufficient reliance, from his control station whether his command has been carried out by remote control system.

19.1.1.3 With respect to Integrated programmable control systems of processing plant (see Part VII), PRS may agree for compliance, in specific conditions, with equivalent requirements, relevant for applied technique of control, monitoring and graphical presentation of the process. The above does not apply to the part of integrated system covering the object.

19.1.2 Automatic Systems Components and Units

19.1.2.1 Individual components and units of systems and their external connections are to be permanently and clearly marked. The marking is to ensure an easy and explicit identification with the system diagram. Analog indicators are to be marked with rated values, according to standards, using colors.

19.1.2.2 Components and units to be installed in spaces or areas of explosion risk are to be of intrinsically safe or flame-proof type.

19.1.2.3 Control elements intended for fixing the settings are to be secured against unintentional change of the position. Their repeated securing in case of readjustment is to be enabled..

19.1.2.4 Pressure sensors are to be connected to the piping installation by means of 3-way cocks in order to supply the testing pressure, de-aeration of the piping and disconnecting of the damaged sensor.

19.1.2.5 Temperature sensors should be installed in the proper sockets, providing the ability to place them in thermo calibrators and check their settings during surveys.

19.1.2.6 Conducting surfaces of plug-in connections are to be of such design as to prevent the increase of contact resistance limiting the correct operation of the equipment.

19.1.2.7 At the terminals of cables and bunches of conductors to the components, as well as at the connections to moving parts, means are to be provided to relieve components from the influence of tension of cables and conductors.

19.1.2.8 Replaceable blocks (printed cards) with plug-in connections are to be so designed as to preclude the possibility of erroneous replacement. They should also be capable of being effectively and permanently fixed in working position.

When it is necessary, due to design or functional features of the component or unit, the permanent marking of correct mounting position should be provided or the component or unit itself should be so designed that mounting in other than correct position is impossible.

19.1.2.9 Printed circuit cards are to be covered with electro-insulating varnish on the side on which current lines are located.

19.1.2.10 Final control elements (servo-motors, controllers, etc.) are to be so designed that no uncontrollable movement of their working parts is possible.

19.1.2.11 Pneumatic and hydraulic components and units are to withstand, without damage, short-time overloads caused by an increase of the working medium pressure equal to 1.5 times the rated value.

19.1.2.12 Components or units of automatic systems are to be so designed as to ensure the possibility of their checking and calibration during operation.

19.1.2.13 Measuring range of analogue sensors should be at least 20% greater than the expected deviation of the input signal value (measured parameter).

19.1.2.14 Pneumatic systems are to be fitted with effective means for ensuring the required degree of purity and dryness of air supplied.

19.1.2.15 Drying and filtering equipment used in automatic systems of main propulsion and electric generating sets are, as a rule, to be doubled and so arranged as to ensure the operation of one of them when the other is out of action. Double drying and filtering equipment need not be used, provided it is of self-cleaning type or of such design that quick replacement of contaminated inserts is possible without stopping the air supply.

19.1.2.16 Where components and units requiring forced cooling are used, effective means are to be provided to prevent their damage in case of cooling failure.

Measures are also to be taken to enable components or units to operate in case of contamination by the cooling air.

19.1.2.17 Elements intended for control are to be arranged with easy access, and are to be marked appropriately to their assignment, as well as are to be secured against self-acting change of the position.

19.1.3 Requirements for Automatic Systems

19.1.3.1 All control systems are to operate independently or are to be so designed that a failure in one of those systems will not interfere with the operation of the other systems.

19.1.3.2 Electric and electronic circuits of automatic systems are to be provided with means of protection capable of selective disconnecting the damaged parts of the system.

19.1.3.3 Each automatic system is to be so designed that the failure in one circuit of lamps, sirens and similar signalling devices does not interfere with the operation of other circuits.

19.1.3.4 Failure of power supply to automatic or remote control systems is not to result in dangerous conditions.

19.1.3.5 Automatic systems are to be so designed that typical failures of such systems do not result in hazardous conditions and do not lead to the secondary failures in the system itself and in automated machinery concerned.

19.1.3.6 Each automatic or remote control system is to prevent the automatic restart of controlled machinery after its stopping by the safety system. Restart should be possible after manual reset (e.g. by control lever being brought to start position).

19.1.3.7 Where hydraulic, pneumatic, electric and electronic components are situated in common desks, consoles and other similar units, they are to be so separated from each other that possible leakage of working medium does not affect the electric, electronic or pneumatic components.

The sections of desks, consoles and other units which incorporate the equipment containing liquid medium, are to be provided with drip trays fitted with drain pipes.

19.1.3.8 Failure of power supply to automatic or remote control systems is not to result in dangerous conditions.

19.1.3.9 Automatic systems are to be built of such components and units that their replacement with the other ones of the same type does not affect the operation of the system. If readjustment is necessary, it should be possible by simple means.

19.1.3.10 Automatic systems are to be protected against malfunctions as a result of short time deviations of parameters due to rolling and pitching, starting or stopping of the machinery or due to other similar, normal fluctuation of parameters.

19.2 Power Supply of Automatic Systems

19.2.1 Control system of the main propulsion is to be supplied through two independent feeders. One of these feeders is to be supplied from the main switchboard (directly or through a transformer) and the second may be supplied from the nearest section switchboard supplying essential consumers. Switching on of the second power source is to be effected automatically.

19.2.2 Alarm system is to be always supplied from two independent power sources. Switching on of the stand-by power source is to be effected automatically.

Where the stand-by power source of the alarm system is an automatically started emergency generating set, the alarm system circuits monitoring the conditions affecting the unit's manoeuvrability and parameters of generating sets prime movers are to be additionally supplied from an accumulator battery of a capacity sufficient for 30 minute operation of that part of the system.

19.2.3 Supply of automatic equipment essential for starting and operation of the emergency generating set is to be taken from starting accumulator batteries or from separate battery located in the emergency generating set compartment.

19.3 Monitoring Systems

19.3.1 Alarm System

19.3.1.1 In addition to compliance with the applicable requirements of the present Chapter, alarm signalling is to comply, within the scope agreed with PRS, with the requirements of the *Code on Alerts and Indicators.*

19.3.1.2 Depending on the extent of machinery automation, the alarm system is to give the following types of alarms:

- **.1** alarm to indicate that limit values of parameters have been exceeded;
- **.2** alarm to indicate that safety system has operated;
- **.3** alarm to indicate the failure of power supply to particular automatic system or that the stand-by power supply has been switched on.

Alarm conditions of machinery are to be indicated in the relevant control stations. The arrangement of the alarm display is to make possible identifying the particular fault condition and its location within the machinery space.

19.3.1.3 Alarm system is to function independently of control and safety systems so that a failure or malfunction in these systems will not prevent the alarm system from operating.

19.3.1.4 Alarm system is to have such self-monitoring properties that alarm signal will be given in the case of a broken circuit or other typical failures.

19.3.1.5 The alarm system is to operate simultaneously both visual and audible signals.

19.3.1.6 Visual signal is to be given by intermittent light and should indicate the reasons causing the alarm. Cancelling the visual signal should be possible only after the reasons of its operation have been eliminated. Acknowledgement of visual signal is to be clearly indicated by the change of its form (i.e. change from intermittent light to steady light or change in flickering frequency).

19.3.1.7 Audible signal may be common for all types of alarms. If the possibility of switching off the audible signal is provided, the readiness of actuating new alarms from other parameters is to be maintained until the reason of previous signal has been eliminated.

Switching off audible signals is not to extinguish visual signals.

Audible signals for machinery are to be clearly distinguished from surrounding sounds and other audible signals. The local switching off the audible signal on the navigation bridge and in the accommodation area, if provided, is not to stop the audible signal in the machinery space.

19.3.1.8 Each control station is to be equipped with the indicator informing which station is in charge of control. Transfer of the control from one station to another is to be accompanied by audible and visual signals at both stations. The control from a new control station is to be possible only when it has been confirmed that the control was taken over by the new position.

19.3.1.9 For easy identification of transitory alarm conditions which are automatically eliminated, the alarm system is to have memory features, so that the transitory alarm conditions can be maintained until they are confirmed.

19.3.1.10 Disconnection or omission of any part of the alarm system is to be clearly indicated.

19.3.1.11 A short-time interruption of power supply to the alarm system is not to cause a loss of information on alarm conditions prior to the interruption.

19.3.1.12 Alarms shall be visual and audible and shall indicate abnormal conditions only. In areas where the audible signal may not be heard due to background noise, additional visual and audible display units shall be installed. It is recommended to use a rotary light signals.

19.3.1.13 The sound of the general alarm system is to be different from the sounds of all other signalling systems.

19.3.1.14 Alarm delay is to be provided for transitional states which can cause these alarms (taking into account the safety of devices).

19.3.1.15 Reduction of the illumination level of any indicators is to be provided that could have a negative impact on the observations from the space.

19.3.1.16 Each panel with indicators of this system should be able to use the function to check the operation (test of lights / sound).

19.3.2 Safety System

19.3.2.1 Safety system of particular units of automated machinery plant is to operate automatically after exceeding limit values of the given parameters causing a failure and is to cover all foreseeable fault conditions assumed with regard to operational properties and characteristics of the machinery concerned so that:
- normal operating conditions are restored, or
- the machinery operation is temporarily adjusted to the prevailing conditions (by reducing the load of machinery), or
- machinery ~~and boilers~~ are protected from failure by stopping.

19.3.2.2 Means are to be provided to trace the cause of the safety system action.

19.3.2.3 The safety system is to be independent from other control and alarm systems so that failure or malfunction in these systems will not prevent the safety system from operating.

19.3.2.4 Safety system is to have such self-monitoring properties that alarm signal will be given at least in the case of short circuit, earth fault, broken fuse or broken circuit.

19.3.2.5 Safety systems of different units of the machinery plant are to be independent. Failure in the safety system of one device or the plant is not to interfere with the operation of the safety system in another device or plant.

19.3.2.6 Safety system is to be activated after operation of the alarm system in the proper sequence of functions.

19.3.2.7 When the switching-off facilities in the safety system are provided, the switching-off device is to be of such a design as to exclude the possibility of its unintentional use, and in the case of the safety system being switched off, its position is to be indicated by means of a special signal.

19.3.2.8 In case of activation a safety system, that has two or more functions, they should be activated in proper sequence, providing at first the activation of function that disturbs the controlled unit at least.

19.3.2.9 Each safety system panel with indicators should allow for checking the indicators operation (visual/audible signal).

19.3.3 Indicating and Recording Systems

19.3.3.1 Indicating and recording systems are to be independent of other systems and so designed that their failures do not affect the other systems.

19.3.3.2 A failure in recording system is to be indicated by an audible and visual signal.

19.3.3.3 Means are to be provided to ensure accurate reading of indication on indicating instruments taking into account lighting conditions at the point of their installation.

19.3.3.4 Indicating instruments are to be so designed that the operator will receive all necessary information directly, without the necessity of calculations in the units normally used for the measured variable.

19.3.3.5 Each panel with indicators of the system should allow for checking the operation of indicators (visual/audible signal check).

19.4 Electrical Power Supply and Distribution Control System

19.4.1 The arrangement of the unit's electric generating plant is to ensure the continuity of electric power supply in accordance with the following requirements:

- **.1** Where electric power demand normally is supplied by one generator, there are to be adequate solutions in case of its failure for automatic starting and connecting to the main switchboard a stand-by generator of sufficient capacity to permit propulsion and steering and to ensure the safety of the unit with automatic restarting of the essential auxiliaries, including, where necessary, sequential operations. This standby electric power supply should be able to take the load in no more than 45 seconds after a power failure; it is recommended that the load securing occurred within 30 seconds. The time of taking over the load by a stand-by generator is to be short enough to delay the starting of the emergency source of electric power.
- **.2** Where electric power demand normally is supplied by two or more generating sets operating in parallel, arrangements are to be provided (e.g. load shedding of less essential consumers for which the load shedding is unconditionally allowed and, where necessary, also the consumers for which the load shedding is allowed) to ensure that in the case of failure of one of these units, the remaining ones are kept in operation without overload, and to ensure the safety of the unit.

19.4.2 Failure to start the set is to be signaled by the alarm system.

19.4.3 The automatic control system of generating sets is to be provided with interlocking arrangement preventing the generating set from being automatically connected when a short-circuit occurs on the busbars of the main switchboard.

19.5 Control Systems of Steam Boilers

19.5.1 Control characteristics of different automatic control systems of operation of steam boilers are to be so selected as to maintain the water level, steam pressure and other controlled parameters within the predetermined limits over the entire load range of the boiler, and to ensure rapid changes of boiler load in accordance with boiler characteristics.

19.5.2 The automatic control system of boiler firing installation is to be so designed that starting of a cold boiler is only possible from the local control station.

19.5.3 The automatic control system of boiler firing installation is to be so designed that fuel supply is only possible when the following conditions are fulfilled:

- **.1** water level is normal;
- **.2** viscosity and temperature of fuel oil are sufficient for its proper atomisation;
- **.3** pre-purging of the combustion chamber has been effected during at least 30 sec., and the dampers in the air ducts are fully opened;
- **.4** fuel supply to the burners is set for the minimum value;
- **.5** burner is in the operating position;
- **.6** control systems and power supply are ready (presence of power) ;
- **.7** air is fed to the boiler furnace;
- **.8** the pilot burner is alight or electrical ignition switched on.

19.5.4 The automatic control system of boiler firing installation is to be so designed that purging of combustion chamber always takes place after the fuel supply has been cut off, whether manually or automatically.

For the boiler fired by more than one burner, purging of the combustion chamber is to take place after switching off of the last burner.

19.5.5 Where the boiler is fired by more than one burner, the control systems of burners are to be independent of each other.

19.5.6 In any case, failure of pilot burner control system is not to disturb the operation of the main burners.

19.5.7 The automatic boiler firing installation is to be provided with safety system shutting off the fuel oil supply when the following failures occur:

- **.1** the ignition of the fuel fails within 5 sec. from the beginning of fuel admission;
- **.2** the viscosity or the temperature of fuel oil is too low;
- **.3** the values of parameters of atomising steam or air intended for fuel atomising fall;
- **.4** the water level in the boiler is below the permissible value;
- **.5** fade out of the flame at the burner .

19.5.8 The restarting of firing installation after the elimination of defects is to be possible from the local control station only.

19.5.9 The automatic control system of boiler firing installation is to be so designed that the ignition device is switched on after a certain time of purging the combustion chamber in accordance with the manufacturer’s requirements.

19.6 Processing Systems – Instrumentation and Control Systems

19.6.1 Essential consumers shall have a power supply with built in redundancy with at least one UPS capable of maintaining the function of the system for sufficient time to monitor and control an emergency or a failure of main power generator. The minimum duration is 30 minutes.

19.6.2 Essential consumers mean measurement and control equipment, remotely controlled valves, in particular SDV valves, blow-down valves and electrical installation of the flare.

19.6.3 Systems, including main control modules and instruments of control of operating parameters should be on the principle made for "safety in the case of failure" “

19.6.4 Any damage to system components and control modules or lack of power supply should lead to the least dangerous state.

19.7 Operation of safety and alarm systems

19.7.1 It is recommended that the mode of operation of safety and alarm systems is compatible with the following table 19.7.1.

Table 19.7.1

System or equipment	Parameters	Alarm system	Safety system	Remarks
1	2	3	4	5
Receivers with dual power supply	Lack of main power	failure		
Spaces with mechanical ventilation	Lack of ventilation	failure		
Power Management System- PMS / Main Generator sets .	Power supply to control systems (including PMS) or monitoring systems	failure of supply in one of systems		
	Starting failure of prime mover	failure of start or no start		
	Frequency	maximum minimum		
	Voltage	maximum minimum		
	Excessive difference of loads	maximum		
	Generator standby	lack of “ready to start” mode		
Internal combustion engines driving main generators	Starting air pressure before the engine or in the tank	minimum		
	Lubricating oil pressure	minimum	stop	
	Cooling water flow rate or pressure	loss of flow or minimum pressure		
	Lubricating oil temperature	maximum		
	Engine rpm	overspeed		
	Cooling water temperature	maximum		
	Fuel leakage from high pressure pipings	physical value agreed with PRS respectively to applied solutions		
	Fuel level in settling tank	minimum		
	Exhaust gas temperature	maximum		
Gas turbines driving main generators	Speed	overspeed	stop	
	Lubricating oil pressure	low		
	Lubricating oil pressure	minimum	stop	
	Lubricating oil temperature	maximum		
	Gas temperature after combustion chambers	maximum		
	Combustion (in combustion chambers)	flame decay or ignition failure	stop	
	Vibration level	high		
	Turbine safety system	initiation		
Internal combustion engines driving emergency generators/	Generating set in the “ready to start” mode	lack of “ready to start” mode		

emergency generating sets				
Storage Batteries/Uninterruptible Power System (UPS)	No charging / discharging	failure		
	Damage/ Lack of ventilation	failure		
	Automatic by-pass of circuits maintaining of power supply.	failure		
	Operation of battery protection device	failure		
Navigation lights	Lack of power supply	failure		indication on MCS and PCS
	Short circuit in any circuit	failure		indication on MCS and PCS
	Bulb failure	failure		indication on MCS and PCS
Main switchboards / power distribution systems	Insulation resistance	minimum		remote measurement, insulated distribution systems
	Insulation resistance in high voltage distribution system without automatic disconnection	minimum		insulated distribution systems or high resistance earthed systems
	Loss of supply voltage of circuits associated with safety systems	failure		
	Overload alarm for any motors without overcurrent trip	failure		
Computer systems	Initiation of filters protection systems	failure		
	Lack of supply voltage for essential circuits of control and monitoring systems	failure		
	Lack of voltage on high-voltage switchboard busbars	failure		
	Failure/communication error	failure		
Cooling and anticondensation in electric equipment	Failure in cooling of equipment systems and electrical installations	failure or loss of flow		
	Winding temperature in the cooled equipment for essential services	high		remote measurement
	Leakage on water cooled heat exchangers	failure		
Rotating machines	Stator winding temperature	high		applies to machines with a power> 500 kW / kVA and high voltage motors
Liquid-cooled transformers	Level of coolant	low		
	Coolant temperature	high	shutdown	
	Gas pressure		high: shutdown	
	Interturn short circuit		shutdown	

Converters/ Semiconductor	Lack of Power supply	failure		
	Secondary side earth fault (IT distributions)	failure		
	Conductivity of cooling liquid	high		the liquid in contact with parts under voltage
	Trip from operation any unit modules	failure		
Pressurised spaces (Ex-p)	Pressure to Ex-p (zone 2)	loss		
Piping systems				
Bilge system	vacuum on suction side of the pump	minimum		
	level in bilge wells of machinery space	maximum		
Fuel preparation systems	level of the fuel in the settling tank	minimum		
Sludge systems	level in sludge tanks	maximum		
Steam boilers and associated systems				
Boiler	pressure of steam	maximum		
	water level	maximum minimum	shutdown of fuel oil supply at minimum level	
	temperature of superheated steam	maximum		
	temperature of saturated steam	maximum		
Circulating pump	water flow through pump	no flow	depending on arrangement of system and properties of the boiler	
Feed water system	pressure on delivery side of feed water pump	minimum	start of stand-by pump	
Firing system	pressure of fuel oil before burner	minimum		
	flame extinguishing	–	shutdown of fuel oil supply	
	pressure or flow of combustion air	minimum	shutdown of fuel oil supply	
	temperature of fuel oil before burner	maximum minimum	shutdown of fuel oil supply at minimum temperature	
	level in daily service tank	minimum		

19.7.2 Configuration of monitoring systems shall be agreed with PRS – this applies, among the others, to mode of action (function) and arrangement of the components.

20 COMPUTER-BASED SYSTEMS

20.1 The requirements of *Publication No. 9/P – Requirements for Computer-based Systems*, except for the requirements of 1.6, 4.7 and 9.1, apply.

20.2 In relation to environmental conditions, for computer-based systems, paragraph 2.1.1.2 of Part VI of *this Publication* applies.

20.3 In relation to required certificates for computer-based systems, table 5.4.3 of Part VII of *this Publication* applies.

PART VII
Hydrocarbon Processing Systems

1 GENERAL

1.1 Application

Requirements of this Chapter *VII – Hydrocarbon Processing Systems* apply to machinery equipment and systems intended for hydrocarbons extraction and processing, used on stationary offshore platforms, further called *units*.

1.2 General Requirements

1.2.1 Environmental Conditions

Requirements of *Part VI* of this *Publication* apply.

1.2.2 Materials and Welding

Requirements of *Part IX, PRS Rules for the Classification and Construction of Sea-Going Ships* apply.

1.2.3 The following items are subject to the requirements specified for machinery:

.1 pressure vessels and atmospheric vessels for flammable and explosive media,
.2 knock out drums (separators),
.3 crude oil export system pumps,
.4 gas compressors,
.5 a flare,
.6 adjustment valves, remotely controlled shutdown valves.
.7 safety valves.

1.2.4 The following items are subject to the requirements specified for systems:

.1 crude oil separation system,
.2 gas processing and compression system,
.3 water treatment and injection system,
.4 chemical injection system,
.5 process sewage and liquid hydrocarbons collection system,
.6 depressurization systems,
.7 gas hydrocarbons neutralization and emergency disposal system.

1.2.5 Systems/installations covered by Part VII

.1 control and monitoring systems (alarm, indication, recording, safety systems) of production installations;
.2 integrated control and monitoring systems of processing plant.

1.3 Terms and Definitions

The generally applicable terms are given in *Part I – Survey Regulations*. The following definitions are specific for this Part VII:

B D V   V a l v e   (B l o w - d o w n   V a l v e) – a remotely controlled valve fulfilling appropriate requirements, used for relieving and depressurization of installation within process of extraction, production and export of oil and gas or machinery components of the process.

E S D – E m e r g e n c y   S h u t   D o w n – emergency shutting down and isolating the process system by ESD system.

E S D   S y s t e m – Emergency Shut Down System – superior safety system isolating extraction, production systems and ignition sources, as well as shutting down or activating particular machinery items in case of a serious hazard. In result of the ESD system activation the technological process is shut down, while operating machinery and electrical systems of the *unit* bringing to safe operation condition. Emergency systems are activated.

HAZOP (Hazard and Operability Study) - hazard and operability analysis.

P&ID Diagram (Piping and Instrumentation Diagram) – system diagram including monitoring and measuring instruments and their functions.

PFD Diagram (Process Flow Diagram) – logical scheme of a technological process flow of the given system.

Pressure Safety Valve (PSV) – the valve protecting from excessive pressure increase or pressure difference in the system, which opens and closes automatically at defined pressure or pressure difference.

~~Process system – all pipings and mechanical and electrical machinery, within the oil and gas extraction, production and export process path.~~

Processing plant – any pipings and mechanical and electrical machinery used for extraction, production and export of crude oil and gas.

Production systems – systems forming the process path of oil and gas extraction, production and export.

PSD – Process Shut Down – shutting down the technological process by PSD system.

PSD System – Process Shut Down System – safety system intended for shutting down and isolating the process of extraction, production and export of oil and gas – by means of closing appropriate valves and stopping the machinery. In result of PSD system activation the technological process is shut down, while the *unit* machinery and electrical systems, including production support systems, are still working.

Shut Down Valve (SDV) – remotely controlled valve fulfilling appropriate requirements, used for isolating the process of extraction, production and export of oil and gas or storage arrangements of the process.

SSSV valve (Sub Surface Safety Valve) – an isolating valve located under water or under sea bed on the inlet of well stream to the *unit*.

SSV Valve (Surface Safety Valve) – an isolating valve located above water level on the inlet of well stream to the *unit*.

Utility systems – machinery and electrical systems supplying energy for technological process of oil and gas extraction, production and export. Technical requirements for these systems are contained in *Parts IV* and *VI*.

1.4 Standards

The below given standards apply to *unit* production systems. Other standards may be considered alternative or additional, provided their application ensures comparable or higher safety level of designed system.

Any exceptions, modifications and deviationss from the below standards shall be documented and agreed between executor, purchaser and PRS.

Table 1.4

Designation	Title
ANSI/ASME B31.3	Chemical Plant and Petroleum Refinery Piping
API RP 14C	Analysis, Design, Installation, and Testing of Basic Surface Safety Systems for Offshore Production Platforms
API RP 14E	Design and Installation of Offshore Production Platform Piping Systems
API RP 520	Sizing, Selection and Installation of Pressure Relieving Devices in Refineries
API RP 521	Guide for Pressure Relieving and Depressurizing Systems
API Spec 12D	Field Welded Tanks for Storage of Production Liquids
API Spec 12F	Shop Welded Tanks for Storage of Production Liquids

API Spec 12J	Oil and Gas Separators
API Spec 6FA	Fire Test for Valves
API Spec 6FC	Fire Test for Valve With Automatic Backseats
API Spec 6FD	Fire Test for Check Valves
API Std 610	Centrifugal Pumps for Petroleum, Heavy Duty Chemical and Gas Industry Services
API Std 614	Lubrication, Shaft-Sealing, and Control-Oil Systems and Auxiliaries for Petroleum, Chemical and Gas Industry Services
API Std 618	Reciprocating Compressors for Petroleum, Chemical and Gas Industry Services
API Std 650	Welded Steel Tanks for Oil Storage
API Std 660	Shell-and-Tube Heat Exchangers
EN 13480	Metallic Industrial Piping
EN 13445	Unfired pressure vessels
ISO 10418	Petroleum and natural gas industries - Offshore production platforms - Analysis, design, installation and testing of basic surface safety systems
ISO 10474	Steel and steel products - Inspection documents
ISO 13631	Petroleum and Natural Gas Industries - Packaged reciprocating gas compressors

1.5 Technical Documentation

Prior to the machinery construction, the following technical documentation shall be submitted, in triplicate, to PRS Head Office for consideration and approval:

.1 process system basis of design and process simulations,
.2 machinery arrangement plan,
.3 hazardous zones arrangement drawing,
.4 P&ID and PFD system diagrams,
.5 process shutdown and emergency process shutdown cause and effect matrix.
.6 description of PSD and ESD system operation principle,
.7 flare and blowdown system technical documentation (including relevant calculations for e.g. capacity requirements, back pressure, equipment sizing, depressurising profile, low temperature effects, gas liquid particles entrainment etc.),
.8 sizing calculations (for relief valves and bursting discs, BDV valves),
.9 flare radiation calculations and plots,
.10 cold vent dispersion calculations and plots,
.11 HAZOP study report ,
.12 piping and fittings material specification for process and utility systems (covering relevant data, e.g. maximum or minimum design temperature or pressure, corrosion allowance, reference standards, branch requirements etc.);
.13 specification of control and measurement instruments and automatic systems,
.14 principle and functional electrical diagrams for control and monitoring systems,
.15 pneumatic and hydraulic diagrams,
.16 test programmes, including acceptance criteria,
.17 software and hardware documentation (see Part VI, Chapter 20), for computer controlled systems..

2 EQUIPMENT REQUIREMENTS

2.1 General Requirements

Paragraphs 2.2 to 2.5, and 2.7 include specific requirements for machinery applicable in crude oil processing systems on stationary offshore units. Requirements of *Part VII* of the *Rules for the Classification and Construction of Sea-Going Ships* supplement the above requirements.

2.2 Pressure Vessels and Atmospheric Tanks for Flammable and Explosive Media

2.2.1 All vessels intended for the storage of easily flammable substances shall be placed possibly far from drilling heads. The vessels shall also be located possibly far from potential ignition sources such as combustion engines, boilers and such spaces as workshops or welding shops.

2.2.2 If the vessels intended for the storage of easily flammable substances are a part of pontoon structure and are located in close vicinity of spaces containing potential sources of ignition (engine room, boiler room, workshop), a minimum 0.75 m wide cofferdam shall be installed.

2.2.3 All explosion hazardous atmospheric vessels intended for the storage of easily flammable substances shall be protected against atmospheric air ingress through inert or shielding gas delivery.

2.3 Knock out Drum

2.3.1 A knock out drum in depressurizing system shall have sufficient capacity to remove slugs and droplets that would not be completely burned in the flare or which could fall back onto the installation.

Typical performance standards for knock out drums are:

- separation of liquid droplets down to 300-400 micron with normal liquid level at start of depressurizing,
- capacity to hold entrained liquid from process segments while isolation valves are closed, for a minimum of 90 s,
- capacity to hold liquid from condensing vapours,
- capacity to hold liquid from a typical process segment that has not been successfully isolated while depressurizing valve is open (e.g. leaking or open shut down valve at the end of system). The liquid holding capacity should be based on evaluation of the time required for manual intervention and the flow rates of possible sources. Installation of alarms on valves that could cause significant inflow if they fail to operate or operate inadvertently, shall also be considered,
- in estimating capacity to hold liquid, the pump out rate should not be taken into consideration

2.3.2 The sizing and internal design of knock out drum to ensure efficient liquid removal shall also include consideration of the possibility of gas flow picking up liquid slugs when passing through the drum.

2.3.3 The knock out drum shall be fitted with high level monitoring which initiates a complete process shutdown if design levels are exceeded. The high level shutdown should be initiated when the knock out drum level is such that the drum still has sufficient available capacity to allow full process depressurization.

2.4 Oil Export System Pumps

High capacity pipeline export pumps are recommended to be fitted with a minimum flow bypass system. The bypass system shall ensure maintaining the minimum pump capacity enabling limiting pump temperature rise.

2.5 Gas Compressors

2.5.1 Compressor shall be monitored for leakage. The compressor shall be automatically tripped and depressurized if unacceptable leaks or other malfunctions are detected

2.5.2 Compressor recycle line shall be self-draining to the tie-in point upstream of the compressor, with the recycle line valve located at the high point. The recirculated gas shall be led through scrubber.

2.5.3 Compressor recycle valves which are required to operate as part of emergency depressurization shall be fitted with separate solenoids controlled from the shutdown system.

2.6 Flare

2.6.1 Flares shall normally be ignited by a continuous pilot flame. The pilot flame shall be supplied with a reliable source of gas. A back-up system shall be provided to secure supply of gas during all operating conditions.

2.6.2 Re-ignition of pilot flame shall be possible at all times. If the manual ignition panel is located in a location that may not be accessible in an accidental event, remote ignition shall be possible from a safe and accessible location.

2.6.3 In the case of a gas separation and recovery system, the flare may be ignited by a continuous pilot flame or an automatic ignition system.

2.6.4 An automatic ignition system shall be activated by both the PSD and ESD system.

2.6.5 The flare ignition system shall have the same high reliability as the PSD or ESD system. System elements that could make the whole system inoperable when failed, shall be avoided.

2.6.6 The gas cloud formation may be the effect of ignition failure. Gas cloud explosion consequences shall be analyzed and assessed in respect of reliability of the ignition system.

2.6.7 The maximum ignition time shall be decided from gas flow calculations for representative release scenarios.

2.6.8 The ignition system shall be provided with adequate redundancy to ensure proper operation in any operational conditions.

2.6.9 The ignition system reliability maintenance requires: at least minimum two attempts in each ignitron sequence and provision of parallel components to remove sources of single failure making the system inoperable.

2.6.10 The flare shall comply with API RP 521 Standard or equivalent.

2.7 Safety Valves

2.7.1 All pressure systems shall be provided with safety devices set for a pressure no higher than the maximum design pressure of the system. The devices shall have suitable capacity and characteristics to limit pressure build up to within limits allowed for the system or component.

2.7.2 It is recommended that during design of safety valves system account should be taken of:
- flow resistance in the flare nozzle and the piping distributing gas from safety valves,
- blocked outlet,
- failure of pressure control valve,
- gas blow by at level control valve in separator,
- excessive energy input (from heater or fire),
- rupture of heat exchanger tube,
- pressure build-up due to thermal expansion,
- backflow .

Two phase flow should also be considered for the design cases listed above.

If design for full flow relief proves impractical, then application of high integrity pressure protection systems (HIPPS) may be considered. The acceptability of such systems shall be considered on a case basis and will be dependent upon demonstration of adequate reliability and response of the complete system to a signal from detector to actuated device. The reliability target should be an order of magnitude higher than critical failure of a typical relief device. Such systems may not replace the safety valves installed on a pressure vessel.

2.7.3 Rupture discs shall be used in systems containing substances that could render a safety valve ineffective, or when rapid pressure rise can be predicted.

2.7.4 In installations where rupture discs are installed in series with safety valves or other rupture disc, the volume between the devices shall be monitored for leakage and pressure rise. An alarm shall be given at the production control station if a leak is detected.

2.8 Shutdown Valves operating within PSD and ESD systems

2.8.1 The SDV valves shall operate on fail-safe principle.

2.8.2 Ensuring the possibility of checking essential SDV in the Partial Stroke Test is recommeded.

3 REQUIREMENTS FOR PRODUCTION SYSTEMS

3.1 General Requirements

3.1.1 The system shall be so designed that it can withstand the most unfavourable combinations of pressure and temperature of the medium, in particular those characteristic for transition conditions.

3.1.2 The system shall be divided into segments. Each segment shall be subdivided by shutdown valves that are operated from the process control station. The valves shall subdivide production systems based on consideration of plant layout, fire zones, depressurising system and working pressure ratings.

3.1.3 The shutdown valves should divide the process system into segments such that a leakage from any segment does not cause a hazard. The adequacy of selected segmentation should be confirmed through a HAZOP study.

3.1.4 Structure and control system of process shutdown valves (PSV) shall meet the executed ESD functions. The following valves shall be designated as shutdown valves:

- **.1** sub surface safety valves (SSDV) and surface safety valves (SSV) shutdown valves on the inlet of well stream to production system,
- **.2** valves on oil import and export pipings,
- **.3** valves on gas piping,
- **.4** segregation valves between two segments of the same system or between systems with different design pressure,
- **.5** segregation valves for systems of different production process.

3.1.5 The production systems shall be fitted with sufficient drain and vent points to enable draining and depressurization of all segments in a controlled manner. They shall be permanently or temporarily connected to the depressurizing system or drain disposal systems.

3.1.6 Consideration should be given to installing 2 block valves in series at depressurizing points from high pressure systems (the maximum pressure 2 MPa and above). This will enable gas shut off if ice or hydrates form in one of the valves causing it untight.

3.1.7 Where use of several shutdown valves is required to maintain appropriate capacity of depressurizing system, their number and capacity shall be so selected that in case of one of the valves becoming inoperable the capacity of the system is not excessively reduced.

3.1.8 High pressure and low pressure systems shall be isolated, except shutdown valves, by spades, blinds or other positive means. An interlocked double block may also be accepted. A shutdown valve shall be fitted between the double block valves line and depressurizing system. These valves are to be rated for the highest pressure.

3.1.9 Piping with a bore less than 19 mm shall be avoided in process piping systems where practicable. If used, particular attention shall be paid to providing suitable supporting arrangements to prevent damage caused by vibrations, relative thermal expansions or other imposed loads from adjacent pipework or operations.

3.1.10 Service and utility systems (e.g. steam, heating medium, cooling medium, compressed air, etc.) that are connected to systems containing flammable or toxic liquids or gases shall normally not be combined with similar systems located in non-hazardous areas nor connected to non-hazardous systems. Where this is impracticable, such connections shall be designed to eliminate or control the risk of ingress of hazardous material from one system to the other due to incorrect operation or leaks.

3.1.11 Single non-return valves are not regarded as reliable means of protection against mixing gas and liquid substances.

3.1.12 The following is recommended before designing the interconnection of systems referred to in 3.1.10:

– identify possible failure modes and define a realistic range and size of a leak,
– evaluate possible consequences of mixing two substances from two different production systems interconnected by a utility system,
– describe and evaluate reliability, maintainability and testability of active and passive protection systems (e.g. liquid seals, non-return valves, detectors, actuated valves, primary and secondary control loops etc.).

If the potential consequences of mixing substances from different production systems interconnected by a utility system are found to be significant, or if the reliability of protective measures is difficult to maintain or verify, then separate utility systems connected independently with production systems shall be specified.

3.1.13 Heating or cooling circuits in hydrocarbon process systems shall have facilities to detect small hydrocarbon leakages. See 3.1.10 for protection against major leakages.

3.1.14 Heat exchangers shall be protected from thermal expansion of fluids blocked in one side when flow is maintained through the other side. In such case the heat exchanger shall be taken out of service.

3.2 Crude Oil Separation System

The separators shall have sufficient capacity to separate the components of the well stream, and effective means for removal of sand and water.

3.3 Crude Oil Export System

3.3.1 The values of critical operational parameters and response time in the pump protection system shall be so selected to prevent damage to downstream pipelines and fittings connected to pumps.

3.3.2 Non-return valve shall be installed downstream pumps to prevent backflow.

3.4 Gas Treatment and Compression System

3.4.1 Liquid scrubbers with appropriate components (e.g. mist pads) shall be installed immediately upstream of gas compressors. The compressor train shall be tripped or otherwise protected if liquid levels reach an unacceptable level within an upstream scrubber.

3.4.2 Gas coolers in systems with significant pressure differential between the gas and cooling medium side shall be fitted with quick acting relief devices (e.g. bursting discs), in accordance with API RP 521 Standard.

3.4.3 The design pressure and temperature of the process segment that contains the compressor shall take into account compressor settle-out conditions.

3.4.4 It is recommended that design of location of vent points from the glycol regeneration re-boiler shall include consideration of emissions of harmful substances (e.g. aromatics) and their effect on personnel.

3.5 Water Injection and Treatment Systems

3.5.1 A non-return valve and an automatic shutdown valve shall be fitted at the injection point to the well.

3.5.2 Water injection and treatment pipings shall be fitted with a system to prevent water freezing during periods of shutdown.

3.6 Chemical Injection System

3.6.1 Non-return valves shall be installed at injection points to production systems.

3.6.2 Containers with chemicals shall be stored and emptied in a closed space, equipped with draining system. Incompatible chemicals shall be located in separate closed spaces.

3.6.3 Piping from transportable tank containers or boat loading stations shall be designed as self draining.

3.6.4 Provisions for lashing of transportable tank containers shall be incorporated in the bunded area intended for storage of chemicals. Permanent piping installations, joints and hose couplings shall be protected against damage from transportable tank containers handling operations.

3.6.5 Injection systems supplied with cryogenic liquids (e.g. liquid nitrogen) shall be installed in enclosed insulated bunds that are designed to collect any leaks and prevent adverse low temperature effects on adjacent structures or other equipment.

3.6.6 Safety showers and eye washing stations shall be installed at locations where harmful substances are stored and handled.

3.7 Production Sewage and Liquid Hydrocarbons Drainage System

3.7.1 Open System of Production Sewage Drainage

3.7.1.1 An open system of production sewage drainage shall fulfil the requirements of Chapter 7, *Part VI* of the PRS *Rules for the Classification and Construction of Sea-Going Ships*.

3.7.1.2 Production equipment from which spillage can be expected shall be located above drip trays or coamings which will collect and direct escaped fluids to an open drainage system.

This requirement applies to: atmospheric and pressure vessels provided with multiple flanges and measuring instruments, pumps, heat exchangers, seal and lubrication oil systems under rotating machinery, sample points, pig receivers and launchers

3.7.1.3 The capacity of the drip tray shall be based on assessment of potential leak rates and may normally be approximately 50 mm of coaming height for equipment other than pressure and atmospheric vessels,

3.7.1.4 The capacity of drip trays under large atmospheric and pressure vessels and heat exchangers should be based on an assessment of the number of leak sources, and volume and consequence of leak e.g. onto equipment or deck below.

A capacity to hold 5% of the vessel volume can normally be regarded as adequate, provided that there is also sufficient capacity of the collection system. It is assumed that in case of catastrophic ruptures spillage can be handled through the bilge system.

3.7.1.5 Open drain systems for areas that are classified as hazardous shall be separate from drain system for non-hazardous areas.

3.7.1.6 If there is a possibility of air ingress to the production sewage treatment plant, it shall be vented with inert gas. Measures shall be taken to prevent spread of fire through the drainage system (e.g. water seals with level alarms).

3.7.2 Closed Liquid Hydrocarbons Drainage System

3.7.2.1 The production plant shall be equipped with a closed drainage system for hydrocarbons collected from emptied production plants to dedicated tank..

3.7.2.2 The systems referred to in 3.7.1 shall be separate from the systems referred to in 3.7.2.

3.8 Safety Systems

3.8.1 General

3.8.1.1 Production systems shall include safety arrangements, aimed at:
– protection against excessive pressure,
– minimization of hydrocarbons release in case of system rupture;
– collection and discharge of hydrocarbons released.

3.8.1.2 The systems shall be designed to handle the maximum process medium flow expected due to any single equipment failure or accident situation (e.g. caused by blocked outlet or fire). Particular consideration shall also be given to possible cascade effects where accident in one process segment can cause accidents elsewhere.

3.8.1.3 Relief valves, as a rule, shall be directly, without block valves, connected with the protected space. Block valves or control valves in depressurizing system piping shall not be installed after the safety valve.

3.8.1.4 Where use of several PSV valves is necessary for maintaining the required capacity of protecting system, the system shall be so configured to ensure full designed flow even at failure of one of PSV valves.

3.8.1.5 Block valves may be installed in pipings protected by several PSV valves. The block valves shall be reliably mechanically lockable in open position.

3.8.1.6 Discharges of the depressurizing system from relief valves and automatic and manual depressurization valves are to be led to a location remote from ignition sources and ventilation inlets.

3.8.1.7 Hydrocarbon supply and discharge piping to and from relieving devices shall be self-draining away from the relief device back to pressure source and to knockout drum, as applicable. The depressurizing pipings tie-in to collection header shall normally be at the top of the header, preferably at 45° to the flow direction in the header.

3.8.1.8 The design of piping, valves, and knock out drums shall consider generation of low temperatures, hydrates, possible slugging flow, and heat input from gas combustion in the flare.

3.8.2 Depressurizing System

3.8.2.1 The depressurizing system shall ensure safe collection and disposal of hydrocarbons from process lines, during normal operations and during emergency conditions.

It is normally recommended that detection of fire or gas release in the process area should results in automatic depressurization of the production plant. Where this recommendation is not applicable, HAZOP analysis shall be performed, including effects of additional time allowed for activation of depressurization procedure as a preventive measure.

3.8.2.2 The depressurizing system shall be designed according to the *fail safe* principle. This normally means that blow down valves are spring return, and fail to open position (e.g. in case of power supply decay).

3.8.2.3 Process systems with process medium containing significant energy shall be depressurized in emergency mode, only. The rate of depressurizing shall be sufficient to ensure that piping and appliance rupture will not occur in case of external heat input from a gas combustion.

3.8.2.4 The maximum medium energy content locked in depressurized process segment should be determined based on assessment of the potential for incident occurrence. Locked in volume equivalent to 1000 kg of burned hydrocarbons is commonly regarded as acceptable if the plant is located in an open area. The acceptable locked in energy limit should be based on:

– system response time,
– heat input respective to defined accident scenarios,
– structural material properties and utilization ratio for particular materials,
– other protection measures, e.g. active and passive fire protection measures,
– system process integrity requirements.

3.8.2.5 It shall be possible to activate the depressurizing system manually from the process control station, in addition to any automatic actions initiated through the ESD or fire and gas detection systems.

3.8.2.6 The hydrocarbons piping layout shall aim at providing protection from external loads (e.g. from fire, explosion, terrorist attack, dropped or swinging loads).

3.8.3 Gas Hydrocarbons Neutralization and Emergency Disposal Systems

3.8.3.1 The gas hydrocarbons neutralization and emergency disposal systems are used for collecting and discharging gas hydrocarbons from processing equipment and systems, gas fuel supply systems, safety systems (see 3.8.1, 3.8.2). Liquids shall be separated from hydrocarbons in a knock out drum before their discharge.

3.8.3.2 The gas hydrocarbons neutralization and emergency disposal systems include:
– cold blowdown systems used for gas hydrocarbons disposal directly to atmosphere,
– hot blowdown systems used for combustion of gas hydrocarbons in a flare.

3.8.3.3 The gas hydrocarbons neutralization and emergency disposal systems shall be so designed that the lowest pressure sources can enter the system without unacceptable reduction in capacity due to back pressure. The above requirement may result in a need for two or three separate systems.

3.8.3.4 The gas hydrocarbons neutralization and emergency disposal systems shall be continuously purged with nitrogen or fuel gas supplied upstream in headers and sub-headers.

3.8.3.5 Hydrocarbon disposal system vents shall be located at a safe distance from ignition sources and ventilation intakes. An extinguishing system shall be fitted to extinguish the vent if it is accidentally ignited by lighting or electrostatic discharge.

3.8.3.6 The system parameters shall be so selected to eliminate the dew point of vented gas-air mixture and to prevent generation of condensate that falls back to the plant at the minimum anticipated ambient temperature.

3.8.3.7 Open vent discharge piping shall be protected against the effects of rain and ingress by foreign bodies.

3.8.3.8 The open vent protection shall include a 10 mm ‘weep-hole’ to drain out rainwater, a wire mesh at outlet and flame arrestors.

3.8.3.9 Flare and hydrocarbon disposal system structures shall be fitted with stairs, ladders, handrails or guards to provide safe personnel access for maintenance and inspection.

3.8.3.10 The flare and the system of hydrocarbon disposal to atmosphere shall comply with API RP 521 or equivalent.

3.8.3.11 The flare shall be so located to prevent accidental ignition from cold blowdown system.

3.8.3.12 The heat radiation due to gas ignition in the flare shall not exceed:
– 6.3 kW/m^2 for areas where, in emergency situations, personnel equipped with protective clothing, however, without any shields, may be present for not more than one minute,
– 4.7 kW/m^2 for areas where, in emergency situations, personnel equipped with protective clothing, however, without any shields, may be present for several minutes,
– 1.6 kW/m^2 in any area, where personnel may be present continuously.

Heat radiation due to gas ignition in a flare may not result in exceeding:
- permitted operation temperature of electrical and mechanical equipment,
- 50% of lower limit of gas stream ignition from the cold blowdown system, in the places where personnel may fall in the gas cloud.

At determining intensity of heat radiation and the extent of heat affected zone, the least favourable atmospheric conditions shall be considered.

The above requirements apply also to emergency situations (flare flame decay or gas ignition from cold blowdown system).

3.8.4 Pig launcher and receiver

3.8.4.1 Pig launchers and receivers shall be fitted with:

– double safety and shut down valves that will isolate flow of hydrocarbons when the door is opened,
– a system to ensure that pig launchers and receivers are flushed and depressurized before the door can be opened,
– a device that enables the operator to confirm that the vessel is completely depressurized before the door is opened (e.g. pressure gauge, pressure measuring systems and pressure sound alarm, etc.)

3.8.4.2 Pig launchers and receivers shall be arranged with the centre-line oriented away from any essential equipment or structures.

3.8.4.3 Trays to collect spillage shall be provided below inlet to/outlet from pig launchers and receivers. The tray arrangement shall allow safe handling and storage of 'pigs' and deposits from the pipeline.

4 PROCESS SAFETY SYSTEMS

4.1 General

4.1.1 Process safety systems shall be fully independent of the process control systems.

4.1.2 Process safety systems shall be automatically monitored.

4.1.3 Process safety systems shall be continuously power supplied, without any breaks, including the time necessary for activating the emergency source of power. It applies also to hydraulic and pneumatic supply.

4.1.4 After loss of main power, automatic switch to emergency source of power shall be effected. Additionally, an Uninterruptible Power Supply (UPS) capable of at least 30 minutes continuous operation on loss of main power shall be installed as a temporary power source.

4.1.5 There shall be two independent levels of protection to prevent the effects of a malfunction or fault in process equipment and piping systems. The first level may be for example a detector shutting down automatically the medium flow at excessive pressure, the second level being the safety valve.

4.1.6 The shut down valves shall be capable of being manually controlled and shall have local status indicators.

4.1.7 The process safety systems shall comply with the requirements of Chapter 19, *Part VI* of the *Publication*, applicable to safety systems.

4.2 Isolation and shut down of machinery, section, process plant

4.2.1 Essential machinery, sections and process plants that could endanger the safety if they fail outside pre-set conditions shall be provided with automatic and/or manual shut down (isolation). Machinery, sections or process plants designed for automatic shutdown shall also be designed to enable manual shutdown.

4.2.2 Sections and machinery shut down (isolation) systems operating according to 4.2.1 shall fulfil the requirements of 4.4.2.3.

4.3 PSD System

4.3.1 PSD system shall ensure shutdown and isolation of oil and gas extraction, production and export process and its components, by closing particular shutdown valves (SDV) and the equipment shutdown. The PSD system may operate by several modes.

4.3.2 Manual activation of PSD system shall be ensured. Automatic activation may also be provided, after detecting abnormal conditions by process parameters monitoring devices.

4.3.3 PSD system activation, in the whole technological process shutdown mode, shall close e.g.:
– surface safety valve (SSV, SDV) and/or underwater safety valve (USV) installed on the well stream inlet,
– SDV valves in the lines of oil and gas separation,
– shut down valves installed on the lines of water injection to deposit,
– a shut down valve fitted on the oil export pipings,
Moreover, the process fluid pumps and supply of thermal energy to process installation shall be tripped.

4.4 ESD System

4.4.1 ESD System Purpose and Characteristics

4.4.1.1 In case of a serious hazard, the ESD system shall prevent or minimize dangerous incidents and reduce their extent and duration. It is achieved by a combination of activities aimed at stopping the flow of hydrocarbons and bringing the process and other systems to a defined safe condition. Where reasonable, the ESD system disposes the process medium from the process plant through the liquid hydrocarbon drainage system and by gas hydrocarbons blowdown and combustion in a flare.

4.4.1.2 Activation of ESD system results in complete stop of deposit exploitation and bringing the process systems to a safe condition. This is achieved by:
- activation of the PSD system,
- closing the shut down valves which are not closed by PSD and are located on the well fluid inlet, including SSSV valve,
- opening blowdown valves fitted on the process system, for depressurization and disposal of liquid hydrocarbons from the system,
- closing fire dampers.

4.4.1.3 The ESD system includes:

.1 ESD operator position,
.2 ESD control panel,
.3 ESD manual activation buttons,
.4 selected detectors of process monitoring,
.5 inputs/outputs and lines of signal transmission to such systems as: fire detection, gas detection, alarm, communication, PSD, depressurization and neutralization of hydrocarbons, drill control, fire protection, ventilation.

4.4.1.4 Arrangement of ESD manual activation buttons

ESD manual activation buttons shall be located in at least the below places:

.1 life boat embarkation stations and muster stations,
.2 a helideck,
.3 central control station – at the position of ESD operator,
.4 *unit* central control station,
.5 exits from the region of operation heads and drilling tower,
.6 main exits from accommodation spaces,
.7 descents from decks with process equipment,
.8 main evacuation route.

4.4.2 General Requirements for ESD System

4.4.2.1 The ESD system shall isolate each potential ignition source, before inflow of combustion gases.

4.4.2.2 The ESD system shall be designed to reduce the hazard of system inadvertent use or malfunction.

4.4.2.3 After activating ESD, automatic return of equipment and systems to pre-set condition shall not be possible. The system fittings shall be unlocked manually at their locations and remotely on the ESD operator position. Essential devices, such as wellhead valves, shall be reset locally and additionally from the ESD operator position.

4.4.2.4 The ESD system shall be so designed to enable selective isolation from operator position of:

.1 vent system, except ventilators supplying combustion air to engines driving main generators;
.2 air conditioning systems;
.3 engines driving main generators and ventilators supplying them with combustion air;
.4 engines driving the emergency generator.

4.4.2.5 The ESD operator position shall be located in a non-explosion hazardous area, in a permanently manned room.

4.4.3 General Requirements for ESD Controlled Systems

4.4.3.1 The systems shall be designed fail safe. This means that failure of power supply shall not result in opening of closed valves, as well as closing valves installed on pipings which shall continuously deliver medium, such as cooling water or fire mains.

4.4.3.2 Emergency machinery shut down/ process tripping shall be as simple as possible.

4.4.3.3 Emergency machinery shut down/ process tripping shall activate alarm on the ESD operator position.

4.4.3.4 Condition of ESD controlled systems shall be explicitly displayed on the ESD operator position (leds, indicators, etc.).

4.4.3.5 Gas detection in close vicinity to a crane shall activate alarm in the crane cabin. Automatic switch-on blockade shall be provided for the cranes which are not operated currently.

4.4.3.6 After ESD activation, personal lifts shall be automatically stopped and possibility of their easy and quick abandonment shall be ensured.

4.4.3.7 In the case of typical failure of ESD system (e.g. power loss, a short or a break in supply circuits), all ESD controlled systems shall be brought to a safe condition defined for production process and the *unit*. The safe condition means generally shutting down and isolating of the technological process and utility systems, supply of fire pumps being maintained.

4.4.3.8 Energy supply and operability of the below systems shall be maintained after ESD activation:

.1 emergency lighting (for at least 30 minutes) of:
- life boat and liferaft embarkation positions and overboard launching areas;
- all corridors of accommodation spaces and service spaces;
- staircases and exits, personnel and service lifts and lift trunks;
- machinery rooms, main generating sets room and engine control room;

.2 general alarm systems;
.3 the public address system;
.4 battery supplied radio communication appliances.

4.4.3.9 The electrical equipment to be energy supplied after activation of ESD system, shall be certified for use in zone 2 of explosion hazard. The equipment in spaces which may be effectively isolated/separated from ventilation is an exception.

4.4.3.10 ESD may be activated automatically after the alarm for *unit* abandonment.

5 CERTIFICATION OF EQUIPMENT

5.1 General

Quality Assurance

The manufacturer is normally to have an implemented Quality Assurance System. The manufacturer is to maintain a traceable record of nonconformities and corrective actions and make it available to the PRS surveyor on request.

5.1.1 Application of Standards

The equipment is to be manufactured according to the recognized standards (see 1.4). In case the PRS requirements of this chapter surpass the standard requirements, the PRS requirements shall apply.

5.1.2 Application of Requirements of Parts IV and VI of this Publication

For the equipment mentioned in *Part VII*, also the particular requirements of *Parts IV* and *VI* apply, excluding the certification requirements. Within the scope of certification, only the requirements specified in Chapter 5 of this *Part* apply.

5.2 Categorization of Equipment

Equipment categorization was established, considering that equipment function and importance to safety.

Category I equipment is to be surveyed and certified by PRS.

For category II equipment the Works Certificate – ISO 10474 (EN 10204:2004) type 3.1 certificate is accepted. Third party (type 3.2) certificate may be accepted.

5.3 PRS Acceptance of Equipment

5.3.1 Acceptance of Oil and Gas Processing Systems Equipment – PRS Basic Activities

Table 5.3.1

Acceptance of oil and gas processing systems equipment - PRS basic activities	
DA	Design Approval
DR	Design Review
FI	Factory Inspection/Audit
WI	Works Inspection
FAT	Factory Acceptance Test[1)] attended by PRS
FR	Fabrication Record Review
TA	Execution of PRS Type Approval Procedure

1) Functional, pressure and load tests, as applicable, included

5.3.2 Acceptance of Oil and Gas Processing Systems Equipment - PRS Standard Procedures

Table 5.3.2

Acceptance of oil and gas processing systems equipment - PRS standard procedures			
Procedure	PRS activities	PRS issues	Conditions, remarks
1	2	3	4
1a	TA + FAT, FR	Type Approval Certificate + Product Certificate (Metryka PRS)	PRS acceptance of the product (and issuing product certificate after FAT and FR) is obligatory only in case that the requirement to certify every product is included in *Type Approval Certificate*

1	2	3	4
1b	DR, FI, FAT, FR	Type 3.2 Inspection Certificate (EN 10204:2004) or Product Certificate (Metryka PRS)	Condition for application of the1b procedure: other IACS Class Society Type Approval Certificate recognized by PRS.
2	DA, WI, FAT, FR	Product Certificate (Metryka PRS)	–
3	WI, FAT, FR	Test Certificate (Metryka PRS)	–
4	Works Certificate (3.1) Review	PRS Surveyor reports reviewing and accepting the Works Certificate	The Works Certificate shall contain, as a minimum, the following data: – equipment specification or data sheet – limitations with respect to operation – manufacturer's statement, confirming that the equipment has been constructed, manufactured and tested according to recognized methods, codes and standards.

5.4 PRS Acceptance and Certification Procedures for Various Equipment Types

5.4.1 Pressure Containing Equipment and Storage Vessels

Table 5.4.1

Pressure containing equipment and storage vessels – acceptance procedures				
Feature	Conditions	Category I	Category II	PRS Procedure
Pressure	$1 < P \le \dfrac{20000}{D_i + 1000}$		X	4
	$P > \dfrac{20000}{D_i + 1000}$	X		2 [1)]
	Vacuum or external pressure	X		
Medium	Steam	X		
	Toxic fluid	X		
	Thermal oil	X		
	Liquid with flash point below 100°C	X		
	Flammable fluid with $T > 150$ °C	X		
	Other fluids with $T > 220$ °C	X		
	Compressed air or gas $PV \ge 1.5$	X		
Material	$\sigma_y \ge 360$ MPa or $\sigma_t \ge 515$ MPa	X		

Note 1): In special cases, the procedure 3 may be applied, provided that the manufacturer has an implemented Quality Assurance System, certified by a Recognized Organization. For a series produced equipment, the procedure 1a or 1b (Table 5.3.2) may be applicable.

Abbreviations in Table 5.4.1

P – internal design pressure (bar)

D_i – inside diameter (mm)

V – volume (m^3)
σ_y – specified yield strength
σ_t – specified ultimate tensile strength.

5.4.2 Piping and components

Table 5.4.2

Pipings and components – acceptance procedures				
Component	Characteristics	Category		PRS Procedure[1)]
		I	II	
Pipe spools, prefabricated in the shipyard, special pipes	Welded and bent pipe spools, flow metering and instrumentation pipe spools, pig launchers and receivers, any pipe spools of wall thickness exceeding 25.5 mm.	X		2
Flanges and couplings	Standard		X	4
	Non-standard type for flammable or toxic fluids	X		2
Valves	Valve body of welded construction, PN>100	X		2
	Valves for hydrocarbons P≥50 MPa, DN>300 and P≥10 MPa	X		2
	Valves, except those listed above, designed and manufactured according to recognized standards		X	4
Shut-down valves (SDV)		X		2
Pressure safety valves and rupture discs		X		1a, 1b, 2
Flexible hoses	For flammable or toxic fluids	X		1a, 1b
Expansion joints, bellows	For flammable or toxic fluids	X		1a, 1b
Swivels	Swivel joints connecting parts conveying toxic or flammable fluids under pressure.	X		1a, 1b, 2
General instruments	Standard instruments, well proven in offshore industry.		X	4
Flare and vent		X		2
Hydraulic and pneumatic control and shutdown panels	Pneumatic and hydraulic systems	X		2

Note 1)
Where two or three certification procedures are shown for an equipment type, the certification and approval is to be done according to one of those procedures. That procedure is chosen by PRS in agreement with the Contractor.

5.4.3 Machinery equipment, control, safety

Table 5.4.3

Component	Acceptance procedures – Machinery equipment, control, safety Characteristics	Category I	Category II	PRS Procedure [1)]
1	2	3	4	5
Skids [2)]	Complete skids (compressor skid, water injection pump skid etc) with drive, piping, valves and instruments	X		2
Pumps [3)]	Non standard design	X		2
	High capacity and pressure pumps, e.g. crude export, water injection, firewater	X		1a, 1b, 2
	Process medium pumps, power rating < 300 kW	X		3
	Other pumps, not mentioned above		X	4
Gas turbines and transmission gears	Direct drive of production systems	X		1a, 1b, 2
Combustion engines and transmission gears	Non standard design	X		1b, 2
	Power rating > 500 kW	X		1a, 1b, 2
	Power rating < 500 kW		X	4
	For installation in hazardous area	X		1a, 1b, 2
Process and fuel gas compressors		X		1a, 1b, 2
Control and monitoring systems		X		1a, 2
Process safety systems		X		1a, 2
Integrated programmable control systems of process plant		X		1a, 2

Notes to Table 5.4.3

1) Where two or three certification procedures are shown for an equipment type, the certification and approval is to be done according to one of those procedures. That procedure is chosen by PRS in agreement with the Contractor.

2) The components within the skid are to be certified accordingly with requirements, as applicable, shown in Tables 5.4.1, 5.4.2, 5.4.3.

3) Pumps for toxic fluid shall be delivered with the 3.2 Type Certificate or be certified according to Procedure 3 (see Table 5.3.2).

5.5 Certification of Materials

5.5.1 Materials for pressure retaining equipment

5.5.1.1 For materials for pressure retaining equipment in category I, the certificate type 3.2 – ISO 10474 (EN 10204:2004) is required.

Works certificate type 3.1, including test results of all specified tests from samples taken from the product supplied, inspection and tests being witnessed and signed by Quality Assurance Representative, may be considered by PRS.

5.5.1.2 Materials for pressure retaining equipment in category II may be accepted with type 3.1 – ISO 10474 (EN 10204:2004) certificate. Third party certificate, type 3.2, may be accepted.

5.5.2 Piping material

Pipes shall be manufactured and tested according to a recognized standard. Type 3.1 certificate (ISO 10474 (EN 10204:2004)), confirming the compliance with the standard is accepted. The manufacturer is to have an implemented Quality Assurance System certified by a Recognized Organization.

Flanges and couplings – acc. to Table 5.4.2.

PART VIII

Radio, navigation, signalling, life-saving, environment protection equipment and lifting appliances

1 GENERAL

1.1 Scope of Application

1.1.1 This part of *Publication* applies to fixed offshore platforms called thereafter *units* on which PRS performs technical supervision on behalf of the Administration in scope of radio and navigation equipment, signalling equipment, life-saving equipment, environment protection equipment and lifting appliances.

1.1.2 As a result of the supervision PRS issues, renews and confirms documents of the unit in the scope and mode specified in paragraphs 2, 3 and 4 of this part of *Publication*.

1.1.3 The following instruments form the basis for the requirements contained in this *Part* of *Publication*:
- *Code for the Construction and Equipment of Mobile Offshore Drilling Units 2009(2009 MODU CODE);*
- *International Convention for the Safety of Life at Sea, 1974 (SOLAS 1974);*
- *International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL 73/78);*
- *Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1992 (Helsinki Convention);*
- *ILO Occupational Safety and Health (Dock Work) Convention, 1979, C 152;*
- *International Life-Saving Appliances (LSA) Code;*
- *Rules for Statutory Survey of Sea-going Ships, PRS* thereafter referred to as *RSSSS;*
- *Regulation of the Minister of Transport and Maritime Economy on methods for navigational markings in Polish marine zone;*
- *Recommendations of International Association of Marine Aids for Navigation and Lighthouse Authorities – IALA, Rec. O-139.*

1.1.4 The scope of requirements to be applied may be modified, reduced or extended to the extent specified by the Administration.

1.2 Definitions and abbreviations

1.2.1 In the present Part of the *Publication*, the following definitions have been adopted:

Digital Selective Calling (DSC) – technique using digital codes which enables the radio station to establish contact with, and transfer information to, another station or group of stations, and complying with the relevant recommendations of the International Telecommunication Union - Radiocommunication Sector (ITU-R).

Approved service supplier – organization or person holding an *Approval Certificate* issued by PRS S.A., providing services such as measurements, tests or examinations within a scope and conditions specified by PRS S.A.

Identities of maritime mobile service in GMDSS (MMSI) – identities of maritime mobile service, identities of ship stations, coast stations, INMARSAT identities and serial numbers of equipment, which can be transmitted by ship radio devices for the purpose of identification of the unit.

International NAVTEX – coordinated broadcast and automatic reception on 518 kHz of maritime safety information by means of narrow-band direct printing telegraphy.

Maritime Safety Information (MSI) – navigational and meteorological warnings, meteorological forecasts and other urgent safety related messages broadcast to ships.

Technical supervision – a set of activities aimed at ascertaining that the surveyed object conforms to the specified requirements.

Sea area A1 – an area within the radiotelephone coverage of at least one VHF coast station in which continuous DSC alerting is available, and which is defined by the Administration.

Sea area A2 – an area, excluding sea area A1, within the radiotelephone coverage of at least one MF coast station in which continuous DSC alerting is available, and which is defined by the Administration.

S u r v e y – a set of activities relating to a *unit*, its machinery, appliances, equipment, etc. realized through review of technical documentation, as well as carrying out appropriate examinations, measurements and tests.

A n n i v e r s a r y d a t e – the day and month of each year which will correspond to the date of expiry of the relevant certificate.

I n c i n e r a t i o n – in accordance with the definition from Helsinki Convention means the deliberate combustion of wastes or other matter at sea for the purpose of their thermal destruction. Activities incidental to the normal operation of ships or other man-made structures are excluded from the scope of this definition;

N o x i o u s l i q u i d s u b s t a n c e – any substance of Category X,Y,Z or OS according to Chapters 17 and 18 of the *IBC Code*, as well as any other liquid substance assessed under the provisions of Appendix I to Annex II of *MARPOL 73/78* as falling into Category ~~A, B, C or D~~ X, Y, Z or OS.

1.2.2 Abbreviations

Abbrev.	English name	Description
AIS	Automatic Identification System	Automatic Identification System
AIS-SART	AIS Search and Rescue Transmitter	AIS Search and Rescue Transmitter used for the purpose of locating survival craft
DSC	Digital Selective Calling	Digital Selective Calling
EPIRB	Emergency Position-Indication Radio Beacon	Emergency Position-Indication Radio Beacon
GMDSS	Global Maritime Distress and Safety System	Global Maritime Distress and Safety System
GPS	Global Positioning System	Global Positioning System
INMARSAT	International Maritime Satellite	International Maritime Satellite
IMO	International Maritime Organization	International Maritime Organization
MF	Medium Frequency	Medium frequency within ranges 300 KHz ÷3 MHz
SSAS	Ship Security Alert System	Ship(unit) Security Alert System
VHF	Very High Frequency	Very high frequency within ranges 30÷300 MHz

1.3 Scope of survey activities

1.3.1 PRS conducts surveys of the following installations and equipment, not covered by classification survey:
.1 life-saving appliances;
.2 identification signs and signal means;
.3 radio equipment;
.4 navigation equipment;
.5 lifting appliances;
.6 pollution prevention systems;
.7 documents related to the above equipment.

1.4 Survey mode

1.4.1 PRS conducts technical survey of the design, manufacture and installation of the radio, navigation, signalling, life-saving, environment protection and lifting equipment as well as survey of the equipment when in service, after installation on the *unit*.

1.4.2 In result of the survey of the manufacture of the equipment referred to in 1.4.1, PRS issues type approval certificates and product certificates, where relevant.

1.4.3 PRS conducts its supervision of the *units* and their equipment by carrying out surveys. In result of the survey PRS issues relevant PRS documents and prepares appropriate reports being the basis for the issue, confirmation or renewal of administration document.

1.4.4 Installation of the equipment, initial setup, repairs and servicing as well as assisting in the survey activities shall be conducted by the service suppliers, approved by PRS in accordance with requirements of Publication *51/P – Procedural requirements for service suppliers.*

1.4.5 A certificate ceases to be valid in the case of not conducting or not completing the periodical, intermediate or annual survey in a due time. The validity of the certificate may be restored after carrying out the appropriate survey with positive result which, in such circumstances, shall include the activities of the survey that was not carried out in due time.

1.4.6 If during any survey (initial, annual, intermediate, renewal or other) significant deficiencies were found, immediate activities aimed at the removal of the deficiencies shall be taken, and the administration informed thereon accordingly. If the deficiencies have not been removed definitely, PRS shall withdraw relevant certificates and advise the administration of the fact. It does not apply to the case, when based on PRS agreement with the Administration, activities are taken resulting in changing the deficiencies status into insignificant.

1.5 Technical documentation of the equipment

1.5.1 General

1.5.1.1 Prior to the commencement of construction of a *unit* to be surveyed by PRS, technical documentation of the equipment and installations, as defined in 1.5.2, and programme of tests of the equipment after installation shall be submitted to PRS Head Office for consideration and approval.

1.5.1.2 Prior to the commencement of alteration and/or reconstruction of the *unit*, technical documentation of the equipment and installations being replaced, repaired or altered, shall be submitted to PRS Head Office for consideration and approval.

1.5.1.3 In the case of installation of the new equipment on the *unit* in service, the installation documentation for this equipment, in the scope required for a new constructed *unit*, shall be submitted to PRS Head Office for consideration and approval.

1.5.2 Technical documentation of the *unit* under construction

1.5.2.1 General documentation:

.1 Technical description of the *unit*.

1.5.2.2 Documentation of life-saving appliances:

.1 list of life-saving appliances, their types and manufacturers;
.2 arrangement plan of life-saving appliances;
.3 evacuation plan.

1.5.2.3 Documentation of signal means

.1 list of signal means, their types, specifications and manufacturers;
.2 plans for positioning of the signal means and identification signs and base coordinates of their arrangement;
.3 plan for positioning of the signal means and identification signs, as well as for positioning of the other lights and horizontal and vertical sectors of light;
.4 plan of shadow sectors of all-round lights, except anchor lights;

1.5.2.4 Documentation of radio installations

.1 list of the radio installations, their types and manufacturers;
.2 declaration of the sea areas, for the *unit* site;
.3 declaration on the methods of maintenance of the radio installations;
.4 connection diagram of the radio installations and sources of energy, type of cables;
.5 method of grounding of the radio installations;
.6 calculation of the capacity of the reserve source batteries of electrical energy for the radio installations;
.7 arrangement of the radio installations in the MCS;
.8 common plans of antennas of the radio and navigation equipment (at least two views).

1.5.2.5 Documentation of navigation equipment

.1 list of the navigational equipment, their types and manufacturers;
.2 connection diagram of the navigational equipment and sources of electrical energy, type of cables;
.3 method of grounding of the navigational equipment;
.4 arrangement of the navigational equipment in the MCS;
.5 common plans of antennas of the radio and navigational equipment (at least two views);

1.5.2.6 Marine pollution prevention equipment documentation

.1 Within the scope of *MARPOL 73/78 Annex 1 requirements*:
- list of 15 ppm oil filtering equipment, providing types and manufacturers;
- bilge oily water and oil residues piping diagram;
- *Shipboard Oil Pollution Emergency Plan* or *Shipboard Marine Pollution Emergency Plan*;

.2 Within the scope of *MARPOL 73/78 Annex IV* requirements:
- list of sewage treatment equipment, providing types and manufacturers;
- sewage piping diagram;

.3 Within the scope of *MARPOL 73/78 Annex V* requirements:
- list of garbage treatment arrangements, providing types and manufacturers
- *Garbage Management Plan*

.4 Within the scope of *MARPOL 73/78 Annex VI* requirements*73/78*:
  .1 list of refrigerating arrangements using ozone depleting substances;
  .2 list of equipment for incineration of oil wastes, their types and manufacturers;
  .3 documentation of marine pollution prevention arrangements: incinerator procedures manual;
  .4 technical passport for the engines of power 130 kW and above;
  .5 Record book of engine parameters for the engines of 130 kW and above;
  .6 VOC Management Plan.
  .7 Transfer procedure for the VOC collection system (VOC).

1.5.2.7 Documentation of lifting appliances:

.1 general arrangement plan of the *unit* showing arrangement of lifting appliances as well as their technical characteristics and working range;
.2 deck gantries system drawings:
- assembly drawing of deck crane gantries containing mechanisms and securing devices specification;
- drawings of all the load-bearing structure elements covering jib, slewing column, turret, platform, gate, trucks, slewing circle assembly, post, etc. together with their strength calculations and material specifications;
- detailed drawings of rope sheaves, axes, pins, rail wheels, running frames, slewing circle assembly including its bearing screws;
- list of applied blocks, chain cables, shackles, hooks etc. indicating the material grade, SWL, proof load, standard in accordance with which a particular element is manufactured;

- list of ropes indicating nominal diameter, workmanship and structure, as well as the required minimum breaking load;
- technical documentation of machinery components and their drives covering:
  - assembly drawings with cross-sections;
  - drawings of shafts, gear wheels, rope drums, brakes and clutches together with their strength calculations;
  - drawings of foundation frames;
  - diagram of hydraulic system indicating its components specification;
- electrical equipment technical documentation covering operating description and main characteristics;
- electric drive diagram indicating its essential controls, together with components' specifications;
- test programme.

.3 Lifts:

- technical description;
- lift general view;
- diagram of forces acting on the lift elements together with their strength and stability calculations;
- drawing of the engine room and its trunk; drawings of the trunk doors, guide rails and buffers showing details of their fixing arrangements; drawings of cars and counterweights showing details of their suspension; drawings of load bearing strands and rope suspension devices together with their strength calculations;
- drawings of safety arrangements;
- technical documentation of machinery components and their drives, covering:
  - assembly drawings with cross-sections;
  - drawings of shafts, gear wheels, rope sheaves and drums, brakes, couplings and their strength calculations;
- electrical equipment technical documentation covering:
  - operating description and main characteristics;
  - electric drive essential diagram indicating control means and including electrical equipment specifications;
- lift operating and maintenance instructions;
- test programme.

2 SURVEYS FOR THE ISSUE OF ADMIMNISTRATION CERTIFICATES AND PRS DOCUMENTS

2.1 General

2.1.1 All surveys within the scope of supervision shall be harmonized as far as practicable.

2.1.2 In the harmonized system of survey and certification the following principles apply:

.1 one-year standard interval between consecutive surveys: initial, annual, intermediate, and renewal, except for MARPOL Annex IV, where only initial and renewal surveys are performed.

.2 a scheme providing the necessary flexibility for planning the relevant surveys having due regard to:
- completion of the renewal survey within 3 months before the expiry date of the existing Safety Certificate, without loss of its validity;
- a time window of 6 months (3 months before and 3 months after the anniversary date of the certificate) for annual and intermediate surveys;

.3 a maximum period of validity of 5 years for all certificates.

2.2 Types of survey

2.2.1 Initial survey

2.2.1.1 The initial survey before the *unit* is put into service, aimed at the first issue of appropriate certificates shall include a complete inspection of the equipment, its arrangement and mounting to ensure that the relevant requirements are complied with, and the *unit* technical condition is satisfactory and appropriate for its intended service.

2.2.1.2 The initial survey refers to a newly constructed *unit* as well as to an existing *unit* which has not been surveyed by PRS before or which returns to PRS class, to ensure that the *unit* is in satisfactory condition for the service for which it is intended.

2.2.1.3 The initial survey is performed on the basis of technical documentation approved by PRS.

2.2.2 Renewal survey

2.2.2.1 A renewal survey is a complete inspection of the *unit* equipment within the scope of the particular certificate, to ensure that it is in a satisfactory technical condition and are fit for the *unit* intended service.

2.2.2.2 The renewal survey shall be held within three months before the expiry date of the Safety Certificate.

2.2.3 Intermediate survey

2.2.3.1 An intermediate survey is an inspection of specific items of the equipment on a *unit* relevant to the particular certificate, to ensure that they are in satisfactory condition and are fit for the *unit* intended service.

2.2.3.2 An intermediate survey shall be held within three months before or after the second or third anniversary of the relevant certificate and shall take place of one of the annual surveys.

2.2.3.3 When the intermediate survey has not been carried out within the due dates, the provisions specified in 1.4.5 apply.

2.2.4 Annual Survey

2.2.4.1 The annual survey is an inspection of the equipment of the *unit* within the scope relating to the particular certificate to ensure that it has been maintained in accordance with the relevant requirements and is fit for the service for the unit intended service.

2.2.4.2 The annual survey shall be held within three months before or after each anniversary date of the Safety certificate.

2.2.5 Additional Survey

2.2.5.1 The additional survey is an inspection, either complete or partial according to the circumstances, to be made after damage, a repair resulting from execution of recommendations issued after a survey or whenever any important repairs or replacements are made.

2.2.5.2 The additional survey of the *unit* shall be carried out whenever an accident occurs or a defect is discovered which affects the safety or integrity of the *unit* or the efficiency or completeness of its equipment.

The operator of the unit shall report an accident or damage at the earliest opportunity to the Administration and to the PRS.

The aim of the additional survey shall assess the extent of damage, specify the scope of work required to eliminate the consequences of damage and to determine the possibility and conditions for maintenance of the validity of the appropriate certificates.

2.2.5.3 The additional survey shall be such as to ensure that the repairs and any renewals have been effectively made and that the *unit* and its equipment continue to be fit for the service for which the *unit* is intended.

2.3 Scope of surveys

2.3.1 Life-saving appliances

2.3.1.1 Initial Survey

2.3.1.1.1 For the life-saving appliances, the examination of plans and designs shall consist of:

.1 examining the provision and disposition of the survival craft and rescue boats and, where applicable, marine evacuation systems (*SOLAS 74/00 Reg. III/11 to 16, 31 and 33*);

.2 examining the design of the survival craft, including their equipment, launching and recovery appliances and embarkation arrangements (*SOLAS 74/96 Regs. III/16, 31, 32, 33; LSA Code paras. 3.2, 4.1 to 4.9, 6.1 and 6.2*);

.3 examining the design of the rescue boats, including their equipment and launching and recovery appliances and their arrangement (*SOLAS 74/00 Regs. III/17 and 31; LSA Code paras 5.1 and 6.1*);

.4 examining the provision, specification and stowage of two-way VHF radiotelephone apparatus and rescue and search equipment (*SOLAS 74/00 Reg. III/6*);

.5 examining the provision, specification and stowage of the distress flares an the line-throwing appliance and the provision of on board communications equipment and the general alarm system (*SOLAS 74/00 Regs. II-2/12.1 and 12.2 and Regs. III/6 and 18; LSA Code paras. 3.1, 7.1 and 7.2)*;

.6 examining the provision, specification and stowage of the lifebuoys, including those fitted with self-igniting lights, self-activating smoke signals and buoyant lines, lifejackets, immersion suits, anti-exposure suits and thermal protective aids (*SOLAS 74/00 Regs. III/7 and 32; LSA Code paras 2.1 to 2.5 and 3.1 to 3.3*);

.7 examining the plans for the lighting of the assembly and embarkation stations and the alleyways, stairways and exits giving access to the assembly and embarkation stations, including the supply from the emergency source of power (*SOLAS 74/88 Reg. II-1/43 and III/11*);

2.3.1.1.2 For the life-saving appliances on the *unit*, the check that the required documentation has been placed on board shall consist of:

.1 confirming that the fire control plans are permanently exhibited, or alternatively, emergency booklets have been provided and that a duplicate of the plans or the emergency booklet are available in a prominently marked enclosure external to the *unit's* deckhouse (*SOLAS 74/00 Reg. II-2/15.2.4) (SOLAS 74/88 Reg. II-2/20*);

.2 confirming that the checklist for life-saving appliances maintenance is placed onboard (*SOLAS 74/00 Regs. II-2/14.2.2 and 14.4*);

.3 confirming that emergency instructions are available for each person on board, that the assembly list is posted in conspicuous places and they are in a language demanded by the Administration and in English language (*SOLAS 74/00 Regs III/8 and 37*);

.4 confirming that the training manual and training aids for the life-saving appliances have been provided and are available in the working language of the ship (*SOLAS 74/00 Reg. III/35*);

.5 confirming that the instructions for on board maintenance of the life-saving appliances have been provided (*SOLAS 74/88 Reg. III/36*);

2.3.1.1.3 For the life-saving appliances on the *unit*, the survey after installation shall consist of:

.1 checking the provision and disposition of the survival craft, where applicable, marine evacuation systems and rescue boats (*SOLAS 74/88 Regs. III/11 to 16 and 31; LSA Code punkt 6.2*);

.2 deployment of at least 50% of the MES after installation (*LSA Code para. 6.2.2.2*);

.3 examining each survival craft, including its equipment. For liferafts provided for easy side to side transfer, verifying that they are less than 185 kg in weight (*SOLAS 74/88 Reg. III/31; LSA Code paras. 2.5, 3.1 to 3.3 and 4.1 to 4.9*) *(SOLAS 74/00 Reg. III/31.1)*;

.4 examining the embarkation stations for each survival craft and the testing of each launching appliance, including overload tests, tests to establish the lowering speed and the lowering of each survival craft to the water with the unit at its lightest draught, the recovery of each lifeboat (*SOLAS 74/00 Regs. III/11, 12, 13, 16, 31 and 33; LSA Code para. 6.1*);

.5 examining the embarkation stations for each marine evacuation device, where applicable, and the launching arrangements, including inspection for the lack of side shell openings between the embarkation station and waterline, checking distance to the propeller and other life-saving appliances and ensuring that the stowed position of MES is protected from heavy weather damage, as much as practicable (*SOLAS 74/00 Reg. III/15; LSA Code para. 6.2*);

.6 examining each rescue boat, including its equipment. For inflatable rescue boats, confirming that they are stowed in a fully inflated condition (*SOLAS 74/88 Regs. III/14 and 31; LSA Code paras. 2.5, 5.1 and 6.1*);

.7 examining the embarkation and recovery arrangements for each rescue boat and testing each launching and recovery appliance, including overload tests, tests to establish the lowering and recovery speeds and ensuring that each rescue boat can be lowered to the water and recovered with the unit at its lightest draught (*SOLAS 74/88 Regs. III/14, 17 and 31; LSA Code para. 6.1*);

.8 testing that the engine of the rescue boat(s) and of each lifeboat, when so fitted, start satisfactorily and operate both ahead and astern (*SOLAS 74/00 Reg. III/19*);

.9 confirming that there are posters or signs in the vicinity of, or on, survival craft (*SOLAS 74/88 Regs. III/9 and 20*);

.10 examining the provision and stowage and checking the operation of portable on board communications equipment, if required, and two-way portable VHF radiotelephone apparatus and search and rescue locating devices (*SOLAS 74/88 Regs. II-2/12.2 and III/6*);

.11 examining the provision and stowage of the distress flares and the life line-throwing appliance, checking the provision and operation of fixed on board communications equipment, if provided, and testing the means of operation of the general alarm system (*SOLAS 74/00 Regs. III/6 and 18; LSA Code Parts 3.1, 7.1 and 7.2*);

.12 examining the provision, disposition and stowage of the lifebuoys, including those fitted with self igniting lights, self-activating smoke signals and buoyant lines, lifejackets, immersion suits and thermal protective aids (*SOLAS 74/00 Regs. III/7 and 32 to 37; LSA Code paras.2.1, 2.5 and 3.3*) ;

.13 checking the lighting of the assembly and embarkation stations and the alleyways, stairways and exits giving access to the assembly and embarkation stations, including when supplied from the emergency source of power (*SOLAS 74/88 Regs. II-1/43 and III/11*);

2.3.1.1.4 Completion of the initial survey

On completion of the life-saving appliances and equipment initial survey, the *Report of life-saving equipment survey* is issued.

2.3.1.2 Annual Survey

2.3.1.2.1 For the life-saving equipment of the *unit*, the examination of current certificates and other records shall consist of:

.1 checking the validity of the *Safety Certificate* (Karta bezpieczeństwa);

.2 checking the validity of the *Certificate of Fixed Offshore Unit*;

.3 checking that the personnel is certificated as required by the *STCW Convention* to the satisfaction of the Administration;

.4 checking the manning and supervision of survival craft (*SOLAS 74/00 Reg. III/10*);

.5 checking whether any new equipment has been fitted and, if so, confirming that it has been approved before installation and that any changes are reflected in the appropriate certificate;

.6 confirming that the fire control plans are permanently exhibited or, alternatively, that emergency booklets have been provided and that a duplicate of the plans or the emergency booklet are available in prominently marked enclosure external to the ship's deckhouse (*SOLAS 74/00 Reg. II-2/15.2.4*) (*SOLAS 74/88 Reg. II-2/20*);

.7 checking that log-book entries are being made and in particular (*SOLAS 74/00, Reg. III/19 and 20*):
- the date when the last full assembly of the crew for boat and fire drill took place;
- the records indicating that the lifeboat equipment was examined at that time and found to be complete;
- the last occasion when the lifeboats were swung out and when each one was lowered into the water;
- the records indicating that crew members have received the appropriate on board training;

.8 confirming, that the training manual and training aids for the life-saving appliances are available on board in the working language of the *unit* (*SOLAS 74/00 Reg. III/35*);

.9 confirming that the checklist and instructions for on board maintenance of the life-saving appliances are on board (*SOLAS 74/00 Reg. III/36*);

2.3.1.2.2 For the life-saving appliances of the *unit* the annual survey shall consist of:

.1 examining and testing of the general emergency alarm system (*SOLAS 74/88 Reg. III/20*);

.2 checking that emergency instructions are available for each person on board and that copies of the suitable updated assembly list are posted in conspicuous places and that they are in a language demanded by the Administration and in the English language and confirming that there are posters or signs in the vicinity of survival craft and their launching stations (*SOLAS 74/00 Regs. III/8, 9 and 37*);

.3 examining each survival craft, including its equipment and, when fitted, the on-load release and hydrostatic lock and, for inflatable liferafts, the hydrostatic release unit and float-free arrangements. Checking that the hand held flares are not out of date (*SOLAS 74/00 Regs. III/20 and 31; LSA Code paras. 2.5, 3.1 to 3.3*);

.4 checking that the liferafts can be easily launched *(SOLAS 74/00 Reg. III/31.1)*;

.5 checking that the falls used in launching appliances have been periodically inspected and have been renewed as necessary in the past 5 years (*SOLAS 74/00 Reg. III/20*);

.6 examining the embarkation arrangements and launching appliances for each survival craft. Each lifeboat shall be lowered to the embarkation position or, if the stowage position is the embarkation position, lowered a short distance and, if practicable, one of the survival craft shall be lowered to the water. The operation of the launching appliances for davit-launched liferafts shall be demonstrated. Checking that the test of launching appliances, including the dynamic testing of the winch brake, and servicing of lifeboat and rescue boat on-load release gear, including free-fall lifeboat release systems and davit-launched liferaft automatic release hooks, have been carried out (*SOLAS 74/00 Regs. III/11, 12, 13, 16, 20 and 31; LSA Code para. 6.1*);

.7 examining each rescue boat, including its equipment. For inflatable rescue boats, confirming that they are stowed in a fully inflated condition (*SOLAS 74/88 Regs. III/14 and 31; LSA Code paras. 2.5 and 5.1 and 6.1*);

.8 confirming that there are information and warning posters or signs in the vicinity of, or on, the survival craft, and on the launching control devices for life-saving equipment (*SOLAS 74/00 Regs. III/9 and 20*);

.9 examining the embarkation and recovery arrangements for each rescue boat. If practicable, the rescue boat(s) shall be lowered to the water and its recovery demonstrated (*SOLAS 74/00 Regs. III/14, 17 and 31; LSA Code para. 6.1*);

.10 testing that the engine of the rescue boat(s) and of each lifeboat, when so fitted, start satisfactorily and operate both ahead and astern;

.11 examining and checking the operation of two-way VHF radiotelephone apparatus and the search and rescue locating devices (*SOLAS 74/88 Reg. III/6)*;

.12 examining the line-throwing appliance and checking that its rockets and the ship's distress signals are not out of date, and examining and checking the operation of on board communications equipment and the general emergency alarm system (*SOLAS 74/00 Regs. II-2/12.2 and III/6 and 18; LSA Code paras 3.1, 7.1 and 7.2*);

.13 examining the provision, disposition, stowage and the condition of the: lifebuoys, including those fitted with self-ignition lights, self-activating smoke signals, buoyant lines, lifejackets, and their whistles and lights, immersion suits, anti-exposure suits and thermal protective aids and that their associated batteries are not out of date (*SOLAS 74/88 Reg. III/7 and 32; LSA Code paras 2.2 and 2.5*);

.14 checking the lighting of the assembly and embarkation stations and the alleyways, stairways and exits giving access to the assembly and embarkation stations, including when supplied from the emergency source of power (*SOLAS 74/88 Regs. II-1/42 or 43 and III/11*);

.15 deployment of the Marine Evacuation System (MES) (*SOLAS 74/88 Reg. III/20.8.2; LSA Code para. 6.2.2.2*);

2.3.1.2.3 Completion of the annual survey:

.1 after satisfactory survey, issuing of *Report of life-saving equipment survey*,

.2 if the survey shows that the condition of the equipment is unsatisfactory, see paragraph 1.4.6.

2.3.1.3 Renewal survey

2.3.1.3.1 For the life-saving equipment of the *unit*, the examination of certificates and other records shall consist of verification of the presence of the previous *Safety Certificate* (*Karta Bezpieczeństwa).*

2.3.1.3.2 For the life-saving equipment of the *unit*, the examination of current certificates and other records shall consist of:

.1 the provisions of par. 2.3.1.2.1, except for the validity of *Safety Certificate* (*Karta Bezpieczeństwa).*

2.3.1.3.3 For the life-saving equipment of the *unit* the renewal survey shall consist of:

.1 the provisions of 2.3.1.2.2.

2.3.1.3.4 Completion of the renewal survey:

.1 after satisfactory survey, issuing *Report for the life-saving equipment survey* of the *unit;*

.2 if the survey shows that the condition of the equipment is unsatisfactory, see par. 1.4.6.

2.3.2 Radio, navigation and signalling equipment

2.3.2.1 General

.1 Survey and testing of radio, navigation and signalling equipment as far as radio and navigation equipment is concerned shall be performed by PRS surveyor in the presence of an recognized service supplier (service company) specialist. Service company specialist is responsible for performing all necessary tests and measuring technical parameters of the equipment being surveyed.

.2 Testing of radio installations and navigation equipment shall be performed after installation on the *unit* and subsequently of a yearly intervals, during annual and renewal surveys of the *unit*.

.3 The survey of an Automatic Identification System (AIS) shall be conducted by utilizing appropriate equipment and shall verify the correct programming of the *unit* static information, correct data exchange with connected sensors as well as verifying the radio performance by radio frequency measurement and on-air test in accordance with the guidelines contained in MSC.1/Circ. 1252.

.4 Upon completion of the survey, the service company specialist shall sign and stamp the relevant report prepared by PRS surveyor or send an own test report to PRS Head Office.

2.3.2.2 Initial survey

2.3.2.2.1 For the radio, navigation and signalling equipment of the *unit*, the examination of plans and designs shall consist of:

.1 establishing the sea areas declared for operation, the equipment installed to fulfill the functional requirements for the sea areas of operation, the methods adopted to ensure the availability of the functional requirements and the arrangements for supply from an emergency source of energy, if any;
.2 establishing which radio equipment shall be surveyed and, if duplication of equipment is used as a means of ensuring the availability of the functional requirements, establishing which is the „basic equipment" and which the „duplicated equipment";
.3 examining the plans for the provision and positioning of the radio installation including sources of energy and antennas;
.4 examining the plans for the provision and positioning of the radio life-saving appliances;
.5 examining the plans for the provision and positioning of the radar, Automatic Identification System, daylight signalling lamp, and night vision equipment;
.6 examining the plans and specification of signal lights, signal shapes and sound signal means.

2.3.2.2.2 For the radio, navigation and signalling equipment, the check that documentation, etc., has been placed on board shall consist of:

.1 checking for a valid radio license issued by the Flag Administration;
.2 checking the GMDSS radio operator's certificate of competence;
.3 checking the radio record (log);
.4 checking the carriage of up-to-date ITU publications appropriate for the unit site;
.5 updated list of radio stations in operation and safety communication (MRCC, Maritime Safety Centre)
.6 checking if the shadow sector diagram is provided at the radar;
.7 checking the provision of International Code of Signals and IIIrd Volume of IAMSAR Manual at the radio equipment station;
.8 checking the carriage of operating manuals for all radio and navigational equipment;
.9 checking the carriage of service manuals for all radio equipment when at-sea maintenance is the declared option;

2.3.2.2.3 For the radio, navigation and signalling equipment of the *unit*, the survey after installation shall consist of:

.1 checking the provision of the radio equipment in accordance to the requirements of paragraph 7.1; the equipment has to be operated from MCS;
.2 confirming the provision of equipment for the radio installation with due regard to the declared sea areas in which the *unit* is operated and the declared means of maintaining the availability of functional requirements*;*
.3 checking distribution and protection against mechanical damage and electromagnetic field effect for each radio installation;
.4 confirming the ability to initiate the transmission of *unit*-to shore distress alerts by at least two separate and independent means, each using a different radiocommunication service, from MCS*;*
.5 examining visually all antennas, and feeders for satisfactory siting and absence of defects;
.6 checking insulation and safety of all antennas and their wiring;
.7 examining the provision of means of protection from electric shock and electromagnetic field effect;
.8 examining the reserve source of energy, including:
– checking there is sufficient capacity to operate the basic or duplicated equipment for 1 hour or 6 hours, as appropriate*;*
– if the reserve source of energy is battery:
1) checking its siting and installation;

2) where appropriate, checking its condition by specific gravity measurement or voltage measurement;
3) with the battery off charge, and the maximum required radio installation load connected to the reserve source of energy, checking the battery voltage and discharge current;
4) checking that the charger(s) are capable of re-charging the reserve battery within 10 hours;
5) checking that information of ship's position is provided continuously and automatically to all two-way communication equipment;

.9 examining the VHF transceiver(s), including:
- checking for operation on channels 6, 13 and 16*;*
- checking frequency tolerance, transmission line quality and radio frequency power out*;*
- checking for correct operation of all controls including priority of control units;
- checking that the equipment operates from the main, emergency (if provided) and reserve sources of energy;
- checking the operation of the VHF control unit(s) or portable VHF equipment provided for navigation safety;
- checking for correct operation by on-air contact with a coast station or other ship;

.10 examining the VHF DSC controller and channel 70 DSC watch receiver, including:
- checking for correct transmission by means of a routine or test call to a coast station, other *unit*, on board duplicate equipment or special test equipment;
- checking for correct reception by means of a routine or test call from a coast station, other *unit*, on board duplicate equipment or special test equipment;
- checking the audibility of the VHF/DSC alarm;
- checking that the equipment operates when supplied from the main, emergency (if provided) and reserve sources of energy*;*
- performing an off-air check confirming the correct Maritime Mobile Service Identity is programmed in the equipment

.11 examining the condition and operation of MF/HF DSC controller(s), including:
- checking that the equipment operates when supplied from the main, emergency (if provided) and reserve sources of energy;
- checking operation by means of a test call on MF and/or HF to a coast radio station if the rules of the berth permit the use of MF/HF transmissions;
- checking the off-air self-test program;
- checking the audibility of the MF/HF DSC alarm;
- confirming that the correct Maritime Mobile Service Identity is programmed in the equipment

.12 examining the MF/HF DSC watch receiver(s), including:
- confirming that only distress and safety DSC frequencies are being monitored;
- checking that a continuous watch is being maintained whilst keying MF/HF radio transmitters*;*
- checking for correct operation by means of a test call from a coast station or other ship;

.13 examining the INMARSAT Ship Earth Station(s) and the Enhanced Group Call equipment (EGC), including:
- checking that the equipment operates when supplied from the main, emergency (if provided) and reserve sources of energy,
- where an uninterrupted supply of information from the ship's navigational or other equipment is required, ensuring such information remains available in the event of failure of the ship's main or emergency source of electrical power;
- checking the distress function by means of an approved test procedure where possible;
- checking for correct operation by inspection of recent hard copy or by test call;

.14 examining the condition and operation of NAVTEX equipment, including:
- checking for correct operation by monitoring incoming messages or inspecting recent hard copy;
- running the self-test program if provided;

.15 examining the condition and operation of 406 MHz satellite EPIRB (SOLAS 74/88, Regs. IV/7 and 14), including:
- checking position and mounting for float free operation;

- checking the painter for proper securing and condition;
- carrying out visual inspection for defects;
- carrying out the self-test routine;
- checking that the EPIRB ID and other required data are clearly marked on the outside of the equipment;
- decoding the EPIRB identity number and other required data, confirming it is correct;
- inspection of documents with EPIRB registration data or ascertaining the data through contact defined by the Flag state Code (Maritime Identification Digit - MID);
- checking the battery expiry date;
- if provided, checking the hydrostatic release unit and its expiry date;
- checking the emission on operational frequencies, of distress signal, by a self-test or with the use of appropriate testing device, without transmission of a distress call to the satellite;
- if possible, checking the emission on operational frequencies, coding and registration on the 121.5 MHz homing signal, by a self-test or with the use of appropriate testing device, without transmission of a distress call to the satellite; after carrying out the above tests and securing the EPIRB – checking if it is not operating;
- checking provision of the EPIRB manual onboard the unit;
- checking that the EPIRB has been subject to maintenance at intervals not exceeding five years at an approved shore-based maintenance facility;

.16 examining the condition and operation of the two-way VHF radiotelephone apparatus, including:
- checking for correct operation on Channel 16 and one other by testing with another fixed or portable VHF installation;
- checking the battery charging arrangements where re-chargeable batteries are used;
- checking the expiry date of primary batteries where used;
- where appropriate, checking any fixed installation provided in a survival craft;

.17 examining the condition and operation of search and rescue locating devices, including:
- checking the position and mounting of the equipment;
- monitoring response on ship’s 9 GHz radar (radar transponder) or on AIS receiver (AIS-SART device);
- checking the battery expiry date;

.18 examining the test equipment and spares carried, to ensure the set is adequate to the sea areas in which the unit operates and the declared options for maintaining functional readability of the unit;

.19 checking the provision of noise protection, where in the service conditions the acoustic noise level in the radio room may be a source of interference of the appliances operation;

.20 checking that the unit fit for cooperation with the helicopter is provided with the VHF radiotelephone operating in the air band of 118 to 137 MHz (including frequency 121.5 MHz and 123.1 MHz);

.21 checking the provision and operation of daylight signalling lamp, permanently available at CMS and not operating on main energy source;

.22 checking the provision and operation of Automatic Identification system(AIS);

.23 checking the provision and operation of SSAS system;

.24 verifying that Certificates of Compliance with MED Directive are provided for all radio and navigation equipment; for the equipment which has been installed before 1 February 1992. Administration of the unit location may exempt from the provision of such Certificates, provided it has been agreed with PRS S.A.;

.25 checking the provision and operation of night vision equipment, if provided;

.26 examining the provision, condition, positioning and checking the operation of, as appropriate, the navigation lights, shapes and sound signalling equipment.

2.3.2.2.4 Completion of the initial survey

If the initial survey has been completed positively, Report on the unit radio safety survey and Report on the unit radio, navigation and signalling equipment survey are issued.

2.3.2.3 Annual survey

2.3.2.3.1 For radio, navigation and signalling equipment of the *unit*, the examination of current certificates and other records shall consist of:

.1 checking the validity of *Safety Certificate* of the unit;
.2 checking the validity of radio license issued by the Administration;
.3 checking the validity of the *Certificate of Fixed Offshore Unit*;
.4 checking that the GMDSS operators are certificated to operate the GMDSS equipment;
.5 checking the records in the radio logbook;
.6 checking the provision of current ITU publications;
.7 checking the provision of nautical publications appropriate for the *unit* site;
.8 checking whether any new equipment has been fitted and, if so, confirming that it has been approved before installation and that any changes are reflected in the appropriate certificate;
.9 checking that the shadow sector diagram is provided onboard;
.10 checking the provision of International Code of Signals at radio equipment positions;
.11 checking if the copy of report on the automatic identification system issued by PRS approved service supplier for radio equipment, is kept onboard;
.12 checking the provision of operation manuals for all radio and navigation equipment;
.13 checking the provision of service manuals for all radio equipment when at-sea maintenance is the declared option.

2.3.2.3.2 For the radio, navigation and signalling equipment, annual survey of the *unit* shall consist of activities specified in 2.3.2.2.3.

2.3.2.3.3 Completion of the annual survey shall consist of:

.1 after satisfactory survey, issuing *Report of radio, navigation and signalling equipment survey*;
.2 if the survey shows that the condition of the equipment is unsatisfactory, see paragraph 1.4.6.

2.3.2.4 Renewal survey

2.3.2.4.1 For radio, navigation and signalling equipment of the *unit*, the examination of current certificates and other records shall consist of:

.1 checking the provision of the previous Safety Certificate of the *unit*;
.2 checking the validity of radio license issued by the Administration;
.3 checking the validity of the Statement of Compliance;
.4 checking the validity of the Certificate of Fixed Offshore Unit;
.5 checking that the GMDSS operators are certificated;
.6 checking the records in the radio logbook;
.7 checking the provision of current ITU publications, respective for GMDSS area;
.8 checking the provision of up-to-date list of radio stations for operation and safety communication (MRCC, Maritime Safety Centre);
.9 checking whether any new equipment has been fitted and, if so, confirming that it has been approved before installation and that any changes are reflected in the appropriate certificate;
.10 checking that the shadow sector diagram and minimum measuring distance diagram are provided at the radar;
.11 checking the provision of International Code of Signals at radio equipment positions;
.12 checking that the copy of report on annual survey of the automatic identification system issued by a PRS approved service supplied for radio equipment, is kept onboard;
.13 checking the provision of operation manuals for all radio and navigation equipment;
.14 checking the provision of service manuals for all radio equipment when at-sea maintenance is the declared option.

2.3.2.4.2 For the radio, navigation and signalling equipment, the renewal survey of the unit shall consist of activities described in 2.3.2.2.3.

2.3.2.4.3 Completion of the renewal survey of radio, navigation and signalling equipment of the *unit* shall consist of:

.1 after satisfactory survey, issuing *Report of radio, navigation and signalling equipment survey*.

.2 if the survey shows that the condition of the equipment is unsatisfactory, see paragraph 1.4.6.

2.3.3 Installations and equipment for preventing pollution of marine equipment

2.3.3.1 Initial survey

2.3.3.1.1 The initial survey carried out before the *unit* is put into service, aimed at issuing for the first time of appropriate certificates, shall include a complete inspection of the pollution prevention installations and equipment to ensure that their arrangement and functioning is in compliance with the relevant requirements so that the possibility of pollution is adequately prevented.

2.3.3.1.2 The initial survey applies to a newly constructed *unit* as well as to an existing *unit* which has not yet been surveyed by PRS or which return to PRS class, and is aimed at ensuring that the *unit* is adequately surveyed in scope of pollution prevention equipment.

2.3.3.1.3 Completion of initial survey

.1 after satisfactory survey, the *Statement of Compliance* and appropriate *Record of Equipment* (marine pollution prevention) shall be issued;

.2 if the survey result is unsatisfactory, see proceedings described in 1.4.6.

2.3.3.2 Renewal Survey

2.3.3.2.1 A renewal survey is a complete inspection of pollution prevention installations and equipment to a scope defined in relevant documents aiming to ensure that these items are in satisfactory condition for the service the unit is intended and the possibility of pollution is adequately prevented.

2.3.3.2.2 The renewal survey shall be held within three months before the expiry date of the Safety Certificate.

2.3.3.2.3 Completion of Renewal Survey:

.1 after satisfactory survey, issue of the *Statement of Compliance* and appropriate *Record of Equipment* (marine pollution prevention);

.2 if the survey shows that the condition of the equipment is unsatisfactory, see paragraph 1.4.6;

2.3.3.3 Intermediate Survey

2.3.3.3.1 The intermediate survey is an inspection of specific pollution prevention installations and equipment in a scope defined in relevant documents, aimed at ensuring that they are in satisfactory condition for the service the unit is intended and the possibility of pollution is adequately prevented.

2.3.3.3.2 The intermediate survey shall be held within three months before or after the second or third anniversary date of the appropriate certificate and shall take place of one of the annual surveys.

2.3.3.3.3 When an intermediate survey has not been carried out within the due dates, the provisions specified in 1.4.5 apply.

2.3.3.3.4 Completion of Intermediate Survey:

.1 after satisfactory survey, the issue of the *Statement of Compliance* and appropriate *Record of Equipment* (marine pollution prevention);

.2 if the survey shows that the condition of the equipment is unsatisfactory, see paragraph 1.4.6;

2.3.3.4 Annual Survey

2.3.3.4.1 The annual survey is an inspection of the *unit* and its equipment within the scope relating to the particular certificate, to ensure that the marine pollution prevention installation and equipment have been maintained in accordance with the relevant requirements and the possibility of pollution is adequately prevented.

2.3.3.4.2 The annual survey shall be held within three months before or after each anniversary date of the Safety certificate.

2.3.3.4.3 Completion of Annual Survey

.1 after satisfactory survey, issue of the *Statement of Compliance* and appropriate *Record of Equipment* (marine pollution prevention);

.2 if the survey shows that the condition of the equipment is unsatisfactory, see paragraph 1.4.6;

2.3.3.5 Additional Survey

2.3.3.5.1 An additional survey is an inspection, either general or partial according to the circumstances, to be made after damage, a repair resulting from execution of recommendations issued after a survey or whenever any important repairs or renewals are made to the marine environment protection equipment.

2.3.3.5.2 An additional survey of the *unit* marine environment protection equipment shall be carried out whenever an accident occurs or a defect is discovered which may affect its technical condition.

The operator of the *unit* shall report an accident or damage at the earliest opportunity to the Administration and to the PRS.

The aim of the additional survey shall assess the extent of damage, specify the scope of work required to eliminate the consequences of damage and to determine the possibility and conditions for maintaining the validity of appropriate certificates.

2.3.3.5.3 The additional survey shall be such as to ensure that the repairs and any renewals have been effectively made and that the *unit* and its equipment continue to be fit for the service for which it is intended and no risk of pollution exists.

2.3.3.5.4 Completion of additional survey

For the pollution prevention equipment of the *unit*, the completion of the additional survey shall consist of:

.1 after satisfactory survey, issue of the *Statement of Compliance* and appropriate *Record of Equipment* (marine pollution prevention);

.2 if the survey shows that the condition of the equipment is unsatisfactory, see paragraph 1.4.6;

2.3.4 Lifting appliances

2.3.4.1 All boom derricks, together with their gear attached, shall be submitted at least every 12 months to a close-up annual survey and at least every 5 years to a close-up 5-year survey. During the annual survey, the lifting appliance shall be subjected to proof load tests under load equal to SWL, while at the 5-year survey - subjected to load tests under proof load as specified in the following table:

SWL [t]	Test load
Less than 20	1.25xSWL
From 20 to 50	SWL + 5t
Above 50	1.1SWL

Survey results shall be entered in Part V of *Lifting Appliances Book*.

2.3.4.2 Lifts shall be submitted to tests in a scope as defined in paragraph 10.4.5 of *RSSSS*, *Part IV-Lifting appliances*.

2.3.4.3 Irrespective of periodical surveys, the lift shall be subjected to an occasional survey after its damage or repair, or conversion made between periodical surveys.

2.3.4.4 All parts of interchangeable gear and loose gear shall be subject at least every 12 months to a close-up survey, by PRS Surveyor. The results of the close-up examinations shall be recorded in *Lifting Appliances Book.*

2.3.4.5 During periodical surveys, availability of tests and examination certificates of lifting appliances, interchangeable gear and ropes, loose gear, as well as all relevant stamps, shall be checked. Technical condition of steel structures, together with their nods and machinery items connections and of lifting appliance gear shall be determined.

If during periodical surveys, performed examinations reveal defects adversely affecting appliance service safety or its wear exceeding permissible values, the damaged or worn parts shall be repaired or replaced, and defects removed.

At least every 5 years, measurements of actual thickness of steel structure walls shall be executed.

2.3.5 Additional surveys and tests of lifting appliances shall be performed in accordance with paragraph 10.5 of *RSSSS, Part IV- Lifting appliances*.

3 DOCUMENTS FOR MARITIME ADMINISTRATION

3.1 Report of life-saving equipment survey;

3.2 Report of radio, navigation and signalling equipment survey;

3.3 Statement of Compliance (marine pollution prevention)l;

3.4 Record of Equipment (marine pollution prevention).

4 PRS DOCUMENTS

4.1 Units provided with gantry cranes covered by PRS supervision shall have the below documents:

4.1.1 Lifting Appliances Book;

4.1.2 Certificate of Lifting Appliance Survey;

4.1.3 Certificate of Test and Thorough Examination of Interchangeable Components and Loose Gear;

4.1.4 Certificate of Test and Thorough Examination of Wire Rope.

4.2 A lift covered with PRS survey shall have the below valid documents and certificates:

4.2.1 Lift Book.

4.2.2 Certificate of Test and Thorough Examination of Lifts and their Accessory Gear, before being taken into use and after 5 yearly examination;

4.2.3 Certificate of Test and Thorough Examination of Wire Rope;

4.2.4 Survey Report on Lift, issued after an annual survey and after an occasional survey, where survey has not been completed with tests.

5 SIGNAL MEANS AND IDENTIFICATION SIGNS

5.1 General

5.1.1 Definitions and terms used in this chapter have the meaning as defined in the PRS *Rules for Statutory Survey of Sea-going Ships, Part III* (thereafter referred to as *RSSSS*).

5.1.2 The scope of supervision of production and installation of the signalling equipment is described in par. 1.3 of *RSSSS, Part III*.

5.2 Provision of the Equipment

Each unit shall be equipped with navigation lights, identification signs and signal means in accordance with the recommendations of IALA *(International Association of Marine Aids for Navigation and Lighthouse Authorities)* concerning marking offshore structures[1)] and the requirements of Administration[2)].

5.3 Design of signal signs and means

The design of navigation lights, identification signs and signal means referred to in par. 5.2 shall be in accordance with the requirements defined by the Administration and is subject to PRS supervision.

5.4 Signal signs and means installation requirements

5.4.1 If by the specific design of the unit it is impossible to comply with the requirements for the arrangement of signal means, PRS may accept different arrangement from that specified by the rules, provided the arrangement to the possible extent complies with the requirements specified in 5.2.

5.4.2 Installation of navigation lights, identification signs and signal means as referred to in par. 5.2 shall be in accordance with the requirements of the Administration and is subject to PRS supervision.

5.4.3 For the lights referred to in 5.2, a spare set of lights shall be provided, which shall be installed permanently, together with the basic set.

5.4.4 Appropriate number of spare parts for lights shall be provided, which shall include at least two bulbs for each basic set light.

5.4.5 The power supply systems for identification signs and signal means shall be in compliance with the requirements of para. 6.5 of Part VI of this Publication.

5.4.6 Lights and sound means referred to in 5.2 shall be provided with reserve source of energy, of capacity sufficient for their independent 96 hour operation in the case of the failure of main and emergency supply source; the reserve source of electrical supply shall be maintained permanently charged, with an automatic switch to reserve source in case of failure of main and emergency source.

5.4.7 The failure of the light, its supply, reserve supply or the reserve supply source charger shall be indicated in MCS by visual and sound alarm signals; the possibility of switching the light to reserve one shall be ensured in the case of basic light failure.

5.4.8 Reserve sound signal means shall be ensured, which shall be independent of the main signal means and which shall automatically take over functions of signal means partially or completely out of order.

5.4.9 The signal means control device shall be located in MCS, where it is permanently supervised.

5.4.10 Supply systems of signal means control devices shall comply with the requirements of Part VIII of *this Publication*.

5.4.11 Where automatic mode of switching on/off the signal means is used (such as twilight sensor, visibility sensor), manual mode of the system operation shall be ensured; setting and indicating the system operation mode shall be possible in MCS.

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1) IALA Recommendation O-139 – The Marking of Man-made Offshore Structures.
2) Regulation of the Minister relevant for maritime economy matters.

6 LIFE-SAVING APPLIANCES AND ARRANGEMENTS

6.1 General

6.1.1 For the purpose of this chapter, unless expressly provided otherwise, the terms related to life-saving appliances and arrangements have the meaning as defined in regulation 3 of Chapter III of the *SOLAS 74 Convention*.

6.1.2 Life-saving appliances and arrangements are subject to evaluation, tests and approval in accordance with the requirements of regulation 4 of Chapter III of the *SOLAS 74 Convention*.

6.1.3 Life-saving appliances and arrangements shall comply with the relevant provisions of the *SOLAS 74 Convention* and the *LSA Code*.

6.2 Survival craft

6.2.1 Lifeboats and Liferafts

6.2.1.1 Each unit shall be equipped with fire-protected lifeboats complying with the requirements of the *LSA Code*, installed in at least two widely separated locations on different sides or ends of the *unit*. The arrangement of the lifeboats shall provide sufficient capacity to accommodate the total number of persons on board if:

.1 all the lifeboats in any one location are lost or rendered unusable; or

.2 all the lifeboats on any one side, any one end, or any one corner of the unit are lost or rendered unusable;

6.2.1.2 In addition, each unit shall carry liferafts complying with the requirements of the LSA Code and approved to the actual operating height, of such aggregate capacity as will accommodate the total number of persons on the *unit.*

6.2.1.3 In the case when due to the size or specific design of the *unit*, lifeboats cannot be located in widely separated locations to satisfy paragraph 6.2.1.1, the Administration may permit for such aggregate capacity of the lifeboats as to accommodate the total number of persons on the *unit*. However in such case, the liferafts under paragraph 6.2.1.2 shall be served by liferaft launching appliances or marine evacuation systems complying with the requirements of the *LSA Code*.

6.2.1.4 Each survival craft shall be fully equipped as required by this *Publication* and the *LSA Code*; however, in the case of units operating in areas such that, in the opinion of the Administration, certain items of equipment are unnecessary, the Administration may allow these items to be dispensed with.

6.2.2 Assembly and embarkation stations

6.2.2.1 If separate, assembly stations shall be positioned close to the survival craft embarkation stations. Each assembly station shall have sufficient space to accommodate all persons assigned to assemble at that station, but at least 0.35 m^2 per a person.

6.2.2.2 The assembly and embarkation stations shall be readily accessible from accommodation and working areas.

6.2.2.3 The assembly and embarkation stations shall be adequately illuminated by emergency lighting.

6.2.2.4 Alleyways, stairways and exits giving access to the assembly and embarkation stations shall be adequately illuminated by emergency lighting. Such lighting shall be capable of being supplied from the emergency source of power.

6.2.2.5 Alleyways, stairways and exits giving access to the assembly and embarkation stations shall be marked by means of safety signs recommended by IMO in res. A.752(18) i A.760(18) – see *Publication Nr 41/P – Symbols Related to Life-saving Appliances and Arrangements and Escape Routes. Guidelines for Passenger Safety Instructions.*

6.2.2.6 The assembly stations and embarkation stations for survival craft launched either by falls or free-fall shall be arranged in such way as to allow for safe and efficient handling of a stretcher within the craft. Survival craft embarkation arrangements shall be designed in such a way as to allow for lifeboats to be boarded and launched directly from the stowed position and davit-launched liferafts to be boarded and launched from a position immediately adjacent to the stowed position or from a position to which the liferaft is transferred prior to launching. Where necessary, means shall be provided for bringing the davit launched liferaft against the *unit's* side and holding them alongside so that persons can be safely embarked..

6.2.2.7 At least two widely separated fixed metal ladders or gangways shall be provided extending from the deck to the surface of the water. The fixed metal ladders or gangways and sea areas in their vicinity shall be adequately illuminated by emergency lighting.

6.2.2.8 If fixed ladders cannot be installed, alternative means of escape with sufficient capacity to permit all persons on board to descend safely to the waterline shall be provided.

6.2.3 Survival craft launching stations

6.2.3.1 Launching stations shall be in such positions as to ensure safe launching having particular regard to clearance from any exposed propeller or steeply overhanging portions of the *unit's* structure.
As far as possible, launching stations shall be located so that survival craft can be launched down a straight side of the *unit*, except for survival craft specially designed for free-fall launching and survival craft mounted on structures intended to provide clearance from lower structures.

6.2.4 Stowage of survival craft

6.2.4.1 Each survival craft shall be stowed:

- **.1** so that neither the survival craft nor its stowage arrangements will interfere with the operation of any other survival craft or rescue boat at any other launching station;
- **.2** as near the water surface as is safe and practicable;
- **.3** in a state of continuous readiness so that two crew members can carry out preparations for embarkation and launching in less than 5 min;
- **.4** as far as practicable, in a secure and sheltered position and protected from damage by fire and explosion.

6.2.4.2 Where appropriate, the *unit* shall be so arranged that lifeboats, in their stowed positions, are protected from damage by heavy seas.

6.2.4.3 Lifeboats shall be stowed attached to their launching appliances.

6.2.4.4 Liferafts shall be so stowed as to permit manual release of one raft or container at a time from their securing arrangements.

6.2.4.5 Davit-launched liferafts shall be stowed within reach of the lifting hooks, unless some means of transfer is provided which is not rendered inoperable within the limits of trim and list for any damaged condition or by unit motion or power failure.

6.2.5 Survival craft launching and recovery arrangements

6.2.5.1 Launching appliances complying with the requirements of the *LSA Code* shall be provided for all lifeboats and davit-launched liferafts.

6.2.5.2 Launching and recovery arrangements shall be such that the appliance operator on the *unit* is able to observe the survival craft at all times during launching and lifeboats during recovery.

6.2.5.3 Only one type of release mechanism shall be used for similar survival craft carried on board the *unit*.

6.2.5.4 Preparation and handling of survival craft at any one launching station shall not interfere with the prompt preparation and handling of any other survival craft or rescue boat at any other station.

6.2.5.5 Falls, where used, shall be long enough for the survival craft to reach the water with the unit under most unfavourable conditions, such as maximum height over water, in the lightest transit or operational condition.

6.2.5.6 During preparation and launching, the survival craft, its launching appliance and the area of water into which it shall be launched shall be adequately illuminated by emergency lighting.

6.2.5.7 Means shall be available to prevent any discharge of fluids onto survival craft during abandonment.

6.2.5.8 All survival craft required for abandonment by the total number of persons permitted on board, shall be capable of being launched with their full complement of persons and equipment within 10 min from the time the signal to abandon the unit is given.

6.2.5.9 Manual brakes shall be so arranged that the brake is always applied unless the operator, or a mechanism activated by the operator on the unit or in the survival craft, holds the brake control in the "off" position.

6.2.5.10 Each survival craft shall be so arranged as to be clear during launching of each leg, column, footing, brace, mat and any similar structure below the hull with the unit in an intact condition. The Administration may allow a reduction in the total number of survival craft when the unit is in the transit mode and the number of personnel on board has been reduced. In such cases, sufficient survival craft, to meet the provisions of this chapter, shall be available for use by those personnel remaining on board.

6.2.5.11 Consideration shall be given to the location and orientation of the survival craft with reference to unit's design such that clearance of the unit is achieved in an efficient and safe manner having due regard to the capabilities of the survival craft.

6.2.5.12 Notwithstanding the requirement of paragraph 6.1.2.8 of the *LSA Code*, the speed of lowering need not be greater than 1 m/s.

6.3 Rescue boats

Each unit shall carry at least one rescue boat complying with the requirements of the *LSA Code,* where there is no assisting vessel. A lifeboat may be accepted as a rescue boat, provided that the lifeboat and its launching and recovery arrangements also comply with the requirements for a rescue boat.

6.3.1 Stowage of rescue boat

6.3.1.1 Each rescue boat shall be stowed:

- **.1** in a state of continuous readiness for launching in not more than 5 min;
- **.2** if of an inflated type, in a fully inflated condition at all times;
- **.3** in a position suitable for launching and recovery;
- **.4** so that neither the rescue boats nor their stowage arrangements will interfere with the operation of any survival craft at any other launching station;
- **.5** in compliance with section 6.2.4, if they are also lifeboats.

6.3.2 Rescue boat embarkation, launching and recovery arrangements

6.3.2.1 The rescue boat embarkation and launching arrangements shall be such that the rescue boat can be boarded and launched in the shortest possible time.

6.3.2.2 Launching arrangements shall comply with section 6.2.5.

6.3.2.3 Rapid recovery of the rescue boat shall be possible when loaded with its full complement of persons and equipment. If the rescue boat is also a lifeboat, rapid recovery shall be possible when loaded with its lifeboat equipment and the approved rescue boat complement of at least six persons.

6.3.2.4 Rescue boat embarkation and recovery arrangements shall allow for safe and efficient handling of a stretcher. Foul weather recovery strops shall be provided for safety if heavy fall blocks constitute a danger.

6.4 Lifejackets

6.4.1 A lifejacket complying with the requirements of the *LSA Code* shall be provided for every person on board the unit. In addition, a sufficient number of lifejackets shall be stowed in suitable locations for those persons who may be on duty in locations where their lifejackets are not readily accessible.

6.4.2 Each lifejacket shall be fitted with a lifejacket light complying with the requirements of the *LSA Code*.

6.4.3 Lifejackets shall be so placed as to be readily accessible and their position shall be plainly indicated. Where, due to the particular arrangements of the unit, the lifejackets provided in compliance with the requirements of paragraph 6.4.1 may become inaccessible, alternative provisions shall be made to the satisfaction of PRS which may include an increase in the number of lifejackets to be carried.

6.4.4 The lifejackets used in totally enclosed lifeboats, except free-fall lifeboats, shall not impede entry into the lifeboat or seating, including operation of the seat belts in the lifeboat.

6.4.5 Lifejackets selected for free-fall lifeboats, and the manner in which they are carried or worn, shall not interfere with entry into the lifeboat, endanger occupant safety or operation of the lifeboat.

6.5 Immersion suits and anti-exposure suits

6.5.1 Each unit shall carry an immersion suit complying with the requirements of the *LSA Code* subchapter 2.3, and of an appropriate size, for each person on board. In addition a sufficient number of immersion suits shall be stowed in suitable locations for those persons who may be on duty in locations where their immersion suits are not readily accessible.

6.6 Lifebuoys

6.6.1 At least eight lifebuoys of a type complying with the *LSA Code* shall be provided on each *unit*. The number and placement of lifebuoys shall be such that a lifebuoy is easily accessible from exposed locations.

6.6.2 Not less than one-half of the total number of lifebuoys shall be provided with self-igniting lights complying with the *LSA Code*. Not less than two of these lifebuoys shall also be provided with self-activating smoke signals complying with the LSA Code and be capable of quick release from the MCS, or a location readily available to operating personnel. Lifebuoys with lights and those with lights and smoke signals shall be equally distributed along the accessible portions of the perimeter of the *unit* and shall not be the lifebuoys provided with lifelines in compliance with the provisions of paragraph 6.6.3.

6.6.3 At least one lifebuoy on each side and stern of the unit in widely separated locations shall each be fitted with a buoyant lifeline complying with paragraph 2.1.4 of the *LSA Code*, the length of which shall be at least two times the distance from the place of stowage to the waterline at lightest draught or 30 m, whichever is greater. The lifeline shall be so stowed that it can easily run out.

6.6.4 Each lifebuoy shall be marked in block capitals of the Roman alphabet with the name and operator of the *unit* on which it is carried.

6.7 Radio life-saving sppliances

6.7.1 Two-way VHF radiotelephone apparatus

All lifeboats shall carry a two-way VHF radiotelephone apparatus. In addition, at least two such apparatuses shall be available on the *unit*, so stowed that they can be rapidly placed in any liferaft. All two-way VHF radiotelephone apparatus shall conform to performance standards not inferior to those adopted by the IMO.

6.8 Search and rescue locating devices (SARLD)

All lifeboats shall carry at least one search and rescue locating device. In addition, at least two search and rescue locating devices shall be available on the *unit*, so stowed that they can be rapidly placed in any liferaft. All search and rescue locating devices shall conform to performance standards not inferior to those adopted by the IMO.

6.9 Distress flares

Not less than 12 rocket parachute flares complying with the *LSA Code* shall be carried and be stowed on or near the MCS.

6.10 Line-throwing appliance

A line-throwing appliance complying with the requirements of the *LSA Code* shall be provided.

6.11 Operating instructions

6.11.1 Illustrations and instructions shall be provided on or in the vicinity of survival craft and their launching controls and shall:

- **.1** illustrate the purpose of controls and the procedures for operating the appliance and give relevant instructions or warnings;
- **.2** be easily seen under emergency lighting conditions; and
- **.3** use symbols in accordance with the recommendations of the IMO.

6.12 Operational readiness, maintenance and inspections

6.12.1 Before the *unit* leaves the port and at all times during operation and transit, all life-saving appliances shall be in working order and ready for immediate use.

6.12.2 Instructions for on-board maintenance of life-saving appliances complying with *SOLAS 74* regulation III/36 shall be provided and maintenance shall be carried out accordingly.

6.12.3 The Administration may accept, in lieu of the instructions in paragraph 6.12.2, a planned maintenance programme which includes the requirements of SOLAS regulation III/36.

6.12.4 Maintenance, testing and inspections of life-saving appliances shall be carried out based on the guidelines developed by the IMO and in a manner having due regard to ensuring reliability of such appliances.

6.12.5 Falls used in launching shall be inspected periodically with special regard for areas passing through sheaves, and renewed when necessary due to deterioration of the falls or at intervals of not more than five years, whichever is the earlier.

6.13 Spares and repair equipment

6.13.1 Spares and repair equipment shall be provided for life-saving appliances and their components which are subject to excessive wear or consumption and need to be replaced regularly.

6.14 Weekly inspections

6.14.1 The following inspections shall be carried out once a week and a report shall be entered in a log-book:

- **.1** all survival craft, rescue boats and launching appliances shall be visually inspected to ensure that they are ready for use. The inspection shall include, but is not limited to, the condition of hooks, their attachment to the lifeboat and the on-load release gear being properly and completely reset;
- **.2** all engines in lifeboats and rescue boats shall be run for a total period of not less than 3 min, provided the ambient temperature is above the minimum temperature required for starting and running the engine. During this period of time, it shall be demonstrated that the engine and gear box are engaging satisfactorily. If the special characteristics of an outboard motor fitted to a rescue boat would not allow it to be run other than with its propeller submerged for a period of 3 min, a suitable water supply may be provided.
- **.3** lifeboats, except free-fall lifeboats shall be moved from their stowed position, without any persons on board, to the extent necessary to demonstrate satisfactory operation of launching appliances, if weather and sea conditions so allow; and
- **.4** the general emergency alarm shall be tested.

6.15 Monthly inspections

6.15.1 Inspection of the life-saving appliances, including lifeboat equipment and emergency lighting, shall be carried out monthly using the checklist required by SOLAS regulation III/36 (activities complying with SOLAS III/20.7) to ensure that they are complete and in good order. All lifeboats, except free-fall lifeboats, shall be turned out from their stowed position without any persons on board, if weather and sea conditions so allow. A report of the inspection shall be entered in a log-book.

6.16 Servicing of inflatable liferafts, inflatable lifejackets, marine evacuation systems, and maintenance and repairs of inflated rescue boats

6.16.1 Each inflatable liferaft, inflatable lifejacket and marine evacuation system shall be serviced:

- **.1** at intervals not exceeding 12 months, provided where in any case this is impracticable, the Administration may extend this period to 17 months;
- **.2** at an approved servicing station which is competent to service them, maintains proper servicing facilities and uses only properly trained personnel; and
- **.3** in addition to or in conjunction with the servicing intervals of marine evacuation systems under paragraph 6.16.1, each marine evacuation system shall be deployed from the ship on a rotational basis at intervals to be agreed by the Administration provided that each system shall be deployed at least once every six years.

6.16.2 All repairs and maintenance of inflatable rescue boats shall be carried out in accordance with the manufacturer's instructions. Emergency repairs may be carried out on board the *unit*; however, permanent repairs shall be carried out by an approved servicing station.

6.17 Marking of stowage locations

6.17.1 Containers, brackets, racks, and other similar stowage locations for life-saving equipment shall be marked with symbols in accordance with the relevant IMO recommendations ~~indicating the devices stowed in that location for that purpose~~.

6.17.2 If more than one device is stowed in that location, the number of devices shall also be indicated.

6.18 Periodic servicing of launching appliances and on-load release gear

6.18.1 Launching appliances shall be:

- **.1** maintained in accordance with instructions for on-board maintenance as required in paragraph 6.12;
- **.2** subject to a thorough examination at the annual surveys, as specified in section 2.2.4; and
- **.3** upon completion of the examination referred to in .2, subjected to a dynamic test of the winch brakes at the maximum lowering speed. The load to be applied shall be the mass of the survival craft or rescue

boat without persons on board, except that, at intervals not exceeding five years, the test shall be carried out with a proof load of 1.1 times the mass of the survival craft or rescue boat and its full complement of persons and equipment.

6.18.2 Lifeboat or rescue boat on-load release gear, including free-fall lifeboat release systems shall be:

.1 maintained in accordance with instructions for on-board maintenance, as required in paragraph 6.12;

.2 subject to a thorough examination and operational test at the annual surveys in section 2.2.4 by properly trained personnel familiar with the system; and

.3 operationally tested under a load of 1.1 times the total mass of the lifeboat or rescue boat when loaded with its full complement of persons and equipment whenever the release gear is overhauled. Such overhauling and test shall be carried out at least once every five years.

.4 notwithstanding subparagraph .3 above, the operational testing of free-fall lifeboat release systems shall be performed either by free-fall launch with only the operating crew on board or by a simulated launching carried out based on guidelines developed by the IMO.

6.18.3 Davit-launched liferaft automatic release hooks shall be:

.1 maintained in accordance with the instructions for on-board maintenance in paragraph 6.12;

.2 subject to a thorough examination and operational test at the annual surveys in section 2.2.4 by properly trained personnel familiar with the system; and

.3 operationally tested under a load of 1.1 times the total mass of the liferaft when loaded with its full complement of persons and equipment whenever the automatic release hook is overhauled. Such overhauling and test shall be carried out at least once every five years.

7 RADIO AND NAVIGATION EQUIPMENT

7.1 General

7.1.1 For the purpose of this chapter, unless expressly provided otherwise, the terms related to radio and navigation equipment have the meaning as defined in regulation 2 of Chapter IV and V of the *SOLAS 74 Convention*.

7.1.2 Radio and navigation equipment are subject to evaluation, tests and approval in accordance with the requirements of regulation 1.4.1 and shall conform to the performance standards not inferior to those adopted by IMO.

7.2 Radio equipment of units under tow and on site

7.2.1 Non-self-propelled unit under tow when manned and unit, while stationary on site in the sea area A1+A2 shall be equipped with:

.1 a VHF radio installation capable of transmitting and receiving:
- DSC on the frequency 156.525 MHz (channel 70). It shall be possible to initiate the transmission of distress alerts on channel 70 from MCS; and
- radiotelephony on the frequencies 156.300 MHz (channel 6), 156.650 MHz (channel 13) and 156.800 MHz (channel 16);
- general radiocommunications using two-way radiotelephony;

.2 a radio installation capable of maintaining a continuous DSC watch on VHF channel 70 which may be separate from, or combined with, that required by subparagraph 7.2.1.1

.3 a MF radio installation capable of transmitting and receiving, for distress and safety purposes, on the frequencies:
- 2,187.5 kHz using DSC; and
- 2,182 kHz using radiotelephony;

.4 a radio installation capable of maintaining a continuous DSC watch on the frequency 2,187.5 kHz which may be separate from, or combined with, that required by subparagraph 7.2.1.3; and

.5 means of initiating the transmission of ship-to-shore distress alerts by a radio service other than MF operating either:
- through the polar orbiting satellite service COSPAS-SARSAT on 406 MHz; this requirement may be fulfilled by the satellite EPIRB, required by subparagraph 7.2.1.10, either by installing the satellite EPIRB close to, or by remote activation from, MCS; or
- through the INMARSAT geostationary satellite service by additional ship earth station;

It shall be possible to initiate transmission of distress alerts by the radio installations specified in subparagraphs 7.2.1.3 and 7.2.1.5 from MSC or location accepted by the PRS.

.6 The unit shall, in addition, be capable of transmitting and receiving general two-way communication using radiotelephony by either:
- a radio installation operating on working frequencies in the bands between 1,605 kHz and 4,000 kHz; This requirement may be fulfilled by the addition of this capability in the equipment required by subparagraph 7.2.1.3; or
- an INMARSAT ship earth station.

.7 Search and rescue locating device(2 pcs) capable of operating in the 9 GHz band (SART) or in the frequency dedicated for AIS (AIS-SART), which:
- shall be so stowed that it can be easily utilized; and
- may be one of those required for a survival craft;

.8 a receiver capable of receiving international NAVTEX service broadcasts;

.9 satellite EPIRB which shall be:
- capable of transmitting a distress alert either through the polar orbiting satellite service COSPAS-SARSAT operating in the 406 MHz band:
- installed in MCS;
- ready to be manually released and capable of being carried by one person to the survival craft;
- capable of being manually initiated;

.10 hand-held VHFGMDSS radiotelephone apparatus (3 pcs.) for two-way communication with survival craft, which shall be so located as to be readily used;
.11 a VHF radiotelephone the aeronautical frequencies 121.5 MHz and 123.1 MHz from MCS for communication with helicopter;
.12 *International Code of Signals* and updated copy of Volume III of the *International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual*.

7.2.2 Ship security alert system (SSAS)

Each *unit* shall be provided with ship security alert system. Provision of ship security alert system may be complied with by using the radio installation fitted or other radiocommunication equipment provided for general communication, or special equipment dedicated solely for that purpose.

7.2.3 Requirements for providing the operational readiness of the radio equipment

For *units* at the site in sea areas A1 and A2 availability shall be ensured by using such methods as duplication of equipment, shore based maintenance or at-sea electronic maintenance capability. Information about the applied method of readiness shall be communicated to PRS.

7.3 Navigation equipment

Each unit shall be equipped with:
.1 charts and nautical publications;
.2 daylight signalling lamp or other means, to communicate by light during day and night using an energy source of electrical power not solely dependent upon the *unit's* power supply;
.3 a 9 GHz radar;
.4 automatic identification system (AIS);
.5 night vision equipment.
.6 radar beacon (racon)

7.4 Exemptions

The Administration may, if it considers that the sheltered nature of the installation or environmental or navigational conditions of the specific area are such as to render the application of any specific requirements of this chapter unreasonable or unnecessary, exempt from those requirements individual units or classes of units.

7.5 Equipment arrangement

7.5.1 In case the unit is under tow when manned, the radio equipment shall be installed in a way as to allow the operator to be facing the direction of tow and provide an efficient visibility is provided. A clock shall be provided in the vicinity of the radio equipment.

7.5.2 It shall be possible to initiate transmission of the distress alert by the VHF and MF radio installations from a position in an accessible and protected area which is acceptable to PRS.

7.5.3 The radio equipment may be installed as a desktop, bulkhead or overhead unit or may be integrated in an instrument GMDSS console or panel. They may be installed separately or complete within the GMDSS console.

7.5.4 In accordance with appendix AP-11 of Radio Regulations, the following publications shall be available in the unit:
.1 operator's manual for each equipment;
.2 service manual in case the at-sea maintenance of radiocommunication equipment has been declared;
.3 List of Ship Stations and Maritime Mobile Service Identity Assignments
.4 List of Coast Stations and Special Service Stations (MRCC, Maritime safety Centre);
.5 Manual for Use by the Maritime Mobile and Maritime Mobile-Satellite Services (Maritime Manual).

7.5.5 Each radio equipment shall be:

.1 so installed that no harmful interference of mechanical, electrical or other origin disturbs the equipment efficient operation and electromagnetic compatibility with other appliances is ensured and any harmful interference is precluded;

.2 is so located as to ensure the greatest possible degree of safety and operational availability;

.3 is protected against the harmful effects of water, extreme temperatures and other adverse environmental conditions;

.4 if the acoustic noise level in a room fitted with operating controls for radio equipment is so high or could be so high, during particular operating conditions, that it may disturb or prevent proper use of the radio equipment, adequate noise protection shall be provided by mechanical or other means.

7.5.6 Ship security alert system (SSAS) shall be capable of being activated from MCS and in at least one other location.

7.5.7 Radar screen shall be located in MCS.

7.5.8 Control panel of the AIS system shall be located in MCS where commanding view is provided.

7.6 Antennas arrangement

7.6.1 Antennas for radio equipment shall be arranged and secured in accordance with the requirements of paragraph 4.4 of *RSSSS, Part IV- Radio Installations*.

7.6.2 Antennas for navigation equipment shall be arranged and secured in accordance with the requirements of chapter 4, *RSSSS, Part V- Navigation Equipment*,, and thus:

.1 radar antennas – see 4.2.6.2, 4.2.6.3;

.2 antennas for automatic identification systems (AIS) – see 4.2.11.2 ÷ 4.2.11.5;

.3 antennas for radionavigation systems receivers GPS – see 4.2.10.2, 4.2.10.3.

7.7 Power supply

7.7.1 Radio equipment referred to in 7.1.1.1 to 7.1.1.4 shall by supplied by separate circuits from radio switch-board or from a separate section of the bridge console.

7.7.2 Navigation equipment referred to in 7.3 shall by supplied by separate circuits from navigation switch-board or from a separate section of the bridge console.

7.7.3 Radio equipment switchboard, if not supplied from the bridge console, shall be supplied by separate feeders from the main and emergency source of electrical power, in accordance with the requirements of *Part VI (Electrical Equipment and Automation Systems)* of this *Publication).* The feeders shall be laid as widely as possible horizontally and vertically separated from each other. Arrangements shall be provided for rapidly switching from one source of power to the other.

7.7.4 In case of units constructed before 1 February1995, the radio equipment may be supplied by a single feeder which is supplied from main and emergency source of electrical power.

7.7.5 Each unit shall be provided with a reserve source of electrical power to supply the radio equipment to maintain distress communication and ensure unit safety in the event of failure of the *unit's* main and emergency source of electrical power. Reserve source of electrical power shall be capable of simultaneous supply of VHF/DSC and MF/DSC equipment, required by 7.2.1.1÷7.2.1.4 for sea areas A1+A2, for a period of at least:

.1 one hour, on *units* provided with an emergency supply which complies with the requirements contained in Chapter 9, *Part VI - Electrical Equipment and Automation Systems*, of this *Publication*;

.2 six hours, on *units* not provided with an emergency source of power or in the case the emergency source of power does not provide for the compliance with all relevant requirements contained in Chapter 9 of Part *VI Electrical Equipment and Automation Systems*, of this *Publication*.

7.7.6 Where the reserve source of electrical power is an accumulator battery requiring charging, then:

.1 a means of automatic charging of such batteries shall be provided which shall be capable of recharging them to minimum capacity within 10 h; and

.2 the capacity of the battery shall be checked, using an appropriate method, at intervals not exceeding 12 months.

7.7.7 Racon and AIS shall be provided with reserve energy source of capacity sufficient for their independent operation for 96 hours after failure of main and emergency supply source; the reserve source of supply shall be maintained permanently charged with automatic switch thereto in the case of failure of main and emergency source.

7.8 Wiring

7.8.1 Cabling and wiring of the radio and navigation equipment shall be in accordance with the requirements of 16.8, *Part VI - Electrical Equipment and Automation Systems* of this *Publication*.

7.8.2 Cables used for wiring of radio and navigation equipment shall be screened. In all cases, the electrical continuity of all cable sheaths shall be provided. At the points of cable penetration into bulkheads of spaces in which receivers are installed, the sheaths shall be earthed.

7.8.3 All aerial cables shall be earthed and shall be installed separately from other cables. If it is impossible to provide for separate installation of cables, double-screened cables shall be used.

7.8.4 Internal bend radius of special cables and concentric cables of high diameter, shall be not less than the values specified by the manufacturer.

7.8.5 The value of insulation resistance of any new cable disconnected in both ends, shall be not less than 20 MΩ, notwithstanding the length of the cable.

7.8.6 The value of aerials insulation resistance against the *unit* structure shall be not less than 10 MΩ in normal climatic conditions, and not less than 1 MΩ in high humidity conditions.

7.9 Earthing

7.9.1 Radio and navigation equipment shall have operational and protective earthing of high frequency which shall be routed in its shortest way and to comply with the requirements of *Part VI* of this *Publication*.

7.9.2 Operational earthing of high frequency cables, which is provided to assure normal operation of transmitters, shall be made of copper rod, routed in its shortest way from the transmitter/ antennas switch/ antenna coupler to metal wall or deck, having a reliable electric contact with the *unit* structure, with down-leads to earthing terminals of transmitters, in accordance with the requirements of *Part VI*. The length of the rod from the transmitter to the point of connection to the wall or deck shall not exceed 1500 mm. Depending on the output power of the transmitter, the cross-section of copper rod and the down-leads shall be not less than:

.1 25 mm^2 for the transmitter power less than 50 W;

.2 50 mm^2 for the transmitter power from 50 to 500 W;

.3 100 mm^2 for the transmitter power more than 500 W.

7.9.3 In all cases, where applicable, operational earthing of each transmitter can be made separately and directly to the metal wall or deck by direct connection of the transmitter earthing terminals to the nearest metal wall or deck by means of copper ribbon or wire of the appropriate cross-section.

7.9.4 If the transmitter has an output more than 50 W, the earthing (by connecting the copper ribbon or flexible wire to the transmitter cover) shall be made in at least two connection points, separated from each other as far as possible.

7.9.5 Operational earthing of receivers shall be made by means of a copper ribbon or a flexible copper wire having a cross-section not less than 6 mm^2 and shall be routed in a shortest way from each receiver to main earthing ribbon of transmitters or directly to the closest wall having good electric connection with the *unit* structure.

7.9.6 Operational earthing of the navigation equipment shall be made by means of a copper ribbon or a flexible copper wire having a cross-section not less than 6 mm^2 and shall be routed in a shortest way from each device to the closest wall having good electric connection with the *unit* structure.

7.9.7 Metal covers of radio and navigation equipment shall be electrically connected and routed in shortest possible way to the *unit* structure. Where the cable leads into the device, the protective sheath of the cable shall be electrically connected with the metal cover of the device.

7.9.8 Connecting wires of protective earthing of the covers shall be as short as possible but not longer than 150 mm.

7.9.9 Earthing of the lowest ends of the fixed rigging on masts and funnels shall be made by means of the strand of the wire rope or flexible wires.

7.9.10 Total resistance of the electrical connections of any earthing shall be not more than 0.02 Ω.

7.9.11 Points of earthing of the device to the *unit* body shall be accessible for periodical measurements and maintenance.

7.9.12 Earthing of radio devices shall not be used as a lightning conductor.

7.10 Approval of the equipment

All navigation and radio equipment, installed on the *unit* shall have appropriate certificates of compliance with the requirements of Council Directive *96/98/EC* of 20 December 1996 *on marine equipment*, as amended, thereafter called MED directive.

7.11 Installation and repairs of the equipment

After approval by PRS of the installation documentation of the radio and navigation equipment on the *unit*, its installation/ servicing and repairs under PRS supervision shall be performed by a service supplier approved in accordance with Publication *No 51/P – Approval of service suppliers.*

8 POLLUTION PREVENTION

8.1 Requirements for the prevention of oil pollution

8.1.1 General

8.1.1.1 There are five categories of discharge, that may be associated with the operation of a *unit* engaged in the exploration, exploitation and associated off-shore processing of sea-bed mineral resources, according to article 2(3)(b)(ii) of the *MARPOL Convention* and Unified Interpretation No 63 to Annex I to *MARPOL Convention*. Diagram 8.1 shows the division of discharge from *units*, in accordance with Appendix 5 to Unified Interpretations of ANNEX I to *MARPOL Convention*. The following groups of discharges are distinguished:

.1 drainage from machinery spaces of the *units*:
contaminated sea water associated with *unit* operations, such as produced oil tank cleaning water, produced oil tank hydrostatic testing water, water from ballasting of produced oil tank, used to carry out inspection by rafting;

.2 wastewater associated with crude oil exploration and processing;

.3 production water discharge; and

.4 displacement water discharge.

8.1.1.2 Discharge of drainage from machinery spaces of *units* and contaminated ballast water shall comply with the requirements of *MARPOL 73/78 Convention* and local and national regulations of the coastal State Administration[1)].

8.1.1.3 Discharge of wastewater associated with crude oil exploration and processing on the *unit*, such as processing of oil and gas, dehydration and separation of oil, shall comply with the requirements of local and national regulations of the coastal State Administration[2)].

8.1.1.4 With respect to stationary or floating platforms engaged in exploration and exploitation of the sea-bed and subsoil thereof adjacent to the coast over which the coastal State exercises sovereign rights for the purposes of exploration and exploitation of their natural resources, the Administration is the Government of the coastal State concerned.

[1)] For the Baltic Sea area, requirements of Annex IV to *Helsinki Convention* apply.
[2)] For the Baltic Sea area, requirements of Annex VI to *Helsinki Convention* apply.

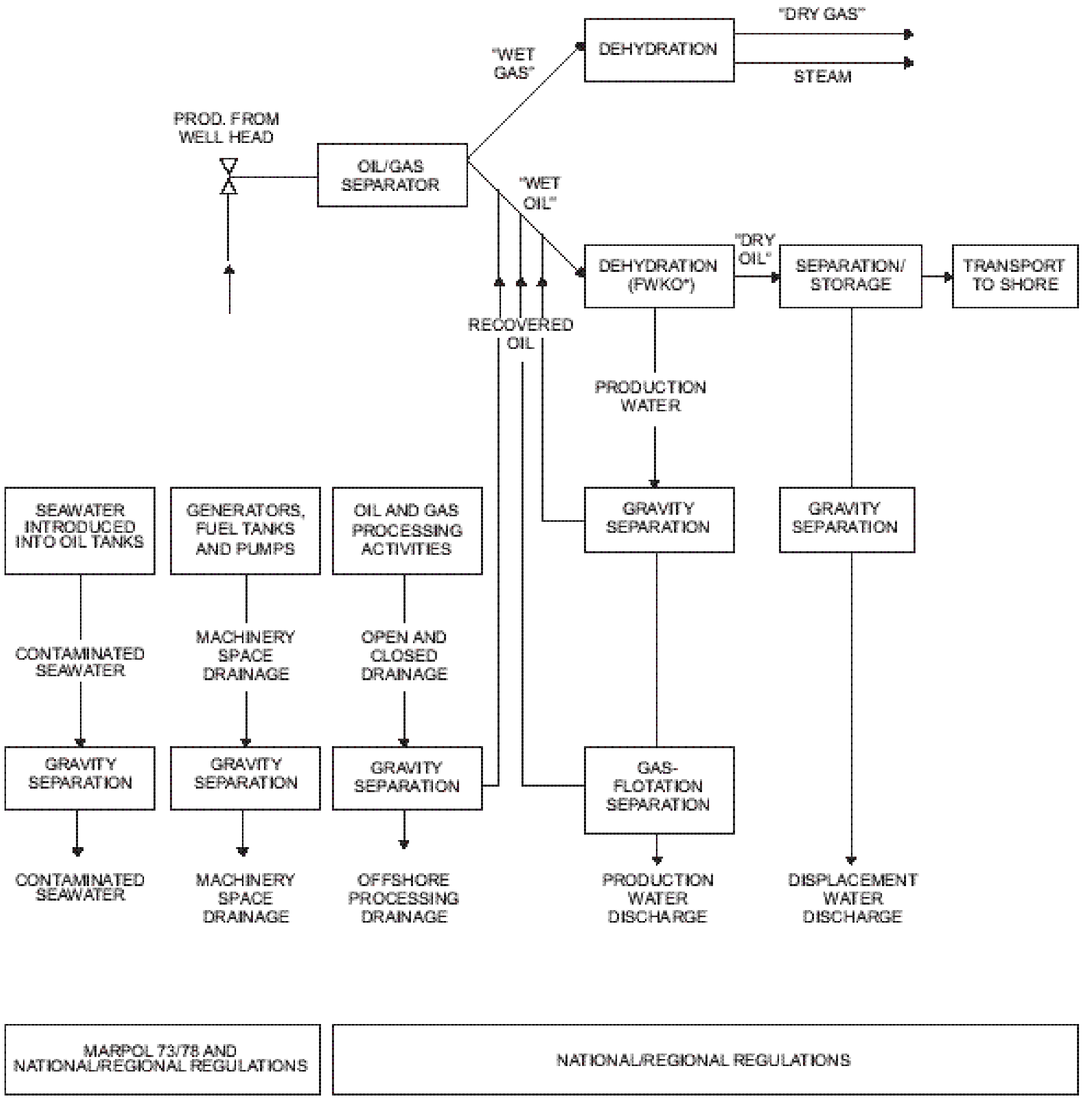

Diagram 8.1 – Discharges from *units*

8.1.2 Requirements for prevention of sea pollution by oily wastes from machinery spaces of *units*

8.1.2.1 General

8.1.2.1.1 *Units* when engaged in the exploration, exploitation and associated offshore processing of sea-bed mineral resources shall comply with the requirements for prevention of pollution by oil from machinery spaces as applicable to ships of 400 gross tonnage and above other than oil tankers, in accordance with Regulation 39, Annex I to *MARPOL Convention*

8.1.2.1.2 Each unit shall be equipped, as far as practicable, with systems for handling of oily bilge water and oil residues (sludge).

8.1.2.2 Operational records of oil operations in machinery spaces

8.1.2.2.1 Each *unit* shall be provided with the *Oil Record Book (ORB)* in the form developed by IMO.

8.1.2.2.2 In the *Oil Record Book* the records shall be kept concerning such operations as bunkering of fuel oil and lubricating oil as well as purifying, incineration or discharge of oil residues (sludge) and oily water.

8.1.2.3 Oil residues systems

8.1.2.3.1 *Units* shall be fitted with tanks for oil residues (sludge) of sufficient capacity, taking into account its machinery type and possibility and frequency of emptying these tanks. These tanks are intended for holding oil residues (sludge) which arise:

a. during filtering of oily bilge waters,
b. during centrifugation process of fuel oil and lubricating oil,
c. due to oil leakage from the devices and mechanisms,
d. due to dehydration of fuel oil and lubricating oil tanks,
e. during the replacement of used oils,

taking into account Unified Interpretation No 16 to Annex I to *MARPOL Convention* and guidelines contained in MEPC.l/Circ.642 of 12 November 2008, providing revised guidelines for handling of oil residues in the machinery spaces.

8.1.2.3.2 The arrangement of pipelines for handling of oily bilge water and oil residues (sludge) shall preclude direct overboard discharge, with the exception for the standard connection for the discharge of bilge water and oil residues as defined in regulation 13 of the Annex I to *MARPOL Convention*.

8.1.2.3.3 Each *unit* shall be fitted with a transfer pump and piping to transfer oil residues (sludge) between sludge tanks or for their incineration in incinerator/boiler, or discharge the oil residues by the standard discharge connection to floating reception facility.

8.1.2.3.4 The construction and equipment of tanks for oil residues on units delivered after 31 December 1979 as defined in regulation 1.28.2 of the Annex I to *MARPOL Convention*, shall be such as to enable cleaning and discharge of residues to floating reception facilities. The *units* delivered before that date shall comply with this requirement as far as reasonable and practicable.

8.1.2.4 Oily bilge water systems

8.1.2.4.1 The *units* shall be fitted with the filtering equipment (oil separator), which shall be of a design approved by the Administration, according to IMO requirements as described in paragraphs 1.7.1 and 1.7.2, Part *IX of the RSSSS*, and shall ensure that oil content in any oily mixture discharged into the sea after passing through this equipment without dilution will not exceed 15 ppm.

8.1.2.4.2 The oil filtering equipment mentioned in 8.1.2.4.1 shall be fitted with visual and audible alarm giving warning when the oil content in the oily mixture exceeds 15 ppm. The system shall also be fitted with an arrangement for automatically stopping any discharge of the oily mixture overboard. Stopping the discharge overboard of the effluent shall be achieved by way of switch-over of the valves, i.e. by closing the discharge valve and opening the return valve to the oily bilge water holding tank or to the bilges. Other arrangements are subject to PRS consideration in each particular case.

8.1.2.4.3 To fulfill the requirement for the effluent from oily water separator systems not to be diluted, the system used for cleaning and filling of the oily water separator and zero adjusting of 15 ppm alarm shall be designed taking account of the equipment manufacturer's recommendations and the revised guidelines for pollution prevention for machinery bilges specified in chapter 4.2.10.2 of IMO resolution MEPC.107(49).

8.1.2.4.4 It is recommended that *units* be fitted with fixed or detachable holding tank for oily bilge water of the capacity in accordance with the guidelines for handling oily wastes in machinery spaces contained in MEPC.l/Circ.642. The procedure for handling of oily bilge water is described in paragraph 8.1.1.5.

8.1.2.4.5 The bilge piping system of the *unit* shall be fitted with a pump to transfer the oily bilge water to the holding tank and emptying such a tank through the standard discharge connection fitted on the deck to floating reception facility or allowing suction of oily bilge water from the tank through the 15 ppm oil filtering equipment.

8.1.2.5 Handling of oil residues and oily bilge water from the machinery spaces

8.1.2.5.1 Procedures outside special areas as defined in Annex I to MARPOL Convention

Due to the fact that the *units* are not deemed to comply with provisions of the paragraph 15.2.1 of the Annex I to *MARPOL Convention* which require the ship to be "en route" to be allowed for discharge of oil or oily mixtures from machinery spaces to the sea outside special areas, the *units* may be exempted by the coastal State Administration from the compliance with the provisions of paragraph 15.2, provided the oily water and mixtures will be handled in the following way:

a. discharged directly to the shore reception facilities through the standard discharge connection; or
b. incinerated in the onboard incinerators[1)];
c. oily bilge water will be purified in the oil filtering equipment for oily formation and production water and discharged to the sea, provided the oil content in the oily mixture does not exceed 15 ppm in accordance with the requirements of regulation 34 of the Annex I to *MARPOL Convention*;
d. discharged it to the sea using filtering equipment 15 ppm after the exemption from the Administration has been granted from the "en route" discharge requirement;
e. added it to the flush of production water to the oil deposit; or
f. processed using a combination of the above methods.

8.1.2.5.2 Procedures in special areas as defined in Annex I to MARPOL Convention

Due to the fact that the stationary *units* are not deemed to comply with provisions of the paragraph 15.3.1 of the Annex I to *MARPOL Convention* which require the ship to be "en route" to be allowed for discharge of oil or oily mixtures from machinery spaces to the sea within special areas, the *units* may be exempted by the coastal State Administration, if it deems that no harm will be made to the environment as a result of such exemption, from the compliance with the provisions of paragraph 15.3, provided the oily water and mixtures will be handled in the same way as described in paragraph 8.1.2.5.1 above.

8.1.3 Requirements for the prevention of oil pollution by oily water due to ballasting of oil tank

8.1.3.1 General

In case of discharge of ballast water which is not a clean ballast in any oil fuel tank, such ballast water shall be handled according with regulation 16.2 of the Annex I to MARPOL Convention:

a. discharged to a floating reception facility; or
b. discharged into the sea after filtering by oil filtering equipment complying with the requirements of paragraphs 8.1.2.4.1 and 8.1.2.4.2.

8.1.4 Requirements for the prevention of sea pollution by oily production water

Discharges of production wastes such as production water shall be

- utilized by adding to crude oil extraction and separation process, or
- transferred to the floating reception facility, or
- discharged into the sea after filtering by oil filtering equipment complying with the requirements of paragraphs 8.1.2.4.1 and 8.1.2.4.2

Local and state regulations of the given coastal state Administration also apply[2)].

8.2 Requirements for the prevention of sea pollution by sewage

The *units* shall comply with the requirements concerning prevention of sea pollution by sewage in accordance with the provisions of paragraphs 4.1.4.1, 4.1.6 and 4.1.7 of the *RSSSS, Part IX – Environmental Protection.*

[1)] In accordance with Helsinki Convention provisions, on the Baltic Sea, in the internal or territory waters of the given coastal state, incineration including oil wastes is prohibited.

[2)] For the Baltic Sea area, requirements of Annex VI to *Helsinki Convention* apply.

8.3 Requirements for the prevention of sea pollution by garbage

The *units* shall comply with the requirements concerning prevention of sea pollution by garbage in accordance with the provisions of paragraphs: 5.1.1 (subject to conditions defined in regulation 5 of Annex V to *MARPOL 73/78 Convention*), 5.1.2 - 5.1.8, 5.2.1 and 5.2.2 of *RSSSS*, *Part IX*, as well as local and state regulations of the given coastal state[1)].

8.4 Requirements for the prevention of air pollution

8.4.1 The *units* shall comply with the requirements for the prevention of air pollution in accordance with the provisions of following paragraphs of *RSSSS, Part IX* in the scope and extent relevant to such *units*:

- **.1** Requirements for the prevention of emission of ozone depleting substances from refrigerating systems – para. 6.1;
- **.2** Requirements for the reduction of emission of nitrogen oxides **(**NO_X) from marine diesel engines – para. 6.2;
- **.3** Requirements for the reduction of emission of sulphur oxides **(**SO_X) and particulate matter (PM) – para. 6.3.

8.4.2 Emissions directly arising from the exploration, exploitation and associated offshore processing of sea-bed mineral resources according to article 2(3)(b)(ii) of *MARPOL Convention* exempted from compliance with the provisions of Annex VI to *MARPOL Convention*. Such emissions include:

- **.1** emissions resulting from the incineration of substances that are solely and directly the result of exploration, exploitation and associated offshore processing of sea-bed mineral resources, including but not limited to flaring of hydrocarbons and burning of cuttings, muds, and/or stimulation fluids during well completion and testing operations, and flaring arising from emergency conditions;
- **.2** the release of gases and volatile compounds entrained in drilling fluids and cuttings;
- **.3** emissions associated solely and directly with the treatment, handling, or storage of sea-bed minerals; and
- **.4** emissions from marine diesel engines that are solely dedicated to the exploration, exploitation and associated offshore processing of sea-bed mineral resources.

8.4.3 The requirements specified in the regulation 18 of Annex VI to *MARPOL Convention* may not be applied to hydrocarbons which are the product of exploitation and offshore processing if used on site as fuel, subject to approval by the Administration.

8.4.4 Permissible emissions from the gas turbines installed on the unit are subject to the requirements of local and national regulations of coastal State Administration.

[1)] In accordance with Helsinki Convention provisions, on the Baltic Sea, in the internal or territory waters of the given coastal state, incineration including garbage is prohibited.

9 LIFTING APPLIANCES

9.1 General

9.1.1 Construction of lifting appliances on open decks shall ensure their safe service in the intended working range and in the anticipated ambient temperatures.

Unless the customer has specified the interval of ambient temperatures, this shall be agreed by the design engineer with PRS. It is recommended that the interval be determined from –25° C to +45° C, and for electrical equipment from –25° C do +55° C.

9.1.2 Axes and pins supporting revolving assemblies and elements shall be effectively secured against revolution and axial displacement. The securing elements shall be so designed as not to be damaged by the reactive forces.

Guiding and running rollers installed on pins as well as fixed rope ends securing the rope to the structure shall be effectively secured against axial displacement. Securing elements which bear axial forces shall not be loaded by pin-born forces.

All points to be lubricated shall be so arranged as to make their service safe and convenient.

9.1.3 All screw joints, keyed joints and cotter joints of lifting appliances shall be secured against self-loosening and disconnection.

9.1.4 Interchangeable gear and loose gear shall be so secured as to avoid their bending or torsion this being achieved by the use of swivels. Swivels with ball bearings or roller bearings capable of being lubricated are permitted. Loaded swivels shall turn freely.

9.1.5 Arrangement of pulleys, blocks and the arrangements for rope fixing to the steel structure shall be such as to prevent ropes from falling off the pulleys or drums as well as rubbing against each other or the steel structure. Rope fixing arrangements shall be so designed as to withstand the maximum static proof load.

9.1.6 Rope ends fixed to the steel structure or to fittings may be provided with the following rope end fittings:
– braid rope plaited on a thimble;
– braid rope plaited on a thimble with its end gripped in pressed clamp;
– rope poured in a conical socket;
– rope fitted in a socket with self-locking wedge additionally fitted with at least one rope socket.

The rope end fittings shall comply with the standards recognized by PRS and their dimensions shall correspond to the rope diameter and breaking load. Cast and pressed joints may only be effected by workshops approved by PRS for such operations.

9.1.7 Ends of wire ropes which are fixed to winch drums ~~do not shall~~ need not be provided with thimbles or end terminations.

9.1.8 Cargo hooks, grab links and other load-handling devices underslung to a single runner shall be so installed as to enable their turning when loaded. It is recommended that rolling bearings be applied.

9.1.9 Design of mechanisms of lifting appliances with the drive capable of being disengaged shall preclude the fall of cargo and spontaneous motion of the lifting appliance or its movable components after the drive has been disengaged.

Mechanisms with hydraulic drive shall be provided with a means to preclude the fall of cargo and spontaneous motion of the lifting appliance or its movable components in case of the hydraulic oil pressure drop.

9.1.10 Lifting and luffing radius changing mechanisms shall be so designed that lowering the cargo or boom or jib at normal operation of the appliance be possible only by the use of its drive.

The lifting mechanism shall be provided with a means to safely lower and put the underslung cargo in case of the control unit failure or power failure.

9.2 Cranes

9.2.1 The present Chapter applies to cranes intended for loading, lifting and moving cargo, installed and operated on *units*.

9.2.2 Using cranes for personnel handling in baskets or equipment of similar design shall be considered by PRS on case-by-case basis.

9.2.3 Calculations

9.2.3.1 Calculations of cranes strength and stability shall be performed in accordance with the applicable requirements contained in par. 5.7.2*, of RSSSS, Part IV- Lifting appliances.*

9.2.4 Cranes design and equipment

9.2.4.1 Design and equipment of cranes shall comply with the requirements of par. *5.7.3, of RSSSS, Part IV - Lifting appliances.*

9.3 Lifts

9.3.1 All lifts installed and operated on *units*, intended for transport of personnel, personnel and cargo and exclusively for cargo with a single cabin (platform), travelling on, and guided by, rails and suspended on ropes, shall comply with the requirements of par. *6, of RSSSS, Part IV- Lifting Appliances.*

9.3.2 Lifts of other type shall be considered by PRS on case-by-case basis.

PART IX

Requirements for the issue of Safety Operation Certificate
(withdrawn)

PART X

Helideck

1 GENERAL PROVISIONS

1.1 Application scope and purpose

1.1.1 Part X of this *Publication* defines technical requirements for helicopter aerodromes (heliports) at the sea[1)], further referred to as helideck, located on production platforms – stationary offshore *units*, defined in 1.2.1 of Part I as *units* or *marine units*.

1.1.2 The requirements of Part X concern helidecks onboard *units* permanently positioned on international waters, within boundaries of the Polish exclusive economic zone, according to art. 2.1, item 3) of the act of 21 March 1991 on the maritime areas of the Republic of Poland and the maritime administration (Journal of Laws 2017.2205 uniform text of 29.11.2017, as further amended).

1.1.3 In accordance with the position of the Civil Aviation Authority (Letter ULC-LTL-1/511-0015/01/13 of 19.02.2013), the helideck referred to in 1.1.1 and 1.1.2 is not entered in the register of civil airports or landing areas[2)].

1.1.4 The purpose of technical requirements of Part X is the promotion of helicopter operational safety by ensuring compliance of helideck structure and technical equipment with the requirements of this Part, including applicable requirements of documents referred to in 1.2.

1.1.5 The requirements of next chapters, which correspond to applicable provisions and requirements of international legal documents referred to in 1.2, are affixed with their sources: abbreviation of the source document title (see 1.4.2) and the number of chapter/paragraph. Example: [Z14 – 3.3.3.a)].

1.1.6 The requirements not affixed with information in parentheses [ ] according to 1.1.5, are detailed extension of international requirements of legal documents referred to in 1.2.

1.1.7 After checking the compliance with technical requirements of Part X, the Polish Register of Shipping may issue *Helideck Facilities Compliance Certificate*, further referred to as *Helideck Certificate*, confirming the verification of compliance with the requirements of documents referred to in 1.2 and other requirements of this Part of *Publication*.

1.1.8 The *Helideck Certificate* constitutes the technical basis for helideck authorization by helicopter operator according to JAR-OPS 3.220.

1.2 International legal documents

The requirements of the below international legal documents apply to technical equipment of heliports located as referred to in 1.1.2.

1.2.1 Annex 14 to the *Convention on International Civil Aviation*. Aerodromes, Volume II, Heliports, Fourth Edition July 2013[3)]. ICAO.

1.2.2 Annex 6 to the *Convention on International Civil Aviation*. Operation of aircraft, Part III – International operations – Helicopters, Annex A, Chapter 4: Helicopter performance and operating limitations.

1.2.3 Joint Aviation Requirements. JAR-OPS 3 Commercial Air Transportation (Helicopters). JAR-OPS 3.220; AMC No 2 to OPS 3.220 (Authorization of Heliports by the operator).

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1) A heliport, referred to in 1.1, is not an aerodrome in understanding of the Polish Act of 6 July 2002 „Aviation law”.

2) The same as in the British shelf of the North Sea, the helidecks are treated as „unlicensed landing areas”.

3) Basic technical requirements of Part X (with affixed source) correspond to the requirements covered by current issue of Annex 14 – July 2013 (English version). The Polish terminology used in Part X is according to the Polish issue of Annex 14 (July 2009).

1.3 Legal and technical documents for reference

In 1.3, titles are given of selected rules, recommendations and other materials used for information and comparison purposes, formally not binding on the Polish maritime areas.

1.3.1 Annex 14 to the Convention on the International Civil Aviation. Heliports, Volume I – Aerodrome Design and Operations.

1.3.2 Heliport Manual, Doc. 9261 – AN/903 ICAO.

1.3.3 CAP 437 Offshore Helicopter Landing Areas – Guidance on Standards, Civil Aviation Authority (UK).

1.3.4 Offshore Helideck Design Guidelines, Health & Safety Executive (UK).

1.3.5 NORSOK Standard C-004 – Helicopter Deck on Offshore Installations.

1.3.6 Ministry of National Defence – Defence Standard NO-19-A206:2009 Okręty i pomocnicze jednostki pływające marynarki wojennej, okrętowa infrastruktura lotnicza, wymagania. (Naval ships and auxiliary floating *units* of the Navy, shipboard aviation infrastructure, requirements)

1.3.7 Prevention of Fire and Explosion, and Emergency Response on Offshore Installation, Health & Safety Executive (UK).

1.4 Terms and abbreviations

Valid general terms are given in *Part I – Survey Regulations*. The below terms pertain to the subject of this Part of *Publication*.

1.4.1 Terms

D value – the largest overall dimension of the helicopter when rotor(s) are turning measured from the most forward position of the main rotor tip path plane to the most rearward position of the tail rotor tip path plane or helicopter structure (See Table 3.2)

Landing area – the area intended for the touch-down and parking of helicopter and the supporting structure.

Helideck – A helicopter areodrome (heliport) located on an offshore facility such as production *unit* used for the exploitation of oil or gas [Z14 – 1.1], further called helideck. The above term means the landing area and its equipment covered with the requirements of chapters 4 to 7.

Operator – the *unit* operator.

Air Operator – the organization, entity or person independent from the *unit* operator or separate organizational structure of the *unit* operator having at disposal a helicopter/helicopters and executing air operations for the benefit of the *unit*, having Air Operator's Certificate (AOC) complying with Annex 6 to *Convention on International Civil Aviation* (see 1.2.2).

Obstacles – [Z14 – 1.1] all immobile (whether temporary or permanent) or mobile objects or their parts, which:
- are located on an area intended for the surface movement of aircraft; or
- extend above a defined surface intended to protect aircraft in flight; or
- stand outside those defined surfaces and that have been assessed as being a hazard to air navigation.

Final Approach and Take-Off Area (FATO) [Z14 – 1.1] –a defined area over which the final phase of the approach manoeuvre to hover or landing is completed and from which the take-off manoeuvre is commenced.

Touchdown and Lift-Off Area (TLOF) – an area on which a helicopter may touch down or lift off [Z14 – 1.1].

Helideck Certificate – the certificate of helideck facilities compliance issued by PRS for the *unit*.

1.4.2 Abbreviations

AOC – Air Operator's Certificate.

ASPSL – Array of Segmented Point Source Lighting.

CAP 437 – document CAP 437 Offshore Helicopter Landing Areas – Guidance on Standards, Civil Aviation Authority (UK)

FATO – Final Approach and Take-Off Area.

HAPI – Helicopter Approach Path Indicator.

HLO – Helicopter Landing Officer.

IMC – Instrument Meteorological Conditions.

JAR – Joint Aviation Requirements. JAR-OPS 3 Commercial Air Transportation (Helicopters).

LOS – Limited Obstacle Sector – radial sector 150^{o} in the vicinity of the landing area, within which limited height obstacles are acceptable.

LP – Luminescent Panel.

MTOM – Maximum Take-Off Mass.

TLOF – Touchdown and Lift-Off Area.

UKE – Urząd Komunikacji Elektronicznej (Office of Electronic Communications).

ULC – Urząd Lotnictwa Cywilnego (Civil Aviation Authority).

VMC – Visual Meteorological Conditions.

Z 14 – ICAO, Annex 14 to the *Convention on International Civil Aviation*, Volume II, Heliports, Fourth Edition July 2013.

1.5 Technical documentation

1.5.1 Documentation of the constructed helideck

1.5.1.1 For the purpose of the issue of *Helideck Certificate*, the documents referred to in paragraphs 1.5.1.2 to 1.5.1.16 shall be submitted to Polish Register of Shipping for consideration.

1.5.1.2 Basic data of the helideck location:
– the name,
– geographical location,
– height above the sea level (elevation).

1.5.1.3 Description of the anticipated use of the helideck, including:
– types and Maximum Take-off Mass (MTOM) of helicopters landing on the *unit*,
– anticipated meteorological conditions (minima), at which helicopter landings and take-offs will be performed.

1.5.1.4 Drawings of the location of the landing area onboard the *unit*, with indication of distances to the obstacles, as well as indication and location of hot gas emission sources and structures causing turbulences at the landing area and approach paths thereto. Position of the platform related to geographical directions shall be shown and prevalent wind directions and speed rates indicated.

1.5.1.5 Dimensional drawing of the helideck including safety nets and entry/exit and escape routes.

1.5.1.6 Drawings of obstacles and obstacle free areas above and below the helideck level, including dimensions.

1.5.1.7 Drawing of the landing area marking and lighting.

1.5.1.8 Drawing of obstacles color marking and lighting.

1.5.1.9 Scheme of helideck and obstacles lighting system.

1.5.1.10 Design drawing of helideck, including drainage system, helicopter securing deck fittings, entry/exit and escape routes, safety nets and platforms; technology of anti-slip coating laying.

1.5.1.11 Documentation of load-bearing structure of landing area:
– design drawings,
– strength calculations.

1.5.1.12 Specification and arrangement of fire-fighting and life-saving equipment.

1.5.1.13 Specification and arrangement of the machinery and equipment for deck operations.

1.5.1.14 Specification of communication and radio-navigation equipment.

1.5.1.15 Specification of meteorological observations equipment.

1.5.1.16 Specification of electric supply for the helideck stationary communication, radio-navigation and meteorological observations equipment.

1.5.2 Documentation of the helideck in service

1.5.2.1 The scope of the documentation of the helideck in service, submitted to Polish Register of Shipping for consideration for the issue of Helideck Certificate shall be in accordance with 1.5.1. The documentation shall also include photographs of the landing area and obstacles, in particular the photographs made from directions of typical landing approach of helicopter.

1.5.2.2 Some drawings referred to in 1.5.1 may be, upon agreement with PRS, replaced with photographs (principal dimensions being given).

1.5.2.3 Enclosing remarks or technical opinions of the air operator concerning the properties of the given helideck is recommended.

1.5.3 Instructive documentation – helideck manual

1.5.3.1 The helideck manual shall include drawings, diagrams and lists referred to in 1.5.1, with a possible exception in 1.5.1.11. It is recommended that the whole documentation should be in A4 format. The instructive documentation shall also include instructions according to 1.5.3.2 to 1.5.3.5.

1.5.3.2 Helideck operation manual, including:
– instructions for communications with the aircraft,
– instructions for informing the aircraft on meteo conditions,
– instructions for inspections of landing area and maintenance of proper condition of the landing area surface for air operations,
– instructions for the operation of landing area and obstacles lighting,
– instructions for preparing passengers for taking seats in helicopter and their embarking therein.

1.5.3.3 Fire-fighting instructions.

1.5.3.4 Emergency instructions.

1.5.3.5 Instructions for the operation and maintenance of helicopter landing area systems and other helideck installations.

1.6 Information for Air Operator

Information for air operator shall cover data mentioned in 1.6.1 and 1.6.2, in the form of concise records, sketches and photographs.

1.6.1 Identification data of helideck:
– Operator – name, address, phone No., etc.
– helideck name (e.g. „Baltic Beta"),
– call sign rtf (e.g. „Baltic Beta" or other assigned to radiostation, referred to in 7.2.2),
– assigned frequency VHF,
– identification marking on the landing area (drawing or photo),
– marking on the sides of the *unit* pontoon.

1.6.2 Basic data of helideck:
– helideck geographical coordinates,
– situation of the landing area in relation to true north,
– helideck elevation (height above sea level),
– the greatest height of obstacles above the sea level.
– helideck type – permanent, manned/unmanned,
– „D" value and maximum MTOM value of the helideck,
– landing area dimensions, friction coefficient.
– arrangement of landing area and obstacles (including drilling derrick, flares, cranes, exhaust gas and cold blowouts gas outlets, windsock, etc) onboard the *unit*,
– obstacle free sectors (sector 210º boundaries shall be described in relation to true north), marking and lighting of obstacles,
– marking and lighting of landing area,
– entry/exit and evacuation routes,
– fire-fighting and emergency equipment.

2 ARRANGEMENT OF LANDING AREA ON THE *UNIT*

2.1 Phenomena caused by wind flow around platform structures and gas emission

2.1.1 Turbulence and local differences and changes of air temperatures are the phenomena having negative effect on the safety of air operations on the *unit*. The phenomena are result of wind flow around the platform structures and of hot gas emissions (e.g. exhaust gas outflow from gas turbine or internal combustion engines).

2.1.2 Magnitude of turbulence caused by wind flow around the platform structures and hot gas emissions, in particular turbulences in the vicinity of landing area, on helicopter approach paths and in take-off regions, shall be assessed. The assessment shall be performed for all wind directions and velocities and for different conditions of production systems. The condition of normal operation of power turbine, as well as transitional conditions such as Process Shutdown (PSD) or Emergency Shutdown (ESD) of production systems, shall be considered, taking into account combustion of process gases in the flare and/or cold blowouts.

2.1.3 The cold gas emission should not lead to gas concentration exceeding 10% of the low explosion level at places where helicopter may be present.

2.1.4 It is recommended to use numerical criteria for permissible variability of temperatures and air velocity, according to CAP 437 Ch. 2 – 2.3.

2.2 Location of landing area onboard the *unit*

2.2.1 General

The location and design of the landing area shall ensure:

- adequate clearance of helicopter rotors, hull and undercarriage from the obstacles during approach to landing, landing, start and take-off;
- possible small turbulence and small air temperature differences at helicopter approach path, landing and departure path, at all meteorological conditions within limits defined in the Certificate;
- the surface around the touch-down area sufficient for safe movement of passengers and crew;
- safe exits from the landing area in normal service and in emergency cases.

2.2.2 Recommended landing area locations onboard the *unit*

2.2.2.1 It is recommended that the *unit* should be so positioned in the sea bed that at the prevalent wind directions the turbulence present behind the objects on the platform and hot gas streams do not interfere with the helicopter landing approach path. That means that on the Baltic Sea, the landing area (extended beyond the platform hull) shall be situated south to west of the platform centre.

2.2.2.2 Where execution of the recommendation in 2.2.2.1 is not practicable, adoption of more restrictive operating rules for the helideck may be necessary, at defined wind directions and velocity.

3 LANDING AREA DIMENSIONS

3.1 The landing area shall include one FATO zone and one coincident or collocated TLOF zone [Z14 – 3.3.2].

3.2 A FATO may be any shape but shall be of sufficient size to contain an area within which can be accommodated a circle of diameter of not less than 1 D of the largest helicopter[1)] the helideck is intended to serve [Z14 – 3.3.3].

Table 3.2
Helicopter dimensions and mass

Type	*D* [m]	Perimeter *D* marking	Main rotor diameter [m]	MTOM [kg]	Permitted MTOM
1	2	3	4	5	6
Bolkow Bo 105D	12	12	9.9	2400	2.4t
EC 135 T2+	12.2	12	10.2	2910	2.9t
Bolkow 117	13	13	11	3200	3.2t
Agusta A109	13.05	13	11	2600	2.6t
Dauphin AS365 N2	13.68	14	11.93	4250	4.3t
Dauphin AS365 N3	13.73	14	11.94	4300	4.3t
EC 155B1	14.3	14	12.6	4850	4.9t
Sikorsky S76	16	16	13.4	5307	5.3t
Agusta/Westland AW 139	16.66	17	13.8	6400	6.4t
Bell 412	17.13	17	14.02	5397	5.4t
Bell 212	17.46	17	14,63	5080	5.1t
Super Puma AS332L	18.7	19	15.6	8599	8.6t
Bell 214ST	18.95	19	15.85	7936	8.0t
Super Puma AS332L2	19.5	20	16.2	9300	9.3t
EC 225	19.5	20	16.2	11 000	11.0t
Sikorsky S92	20.88	21	17.17	12 020	12.0t
Sikorsky S61N	22.2	22	18.9	9298	9.3t
EH 101	22.8	23	18.6	14 600	14.6t

Notes:
– at design of new, or reconstruction of, landing area, it is recommended to check at the manufacturers the dimensions and masses of currently manufactured helicopter versions; generally the new versions are bigger and heavier than the old ones,
– columns 3 and 6 include markings painted on the landing area acc. to 5.6.2.2 and 5.6.2.3.

3.3 The TLOF zone may have any shape, however, it shall have sufficient size to accommodate:
– for helicopters with an MTOM of 3 175 kg or less, an area within which can be accommodated a circle of diameter not less than 0.83 *D* of the largest helicopter the helideck is intended to serve [Z14 – 3.3.4b)];
– for helicopters with an MTOM of more than 3 175 kg, an area within which can be accommodated a circle of diameter not less than 1 *D* of the largest helicopter[2)] the helideck is intended to serve [Z14 – 3.3.4a)]

3.4 It is recommended for helicopters with a MTOM of 3 175 kg or less, that the TLOF should be of sufficient size to contain an area within which can be accommodated a circle of diameter of not less than 1 *D* of the largest helicopter the helideck is intended to serve [Z14 – 3.3.5)].

[1)] It applies to helicopters with one main rotor
[2)] It applies to helicopters with one main rotor

4 OBSTACLE FREE AREAS, MARKING AND LIGHTING OBSTACLES

4.1 Obstacle free areas at or above the landing area level

4.1.1 The TLOF zone on the landing area shall be completely free from obstacles. Objects whose function requires them to be located within the TLOF (such as lighting) shall not exceed a height of 2.5 cm. Such objects shall only be present if they do not represent a hazard to helicopters [Z14 – 3.3.14].

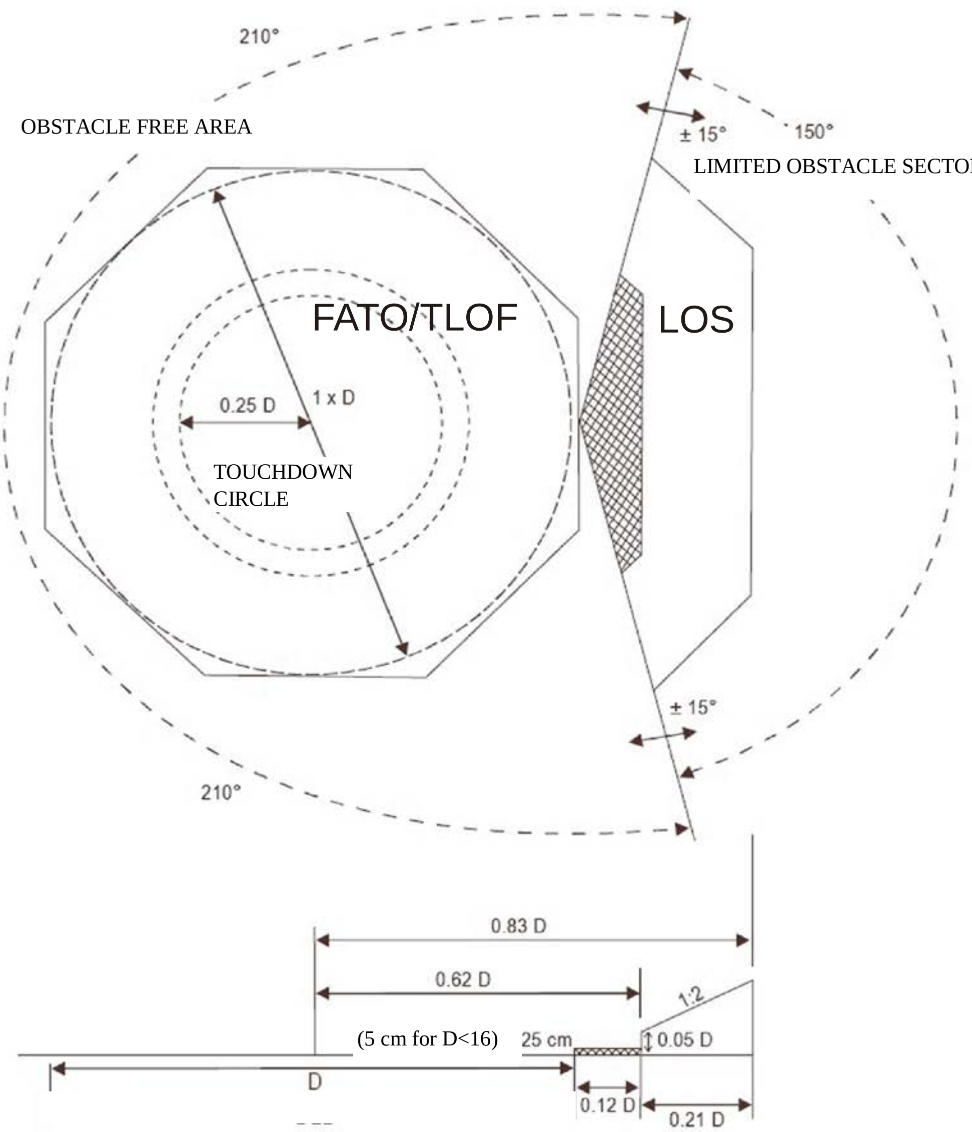

Fig. 4.1-1. Free obstacle area and limited obstacle sector (LOS). TLOF diameter 1*D*

4.1.2 Safety nets located around the landing area[1], shall not extend above the helideck [Z14 – 3.3.15].

4.1.3 The obstacle free area for helicopter approach and take-off shall cover the whole final approach and take off (FATO) area and extend in at least 210° radial sector, the tip of which is situated at the perimeter of the circle of diameter D, to the distance ensuring undisturbed straight ascent of helicopters the landing area is intended to serve[2]. The obstacle free area bounds the limited obstacle sector (LOS) [Z14 – 4.1.22 ÷ 26] – see Figs. 4.1-1 and 4.1-2.

[1] Applicable to landing areas constructed after 1 January 2012.

[2] For helicopters of performance class 1 or 2, the case of flight with one disabled engine shall be considered.

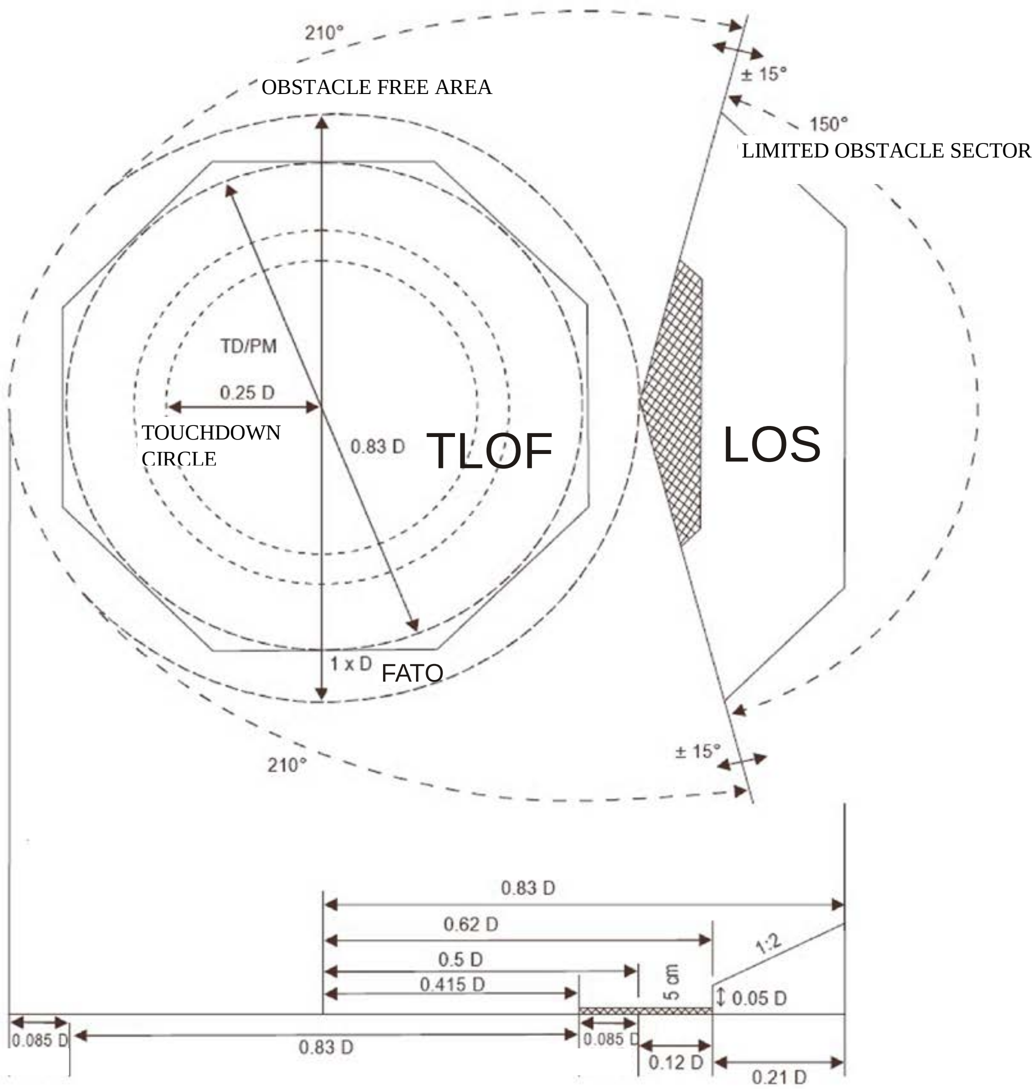

Fig. 4.1-2. Free obstacle area and limited obstacle sector (LOS). TLOF diameter at least 0.83*D*

4.1.4 Beyond the TLOF, installation of necessary objects (such as lighting) is permitted, provided their structure is easy to be broken and the maximum elevation is:

– 25 cm – for the TLOF designed for helicopters of *D* more than 16 m [Z14 – 3.3.11];
– 5 cm – for the TLOF designed for helicopters of *D* not more than 16 m, as well as in each case when the TLOF area is reduced according to 3.3 [Z14 – 3.3.12, 3.3.13].

4.2 The obstacle free areas below the level of the landing area [Z14 – 4.2.12, 4.2.14]

4.2.1 In the vicinity of the landing area, below its level, helicopters operation shall be undisturbed by obstacles.

4.2.2 In the immediate vicinity of the helideck, in the space bounded by planes passing external edges of the TLOF (including safety nets), obstacle protection for helicopters shall be provided below the helideck level. This protection shall extend over an arc of at least 180 degrees (measured horizontally), with a descending gradient having a ratio of one unit horizontally to five units vertically from the edges of the FATO within the 180-degree sector, see Fig. 4.2.

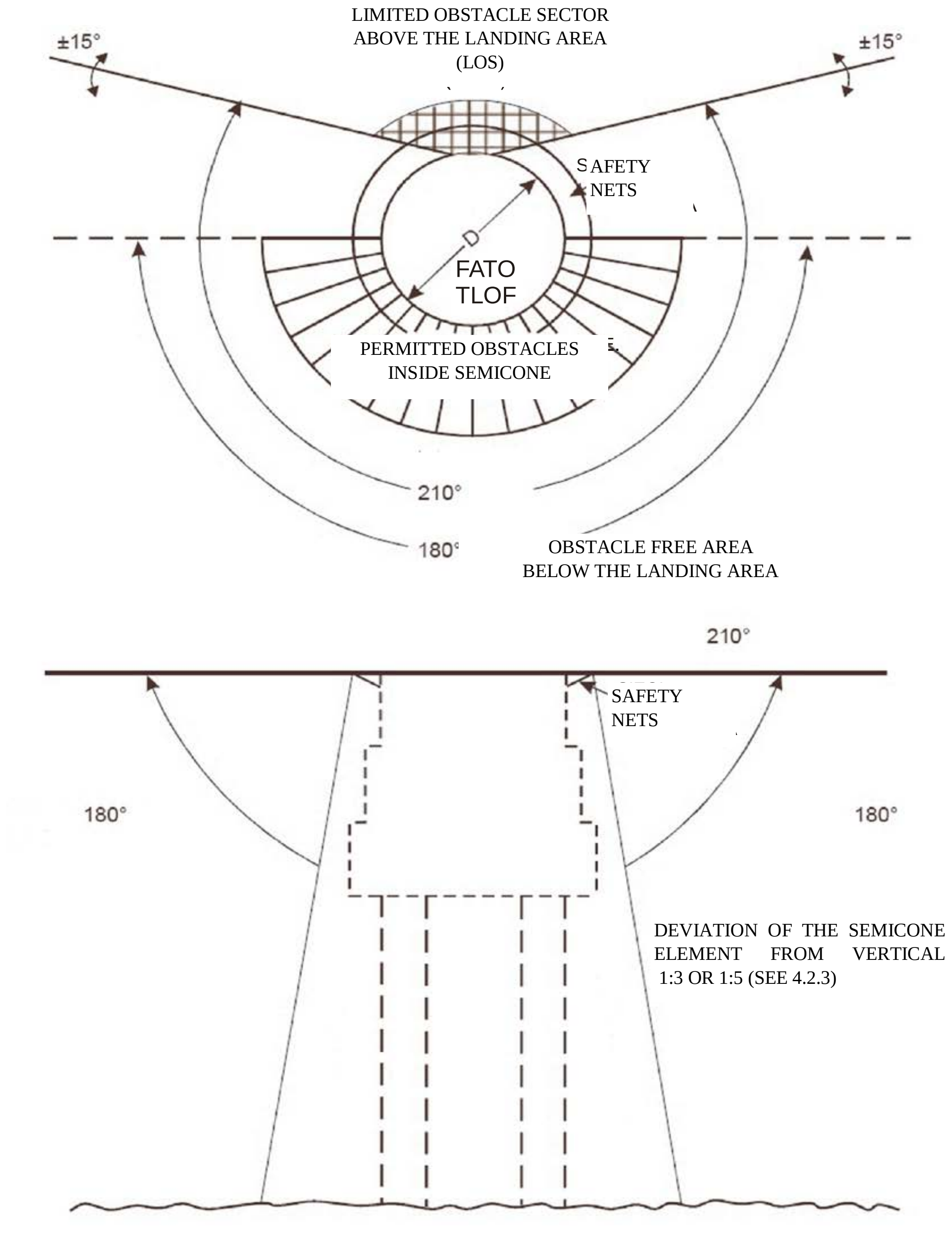

Fig. 4.2. Obstacle free areas below the landing area level

4.2.3 The descending gradient referred to in 4.2.2 may be reduced to a ratio of one unit horizontally to three units vertically within the 180-degree sector for multi-engine helicopters operated in performance class 1 or 2.

4.2.4 Ships and other floating and stationary objects, which aid the *unit* operation, shall not be present in places where they could impair the safety of helicopter take-off or landing on the *unit*.

4.3 Marking the obstacles

4.3.1 Permanent obstacles which could impair the safety of helicopter operation shall be well visible from above. They shall be painted in stripes 0.5 to 6 meters wide, black and white, black and yellow, or red and white. The colors shall contrast as far as possible with the surroundings.

4.3.2 Color marking according to 4.3.1 shall be applied among the others to drilling derrick, flare, crane jibs located in the vicinity of landing area, *unit* supports in the above-water part. The color marking according to 4.3.1 (black-white or black-silver) is recommended for gas turbine exhaust funnels even if it is not an obstacle in the meaning of chapter 3.

4.3.3 Appropriate color marking according to Annex 14 to the *Convention of International Civil Aviation*, Aerodromes, Volume I – Aerodrome design and operations, Chapter 6, may be used.

4.4 Lighting of obstacles

4.4.1 The *unit* structures and objects which may pose hazard to helicopters in the night or at poor visibility shall be marked with low-intensity obstacle lights of type A, in accordance with Annex 14 to the *Convention of International Civil Aviation,* Aerodromes, Volume I – Aerodrome design and operations, Chapter 6. Lighting shall be applied to:
– drilling derrick,
– flare,
– aerial masts,
– gas turbine exhaust funnel,
– platform legs (above the landing area level),
– crane jibs and columns,
– other obstacles in the vicinity of landing area (FATO) and the boundary of limited obstacle sector (LOS).

4.4.2 A type B low-intensity obstacle light shall be installed on the tallest structure of the *unit*. Where legs are the tallest structures of the *unit*, the light shall be placed on each of them.

4.4.3 A type A low-intensity obstacle lights shall be installed at intermediate levels on the objects of height above 15 m, spaced about 10 m.

4.4.4 The obstacle lights shall be visible from the helicopter approaching the *unit* and landing in each direction applicable on the given helideck.

4.4.5 Instead of obstacle lights, illumination of an obstacle is allowed to be used, provided that this ensures better identification of the obstacle and does not blind the pilot.

4.4.6 A reserve energy source on the *unit* shall have capacity sufficient to continuous (UPS) supply, in addition to other required consumers, all obstacle lights.

5 LANDING AREA DESIGN AND EQUIPMENT

5.1 Strength of deck and landing area supporting structure

5.1.1 General

The size and strength of the landing area shall be adapted to the biggest and heaviest maximum take-off mass (MTOM) of the helicopter which can be served on the landing area.

5.1.2 Strength issues

5.1.2.1 The strength calculations of the helideck and supporting structure shall be performed according to 8.8.3 of *Part II – Hull* of the *PRS Rules for the Classification and Construction of Sea-going Ships*.

5.1.2.2 The loads shall be adopted according to 8.8.2 of *Part II – Hull* of the *PRS Rules for the Classification and Construction of Sea-going Ships*.

5.1.2.3 Additionally, at emergency touch-down of helicopter, variable loads (acting non-simultaneously) shall be taken into account, considering simultaneous permanent loads and environmental loads.

Variable loads:

- locally applied loads (by main wheels of helicopter), forces of value given by the helicopter manufacturer, which cause the undercarriage destruction[1)];
- surface distributed force of (recommended) value equal to 2.5 × MTOM;
- horizontal force of value equal to 0.5 MTOM, applied at two points (through the main wheels of helicopter).

Permanent loads: weight of landing area and its equipment.

Environmental loads: due to wind, snow, ice.

5.1.2.4 The loads referred to in 5.1.2.3 may result in local deformations of the landing area deck and stiffeners, however, the basic function of the landing area shall be maintained.

5.1.2.5 Where designated TLOF area is lower than FATO area, verification of strength under variable loads may be limited to TLOF area [Z14 – 3.3.8].

5.1.2.6 If below the landing area manned spaces or machinery whose damage could be hazardous are located, the acceptance of documentation for the strength of landing area and beneath structures and for resistance to effects of possible accidents related to helicopter operations shall be specially considered by PRS.

5.1.2.7 Checking the strength of landing area according to loads specified in Heliport Manual[2)], para. 1.3.2, is recommended.

5.2 Landing area surface

5.2.1 Design of the landing area

5.2.1.1 The surface of landing area, at least within TLOF, shall provide ground effect [Z14 – 3.3.9].

Comment*: it means that the plating of helideck shall not be an openwork surface; if the external surface of the deck, e.g. consisting of extruded panels, is an openwork, the plating underneath shall be uniform.*

5.2.1.2 Landing area shall be arranged to ensure that a sufficient and unobstructed air-gap below is provided, which encompasses the full dimensions of the FATO, of recommended height at least 3 m, [Z14 – 3.3.6].

[1)] Where no detailed information is available on the types of helicopters and/or on the forces which cause the undercarriage destruction, the loads according to Helideck manual, 1.3.2, Tables 1-2, 1-3 (case A) shall be applied. Methods of calculations in 5.1.2.1 of this Part X is not applicable to this case.

[2)] Requirements of 5.1.2.1 and 5.1.2.2 of this Annex do not apply to the calculation.

5.2.2 Landing area surface drainage

5.2.2.1 The landing area shall be equipped with means to remove rain water, spilled fuel and fire-extinguishing agents from its surface, as well as their drainage to relevant sewage system.

5.2.2.2 A descending gradient about 1:100 from the centre of landing area shall be provided. A sewer or low framing (see 4.1.4) leading the liquid from deck to sewage system shall be provided.

Where the deck external surface, e.g. consisting of extruded panels, is an openwork, the required slope, sewer and framing shall be provided for a uniform plating of helideck below the openwork external surface.

5.2.2.3 The means referred to in 5.2.2.1 and 5.2.2.2 shall ensure drainage of oil spill of the greatest volume which can be expected in case of used types of helicopters.

5.2.3 Earthing clamps

Clamps shall be installed onboard for connecting earthing wires to the equipment used for neutralization of electrostatic loads and for bunkering.

5.2.4 Anti-slip surface

5.2.4.1 Convention requirements [Z14 – 3.3.16]

The surface of the TLOF shall be anti-slip to both helicopters and persons and be sloped to prevent pooling of water.

5.2.4.2 Friction coefficient

The helideck shall be covered with anti-slip coating ensuring maintaining adequate friction coefficient, also for the water flooded or oily surface.

The coating type and its application technology shall ensure maintaining, for at least 3 years, the coating integrity and minimum values of the friction coefficient. It shall be confirmed with relevant certificate for the coating type.

The minimum values of the friction coefficient, measured in samples, shall amount to:

– for a new, watered surface	0.7
– for a new, oily surface	0.3
– for a watered surface in service	0.6
– for an oily surface in service	0.2.

5.2.4.3 Minimum friction coefficient measured on the helideck surface

The value of the friction coefficient for wet (watered) helideck surface for all directions and places, in particular in touch-down region and in regions of helicopters taxiing and parking, measured with the use of an instrument shown in Fig. 5.2.5, shall be not less than 0.6.

The *unit* Operator shall ensure removal of snow and ice, as well as any impurities such as oils, lubricants, bird excrements, debris, from the surface of the landing area.

5.2.5 Checking the helideck anti-skid properties

5.2.5.1 Measurement of the friction coefficient

The measurement of the friction coefficient on the helideck surface shall be performed in the following cases:

- after the first anti-slip coating has been laid,
- after skid-resistant coating replacement,
- in case of any doubts regarding the coating performance,
- before the issue, extension and annual confirmation of the Helideck Certificate.

5.2.5.2 Instrument for the measurement of the friction coefficient on the helideck surface

The instrument block is a cuboid of the base dimensions 150 mm × 150 mm and height 100 mm, made of relatively heavy metal, with two grips affixed to adjacent sides, with drilled holes for dynamometer fixing.

The instrument element made of air rubber tyre has the following properties: Shore hardness A-50, thickness ca. 5 mm. It has cut (blunt) edges and is attached at the block bottom.

The mass of the whole set amounts to ca. 20 kg. The exact mass of the block with the tyre shall be durably marked (e.g. punched) on the visible metal surface. Provision of handles for lifting the block is recommended.

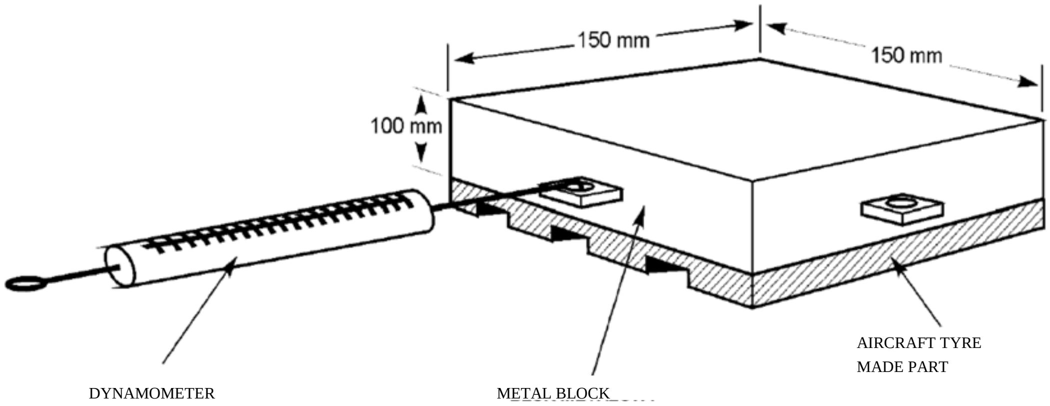

Fig. 5.2.5. Instrument for measuring the friction coefficient on landing area

5.2.5.3 The method of measuring the friction coefficient with the use of the instrument shown on Fig. 5.2.5:
- connect the dynamometer as shown in Fig. 5.2.5;
- pull the instrument at directions corresponding to typical directions of helicopter touch-down, and note down readings every 1.5 m when the instrument moves with uniform rate on helideck, the dynamometer being maintained parallel to the deck;
- connect the dynamometer to the second side of the instrument and pull it transversely to directions mentioned above;
- divide the value of the noted down force by the instrument weight.

5.2.6 Use of nets on the helideck surface (optional), limitations

5.2.6.1 The use of nets on the stationary *unit* helideck surface is required when the skid-resistant surface does not comply with the conditions given in 5.2.5.

5.2.6.2 The sisal rope net (recommended material) with eye dimension not exceeding 200 mm, shall be attached every 1.5 m around the perimeter and tighten by force at least 2.25 kN. By forceful move of hand the net shall not locally raise by more than 25 cm above the deck.

5.2.6.3 Nets are not allowed to be used at operations of helicopters with skid-type undercarriage.

5.3 Helicopter securing deck fittings

5.3.1 Arrangement of fittings

The helicopter securing deck fittings shall be installed in the touch-down region and parking area (if outside TLOF). The arrangement of fittings shall be appropriate for the helicopter type, the landing area is intended to serve.

5.3.2 Fitting design

Fittings shall be recessed, with transverse pin of diameter not exceeding 22 mm or cross-shaped, appropriate for air hook of securing equipment, e.g. according to the Standard NO-07-A025:2003, Fig. B.2. The fitting shape shall facilitate their dewatering (by compressed air) and deicing. It is recommended that the fitting body should be of bowl shape, not cylindrical.

5.3.3 Checking the securing deck fitting strength

All fittings after their installation onboard the *unit* are subject to weld examination by non-destructive methods (e.g. with liquid penetrant or magnetic particle method).

After fittings installation onboard and before the issue of Helideck Certificate, all fittings shall be tested for strength, with a force 45 kN, directed vertically upwards, exerted for 3 minutes.

5.4 Safety nets

5.4.1 Technical characteristics

The helideck boundaries shall be provided with fixed or lifted safety nets, spread on tubular frames, complying with the below requirements:

Elevation above the deck plane	–	0 [1)]
Dimensions of a net segment, in spread position, measured from deck and side	–	Width min. 1.5 m, at the frame slope 1:10
Length of net segment frame	–	Min. 2 m
Gap between adjacent frames	–	Less than 100 mm, recommended to be as low as possible; spaces between the frames which cannot comply with the requirement, shall be filled with the net.
Material and recommended pipe diameter	–	Aluminium alloy or steel, 120 mm.
Attachment of frame pins on the side	–	Up to 0.3 m below the deck plane.
Filling the frame	–	Elastic net of eye size 80 mm, made from woven stripes or ropes from flame-retardant synthetic fibre (e.g. polypropylene); the net shall not be tight – it should not spring-back; filling the frames with steel rope net is allowed.
Net strength	–	2 kN/m^2.

The lifted nets shall additionally fulfil the following requirements:

Change of net position	–	It is recommended that the nets should be laid and lifted mechanically by means of electric or hydraulic servomotors, centrally controlled. The segment of manually laid and lifted nets shall enable its laying, lifting and securing by one or two persons; forces allowable at manual works shall not be exceeded. The same condition shall be fulfilled by mechanically laid and lifted nets which are laid and lifted manually in emergency conditions.
Elevation above the deck plane in lifted position	–	Min. 1.2 m

5.4.2 Checking net strength

Test load of the laid segment, static	–	By mass of 455 kg for 10 min.

[1)] Valid for the landing area constructed after 1 January 2012. On landing areas constructed before that date – up to 100 mm.

Test load of the laid segment, dynamic	–	By mass of 100 kg dropped from the height of 1 m to the net centre.

The strength of the safety net filled with synthetic fibre ropes or stripes shall be examined by test load once a year. The strength of steel rope nets shall be examined at least every three years.

5.5 Access ways, escape ways

5.5.1 General

5.5.1.1 The arrangement of the helicopter landing area access and exit ways shall take into account the requirement that passengers should not walk around the helicopter tail rotor and in front of the helicopter nose (with low located main rotor). Various anticipated directions of helicopter touch-down shall be considered.

5.5.1.2 At least two landing area access/exit ways shall be ensured.

5.5.1.3 An evacuation analysis shall be prepared for the case of a catastrophic accident or fire on the landing area. Provision of third escape way may be necessary due to the fact that in case of fire the escape upwind is most safe.

5.5.2 Landing area access and exit ways

5.5.2.1 The landing area access and exit ways shall provide:
- safe, possibly short and straight route between the landing area and the room on the *unit*, dedicated for the needs of helideck operation,
- comfortable stairs (ladders are not accepted on the normal access way) and handrails,
- the possibility of closing the access of unauthorized persons to the helideck,
- the possibility of checking the identity of helicopter boarding and unboarding persons with the list,
- the possibility of transporting fire-fighting, emergency and medical equipment (stretchers).

5.5.2.2 The end segments of the handrails at stairs leading to helideck shall be laid horizontally and secured so that they don’t constitute an obstacle on the landing area (see 4.1). The segments shall be lifted and secured for the time of the passage of passengers. The segments shall be painted according to 4.3.

5.5.2.3 In front of the entrance to the landing area, durable and clearly visible warning plates shall be placed, prohibiting the entry of unauthorized persons and to warn of the helicopter tail rotor and of the helicopter with active (flashing) anti-collision light.

5.5.3 Escape ways

5.5.3.1 At least two escape ways from the landing area shall be ensured. If they are at once access ways, referred to in 5.5.2, provision of a third way as an escape way is recommended. Ladders may be installed on such way.

5.5.3.2 The escape way shall ensure the possibility of quick abandonment of helideck and descent below the deck level.

5.5.3.3 The arrangement of escape ways shall not compromise any rescue action on the landing area.

5.5.3.4 The arrangement of escape ways shall take into consideration a disturbed escape due to action of fire-extinguishing equipment (foam monitor, hydrants).

5.6 Colors and markings on the landing area

5.6.1 Wind direction indicator (windsock)

The wind direction indicator shall be installed in such place that it indicates real wind direction, undisturbed by local obstacles. The indicator shall be well visible from the helicopter. At night the indicator shall be lighted.

5.6.2 Basic lighting of the landing area

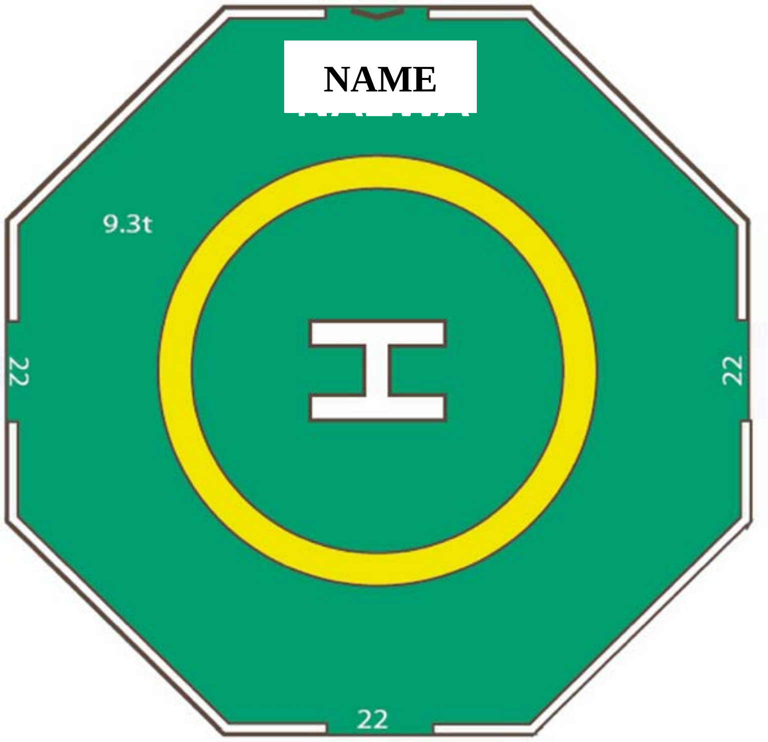

Fig. 5.6.2. Basic marking of landing area (example – octagonal landing area)

5.6.2.1 A helideck shall have anti-slip coating of dark, recommended dark green color.

5.6.2.2 The helideck boundaries shall be marked with white line, 30 cm in width. In the white line information shall be inserted on *D* value for the landing area (see Fig. 5.6.2). The information shall use integer number. Letters shall be white and about 90 cm high.

5.6.2.3 Information on the helicopter maximum take-off mass (MTOM) on the given landing area shall be placed in visible place for the pilot approaching to land in typical direction. The information shall be expressed by two- or three digital number, which reflects the helicopter mass in tons, rounded up to 100 kg. Letters shall be white and 12 cm high. At the end of the number, letter *t* shall be placed.

5.6.2.4 The place where the limited obstacle sector (LOS) begins in the sector of 150° shall be marked in the landing area – see Fig. 5.6.2.4. The mark indicating LOS beginning and boundaries, of black color, consists of two connected straight line segments of 79 cm in length and 10 cm in width. The mark may be painted on white unbroken line of helideck boundary.[1].

[1] The mark is used for checking by HLO, before helicopter landing, that there are no obstacles which extend beyond LOS area.

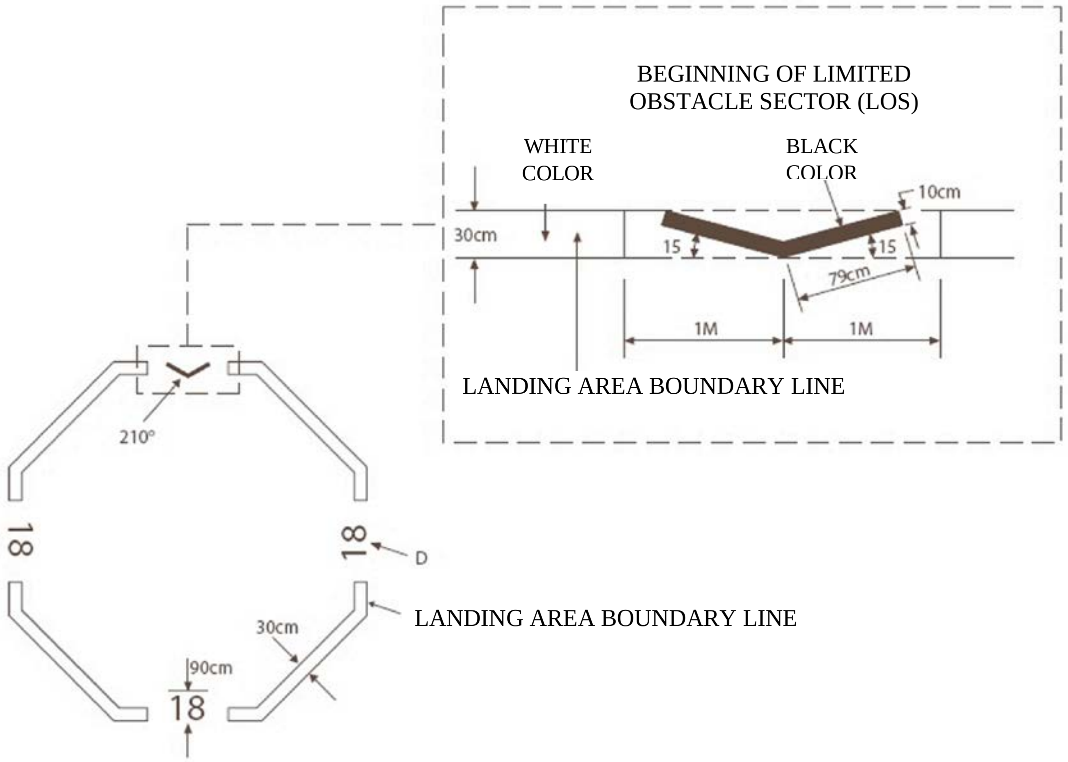

Fig. 5.6.2.4 Dimensions and arrangement of the landing area marking (example – octagonal landing area)

If the symmetry axis of the LOS area is not the symmetry axis of helideck, then the mark should precisely indicate that (it should be respectively “twisted”).

5.6.2.5 The touch-down circle shall also be marked on the helideck (see Fig. 5.6.2.5). The circle centre shall normally coincide with the centre of diameter *D* circle (see 3.1 to 3.4). The internal diameter of the touch-down circle shall be 0.5 *D*, the line width – 1 m and color – yellow.

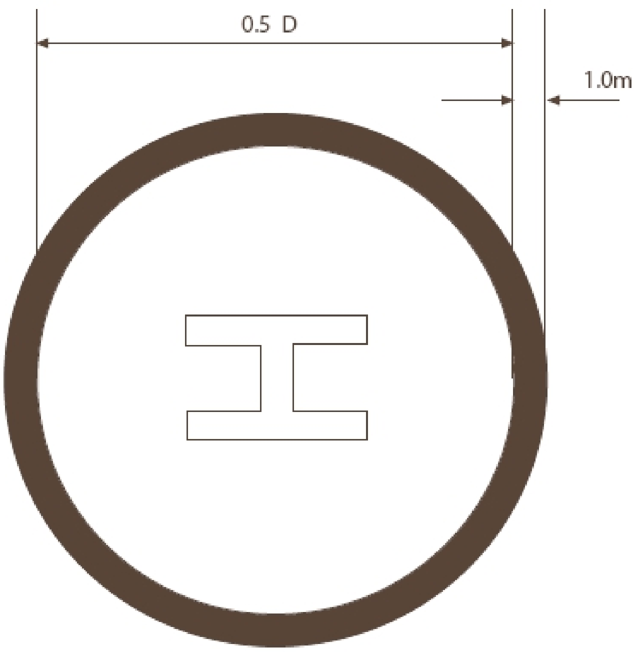

Fig. 5.6.2.5 Marking of touch-down circle

5.6.2.6 The centre of the touch-down circle may be displaced by not more than 0.1*D* in relation to the centre of diameter *D* circle, if it is of benefit and has no negative effect on the helicopter start and landing safety and on helideck activities.

5.6.2.7 In the centre of the touch-down circle, white letter *H* shall be placed with its horizontal stroke normally in line with the centre of mark referred to in 5.6.2.4 (in the symmetry axis of the LOS area).

Where the symmetry axis of the LOS area is not the symmetry axis of the helideck (see 5.6.2.4) then the horizontal stroke of letter H shall be parallel to the symmetry axis of the LOS area.

5.6.3 Prohibited landing marker

Typical prohibited landing marker, so enlarged to fully cover the letter *H*, shall be used when the landing area cannot be used. The marker is a 4 m square, of red color, crossed by two yellow diagonal stripes 0.5 m wide.

5.6.4 Marking the prohibited touch-down direction [Z14 – 5.2.14]

If for safety reasons the helicopter touch-down in specified directions shall be prohibited (e.g. dangerous access to take-off/touch-down path due to vicinity of tail rotor), the mark of prohibited touch-down directions shall be used according to Figs. 5.6.3-1 and 5.6.3.2. The mark consists of white and red stripes 0.5 m wide.

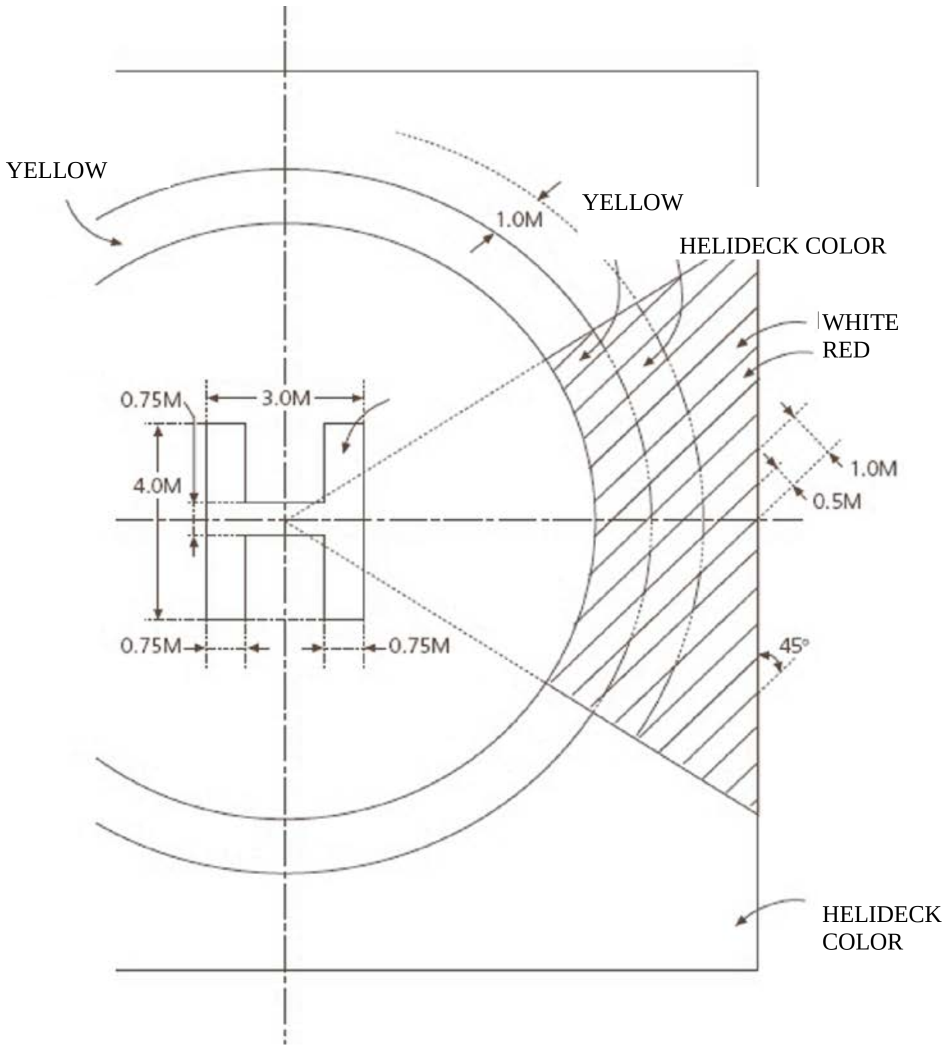

Fig. 5.6.3-1. Dimensions of the mark of prohibited touch-down direction

Fig. 5.6.3-2 Example of the mark of prohibited touch-down direction

5.7 Landing area lighting

5.7.1 General

5.7.1.1 The landing area equipment intended for night landings and starts shall include [Z14 – 5.3.9.3]:
- perimeter lights,
- ASPSL (Array of Segmented Point Source Lighting) and/or LPs (Luminescent Panels) to identify the touchdown marking (see 5.6.2.5) and/or to illuminate TLOF.

5.7.1.2 The reserve energy source onboard the *unit* shall be capable of supplying, in addition to other required consumers, continuously (UPS) all landing area lights.

5.7.2 Landing area perimeter lights [Z14 – 5.3.9.5÷5.3.9.13]

5.7.2.1 The perimeter lights shall be placed along the edge of the TLOF area or outside, within a distance of 1.5 m from the TLOF edge.

5.7.2.2 The lights shall be located on straight lines, in a pattern which will provide information to pilots on drift.

5.7.2.3 TLOF perimeter lights shall be uniformly spaced at intervals of no more than 3 m. There shall be a minimum number of four lights on each straight sector of the TLOF edge, including a light at each corner.

5.7.2.4 If the arrangement according to 5.7.2.2 on the circle-shaped landing area may not be executed, the lights may be distributed equally around the perimeter of TLOF, with half the space between lights in a sector 45°.

5.7.2.5 If the arrangement is according to 5.7.2.4, at least 14 lights shall be provided.

5.7.2.6 The TLOF perimeter lights shall be fixed omnidirectional lights showing green. It is recommended to use the table according to CAP 437 Ch.4 – ISO-Candela Diagram for Helideck Perimeter Lights.

5.7.2.7 The lights shall be installed so that they are not visible for the pilot hovering below the helideck level (TLOF elevation).

5.7.3 Lighting of landing circle [Z14 – 5.3.9.3, 5.3.9.11, 5.3.9.12]

5.7.3.1 For identification of landing area and lighting of the touch-down circle, the Array of Segmented Point Source Lights (ASPSL) in the form of closed panels (stripes) of photoluminescent diodes (LED) are recommended.

5.7.3.2 Where luminescent panels (LP) are used to facilitate the assessment of elevation above the helideck, they shall not be placed close to the perimeter lights, but around the marking of the landing circle.

5.7.3.3 Where TLOF is illuminated, the lighting sources shall be so arranged as to avoid glare to pilots in flight or to personnel working on the area. The arrangement and aiming of lights shall be such that shadows are kept to a minimum. Proper positioning of lights shall be checked on regular basis.

5.7.3.4 The TLOF illumination sources shall be possible to be dimmed.

5.7.4 Helideck beacon (optional)

It is recommended to install the helideck beacon onboard the *unit*, according to the requirements (*5.3.2 Helideck beacon*) specified in Annex 14 to *International Civil Aviation Convention*, Aerodromes, Volume II – Helidecks.

5.7.5 Wave-off light

5.7.5.1 A wave-off light shall be installed to mean „landing forbidden, fly away of the landing area”, visible from each approach-to-land direction. In order to ensure adequate visibility, introduction of additional lights in another places may be necessary.

5.7.5.2 The wave-off light shall be of red color, with recommended flash frequency of 120/min.

5.7.5.3 The light shall be switched on automatically by the *unit* safety systems in defined circumstances causing helicopter landing unsafe (e.g. emergency blowdown of production systems) and also switched on and off manually by the person managing air operations.

5.7.5.4 The light luminous intensity – at least 700 cd, within 2 to 10° above the horizon; at least 176 cd at other elevation angles.

5.7.5.5 The possibility of lights darkening shall be ensured, not below 60 cd (with switched on light). The time of return to full luminosity after darkening shall not exceed 3 s.

5.7.5.6 The luminance of additional lights according to 5.7.5.1 shall be within 16 to 60 cd.

5.7.5.7 A single damage in the wave-off lighting system shall not make the system inoperable.

5.7.6 Visual indicator of approach path (optional)

The use and placing of visual approach path indicator shall be subject to individual consideration of PRS, operator and air operators.

6 FIRE FIGHTING AND LIFE-SAVING EQUIPMENT

Requirements for fire fighting and life-saving equipment are included in Chapter 7, Part V, paragraphs 7.1 and 7.2.

7 AIR OPERATION SUPPORTING EQUIPMENT

7.1 Deck operations machinery and equipment

7.1.1 Equipment for passenger and cargo operations

Precise scales for passenger luggage and cargo shall be installed near the landing area.

7.1.2 Equipment for securing the helicopter onboard

7.1.2.1 If shut down of the helicopter engines is expected on the landing area, the equipment for helicopter securing onboard shall be provided.

7.1.2.2 A set of appropriate pads to be placed under wheels of helicopters the landing area is intended to serve, shall be provided.

7.1.2.3 Helicopters securing on the landing area shall be performed with the use of adjustable lashing straps or chains, with hooks fit for deck fittings.

7.1.3 Equipment for neutralization of electrostatic charges

Equipment for neutralization of electrostatic charges intended only for use during air operations shall be placed on the *unit*.

The equipment set:
– earthing stick;
– electrical conductor with the clamp, connected with the earthing stick;
– dielectric gloves.

7.1.4 Equipment for landing area clearing and deicing

It is recommended that landing areas should be equipped with permanent installation for deck anti-icing/deicing or other deicing means.

If chemicals are used for deicing of helideck, the deicing procedure shall be specified in the instructions for landing area personnel. The chemicals used shall not pose any danger to marine environment.

7.1.5 Equipment for helicopter washing

On the landing area where helicopters will be parked, a permanent installation for fresh water rinsing, with hose terminal, hose and valve placed on the landing area. The hose length shall enable helicopter rinsing at the parking place. The water jet at hose outlet shall be not less than 40 dm^3/min.

7.1.6 Helicopter engines starting arrangement (optional)

7.1.6.1 If it is intended to stop the helicopter engines on the landing area, then it is recommended to ensure the possibility of starting the helicopter engine using the external electric supply.

7.1.6.2 An energy supply socket 28V shall be installed on the landing area. Two wire cable shall be provided with plugs to the supply socket and to helicopter socket, of length ensuring supply of helicopter parked in the touch-down circle. It is recommended that the cable length should not exceed 14 m.

7.1.6.3 The supply socket shall be connected to the mobile or permanent feeder (transformer/converter). If the feeder is of mobile type, the 28V socket may be a part of the feeder. A permanent feeder shall be installed in a room, as close as possible to the landing area.

7.1.6.4 The feeder shall comply with the conditions specified by the helicopter manufacturers.

Example data of starting feeder for a medium size helicopter: permanent current up to 300 A and instantaneous current (PIC) up to 700 A; within the scope of permanent loads from 0 A to 300 A, the voltage provided to helicopter socket shall remain within 24V to 29V range.

Standard requirements of helicopter manufacturers for starting feeders define also permitted content of higher harmonics.

7.2 Communication and radionavigation equipment

7.2.1 General

Due to special importance of the equipment referred to in 7.2 and 7.3 for air operation safety, the equipment indicators and switches shall be grouped so as to enable providing information to an aircraft by a single person and/or managing air operations on the landing area.

7.2.2 Stationary VHF air radio stations

7.2.2.1 A stationary air VHF radio station, included in the Register of Aerodrome Ground equipment issued by Civil Aviation Authority (Urząd Lotnictwa Cywilnego – ULC) and granted the radio licence in the radiocommunication service (issued by the Office of Electronic Communications – UKE), shall be placed on the *unit*. .

7.2.2.2 The *unit* shall be provided with the second radio station operating in the VHF air band, which shall be a reserve station for air radiocommunication.

7.2.2.3 Stationary radio stations shall be supplied from an emergency switchboard. Uninterruptible supply (UPS) is recommended.

7.2.3 Portable VHF radio stations of the personnel for landing area fire fighting and life-saving services.

One portable VHF air radio station of type approved by ULC, together with a headset, shall be provided for the personnel for landing area fire fighting and life-saving services. Additionally, appropriate number of portable local communication radio stations shall be provided for the mentioned personnel.

7.2.4 Signalling and internal communication

Signalling and internal communication shall be in operation in the vicinity of landing area (a part of signalling and internal communication system, in accordance with Chapter 7 of Part VI). The system shall facilitate proper communication and receiving visual and sound alarm signals during air operations on the landing area.

7.2.5 Radionavigational aids

It is recommended that the *unit* shall be equipped with air radionavigational device to enable non-precise approach – e.g. non-directional beacon (NDB). The device shall have appropriate licences issued by ULC and UKE.

7.3 Equipment for meteorological observations

7.3.1 General

7.3.1.1 All meteorological measuring instruments placed onboard the *unit* shall have valid and placed on the *unit* verification certificate.

7.3.1.2 Measurements referred to in 7.3.2 to 7.3.7 may be executed within the framework of integrated meteorological station.

7.3.1.3 At defining detailed requirements for particular measurements and measuring instruments, recommendations for the British shelf of North Sea may be applied (see 1.3.2, 1.3.3):

– Offshore Helideck Design Guidelines, 11.9 – Meteorological Equipment,

– CAP 437 Offshore Helicopter Landing Areas Guidance on Standards, Civil Aviation Authority, App. G – 6 Design, Sitting and Back-up Requirements for Meteorological Equipment Installed in Offshore Installations.

The above publications are based on the requirements of Civil Aviation Authority (UK), CAP 746 Requirements for Meteorological Equipment at Aerodromes.

7.3.1.4 The electrical supply of stationary equipment for meteorological observations shall fulfil the requirement of 7.2.2.3.

7.3.2 Measurement of wind direction and speed

At least one stationary anemometer shall be installed onboard the *unit*. The anemometer sensor shall be placed possibly high, where the air flow is undisturbed. The indicator shall be accessible for the air radio station operator.

A portable anemometer shall be within the helideck equipment.

7.3.3 Measurement of air temperature and humidity

Measuring instruments shall enable surrounding air temperature measurement, disregarding effect of heat radiation and local heat sources. It is recommended that additional temperature measurement should be carried out on the landing area on the helideck level.

7.3.4 Measurement of atmospheric pressure

At least two stationary atmospheric pressure sensors shall be installed. They shall be so arranged that mutual control can be ensured (in the case when the sensors readings will differ by more than 0.5 hPA, the system shall stop to indicate the pressure value).

Additionally, a precise stationary or portable reserve measuring instrument shall be provided.

7.3.5 Measurement of visibility (non-obligatory)

The visibility measurement instrument sensor shall be installed in accordance with manufacturer‘s instructions, normally in the vicinity of the landing area, with undisturbed visibility of helicopter approach paths. The instrument shall be installed, put in operation and calibrated by a person having appropriate competences.

7.3.6 Measurement and recording of cloud base height (non-obligatory)

The sensor of the cloud base height measuring and recording system shall be installed in accordance with manufacturer’s instructions, normally in the vicinity of the landing area, with undisturbed vertical visibility. The instrument shall be installed, put in operation and calibrated by a person having appropriate competences.

7.3.7 Measurement of atmospheric precipitation (non-obligatory)

The instrument shall be installed, put in operation and calibrated by a person having appropriate competences, in accordance with manufacturer’s instructions.

8 HELIDECK FACILITIES COMPLIANCE CERTIFICATE

8.1 General

8.1.1 Verification process

Polish Register of Shipping issues the *Helideck Facilities Compliance Certificate,* further called the Helideck Certificate at individual request of the Operator, after verification of helideck facilities completed with positive result.

8.1.2 Basic features of Helideck Certificate

The Helideck Certificate confirms the helideck structure and equipment compliance with the requirements of Part X of *Publication No. 105/P – Rules for Construction and Survey of Fixed Offshore Platforms* and with an approved technical documentation, as well as compliance with organizational and technical conditions ensuring safe performance of specified air operations and service works on the landing area for defined meteorological conditions and helicopter sizes/masses. In particular case, the Helideck Certificate may restrict the use of helideck for defined helicopter type operations.

8.1.3 Permanent and temporary Helideck Certificate

Polish Register of Shipping issues permanent Helideck Certificate together with Annex after execution of test landings of helicopter (which are the final phase of verification), in conditions which represent normal operational conditions of the *unit*. Before the performance of test landings, PRS may issue, for the needs of such test flights, a temporary Helideck Certificate.

Before the test flights, the Operator submits to the Air Operator information on the helideck, within the scope given in 1.5.4.

For the helideck in service and not subject to essential changes, PRS need not require test landings before the certificate issue, where sufficient experience from the helideck operation exists.

8.2 Annex to Helideck Certificate

8.2.1 General

8.2.1.1 The Annex to Helideck Certificate includes basic information on the helideck, indispensable for carrying out technical supervision over it.

8.2.1.2 The Annex to Helideck Certificate includes information on the helideck within the necessary scope, according to JAR-OPS 3.220, for the helideck authorization by the Air Operator.

8.2.2 Information to be included in the Annex to Helideck Certificate

8.2.2.1 The helideck identification data, acc. to 1.6.1.

8.2.2.2 Basic particulars of the helideck, acc. to 1.6.2.

8.2.2.3 Updated list of documentation, acc. to 1.5.1.

8.2.2.4 Updated list of instructive documentation, acc. to 1.5.3.

8.2.2.5 List of structures, machinery and equipment subject to periodical surveys.

8.2.2.6 Records on the execution of surveys and confirmation of the Helideck Certificate validity, recommendations, their execution, restrictions.

8.3 Helideck Certificate validity period

The Helideck Certificate validity period is 5 years, provided surveys specified in this Publication are carried out with positive result at due dates and recommendations are executed. In justified cases the certificate may be issued with shorter validity. PRS may also shorten the validity of previously issued certificate.

PRS may suspend the certificate validity or invalidate it for reasons defined in this Part of the *Publication.*

8.4 Verification procedure

8.4.1 Documentation approval

The list of documentation subject to consideration and verification by PRS is given in 1.5.

8.4.2 Initial survey of the helideck equipment

Within the scope of the initial survey of the helideck equipment, the below activities are performed:
- checking the compliance of the helideck structure and equipment with verified documentation,
- checking to full scope the helideck structure features and operation of equipment having effect on the helideck operational safety.

8.4.3 Test landings

At final stage of verification, test landings of helicopter are performed in conditions representative to normal service conditions of the *unit*. The helicopter pilot report is enclosed to the helideck verification documents.

8.5 Confirmation and prolongation of certificate validity

8.5.1 Periodical surveys

8.5.1.1 Types of periodical surveys

Onboard the *unit* for which PRS issued the Helideck Certificate, within each certification cycle, the helideck is subject to periodical surveys:
- annual survey,
- 5-year survey for the renewal of Helideck Certificate.

8.5.1.2 Terms of periodical surveys

a) Terms of periodical surveys of the helideck performed by PRS are assigned in relation to the date of the issue by PRS of the first permanent Helideck Certificate for the *unit*.

b) The annual survey is performed within 3 month period before and after each anniversary of PRS issue of the first permanent Helideck Certificate for the *unit* or the last renewal of the certificate validity.

c) Surveys for the renewal of the Helideck Certificate validity shall be carried out within the period of the certificate validity, i.e. at intervals not exceeding 5 years. In special cases PRS may agree to carrying out the survey at a later date and prolong the certificate validity beyond the 5 year period, however by not more than 3 months.

d) In the case when the Helideck Certificate renewal survey is completed within the 3 month period before or after its validity date, the validity of the new certificate is assigned for a period of 5 years, starting from the validity expiry date of the previous certificate. When the survey has been completed before the 3 month period to the certificate validity expiry, a new period of validity will be counted from the date of survey completion.

The number and dates of annual surveys for confirmation of the Helideck Certificate validity shall be set by deducting back annual periods from the date of validity expiry of the new certificate.

8.5.2 Other surveys

8.5.2.1 Occasional surveys

Occasional surveys of the helideck or the landing area, or particular items of machinery equipment and installations are performed after submitting them for survey other than initial or periodical. The occasional survey may be executed at the request of Operator or Underwriter, or it may be the effect of control action by PRS or Administration.

The scope of occasional surveys and the method of their execution are defined by PRS, taking into account the survey scope and the helideck age and technical condition.

8.5.2.2 After-damage survey

A helideck is subject to after-damage survey in the case of a damage to helideck structure, machinery, installations or other elements of equipment covered by the requirements of this Publication and subject to PRS supervision. The survey is aimed at defining the scope of damage, agreeing the scope of work to remove the damage effects and defining the possibility and conditions of maintaining or reinstatement of the Helideck Certificate validity.

The Operator shall immediately report the damage to Polish Register of Shipping.

8.5.3 The scope of periodical surveys

8.5.3.1 Annual survey

Within the scope of the annual survey, inspections of structure, machinery, installations and other elements of equipment are performed, in accordance with the list given in the Annex to Helideck Certificate (see 8.2).

8.5.3.2 5 year survey for the renewal of the Helideck Equipment Compliance Certificate

Before the commencement of the survey for the renewal of the Helideck Certificate, surveys of machinery due within the first four years of the certification cycle shall be completed.

The survey for the renewal of Helideck Certificate includes annual survey activities and additionally:
- the thickness measurement of the helideck plates,
- a 5-year survey of fire and explosion protection, according to the requirements of Part V.

9 SUSPENSION OF HELIDECK CERTIFICATE VALIDITY

9.1 Automatic suspension of Helideck Equipment Compliance Certificate validity

The validity of the Helideck Certificate is automatically suspended when:

.1 the validity date of Helideck Certificate has ceased before completing the survey for the certificate validity renewal.
In particular cases, PRS may prolong the certificate validity for a maximum of 3 months;

.2 recommendations issued have not been executed until the due date or the helideck certificate issuance conditions were not fulfilled. In such case, PRS may prolong the certificate validity until a new assigned date of recommendations execution or fulfilling the certificate issuance conditions;

.3 damage has occurred to structure, machinery, systems or equipment covered by the requirements of this *Publication*;

.4 changes were made which have effect on the Certificate entries, e.g. change of Operator;

.5 *the unit* has not been submitted for periodical survey after transgressing the prescribed 3 month period;

.6 the MODU certificate issued for the *unit* ceased to be valid.

9.2 Notice of suspension of the Helideck Certificate validity

If the Operator has not paid PRS for services connected with the given *unit*, the Helideck Certificate validity will be suspended. Notice of PRS intent to suspend the validity of Helideck Certificate is sent to the Operator, in advance.

9.3 Period of Helideck Certificate validity suspension

The Helideck Certificate remains invalid from the date of its suspension to the date of its reinstatement. This period shall not be longer than 3 months. If the period of the certificate validity suspension exceeds 6 months, the certificate will be invalidated permanently.

At the request of the Operator, PRS may agree for prolongation of the period of the certificate suspension for the *unit* out of service, pending the PRS decision after damage to the *unit* has been found or in case of commencing the survey for reinstatement of Helideck Certificate validity.

9.4 Reinstatement of the Helideck Certificate validity

The validity of Helideck Certificate may be reinstated only on the basis of positive result of an Occasional Survey (see 8.5.2.1) carried out by PRS.

The case shown in 9.2, where the class reinstatement is effect of the suspension reasons removal, is an exception.

9.5 Information to Operator and Administration

Information on the suspension of the Helideck Certificate validity and on the certificate reinstatement is transferred by PRS by separate letters to the Operator and Administration.

10 INVALIDATION OF HELIDECK CERTIFICATE

The Certificate of Helideck Equipment Compliance becomes invalid when such conditions occur which make validity maintenance not possible or are connected with long-lasting repair.

The Helideck Certificate becomes invalid also in the below cases:

– after any alterations have been made to the *unit* structure, hull, superstructures, mechanisms, machinery and systems having effect on the safety of helideck operation;
– after the *unit* has sunk (has been flooded) or has been transmitted for scrapping, at the written request of Operator.

The helideck whose certificate has been invalidated may be, at the request of Operator, surveyed for reinstatement of certificate validity. The survey scope is each time set by PRS.

Appendix A

THE OFFSHORE PIPELINE SYSTEMS

The Appendix „The Offshore Pipeline Systems" to Publication 105/P consists of the below parts:

I – General Provisions and Principles of PRS Survey
II – Safety Requirements and Design Assumptions
III – Design of the System
IV – Process of the System Construction
V – Operation and Decommissioning

The Appendix is extended and supplemented by the following documents of Polski Rejestr Statków:

Rules for the Classification and Construction of Sea-Going Ships – Part IX – Materials and Welding – 2017,
Publication No. 23/P – Pipelines Prefabrication,
Publication No. 51/P – Procedural Requirements for Service Suppliers,
Publication No. 55/P – Survey of corrosion protection and anti-fouling systems,
Publication No. 56/P – Procedural Requirements for Laboratories,
Publication No. 74P – Principles for Welding Procedure Qualification Tests,
Publication No. 80/P – Non-destructive Testing,
Publication No. 30/I – Principles for Examination of Welders

CONTENTS

PART I – GENERAL PROVISIONS AND PRINCIPLES OF PRS SURVEY

1 GENERAL PROVISIONS

1.1 Introduction

1.1.1 Appendix A to Publication No. 105/P, further called “the Appendix”, contains information and technical requirements for designing, construction, operation and decommissioning of the offshore pipeline systems (defined in 1.6.1 as pipeline systems and further called „the systems”), designated mainly for carrying gaseous and liquid hydrocarbons from stationary off-shore platform to the onshore reception facilities.

1.1.2 The requirements of the Appendix may be respectively used to the subsea pipelines connecting platform or onshore delivery installation with onshore piping or onshore reception installation. The requirements may also be applied to pipelines connected, from the delivery and/or reception side, with offshore loading buoy.

1.1.3 The scope of technical requirements of the Appendix is limited to technical arrangements and materials typically used for pipelines laid at depths not exceeding 300 m (1000 ft) and associated static catenary risers. In some cases, the above scope of requirements is extended by reference to respective international standards.

1.2 PRS Survey

1.2.1 The PRS survey of the system design, construction, operation and decommissioning is carried out in the form of PRS cooperation with the Executor, Owner or Operator, taken for the execution of the purpose referred to in 1.2.2.

1.2.2 The purpose of the PRS survey is, generally, to ensure conditions of safe operation of the pipeline system, through inspection and confirmation of the system structure and technical condition and operation compliance with the Appendix requirements and inspection and confirmation of conformity with national legal regulations applicable on the given area. For the Polish marine and land areas, the valid legal regulations are the acts and regulations mentioned in Chapter 1, Part I of the Publication 105/P.

1.2.3 The PRS survey is an element of the certification procedure for the pipeline system.

1.3 Principles of Survey Performance and Survey Results Confirmation

1.3.1 The Appendix A to Publication 105/P establishes the principles of carrying out PRS certification survey of complete systems and of survey objects comprised by the systems. The Publication informs also on associated activities of the Party requesting survey.

1.3.2 The technical requirements of the Appendix may also be used at execution of other kinds of survey, e.g. construction, investor’s, insurance or author’s supervision.

1.3.3 In relation to shore approach (see 1.5.1) and, particularly, the onshore section of the subsea pipeline, in addition to the Appendix requirements, local requirements for onshore pipelines apply. On the Polish territory, the survey of onshore pipelines is carried out according to the provisions covered in respective legal documents, referred to in Chapter 1, Part III of PRS Publication 105/P.

1.3.4 The sets of export pumps or export compressors, operationally associated with the system, commonly constitute a part of technological system of the platform processing plant. If not specified otherwise, the survey and certification of the sets are carried out within the survey of the processing plant. The survey principles are given in Parts I and VII of PRS Publication 105/P.

1.3.5 PRS confirms ensuring the system safe operation conditions, referred to in 1.1.4, by issuing to the system, its assemblies, parts and materials, respective certificates (equivalent definition – certificates), in accordance with the principles given in Chapter 3.

1.3.6 General requirements for the system associated medium delivery installation are given in Parts II/3.6 and III/6.

1.4 Status of records, alternative requirements

1.4.1 The Appendix records may have the meaning of technical or organizational requirements, or be informative. The status of a record are defined by used words, as below:

- Should, shall – the record formulates a requirement which should be strictly observed. In particular case PRS may agree to departure from the requirement, after considering a written documented application from the Orderer.
- Recommended – Application of one arrangement preferred by PRS is recommended, however, other equivalent arrangements mentioned/not mentioned in the given record may be applied. Execution of the PRS recommended proceeding is not absolutely required[1].
- May, may be... – PRS informs the Orderer that a specified arrangement, method or procedure may be applied or abandoned, or informs on PRS action which may be taken or abandoned at the request of the Orderer or PRS.

1.4.2 PRS may, after consideration, permit the use of alternative technical and organizational requirements, other than those of the Appendix. They may be accepted, provided that they ensure the level of safety not lower than that resulting from the Appendix requirements.

1.5 Appendix Structure, references

1.5.1 Appendix Parts and Chapters

The Appendix consists of five Parts, marked with Roman numerals, e.g. **PART I**. Within the Parts, Chapters marked with Arabic numerals (e.g. Chapter 2) are separated. Chapters are subdivided into subchapters, e.g. subchapter **2.1** and then into paragraphs marked with three or four numerals.

Table 1.5.1

Appendix Parts		
Part	Title of the Part	Contents of the Part
I	General Provisions and Principles of PRS Survey	General provisions and information. Details of method of surveillance and certification of the system by PRS
II	Safety Requirements and Design Assumptions	Guidelines for setting safety, environment protection, efficiency and reliability objectives Presentation of issues and activities associated with establishing design assumptions
III	Design of the System	PRS requirements related to designing the system. Recommended standards as the basis for designing and calculations
IV	Process of the System Construction	PRS requirements related to all phases of system construction and testing
V	Operation and Decommissioning	PRS requirements related to the system operation and its withdrawal from operation

[1] **Note:** in 1.6.1, the term „RC recommendation” (Certification recommendation) has been defined. The RC recommendation, contrary to the term „recommended” used in Publication entries, has the meaning of a requirement („should”). The RC recommendation applies exclusively in special cases, during the pipeline operation period.

1.5.2 Form of references in the Appendix text

Table 1.5.2

Form of references in the Appendix text – examples	
Reference	Example of reference entry
To other Part of the Appendix	Application of respective requirements of Part II is also obligatory
To the record in Publication 105/P or in other PRS Publication	Alternatively, the requirement 1.3.4 of Part II of Publication 105/P may be applied
To a Chapter in the same Part of the Appendix	The requirements of Chapter 3 also apply
To a subchapter in another Part of the Appendix	The requirements of 3.1 of Part III shall also be complied with
To a record in the same Part of the Appendix	The requirement 3.1.1 shall also be complied with
To a record in another Part of the Appendix	The requirement 4.1.4.5 of Part III shall also be complied with
To a Chapter in Part IX of the PRS Rules for the Classification and Construction of Sea-going Ships	The requirements of Chapter 1, Part IX of the PRS Rules for the Classification and Construction of Sea-going Ships are obligatory

The reference may be used in an abbreviated form, in brackets, e.g.: „(see - 3.1.1)", „(the requirements – Part III)", „(III/3.1)", „(the requirements – PRS MOR IX/11)".

1.6 Definitions and abbreviations[2]

1.6.1 Definitions[3]

P R S a c c e p t a n c e – formal acceptance consisting in assigning PRS approval or noted mark to technical documentation, including procedures and test reports, considered within certification supervision. The accepted documentation is used at PRS certification activities.

O f f s h o r e L o a d i n g B u o y – an anchored floating object, usually connected by flexible pipe riser with the subsea pipeline and adapted for connecting by flexible pipeline with a tanker.

M a r i n e s t r u c t u r e – in the meaning of the Polish building law, the pipeline system is a marine structure.

I n t e r n a l D e s i g n P r e s s u r e – Maximum internal design pressure of the pipeline (or its separate section), taken for strength calculations.

O p e r a t i n g P r e s s u r e (O P) – The pressure of transported medium during normal operation of the system, measured at the outlet from pumping station or export compressor.

M a x i m u m O p e r a t i n g P r e s s u r e (M O P) , M a x i m u m A l l o w a b l e O p e r a t i n g P r e s s u r e (M A O P) – maximum permissible pressure of transported medium, measured the outlet from the pumping station or export compressor.

I n c i d e n t a l P r e s s u r e , I n t e r n a l p r e s s u r e s u r g e – Transitional, exceptional and short duration condition of high pressure of transported medium. It may occur e.g. at sudden, emergency stopping of liquid flow in the pipeline.

S t r e n g t h T e s t P r e s s u r e – the pressure at which hydraulic test is performed of pipeline (or its separate section) strength.

L e a k - T e s t P r e s s u r e – the pressure at which hydraulic test of the pipeline (or its separate section) strength is performed.

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[2] Applicable to this Appendix

[3] The definitions in English are in accordance with definitions used in ISO, API and ASME Standards and with definitions found generally in other English standards and regulations.

Burst Pressure – the pressure at which pipeline burst occurs – a term used at strength calculations by limit state design method.

Certification cycle – a period repeating in cycles, counted from the date of completion of survey carried out for the issue or renewal of provisional certificate, equal to its validity period. The certification cycle shall include dates of periodical surveys of the system (where it is applicable).

Vortex-induced Vibration, VIV – Vibrations of unsupported span of the pipeline caused by transversely acting sea current, due to *Vortex Shedding* phenomenon.

Gas pipeline – The term may be used in the Polish text in the meaning of the pipeline system defined in this subchapter carrying gaseous or two-phase hydrocarbon medium, as well as the medium which will take gaseous form after its release to atmosphere.

Information IO – Information for the Operator – a PRS message to the Operator concerning technical and/or organizational matters of the surveyed object. The IO Information is used where it is reasonable, during the pipeline operation period.

Installation (activity) – Operations of installing equipment, parts and systems such as offshore pipeline, riser system and similar.

S-lay Installation Method – Laying a subsea pipeline from the floating unit, at small angle of the pipeline departure from the unit deck, the transitional shape of the laid pipeline section being close to S letter.

J-lay Installation Method – Laying a subsea pipeline from the floating unit, at departure angle close to 90°, with transitional shape of the laid pipeline section being close to J letter. The method generally is not suitable for steel pipelines laid on small depths.

Towing Installation – Laying of onshore fabricated subsea pipeline through towing it, on the water surface, at intermediate depth or along the sea bottom, for its submersion.

Reel-lay Installation – Laying of onshore fabricated offshore pipeline through its reeling out of the drum having horizontal (*Reel*) or vertical (*Carousel*) axis. This method may be combined with *S-lay installation* or *J-lay installation* methods.

Installation Manual – The document describing in detail responsibilities, activities and equipment used for the system installation.

Operation Manual – The document describing in detail responsibilities, required operational activities (including activities in extreme conditions) and equipment used for this purpose.

Maintenance Manual – The document describing in detail procedures for detection and recording of the system damages and faults, preventive actions (such as inspections, replacements) and corrective actions (such as repairs), during the system operation.

Pipeline System Integrity –The term means integrity, completion and ability of the system for safe operation and withstanding imposed loads, generally in the expected time-period. The term may be used for a defined part of the system, e.g. riser integrity.

Isolation Joint – Special element of pipeline separating the cathodic protection system of the subsea pipeline from the protection system of the onshore pipeline or the hydrocarbon reception system. The isolation joint is usually inserted in the pipeline close to shoreline.

Allowable Stress Design – A conventional method of structure strength calculations, adopted in this Appendix.

Limit State Design – A method of strength calculations considering characteristic values and the probability of occurrence of a number of limit states of the structure.

Final Assembling – Operations of joining systems and equipment into a complete system.

Certification supervision – PRS technical supervision fulfilled for the purpose of the issue of certificates. The PRS certification supervision covers at least consideration of design and material documentation, supervision of the system construction and participation in tests and examinations. The certification supervision may cover checking and confirmation of compliance with legal regulations applicable in the given area.

Engineering Criticality Assessment – understood also as *Engineering Critical Assessment*, refers to consideration, including mechanism of cracks creation, of the effect of steel pipe plastic strain on its integrity and fatigue strength.

Survey Object – Complete pipeline system, or its technical documentation, specified materials, semi-finished products, components, parts, systems and applied technological procedures, subject to PRS supervision.

Shore Approach and Onshore Section – The section of a subsea pipeline partly laid or dug in the sea bed, partly laid onshore – underground or on the surface, connected with onshore reception pipeline or directly with land-based hydrocarbon reception technological system. The valve placed upstream the hydrocarbon reception system or the onshore pipeline is usually the section outlet point.

Unsupported Span (of the Subsea Pipeline) – The section of the subsea pipeline which is not laid on the sea bed and is suspended between the edges of a land hollow or between structural supports.

Total Single-Event Strain – For the given pipe cross-section it is the sum of the biggest single-event elastic and plastic deformation, usually along the axis on the pipe perimeter, defined for single technological operation, such as reeling the pipe onto the drum, reeling out of drum or straightening.

Plastic Single-Event Strain – For the given pipe cross-section it is the biggest single plastic deformation, usually along the axis on the pipe perimeter, defined for single technological operation, such as reeling the pipe onto the drum, reeling out of drum or straightening.

Accumulated Plastic Strain – arithmetic sum of absolute values of plastic single-event strains (both directions, i.e. at bending and at straightening), which occurred during pipes transportation, reloading, fabrication and individual operations, when the Reel-Lay method has been applied.

Operator – operator of the system, acc. to Art. 2 of Directive 2013/30/EU of 12 June 2013, also the Owner or Manager of marine structure acc. to the Regulation of Maritime Economy Minister of 23 October 2006 on technical conditions of use and detailed scope of inspections of marine hydrotechnical structures (Journal of Laws 2006, No. 206, item 1516).

Building law (Polish) – the act of 7 July 1994 – Building law (Journal of Laws 2018, item 1202, as amended).

Geological and mining law (Polish) – the act of 9 June 2011 – Geological and mining law (Journal of Laws, item 2126, as amended.

Fabrication – Technological activities aimed at onshore installation of objects being the system components.

Pre-Commissioning tests – Activities previous to commissioning tests, including pressure test, dehydration, cleaning and drying.

Commissioning tests – Activities including filling the system with transported agent, the system tests aimed at confirmation of its capability and safety, and also acceptance tests for the system commissioning.

Riser – a pipe connecting a subsea pipeline or other object or appliance placed on the sea bed with the delivery or reception system of transported medium placed onboard the platform or a floating object. The technical requirements presented in this Appendix to *Publication 105/P* apply mainly to export risers, transporting the hydrocarbon medium from the stationary platform to the subsea pipeline. Drilling risers and production risers are not covered by this Appendix.

Dynamic Riser – The riser, usually connecting the subsea pipeline with a floating object, connecting two points moving against each other.

Static application riser – The riser, usually connecting the subsea pipeline with stationary platform system, connecting two points which do not move against each other, except thermal expansion movements.

The static application riser is also subject to dynamic forces (considerably less than for the dynamic riser) which are considered in structure calculations.

Flexible Pipe Riser – The riser made from flexible pipe, it may be suspended on the platform structure in J-tube.

Free-hanging Flexible Pipe Catenary Riser – a catenary riser made from flexible pipe.

Steel Catenary Riser, SCR – A catenary riser made from steel pipe (the abbreviation SCR may also be used for risers made from other metal).

Catenary Riser – The riser suspended on the platform structure so that its upper section is vertical (or close to vertical) and the lower section lays horizontally on the sea bed; between the sections the riser is arranged along the line close to natural catenary.

Alternative Arrangements – Structural and technological arrangements of nature not referenced in this Appendix requirements.

Novel Features – Structural and technological arrangements not applied up to now in the system construction or applied individually, or applied in the systems of other purpose and/or operated in significantly different conditions.

Unbonded Flexible Pipe – a flexible pipe consisting of elastomer layers and of metal (generally steel) layers of strengthening structures fulfilling various functions.

Bonded Flexible Pipe – a flexible pipe consisting of elastomer layers and strengthening steel and fabric structures, joined by adhesives or vulcanization.

J-Tube – steel pipe fixed vertically to the supporting structure of platform, bent in lower part, usually to horizontal. The flexible pipe riser may be carried inside the J-tube.

Onshore Pipeline – the pipeline laid on the shore, is not subject to this Appendix.

Subsea Pipeline – the pipeline laid on the sea bottom or dug into it, remaining under water surface in its higher state, connecting lower end of riser with the onshore pipeline or directly with technological installation for hydrocarbons reception. The subsea pipeline includes usually short section passing the sea shore and entering the land (shore approach section of the subsea pipeline), which ends at the valve separating from the afore mentioned installation or onshore pipeline.

Limit State – Loading condition, the transgressing of which will result in the pipeline inoperability.

Splash Zone – the zone of riser or other part of the pipeline system which is subject to alternate flooding by sea water and draining due to waves and ebb tides action.

Emergency Shutdown System (ESD System) – A safety system intended for isolating the whole of production installation on the platform and sources of ignition, as well as stopping or operating specified machinery if serious hazard occurs. The ESD system of the object receiving the medium from the pipeline system shall have the same purpose.

Tensioner System – A system of appliances onboard the ship laying the pipeline by S-method, enabling to maintain specified tension force in the released pipeline. A tensioner is an element in the tensioner system.

Pipeline System (further called „the system") – The system includes the export subsea pipeline with its equipment, including the exit section, export riser system.

Environmental Operating Conditions – boundary parameters of environmental phenomena affecting operation safety and integrity of the pipeline system, defined in the pipeline system design. See also – 3.3.3.5 of Part III.

Certificate – a general term: the PRS issued document – a certificate confirming the system or its part compliance with defined requirements, in particular the requirements of this *Publication*.

Pipeline System Safety Certificate – PRS issued certificate, further referred to as „Certificate" confirming the system capability of being safely operated, assumed operational parameters being maintained;

the certificate is issued upon confirmation of: the system compliance with technical standards, proper selection of materials, proper quality of the system manufacture and positive result of examinations and tests.

Pipeline System Certificate – A PRS issued temporary certificate, confirming the system capability of being safely operated within defined time-period, after the day of the certificate issue.

Certificate of Conformity – A PRS issued certificate, confirming the system or its part compliance with the requirements of this *Publication* and with approved technical documentation; the certificates of conformity may also confirm the system or its part compliance with applicable technical standards and legal regulations.

Design temperature – The highest temperature of carried medium which may occur in normal operation, provided by the pipeline design.

Design Factor – The factor which is the measure of using strength properties of material, applied in strength calculations, in accordance with Part III of this *Publication* and with ISO, API and ANSI Standards.

Local Buckling – A local buckling, on small length, resulting in considerable changes of the pipe shape, such as creasing, bending, crushing.

Global Buckling – A buckling existing on the considerable length of the pipeline, usually not resulting in significant pipe deformations.

Requirement(s) – If not specified otherwise in the given record, the term refers to requirements of this Appendix A.

Pipeline Components – Means all associated steel components of the subsea pipeline and riser system, such as flanges, T-connectors, elbows, reduction valves, cut-off valves and other.

Manufacturing – the term refers to manufacture of materials, semi-finished products and elements of the system equipment.

Appendix – If not specified otherwise in the given record, the term refers to this Appendix A to Publication 105/P.

Recommendation RC – a recommendation concerning certification – PRS message to the Operator, related to maintaining the validity of the Pipeline System Certificate. Maintaining the validity of the certificate is conditioned by the performance technical and/or organizational activities shown in the Recommendation RC within specified time-period.

Riser system – the riser system comprises the riser, its supporting, shielding and protective structures, associated pipeline equipment and the corrosion protection system.

Orderer – The subject which orders to Polish Register of Shipping fulfilling the supervision according to this *Publication*. It may be the Executor, the Owner or the Operator of the system, as well as the person or institution authorized by appropriate above mentioned legal person.

1.6.2 Abbreviations[4]

ASAP, *Alliance of Security Analysis Professionals*

ASTM, *American Society for Testing and Materials*

DP, *Dynamic Positioning*

ECA, *Engineering Criticality Assessment* **–** engineering arrangement criticality assessment

ESD, *Emergency Shut Down* – Emergency shut-down of the system on the platform or in reception facility associated with the subsea pipeline system

FMEA, *Fault Mode and Effect Analysis*

[4] The abbreviations are in accordance with those used in ISO, API and ASME Standards and those usually used in documents of standard and rule type, issued by IACS Societies.

FMECA, *Fault Mode, Effect and Criticality Analysis*

FSV, *Flow Stop Valve* – a non-return valve

HDD, *Horizontal Directional Drilling*

HAZID, *Hazard Identification*

ITP, *Inspection and Test Plan*

MAOP *Maximum Allowable Operating Pressure* – Maximum allowable operating pressure of transported medium, measured at the outlet from pumping station or from export compressors

MPQT *Manufacturing Procedure Qualification Test*

NDT *Non-destructive Testing*

PHA, *Preliminary Hazard Assessment*

PRS, *Polish Register of Shipping* – Polski Rejestr Statków

PSD, *Process Shut Down* – Shut-down of the system on the platform or in reception facility associated with the subsea pipeline system

PSL, *Product Specification Level* – Standard for the specification of ordered steel pipes properties, acc. to ISO 3183 and API SPEC 5L.

PSV, *Pressure Safety Valve* – safety valve (remotely controlled, usually a spring valve)

SDV, *Shut Down Valve* – shut down valve, remotely controlled from the ESD/PSD system on the platform or in reception facility associated with the subsea pipeline system.

SMYS, *Specified Minimum Yield Strength* – permitted in the standard minimum yield strength, the material orders are based on.

SMTS, *Specified Minimum Tensile Strength* – permitted in the standard minimum tensile strength, the material orders are based on

TDP, *(Touch-Down Point)* – a changeable point in which the pipeline touches the sea bed during the pipeline lying operations.

VIV, *Vortex Induced Vibrations*

WPQR, *Welding Procedure Qualification Report*

WPS, *Welding Procedure Specification*.

1.7 Standards, normative publications[5]

ISO International Standards

ISO 3183	Petroleum and natural gas industries – Steel pipe for pipeline transportation systems
ISO 13623	Petroleum and natural gas industries – Pipeline transportation systems
ISO 13628-2	Petroleum and natural gas industries – Design and operation of subsea production systems – Part 2 – Specification for unbonded flexible pipe
ISO 13628-10	Petroleum and natural gas industries – Design and operation of subsea production systems – Part 10 – Specification for bonded flexible pipe
ISO 13847	Petroleum and natural gas industries – Field and shop welding of pipelines
ISO 14313	Petroleum and natural gas industries – Pipeline valves
ISO 14723	Petroleum and natural gas industries – Subsea pipeline valves

[5] Current revisions of the standard or publication shall be used.

ISO 15589-2	Petroleum and natural gas industries – Cathodic protection of pipeline transportation systems - Part 2: offshore pipelines.
ISO 15590-1	Petroleum and natural gas industries – Induction bends, fittings and flanges for pipeline transportation systems – Part 1: induction bends
ISO 15590-2	Petroleum and natural gas industries – Induction bends, fittings and flanges for pipeline transportation systems – Part 2: fittings
ISO 15648	Petroleum and natural gas industries – Piping
ISO 16708	Petroleum and natural gas industries – Pipeline transportation systems – Reliability based limit state methods
ISO 21809-1	Petroleum and natural gas industries – external coatings for buried or submerged pipelines used in pipeline transportation systems - Part 1: polyolefin coatings
ISO 21809-2	Petroleum and natural gas industries – external coatings for buried or submerged pipelines used in pipeline transportation systems - Part 2: Fusion-bonded epoxy coatings
ISO 21809-3	Petroleum and natural gas industries – external coatings for buried or submerged pipelines used in pipeline transportation systems - Part 3: Field joint coatings
ISO 21809-4	Petroleum and natural gas industries – external coatings for buried or submerged pipelines used in pipeline transportation systems - Part 4: Polyethylene coatings
ISO 21809-5	Petroleum and natural gas industries – external coatings for buried or submerged pipelines used in pipeline transportation systems - Part 5: External concrete coatings

PN-EN ISO i PN-EN Standards

PN-EN ISO 13628-10	Petroleum and natural gas industries -- Design and operation of subsea production systems -- Part 10: Specification for bonded flexible pipe
PN-EN ISO 21809-1	Petroleum and natural gas industries -- External coatings for buried or submerged pipelines used in pipeline transportation systems -- Part 1: Polyolefin coatings
PN-EN 12474	Cathodic protection of submarine pipelines

AGA – American Gas Association

LG1698	Submarine Pipeline on-bottom, Vol.1: stability Analysis and design Guidelines

API – American Petroleum Institute

API RP 2A-WSD	Planning, Designing and Constructing Fixed Offshore Platforms – Working Stress Design
API RP 2RD	Design of Risers for Floating Production Systems (FPSs) and Tension-Leg Platforms (TLPs)
API RP 14C	Analysis, Design, Installation and Testing of Basic Surface Safety Systems for Offshore Production Platforms
API RP 15LW	Transportation of Line Pipe on Barges and Marine Vessels
API RP 17B	Recommended Practice for Flexible Pipe
API RP 1111	Design, Construction, Operation, and Maintenance of Offshore Hydrocarbon Pipelines (Limit State Design)
API RP 1129	Assurance of Hazardous Liquid Pipeline System Integrity
API SPEC 5L	Specification for Line Pipe
API SPEC 5LCP	Specification, Coiled Line Pipe
API RP 5C8	Care, Maintenance and Inspection of Coiled Tubing
API 5 ST	Specification for Coiled Tubing
API SPEC 6A	Wellhead and Christmas Tree Equipment

API SPEC 6D	Pipeline Valves (Gate, Plug, Ball and Check Valves)
API SPEC 6DSS	Specification for Subsea Pipeline Valves
API SPEC 17D	Design and Operation, of Subsea Production Systems. Subsea Wellhead and Christmas Tree Equipment
API SPEC 17J	Specification for Unbonded Flexible Pipe
API SPEC 17K	Specification for Bonded Flexible Pipe
API STD 600	Steel Gate Valves – Flanged and Butt Welding Ends, Bolted and Pressure Seal Bonnets

ASME – American Society of Mechanical Engineers

ASME B16.5	Pipe flanges and Flanged Fittings
ASME B16.9	Factory –Made Wrought Steel Buttwelding Fittings
ASME B16.10	Face to face and End to End Dimensions of Valves
ASME B16.11	Forged Steel Fittings, Socket Welding and Threaded
ASME B16.20	Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound and Jacketed
ASME B16.25	Buttwelding Ends
ASME B16.34	Valves – Flanged, Threaded and Welding Ends
ASME B31.3	Process Piping
ASME B31.4	Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids
ASME B31.8	Gas Transmission and Distribution Piping Systems

1.8 IACS Societies Publications[6]

– ABS Guide for Building and Classing, Subsea Pipeline Systems
– ABS Guide for Building and Classing, Subsea Riser Systems
– DNV-OS-F101 Submarine Pipeline Systems
– DNVGL-ST-F101 Submarine Pipeline Systems

1.9 Legal regulations mandatory in the Polish marine areas

The list of legal documents mandatory in the Polish marine areas is given in Chapter 1, Part III of *Publication 105/P*.

1.10 Supporting documents, bibliography

[1] ABS Guide for Risk Evaluations for the Classification of Marine-Related Facilities, June 2003
[2] ABS Guide for the fatigue Assessment of Offshore Structures
[3] ABS Guidance Notes on Review and Approval of Novel Concepts, June 2003
[4] DNV-RP-C203 Fatigue Strength Analysis of Offshore Steel Structures
[5] DNV-RP-C205 Environmental Conditions and Environmental Loads
[6] DNV-RP-F105 Free Spanning Pipelines
[7] DNV-RP-F204 Riser Fatigue
[8] Handbook on design and Operation of Flexible Pipes Vol.1. 2014: MARINETEK/NNTU/ 4Subsea AS
[9] Handbook of Offshore Engineering Vol. II (Chapter 11) S. Chakrabati (Ed.), 2005 Elsevier Ltd.
[10] Strain–Based design of Pipelines, Project No. 45892GTH, Report for US Dept. of Interior and US Dept. of Transportation.
[11] GL Noble Denton, Guidelines for Submarine Pipeline Installation 0029/ND.

[6] Application of the recent issue of the publication is recommended.

2 PHASES AND SCOPE OF CERTIFICATION SUPERVISION

2.1 General

2.1.1 The scope of certification supervision

If not specified otherwise, the certification covers the subsea pipeline and its onshore section and the riser. The sections borders are the flow stop valve on the platform and the shut-down valve on the inlet to the transported medium reception facility. The said valves shall be subject to certification as parts of the delivery and receipt installation of the transported medium.

In order to ensure substantial basis for the issue the System Safety Certificate by PRS, the certification supervision shall cover phases referred to in 2.1.2 (.1) to (.6). The principles of allowing reasonable departures from the above requirement are given in 2.1.3.

2.1.2 Supervision phases

.1 Design assumptions (cooperation with PRS is recommended, see 2.2 and Part II).
.2 System designing (PRS supervision – 2.3, information and technical requirements – Part III) .
.3 Manufacture of materials, semi-finished products and components of equipment (2.4).
.4 Fabrication and installation (2.5 and Part IV).
.5 Examinations and tests of the system (2.6 and part IV).
.6 Operation of the system (2.7 and Part V).
.7 Option – decommissioning of the system (2.8 and Part V).

2.1.3 Allowing departure in the case fulfilment of the requirement 2.1.1 is not possible.

In special case, PRS may start certification supervision when the phases referred to in 2.1.2 have already been executed or are under execution, however, not later than before the phase „Fabrication and installation”. The supervision may be commenced and executed not before the Operator transfers to PRS for consideration full set of construction and quality documentation, required for already completed and initiated execution phases, within the scope given in this Chapter.

PRS shall consider submitted documentation for its compliance with this Publication requirements and in case of any nonconformity may impose requirements to be fulfilled for the issue of the Safety Certificate.

2.2 Supervision phase – design assumptions

It is recommended that the design assumptions for the system comply with the requirements of Chapter 3, Part II, and be agreed with PRS. The assumptions may be formally accepted by PRS, after consideration.

2.3 Supervision phase – design of the system

2.3.1 General

2.3.1.1 The system shall be designed in accordance with respective standards or other normative documents included in Part I, paragraph 1.7. Detailed explanations as regards the use of normative documents are given in Part III.

2.3.1.2 In the design phase, the PRS certification supervision consists in the consideration and acceptance of documentation, including verifying conformity of selected drawings, calculations and descriptive documents with the requirements of this Publication and with the standards referred to in 2.3.1.1.

2.3.1.3 PRS may also consider and assess the design for the purposes defined in legal regulations applicable in the Polish marine areas (such as building law and geological and mining law), according to principles established in those regulations.

2.3.2 Technical documentation

2.3.2.1 The Operator shall transfer to PRS the design documentation in due time to enable its consideration and presenting remarks prior to commencing successive phases of the system execution. The design documentation shall include, inter alia, the below mentioned documents:

.1 Design report (see 1.5, Part III), as a mandatory document.
.2 The map of the pipeline route specifying bathymetric data, indicating obstacles to be removed and permanent onshore and offshore building structures which could affect laying and operation of the system, indicating places where the pipeline will be dug in the sea bed and secured.
.3 Characteristics of transported medium, taking into account any possible future changes.
.4 Characteristics of the medium flow, indicating medium pressures and temperatures along the whole length of the system.
.5 Characteristics of the medium flow equipment – pumps, compressors, their safety devices.
.6 Drawings and specifications of the riser, the subsea pipeline, the shore approach and onshore section, their equipment and coatings.
.7 Load calculations of structures, according to the requirements of Part III.
.8 Local strength and stability calculations of structures, in accordance with the requirements of Part III.
.9 Drawings of the platform, including the riser system, the arrangement of cranes, the control, measuring, signalling and safety equipment related to the system operation, processing equipment onboard the platform, crew spaces, life-saving appliances, mooring places.
.10 Drawing of the building/structure of the transported medium reception facility, indicating the arrangement of end components of the system.
.11 Specifications and drawings of measuring, signalling and safety systems and equipment.
.12 Specifications and complete characteristics of structure materials.
.13 Specification and characteristics of anti-corrosion protection means.
.14 Fabrication procedures.
.15 Procedures for the installation of the riser, the subsea pipeline, the shore approach and onshore section.
.16 Analysis of the procedures for the fabrication and installation, as regards maintaining strength properties of the pipeline material.
.17 Procedures for NDT examinations and quality maintenance.
.18 Procedures for the assembly of the system.
.19 Pre-commissioning programs and procedures.

2.3.2.2 The Operator shall transfer the documents presenting technical and organizational design arrangements, associated with the issues referred to in 3.2, 3.5 and 3.6 of Part II, and the reports and environmental data referred to in 3.3 and 3.4 of Part II, if not included in the documentation mentioned in 2.3.2.1 or not transferred in the design assumption phase, or which have been updated and amended.

2.3.2.3 The approved building and executive designs may be the basis for certification of the system executed in the Polish marine areas if the designs contain information and documents as specified in 2.3.2.1 and 2.3.2.2, or if the above information and documents, when omitted in the above designs, are submitted separately.

2.3.2.4 The approval of building and executive design by authorized bodies is not equivalent to acceptance of design documentation by PRS. PRS considers submitted documentation for its conformity with certification requirements included in this Appendix and in the case of a non-conformity it may impose requirements, to be fulfilled for the issue of the Safety Certificate.

2.3.3 Acceptance of alternative arrangements and novel features

2.3.3.1 PRS carries out initial assessment of the influence of alternative arrangements and novel features on the system safety and integrity.

2.3.3.2 PRS accepts the alternative arrangements and novel features having significant effect on the system safety and integrity after detailed consideration, according to the procedure agreed with the Orderer. The procedure contains, inter alia:
– the review of reference lists and approval certificates, if the arrangement has already been applied practically,
– consideration of the arrangement technical documentation, including reports on performed tests and examinations,
– PRS participation in examinations and tests,

– carrying out the risk assessment by PRS or acceptance of such assessment performed by the Orderer or by a Third Party. The proceedings in [1] and [2] (see 1.10) may be followed,
– the issue of the arrangement approval document by PRS.

2.3.3.3 The alternative arrangements and novel features which do not affect significantly the system safety and integrity may be accepted according to commonly used principles (see 3.1).

2.4 Phase of supervision – Manufacture of materials, semi-finished products and equipment components

The principles of PRS supervision of the manufacture of materials and semi-finished products are defined in *Part IX – Materials and Welding* of the *Rules for the Classification and Construction of Sea-going Ships*. In relations to pipeline systems, detailed principles of PRS acceptance of processing systems contained in Chapter 5, Part VII of *PRS Publication 105/P* apply.

The pipeline system materials, machinery and equipment components, covered by tables 5.4.1, 5.4.2 and 5.4.3 in Chapter 5, Part VII of *Publication 105/P*, shall be subject to acceptance procedures of the scope not lower than specified in the above tables, for category I. It applies, in particular, to steel pipes (*Publ. 105/P*, Part VII, Tab. 5.4.1) and to materials, machinery and equipment covered by tables 5.4.2 and 5.4.3 of Part VII in *Publ. 105/P*, such as:
– flexible pipes (they should be accepted in accordance with the requirements of API SPEC 17J or API SPEC 17K),
– flanges and other pipe connections,
– valves,
– flexible joints,
– measuring apparatus,
– safety equipment and systems.

The conditions, upon which the manufacturer's certificate (certificate 3.1, acc. to ISO 10474 (EN10204:20040), for pipes or other materials, may be accepted acc. to procedure 4 of Table 5.3.2, Part VII of *Publ. 105/P*, are subject to agreement with PRS.

2.5 Phase of supervision – Fabrication and installation

2.5.1 General

2.5.1.1 Documentation referred to in 2.5.2 shall be submitted to PRS for approval as a basis for supervision. It is recommended that the documentation should be in the form of installation manual. Prior to commencement of the successive phase of PRS supervision, the as-built documentation acc. to 2.5.2.3 shall be submitted to PRS.

2.5.1.2 PRS supervision at the phase of fabrication and installation:
– consideration and acceptance of documentation referred to in 2.5.2.1 and 2.5.2.2.
– supervision of the execution of technological operations and processes of the pipeline fabrication and installation on the sea bed, including control of processes conformity with installation manual. It applies, in particular, to operations resulting in plastic strain of the pipeline material.

2.5.2 Technical documentation

2.5.2.1 The subsea pipeline installation manual – the documentation which shall be submitted to PRS before the pipeline fabrication and installation, as a basis for surveillance. The manual shall contain at least:

.1 Plan and procedures of quality assurance and control.
.2 Procedures and other welding documents (WPS, WPQR, welders' qualification).
.3 Procedures for fabrication, including procedures for pipes connection by methods other than welding.
.4 Procedures of pipeline laying, including initiating, maintaining tension, pipeline burying, securing, technological breaks, repeated commencing works, completion of laying, drainage of pipeline.
.5 Operational procedures of floating units engaged in operations of the pipeline installation.

.6 Principles of control and recording essential parameters during pipeline installation, including measurement and recording of metal pipeline deformations.
.7 The method of detecting local buckling of metal pipe.
.8 The basis for qualifying objects, installation machinery and equipment (floating units, deck machinery for pipeline laying, measuring and other equipment).
.9 Procedures for cleaning the surface and applying external and internal protective coatings onto connections performed onboard the floating unit (Field Joint Coatings).
.10 NDT examination procedures.
.11 Procedures for measurement and detection of damages to protective coatings.
.12 Procedures for repairs of protective and loading coatings and coverings.
.13 Procedures for tightness and mechanical strength tests (pressure tests) of the pipeline.
.14 Procedure for carrying out survey and measurements after pipeline laying.

The procedures referred to above shall contain technical criteria for acceptance of correctness and results of individual operations carried out during the pipeline fabrication and installation.

The Installation manual shall also contain the below information:
– establishment of hydro- and meteorological conditions of the pipeline installation,
– the principles of the use of processing, measuring and recording equipment, applicable in the pipeline installation process,
– defining the methods of assessment and scope of tolerances for possible damages and installation errors,
– the procedures for damage repair.

2.5.2.2 The installation manual for riser

The installation manual for the riser may be a part of the Installation manual for the subsea pipeline. It shall cover the issues applicable to the riser, referred to in 2.5.2.1.1 to 2.5.2.1.14. It shall also include respective procedures.

2.5.2.3 The as-built documentation after the phase of fabrication and installation.

.1 Material certificates
.2 Manufacturing Procedure Qualification Test (MPQT) Certificate.
.3 Fabrication Procedure Certificate, containing significant parameters recorded during fabrication.
.4 Installation Procedure Certificate, containing all significant parameters recorded currently during the pipeline installation.
.5 NDT Certificate, Welders' Qualification Certificates and NDT Operator Certificate.
.6 Tightness Test and Mechanical Strength Certificates, if such tests of the pipeline or the pipeline section, or the riser have been performed at the phase of installation (before their assembly into the system).
.7 Report on the survey and measurements carried out after the pipeline laying *(as built survey).*
.8 Report on the measurements and repairs of protective and loading coatings and coverings.

2.5.3 Equipment of the pipe-laying ship, equipment for riser installation

The Orderer shall ensure the possibility of verification by PRS of compliance with the requirements of Part IV, paragraphs 2.2 and 4.

2.5.4 Trials of floating units and processing installations intended for pipeline laying and riser installation.

It is recommended that trials referred to in IV/2.3 should be carried out with the presence of Polski Rejestr Statków Surveyor. At the request of the Orderer, PRS may issue the test certificate.

2.6 The phase of supervision – examinations and tests

2.6.1 General

2.6.1.1 The system tests, and at least tests according to IV/5.2 and IV/5.5.3, shall be carried out under direct supervision of PRS.

2.6.1.2 The documentation referred to in 2.6.2 shall be submitted to PRS for approval, as a basis for survey.

2.6.2 Documentation

2.6.2.1 Procedure of final installation of the system – connecting the subsea pipeline with the onshore section, the riser and pumping station/compressor station[7].

2.6.2.2 The documentation for the preparation and performance of pressure tests *(Pre-Commissioning)*.

.1 Pre-commissioning procedures
- cleaning, control of the pipeline geometry
- filling the pipeline with test medium
- performance of strength and tightness tests of the subsea pipeline, together with the onshore section
- performance of strength and tightness tests of the riser
- dewatering
- drying.

.2 Pressure test documentation:
- the pressure and temperature record made during filling the pipeline with the test medium,
- calibration certificates of the measuring apparatus,
- calculation (if possible) of the air content in the tested space,
- the pressure and temperature record (of the test medium and the space) during the pipeline strength and tightness test.

2.6.2.3 Documentation of final tests *(Commissioning)*

.1 Procedures for
- filling the pipeline system with transported medium
- checking the control and measuring apparatus
- checking the PSD and ESD operation in the scope applicable to the pipeline system.

.2 Records
- of expenditure and physical parameters of the medium during the system filling,
- chemical composition of the medium.

.3 Operational manual of the system,
.4 Maintenance manual of the system.
.5 Control and maintenance plan of the system.

Items .4 and .5 (temporary form allowed) are required for the issue by PRS of provisional Temporary certificate according to 4.3.2 or 4.3.3.

2.6.3 PRS Certificates

Upon positive completion of tests and if respective conditions given in Chapter 4 are fulfilled, PRS may issue:
- Pipeline System Certificate of Conformity, acc. to 4.2.2
- Pipeline System Safety Certificate, acc. to 4.2.3
- Temporary Pipeline System Certificate (provisional), acc. to 4.3.2
- Pipeline System Certificate (permanent provisional), acc. to 4.3.3.

2.7 Phase of supervision – Operation

2.7.1 General

2.7.1.1 The above mentioned provisional certificates may be issued, provided PRS supervises the system in the operational phase.

2.7.1.2 The supervision consists in PRS attendance of specified surveys and tests, performed within the surveillance system developed by the Operator and accepted by PRS, and in verification and approval of the survey and test results.

[7] Pressure tests, depending on the system structure, may be performed before or after the final installation of the system – see 5.2 of Part IV

2.7.2 Documentation

2.7.2.1 The operational records: volume and physical parameters of the transported medium at the system input and output.

2.7.2.2 Records on the system surveys.

2.7.2.3 Records on maintenance activities, repairs and modifications.

2.7.2.4 Records on damages, hazardous and unexpected situations.

2.8 Phase of supervision (optional) – Decommissioning

2.8.1 Temporary decommissioning

2.8.1.1 Temporary decommissioning of the system is executed and documented so that the system operation could be re-commissioned.

2.8.1.2 The below documents shall be a part of the documentation submitted to PRS, related to temporary decommissioning of the system:
– Procedure of the system decommissioning,
– Procedure of surveys, if they are required,
– Protocol of the execution of the system decommissioning,
– Map of the pipeline, nautical map with the pipeline marked.

2.8.1.3 PRS Certificate

At the request of the Operator, the system may be temporarily decommissioned, with the Pipeline System Certificate validity maintained. The Operator request shall specify expected decommissioning period and contain, in the form of appendixes, the procedure for the system decommissioning and the procedure of surveys during this period, as well as the procedure for re-commissioning.

After the system survey, if PRS considers it necessary, an entry is made in the Pipeline System Certificate on the system transfer into decommissioning condition.

The basis for the system re-commissioning is Operator's request and the survey carried out, if PRS considers it necessary, to the scope agreed with the Operator.

2.8.2 Abandonment of the pipeline

2.8.2.1 The abandonment of the pipeline is an irreversible operation, upon which maintaining technical efficiency of the object as the pipeline may not be ensured.

2.8.2.2 The below documents shall be a part of the documentation submitted to PRS, related to the abandonment of pipeline:
– Procedure for disconnecting the pipeline from the system,
– Procedure for conducting works ensuring fulfilling the legal requirements, the safety of marine environment, the safety of ships traffic and fishing activities, the safety of other submarine structures,
– Procedure for surveys, if they are required,
– Protocol of the system decommissioning,
– Map of the pipeline, nautical map indicating the abandoned pipeline.

2.8.2.3 PRS Certificate

At the request of the Operator, PRS may issue, for the abandoned subsea pipeline, a single certificate of conformity, after verifying compliance with the requirements of Chapter 3, Part V.

3 PRS ISSUED CERTIFICATES

3.1 General

3.1.1 Polski Rejestr Statków issues, on the basis of approved positive results of certification supervision, certificates for the system, a part thereof, semi-finished products and materials. The PRS certification supervision covers, in general, the consideration of construction and materials documentation, survey of manufacture and participation in examinations and tests.

3.1.2 If PRS, after issuing the certificate, ends its activities related to the supervised object, then only the date of issue is given in the certificate.

3.1.3 The certificates, referred to in 3.1.2, confirm compliance of the system, a part thereof, a semi-finished product, material, at the day of the certificate issue, with specified requirements, in particular those covered by this Appendix.

3.1.4 If PRS, after the certificate issue, continues to supervise the object, the certificate may be issued as provisional one. The provisional certificate is valid from the day of issue until the date given on it. The validity may be prolonged after fulfilling conditions, referred to in 3.3.

3.2 Examples of certificates

3.2.1 Certificates for materials, semi-finished products and equipment components

For PRS accepted materials and semi-finished products, a survey certificate conforming to PN-EN 1024 Standard is issued according to the requirements of *the PRS Rules for the Classification and Construction of Sea-going Ships, Part IX – Materials and Welding*. Where applicable, PRS issues the Product Type Approval Certificate.

For PRS accepted components of equipment, documents are issued according to appropriate requirements of Chapter 5.3, Part VII of *Publication 105/P*.

The acceptance conditions for the manufacturer's certificate (certificate 3.1 acc. to ISO 10474 (EN10204:20040)) are given in 2.4.

3.2.2 Certificate of conformity of pipeline system or a part thereof

3.2.2.1 The PRS issued conformity certificate confirms that the system or its part conforms to the requirements of this Publication and to an approved technical documentation. The conformity certificates may also confirm that the system or its part conforms to applicable technical standards and legal regulations valid in the given area.

The conformity certificate issued for the system covers, if not specified otherwise, the subsea pipeline together with an onshore section and the riser. The borders are usually the flow stop valve (FSV) onboard the platform and the shut-down valve (SDV) on the inlet to the transported medium reception facility. The above valves are not covered with the conformity certificate.

3.2.3 Safety certificate of the pipeline system

3.2.3.1 The certificate confirms the system ability for safe operation, maintaining assumed operational parameters, provided that the Operator observes good operation practices and relevant quality system procedures.

3.2.3.2 The safety certificate covers, if not specified otherwise, the subsea pipeline together with onshore section and the riser. The borders are usually the flow stop valve (FSV) onboard the platform and the shut-down valve (SDV) on the inlet to the transported medium reception facility. The above valves are not covered with the pipeline system safety certificate.

3.2.3.3 The pipeline system safety certificate is issued, provided PRS states: the system conformity with technical standards, appropriate selection of materials, appropriate quality of the system manufacture, positive results of examinations and tests, as well as confirms that the Operator uses appropriate, noted by PRS, procedures referred to in 3.2.3.1. Moreover, PRS verifies that the safety and efficiency of installations associated with the system onboard the platform and onshore have been confirmed with respective certificate issued by PRS or another recognized body.

3.2.4 Test certificates

At the request and at the cost of the Orderer, PRS may issue the Test Certificate after tests of the system components or tests of machinery and technological systems intended for the system construction. The Orderer shall provide respective technical documentation, including test program containing acceptance criteria.

3.3 Principles of issue and maintenance of validity of provisional certificates

3.3.1 General

Permanent provisional certificates are issued generally for a complete pipeline system. The certificate confirms maintaining the system ability for safe operation in the specified period, after the date of the certificate issue. The conditions for PRS certificate issue are:

- stating by PRS: the system conformity with technical standards, appropriate selection of materials, appropriate quality of the system manufacture, positive results of examinations and tests, confirmed by previously issued Certificate of conformity for the pipeline system;
- stating by PRS that the system has the ability for safe operation, confirmed by previously issued Safety certificate for the pipeline system;
- stating by PRS that the Operator implemented appropriate, PRS accepted operational procedures and safety procedures, covered by an approved quality system;
- stating by PRS that the safety and efficiency of the installations associated with the system onboard the platform and onshore have been confirmed by relevant provisional certificate issued by PRS or another approved institution;
- taking by Polski Rejestr Statków, at the request of the Operator, supervision of the system in operation.

3.3.2 Temporary certificate for the pipeline system

If implementation or acceptance of operational and safety procedures, referred to in 3.3.1, is in progress or other reasons exist that preclude the issue of long-term certificate, PRS may issue temporary certificate. Such certificate is issued generally only one time and it is not subject to endorsement or prolongation. For well-ground reasons such certificate may be invalidated by PRS. In special cases the certificate may be renewed, with a new validity term.

3.3.3 Pipeline system certificate

If the conditions referred to in 3.3.1 are complied with, PRS issues for the system, in agreement with the Operator, the Pipeline system certificate. It is a limited time certificate. Its validity may be prolonged respecting the principles specified in 3.3.4 to 3.3.6.

3.3.4 Validity period of the Pipeline system certificate

3.3.4.1 The certificate validity period is only 5 years from the date of certificate issue by PRS.

PRS may, in agreement with the Operator, define another validity period of the certificate, taking into account the system technical condition, including the system operation intensity, hydro- and meteorological factors, corrosion condition, changes of the medium characteristics, etc.

3.3.4.2 Within the validity period of the certificate, PRS surveys for confirming its validity may be arranged. They are, generally, annual surveys. PRS may, in agreement with the Operator, specify another intervals between surveys.

3.3.4.3 The period of validity and dates of PRS surveys for confirmation of certificate validity are shown on it.

3.3.5 Conditions of maintenance of the Pipeline system certificate validity

3.3.5.1 The Operator shall maintain the system in proper condition, complying with issued PRS certificates.

3.3.5.2 The Operator shall ensure to Polski Rejestr Statków:
– informing on the system operation history, including unexpected, also emergency, conditions;
– informing on intended and executed measuring, maintenance and repair activities and agreeing, at PRS request, technical conditions of such works, performed by the Operator and/or a Third Party;
– possibility of carrying out periodical surveys of the system and/or submission of reports and other materials from agreed inspections carried out by the Operator and/or a Third Party.

3.3.5.3 Repairs of significant components of the system and associated corrections of the sea bed shall be performed in agreement with PRS. At the request of PRS, specified repairs and corrections shall be executed under direct or indirect supervision of Polski Rejestr Statków.

3.3.5.4 The Operator shall execute RC recommendations in due time.

3.3.6 Certification recommendations and information

3.3.6.1 RC Recommendation

The RC Recommendation is a message from PRS to the Operator, related to maintenance of the pipeline system certificate validity. The RC Recommendation is issued when, in PRS opinion, the operator shall perform defined technical and/or organizational activities to maintain the system safety.

Execution of the technical and/or organizational activities mentioned in the RC Recommendation until the date specified therein, is a condition of maintaining the certificate validity. Confirmation of the above activities execution requires as a rule performance of PRS survey.

3.3.6.2 IO Information

The IO Information is a PRS message to the Operator, related to technical and/or organizational matters associated with the pipeline system, which is not a condition of maintaining the system certificate validity. The IO Information has a nature of an advice which should be considered by the Operator, and PRS does not impose the method and term of solving the problem being the subject of the Information.

3.3.7 Prolongation and confirmation of the Pipeline system certificate validity

3.3.7.1 The certificate validity, after its expiry, is prolonged by PRS for the following certification period on the basis of survey. PRS agrees the scope of the survey for prolongation of the certificate validity with the Operator.

3.3.7.2 Confirmation of the certificate validity acc. to 3.3.4.2 is carried out by PRS on the basis of survey. PRS agrees the scope of the survey for confirmation of the certificate validity with the Operator. The survey scope may be entered in the certificate.

3.3.8 Suspension, loss and reinstatement of the Pipeline system certificate validity

Suspension, loss and reinstatement of the PRS certificate are governed by the principles given in Chapter 7, Part I of *Publication 105/P*.

The reason of the suspension of the certificate may be, inter alia, suspension or loss of validity of the document referred to in 3.3.1, confirming the safety and efficiency of the installation associated with the system onboard the platform or onshore.

3.3.9 Limited time certificate for the system being a part of the pipeline system

In special cases, PRS may issue, according to principles specified in 3.3, a limited time certificate for a defined system/systems being a part of the pipeline system, for example to the riser system and/or to the gas compression unit.

3.3.10 Other limited time certificates

In well-ground cases, e.g. for the component or material, for which important criteria of its storage method and/or period are specified, PRS may issue a limited time certificate.

4 RISK ASSESSMENT

4.1 General

4.1.1 On demand of the Orderer or a Third Party, PRS may prepare the risk assessment for the system or a part thereof. The assessment may be performed at each phase of the pipeline execution, during its operation and before its decommissioning.

4.1.2 For the system or a part thereof, the below methods of risk assessment may be applied:
– PHA – for the phase of design assumptions and design preparation,
– HAZID, HAZOP, FMEA, FMECA – for the phase of design and next ones,
– other methods, if proved reasonable.

4.1.3 All hazards for possible real scenarios of dangerous and adverse events shall be recognized. Resulting consequences shall be assessed. It is recommended to reference the hazards to respective category, similar as generally defined in 5.5.

4.1.4 The risk assessment may contain opinion or assessment on the system reliability and integrity, with the scope and nature relevant for the given technical condition of the system and the system operation and life phase.

4.2 Conditions for the performance of risk assessment by PRS:

4.2.1 Conclusion by the Orderer of the agreement with PRS for the performance of risk assessment.

4.2.2 Transfer of technical documentation to PRS within the scope respective for the given phase of the pipeline operation and life, in accordance with the requirements of chapter 2. The number of copies should be agreed. If PRS performs the assessment for a part of the system, the scope of transferred documentation shall be in general the same as for the assessment of the whole system.

In reasonable cases PRS may agree to reduction of the documentation scope or may require from the Orderer an additional documentation or a written information. The basis for assessment is always documentation in the scope as transferred by the Orderer to PRS.

4.2.3 Substantial cooperation at the assessment, consisting in the participation of the Orderer representative in PRS organized sessions for risk assessment and/or reliability/integrity assessment, for supplementary explanations.

4.3 Final documents transferred to the Orderer

The final document from the assessment of risk and/or reliability of the system is a report including:
– reports of held sessions of the risk/reliability assessment,
– technical and/or organizational information and recommendations after the assessment, where necessary,
– final conclusions.

Moreover, at the request of the Orderer, PRS may transfer 1 copy of documentation referred to in 4.2.2, marked as the basis for the performed assessment, which is signed and stamped.

4.4 PRS acceptance for the risk assessment performed by the Orderer or a Third Party

PRS may accept the risk assessment for the system or a part thereof, performed by the Orderer or a Third Party. The assessment executor shall:
– fulfil general conditions, referred to in 4.1.2, 4.1.3,
– submit documentation according to 4.2.2 for PRS acceptance,
– submit final documents from the risk assessment, acc. to 4.3, for PRS acceptance.

4.5 Consideration and categorization of hazards

The below tables present examples of hazards categorization. The tables may be used respectively for the assessment of hazards associated with particular dangerous and adverse scenarios.

Tab. 4.5.2 Categories of the system location areas	
Category of area	Area features
1	In this area, no frequent human activity is noted
2	The area in which the riser and the subsea pipeline are located close to the manned platform, and the area in which human activity is frequently met. This area shall be established based on the risk assessment. Approximately, the safety distance shall be maintained there, that means at least 500 m from the system components which pose any hazard.

Tab. 4.5.3 Categories of hazard (on the basis of initial risk evaluation as a combination of probability of occurrence and severity of damage consequences)	
Hazard category	Hazard characteristics
Low	Risk of damage to human health or life, natural environment and economic damage is estimated low
Medium	Risk of damage to human health or life, natural environment and economic damage is estimated medium. Risk of economic and political damage is estimated high.
High	Risk of damage to human health or life, natural environment and economic damage is estimated high.. Risk of economic and political damage is estimated high or very high.

Tab. 4.5.4 General category of hazard to the system construction and operation

Phase of execution or operation	Factor of categories A and C		Factor of categories B, D and E	
	System location		System location	
	1	**2**	**1**	**2**
Construction and installation of the system	Low	Medium	Medium	Medium
Commissioning, tests	Low	Medium	High	High
Operation	Low	Medium [8]	Medium [8]	High
Decommissioning	Low	Low	Medium	High

5 ASSESSMENT OF SYSTEM INTEGRITY

The assessment of the system integrity is performed within the scope of executing particular phases of PRS supervision, referred to in 2.6, 2.7 and 2.8. The basis for the assessment are the results of surveys performed by PRS Surveyors and verification of Operator’s documentation of measuring, maintenance and repair activities carried out by Operator personnel or an approved service supplier.

The scheme *Safety Evaluation of Pipelines* contained in ISO 13623, Annex A, is useful at the assessment of the system integrity.

[8] In normal operation, the riser may be treated as the system component included in category “High”.

PART II – SAFETY REQUIREMENTS AND DESIGN ASSUMPTIONS

1 INTRODUCTION

Part II of the Appendix contains:

- the indications for establishing safety, environment protection, efficiency and reliability objectives,
- the requirements for risk assessment,
- the requirements for quality assurance,
- discussion of basic issues and activities related to design assumptions.

2 ESTABLISHING OF OBJECTIVES

At formulation of design assumptions, the objectives within the scope of safety, environment protection, efficiency and reliability of the system, costs, etc., shall be established in relation to the given location and designation of the system.

2.1 Example objectives related to human and infrastructure safety

- no serious accidents shall occur within the period of the system construction,
- the method of the system construction shall ensure maintaining, in the pipelines, pressures present during the pipeline laying, within permissible limits,
- the system shall not obstruct the floating units access to a specified port. .

2.2 Example objectives related to environment protection

- the effect of the construction and operation of the system on the marine environment shall be reduced to the reasonable degree (ALARP),
- during the system operation and decommissioning, no medium leakages to the ground, sea or atmosphere are permitted,
- the system shall not obstruct fishing activities.

2.3 Example objectives related to the system efficiency and reliability

- the system shall maintain assumed transport capacity within the period of 20 years,
- the probability of the system inefficiency within 20 years shall not be more than 10^{-4} /a year,
- the system (or a defined part thereof) shall not require submarine maintenance works within the period of … .

2.4 Example objectives related to the system costs

- the pipeline installation shall be effected by own technical resources of the Investor,
- the subsea pipeline shall not require maintenance work within its whole operational period,
- surveys of the components of the system in operation shall be effectively performed by means other than diving inspections.

2.5 The assessment of risk and reliability of the system

In the assumption phase, a pre-assessment of the system risk and reliability shall be performed. Submitting the assessment to PRS for information is recommended. The assessment may be made by PRS to the principles specified in Chapter 4, Part I.

2.6 Quality assurance

It is recommended to prepare the quality plan for the phase of execution of design assumptions. The plan shall define responsibilities of persons and teams executing, assessing, agreeing, verifying, issuing and controlling documents and their sending for approval.

3 FORMULATION OF DESIGN ASSUMPTIONS

3.1 General

3.1.1 Chapter 3 provides principles of establishing design assumptions and, in 3.2, lists basic issues which should be considered by the Designer. Some issues and related required activities are discussed in more detail in 3.3 to 3.6. Detailed technical requirements, suitable at establishing the assumptions, are included in Part III and in referred there standards and publications, mentioned in 1.7 of Part I.

3.1.2 Technical and organizational design arrangements presented by the Orderer, related to the issues referred to in 3.2, 3.5, 3.6, and environmental reports and data referred to in 3.3 and 3.4 are subject to PRS consideration and approval, not later than at the design phase (see Chapter 2, Part I).

3.2 Basic issues

- safety and environment protection objectives,
- system location, conditions in places of the medium inflow and receipt,
- obstructions of the pipeline route, other installations,
- planned intermediate and final dates of the system execution,
- planned date of the system decommissioning,
- precise data on the transported medium, including future changes,
- presence of sand or other solid particles in the transported medium,
- the system transporting capacity,
- ensuring continuity of the medium flow,
- protection of the system against excessive increase of the medium pressure,
- the subsea pipeline resistance to external pressure,
- ensuring maintaining the limits of permissible stresses and strains during installation of the pipeline and riser,
- durability and integrity of flexible pipe riser and other components,
- internal obstructions in the subsea pipeline, requirements for valves, elbows and other fittings,
- use of cleaning and/or measuring pig (if applied),
- geometrical requirements for the pipeline subjected to cleaning and/or inspection by a pig,
- assumed scope of monitoring and inspection of the system in service,
- third party actions having effect on the system integrity,
- ecological requirements for the system decommissioning.

3.3 System location, geological conditions

3.3.1 Pipeline route

The pipeline route shall ensure possibly high security of employees and bystanders, proper protection of environment and possibly low probability of the pipeline destruction or damage, and damage to third parties. At least the factors referred to in 3.3.1.1 to 3.3.1.5 shall be analyzed.

3.3.1.1 Surrounding environment
- the environment sensitivity to ecological damage,
- protected areas.

3.3.1.2 Sea bed topography
- sea bed stability,
- sea bed unevenness and diversity,
- settlement,
- seismic loads.

3.3.1.3 Existing installations and structures
- active and abandoned excavating systems,
- existing pipelines and cables,
- buildings and structures protecting the shore,

3.3.1.4 Third Party actions
- ship traffic,
- fishing,
- discharge areas,
- The Navy units activity areas

3.3.1.5 Conditions in the region of the pipeline shore approach section
- local legal conditions,
- population density,
- location of residential settlements and communal infrastructure,
- possible and expected works in the vicinity of the pipeline,
- restrictions to the time of the system construction in the region of the shore approach section.

3.3.2 Review of the pipeline route

3.3.2.1 The review of the pipeline route shall be carried out and documented. The width of the reviewed belt, the review accuracy, the amount and detail of collected information shall ensure further safe installation of the pipeline and safe operation of the system.

3.3.2.2 The review accuracy shall be adopted to local conditions. It shall be increased in places where collisions, or other factors which impede the pipeline installation, occur or may be expected in the future.

3.3.2.3 Positions of obstacles such as wrecks, rocks, cavities shall be established.

3.3.2.4 Within the framework of the route review, local features of bottom topography shall be identified, which affect or may affect installation, stability and strength of the pipeline, such as:
- obstacles to be removed or levelled off prior to commencing of the pipeline installation, such as rocks, stones, big heaps of clay and other significant ground irregularities,
- features of sea bed topography indicating potentially possible ground instability, such as slopes, ground waves, valleys, cavities, sea bed regions subject to erosion or carrying deposits in result of sea currents action.

3.3.2.5 The review results shall be shown on the map. In particular, places referred to in 3.3.2.3 and 3.3.2.4 shall be indicated.

3.3.3 Geotechnical properties of the sea bed

3.3.3.1 Principal parameters of the ground, essential for the assessment of the possibility of loading it by the pipeline, are the shear strength characteristics and deformation characteristics. The parameters shall be determined on the basis of laboratory and/or local examinations.

3.3.3.2 Geotechnical properties of the sea bed may be determined on the basis of available geological information and seismic examinations, drillings and sample examinations, topographical reconnaissance. Visual observations and special tests may be a supplement.

3.3.3.3 Geotechnical properties of the sea bed, necessary for the assessment of pipeline load effects, shall be determined also for the subsurface layers. It applies also to the whole area in the vicinity of the pipeline if low stability of the layers is suspected.

3.3.3.4 Additional examinations may be required for the areas referred to in 3.3.2.5, and for the places where difficulties at trench making works and/or the pipeline covering or at passing the route of another pipeline or cable are expected and for places where the ground hydration is possible upon ~~in result of action~~ of repeated loads.

3.4 Environmental conditions and data

3.4.1 Natural environment phenomena

3.4.1.1 Influence of the below phenomena and parameters, which could impair reliability and safety and obstruct of the system or preclude its proper operation, shall be considered:
- wind,

– waves,
– sea currents,
– ice, icing,
– water and air temperature,
– seismic phenomena (if any),
– water physical and chemical properties,
– changes of physical properties of the sea bed,
– biofouling of subsea sections of the system.

3.4.1.2 Aimed at the assessment of the effect of natural phenomena, the pipeline may be divided into sections, having different features, such as water depth, sea bed topography, water temperature and other.

3.4.2 Collection and use of environmental data

The environmental conditions shall be accurately characterized by the set of data of the system location area. The data set shall be submitted by an approved expert/group of experts.

Variable characteristic features of the environment shall be described based on statistical data collected for many years. If such data are incomplete, a conservative use of statistical data from nearby and similar areas may be permitted.

3.5 Corrosion protection

3.5.1 Corrosion protection during the pipeline construction

The corrosion protection program for pipe surfaces during storage, transport, fabrication, assembly, installation and pressure and commissioning tests, shall be prepared. Particular attention shall be paid to the duration of pipe surface contact with sea water and humid air. Use of inhibitors or other corrosion protection means shall be considered.

3.5.2 Permanent protection of external surface of the pipeline

3.5.2.1 Environmental conditions along the whole route of the pipeline shall be analyzed, for corrosion hazard. The corrosion protection project shall consider such environmental features as:
– maximum and average water temperature along the pipeline route,
– water salinity,
– oxygen content in the water,
– the water pH,
– water and sea bed deposits impedance,
– water currents,
– water bioactivity,
– pipeline arrangement – on the surface, dug in a trench, covered, etc
– effect of corrosion protection systems, existing and working in the vicinity of the designed pipeline.

3.5.3 Permanent protection of internal surface of the pipeline

Aimed at selecting proper means/system of corrosion protection, the below conditions and parameters shall be recognized and determined:
– maximum and average water temperature along the pipeline route,
– flow velocity of transported medium,
– chemical composition of the medium (initial and expected during operation), with particular consideration of corrosive components, such as hydrogen sulphide, carbon dioxide, water, salts, residual oxygen and halogens in sea water.
– chemical (e.g. cleaning) additives to the medium,
– possibility of corrosion,
– possibility of internal inspection of the pipeline surface and of the measurement of pipe wall thickness.

3.6 Protection of the system against excessive rise of internal pressure

If the delivery system is able to deliver, including dynamic effect of quick flow shutdown, the medium of pressure higher than the design internal pressure, then the pipeline system shall be equipped with automatically operated system protecting against excessive pressure rise. The protection system, as a rule, shall consist of the pressure control system and the safety system – preventing the excessive pressure rise.

The control system (e.g. control of compressor or pumps, control valve) shall ensure, at defined conditions of the medium flow, that the internal pressure in no point of the pipeline system exceeds the maximum allowable operating pressure (MAOP).

The safety system (which enables at least the cut-off of the medium inflow by means independent from the control system) shall ensure that the incidental pressure (see definitions) in no point of the system does not exceed the value of MAOP x 1.1.

PART III – DESIGN OF THE SYSTEM

1 GENERAL PROVISIONS

1.1 Basic requirements

The system shall be designed in accordance with the PRS requirements covered by this Part III of the Appendix and additionally:
– in accordance with applicable legal requirements obligatory in the given marine and onshore area;
– the international standard ISO 13623.

1.2 Application of standards, alternative procedure

Other relevant standards or normative documents belonging to the sets given in Part I, para. 1.7 may be applied instead of ISO 13623 Standard. Such set shall be chosen by the Designer or the project Orderer upon PRS opinion. Use of other than above normative documents is allowed upon PRS acceptance.

During designing, in principle, one set of normative documents[9] shall be used, e.g. ISO Standards or alternatively ASME or API Standards. Use in one project principal standards or other normative documents belonging to different sets, including publications referred to in Part I, paragraphs 1.8 and 1.10, shall be verified and assessed by PRS.

In specified conditions, alternative procedure may be permitted, ensuring safety level not lower than applied in the above standards and designing according to considered by PRS and approved standard of the system supplier/executor.

1.3 Initial design

It is recommended that, already within the initial design, the below initial arrangements, assessments and analyses should be performed:

.1 Choice of the pipeline route.
.2 Stability analysis of the pipeline laid on the sea bed, including:
– analysis of bathymetric profile,
– stability and load-capacity assessment of upper layers of the sea bed
– assessment of horizontal forces acting on the pipeline from the ground, including friction forces,
– assessment of hydrodynamical forces acting on the pipeline, in particular on the unsupported or spot supported sections,
– selection of means ensuring protection and stability of the pipeline laid on the sea bed.
.3 Analysis of ensuring the system carrying capacity.
.4 Determination of the internal diameter of the pipeline.
.5 Thermal and hydraulic analysis of the flow.
.6 Selection of construction materials for the pipeline and riser.
.7 Assessment of hydrodynamical forces acting on the riser.
.8 Determination of the maximum allowable operating pressure (MAOP).
.9 Assessment of internal corrosion resistance of the pipeline.
.10 The concept of external corrosion protection.
.11 Selection of methods of installation and assembly of the pipeline and riser.
.12 Selection of the method of execution of the shore approach and onshore section of the pipeline.
.13 Initial risk analysis or update of the analysis performed within the scope of design assumptions.

1.4 Quality Plan

Preparation of the Quality Plan for the design is recommended. The Plan shall present the structure of design team(s), contain the schedule of designing and transferring documents for acceptance. It shall define the responsibility of design teams and persons for designing, agreeing, verifying, issuing and controlling documents.

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[9] Account should be taken of, inter alia, different definitions of the pressure of transported medium, used in various standards and publications and of that the values of design/safety factors applied for the ultimate limit state method are as a rule different from those applied for the permissible stresses method. Taking the above into account, the use of data or calculation result according to one standard as an output value or for comparison with calculation results performed according to an other standard, may lead to false conclusions.

1.5 Design report

From the commencing of further (other than initial) design phases, a design report, identifying all documents specified in 2.3.2 of Part I and presenting all basic data of the system, calculation results, conclusions and recommendations, shall be maintained and updated. The report or documents referred to therein shall include results of arrangements, assessments and analyses referred to in 1.3.

In the report, basic information specified below shall be collected in a concise form:
- chemical composition and physical properties of the transported medium,
- carrying capacity of the system,
- normal operational pressures and temperatures,
- internal design pressure,
- maximum allowable operational pressure (MAOP),
- environmental operational conditions,
- testing pressure of the system,
- testing pressure of the pipes at the manufacturer's works,
- maximum, allowable in the pipeline fabrication and installation process, single and total, plastic strain of pipes.

1.6 Documentation scope and date of transfer for PRS approval

The documentation scope and date of transfer is given in 2.3.2 of Part I. PRS may agree with the Operator the schedule of documentation transfer.

2 SELECTION OF MATERIALS

2.1 General requirements

2.1.1 Materials, semi-finished products and equipment shall be manufactured in accordance with the requirements of relevant standards or other normative documents specified in 1.7 of Part I. Examples of standards useful in particular applications are given in 2.2 to 2.4.

2.1.2 Applied materials shall ensure integrity of the system transporting hydrocarbons of given chemical composition, temperature and pressure, at expected loads. At the selection of materials, the below aspects shall be considered:
- mechanical properties of material,
- properties, temperature, distribution of pressures of the transported medium,
- corrosion resistance in assumed conditions,
- environmental conditions,
- installation methods and procedures,
- weldability,
- fatigue strength,
- resistance to cracking and crack propagation.

2.2 Steel pipes

2.2.1 ISO Standards

Specifications of material, geometrical dimensions and manufacturing processes of steel pipes are contained in ISO 3183 (:2012), including:
- requirements for pipes (PSL2) for subsea pipeline systems – ISO 3183, Annex J.
- requirements for pipes (PSL2) resistant to plastic crack propagation – ISO 3183, Annex G
- requirements for pipes (PSL2) for sour service pipelines – ISO 3183, Annex H.

2.2.2 API Standards

Specifications of material, geometrical dimensions and manufacturing processes of steel pipes are contained in API SPEC 5L, including:
- requirements for crack-resistant pipes – API SPEC 5L, Appendix F/SR5
- additional requirements for crack-resistant pipes – API SPEC 5L, Appendix F/SR19.

2.2.3 ASTM material specifications

Designations of ASTM specifications for materials for steel pipes used in the construction of subsea pipelines may be found in Chapter MATERIALS of ASME B31.4 and ASME B31.8 Standards.

2.2.4 Weldability, general information

2.2.4.1 Carbon equivalent

The carbon equivalent CE is determined on the basis of ladle analysis, aimed at defining weldability of carbon or carbon-manganese steel pipes, according to the formula 2.2.3.1

$$CE = \%C + \%Mn/6 + (\%Cr + \%Mo + \%V)/5 + (\%Cu + \%Ni)/15 \qquad (2.2.4.1)$$

If the maximum value of CE is not specified in the standard for the given material, it is normally assumed (ISO 13623) that is shall not exceed 0.45 for steel with SMYS value up to 360 MPa and 0.48 for SMYS exceeding 360 MPa.

If in the material standard the maximum value of CE is defined, the material qualified for welded structures shall fulfil both material standard criterion and the criterion given above in 2.2.4.1.

2.2.4.2 Cold cracking resistance factor of material

In order to compare susceptibility to cold cracking of various steel grades, the PE factor calculated from formula 2.2.4.2 may be applied.

$$PE= \%C + \%Si/30 + (\%Cr + \%Mn + \%Cu)/20 + \%Ni/60 + \%Mo/15 + \%V/10 \qquad (2.2.4.2)$$

The value of PE factor shall be restricted, in particular for materials used for the sour service pipelines.

2.2.5 Other requirements

The requirements defining criteria and method of the performance of the impact test for the materials used for pipelines carrying media o categories C, D and E acc. to Table 4.5.4 of Part I are specified in ISO 13623 - 8.1.6 and 8.1.7.

The requirements for the material of the pipeline laid by methods where plastic strain of pipes may occur – see e.g. DNV-OS-F101 – Submarine Pipeline Systems, Sec. 10. E 100.

2.3 Flexible pipes

The requirements for flexible pipes and pipelines are contained e.g. in the below standards:

- ISO 13628-2, ISO 13628-10
- PN-EN ISO 13628-10
- API SPEC 17J, API SPEC 17K (substantially in accordance with ISO 13628-10).

2.4 Pipeline equipment

2.4.1 General

2.4.1.1 Steel components of the pipeline equipment, such as flanges, elbows, valves, t-connectors, pipe connectors shall comply with at least the same strength, usability and environmental requirements, as specified for the pipeline where they will be installed.

2.4.1.2 The materials of the pipeline equipment components shall be compatible with the material of pipes as regards their strength, corrosion resistance and welding. The internal diameter of the components shall be equal to internal diameter of the pipe. The ASME B31.8 Standard, Appendix I defines the method of welding the pipeline equipment components in case of any difference in the wall thickness or mechanical properties of material. .

2.4.2 Flanges

Specifications of materials and geometrical dimensions of flanges are contained e.g. in API SPEC 17D and ASME B16.5 Standards.

2.4.3 Dimensions of connections

Typical materials and geometrical dimensions are given e.g. in API SPEC 17D, ASME B16.9, ASME B16.11 and ASME B16.25 Standards.

2.4.4 Seals, sealing materials

Typical materials and geometrical dimensions are given e.g. in API SPEC 6A and ASME B16.20 Standards.

2.4.5 Bolts, pins

Typical materials and geometrical dimensions are given e.g. in API SPEC 17D and ASME B16.5 Standards.

2.4.6 Valves

Typical materials and geometrical dimensions are given e.g. in ISO 14313, API STD 600, API SPEC 6D, ASME B16.10 and ASME B16.34 Standards.

The specification of valves for subsea applications is contained in API SPEC 6DSS and ISO 14723 Standards.

2.4.7 Pipeline equipment of flexible pipe riser

The equipment may include e.g. connectors and bend limiters. See API RP 17B Standard, Chapter 4, API SPEC 17J, API SPEC 17K.

2.4.8 Supporting and securing structures

2.4.8.1 The supporting and securing structures shall comply with API RP2A-WSD and ASME B31.4 Standards.

2.4.8.2 Supporting, fixing, anchoring etc. components shall be manufactured in accordance with ASME B31.4 (for the pipelines transporting liquid media) or with ASME B31.8 (for gas pipelines).

2.4.8.3 Welding the supporting, fixing, anchoring etc. components directly to the pipe forming the pipeline is not permitted. An exemption may be made for clamping rings wholly embracing the pipe and fixed by full circumferential weld.

2.5 Anti-corrosion coatings

The anti-corrosion field joint coatings and covers laid by the pipe manufacturer, as well as by the pipeline fitter, shall be selected taking into account:
- anti-corrosion properties of the coating,
- durability within the expected temperature range,
- adhesion properties and effect of cathodic protection on the properties,
- mechanical properties of the coating,
- impact resistance,
- resistance to sea water,
- resistance to chemical, biological and microbiological agents,
- the coating ageing, brittleness and cracking,
- water absorption,
- the coating impedance,
- compatibility with the cathodic protection system,
- the change of the coating properties over time,
- local legal requirements valid in the given marine area.

3 LOADS AND STRENGTH

3.1 General

3.1.1 Calculation methods

In Chapter 3, basic requirements are given related to the pipeline design and strength calculations with the use of allowable stress design method .

Other calculation methods/formats described in standards and other normative documents specified in 1.7, Part I, may also be used, in particular the method of limit state design (use of API RP 1111, Sept. 2015) is recommended), which at high pressures of the medium and large diameters and lengths of the pipeline may ensure considerable saving of steel.

A part of the requirements specified in Chapter 3 is applicable also for the assessment of risers strength, especially the steel catenary risers. Other requirements for risers are contained in Chapter 4.

3.1.2 Identification of formulas, coefficients, data

The design documentation shall expressly identify the origin of each calculation formula, coefficient and technical data used by the designer in calculations.

3.1.3 Software

Each software used for the pipeline analyses and calculations shall be suitable for proper modelling of the object, and calculation and presentation of effects of loads and their combinations in the form of stresses and strains. The software reliability and accuracy shall be verified and confirmed. The software shall present results by the method which allows identification of adopted loads and resulting stresses in essential points of the object.

3.2 Determination of structure loads

3.2.1 Loads in the construction process

3.2.1.1 Characteristic loads in the construction process

During the pipeline construction, loads may occur due to pipe bending and in result elastic and plastic strains. It applies in particular to operations performed during fabrication and installation of pipeline sections reeled on a drum. The pipe plastic strains may be met during:

– pipes manufacturing and testing by the manufacturer,
– pipes storage and transportation,
– fabrication,
– technological activities associated with pipes/prefabricated elements preparation for installation,
– the pipeline installation; such strains are normally the result of adopted pipeline laying technology, however, they may be caused by unevenness or non-homogeneity of the bottom substrate as well as by undesirable movements of the pipe laying vessel, exceeding proper limits by the pipeline tension force or by other laying errors. Influence of the above factors on the reduction of the pipeline strength shall be considered.

3.2.1.2 Analysis of strains in the construction process

This requirement applies in particular, however not exclusively, to reel-laid pipelines.

If the pipe plastic strain during construction is anticipated in the design or is likely to occur, then the number and geometry of bends at individual operations shall be determined and resulting strains shall be calculated. Such bends may occur during reeling in/rewinding/reeling out fabricated pipe, at the guiding, straightening, in the region of stinger and at the touch down point. The first layer of the reeled pipe is normally subjected to the heaviest strains.

Based on the geometry of expected technological devices (such as a drum, a guiding wheel, a straightener) the following shall be determined for the given pipe (see: Definitions in Part I):

– total single-event strains,
– total plastic strains,

– accumulated plastic strains.

Generally it is assumed [11], [12] that:
– if the biggest total single-event strain, in any direction, exceeds 0.4%, it should be proven by means of ECA analysis that the pipeline safety is not impaired,
– if the biggest total single-event strain, in any direction, exceeds 1% or the accumulated plastic strain exceeds 2%, then for the pipe material additional acceptance requirements shall be applied (example DNV OS-F101 Sec.7 I 300).

3.2.2 Functional loads

The functional loads occur in result of normal use of the system. They include also residual loads which are consequent upon the pipeline construction/installation process.

Generally, the functional loads are due to:
– the weight of the pipeline structure and the bottom response,
– the transported medium mass, pressure, temperature, velocity and changes of flow direction,
– the properties of sea water – hydrostatic pressure, displacement force.

3.2.3 Environmental loads

3.2.3.1 The environmental loads include the loads due to:
– sea currents and waves action,
– high and low tides,
– wind,
– biofouling
– sea bed instability
– sea bed washing out
– seismic movements
– sea bed hydration
– icing

If any of the above loads may in particular case take so high value that it may result in breaching the system integrity and/or damage to environment, then this load value shall be considered as accidental load.

3.2.3.2 The environmental loads referred to in 3.2.3.1 act on the principal components of the system, such as subsea pipeline and the riser, in a different way.

The waves action and sea currents (including tides) may have effect only on the pipeline sections which are neither covered in the trench nor efficiently covered otherwise, including unsupported spans. Moreover, the waves action effect decreases with a depth. To avoid undesirable results, the unsupported spans shall be eliminated and installation of the pipeline on the sea bed without covering avoided where the pipeline could move along the sea bed under hydrodynamical forces. One of the methods of eliminating the unsupported spans is jetting trenches under the pipeline on the edges of ground lowering, so that the pipeline passing the lowering could be supported along the whole span.

Biofouling of the subsea pipeline occurs only at low depths and only on non covered spans.

The catenary riser is subject along its whole length to permanent action of wind (in the non submerged part), waves action and sea currents, while the instability and washing out phenomena, or sea bed hydration which are essential for the subsea pipeline, are of minor importance for the riser. Icing of upper part of the riser may have significant impact on its integrity. The riser connected to the fixed offshore platform (static application riser) is subject to variable loads due to waves action, while, in contrast to dynamic application riser, it is not subjected to the loads due to movements of the floating object housing the reception or delivery facility for the transported medium. The riser is subject to biofouling down to high depth.

The riser housed in J-tube is not practically subject to variable environmental loads.

3.2.4 Accidental Loads

The loads, the occurrence of which is of accidental nature, which may be met in slightly probable but possible circumstances, such as extreme environmental factor (3.2.3), human error or a serious technical failure, are considered accidental loads. The probability of occurrence and consequences of possible accidental loads shall be considered, in order to decide if the pipeline shall be designed so that it withstands the given load (always in combination with other loads, see 3.3.3.5).

The accidental loads include, inter alia, the loads due to:

– collisions with floating objects,
– collisions with fishing equipment (trawling boards, nets),
– strike of objects thrown from floating means,
– hydrotechnical works, such as dredging works carried out in the vicinity of the pipeline.

3.3 Strength calculations

3.3.1 General

3.3.1.1 It shall be confirmed that the subsea pipeline and the riser are capable of withstanding loads which may act during the pipeline construction, operation and decommissioning. The loads may be permanent, instantaneous or cyclic ones. The loads which occur simultaneously shall be considered in combination, taking into account where reasonable the probability or frequency of non-permanent loads, in particular the accidental loads. Examples of the use of loads combination in strength calculations are given in 3.3.3.5.

3.3.1.2 The calculations and analyzes shall include:

– casual strength calculations (3.3.3.1 ÷3.3.3.5),
– analysis of the possibility of crushing the pipeline by external pressure (3.3.3.6),
– analysis of the possibility of local buckling of the pipeline during its installation and assessment of its resistance to buckling propagation (3.3.3.7, 3.3.3.8),
– comparison of the riser and the subsea pipeline burst pressures (3.3.3.9),
– analysis of temperature linear expansion and possibility of global buckling of the pipeline (3.3.3.11),
– assessment of the resistance to damage due to static forces of unsupported spans of the pipeline and/or those subjected to waves action (3.3.3.12),
– analysis of vibrations, casual strength and fatigue strength and fracture resistance – inter alia when permanently unsupported pipeline spans (hung over lowered sea bed or supported on a local, fixed in the sea bed, artificial or natural support) are expected, based on the results of dynamical and fatigue analysis (3.3.4).

3.3.2 Acceptance of data for strength calculations acc. to 3.3.3

3.3.2.1 Initial configuration of the system

Initial configuration of the system shall determine data for calculations, including:

– chemical composition of the transported medium,
– pressure, mass flow, temperature, density and physical state of transported medium,
– depths of the subsea pipeline and height above the sea level of the above-water part of the system,
– geometrical dimensions of the subsea pipeline and the riser, diameters and thicknesses of pipe walls,
– materials for the subsea pipeline and riser,
– assumed lengths of unsupported spans of the subsea pipeline (if any).

3.3.2.2 Internal design pressure

The internal design pressure p_o shall, in any point of the pipeline, be equal to, or higher than, MAOP increased by static pressure of the transported medium head, in the given point.

For the whole typical system, consisting of the subsea pipeline and the riser, exporting hydrocarbon medium from the offshore platform to the shore, the pressure p_o may be adopted as uniform. It shall be equal to, or higher than, MAOP increased by the static pressure of the medium, corresponding to the height above the sea level of the delivery installation onboard the platform.

3.3.2.3 Minimum external hydrostatic pressure

For the pipeline or the pipeline section approaching the shore or the platform, the value of the minimum external hydrostatic pressure p_h taken for calculations shall be equal to 0.

3.3.2.4 Pressures for separate subsea section of the pipeline

For the section of the pipeline carrying hydrocarbon medium (of density less than that of sea water) which does not approach the shore or the platform, is mechanically isolated and may be subjected to separate tests, the pressures p_h and p_o may be taken as corresponding to the highest point of the section.

3.3.3 Calculations of (casual) strength (static analysis)

3.3.3.1 Calculation purposes

On the basis of calculated values of circumferential, longitudinal and shear stresses (if any), the resistance of the pipeline (and the steel catenary riser) structure to plastic strain and buckling is evaluated.

3.3.3.2 Determination of circumferential stress due to pressures

Circumferential stress due only to pressures is calculated from the formula 3.3.3.2-1.

$$\sigma_o = (p_o - p_h)\frac{D_o - t_{\min}}{2t_{\min}} \text{ [MPa]} \qquad (3.3.3.2\text{-}1)$$

where:

σ_o – circumferential stress in the pipe, due to internal and external pressure [MPa]
p_o – internal design pressure [MPa]
p_h – a minimum external hydrostatic pressure [MPa]
D_o – nominal outer diameter of pipe [mm]
t_{min} – a minimum design thickness of pipe wall – nominal thickness of the wall reduced by working tolerance and corrosion addition [mm].

The circumferential stress due to pressure shall not exceed the value calculated from the formula 3.3.3.2-2.

$$\sigma_o \leq w_o \cdot \sigma_m \quad \text{[MPa]} \qquad (3.3.3.2\text{-}2)$$

where:

w_o – design factor, of value given in Table 3.3.3.2
σ_m – for steel of category lower than L555/X80 (ISO 3183 /API Spec 5L), σ_m = SMYS – the lowest yield stress in design temperature [10] (or in an ambient temperature if the calculation concerns the loads expected during construction) as shown in the specification or in the standard the pipe is ordered upon.
For steel of category L555/X80 or higher, SMYS or the product SMTS x 0.87, taking the lower value shall be taken as σ_m .

Table 3.3.3.2 – Design factor w_o

Pipeline location	w_o
Typical[1]	0.77
Navigational routes, anchorages, roadsteads and entries to ports	0.77
Pipeline shore approach and onshore sections	0.67
Installations for launching and receiving cleaning and measuring pigs (pig traps) and pipelines onboard the platform and risers supplying the subsea pipeline carrying liquids.	0.67
Onboard manned platform – installations for launching and receiving cleaning and measuring pigs and pipelines on the platform supplying the gas subsea pipeline. Gas risers SCR.	0.50
Onboard unmanned platform – installations for launching and receiving cleaning and measuring pigs and pipelines on the platform supplying the gas subsea pipeline. Gas risers SCR.	0.60

1 For the pipelines intended for A and C category media, acc. to Table 4.5.1 of Part I, the w_o factor may be increased to the value 0.83.

[10] For temperatures exceeding 50°C, Table 841.1.8-1 Temperature Derating Factor T, for Steel Pipe, in ASME B31.8-2016, may be applied.

3.3.3.3 Longitudinal stresses

The longitudinal stress (e.g. due to static deflection) in the pipe shall not exceed the value calculated from the formula 3.3.3.3.

$$\sigma_W \leq w_W \cdot \sigma_m \quad \text{[MPa]} \tag{3.3.3.3}$$

where:

w_w – design factor equal to 0.8

σ_m – for steel of category lower than L555/X80 (ISO 3183 /API Spec 5L), σ_m = SMYS – the lowest yield stress in design temperature [13] (or in ambient temperature).
For steel of category L555/X80 or higher, SMYS or the product SMTS x 0.87, taking the lower value, shall be taken as σ_m.

3.3.3.4 Equivalent stresses

Circumferential, longitudinal and sheer stresses (if any) due to possible loads existing during construction and due to functional and environmental loads, shall be calculated. Stresses due to incidental loads shall also be calculated or assessed (see 3.2.4)..

The less favourable, real simultaneous and also instantaneous combinations of the above loads shall be considered. For each load combination and related total (including direction) stresses, equivalent stress shall be calculated, according to formula 3.3.3.4-1. The radial stress may be neglected[11]

$$\sigma_{zr} = \sqrt{\sigma_o^2 + \sigma_w^2 - \sigma_o \sigma_w + 3\tau_{ow}^2} \quad \text{[MPa]} \tag{3.3.3.4-1}$$

where:

σ_{zr} – equivalent stress

σ_o – total circumferential stress

σ_w – total longitudinal stress

τ_{ow} –total sheer stress (due to bending and torsion, if any).

The equivalent stress shall not exceed the value calculated according to formula 3.3.3.4-2

$$\sigma_{zr} \leq w_{zr} \cdot \sigma_m \quad \text{[MPa]} \tag{3.3.3.4-2}$$

where:

w_{zr} – design factor of value given in Table 3.3.3.5-1

σ_m – for steel of category lower than L555/X80 (ISO 3183 /API Spec 5L), σ_m = SMYS – the lowest yield stress in design temperature [12] (or in an ambient temperature if the calculation concerns the loads expected during construction) as shown in the specification or in the standard the pipe is ordered upon.
For steel of category L555/X80 or higher, SMYS or the product SMTS x 0.87, taking the lower value, shall be taken as σ_m.

Table 3.3.3.4 – Design factor w_{zr}

Load combinations which may really occur simultaneously	w_{zr}
Pipeline loads during construction and environmental loads	1.00
Functional and environmental loads	0.90
Functional, environmental and incidental loads	1.00
Loads of riser SCR in pressure tests	0.90
Functional and environmental loads of the SCR riser	0.67
Functional, environmental and incidental loads of the SCR riser	0.80
For the load combinations occurring in survival conditions, if considered, the value of factor w_{zr} shall be agreed with PRS.	

[11] For internal pressures higher than 10% SMYS, when consideration of radial stress may be reasonable, the formula for equivalent stress contained in API RP 2RD may be used.

[12] For temperatures exceeding 50ºC, Table 841.1.8-1 Temperature Derating Factor T, for Steel Pipe, in ASME B31.8-2016 may be applied.

At the calculation of casual strength according to 3.3.3.5, the maximum values of variable stresses, referred to in 3.3.4.1, shall be considered (added taking into account direction sign).

Example initial specifications/characteristics of loads which may occur simultaneously, and design factors associated with the above loads (acc. to table 3.3.3.4) for equivalent stresses are given below, in Tables 3.3.3.5-1 and 3.3.3.5-2. A defined state of each environmental or functional load may result, in different point of the pipeline, in different level of circumferential, longitudinal and, in consequence, equivalent stresses. The mentioned tables do not include all the effects of environmental, functional and incidental loads. The summaries in the tables shall be modified and extended based on current calculation results.

3.3.3.5 Use for strength calculations the load combinations for various conditions of the pipeline system and environmental operation conditions

The load combinations shall be considered for defined environmental operation conditions.

The below conditions are distinguished:

– normal operation conditions – defined by determination of boundary values of wind speed and waves height (other parameters such as air temperature, sea current speed may be used), at which operation of the pipeline system with full capacity is permitted and safe; the normal operation conditions are transgressed when at least one of the environmental parameters exceeds the boundary value;

– maximum allowable operation conditions – may be defined by assuming boundary values of wind speed and waves height (other parameters such as air temperature, sea current speed may be used), at which full capacity operation of the pipeline system is permitted and safe, usually upon taking special precautions provided by appropriate procedure; it may be the requirement to reduce the carrying capacity of the medium or specified organizational arrangements;

– survival conditions – the conditions at which at least one of environmental parameters adopted for determination of maximum allowable operation conditions (if determined) or normal operation conditions (if the maximum allowable operation conditions are not determined) exceeds boundary value; continuation of the system operation in survival conditions is not allowed.

Boundary values of wind speed and waves height (or of other parameters such as air temperature, sea current speed), adopted for normal operation conditions may not generally exceed the values for 1 year return period.

At the consideration of loads for calculations acc. to 3.3.3.4, the following parameters are applied:

– for normal operation conditions – wind and wave parameters as for 1 year return period,

– for maximum allowable operation conditions – wind and wave parameters may be determined higher than for 1 year return period if the calculations prove that, for the subsea pipeline and the riser, proper value of design factors w_w and w_{zr} is maintained in these conditions,

– for survival conditions – wind and wave parameters as for 100 years return period.

Table 4 3.3.3.5-1 – Subsea pipeline with unsupported span and the section subject to waves action

Pipeline system conditions	Characteristics of loads which may occur simultaneously									w_{zr} acc. to Table 3.3.3.4
	Functional (see 3.2.2)			Environmental (see 3.2.3)					Incidental (see 3.2.4)	
				Waves action [a]		Sea current [b]		Marine biofouling		
	Liquid in the pipeline	Internal pressure	Internal temperature	Return period or wave height	Waves direction	Speed	Direction			
Operation in normal conditions	Transported medium flow	MAOP	Normal	1 year return period	Prevailing direction according to statistics, respectively for the return period or for maximum wave height	Acc. to statistical data for return periods as for the waves	Acc. to statistical data for return periods as for the waves	Acc. to 5.5 Part II 105/P	-	0.9
Operation in maximum allowable operation conditions	Transported medium flow	Incidental MAOPx1,1	Normal	Max. height specified for allowable conditions				Acc. to 5.5 Part II 105/P	-	0.9
Survival in conditions transgressing the maximum allowable ones	Transported medium flow stopped	MAOP or lower	Normal or lower	100 years return period				Acc. to 5.5 Part II 105/P	-	To be agreed with PRS
Pipeline pressure testing	Water	Strength test pressure	As ambient temperature	Max. height specified for testing	As for normal operation conditions	As for normal operation conditions	As for normal operation conditions	-	-	1.00
Incidental conditions during operation	Transported medium flow	MAOP	Normal	As for normal operation conditions				Acc. to 5.5 Part II 105/P	Collision with fishing equipment (trawl board, net)	1.00
								Acc. to 5.5 Part II 105/P	Strike by an object thrown from a floating means	1.00

a) The wave characteristics shall be adopted acc. to 5.2.1, Part II of *Publication No. 105/P*, considering depth at which the pipeline section exposed to loads due to waves action is placed.

b) The speed and direction of wind for calculations shall be taken from statistics data, according to return periods and associated wind directions and speed – as for the maximum waves action determined for the given condition of the pipeline system. If the statistical data are not exhaustive, the current parameters shall be taken as calculated according to 5.3.1.1, Part III of *Publication No. 105/P*, on the basis of the measurement of speed and direction of surface current and wind, taking into account the depth at which the pipeline section exposed to loads due to waves action is placed.

Table 3.3.3.5-2 – Catenary export riser

Pipeline system conditions [f]	Characteristics of loads which may occur simultaneously											w_{zr} acc. to Table 3.3.3.4
	Functional (see– 3.2.2)			Environmental (see - 3.2.3)							Incidental (see – 3.2.4)	
	Medium in the riser	Internal pressure	Medium temperature	Waves action [a]		Wind		Sea current [b]		Marine biofouling		
				Return period or wave height	Directions (for calculations)	Speed	Directions (for calculations)	Speed	Direction			
Operation in normal conditions	Transported medium flow	MAOP	Normal	1 year return period	In the riser plane	Equal to, or lower than, 36 m/s [c]	In the riser plane	Acc. to statistical data for return periods as for the waves	Acc. to statistical data for return periods as for the waves	Acc. to 5.5 Part II of 105/P	-	0.67
					Perpendicular		Perpendicular					0.67
Operation in maximum allowable operation conditions	Transported medium flow	MAOP	Normal	Max. height specified for allowable conditions	In the riser plane	Speed as agreed	In the riser plane				-	0.67
					Perpendicular		Perpendicular					0.67
Survival in conditions transgressing the maximum allowable ones	Transported medium flow stopped	MAOP or lower	Normal or lower	100 years return period	In the riser plane	51.5 m/s [c]	In the riser plane				-	To be agreed with PRS
					Perpendicular		Perpendicular					
Riser pressure testing	Water	Strength test pressure	As ambient temperature (of water and air)	Max. height specified for testing	In the riser plane	Max. speed specified for testing	In the riser plane	As for normal operation conditions	As for normal operation conditions	-	-	0.90
					Perpendicular		Perpendicular					
Incidental conditions during operation	Transported medium flow	MAOP	Normal	As for normal operation conditions	In the riser plane	As for normal operation conditions	In the riser plane			Acc. to 5.5 Part II of 105/P	Collision with floating object [d]	0.80
					Perpendicular		Perpendicular				Strike by an object thrown from the platform [e]	0.80

a) The wave characteristics shall be adopted acc. to 5.2.1, Part II of *Publication No. 105/P*, considering the depth.
b) The speed and direction of sea current for calculations shall be taken from statistics data, according to return periods and associated wind directions and speed – as for the maximum waves action determined for the given condition of the pipeline system. If the statistical data are not exhaustive, the current parameters shall be taken as calculated according to 5.3.1.1, Part III of *Publication No. 105/P*, on the basis of the measurement of speed and direction of surface current and wind, taking into account the depth.
c) See 5.4.1.1 of Part II of *Publication No. 105/P*. The Orderer/Designer may specify lower values of environmental parameters for normal operation conditions.
d) See 5.9.2 of Part II of *Publication No. 105/P*, for objects of cutter, motor boat type.
e) See 5.9.3 of Part II of *Publication No. 105/P*.
f) For each condition of the pipeline system, the calculation of riser structure response shall be performed for two options of waves direction and wind speed – in the riser plane and perpendicular to it.

3.3.3.6 Assessment of external pressure crush resistance

In the process of installing pipeline with high relation of pipe diameter to its thickness, the pipe crush under external hydrostatic pressure may occur.

For the given pipeline, the assessment of resistance and calculation of minimum external pressure which can cause crushing of pipeline not filled with medium, may be performed in accordance with API RP 1111 Sept. 2015, items 4.3.2.1 and 4.3.2.2.

3.3.3.7 Assessment of local buckling strength

In the process of pipeline installing, local buckling of pipe may occur due to bending and external pressure. The buckling may also be the effect of longitudinal force (usually temporarily too low or of zero value or negative tension force acting in the pipeline section laid on the sea bed but also excessive tensile force) and ovalization of the installed pipe, which originated in the steelmill process or during fabrication.

The pipeline shall be resistant to local buckling in the process of construction and under operation. The assessment of the resistance and calculations of allowable boundary pipe deformations and boundary external pressure may be performed in accordance with API RP 1111 Sept. 2015, item 4.3.2.3.

3.3.3.8 Assessment of resistance to buckling propagation

In the pipeline with high relation of pipe diameter to its thickness, buckling propagation (spreading along the pipeline) may occur due to external hydrostatic pressure.

The assessment of the resistance and calculations, for the given pipeline, of minimum external pressure which causes buckling propagation, may be performed in accordance with API RP 1111 Sept. 2015, item 4.3.2.4.

3.3.3.9 Resistance to cracking

Materials used for pipelines and high-pressure risers, in particular those carrying media of categories C, D and E, acc. to Table 4.5.4 of Part I, shall have appropriate resistance to cracking and crack propagation. Detailed guidelines for the selection and inspection of materials are contained in standards specified in 2.2.

3.3.3.10 Comparing burst pressures

Burst pressures for the subsea pipeline and for the riser shall be calculated, for comparing their values. It is recommended that the riser burst pressure should be higher than the subsea pipeline burst pressure by at least 20%. Calculations shall not take into account corrosion additions and external hydrostatic pressure acting on the subsea pipeline.

The calculations may be performed in accordance with API RP 1111 Sept. 2015, item 4.3.1.1, to the formula (5) – for pipes for which the relation of external diameter to wall thickness exceeds 15, or to the formula (4) – used for all pipes .

3.3.3.11 Analysis of temperature linear expansion and possibility of general pipeline buckling

Temperature of hydrocarbon medium exported from the platform is usually within the range 50 ÷ 150°C. The water temperature on the sea bed does not exceed usually 5°C. After commencing the medium pumping, the temperature of the riser and subsea pipeline, or a part thereof, rises which results in the pipeline expansion. Non-anchored end of the pipeline may move, while between the anchored points of the pipeline elastic buckling, and in extreme case permanent plastic buckling, may occur. In the pipeline covered in a trench, the buckling direction is usually vertical, while in the pipeline freely laying on the sea bed – horizontal.

Multiple changes of temperature repeating at starting and ending the medium delivery may lead to fatigue damage of points subject to buckling.

The effect of the above factors may be reduced, where necessary, e.g. by inserting compensation loops or other compensation means and by proper use of measures ensuring stability of the pipeline on the sea bed, referred to in Chapter 8.

3.3.3.12 Assessment of the resistance of the pipeline unsupported pipeline spans and/or those subject to waves action effect on damage under static forces

The most harmful combination of directions and speed of sea current and waves shall be considered. For static calculations, waves action and sea current vectors are summed up. The highest value of the summed speed component, along the direction perpendicular to the pipeline axis, shall be used for the calculation of transverse force acting on the unsupported pipeline. For the pipelines of diameter significantly less than the wave length, what applies to nearly all executed pipelines, calculation is performed on the basis of Morison equation.

The force directed horizontally in radial direction shall be calculated according to 5.2.2.1, 5.2.2.2 and 5.2.2.4 in Part II of *Publication No. 105/P*.

The resistance of unsupported pipeline spans to plastic strain, including local buckling, under hydrodynamical forces, pressures, inertia forces, weights and temperature changes, may be assessed on the basis of typical strength calculations and information and design formula contained in 3.3.3.

3.3.4 Fatigue strength of the pipeline (dynamical and fatigue analysis)

3.3.4.1 Variable loads, which may cause fatigue degradation of material:
- flow induced vibrations, and changes of internal pressure of the pipeline, including changes due to cyclic commissioning and decommissioning of the system, in particular that carrying liquids,
- variable hydrodynamical forces, due to waves action, acting on unsupported pipeline spans,
- sea current and waves action effect on unsupported pipeline spans, which result in vortex induced vibrations (VIV).

If the above loads cannot be eliminated, e.g. by appropriate procedures of the system commissioning, or shortening or removal of unsupported pipeline spans, then parameters of variable stress cycles shall be calculated and compliance with criteria given in 3.3.4.2 shall be checked.

The maximum values of variable stresses shall be considered (added taking their direction into account) at calculation of casual strength according to 3.3.3.

3.3.4.2 Variable hydrodynamical forces due to waves action may be calculated according to 5.2.2.1, 5.2.2.2 and 5.2.2.4 of Part II, *Publication No. 105/P*. Sea current effect shall be disregarded and only the wave speed component normal to the pipeline axis shall be considered.

The frequency of own (transverse) vibrations of the unsupported pipeline span shall be far different from the frequency of vortex induced vibrations. Permissible length of the unsupported pipeline span shall be calculated. Example calculations associated with vortex induced vibrations are contained in item [6] of Bibliography (DNV-RP-F-105) and in ABS Guide for Building and Classing, Subsea Pipeline Systems.

3.3.4.3 The design fatigue strength of the unsupported pipeline spans, calculated with the use of Palmgren -Miner hypothesis and Wohler curves for welded joints (see Chapter 8, Part II of *Publication No. 105/P*), shall be at least 10 times higher than planned service period. At the request of the Orderer, PRS may consider, in particular case, acceptance for the required design fatigue strength (only for subsea pipeline) reduced to the value not lower than 5 times the service period.

Effect of plastic strain, which can occur during fabrication and installation of the pipeline or SCR riser, on fatigue strength, shall be considered.

3.3.5 Method of the pipeline installation

The method of installation, kind and equipment of the pipeline laying vessel, hydro- and meteorological conditions for the installation process, shall be determined. The adopted method shall ensure, inter alia:
- arrangement of the pipeline in accordance with the design, design execution tolerances being maintained,
- maintaining integrity of anti-corrosion coatings of steel pipe,
- ensuring proper conditions of joining sections and NDT examinations of the pipe, as well as applying anti-corrosion coatings onto joined places and repair of damaged coatings,
- maintaining, during the pipeline installation, plastic strain of the pipe (if considered) within the limits specified in the design. It applies always to installation of metal pipeline through reeling of fabricate pipeline out of a drum (*Reel-Lay*) .
- pipe straightening, in the case of Reel-Lay method of installation,

The pipeline installation manual shall be prepared (see I/2.5.2.2).

3.3.6 Determination of test pressures for the subsea pipeline

3.3.6.1 The pipeline strength test shall be performed at the pressure equal to at least 1.25 x MAOP.

3.3.6.2 If the shore approach section passes onshore through the area qualified to class 4 or 5 of location according to ISO 13623:2009(E) Table B1, the pipeline pressure test on this section shall be performed at pressure equal to at least 1.4 x MAOP. The above locations are the areas of population density above 250 persons per square km. It can be suburbia, inhabited recreation areas, industrial areas.

3.3.6.3 The pipeline tightness test shall be performed at a pressure equal to at least 1.1 x MAOP.

3.3.6.4 The method of carrying out the above pipeline tests and the values of the test pressures and the requirements for pressure tests of risers are specified in Chapter 5 of Part IV.

4 RISER SYSTEM

4.1 General

4.1.1 Technical requirements of Chapter 4 apply generally to static application risers, connecting the subsea pipeline with a stationary onshore object.

4.1.2 The requirements of standards referred to in this Chapter are related to various types and applications of risers, in particular to dynamic risers connecting the pipeline with a floating object. The requirements covered by the mentioned standards, which concern dynamic movements of the floating object, do not apply to static application risers.

4.1.3 The riser shall be designed and constructed in accordance with an appropriate standard. It is recommended to use, with the reservation given in 4.1.2, the standard API RP 2RD– Design of Risers for Floating Production Systems (FPSs) and Tension-Leg Platforms (TLPs).

4.2 General requirements for risers

4.2.1 Standards

Detailed guidelines related to designing, construction and testing of flexible pipe risers are contained e.g. in API RP 17B. Detailed guidelines related to designing, construction and testing of steel catenary risers (SCR) are contained in API RP 2RD.

4.2.2 Computer software

Each computer software used for analyses and calculations of a riser shall allow for proper modelling of the object, as well as calculations and presentation of load and load combination effects in the form of stresses and strains. The software reliability and accuracy shall be checked and confirmed. The software shall present the results of calculations so as to enable clear identification of assumed loads and resulting forces and stresses in essential points of the riser.

4.2.3 Analysis and technical calculations

The below essential components of analysis associated with calculations apply to the risers:
– static analysis,
– dynamic analysis,
– fatigue analysis
– durability analysis.

The differences met at the application of the above analysis components to flexible pipe risers and steel catenary risers are discussed in 4.3 and 4.4.

4.2.4 Design of riser system configuration

The riser is usually connected with the subsea pipeline on the pipeline end manifold (PLEM) or on the connector. The riser may also be integrated in the local subsea pipeline. In each case, transfer of horizontal forces on the sea bed level shall be ensured, to maintain unchanged geometrical form of the riser.

The mechanical design of the riser system shall unambiguously define the riser configuration, together with shielding and supporting systems, corrosion protection system, connectors, (flexible pipe) inflection limiters, etc.

4.2.5 Maintaining the riser integrity

The riser integrity shall be maintained within an expected service life of the pipeline system, taking into account possible changes of the transported medium chemical composition.

4.2.6 Dynamic riser for connecting with offloading buoy

The riser shall be designed, constructed and tested in accordance with an appropriate standard. It is recommended to apply, to full scope, the API RP 2RD standard – Design of Risers for Floating Production Systems (FPSs) and Tension-Leg Platforms (TLPs).

4.3 Flexible pipe risers

4.3.1 General

The flexible pipe riser system shall withstand, maintaining its integrity, the highest static and dynamic loads which may be met in service. Such loads, considered in real combination, shall not result in exceeding maximum allowable axial force expanding the pipe, exceeding the minimum bend radius of the pipe and in the pipe compression due to axial force exceeding allowable value[13].

4.3.2 Selection of materials and equipment

It is recommended that the selection of flexible pipe, the pipeline equipment (see also 2.3 and 2.4) and designing of the shielding and supporting system, should be performed in accordance with API RP 17B.

The structure and materials of flexible pipe shall be selected in cooperation with the pipe supplier. Materials shall be compatible with the transported medium and shall ensure the riser integrity within the expected service life of the system. It applies in particular to metal materials used for unbonded flexible pipes, which in principle get in permanent contact with transported medium or its components characterized by high polymer permeability.

In the subsea connections of the flexible pipe riser, a loose flange shall be used on one side, in order to avoid the pipe turning for adjustment of connecting bolts.

4.3.3 Selection of the pipe geometric dimensions

The pipe internal diameter shall usually be equal to internal diameter of the subsea pipeline. The pipe manufacturer shall define, using computer software, the riser flow characteristics for the given transported medium.

4.3.4 Static analysis

The static analysis of the flexible pipe riser shall cover the pipe local strength analysis acc. to API Spec.17J, Chapter 6, subchapters 6.1 to 6.4, Tables 5, 6 and 7 (or respective chapters of API Spec. 17K – for a bonded pipe), and static analysis of the pre-configured riser and its connecting elements, in particular end connectors. Design factors not exceeding values given in the above tables shall be applied. The static analysis (see also Chapter 8, API RP 17B) is used for initial determination of technical data of the riser subjected to static loads (dead weight, weight of transported medium, displacement force, force due to waves action and sea current, responses). The above mentioned technical data of the riser are as below:

- length,
- weight,
- location of touchdown point and of the place of the riser connection with the subsea pipeline.

The analysis according to 4.3.4 shall be carried out by the flexible pipe riser manufacturer/supplier. The local strength analysis shall be based on confirmed experimental data. API Spec.17J proposes to determine the loads effects due to hydrodynamical forces in accordance with ISO 13628-11 Standard.

The riser manufacturer/supplier shall ensure complete, based on experimental data, information on the properties of the flexible pipe and the riser connecting elements.

[13] Generally, a flexible pipe shall be expanded in axial direction only.

4.3.5 Dynamic analysis

Simultaneous effect on the riser of the sea current and waves action shall be considered, for various possible options of wave height and direction. Loads by hydrodynamical forces may be applied acc. to API RP 17B, subchapter 8.3.

Loads due to sinusoidal wave action may be applied to MES model of the riser. It is recommended to use loads due to irregular wave to final analysis of the riser in design extreme conditions.

Analysis according to 4.3.5 is performed generally by the flexible pipe riser manufacturer/supplier. The analysis shall include:
- tensile force in the point of riser suspension on the platform,
- the distribution of maximum and minimum tensile force along the riser length,
- places and values of the least radiuses of the pipe bend,
- the least distances between the design riser and other risers,
- the least distances to subsea and above water platform structures,
- the bending radius, bending force and moment in the riser touch-down point.

The scope of dynamic analysis for the riser placed in J-pipe may be limited to the loads due to static pressure and inertia forces related to transported medium flow and due to possible effect of demersal sea current (if any) in the region of the riser section freely laid on the sea bed.

4.3.6 Analysis of service durability

The analysis acc. to 4.3.6 is performed generally by the flexible pipe riser manufacturer/supplier. Appropriate requirements of 6.3.4, API Standard Spec 17J and of 8.2.4, Publication API RP 17B apply.

The durability analysis shall consider:
- mechanical and corrosion wear of metal structures of the pipe and connecting/securing elements,
- degradation of physical and chemical properties of plastics,
- mechanical wear of plastics.

4.3.7 Anti-corrosion protection

The anti-corrosion protection of flexible pipe riser shall be ensured by tight external layers of polymer/elastomer. In order to ensure protection for layers damage, protective anodes may be installed on the end connectors of the riser (provided that the metal armour of the pipe is galvanically connected with end connector bodies).

Account shall be taken of the resistance of flexible pipe external layer to possible displacements of lower part of the riser along the sea bed.

4.3.8 Fatigue phenomena

The flexible pipe riser in static application generally is not subject to fatigue damage. It has been found by experiment that vortex induced vibrations do not result in fatigue damage of flexible pipe riser. It is justified by that:
- the natural vibration frequency of the riser is very low due to heavy internal vibration damping appropriate for flexible pipe,,
- relatively large external diameter of the flexible pipe results in considerable hydrodynamical damping forces,
- within the area of waves action and sea current effect, the riser may be effectively secured to the load-bearing structure of platform.

In special case, PRS may require submitting fatigue analysis of the riser, in particular its end (lower and upper) connectors.

4.3.9 Ensuring strength and service durability of the flexible pipe riser

At the design phase, the flexible pipe riser strength and service durability analysis is carried out on the basis of verified analyses referred to in 4.3.4 to 4.3.7.

4.3.10 Selection of the riser installation method

The riser installation method, type and equipment of the vessel installing the riser, hydro- and meteorological conditions of riser installation shall be defined. During installation, the maximum permissible axial force of pipe tension, the minimum bend radius of the pipe may not be exceeded and the pipe compression due to axial force exceeding allowable value may not occur.

The riser installation manual shall be prepared (it may be joint installation manual for the subsea pipeline and the riser; see I/2.5.2.2).

4.4 Steel catenary risers (SCR)

4.4.1 General

The SCR system shall withstand the highest static and dynamic loads expected in service life, maintaining its integrity. The riser shall maintain tightness and strength. During service life, it shall not suffer:
– plastic strain,
– local and global buckling and mechanical wear,
– deformation of transverse cross-section.

4.4.2 Static analysis

The steel catenary risers are covered with the requirements of the following chapters, subchapters and paragraphs of this Part of the Appendix: 1, 2, 3.1, 3.2, 3.3.1, 3.3.2 and 3.3.3.1 to 3.3.3.10.

Within the static analysis (see also Chapter 8, API RP 17B), technical data of the riser subjected to static loads (such as natural weight, weight of transported medium, displacement force, static forces due to waves action and sea current, responses) shall be initially determined. The technical data of the riser are as below:
– length,
– weight,
– location of the touchdown point and of the place of the riser connection with the subsea pipeline,
– downward force acting vertically on the sea bed,
– the force acting in the point of the riser suspension on the platform.

Within the static analysis, consideration of the forces due to waves and sea current action may be limited to the case of the highest wave and wind action parallel to the catenary riser plane and the case of their action perpendicular to the above plane. It means a safe (conservative) approach.

4.4.3 Dynamic and fatigue analysis

4.4.3.1 The frequency of natural vibrations of the catenary section of the riser shall be determined.

4.4.3.2 Variable loads which may lead to fatigue degradation of material:

– flow induced vibrations, and changes of internal pressure inside the pipeline, including changes due to cyclic commissioning and decommissioning of the system, in particular the liquid transporting system,
– variable hydrodynamic forces, due to waves action, acting on the catenary span of the riser - it may be assumed that the wave and wind vectors are parallel to the riser plane and, in the second case, perpendicular to the plane (a conservative approach). At more precise approach, projections of wave and wind vectors to the riser plane and to the vertical plane normal to it, may be considered.
– sea current and waves action on the catenary span of the riser, which causes the vortex induced vibrations. In such case, consideration of wave and sea current action perpendicular to the riser plane may be sufficient.

4.4.3.3 Parameters of variable stress cycles due to loads referred to in 4.4.3.2 shall be determined and compliance with fatigue strength criteria given in 4.4.3.6 shall be verified.

4.4.3.4 Variable hydrodynamic forces due to waves action may be calculated according to 5.2.2.1, 5.2.2.2 and 5.2.2.4 of Part II of *Publication No. 105/P*. Sea current action shall be neglected in this calculation and only the wave action component normal to the riser axis shall be considered.

The Morison equation, in the form in 5.2.2.1, has been created for fixed cylindrical structures, which withstand the action of transverse force. Therefore, for the catenary riser of significant length which usually is a susceptible structure, the use of Morison equation in modified form shall be considered. Such form of equation was placed in API RP 17B, paragraph 8.3.1.2. The Morison equation in modified form is discussed in more detail in Chapter 6.3.4 of API RP 2RD.

4.4.3.5 The frequency of natural vibrations of the catenary riser shall be far different from the vortex induced vibrations frequency. Example calculations associated with the vortex induced vibrations are contained in bibliography item [6] (DNV-RP-F-105) and in ABS Guide for Building and Classing, Subsea Pipeline Systems.

4.4.3.6 It is recommended to consider simultaneous action of waves and sea current on the catenary riser, for various possible options of wave height and direction. At least the directions normal and parallel to the riser plane shall be considered.

4.4.3.7 Loads due to sinusoidal wave action may be applied to the MES model. It is recommended to use loads due to irregular wave in final analysis of the riser in environmental survival conditions. For the purpose of VIV analysis, the riser may be modelled as a simple beam of length equal to the riser length, taking into account appropriate distribution of water speed along the beam length.

4.4.3.8 The design fatigue strength of the riser, calculated with the use of Palmgren – Miner hypothesis and Wohler curves for welded joints (see Chapter 8, Part II of *Publication No. 105/P*), shall be at least 10 times higher than the planned service life. At the request of the Orderer, PRS may consider, in the given case, acceptance for the required design fatigue strength reduced to the value not less than 5 times the service life period.

4.4.3.9 Effect on the fatigue strength of plastic strain which may occur during the riser fabrication and installation, shall be taken into account.

4.4.3.10 The maximum values of variable stresses shall be considered (added, taking into account their direction) at calculations of casual strength, according to 3.3.3.

4.4.3.11 The calculation methods suitable in dynamic and fatigue analyses are presented also in publications referred to in 1.7 and 1.8, Part I, and in API RP2RD. The methods and requirements presented in the said publications concern mainly the risers connected with a floating object. The requirements which do not apply to the riser connected with stationary object, in particular the requirements for dynamic phenomena resulting from the movements of the floating object, shall be disregarded in the analysis.

4.4.4 Analysis of service durability

The below factors shall be regarded in the analysis of service durability:

- a reserve of the fatigue strength of the pipe and other metal structures,
- mechanical and corrosion wear of the pipe and other steel structures, including wear of the lower part of the riser due to possible movements along the sea bed.

4.4.5 Selection of the riser installation method

The riser installation method, type and equipment of the vessel installing the riser, hydro- and meteorological conditions of riser installation shall be defined. The adopted installation method shall ensure:

- positioning the riser according to the design, maintaining design working tolerances,
- maintaining the pipe plastic strain within design limits during installation.

The riser installation manual shall be prepared (it may be joint installation manual for the subsea pipeline and the riser; see I/2.5.2.2).

4.4.6 Anti-corrosion protection

The requirements of Chapter 7 apply. The resistance of anti-corrosion coating to any movements of the lower part of the riser along the sea bed shall be considered.

5 EQUIPMENT AND SHIELDING INSTALLATION IN THE SYSTEM

The equipment and shielding installations shall be constructed in accordance with appropriate standards, given in Part I, paragraph 1.7. In principle, one set of standards shall be used, e.g. API, ANSI or ISO. The use of a PRS approved standard of the system supplier/manufacturer is permitted.

6 PROTECTING SYSTEMS AND EQUIPMENT

The pipeline system shall be protected against excessive rise of internal pressure, in accordance with the requirements of 3.6 of Part II. The system shall be protected against backflow of transported medium[14] and, where necessary for material reasons, against an excessive temperature of the medium on the inlet to the system. Technical arrangements according to API RP 14C, Section A.9 may be applied.

The gas exporting compressors or export pumps onboard the platform shall be equipped or covered by the platform ESD system, complying with the requirements of Chapter 4, Part VII of *Publication 105/P*, and at least of paragraph 7.9 of ISO 13623[15].

7 ANTI-CORROSION PROTECTION

7.1 Standards

Anti-corrosion protection shall be designed in accordance with appropriate standard, given in 1.7 of Part I.

Detailed requirements for the pipelines transporting liquids are contained in ASME B31.4, Chapter VIII and Chapter IX /A461.

Detailed requirements for gas pipelines are contained e.g. in ASME B31.8, Chapter VI and Chapter VIII/A860.

7.2 Anti-corrosion protection means

7.2.1 For the anti-corrosion protection of external surface of the pipeline, appropriate anti-corrosion coating and cathodic protection in the form of galvanic anodes, or protection by forced current (cathodic protection station), shall be used. See also II/3.5.2. For the pipelines of diameter less than 150 mm, PRS may consider limiting the anti-corrosion protection means to the coating of external surface.

7.2.2 Use of protection by forced current is required in each case for gas pipelines made of C-Mn steel, laid in places exposed to stray currents.

7.2.3 If the cathodic protection system of the platform is not compatible with the protection system of the subsea pipeline, the pipeline shall be electrically insulated from the platform by an isolating switching device[16].

7.2.4 For the anti-corrosion protection of the internal surface of the pipeline, appropriate selection of materials for pipes, internal coating, minimized content of water and oxygen in the transported medium, corrosion restricting additives, may be applied. See also II/3.5.3.

7.2.5 Information on the anti-corrosion protection of flexible pipe risers made of unbonded pipes, are given in 4.3.

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[14] The equipment and systems protecting the pipeline system normally are a part of production systems onboard the platform, comprising pumping station or gas compression station and are a part of onshore reception facilities.

[15] Each pump or compressor shall be equipped with permanently active emergency shutdown system stopping driving engines, operated locally and/or remotely. The need for the pipeline isolating from pump/compressor station and the pipeline relieving/degassing shall be considered.

Operation of the emergency shutdown system shall also enable stopping and isolation of all gas fired machinery which may threaten the safety, if they are not necessary in emergency.

For the protection of personnel and for activities necessary for the protection of the object, an interruptible power supply (UPS) device shall be used.

[16] Requirements for the isolating switching device – see e.g. DNV-OS-F101 sec.8 B800.

7.3 Corrosion additions

7.3.1 For the steel pipelines and risers included acc. to Table 4.5.3 of Part I to hazard category „medium" or „high ", made from carbon-manganese (C-Mn) steels, transporting hydrocarbons which during normal operation can contain water in liquid form, at least 3 mm corrosion addition (internal) may be applied.

7.3.2 For steel risers included according to Table 4.5.3 of Part I to hazard category „medium" or „high", made from carbon-manganese (C-Mn) steels, at least 3 mm corrosion addition (external) is recommended to be used, in region of splash zone, irrespective of the internal addition referred to above. Where the liquid of temperature over 5°C above the mean temperature of sea water is carried, the use of higher external corrosion addition shall be considered, at least in the splash zone.

7.4 Additional requirements for the onshore approach section of the subsea pipeline

7.4.1 The requirements given in 7.2 and 7.3 apply.

7.4.2 The pipeline shall have anti-corrosion coating and the sections dug in the sea bed or immersed shall also be protected with the cathodic protection system. Protection by forced current is recommended. For the pipelines of diameter less than 150 mm, PRS may consider limitation of corrosion protection means to the coating laid on the external surface.

7.4.3 The cathodic protection system by a forced current shall be in accordance with the requirements of ISO 15589-1 or PN-EN 12474.

7.4.4 When the cathodic protection system by a forced current has been applied, a uniform distribution of the current along the pipeline shall be ensured and the measuring points of potential shall be defined. In particular, the potential measurement shall be performed:
– in the vicinity of direct current contact wires and high voltage cables,
– in places of passing roads, railways and rivers by the onshore section,
– at pipeline section installed in shielding pipes,
– at isolation switching devices on the pipeline,
– at places where large metal objects and structures equipped, or non-equipped, with cathodic protection, are passed.

7.4.5 If the anti-corrosion protection systems of the reception facility or onshore pipeline are not compatible with the protection system of the subsea pipeline (together with the shore approach section), the approach section shall be electrically isolated by an isolation switching device on the side of the onshore hydrocarbon reception facility or the onshore pipeline.

7.4.6 Protection of the isolation switching device(s) against damage due to lightning or heavy current shall be ensured, where possible.

8 ENSURING STABILITY AND INTEGRITY OF THE PIPELINE ON THE SEA BED

8.1 General

8.1.1 The subsea pipeline laid on the ground, dug in a trench, backfilled or surface loaded, shall not change its position in relation to the place determined during installation.

The pipeline stability analysis in the horizontal and vertical plane shall be performed. The analysis shall consider:
– weight (in the water) per a length unit of the pipeline, in empty and filled conditions,
– geometrical dimensions of the pipeline and unit loads on the bottom,
– the sea bed material density and shear strength (in waterized conditon)
– the ground friction coefficient (horizontal plane)
– possible axial forces acting on the pipeline able to cause global buckling in lateral or upheaval plane,
– external and internal (inertia) forces of hydrodynamical nature.

8.1.2 The hydrodynamical lift force of the pipeline laying aground may be calculated according to formula 8.1.2.

$$F_L = 1/2\, \rho\, C_L\, U_N^2 D \qquad (8.1.2)$$

where:
F_L – lift force [kN/m]
ρ – sea water density [kg/m^3]
C_L – lift coefficient [.] depending on the depth of the pipeline immersion in the sea bed.
U_N – water speed component normal to the pipeline axis [m/s]
D – external diameter of the pipeline [m].

8.1.3 The pipeline stability criterion laying aground

$$\gamma\, F < \mu\, (W_P - F_L) \qquad (8.1.3)$$

where:
γ – safety factor, of value at least 1.1.
F – continuous load due to water flow, calculated from Morison formula (5.2.2.1, 5.2.2.2 and 5.2.2.4, of Part II, *Publication No. 105/P*) [kN/m]
μ – friction coefficient in the sea bed plane [.]
W_P – weight of 1 meter of the submersed pipeline [kN/m]
F_L – lift force per 1 m of the pipeline [kN/m].

8.2 Structures and technologies supporting pipeline stability

8.2.1 Loading and anchoring structures

The loading structures may have the form of mats installed after laying the pipeline. The mat structure shall ensure maintaining, during mat laying, the anti-corrosion coating on the pipeline.

The pipeline may also be structurally loaded by own concrete external coating according to ISO 21809-5, laid during the pipeline installation.

8.2.2 Laying pipeline in a trench

The pipeline laid in a trench shall be protected from lifting and immersing in the ground. The resistance to lifting of an empty pipeline (containing air or gas under atmospheric pressure), resistance to immersion of the pipeline filled with water, shall be checked.

For the operation of digging equipment, the trench digging may require pipeline lifting. In such case it should be checked that the resulting bending stresses do not exceed allowable values.

8.2.3 Pipeline backfilling

The backfilling of the pipeline laid on the ground or in a trench shall be made in a controlled manner. Technology and material used for backfilling shall be such as to preclude the damage to anti-corrosion coating of the pipeline.

8.2.4 Crossing the subsea cable or another pipeline

Crossing (without connecting) shall be such that the distance of at least 0.33 m is maintained between the pipelines or between the pipeline and cable. The crossing structure shall ensure stability and resistance to sea current scouting and shall protect against excessive bending of the pipeline.

8.2.5 Protection of valves and manifolds

Valves, manifolds and other similar objects of the subsea pipeline shall be protected from damage by anchors and bottom fishing gear.

9 RISK AND RELIABILITY ANALYSIS OF THE SYSTEM

At the design phase, the risk and reliability analysis of the system shall be professionally performed and submitted to PRS for assessment. The analysis shall include complete construction process (with particular consideration of the pipeline laying on the sea bed), the system operation and decommissioning.

The analysis may be performed by PRS, to the principles given in Chapter 4, Part I.

PART IV – CONSTRUCTION PROCESS OF THE SYSTEM

1 FABRICATION

1.1 The pipeline fabrication

During fabrication process, possibility of pipes plastic strain shall be avoided or restricted. The plastic strain shall be measured and recorded. Both single or cumulative for the whole construction process plastic strains (found starting from the pipes manufacture until the pipeline laying on the sea bed) shall not exceed values defined by the pipe manufacturer and the pipeline designer.

1.2 Welding

1.2.1 Standards, rules

At the fabrication phase and at further phases of construction, welding shall be performed in accordance with the requirements of ISO 13847 or API STD 1104 Standards.

Welding of the pipeline shall comply with applicable for the subsea pipeline requirements of *Publication No. 23/P – Pipelines prefabrication,* as for pipeline class I.

1.2.2 Welding procedures

Welding procedure specifications (WPS) shall be approved by PRS.

1.2.3 Approval for welding procedure

A welding procedure shall be qualified by PRS in accordance with *Publication No. 74/P* . The welding procedure qualification reports (WPQR) shall be approved by PRS.

1.2.4 Qualifications of welders

Welders shall have documented valid qualifications in accordance with standards.

1.2.5 Approval for welding shop/company

The workshop or a company carrying out welding works on the subsea pipeline or on other components of the system shall be approved by PRS according to principles given in the *Rules for the Classification and Construction of Sea-going Ships – Part IX – Materials and Welding*, Chapter 25 – Welded Structure Manufacturers.

1.2.6 NDT examinations

The NDT operators shall have documented valid qualifications in accordance with standards. For circumferential welds, a visual examination of 100% of welds and radiographic or ultrasonic examination of 100% of welds is required.

In well-grounded cases, in addition to radiographic examinations, PRS may require ultrasonic examination, as well as magnetic particle or eddy current examinations to be carried out.

1.3 Joining pipes by methods other than welding

Joining pipes using methods other than welding shall be performed and verified under supervision of, and in accordance with procedure approved by, PRS.

2 PREPARATION FOR PIPELINE INSTALLATION

2.1 Review of the pipeline route before its laying

It is recommended to perform a review of the pipeline route before its laying if considerable time has passed from the previous review, or:

– the sea bed conditions might change,
– new marine structures appeared in the vicinity of the pipeline route,
– works have been carried out aimed at adaptation of sea bed for the pipeline.

The aim of the review is to disclose new obstacles and hazards along the pipeline route, such as new components of industrial structures on the sea bed or changes to the sea bed geometry.

2.2 Equipment of the pipeline laying vessel

2.2.1 Technological equipment

2.2.1.1 General

Equipment of the vessel shall be selected appropriately to technical properties of the being laid pipeline and to geological and other environmental conditions. The equipment shall ensure compliance with the conditions specified in 3.3.5, Part III.

2.2.1.2 Typical principal components of technological equipment, for example**:**

– *S-Lay* Method– lifting appliances, place for pipes storage, welding/NDT shop and place for FAC coating, tensioner system, stinger,
– *J-Lay* Method (for steel pipelines it is suitable only for big depths) – lifting appliances, place for pipes storage, tensioner system, installation column, welding/NDT shop and place for FAC coating usually in the column,
– *Reel-Lay* Method (contemporary specialized ship) – lifting appliances, a drum with the drive and brake, aligner wheel, straightener, tensioner system, installation column set within angle range 90 to 20^0 to the horizontal, welding/NDT shop and place for FAC coating usually in the column,
– Combination of *S-Lay* and *Reel-Lay* methods (offshore service, general purpose, adopted vessels) – lifting appliances, a drum with the drive and brake, straightener, welding/NDT shop and place for FAC coating, tensioner system, stinger.

2.2.1.3 Tensioner system

It is recommended that the tensioner system should brake the pipeline after inadvertend filling with water. The tensioner system shall have sufficient redundancy to brake the pipeline in case one of tensioners failed to operate.

Optimum division of the force imposed on the pipeline, between the tensioner system and the drum, shall be determined. Such division shall be recorded in the installation manual and controlled during the pipeline laying.

In the case of any fault of the tensioner or tensioner system, the pipeline laying shall not be possible prior to the system repair.

2.2.1.4 Stinger

The stinger structure shall ensure maintaining deformations of laid pipeline within design limits. It is recommended that the stinger should have a possibility of adjusting the angle of its working position and TV camera for recording the pipeline position above the last reel.

2.2.2 Measuring and recording devices of technological equipment.

2.2.2.1 The measuring and recording equipment of the pipeline laying vessel shall include devices referred to in 2.2.2.2 to 2.2.2.5. The equipment shall have valid calibration certificates.

2.2.2.2 Tensioner system equipment

– recorder of total pipe tensioning force,
– indicator of the force imposed by each tensioner,
– indicator of each tensioner setting,
– indicator of pressures in hydraulic system of tensioner system.

2.2.2.3 Stinger equipment

– underwater camera with an image recorder for monitoring the position of the pipe laid on the sea bed,
– sonar – where low water clarity makes use of the camera impossible,

– indicator and recorder of the horizontal and vertical load of the last but one reel, if such measurement is provided by the design,
– indicator and recorder of the stinger position – for adjustable stinger.

2.2.2.4 Detection of local buckling of the newly laid pipeline

Alarm of local buckling detection shall be ensured. If the detection by means of a gauging plate suspended on a cable will be in the given case considered impracticable/risky, then the following measures shall be applied in agreement with PRS:

– increased safety factors in calculating the pipeline resistance to local buckling (see III/3.3.3.7)
– continuous monitoring of the newly laid pipeline by ROV close to the touchdown point,
– precise monitoring and recording of the pipeline laying parameters (recording of tension force, record of the newly laid pipe position against the last and last but one stinger reel), monitoring of lowering and lifting the pipeline for the execution of processing intervals.

2.2.2.5 Equipment of lifting appliances

– A&R winch intended for lifting and lowering the pipeline end to the sea bed (e.g. for the execution of processing interval in the laying process) shall be equipped with an indicator and recorder of the force and length of the paid out rope.

2.2.3 Measuring and recording equipment of the vessel, used during pipeline laying

The equipment shall ensure the measurement, indication and recording of the below parameters:

– position of the vessel,
– water depth/distance to the sea bed
– vessel's movements – pitching and rolling
– trim and heel
– speed and direction of water current
– speed and direction of wind.

The measuring equipment shall have valid calibration certificates.

2.2.4 Positioning of the vessel

2.2.4.1 Dynamic positioning

.1 Vessel's class mark

The pipeline laying vessel shall have valid class certificate of the IACS class society.

– units operating at a distance greater than 500 m from the existing systems shall have at least mark DP1 in their symbol of class.
– units of displacement below 5000 t, operating at a distance less than 500 m from existing pipeline systems as well as the units engaged in operations of joining the pipeline or installing the riser shall have at least mark DP2 in their symbol of class. Units of bigger displacement shall have mark DP3 in their symbol of class.
– units engaged in diving works or another operations at which sudden horizontal movement could pose threat to human life and health, shall have mark DP3 in their symbol of class.

.2 Control positions of dynamic positioning and tensioning force of the newly laid pipeline.

The control position of dynamic positioning and control position of tensioning force, if not integrated together, shall be so placed as to enable direct contact between their operators and access to current information on essential parameters of the pipeline laying process.

For S-lay method of the pipeline laying, the DP system shall be possible of operating in the mode of pipe breaking and in the mode of control of tensioning force (see 2.2.1.3). In the mode of control of tensioning force, the pipe may be moved axially, usually in both directions, by the tensioner system (see also 2.2.1.3).

Before the operation, the plan of communication among individual positions engaged in the pipeline laying shall be prepared. The plan shall be agreed with PRS.

2.2.4.2 Other positioning techniques

Detailed requirements for the floating units positioned with the use of other means, e.g. by anchors – without or with use of side-directional thrusters, etc. may be found e.g. in publications of IACS class societies (a list in I/1.8) and in the bibliography (a list in I/1.10).

2.3 Trials of floating units and processing installation intended for the pipeline laying

2.3.1 Trials purpose and scope

The purpose of the trials is to verify installation manual, and finally ensuring an efficient and safe pipeline laying.

2.3.2 Preliminary verification (example)

Prior to commencing test laying of the pipeline, verification of documents and equipment, within the below example scope, shall be carried out.

- checking calibration certificates and documents of processing equipment, including welding equipment, NDT equipment and measuring and recording equipment, acc. to 2.2.2.2,
- checking calibration certificates and documents of measuring and recording equipment of the vessel, acc. to 2.2.2.3,
- checking the geometry of appliances in the processing of joining pipes and laying the pipeline aground,
- checking operation of the vessel's dynamic positioning.
- checking cooperation of the vessel's dynamic positioning and the tensioner system,
- checking the performance of the tensioner system when one of its elements is inoperable,
- checking qualification documents of DP and NDT operators, welders, employees applying the insulation on the welded joints made onboard.

2.3.3 Test laying of the pipeline

The test laying of the pipeline shall ensure, inter alia:

- verification of operational performance of measuring and recording equipment,
- verification of pipes straightening,
- verification of durability of pipes coating after being reeled out, straightened and tensioned,
- verification of the vessel's dynamic positioning operation,
- verification of cooperation of the vessel's dynamic positioning and the tensioner system,
- verification of performance of the tensioner system when one of its elements is inoperable,
- verification of performance of process installation after loss of power and hydraulic supply,
- verification that the plastic strain of pipe/pipeline, both single and cumulated for the whole process (from pipes supply until pipeline laying aground) do not exceeds the limits specified by the pipe manufacturer and the pipeline designer,
- detailed verification of the results of welding and NDT procedures execution.

3 LAYING OF THE SUBSEA PIPELINE

3.1 Progress and documenting

The pipe-laying process and its documenting shall be supervised by PRS, in accordance with PRS approved installation manual (see 2.5.2.1, Part I).

3.2 Pipe welding and joining

The requirements specified in 1.2 and 1.3 apply.

3.3 The shore approach and onshore section of the subsea pipeline

Possible methods of installation of the shore approach and onshore section of the subsea pipeline (examples):

- in a tunnel,
- horizontal directional drilling (HDD), with possible use of a shielding pipe,

– in a trench.

During installation of the shore approach and onshore section of the subsea pipeline, integrity of external coating and/or other means of anti-corrosion protection shall be ensured. It applies in particular to the HDD method.

3.4 As-laid pipeline route survey

The as-laid route survey shall ensure at least:

– determination of geographical coordinates and depth profile along the pipeline route,
– information on damage to the pipe, coatings and protective coatings of the pipeline, structures ensuring the pipeline stability (8.2, Part III), components of cathodic protection.

4 INSTALLATION AND ASSEMBLY OF THE RISER

4.1 Equipment for riser installation

The riser installation equipment shall be appropriate for the pipe material and for chosen installation method. The specification of equipment shall be presented to PRS for approval.

4.2 Installation of the flexible pipe riser

4.2.1 General

The method and technical equipment for the installation of the flexible pipe riser shall ensure fulfilling conditions referred to in 4.3.10, Part III.

4.2.2 Equipment for monitoring of installation operations

Depending on the type of operation, the equipment may include:

– the remotely operated vehicle (ROV),
– a measuring device for the angle of pipe departure from installation equipment,
– a measuring device for the length of the laid out pipe,
– a measuring device for the tensioning force of the laid out pipe,
– a measuring device for the force imposed by a caterpillar tensioner (if used)

4.3 Installation of SCR riser

The method and technical equipment for the installation of SCR riser shall ensure conditions specified in 4.4.5, Part III.

4.4 Monitoring

Underwater works shall be monitored with the use of an underwater camera. Arrangement of the riser, condition of its attachments and covers, condition and attachment of terminals, shall be observed.

5 EXAMINATIONS AND TESTS OF THE SYSTEM (PRE-COMMISSIONING AND COMMISSIONING)

5.1 Preparatory activities

5.1.1 System completion

The system prepared for tests shall be complete and connected with an efficient pump/compressor station and reception facility. The production installation onboard the platform shall be ready to deliver transported medium, in the amount and of parameters provided by test program. The system shall fulfil the conditions of pressure test preparation specified in 5.2.1.

5.1.2 Cleaning

If the pipeline design provides the use of cleaning pigs, the first used pig shall be of two-way type. It is recommended that the designer and the operator should consider monitoring of the pig position in the pipeline.

5.1.3 Internal control of the pipeline cross-section

If provided in the design, the internal control (gauging) of the pipeline cross-section shall be performed by means of a test two-way pig. The recommended diameter of the disc shall be equal to 95% of internal diameter of the pipeline. The pig position in the pipeline shall be monitored.

5.1.4 Filling of the pipeline with test medium.

The test medium may be fresh water, conditioned sea water, filtered sea water. In special cases, the test medium may be a liquid stable hydrocarbon medium used on the conditions approved by PRS and local administration.

The speed of filling the pipeline water is usually maintained within 0.5 to 1.5 m/s.

Filling with water shall be effected with the use of pigs.

5.1.5 Temperature stabilization

Prior to pressure tests, the temperature of test medium shall be stabilized. The ambient temperature, temperature of surrounding water and test medium shall be recorded.

5.2 Pressure tests

5.2.1 General

5.2.1.1 The subsea pipeline shall be subjected to pressure tests after its laying on the sea bed, backfilling, installation of loading coverings and after installation of permanent components used for connecting with riser. The riser shall be subjected to tests in complete, finished condition and fixed onboard the platform. Performance of pressure tests separately for the subsea pipeline and for the riser is preferable, due to different criteria of tests acceptance for these system components.

In paragraphs 5.2.1.5 (for flexible pipe riser) and 5.2.4.7 (for steel riser), circumstances are discussed in which performance of defined pressure tests after connecting the pipeline with the riser is permitted.

5.2.1.2 In special cases, the pipeline may be divided into sections, separated by welded components or by closing mechanical appliances subject to separate pressure tests. The mechanical appliances shall be previously subject to pressure tests. Carrying out tightness tests for the above mentioned welded components is not possible, therefore they shall be completely subjected to non-destructive examinations (radiographic or other PRS approved examinations).

5.2.1.3 It shall be ensured that valves and measuring devices in the system will not be damaged by high pressure. It applies, in particular, to valves and measuring devices in the pumping station and gas compression station and to devices in the medium reception facility.

5.2.1.4 If the tested space is restricted by closed openings, then tightness of the opening closures shall be checked prior to pressure tests.

5.2.1.5 Flexible pipes (e.g. flexible pipe riser) may be components of the system. For flexible pipes, principles and criteria of pressure test acceptance, set in the standards, and different to metal (steel) pipelines acceptance criteria, apply. Possibility of exact assessment of the tightness of connected steel pipeline with flexible pipes inserts shall be analyzed, considering different susceptibility of these elements. Otherwise, the flexible section may have been chosen for such test pressure which enables the assessment of tightness.

Owing to the above reasons the pressure tests of the steel pipeline shall be performed with disconnected flexible pipe riser (and separated other flexible pipes, if applied). For the above tests, the elements of the system shall be separated by blinds, valves, etc. Where the separation is practically impossible, the designer shall submit the method of assessment of air content in the pipeline system and the feasibility analysis of carrying out exact assessment of the system tightness.

The tightness test of the riser/flexible pipe may be performed either separately or in combination with steel pipeline which previously passed strength and tightness tests with positive result.

5.2.1.6 The steel risers are generally subject to strength test at pressures higher than for the subsea pipeline. In this regard, performance of the strength test of the riser connected with the subsea pipeline is not recommended. See also requirements of 5.2.4.6, 5.2.4.7.

5.2.2 Measuring equipment

The measuring equipment shall enable the measurement and recording, with adequate accuracy, the physical parameters referred to further in Chapter 6.

It is recommended that the measuring equipment should include:

– A device of type *dead weight tester* or a precise pressure transmitter of measuring range at least 1.25x strength test pressure and of accuracy at least 0.1% ,
– thermometer or temperature transmitter of accuracy ± 0.5°C,
– measuring device of water delivery, of accuracy at least 1%.

5.2.3 Raising water pressure test

5.2.3.1 The speed of pressure rise shall be constant and not exceeding the value of 1 bar/min.

5.2.3.2 Assessment of remained air amount in the pipeline and steel riser.

Volume (V_{p1}) of free air remained in the pipeline shall be assessed at water pressures not exceeding 35 bar (or 50% of design pressure if the value is lower than 35 bar). Use of formulae (5.2.3.3-1) and (5.2.3.3-2) is recommended. Generally the volume of free air can be assessed on the basis of diagram of pressure rise relation to the volume of added water. Example is given e.g. in DNV-OS-F101 Sec.10, O 500.

The air volume (V_{p1}) shall not exceed 0.2% of the volume of tested pipeline or of its separated section (if separately tested).

$$V_{p1} = (V_{wp} - V_{wr}) \frac{p_{m0} + p_h}{p_{m1} - p_{m0}} \quad [\mathrm{m}^3] \qquad (5.2.3.3\text{-}1)$$

where:

V_{p1} – volume of free air in the pipeline, at pressure equal to p_{m1} [m³]
V_{wp} – volume of water pumped during the test, acc. to pump meter, from pressure p_{m0} to p_{m1} [m³]
V_{wr} – volume of water pumped during test – a part resulting from elastic increasing diameter and volume of the pipeline under pressure rise within the range p_{m0} to p_{m1} [m³] – calculated from formula 5.2.3.3-2
p_{m0} – absolute pressure of test water measured at the pump, at start of the test (gauge indication at pump + 0.1 MPa) [MPa]
p_{m1} – absolute pressure of test water measured at the pump, at the end of the test (gauge indication at pump + 0.1 MPa) [MPa]
p_h – hydrostatic pressure of test water head (from the gauge level at the pump to the pipeline level on the sea bed), at mean depth of the pipeline [MPa].

For the calculation acc. to 5.2.3.3-1, also all values of pressure in bars and volume in litres may be introduced. The result will be calculated in litres.

$$V_{wr} = \Pi \cdot L_r \cdot d_0^2 \; \frac{(p_{m1} - p_{m0})}{E} \cdot \frac{D_0 - t}{2\,t} \quad [\mathrm{m}^3] \qquad (5.2.3.3\text{-}2)$$

where:

L_r – The length of tested pipeline or of its separated section [m]
d_0 – nominal internal diameter of pipe [m]
p_{m1} - absolute pressure of test water at the end of the test (gauge indication at pump + 0.1 MPa) [MPa]
p_{m0} – absolute pressure of test water, at start of the test (gauge indication at pump + 0.1 MPa) [MPa]
$\boldsymbol{E}$ – Young modulus for steel (200 000 – 220 000) [MPa]
D_0 – external diameter of pipe [mm]
t – thickness of pipe wall [mm]

5.2.3.3 Assessment of remained air amount in the pipeline or in flexible pipe riser

The method of assessment shall be ensured by the flexible pipe manufacturer. For flexible pipes of smooth internal surface, the volume of remained air shall not exceed 0.5% of the volume of tested pipeline/riser. For pipes with internal uncovered steel carcass, the volume of remained air shall not exceed 1%.

5.2.4 Strength test of the subsea pipeline and the riser

5.2.4.1 The test pressure of the subsea pipeline shall be assumed according to 3.3.6.1 or 3.3.6.2 of Part III.

5.2.4.2 The duration of the subsea pipeline test is at least 2 hours. The pressure shall be maintained with accuracy ± 1 bar. If necessary, during the test water may be let out and added. Volumes of let out and added water shall be recorded.

5.2.4.3 Circumferential, longitudinal and equivalent stresses in the subsea pipeline during strength test shall not exceed the value σ_m set respectively in paragraphs 3.3.3.2, 3.3.3.3 and 3.3.3.4 of Part III. At calculating equivalent stresses acc. to 3.3.3.4-1, Part III, stresses due to pressures noted during the test, static bending stresses and stresses due to environmental loads (if any) shall be considered.

5.2.4.4 If the strength test is carried out in combination with tightness test, then at pressure as for strength test, test time, test requirements and criteria will be the same as for the tightness test. Water supplementing and releasing shall not be allowed.

5.2.4.5 For the not being used flexible pipe riser/flexible pipe, for which the manufacturer has carried out water strength test in accordance with API 17J or API 17K, the strength test as specified in 5.2.4 is not required. Test conditions for riser/flexible pipe being used will be subject to separate consideration by PRS.

5.2.4.6 The strength test of a steel riser shall be carried out at test pressure equal to at least 1.5 x MAOP. It is recommended that the riser should not be tested in combination with the subsea pipeline. Test duration – 24 hours.

5.2.4.7 If performance of the test acc. to 5.2.4.6 in combination with the subsea pipeline is necessary, test pressure equal to at least 1.5 x MAOP shall be applied, duration time – 24 hours. Other requirements as for 5.2.4.2 to 5.2.4.4.

5.2.4.8 Circumferential, longitudinal and equivalent stresses during strength test of SCR riser shall not exceed the value of 0.9 x σ_m , for σ_m set respectively in paragraphs 3.3.3.2, 3.3.3.3 and 3.3.3.4 of Part III. At calculating equivalent stresses acc. to 3.3.3.4, Part III, stresses due to pressures noted during the test, static bending stresses and stresses due to environmental loads (if any) shall be considered.

5.2.4.9 For the SCR riser, the possibility of permitting performance of strength test in combination with the subsea pipeline may be considered, at pressure not lower than 1.25xMAOP.

5.2.5 Tightness test of the pipeline and steel riser

5.2.5.1 It is recommended to carry out tightness test directly after the strength test (an additional time for temperature stabilization may be considered). The tightness test may be performed together with the strength test, compliance with the requirements referred to in 5.2.4 being maintained.

5.2.5.2 The pressure and temperature of tested medium and temperature of air and sea water shall be recorded every half an hour (preferably by automatic continuous recording).

5.2.5.3 The test pressure shall be adopted according to 3.3.5.3 of Part III.

5.2.5.4 The test duration shall be at least 8 hours. If it has been found that the pressure changes are not in line with acceptance criteria acc. to 5.2.5.6, the test may be repeated. Duration of the repeated test shall be at least 12 hours.

5.2.5.5 Supplementing and letting out the tested medium during the test is not allowed.

5.2.5.6 The acceptance criterion of tightness test: pressure deviations shall not exceed ±0.25% of test pressure. In special case a deviation ± 0.4% may be accepted, if it has been proven by calculations that such deviation is caused by temperature changes or changes of other outer conditions.

5.2.6 Tightness test of the riser/flexible pipe

5.2.6.1 The stabilization time after raising water pressure shall be at least 10 hours. The condition is considered stable if within an hour the pressure change does not exceed 1% of test pressure.

5.2.6.2 Air vents of an unbonded flexible pipe, located on flanges not immersed in water, shall be of open type.

5.2.6.3 The pressure and temperature of tested medium and temperature of air and sea water shall be recorded every half an hour (preferable automatic continuous recording).

5.2.6.4 The test pressure shall be adopted according to 3.3.5.3 of Part III.

5.2.6.5 The test duration shall be at least 24 hours. Pressure drops not caused by the change of temperature or of other outer conditions are not permitted. If it has been found that the pressure changes do not fulfil acceptance criteria, the test may be repeated.

5.2.6.6 Supplementing and letting out the tested medium during the test is not allowed.

5.2.6.7 Tightness test acceptance criteria:
– the pressure drop during the test does not exceed 4% of test value.
– no pressure drops have been noted, not caused by the change of temperature or change of other external conditions.

5.3 Leaks detection and removal

If the result of pressure test indicates probable leak, the pressure in the pipeline shall be lowered by at least 80% before visual check made by e.g. the diver.

5.4 Pipeline decompression, dewatering and drying

5.4.1 Decompression

The pipeline decompression shall be performed by controlled manner, with established speed of pressure drop. The measuring devices and flexible pipes, for which manufacturers specify maximum permitted decompression speed, shall be observed.

5.4.2 Dewatering

The system shall be drained by means of appropriate medium. The dewatering pigs may be moved by nitrogen or liquid transported medium[17]. For this purpose air may be utilized. The dewatered pipeline may not be left with air inside for the period longer than two weeks. Until that time the pipeline shall be dried and filled with a liquid transported medium, or a gas or liquid neutral medium. For drying pipelines, requirements of 5.4.3 apply.

The volume of discharged water and of the medium moving the pigs shall be recorded. The discharge of water and of other media shall comply with local administration regulations.

5.4.3 Pipeline drying

The system shall be dried internally to such degree that the possibility of hydrates creation is precluded. The below instructions shall be observed:

.1 Drying shall be made directly after dewatering.
.2 The time between drying and commissioning tests shall be as short as possible.
.3 Nitrogen shall be the drying medium. Use of hydrocarbon gas for this purpose is not recommended.

[17] It does not apply to the gas transported in liquid form.

.4 If there is a risk of hydrates creation, methanol or glycol flushing shall be applied.
.5 Production gas may not be introduced into the system if any danger of hydration exists.

Temperature, dew point and nitrogen pressure at the system inlet and outlet, as well as current expenditure and total volume of used nitrogen shall be recorded.

5.5 Commissioning tests

5.5.1 Documentation verification

Prior to introducing the transported medium into the system, the documentation shall be checked for completeness according to 2.6.2, Part I.

5.5.2 Introducing transported medium into the system

The speed of filling the system shall be controlled and recorded. During filling with liquid medium, hydraulic surge shall be prevented.

5.5.3 Functional tests of the equipment and the whole system

The following shall be checked:
- operation of all measuring devices and safety devices and systems, including PSD and ESD on the side of pumps/compressors and reception facility,
- possibility of decompression/degassing of the system,
- operation of the cleaning pig operating device opening lock.

The following shall be recorded:
- physical parameters of transported medium (delivery temperature and pressure, counterpressure in reception facility, medium temperature at the inlet to reception facility, volumetric and mass flow),
- chemical composition of transported medium, including water content.

5.5.4 As-built documentation

The as-built documentation shall comprise, in addition to documents required by building law, updated documents referred to in I/2.3.2, I/2.5.2, I/2.6.2.

6 UPDATED RISK AND RELIABILITY ANALYSIS OF THE SYSTEM

After completion of commissioning tests, the documentation of risk analysis shall be reviewed and updated, considering hazards which can exist during the system operation.

7 QALITY ASSURANCE

At all phases of construction and testing of the system by Executor(s), an efficient operation of the (ISO based) quality assurance system(s) shall be ensured.

PART V – OPERATION AND DECOMMISSIONING

1 OPERATION

1.1 Quality assurance system

The ISO based quality assurance system, implemented by the Operator shall establish, inter alia, the principles for:
- performance of operational records,
- performance of operational works, including subcontracted works,
- supervision and documenting operation works, including subcontracted works,
- monitoring and documenting the system technical condition,
- considering reasons and results of damages and faults,
- determining and documenting repair and preventive activities.

1.2 Survey system

1.2.1 Development of survey system

The Operator shall develop and agree with PRS the survey system for the pipeline system.

The survey system shall be a part of the Maintenance Manual of the pipeline system.

1.2.2 Documents of the survey system

The records of the survey system shall include at least:
- The procedure for external survey of the subsea pipeline (for the part sunk in the ground and backfilled, an alternative assessment method shall be submitted), considering the below issues.
  - the pipeline stability on the sea bed, changes of the sea bed geometry, condition of unsupported sections of the pipeline,
  - corrosion and damages to the pipeline.
  - condition of anti-corrosion coatings and loading structures.
- The procedure for external survey and measurements of the riser, its shields, fixtures and connectors and bio-fouling control.
- Procedure for internal survey of the pipeline and riser if the use of gauging and cleaning pigs is possible.
- Procedure for the performance of pressure tests and monitoring of tightness and integrity of flexible pipe riser.
- Procedure for the performance of pressure tests of the subsea pipeline and steel riser.
- Procedure for the inspection of cathodic protection.
- Procedure for the survey of measuring instruments and surveys and periodical tests of devices (such as PSV, SDV, FSV) and systems (PSD, ESD) protecting the system; it applies to the system components, equipment of hydrocarbon delivery installation onboard the platform, as well as the reception facility.

1.2.3 Frequency of surveys during operation, within the survey system

The following shall be performed annually:
- external survey of the pipeline and riser
- pressure test of the flexible pipe riser (after consideration of monitoring records of the riser tightness and integrity, PRS may in the given year repeal the requirement of the pressure test performance),
- survey of the measuring instruments and periodical tests of protecting devices and systems.

Other tests and surveys may be carried out every 5 years if the properties of the pipeline system or existing conditions do not justify their performance at other intervals. Respectively to the results of performed surveys and tests, PRS may require or give consent to the change of intervals between successive activities.

1.3 Repairs

The repairs of essential components of the system and associated corrections of the sea bed substrate shall be performed in agreement with PRS (see Part I/3.3.5.3).

1.4 Documentation for PRS approval and PRS certificates

See – Part I/2.7.2.

2 DECOMMISSIONING

2.1 General

Decommissioning of the system is executed and documented so that to enable its further re-commissioning.

2.2 Technical instructions

At the system decommissioning the following shall be considered:
- local legal regulations,
- ensuring safety of the marine environment,
- ensuring safe movement of ships and fishing activity,
- anti-corrosion protection of the system during decommissioning period,
- effect, e.g. of corrosion, of the decommissioned system on other structures.

Performance of periodical surveys of the system may be required, respectively to the decommissioning period and to applied means of technical maintenance. The survey procedure is subject to PRS approval.

2.3 Documentation for PRS approval and PRS certificates

See – Part I/2.8.1.2.

2.4 The system risk and integrity assessment

The risk assessment shall be reviewed and updated, taking into account the condition of temporary decommissioning of the system and transition to this condition and re-commissioning of the system. PRS may confirm integrity of the temporarily decommissioned system by a record in the certificate.

3 PIPELINE ABANDONMENT

3.1 General

The pipeline abandonment is an irreversible operation. Upon completion of the operation, maintaining technical performance of the object as a pipeline is not ensured.

3.2 Technical requirements

3.2.1 The pipeline shall be:
- effectively emptied from hydrocarbons and possible sources of hydrocarbons shall be isolated,
- filled with water or another neutral medium and plugged.

3.2.2 The following shall be considered:
- local legal regulations,
- ensuring safety of the marine environment,
- ensuring safe movement of ships and fishing activity,
- effects, e.g. corrosive or mechanical, of the abandoned pipeline on other structures.

3.2.3 Performance of periodical surveys of the abandoned pipeline may be required, to check if it poses any hazard to marine environment, ships' traffic and fishing activity, as well as to other objects and subsea structures.

3.3 Documentation for PRS approval and PRS certificates

See – Part I/2.8.2.2.

3.4 Risk assessment for the abandoned system

Performance of risk assessment for the abandoned pipeline is required, with particular regard to the issues referred to in 3.2.

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