RUSSIAN MARITIME REGISTER OF SHIPPING

CIRCULAR LETTER **No. 315-06-1423c** dated 31.07.2020

Re:

amendments to the Rules for the Classification, Construction and Equipment of Mobile Offshore Drilling Units and Fixed Offshore Platforms, 2018, ND No. 2-020201-015-E

Item(s) of supervision:

dynamic positioning systems

Entry-into-force date: **01.09.2020** Valid till: **-** Validity period extended till: **-**

Cancels / amends / adds Circular Letter No. **-** dated **-**

Number of pages: 1+18

Appendices:

Appendix 1: information on amendments introduced by the Circular Letter

Appendix 2: text of amendments to Part XIV "Automation"

Director General Konstantin G. Palnikov

Text of CL:

We hereby inform that referring to IMO circular MSC.1/Circ.1580 "Guidelines for Vessels and Units with Dynamic Positioning (DP) Systems" and considering the scope of IACS UR E22 (Rev.2) the Rules for the Classification, Construction and Equipment of Mobile Offshore Drilling Units and Fixed Offshore Platforms shall be amended as specified in the Appendices to the Circular Letter. The amendments will be introduced into the Rules at their re-publication.

It is necessary to do the following:

1. Bring the content of the Circular Letter to the notice of the RS surveyors, interested organizations and persons in the area of the RS Branch Offices' activity.
2. Apply the provisions of the Circular Letter during review of the design documentation on MODUs, FOPs and drilling ships, during survey of MODUs, FOPs and drilling ships under construction and in service, during review and approval of the technical documentation on equipment/products installed on MODUs, FOPs and drilling ships contracted for construction or conversion on or after 01.09.2020.

List of the amended and/or introduced paras/chapters/sections:

Part XIV: Chapter 5.5, Chapter 5.10 and Section 7

Person in charge: Sergey V. Vinnichenko 315 +7 812 6050517

"Thesis" System No. 20-159806

Appendix 1 to Circular Letter
No. 315-07-1423c dated 31.07.2020

Information on amendments introduced by the Circular Letter
(for inclusion in the Revision History to the RS Publication)

Nos.	Amended paras/chapters/sections	Information on amendments	Number and date of the Circular Letter	Entry-into-force date
1	Chapter 5.5	Chapter has been completely amended considering that the programmable equipment of MODU/FOP and drilling ships is covered by IACS UR E22 (Rev.2)	315-06-1423c of 31.07.2020	01.09.2020
2	Chapter 5.10	New Chapter containing requirements for programmable electronic systems has been introduced considering that the programmable equipment of MODU/FOP and drilling ships is covered by IACS UR E22 (Rev.2)	315-06-1423c of 31.07.2020	01.09.2020
3	Section 7	Section has been completely amended considering IMO circular MSC.1/Circ.1580	315-06-1423c of 31.07.2020	01.09.2020

RULES FOR THE CLASSIFICATION, CONSTRUCTION AND EQUIPMENT OF MOBILE OFFSHORE DRILLING UNITS AND FIXED OFFSHORE PLATFORMS, 2018,

ND No. 2-020201-015-E

PART XIV. AUTOMATION

5 COMPUTERS AND COMPUTER-BASED AUTOMATION SYSTEMS

1 **Chapter 5.5** is replaced by the following text:

"**5.5 SOFTWARE REQUIREMENTS**

5.5.1 General.

5.5.1.1 The software development procedure shall comply with the applicable international or national standards spanning the software lifecycle and integration of the latter into an appropriate computer-based system.

5.5.2 Quality Management Systems Requirements.

5.5.2.1 System integrators and suppliers shall operate a quality system regarding software development and testing and associated hardware such as ISO 9001 taking into account ISO 90003, GOST R ISO/IEC 90003-2014, etc.

5.5.2.2 The quality management system specified in 5.5.2.1 shall include the following:

.1 relevant procedures regarding responsibilities, system documentation, software configuration management and competent staff;

.2 procedures regarding organization set in place for acquisition of related software and hardware from suppliers;

.3 procedures regarding organization set in place for software code writing and verification. Having a specific procedure for programmable electronic systems verification of Category II and III (refer to 5.10.3) at the level of systems, sub-systems and programmable devices and modules. Having check points for Category II and III systems and providing possible verification by the Register, i.e. submitting technical documentation to RS for review, performing the relevant tests, submitting the peer review results to RS and audits of the firm's technical control, etc., in compliance with 5.10.8;

.4 having a specific procedure for software installation and amendments thereto on board MODU/FOP and drilling ships including interactions with owners.

5.5.3 Software lifecycle.

5.5.3.1 Design.

.1 risk assessment of system.

This step shall be undertaken to determine the risk to the system throughout the lifecycle by identifying and evaluating the hazards associated with each function of the system.

A risk assessment report shall be submitted to the Register upon request. This document shall normally be submitted by the system integrator or the supplier, including data received from other suppliers.

IEC/ISO 31010 "Risk management — Risk assessment techniques" may be applied to determine a method of risk assessment. The method of risk assessment shall be defined in the report submitted to the Register.

If based on the risk assessment system category is changed, such changes shall be submitted to the Register for review.

Where the risks associated with a computer-based system are well understood, the risk assessment may be omitted upon submission of the relevant justification by the supplier or system integrator. Such justification shall include the following:

risk identification technique;

equivalence of the context of use of the current computer-based system and the computer-based system initially used to determine the risks;

adequacy of existing control measures in the system intended use under consideration;

.2 code production and testing.

The following documentation shall be provided to the Register for Category II and III systems (refer to 5.10.3) by the supplier and system integrator:

software modules functional description and associated hardware description for programmable devices;

evidence of verification (detection and correction of software errors) for software modules, in accordance with the selected software development standard. Evidence requirements of the selected software standard may differ depending on how critical the correct operation of the software is to the function it performs (for example, IEC 61508 and GOST R 61508 have different requirements depending on Safety Integrity Levels (SILs), similar approaches are taken by other recognized standards).

In addition, for Category II and III systems evidence of functional tests for programmable devices at the software module, subsystem, and system level shall be supplied by the supplier via the system integrator. The functional testing shall be designed to test functions provided by the operating system, function libraries, software shell, etc. and used by the inspected software.

5.5.3.2 Integration testing before installation on MODU/FOP and drilling ships.

Intra-system integration testing shall be carried out between system and sub-system software modules before being integrated on drilling ships, MODU/FOP. The objective is to check that software functions are properly executed, that the software and hardware it controls interact and function properly together and that software systems react properly in case of failures. Faults shall be simulated as realistically as possible to demonstrate appropriate system fault detection and system response. The results of integration testing shall also confirm findings of the appropriate failure mode and effects analysis (FMEA), if the latter shall be submitted according to the requirements of the Rules. Functional and failure testing can be demonstrated by simulation tests.

5.5.3.3 Approval of programmable devices.

Programmable devices integrated inside a computer-based system shall be delivered with the RS documents listed in the Nomenclature of items of the RS technical supervision (refer to Appendix 1, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships).

List of technical documentation submitted to the Register in addition to the documentation specified in 1.4.1 of this Part, as well as the list of relevant tests and checks is specified in 5.10.8. Technical documentation shall address the compatibility of the programmable device with the relevant computer-based systems, list of necessary tests to be carried out on MODU/FOP and drilling ships during integration into the computer-based systems and it shall identify the programmable device scope of application as well as the computer-based system components using, if possible, such a device.

5.5.3.4 Final integration and testing on MODU/FOP and drilling ships.

.1 prior to final integration the simulation tests of a computer-based system shall be undertaken to check safe interaction of the latter with other computerized systems and functions that could not be tested previously;

.2 after final integration of the computer-based system the relevant tests shall be carried out on drilling ships, MODU/FOP to check the computer-based system in actual operating conditions and integrated with all other systems in interaction:

performing functions it was designed for;

reacting safely in case of failures originated internally or by devices external to the system;

interacting safely with other systems implemented on MODU/FOP and drilling ships.

The list of relevant tests and checks is given in 5.10.8.

5.5.3.5 Software modifications during operation.

5.5.3.5.1 Responsibilities.

.1 organizations in charge of software modifications during operation shall be clearly declared by owner to the Classification Society. A system integrator shall be designated by the owner and shall fulfil the requirements specified in 5.5.1, 5.5.2, 5.5.3.1 to 5.5.3.4;

.2 during the drilling ship, MODU/FOP operation, it is the responsibility of the owner to manage traceability of these modifications. The system integrator shall support traceability of these modifications by updating the software registry. This software registry shall contain the following:

list and versions of the software installed in Category II and III systems;

date and results of the software security scans carried out in accordance with 5.5.3.6.

5.5.3.5.2 Change management.

The owner shall ensure that necessary procedures for software and hardware change management exist on drilling ship, MODU/FOP, and that any software modification and (or) upgrade are performed in strict compliance with the procedures. All changes to computer-based systems in the operational phase of drilling ship, MODU/FOP shall be recorded in accordance with 5.5.3.5.1.2.

5.5.3.6 Software security.

Owner, system integrator and suppliers shall adopt security policy and include it in their quality management systems.

For Category I, II, and III systems, physical and logical security measures shall be in place to prevent unauthorized or unintentional modification of control software or limiting values of controlled parameters within the computer-based systems, the appropriate structural means and organizational measures shall be provided. The above means and measures shall provide protection whether undertaken directly at the physical system or remotely.

Prior to software installation on MODU/FOP and drilling ships the software code, executables and physical medium used for installation shall be scanned for viruses and malicious software. Results of the scan shall be documented and kept with the software registry.".

2 New **Chapter 5.10** is introduced reading as follows:

"**5.10 PROGRAMMABLE ELECTRONIC SYSTEMS**

5.10.1 Scope.

These requirements apply to the use of programmable electronic systems which provide control, alarm, monitoring or safety functions in addition to the requirements set forth in this Section.

Navigational equipment of drilling ships, MODU/FOP is excluded.

5.10.2 General.

5.10.2.1 Programmable electronic systems are to fulfill the requirements of the system under control for all operating conditions, taking into account danger to persons, environmental impact, damage to drilling ships, MODU/FOP as well as equipment, usability of programmable electronic systems and operability of non computer devices and systems, etc.

5.10.2.2 When systems or their devices and components other than provided by these Rules are applied, an engineering analysis carried out in accordance with a relevant international or national standard and proving the equivalent effectiveness of the specified systems, devices and components with regard to those determined in these Rules in accordance with 1.3.4 of General Regulations for the Classification and Other Activity, shall be obligatory submitted to the Register.

5.10.2.3 The use of unconventional technology for category III systems shall not be permitted.

5.10.3 System categories.

5.10.3.1 Programmable electronic systems shall be assigned into three system categories as shown in Table 5.10.3.1 according to the potential (possible) extent of the damage caused by a single failure within the programmable control and monitoring electronic systems.

Table 5.10.3.1

System categories

Category	Effects	System functionality
I	Those systems, failure of which will not lead to dangerous situations for human safety, safety of drilling ship, MODU/FOP and/or threat to the environment	Monitoring function for informational/ administrative tasks
II	Those systems, failure of which could eventually lead to dangerous situations for human safety, safety of drilling ship, MODU/FOP and/or threat to the environment	Alarm and monitoring functions; control functions which are necessary to maintain drilling ship, MODU/FOP in normal operational and habitable conditions
III	Those systems, failure of which could immediately lead to dangerous situations for human safety, safety of drilling ship, MODU/FOP and/or threat to the environment	Control functions for maintaining the drilling ship, MODU propulsion and steering; safety functions

Notes: 1. Consideration shall be given to the extent of the damage directly caused by a failure, but not to any consequential damage.

2. Identical redundancy will not be taken into account for the assignment of a system category.

5.10.3.2 Assignment of a programmable electronic system to the appropriate category shall be carried out depending on the greatest likely extent of direct damage to machinery and equipment, based on risk assessment for all operating conditions of the MODU/FOP or drilling ship specified in 3.1.2, Part X "Electrical Equipment".

The relevant examples of the assignment of a programmable electronic system to the appropriate categories are given in Table 5.10.3.2. The list of the examples given is not exhaustive.

Table 5.10.3.2

Examples of assignment to system categories

System category	Examples
I	Maintenance support system Information system Diagnostic system
II	Liquid cargo transfer control system Automation system for bilge pumping system of machinery spaces Fuel oil treatment automation system Ballast remote automatic control system Stabilization and ride control systems Alarm and monitoring systems for propulsion systems
III	Control system of propulsion system, meaning the means to generate and control mechanical thrust in order to move the MODU. Control system of devices used only during manoeuvring (e.g. bow tunnel thrusters) are not in the scope of this requirement Steering system control system Electric power system (including power management system) Fire detection system Fire-fighting system Flooding detection and fighting system Control bilge system Internal communication systems involved in evacuation phases Ship systems involved in operation of life saving appliances equipment Control system of dynamic positioning system of equipment classes 2 and 3 Towing winch emergency release system if a winch is provided

5.10.4 Data communication links.

5.10.4.1 These requirements apply to system categories II and III using shared data communication links (local network) to transfer data between programmable electronic systems and equipment.

5.10.4.2 Loss of a data communication link shall be specifically addressed in risk assessment analysis.

If a single failure in any component of the data communication link hardware or software causes loss of data communication link, means shall be provided to automatically restore data communication link.

For category III systems a single failure in data communication link hardware shall not influence the proper working of the system in general.

5.10.4.3 Loss of a data communication link shall not affect the ability to operate essential services by alternative means.

5.10.4.4 Means shall be provided to ensure the integrity of data and provide timely recovery of corrupted or invalid data.

5.10.4.5 The data communication link shall be self-checking, detecting failures on the link itself and data communication failures on nodes connected to the link. Detected failures shall initiate an alarm.

5.10.4.6 System self-checking capabilities shall be arranged to initiate transition to the least hazardous state for the complete installation in the event of data communication failure.

5.10.4.7 The characteristics of the data communication link shall be such as to transmit all necessary information in adequate time and to prevent overloading.

5.10.4.8 At least the following local network hardware statuses shall be monitored:

link up of each port on the network device/network topology change;

link down of each port on the network device;

power on or network hardware reset;

temperature increase of network devices in case this parameter is critical for operation, and the manufacturer has provided its necessary monitoring.

5.10.5 Additional requirements for wireless data communication links.

5.10.5.1 For system category III, the use of wireless data communication links is not allowed.

5.10.5.2 Functions that are required to operate continuously to provide essential services dependant on wireless data communication links shall have an alternative means of control that can be brought in action within an acceptable period of time.

5.10.5.3 Wireless data communication shall employ recognized international wireless communication system protocols that incorporate the following:

.1 message integrity. Fault prevention, detection, diagnosis, and correction so that the received message is not corrupted or altered when compared to the transmitted message;

.2 configuration and device authentication. Shall only permit connection of devices that are included in the system design;

.3 message encryption. Protection of the confidentiality and criticality of the data content;

.4 security management. Protection of network assets, prevention of unauthorised access to network assets.

5.10.5.4 The wireless system shall comply with the radio frequency and power level requirements of International Telecommunications Union and flag state requirements.

Consideration shall be given to system operation in the event of port state and local regulations that pertain to the use of radio-frequency transmission prohibiting the operation of a wireless data communication link due to frequency and power level restrictions.

5.10.5.5 During mooring and sea trials for wireless data communication equipment, tests shall be conducted to demonstrate that radio-frequency transmission does not cause failure of any equipment and does not self-fail as a result of electromagnetic interference via wireless data communication links during expected operating conditions.

5.10.6 Protection against modifications.

5.10.6.1 Programmable electronic systems of category II and III shall be protected against program modification by the unauthorized personnel (user).

5.10.6.2 For systems of category III, modifications of parameters by the manufacturer shall be approved by the Register.

5.10.6.3 Any modifications in software or hardware made after performance of the tests witnessed by the Register as per item 6 of Table 5.10.8 shall be documented and submitted to the Register for approval.

5.10.7 Technical documentation.

5.10.7.1 For approval of programmable electronic systems of category II and III documentation in compliance with 1.4 shall be submitted.

When alternative design or arrangement is intended to be used, an engineering analysis carried out in accordance with a relevant international or national standard shall be submitted in addition (refer to 5.10.2.2).

For MODU/FOP and drilling ships with the distinguishing marks **AUT1-ICS**, **AUT2-ICS** in the class notation where computer-based systems are combined into a network forming a common integrated system, the designer shall submit a vision document of a system architecture specifying where computer-based systems and network hardware are installed, brief description of the systems interaction and, if provided, with outside ship systems and devices, as well as protection principles against malicious information attacks of an integrated system, its division plan, if necessary, into subsystems, or other actions aimed at preventing cyber threats or failure consequences caused by such attacks. The vision document shall be supplemented with an initial review of probable vulnerabilities, as well as the failure mode and effect analysis of the integrated system with shipboard computer-based systems used for control and monitoring combined into a network. The analysis to be submitted shall include, as a minimum, the programmable electronic systems of categories II and III, as well as network hardware. A single failure concept shall be applied during the analysis, and failure spread probabilities through a network combining integrated computer-based systems shall be taken into account. Upon the integrated system analysis completion, it is necessary to draw conclusions and provide recommendations to reduce risks of failures caused by cyber threats that may lead to dangerous situations for human safety, drilling ship, MODU/FOP safety and/or threat to the environment. The vision document and analysis shall be used and specified by the system integrator of ship computer based systems, and the recommendations on the performed analysis shall be used by the shipowner.

5.10.7.2 For all tests required in accordance with the system category a test program shall be submitted and the test results shall be documented (by reports).

5.10.7.3 Additional documentation may be required for systems of category III. The documentation shall include a description of testing methods and required test results.

5.10.7.4 For wireless data communication equipment, the following additional technical documentation shall be submitted:

.1 details of manufacturer's recommended installation and maintenance practices;

.2 network plan with arrangement and type of antennas and identification of location;

.3 specification of wireless communication system protocols and management functions (refer to 5.10.5.3);

.4 details of radio frequency and power levels;

.5 evidence of type testing in accordance with shipboard conditions;

.6 on-board test program for MODU/FOP and drilling ships (mooring and sea trials).

5.10.7.5 Necessary documents for approval of programmable electronic systems of category I shall be submitted if requested.

5.10.7.6 All changes or modifications shall be documented by the manufacturer and submitted to the Register for review and approval. Subsequent significant modifications to the software and hardware for system categories II and III shall be submitted anew for review and approval.

N o t e . A significant modification is a modification which influences the functionality and/or safety of the system.

5.10.8 Tests and evidence.

Tests and appropriate documents (reports, certificates) shall be issued in accordance with Table 5.10.8.

Table 5.10.8

Tests and evidence according to system category

Nos.	Requirement	Supplier involved	System integrator involved	Owner involved	Category I[1]	Category II	Category III
1	Quality Plan	×	×		Ⓐ[2]	Ⓐ	Ⓐ
2	Risk assessment report		×		Ⓘ[2]	Ⓘ[2]	Ⓘ[2]
3	Software modules functional description and associated hardware description	× (if necessary)	×			Ⓘ	Ⓘ
4	Evidence of verification of software code	× (if necessary)	×			Ⓘ	Ⓘ
5	Evidence of functional tests for elements included in systems of Category II and III at the level of software module, sub-system and system	×	×			Ⓘ	Ⓘ
6	Test programs and procedures for functional tests and failure tests including a supporting FMEA or equivalent, at the RS request, depending on available relevant requirements in the RS rules		×			Ⓐ	Ⓐ
7	Factory acceptance test including functional and failure tests	×	×			Ⓦ	Ⓦ
8	Test program for simulation tests for final integration of the system		×			Ⓐ	Ⓐ
9	Simulation tests for final integration of the system		×			Ⓦ	Ⓦ
10	Test program for on-board tests (includes wireless data communication testing)		×			Ⓐ	Ⓐ
11	Mooring and sea trials tests (includes wireless data communication testing)		×			Ⓦ	Ⓦ
12	List and versions of software installed in system Functional description of software User manual including instructions during software maintenance List of interfaces between system and other ship systems List of standards for data communication links Additional documentation, at the RS request, if relevant requirements are available in the RS rules including "Failure modes and effects analysis" (FMEA) or an equivalent document		×			Ⓘ	Ⓘ
13	Updated software registry		×	×		Ⓘ	Ⓘ
14	Procedures and documentation related to security policy		×	×		Ⓘ	Ⓘ
15	Test program for compliance with the shipboard service conditions	×	×		Ⓐ[3]	Ⓐ	Ⓐ
16	Tests for compliance with the shipboard service conditions	×	×			Ⓦ	Ⓦ
17	Test reports according to the shipboard service conditions	×	×		Ⓐ[3]	Ⓐ	Ⓐ

Symbols:

× — the Party shall design and submit the relevant technical documentation to the Register for review and/or carry out the relevant tests and submit the item of technical supervision to the Register;

Ⓐ — technical documentation shall be submitted for approval;

Ⓘ — technical documentation shall be submitted for reference (for information purposes);

Ⓦ — the RS representative shall take part in the tests.

[1] RS may request additional technical documentation if relevant requirements are available in the RS Rules.

[2] Risk assessment is permissible to be omitted considering the requirements of 5.5.3.1.1.

[3] If relevant requirements are available in the RS rules.

".

7 DYNAMIC POSITIONING SYSTEMS

3 **Section 7** is replaced by the following text:

"**7 DYNAMIC POSITIONING SYSTEMS**

7.1 APPLICATION AND MARKS IN CLASS NOTATION

7.1.1 The requirements of this Section apply to the following:

electric and electronic equipment of the dynamic positioning systems;

automated control systems for thruster units;

ship systems affecting dynamic positioning system operation as specified in 7.5.12 and 7.14.1.

7.1.2 Observance of the requirements of this Section and applicable requirements of other sections of this Part is mandatory for MODUs and drilling ships, which are assigned in compliance with 2.4.2, Part I "Classification", one of the following marks: **DYNPOS-1**, **DYNPOS-2** or **DYNPOS-3**, added to the class notation.

7.2 DEFINITIONS AND EXPLANATIONS

7.2.1 Dynamic positioning control system (DP control system) means a computer-based programmable system intended for automatic and remote automated control of the auxiliary thrusters, propulsion plants, steering gear, if part of the dynamic positioning system, in order to dynamically keep position and/or heading of the ship with prescribed accuracy under the action of disturbing environmental forces, and consisting of the following:

computer-based system with associated software and interfaces for generation of control signals in automatic mode or with the use of a single control device (joystick);

operator panel system with controls and data displays;

position reference systems;

external force sensors;

power cabling;

information and control cabling.

Dynamic positioning operation (DP operation) means using the dynamic positioning system to control at least two degrees of freedom in the horizontal plane automatically.

Dynamic positioning system (DP system) means the complete installation intended for control of power supply system of the MODU or drilling ship, auxiliary thrusters, propulsion plants, steering gear, if part of the dynamic positioning system, in order to dynamically keep position and/or heading of the ship with prescribed accuracy under the action of disturbing environmental forces.

The dynamic positioning system shall comprise, but not be limited to, the following main systems:

power supply system;

thruster system;

dynamic positioning control system.

Failure modes and effects analysis (FMEA) of dynamic positioning system of ships with distinguishing marks **DYNPOS-2** or **DYNPOS-3** in the class notation means a systematic analysis of all potential failures and effects with respect to ship systems and sub-systems, individual machinery items and devices involved in MODU or drilling ship dynamic positioning operations carried out to a level of detail that is required to demonstrate that no single failure will cause a loss of position and/or heading as per the worst-case failure design intent.

Hidden failure means a failure that is not immediately evident to dynamic positioning system operator or maintenance personnel and has the potential for failure of equipment to perform a dynamic positioning control system on-demand function (back-up devices, systems and sub-systems of the dynamic positioning system, protective devices for diesel-generator plants, protective devices in main switchboard and switchboards, back-up power supplies, other equipment of the dynamic positioning system).

Independent joystick system means a system for automated control of thruster system using one control providing remote automated positioning control and automatic heading control. The system shall be independent of the main or back-up dynamic positioning control system and shall have its own UPS.

Joystick system means a system for remote automated control of thruster system using one control and providing remote automated positioning and remote automated or automatic heading control.

Loss of position and/or heading of the MODU or drilling ship means that the ship's position and/or heading is outside the limits set for carrying out the dynamic positioning activity in progress.

Main dynamic positioning control station (main DP control station) means an operator workstation designated for dynamic positioning operations, which is equipped with control panels, ensures a good view of the MODU/drilling ship exterior limits, and where dynamic positioning control system panels and displays are installed, as well as relevant devices for automatic and joint automated control and devices for separate remote control of thrusters, propulsion plants, steering gear, if part of the dynamic positioning system, emergency stop devices for propulsion plant and thrusters, independent joystick system, devices for switching between control systems, necessary information sources, such as indicators and displays, position reference systems, alarm panels, communication systems.

MODU or drilling ship dynamic position and/or heading keeping means maintaining a desired position and/or heading within the required accuracy and under specified environmental conditions.

Power supply system means the system necessary to supply the dynamic positioning system with power under all operating conditions including emergency ones and comprising:

prime movers of generators with necessary piping and auxiliary systems including fuel, cooling, lubrication oil, hydraulic, pneumatic and pre-heating systems;

generators;

switchboards;

cabling;

independent power supplies, including uninterruptible power supplies;

power management systems.

Redundancy of dynamic positioning system means duplication or multiple redundancy of its components, at which an installation consisting of a power supply system and thruster units with their individual control systems is functioning under control of a computer-based system in such a way that failure of particular control systems, particular thruster units or components of the power supply system does not affect the performance of the task to ensure the ship position keeping and/or heading holding.

Ship means, for the purposes of this Section, a drilling ship or a self-propelled mobile offshore drilling unit.

Single failure in dynamic positioning system means a failure in active components and/or passive elements of a dynamic positioning system, as defined in 7.5.5 and 7.5.6.

Thruster system means the system intended for providing adequate thrust in longitudinal and lateral directions at each instant of time as well as yawing moment which can compensate for the environmental factors affecting the MODU or drilling ship.

The system shall comprise the following items:

thrusters with drives and auxiliary equipment including hydraulic piping and tanks (if any);

main propulsion plant of the MODU or drilling ship with supporting systems and steering gear if under the dynamic positioning system control;

means for individual manual control of each propulsion unit, steering gear and thruster; and

associated cabling connecting all system's machinery and systems to the dynamic positioning control system.

Worst-case failure (WCF) means the identified single fault in the dynamic positioning system resulting in maximum detrimental effect on the dynamic positioning system capability to maintain a desired position and/or heading of MODU or drilling ship as determined through the FMEA.

Worst-case failure design intent (WCFDI) means the specified minimum dynamic positioning system capabilities to be maintained following the worst-case failure. The worst-case failure design intent is used as the basis of the design. This usually relates to the number of thrusters and generators that can simultaneously fail.

7.3 SCOPE OF SURVEYS

7.3.1 The following equipment of the DP system is subject to survey during manufacture and on board:

electric machines and electric machine converters of ship's power supply system;
electric drives of propulsion units, steering gear and thrusters;
power static semi-conductor converters and transformers;
switchboards;
switchgear and control gear and protective devices;
uninterruptable power supply arrangements;
power and control, including information, cabling;
control and monitoring consoles of dynamic positioning control system;
computers and computer-based systems with software;
ship's position reference systems;
external force sensors.

7.4 TECHNICAL DOCUMENTATION REVIEW

7.4.1 Prior to commencement of survey of DP system equipment and in addition to the information specified in 1.4 hereof, the following documentation shall be submitted to the Register for review:

Table 7.4.1

List of documentation for products

Equipment/ system	Name of documentation	Description	Distinguishing mark in class notation
Dynamic positioning control system	Technical description**	Technical description shall contain information as follows: description of the DP control system operating modes; description of interaction with ship systems including control system for ship's power supply system as well as the automatic system for the shutdown of non-explosion proof type electrical equipment (refer to 7.9.4, Part X "Electrical Equipment"); system performance (response times, positioning accuracy, operating conditions, etc.); list of redundant equipment in compliance with the requirements covered by class notation; functional diagram of the system; list of system components (control stations, position reference systems, etc.); description of self-check system and alarm and monitoring system within dynamic positioning control system, list of the alarm and monitoring system signals; user interface description;	**DYNPOS-1** **DYNPOS-2** **DYNPOS-3**
		description of software solutions responsible for function of continuous analysis which provides verification that the ship will remain in position and/or heading will be maintained if the worst-case failure occurs under current environmental conditions as well as simulation of the DP system behaviour following the worst-case failure based on the manual input of environmental condition data; DP capability plots demonstrating position keeping capacity at least for fully effective DP system and following a single worst-case	**DYNPOS-2** **DYNPOS-3**

Equipment/ system	Name of documentation	Description	Distinguishing mark in class notation
		failure in DP system, as determined through the FMEA	
	Software description**	This document shall contain as follows: list of software modules specifying their purposes; protection measures against unauthorized modification of software; protection measures against modifications of settings; record keeping and procedure of software updating; methods and programme for software testing	**DYNPOS-1** **DYNPOS-2** **DYNPOS-3**
	Schematic and functional diagrams*	DP control system diagrams with indication of inputs and outputs, feedbacks and power supplies	**DYNPOS-1** **DYNPOS-2** **DYNPOS-3**
	Failure modes and effects analysis (FMEA)**	The document shall specify analysis of possible failures and their effects to confirm compliance with the requirements in the ship class notation	**DYNPOS-2** **DYNPOS-3**
	Procedure for DP system recovery**	Blackout recovery procedure for dynamic positioning system	**DYNPOS-1** **DYNPOS-2** **DYNPOS-3**
	Factory testing programme*		**DYNPOS-1** **DYNPOS-2** **DYNPOS-3**
	Programme of mooring and sea trials*	The document shall include testing procedures to verify the system functioning in all operating conditions as well as to check all FMEA provisions (for systems **DYNPOS-2, DYNPOS-3**)	**DYNPOS-1** **DYNPOS-2** **DYNPOS-3**
	Operation manual**	Operation manual, equipment installation instruction and maintenance instruction may be combined to form one document	**DYNPOS-1** **DYNPOS-2** **DYNPOS-3**
	Equipment installation instruction**		**DYNPOS-1** **DYNPOS-2** **DYNPOS-3**
	Equipment maintenance instruction**		**DYNPOS-1** **DYNPOS-2** **DYNPOS-3**
Independent joystick system	Technical description**	Technical description shall contain information as follows: description of the system operating modes; system performance (reaction times, positioning accuracy, operating conditions, etc.); functional diagram of the system*; list of the system components; user interface description	**DYNPOS-1** **DYNPOS-2** **DYNPOS-3**
	Software description**	This document shall contain as follows: list of software modules specifying their purposes; protection measures against unauthorized modification of software; protection measures against modification of settings; record keeping and procedure of software updating; methods and programme for software testing	**DYNPOS-1** **DYNPOS-2** **DYNPOS-3**
	Schematic diagrams*		**DYNPOS-1** **DYNPOS-2** **DYNPOS-3**

Equipment/ system	Name of documentation	Description	Distinguishing mark in class notation
	Factory testing programme*		**DYNPOS-1 DYNPOS-2 DYNPOS-3**
	Programme of mooring and sea trials*	The document shall include testing programme to verify the system functioning in all operating modes as well as to check FMEA findings (for systems **DYNPOS-2, DYNPOS-3**)	**DYNPOS-1 DYNPOS-2 DYNPOS-3**
	Operation manual**	Operation manual, equipment installation instruction and maintenance instruction may be combined to form one document	**DYNPOS-1 DYNPOS-2 DYNPOS-3**
	Equipment installation instruction**		**DYNPOS-1 DYNPOS-2 DYNPOS-3**
	Equipment maintenance instruction**		**DYNPOS-1 DYNPOS-2 DYNPOS-3**
Position reference systems	Programme of mooring and sea trials*	The document shall include testing programme to verify the system functioning in all operating modes	**DYNPOS-1 DYNPOS-2 DYNPOS-3**
	Operation manual**	user interface description; description of the system operating modes;	**DYNPOS-1 DYNPOS-2 DYNPOS-3**
	Technical description**	Technical description shall contain information as follows: list of equipment; equipment characteristics; operating conditions; connection diagrams*	**DYNPOS-1 DYNPOS-2 DYNPOS-3**
External force sensors (heading, motions, wind speed, wind direction)	Technical description**	Technical description shall contain information as follows: list of equipment; equipment characteristics; operating conditions; connection diagrams*; user interface description	**DYNPOS-1 DYNPOS-2 DYNPOS-3**
	Sea and mooring trials programme*	The document shall include testing programme to verify the system functioning in all operating modes	**DYNPOS-1 DYNPOS-2 DYNPOS-3**
Power management system	Failure modes and effects analysis (FMEA)**	The documents shall specify analysis of possible failures and their effects to confirm compliance with the requirements in the ship class notation	**DYNPOS-2 DYNPOS-3**
	Blackout recovery procedure for ship's power supply system**	Procedure shall describe recovery process for ship's power supply system in relation to the mode of ship dynamic position and/or heading keeping	
*The document shall be approved. **The document shall be agreed.			

7.4.2 When the DP system components are manufactured by various manufacturers, each of them shall submit a set of technical documentation for the manufactured equipment compliant to the applicable requirements of 1.4 and 7.4.1.

7.5 DESIGN OF THE DP SYSTEMS, CLASSES

7.5.1 The design of the dynamic positioning control systems shall conform to the general requirements set forth in Section 2.

7.5.2 Where the propulsion plant and rudder system of a self-propelled ship form part of the DP system, the requirements of this Chapter shall be fully applied thereto, in addition to the requirements placed upon the propulsion machinery and rudder system.

7.5.3 The DP systems shall be subdivided into classes based on their design capability to maintain position and/or heading of the ship if the worst-case failure occurs, as specified below.

7.5.4 Class 1 DP system, which corresponds by its characteristics to mark **DYNPOS-1** in the class notation, is a system with minimum redundancy as indicated in 7.5.8. In this case, the loss of position and/ or heading of the ship may occur in the event of a single failure.

7.5.5 Class 2 DP system, which corresponds by its characteristics to mark **DYNPOS-2** in the class notation, shall have such redundancy that a loss of position and/or heading shall not occur in the event of a single failure under specified/considered environmental conditions according to the design in any active component or system (generator, thruster, propulsion unit and steering gear, if part of the DP system, main switchboard section or switchboard, control cabling, remotely controlled valve, etc.) or one passive component of the system (cable, piping, heat exchanger, manually controlled valve, etc.), failure of which may immediately cause deterioration of the DP system capability to maintain ship's position and/or heading.

Common passive components may be used in the systems, which will not immediately affect heading or position keeping capabilities upon failure (e.g. components in ventilation and seawater systems not directly cooling DP system running machinery). Common passive components of the system shall not be usually considered to fail owing to adequate protection from mechanical damage and component properties confirmed by results of technical supervision of the Register.

7.5.6 Class 3 DP system, which corresponds by its characteristics to mark **DYNPOS-3** in the class notation, shall have such redundancy that a loss of position and/or heading shall not occur in the event of a single failure or an accident under specified/considered environmental conditions according to the design in the system components in the following cases:

failure in any component, as indicated in 7.5.5, as well as any passive component in the DP system;

failure in all active and passive components located in any one watertight compartment, from flooding, fire or activation of the automatic system for the shutdown of non-explosion proof type electrical equipment (refer to 7.9.4, Part X "Electrical Equipment");

failure in all active and passive components located in any one fire subdivision, from fire, flooding or activation of the automatic system for the shutdown of non-explosion proof type electrical equipment (refer to 7.9.4, Part X "Electrical Equipment").

7.5.7 For Class 2 and 3 DP systems, the controls of operator panels of the dynamic positioning control system shall be designed so that no single inadvertent act of the operator of the dynamic positioning control system can lead to a loss of position and/or change in heading.

7.5.8 Class 1 DP system shall be designed with redundancy of the position reference system.

Duplication of computer-based DP control system is not mandatory; however, it is necessary to provide independent joystick system with automatic ship heading keeping function as specified in 7.9.4.

7.5.9 Class 2 DP system shall be designed with redundancy of the following components:

power supply system;

thrusters with their local control systems;

computer-based systems with the operator panels and controls of DP control system;

position reference systems and external force sensors.

7.5.10 Class 3 DP system shall be designed with redundancy of components as provided for Class 2, but in addition, all the redundant components shall be separated by "A-60" class fire-resisting bulkheads and in case of equipment below the main bulkhead deck they shall be also separated by watertight bulkheads.

7.5.11 The redundant components ensuring single failure tolerance shall function continuously or be switched on automatically. In this case, the redundant equipment performance shall be sufficient for carrying out the DP activity in progress with account of the ship purpose and required accuracy until such activity can be safely completed.

For Class 2 and 3 DP systems, the provision shall be made regarding possible tracking of hidden failures that, as determined through the FMEA, can lead to loss of duplication of equipment or systems included in DP system operation upon request of the control system algorithm. In this case, various software and hardware may be used (tracking continuity of data communication

links, tracking of equipment "status", available unacknowledged failure signals, etc.). To achieve the purposes above, start of the periodical equipment testing programmes is allowed as well as monitoring of certain systems.

7.5.12 For MODUs where dynamic positioning operations are required to maintain operational control over the integrity of the well, dynamic positioning systems not inferior to Class 3 shall be used.

7.6 POWER SUPPLY SYSTEM

7.6.1 The power system necessary to supply the thruster system shall have a sufficient capacity and shall respond in time to power demand changes caused by operating modes needed at the moment.

Sudden load changes in ship's power supply system resulting from any single failures in DP system shall not cause loss of ship's electric power.

7.6.2 For Class 1 DP systems, the power system need not be redundant.

7.6.3 For Class 2 DP systems, the power system shall be divisible into two or more independent systems, so that after failure of one of them the remaining power supply systems can supply power to the connected thruster units with supporting systems to ensure maintaining of position and/or heading of the ship. While in use, the power system may be run as a common electric power supply system.

7.6.4 For Class 3 DP systems, the power system shall have characteristics mentioned in 7.6.3, but in addition, it shall be physically divided by "A-60" class division (bulkhead) into two or more independent systems. Where the power supply systems are located onboard below the operational waterline, they shall be also divided by watertight bulkheads. During operation, such systems shall function separately.

7.6.5 For Class 2 and 3 DP systems at least one power management system shall be provided. Such system shall have structure ensuring performance in case of any single failure, as indicated in 7.5.5 and 7.5.6.

7.6.6 The programmable electronic systems (computer-based or microprocessor (PLC) systems) shall be supplied in such a way as to minimize voltage bumps, harmonic interference and to provide protection against erroneous connection (connection with a wrong polarity).

7.7 THRUSTER SYSTEM

7.7.1 Each electric drive of the thrusters shall be power supplied by a separate supply circuit without the use of common feeders or common protective devices.

7.7.2 Each electric drive of thrusters shall be provided with its own control system supplied by a separate circuit without the use of common feeders or common protective devices. Such control system shall provide, if necessary, remote automated control of the respective thruster, which shall be independent of the dynamic positioning control system.

7.7.3 Failures in the thruster system, including failed control commands for propeller pitch, azimuth and/or propeller speed, shall not cause change in heading or increase in thrust magnitude.

7.7.4 To eliminate electromagnetic interaction between command signals, feedback signals of the local control systems of thruster units and electronic (computer-based) dynamic positioning control system, the mentioned control systems shall meet the requirements set forth in 2.2, Part X "Electrical Equipment".

7.7.5 The thruster system with thrusters control systems and support auxiliary arrangements and equipment of Class 2 and 3 DP systems shall be supplied with power in compliance with 7.6.3 and 7.6.4. If a failure of one of the power supply systems with thruster units connected to it occurs, the thruster units remaining in operation shall provide sufficient resultant thrust in the longitudinal and lateral directions as well as yawing moment for maintaining position and/or heading of the ship under the environmental forces action stipulated in the design.

7.7.6 Each thruster unit shall have an emergency stop system accessible for actuation both from the thruster unit local control station and the DP control station. Emergency stop systems of thruster units used in Class 2 and 3 DP systems shall have control loop monitoring. In

Class 3 DP systems the engineering solutions shall be provided for such monitoring in the event of failure or accident according to 7.5.6.

7.8 CONTROL STATIONS

7.8.1 The main dynamic positioning control station shall be generally located on the navigation bridge where the operator has a good view of the ship's exterior limits. DP system operator's workstation shall be equipped with the panels of the dynamic positioning control system with relevant devices for automatic and automated control, including devices for remote automated control system for thrusters, propulsion plants and rudders, if part of the DP system, emergency stops for propulsion plants and thrusters, independent joystick system, devices for switching between control systems, necessary information sources, such as indicators, controls for position reference systems, alarm panels, communication systems.

7.8.2 The display switching system and controls shall be designed with due regard to the national ergonomic standards. The thruster and propulsion unit control mode shall be selectable by simple actions of the operator and the mode selected shall be clearly distinguishable among the following control modes provided:

automatic control of thruster system;

remote automated control of all units within thruster system with the use of a single control device;

remote automated control of each unit being part of the thruster system;

manual control of ship's propulsion plant, thrusters and rudders from the local control stations.

7.8.3 The alarm and monitoring system of the DP system shall meet the general requirements set forth in 2.4.

7.8.4 The alarm and monitoring system of the DP system, in addition to audible and visual signals relating to the DP system machinery and devices, shall contain textual and graphic information on failures.

7.8.5 The control system shall provide for quick transfer from the automatic to remote automated control of the thrusters, propulsion plants and rudders, if involved in DP system operations, using both individual controls (according to the number of thruster units) and a single common joystick. Transfer from the remote automated to automatic control shall be effected with similar quickness.

7.9 COMPUTER-BASED DYNAMIC POSITIONING CONTROL SYSTEMS

7.9.1 The redundancy requirements shall not be applicable to computer-based systems in Class 1 dynamic positioning control systems.

7.9.2 Computer-based systems in Class 2 dynamic positioning control systems shall be duplicated and independent of one another.

The dynamic positioning control systems shall be designed with a logic that would render fault development and transfer from one system to another impossible. The redundant system components shall interact in such a manner that if one of these components fails, it is isolated (disconnected) while the other component is activated. The control station shall represent sufficient visual and audible information on transfer to the back-up system or component. Malfunctions of common facilities, such as plant interfaces, arrangements for switching between systems, data transfer, data buses and software, including self-checking routines shall not be capable of causing the failure of both systems.

7.9.3 Computer-based systems in Class 3 dynamic positioning control systems shall be duplicated as indicated in 7.9.2, and furthermore, provision shall be made for an independent back-up dynamic positioning control system arranged in a special space separated by "A-60" class bulkhead from the main control station. During normal dynamic positioning control, the back-up system shall be in "hot back-up" state in "on" condition and shall be automatically updated by data input from the position reference system and external force sensors, thruster system feedback sensors, etc. Change-over of control to the back-up system shall be possible at all times and shall be effected manually from the back-up control station.

7.9.4 Independent joystick system with automatic ship heading keeping function shall be provided for DP systems irrespective of their Class.

7.9.5 In computer-based systems of Class 2 and 3 DP systems the software function of continuous analysis shall be implemented to verify that heading will be maintained and/or the ship will remain in position if the worst-case failure occurs. The analysis shall verify that, following the worst-case failure, the remaining in operation thrusters, propulsion plants and rudders, if involved in DP system operations, can generate the same resultant thrust and yawing moment as required prior to the accident under current environmental conditions.

7.9.6 The control systems with the software function of failure consequence analysis according to 7.9.5 shall actuate warning alarm where the analysis outcome establishes DP system's inability to maintain position and/or heading of the ship after the worst-case failure under current environmental conditions.

7.9.7 For DP system operations, which will take a long time to safely terminate, the failure consequence analysis shall be capable of simulating the DP system behaviour after the worst-case failure based on manual inputs of weather trend.

7.9.8 If the ship's equipment and/or systems (e.g. processing facilities for sea cable or pipe laying, etc.) are capable of generating disturbances with direct impact on DP performance, required data inputs shall be submitted automatically to the DP control system from such equipment/systems. Additionally, provisions shall be made for such data inputs into the DP control system manually.

7.9.9 Redundant computer-based systems shall be arranged with automatic transfer of control after a failure in one of the computer-based systems. The automatic transfer of control from one computer-based system to another shall be smooth, without significant disturbing effects on the thruster system. The alarm and monitoring system shall give the signal if the system, which take over control, is for whatever reason unable to provide automatic control during the transfer of systems.

7.9.10 A dedicated uninterruptible power source (UPS) shall be provided for each DP control system, including independent joystick system. The UPS battery capacity shall be sufficient for servicing the computer-based DP control system and external force sensors connected to it as well as position reference system for 30 minutes following a main supply failure. For Class 2 and 3 DP systems, UPS shall be connected to independent power supply systems as indicated in 7.6.3 and 7.6.4. UPS for Class 3 back-up dynamic positioning control system shall be arranged considering 7.9.3. During change-over from the main supply to the battery supply, the alarm and monitoring system signal shall be given. The alarm and monitoring system signal shall also be given when the accumulator battery is discharged.

7.9.11 Application programs and database of dynamic positioning control system programmable devices shall be protected against destruction or data loss due to faults in the equipment power supply system.

7.10 POSITION REFERENCE SYSTEMS

7.10.1 Position reference systems shall be based on the operating requirements with due regard to the acceptable performance characteristics. The systems shall be simultaneously and coordinately available to the DP control system during operation. The position reference systems shall produce data with adequate accuracy. Provision shall be made for visual and audible alarm to indicate deviations from true data or excessive degradation of the signals from the position reference systems.

7.10.2 For Class 1 DP systems, at least two independent position reference systems shall be installed.

7.10.3 For Class 2 and 3 DP systems, at least three independent position reference systems shall be installed.

7.10.4 When two or more position reference systems are required, they shall not all be of the same type, but jointly such systems shall involve at least two different physical principles for position reference.

7.10.5 For Class 3 DP systems, one of the position reference systems shall be connected to the back-up control system and located in a space separated by "A-60" class bulkhead from the spaces containing other position reference systems.

7.11 EXTERNAL FORCE SENSORS

7.11.1 For the DP systems, provision shall be made for at least the following external force sensors determining:

heading;

magnitude of ship motions;

wind speed;

wind direction.

The sensors shall be selected on the basis of the operating requirements with due regard to the acceptable performance characteristics.

7.11.2 For Class 2 or 3 DP systems where required accuracy of keeping ship's position or heading is fully dependent on correct signals from external force sensors, at least three independent external force sensor systems shall be available for each parameter (e.g. three gyro compasses or three heading sensors engaging other physical principles, but in compliance with 7.11.1, shall be provided for heading).

7.11.3 For Class 3 DP systems, one group of sensors of each type, in addition to the requirements set forth in 7.11.2, shall comply with the requirement for separation thereof by "A-60" class bulkhead from other sensors.

7.12 ALARM AND MONITORING SYSTEM

7.12.1 In addition to the requirements set forth in 2.4, the alarm and monitoring system shall be arranged with facilities to preserve and indicate the data on failure alarms and change in their state.

7.12.2 Parameters monitored by the alarm and monitoring system shall be subdivided structurally into parameters, which to a certain degree are informative, and parameters, which when alarmed require immediate actions to be taken by the personnel.

7.13 CABLE ROUTEING AND PIPING OF DP SYSTEM MACHINERY AND DEVICES

7.13.1 For Class 1 and 2 DP systems cable routes of electrical equipment and control systems, as well as hydraulic, fuel and lubricating oil and other piping shall be installed with due regard to the requirements set forth in 16.8.4, Part X "Electrical Equipment" and Section 5, Part VIII "Systems and Piping" of the Rules for the Classification and Construction of Sea-Going Ships.

7.13.2 For Class 3 DP systems, cables of stand-by electric and electronic equipment and piping of stand-by support systems and control systems shall not be routed together with cables and piping systems of the main equipment through the same spaces (compartments). Such installation may be only accepted in cases when the cables of stand-by equipment and, in turn, piping of stand-by systems run in "A-60" class fire-protective ducts. Use of cable connection boxes is not allowed in fire-protective ducts.

7.14 REQUIREMENTS FOR NON-DP SHIP SYSTEMS

7.14.1 Single failure in ship systems not directly part of the DP system (e.g. fire-extinguishing systems, ventilation systems of engine-room and other spaces where the DP system equipment is installed (refer to 3.2.10, Part VIII "Systems and Piping"), air heating and conditioning in ship spaces and accommodations, emergency stop systems of fuel, lubricating oil transfer pumps, automatic system for the shutdown of non-explosion proof type electrical equipment, etc.) shall not affect DP system operation, exceeding criteria as specified in 7.5.5 and 7.5.6.".