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RULES

FOR THE CLASSIFICATION AND CONSTRUCTION OF NUCLEAR SHIPS AND NUCLEAR SUPPORT VESSELS

PART VIII

ELECTRICAL AND AUTOMATION EQUIPMENT

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RULES FOR THE CLASSIFICATION AND CONSTRUCTION OF NUCLEAR SHIPS AND NUCLEAR SUPPORT VESSELS

Rules for the Classification and Construction of Nuclear Ships and Nuclear Support Vessels developed by Russian Maritime Register of Shipping (RS, the Register) have been approved in accordance with the established approval procedure and come into force on 1 October 2022.

The present edition is based on the 2022 edition of the Rules for the Classification and Construction of Nuclear Ships and Floating Facilities and on the 2017 edition of the Rules for the Classification and Construction of Nuclear Support Vessels, taking into account Circular Letters No. 110-312-1-1695c dated 04.02.2022 and No. 110-312-1-1702c dated 14.02.2022, amendments and additions developed immediately before publication.

The Rules set down specific requirements for the nuclear ships, nuclear support vessels and supplement the Rules for the Classification and Construction of Sea-Going Ships and the Rules for the Equipment of Sea-Going Ships of Russian Maritime Register of Shipping.

The Rules are published in the following parts:

Part I "Classification";
Part II "Safety Standards";
Part III "Hull";
Part IV "Stability. Subdivision";
Part V "Fire Protection";
Part VI "Nuclear Steam Supply Systems";
Part VII "Special Systems";
Part VIII "Electrical and Automation Equipment";
Part IX "Radiation Safety";
Part X "Physical Security".

REVISION HISTORY[1]
(purely editorial amendments are not included in the Revision History)

Amended paras/chapters/sections	Information on amendments	Number and date of the Circular Letter	Entry-into-force date
Table 15.1	The Table has been supplemented by item 37 "Vibration of the main turbines" and Footnote 2	110-312-1-1863c of 22.11.2022	15.12.2022

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

1 GENERAL

1.1 The electrical equipment of the nuclear ships and nuclear support vessels[1] shall comply in full with the requirements in Part XI "Electrical Equipment" of the Rules for the Classification and Construction of Sea-Going Ships[2] and requirements of this Part.

1.2 The automation equipment of nuclear ships and NS vessels shall comply in full with the requirements in Part XV "Automation" of the Rules for the Classification and requirements of this Part.

1.3 All the electrical equipment installed in the controlled area spaces shall have protective enclosure not lower than IP 56, and the RM spaces — IP 57.

1.4 In addition to automation systems specified in Part XV "Automation" of the Rules for the Classification, the following shall be subject to technical supervision on the nuclear ship: control, protection, alarm and indication systems required for the SSS and safety systems operation.

1.5 Definitions and explanations relating to adopted abbreviations and terms are given in Part I "Classification".

1.6 The extent of technical documentation on electrical and automation equipment submitted for review to the Register within the technical design is specified in Part I "Classification" of the Rules for the Classification and in 3.1.6 and 3.1.7, Part I "Classification" of the Rules for the Classification and Construction of Nuclear Ships and Nuclear Support Vessels[3].

[1] Hereinafter referred to as "the NS vessels".
[2] Hereinafter referred to as "the Rules for the Classification".
[3] Hereinafter referred to as "these Rules".

2 GENERAL REQUIREMENTS TO ELECTRICAL EQUIPMENT OF NUCLEAR SHIP

2.1 The electric installation of the ship shall consist of the main and emergency electrical systems.

2.2 The electric installation with generators off shall be capable of supplying electric energy to the systems required for disabling the reactor and keeping it in safe state for at least during 30 days under any state class, including SC4 and taking into account a single failure of the electrical system in addition to an initial event which caused the state class.

2.3 When starting up the and shutting down the reactor, the safety control systems and security systems of the reactor shall be supplied with electric energy from at least two independent sources.

2.4 The stand-by and emergency generators, in case one of them fails, shall supply electric energy to the consumers required for starting up SSS from cooled (or hot stand-by) state and maintaining the minimal habitability conditions. The emergency generators may be used for starting up SSS, in case they produce enough power, and for supplying electric energy to the consumers important for safety of the ship.

2.5 The main electrical system shall be capable of providing reliable electric energy supply for the SSS consumers and for all ship's critical consumers from two electric stations at least in all operational and transient modes.

2.6 Design of electric installation shall allow for periodic inspections and tests of the equipment critical for safety of SSS and the ship.

2.7 In accordance with 8.5, Part II "Safety Standards", electrical equipment of the machinery and systems important for the SSS safety shall be capable of faultless operation under continuous heel up to 30°, roll up to 45° and trim up to 10°.

2.8 All electric energy consumers depending on their importance for the SSS safety shall be referred to one of four power supply reliability groups:

.1 first group — consumers not allowing for power failure in all modes in terms of safety, including total power loss from the main, stand-by and emergency power sources (blackout mode) and requiring mandatory power supply availability after emergency protection drive reactor actuation. Transient power supply sources shall be provided for such consumers;

.2 second group — consumers allowing for power failure for a period, determined by safety conditions at power loss from the main and stand-by power sources, and requiring require mandatory power supply availability after emergency protection drive reactor actuation. Power supply from emergency diesel generators shall be provided for such consumers;

.3 third group — consumers allowing for power failure, when switching off the main power sources and after emergency protection drive reactor actuation, and providing safe and minimum habitability onboard the ship. Power supply from stand-by diesel generators shall be provided for such consumers;

.4 fourth group — consumers not imposing increased requirements to power supply reliability and not requiring mandatory power supply availability in case of the reactor emergency protection drive actuation.

The list of consumers affecting the SSS safety divided into groups depending on the reactor plant design shall be submitted by the ship’s designer to the Register for approval.

3 MAIN ELECTRICAL SYSTEM OF NUCLEAR SHIP

3.1 The following shall be envisaged for the main electrical system.

3.1.1 Failure of a single component within any main generator, drive motor of the latter and associated auxiliary machinery shall not cause shutdown of the reactor and loss of the ship maneuverability. Simultaneously provision shall be made for fast recovery of the required electric power needed for maintaining the ship in a normal operational state and under normal habitability conditions.

3.1.2 Failure of a single component within distribution devices of the main electrical system shall not cause shutdown of the reactor and loss of the ship maneuverability.

3.2 The following shall be provided as part of the main electrical system (minimum):

two main generators;

two stand-by generators;

two main switchboards.

The main electrical system may be constructed on the principle of the integrated electrical power system. In this case different voltage levels are normally used for the propulsion system and for the main part of electrical consumers (auxiliary consumers). At least two main switchboards shall be provided for receiving power from the main power sources, provision of the electric propulsion system, and power transmission to the auxiliary power system, and at least two main switchboards for the auxiliary consumer power system. Power take-off for auxiliary consumer power supply shall be performed through power converters (for instance, voltage transformers) connected to the auxiliary power system main switchboard. The number and power output of these converters shall meet the requirements imposed on the main power sources. At least two converters shall be provided for each power plant.

3.3 The main electrical system shall include at least two separate electrical stations implemented so as not to effect each other's operation in case of failure in any station at SC1 or SC2.

3.4 Every electrical station of the main electrical system shall include the main generator (generators), stand-by generator (generators) and main switchboard.

3.5 Power supply of the machinery and systems of the operating SSS shall be provided from at least two power plants.

The fastest possible activation of stand-by sources (hot stand-by) shall be provided in the systems with one primary source (one reactor plant) or in modes with one reactor plant operation (for SSS with several reactor plants).

3.6 Total power of operating main generators within every electrical station of the main electrical system shall be sufficient for full electricity supply to all the consumers required for maintaining the ship in a normal operational state and normal habitability conditions.

3.7 Loss of voltage at the buses of any main switchboard shall automatically actuate stand-by generators to take up load for a time necessary for the SSS safe operation.

3.8 Parallel operation of the stand-by generators with the main generators shall be provided at least for a time necessary for transferring load.

3.9 Total power of the stand-by and main generators which remain operational shall be sufficient to supply electric energy to the consumers required for maintaining the ship in normal operational state and normal habitability conditions. In this case it is permitted that consumers which are not critical for the safety of the ship be disconnected.

3.10 Power of the stand-by generators actuated under abnormal conditions shall be sufficient to supply electric energy to the consumers providing safety of the ship, to return the latter into a normal operational state at the minimal habitability conditions, as well as to perform the scheduled SSS startup and cooling.

3.11 It is permitted that the jumpers between the buses of main switchboards with appropriate switching devices be used for ship's electrical power system.

3.12 Controls and instruments located in the central control station shall be arranged in consoles and panels so as to prevent a failure of the remote control and monitoring more than one electrical station when some of them fails.

3.13 The critical consumers of electric energy if they are two or more in number (provided they are mutually redundant and stand-by consumers are engaged automatically once running equipment fail) shall be separately connected to the different main switchboards both as related to power supply and control.

3.14 Power supply of the SSS consumers of the first and second power supply reliability groups shall be provided from the special SSS switchboards supplied from the main switchboard and emergency switchboard. Power supply of the SSS consumers of the third power supply reliability group shall be provided directly from the main switchboard or from the group switchboards intended exclusively for these consumers and fed from the main switchboard.

Consumers of the fourth power supply reliability group shall be supplied in accordance with the requirements of Part XI "Electrical Equipment" of the Rules for the Classification.

3.15 Each of the main switchboards within the main electrical system shall be located in a separate compartment.

The separate compartments are those isolated from each other with watertight fire structures.

3.16 The main generators of electrical stations may be located in a common machinery space, provided that the requirements stated in 3.15 are met.

3.17 When the main generators are located in one common machinery space, the stand-by generators shall be located in other separate compartments.

4 EMERGENCY ELECTRICAL SYSTEM OF NUCLEAR SHIP

4.1 The emergency electrical system and generators independent of SSS engaged in emergency power supply, as well as the emergency distribution systems shall perform their safety junctions taking into account the a single failure concept at SC1 — SC4 (also refer to 2.2).

4.2 In addition to the requirements specified in Section 9, Part XI "Electrical Equipment" of the Rules for the Classification, power of the emergency electrical system shall be sufficient to shut down the reactor, subsequently switch over into the cold subcritical state, and supply the consumers intended for performing the reactor safety functions.

4.3 The emergency electrical system shall include not less than two emergency generators and two emergency electric energy distribution systems independent on each other. It is permitted that separate emergency distribution systems with associated emergency generators be envisaged for the SSS consumers and those consumers be fed according to the requirements specified in Section 9, Part XI "Electrical Equipment" of the Rules for the Classification. In this case the SSS consumers shall be supplied from at least two emergency generators with distribution systems and one emergency generator with an independent distribution system for power supply of the consumers according to the requirements specified in Section 9, Part XI "Electrical Equipment" of the Rules for the Classification.

4.4 Each emergency generator shall be connected only to an associated emergency switchboard.

4.5 The emergency switchboards shall be powered from every main switchboard. When the emergency switchboards are used for power supply of the consumers in emergency modes only (from the emergency generators), they may not be connected to the main switchboards.

4.6 The consumers in charge of the safety systems shall be powered from the emergency switchboards via two feeders. When the system features full functional redundancy of machinery, power may be supplied via one feeder, provided power to the redundant machinery is supplied from the other emergency switchboard and requirements of 4.1 are met.

4.7 Each emergency generator shall automatically start by signal of voltage loss at the associated emergency switchboard bus and by the reactor emergency protection system actuation signal. In case of separate systems of emergency power supply for the SSS consumers and the consumers specified in Section 9, Part XI "Electrical Equipment" of the Rules for the Classification (refer to 4.3), emergency generators intended to supply the SSS consumers shall start by the signal of voltage loss at the connected buses on the emergency switchboards of the SSS consumers and by the emergency protection drive reactor actuation signal.

4.8 Power of the SSS emergency cooling console, when supply from the main and emergency sources fails, shall be supplied from a transient electric energy source. Switch over from main supply to emergency and further to transient source of electric energy shall be performed automatically.

4.9 The emergency electrical system shall take up load in a short time determined by the reactor safety conditions.

4.10 The emergency electrical system shall be designed so as to exclude direct synchronization of electric energy sources in emergency.

4.11 Measuring instruments for every emergency generator installed in the emergency switchboard shall be redundant in the central control station.

4.12 NPP shall be capable of starting only from power sources of the ship.

4.13 Non-self-propelled floating facility shall have a stand-by power source to cool SSS and provide normal habitable conditions, fire safety, buoyancy, ship signals and communication, escape routes.

5 TRANSIENT POWER SUPPLY SOURCES

5.1 The provision shall be made for at least two independent transient power supply sources.

5.2 The devices measuring the SSS, RM parameters and other instruments and indicators critical for the ship safety shall be powered from each transient power supply source for 30 min.

5.3 The transient power supply sources may not be required in case justification is provided that the consumers specified in 5.2 have uninterrupted power supply where a single failure concept at any state, including SC4, is provided.

5.4 The transient power supply sources shall be distributed and installed so that not more than one transient power supply source fails at SC1 — SC4.

5.5 Batteries to be used as transient sources for SSS only may be located below the bulkhead deck.

5.6 A charger of sufficient power shall be provided for charging the battery from completely discharged state to full charge during not more than 8 h.

5.7 A common light indication (non-critical) of low battery shall be fitted in the central control room.

5.8 UPS with accumulator batteries may be used as the transient power supply sources. UPS shall meet the requirements of 9.7, Part XI "Electrical Equipment" of the Rules for the Classification.

6 LIGHTING

6.1 Main lighting.

6.1.1 Each space within the controlled area important for the SSS safety shall be fitted with at least two main lights.

6.1.2 The main lights within the controlled area shall be powered from the special switchboards earmarked for the controlled area only.

6.1.3 The main lighting switchboards listed in 6.1.2 shall be powered from the different main switchboards via separate feeders.

6.1.4 The main lighting network of the controlled area spaces shall feature switchboard remote enable/disable system with appropriate indication in the central control station (main handling operations control room).

6.1.5 Switches of the main lights of separate compartments or groups of compartments within the controlled area shall be installed outside these compartments.

6.2 Emergency lighting.

6.2.1 Emergency lights shall be fitted in spaces as follows:

.1 central control station (main handling operations control room);

.2 reactor emergency cooling station;

.3 all spaces and passages to be attended by personnel within the controlled area and spaces important for the SSS safety;

.4 RM station (if located separately);

.5 SSS special switchboards, if any;

.6 storages places of new and irradiated fuel assemblies;

.7 valve and handling operations control rooms.

7 ELECTRICAL EQUIPMENT OF SSS AUTOMATION AND MONITORING SYSTEM OF RM SYSTEM

7.1 The automation and monitoring systems supporting operation of the safety systems and RM system shall be powered from the main and emergency switchboards. Power supply shall be switched over to the emergency sources automatically.

The list of automation and monitoring devices powered from the transient electric energy sources shall be approved by the Register.

7.2 For automation and monitoring systems referred to the first power supply reliability group, UPS shall be provided in each system or a centralized power supply system with UPS intended exclusively for supplying these systems shall be arranged.

8 SUPPLY FROM EXTERNAL POWER SOURCE

8.1 Provision shall be made for a power supply board from an external electric energy source.

8.2 Provision shall be made for power supply from the switchboard mentioned in 8.1, to every main switchboard.

9 CONTROLLED AREA CABLING

9.1 Number of cables passing through the containment and shielding barrier shall be minimized.

9.2 Requirements for cable glands shall not be lower than the requirements to tightness of the spaces as regard to leakages and fire resistance of bulkheads. These requirements shall not be a hurdle for conducting inspections and tests.

9.3 The cables shall be led in through glands fitted from outside these compartments. Free spaces of these glands not filled with the cables from inside these compartments shall be properly packed with compound all over the protection thickness.

Cable penetrations of the controlled area spaces shall be as close to electrical equipment as possible.

9.4 Application of electrical cables with outer metal screen is not allowed.

9.5 Perforated panels and bridges are not allowed for cable installation.

9.6 Cables shall be laid in the shortest routes possible.

9.7 Cables shall be laid at distances from the planes of bulkheads, decks, framing and other hull structures so as to facilitate decontamination when necessary.

9.8 Cables running through the containment shall be led using special gaskets or a special bulkhead connector — cable passage of leak-tight or other construction approved by the Register and performing the same junction. In the first case, the cables shall feature longitudinal tightness. Methods and standards for cable testing for longitudinal tightness and emergency factors shall meet the requirements of normative documents approved by the Register. In the second case, the cables shall be connected from both sides of the passage through the containment, and longitudinal tightness of the cable is not required.

Transit cables may be laid through the containment only in exceptional cases when this space cannot be bypassed and provided they are laid in steel tight pipes.

Transit cables are not allowed to run through the controlled area spaces. Where, however, it shall be deemed necessary (structurally impossible to get around these spaces, etc.), the cables shall be laid in tight conduits linings or ducts. Use of cables with outside wire braiding is not allowed.

9.9 Design of the cable glands passing through the containment shall allow inspecting its tightness in the course of installation and operation and guarantee tightness of the containment under conditions stated by the design-basis accidents. The air leakage rate shall not exceed 0,5 l/h through one bundled cable entry under absolute test pressure of 0,5 MPa after operational effect, emergency states and fire.

For getting the RS approval for application of cables and glands passing through the containment, their samples shall be tested for longitudinal tightness under circumstances of the design basis accident.

9.10 The safety system cables shall be laid separately from the main lines. Cables included in the safety system components which perform mutual backup junctions shall be laid at the opposite ship sides, and where it is not possible in several different spaces separated by fire structures both within and outside the controlled area.

9.11 A single wire system cannot be applied for one-phase alternate current with the ship hull used as a return wire.

9.12 The cables and electrical equipment that shall be kept operational also after design accidents shall withstand environmental factors (pressure, temperature, humidity, etc.) associated with those accidents.

9.13 All the cables running from the transient power supply sources (if any) to the designated switchboards and going from the switchboards to consumers shall be distant from each other and from cable routes of the main and emergency distribution systems as far as possible.

9.14 The local cables connected to the equipment to be dismantled in reloading the core shall be marked.

9.15 The control equipment for the electric motors located within the controlled area shall be installed outside the latter. Start buttons are allowed in that case.

9.16 Packing cable boxes and individual cable glands shall be installed from the "cleaner" space side as far as it is practicable. In this case, a clearance on the opposite side shall be filled in with cable compound to the thickness of protective layer.

9.17 It is recommended that single-row installation of cables in the cable boxes be used to provide their proper radioactive decontamination, and power cables, and monitoring and signalling device cables be segregated.

9.18 Bunched and individual cables shall be laid at a distance of at least 60 mm from bulkhead surfaces, decks, framing and other hull structures.

9.19 Cable runs shall be laid so that to provide access for their decontamination.

9.20 All fitter tools for electrical equipment and cabling shall be of simple design and shall have corrosion protection. Use of perforated parts and products is not allowed.

10 INTERNAL COMMUNICATION

10.1 Reliable communication between the central control station and spaces mentioned below shall be provided even in case of the total lack of power supply on the nuclear ship:

.1 bridge;

.2 reactor emergency cooling control station;

.3 main engine;

.4 main generators;

.5 stand-by generators;

.6 emergency generators;

.7 compartments to be attended within the controlled area important for the SSS safety;

.8 storages of fuel assemblies.

10.2 Reliable communication between the central control station and spaces as mentioned below shall be provided even at total lack of power supply on the NS vessel:

.1 wheelhouse;

.2 engine room;

.3 valve control station;

.4 observation station in the new fuel assemblies storage room;

.5 handling operations observation station in the irradiated fuel assemblies storage room;

.6 decontamination space;

.7 RM station;

.8 special-purpose sanitary room.

10.3 On the NS vessel provision shall be made for two-way loudspeaking and telephone communication of the main handling operations control room with the station from where repairs of the served ship are controlled.

10.4 All closures in ship structures of the NS vessel bounding the controlled area shall be provided with signalling of their opening, and information shall be displayed in the main handling operations control room or at the RM station. It is recommended that local audible signalling of door or other closure opening be installed.

10.5 In the controlled area process spaces permanently or periodically attended by personnel a signalling system shall be provided to warn personnel of a necessity to urgently leave the controlled area spaces. The system shall include light panels with appropriate text in the controlled area main spaces and sound signals to be clearly heard in all spaces, different in tone from all the other signals. The warning alarm system shall be started from the main handling operations control room (central control station) or RM station.

11 ELECTRICAL EQUIPMENT INSPECTIONS AND TESTS

11.1 Provision shall be made for testing the stand-by and emergency generators. The tests shall include checking automatic, remote and local startup as well as checking start-up time and 100 % load take-up. Speed regulators of the primary motors shall be tested in operation as well.

12 ELECTRICAL POWER EMERGENCY SOURCES OF NS VESSEL

12.1 An independent emergency source of electrical power shall be installed on each NS vessel. Its capacity shall be sufficient for feeding the consumers referred to in 12.2.

A diesel-generator shall be used as an emergency power source.

On non-self-propelled vessels of a simple design, permanently lying at berths and referred to the category of berth-connected ships (floating RM stations, special-purpose sanitary stations, etc.), a necessity to provide an emergency source of electrical power, its type and capacity shall be agreed by the Register.

12.2 In addition to the consumers referred to in Part XI "Electrical Equipment" of the Rules for the Classification, the following consumers shall receive electrical power from emergency switchboard busbars fed by the emergency generator, directly or through a transformer, from separate feeders:

.1 electric drives of pumps of all cooling circuits for irradiated fuel assemblies storage facilities;

.2 electric drive of one of the washing water pumps for the special-purpose sanitary space;

.3 electric drives of fans for the emergency ventilation system and air supply to pneumatic suits;

.4 signalling of closing the doors to the controlled area;

.5 emergency lighting, alarm system and internal communication in the controlled area spaces;

.6 RM and nuclear hazard occurrence fixed devices, in case they are supplied from the vessel's electrical system;

.7 control, monitoring and signalling positions in the valve control and handling operations control stations.

13 RM SYSTEM POWER SUPPLY

13.1 Electrical power supply to fixed components of the RM system shall be realized from the main and emergency switchboards. Where these components and systems are fed through converters, they shall be at least two in number, located on either side, and automatically switched over.

13.2 Power supply of the RM components shall be automatically switched over to the emergency source.

13.3 There shall be no additional switches on the supply feeders of fixed components of the RM system except those installed on the main and emergency switchboards.

13.4 Pilot lamp of voltage indication and power supply failure audible alarm shall be provided on the power supply switchboard of the RM system.

13.5 Power supply system of the RM components shall not be used for any purpose other than for intended use.

14 GENERAL REQUIREMENTS FOR AUTOMATION EQUIPMENT OF NUCLEAR SHIP

14.1 In addition to the requirements for components and appliances of the automation systems specified in Part XV "Automation" of the Rules for the Classification, the NPP control, monitoring and protection systems shall also comply with the requirements of Sections 13 and 14, Part VI "Nuclear Steam Supply Systems", as far as applicable.

14.2 For automation systems with redundancy according to a single failure concept it is allowed to use common sensors in channels of protection, control, monitoring, alarm and indication if failure in channels of control, monitoring, alarm and indication does not affect operability of protection system.

14.3 Short power loss (up to 1 s) in the systems shall not affect operation of protection and control channels and shall not result in false actuation.

14.4 List of the SSS equipment subject to control and monitoring from central control station as well as level of automation and monitored parameters shall be justified in the design.

14.5 Automation systems required for operation of systems specified in 3.8, Part VI "Nuclear Steam Supply Systems" shall be reserved and shall comply with a single failure concept (refer to Section 7, Part II "Safety Standards").

14.6 In multi-channel automation systems the channels shall be galvanically independent.

14.7 Systems, specified in 14.5, shall be provided with the sound and light alarm system to indicate completeness failure, if necessary.

14.8 The SSS control, protection and monitoring systems shall allow remote actuation of safety systems.

14.9 For control channels of safety systems, priority of automatic control over remote control shall be set by signals on protection actuation.

14.10 Failures in systems specified in 14.5, shall be examined taking into account 7.4, Part II "Safety Standards" in accordance with the following emergency situations:

.1 failure of functional components within system (for example, fuse, card, module, etc.);

.2 failure of structural components (e.g., device, console, panel, etc.);

.3 failure of structural components group (e.g., those located in common compartment).

15 ALARM, INDICATION AND PROTECTION SYSTEMS

15.1 The list of the SSS alarm, indication and protection parameters is given in Table 15.1.

15.2 An emergency parameters recorder providing record of pre-emergency and emergency values of the SSS parameters at design-basis and beyond design-basis accidents conditions shall be fitted on the nuclear ships.

15.3 The emergency parameters recorder shall functionally meet the following requirements:

.1 recording method shall provide the possibility to determine the date and time of information recording at its replay using a special device;

.2 special shielding container shall comply with the conditions specified in 5.20, Part V "Navigational Equipment" of the Rules for the Equipment of Sea-Going Ships.

Equipment of the emergency parameters recorder with a device providing detection of the special shielding container in the cases specified in 15.4 is not mandatory;

.3 recording of other additional information from the ship equipment specified in 5.20.6, Part V "Navigational Equipment" of the Rules for the Equipment of Sea-Going Ships and fitted with respective outputs providing interface of this equipment with the emergency parameters recorder may be provided. Recording of additional information shall not falsify basic information or affect its integrity;

.4 changing the data set to be recorded and the recorded information shall be avoided. Recording of the unauthorized tampering attempts in the emergency parameters recorder operation shall be provided;

.5 a module for documenting the received information on a non-volatile data medium shall be designed for a re-recording cycle of at least 12 h or at least 72 h in emergency mode.

15.4 The emergency parameters recorder may be fitted on the roof of the navigating bridge, in the navigating bridge or at the central control station. When the emergency parameters recorder is fitted in the navigating bridge or at the central control station, a device providing its detection is not required.

Table 15.1

No.	Parameter to be checked	Measurement point	Tolerance for alarm parameter	Protection, stop or change of mode	Parameter indication		Record on emergency parameters recorder
					Central control station	Emergency cooling control station	
1	2	3	4	5	6	7	8
1	Neutron power[1]	Ionization chamber	↑	×	●		+
2	Reactor power doubling period	Ionization chamber	↓	×	●		+
3	Position of regulating rods	Control rods group and emergency protection drive	↓↑	×	●	●	+
4	Reactivity	Ionization chamber					
5	Pressure inside reactor	Primary circuit	↓↑	■×	●	●	+
6	Level in volume compensator	Volume compensator	↓↑	▼	●		+
7	Pressure in safety system cylinders and tanks	On container	↓↑	▼■	◗		+
8	Water temperature at reactor output	Nuclear reactor	↑	▼	●	●	+
9	Water temperature at reactor input	Nuclear reactor	↑	▼	●		+
10	Coolant temperature before filter of primary circuit	After coolant circulating pump	↑	▼	◗		+
11	Coolant activity as per the standard RM sensors	Primary circuit	↑	▼	◗		+
12	Feed-water flow	After feed-water valve	↓	▼×	●		+
13	Water flow at the auxiliary feed-water pump discharge	After auxiliary feed-water pump			◗	◗	+
14	Feed-water pressure	After feed-water pump	↓	▼■	◗		+
15	Feed-water temperature	At SG input	↓↑	▼	◗		+
16	Feed-water salinity	Before feed-water pump	↑	▼	◗		+
17	Steam pressure	After SG	↓↑	▼	●		+
18	Steam temperature	In main steam line	↓	▼	●		+
19	Steam and steam-water mixture activity	After SG and main condenser	↑	▼	◗		+
20	Primary circulating pump rpm	In primary circulating pump	↓	▼	◗	◗	+

No.	Parameter to be checked	Measurement point	Tolerance for alarm parameter	Protection, stop or change of mode	Parameter indication		Record on emergency parameters recorder
					Central control station	Emergency cooling control station	
1	2	3	4	5	6	7	8
21	Primary circulating pump load current	After NSSS switchboard	↑	▼	◗		+
22	Temperature under the top cover of the primary circulating pump	In primary circulating pump	↑	▼	◗		+
23	Temperature under the top cover of the coolant circulating pump	In coolant circulating pump	↑		◗		+
24	Coolant flow at coolant circulating pump discharge	After coolant circulating pump	↓	■	◗	◗	+
25	Distillate flow after boost pump	After boost pump	↓		◗		+
26	Pressure in containment	In containment	↑	▼■	◗	○	
27	Air temperature in instrument space	Instrument space	↑		◗		+
28	Water activity in tertiary circuit	After equipment	↑	▼	◗		+
29	Pump state and valve position in primary to quaternary circuits in safety system	On pumps and valves			○		+
30	Before pressure on reactor plant and safety system pumps	On the pump	↓	▼■	◗		+
31	Water levels in reactor plant tanks, safety systems tanks, deaerating plant tanks, and ice boxes	On container	↓	▼■	◗		+
32	Water presence in reactor box	On drainage pipeline	↑	▼			+
33	Water presence in instrument space		↑	×			+
34	Pressure in the SSS pneumatic control system	Within the system	↓	▼■	◗		+
35	Indication of power supply availability on SSS panels and contactors position	On SSS panels	↓		○		+
36	Vacuum in main condenser	On main condenser	↓	▼	◗		
37	Vibration of the main turbines [2]	Bearings	↑		◗		

[1] Record is made after processing in CPS.

[2] Exceeding of the parameter shall not lead to an automatic shutdown of the main turbines.

Notes: Parameters in items 1–26 are subject to cyclic recording during the reactor normal operation at power.

No.	Parameter to be checked	Measurement point	Tolerance for alarm parameter	Protection, stop or change of mode	Parameter indication		Record on emergency parameters recorder
					Central control station	Emergency cooling control station	
1	2	3	4	5	6	7	8

Symbols:
● – remote indication (constant);
◗ – remote indication (on call);
↑ – alarm signal when parameter reaches upper limit value;
↓ – alarm signal when parameter reaches lower limit value;
○ – alarm signal;
■ – automatic start of stand-by pumps;
▼ – mode change, load decrease;
× – nuclear reactor stop;
+ – available.

Russian Maritime Register of Shipping

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Part VIII
Electrical and Automation Equipment

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