RULES

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

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RULE CHANGE NOTICE

ENTERS INTO FORCE:

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

The present Rule Change Notice to the Rules for the Classification and Construction of Nuclear Ships and Nuclear Support Vessels (hereinafter — RCN) has been approved in accordance with the established approval procedure and contains information on amendments and additions, except for editorial amendments. RCN amendments come into force on 1 July 2025

REVISION HISTORY

PART I. CLASSIFICATION

Item	Applicability	Description	Remarks
Para 1.2	Nuclear ships under design Steam generating unit Definitions	New definitions "Integrated case" and "Steam generating unit case (SGU case)" have been introduced. Definitions "Steam generating unit (SGU)" and "Reactor plant" have been specified	
Appendix 3. Para 6.2.2.1	Nuclear ships under design Steam generating unit Technical documentation	Abbreviation "SGU" has been introduced. SSS technical description has been specified	

PART II. SAFETY STANDARDS

Item	Applicability	Description	Remarks
Para 5.1	NS vessels under design Systems and equipment Technical documentation	Requirements have been specified regarding safety classes of systems and equipment of NS vessels affecting the ship’s safety	
Para 5.4.1	Nuclear ships under design Steam generating unit Technical documentation	Abbreviation "SGU" has been introduced	

Item	Applicability	Description	Remarks
Para 5.4.3	Nuclear ships under design Steam generating unit Technical documentation	Abbreviation "SGU" has been introduced	
Para 9.9.1	Nuclear ships under design Steam generating unit Technical documentation	Requirements have been specified regarding analysis of accidents followed by the primary coolant loss	

PART III. HULL

Item	Applicability	Description	Remarks
Para 3.4.1	NS vessels under design Steam generating unit Technical documentation	Abbreviation "SGU" has been introduced	

PART VI. NUCLEAR STEAM SUPPLY SYSTEMS

Item	Applicability	Description	Remarks
Para 2.3.13	Nuclear ships under design Steam generating unit Technical documentation	Requirements have been specified regarding the scope of technical supervision for SGU	

Item	Applicability	Description	Remarks
Section 7 (new)	Nuclear ships under design Steam generating unit Technical documentation	New Section 7 "Steam Generating Unit" has been introduced. Existing Sections 7 — 14 and references thereto have been renumbered 8 — 15, respectively	
Para 8.4 (new para 9.4)	Nuclear ships under design Steam generating unit Technical documentation	Requirements have been introduced for the SG cassettes inbuilt in the SGU reactor body	

PART VIII. ELECTRICAL AND AUTOMATION EQUIPMENT

Item	Applicability	Description	Remarks
Table 15.1, Note	Nuclear ships under design Steam generating unit Technical documentation	Note has been supplemented by item 2 regarding paraments for SGU of integral type to be monitored	

PART I. CLASSIFICATION

1 GENERAL

Para 1.2. **New definition "Integrated case"** is introduced reading as follows:

"Integrated case is a combined-shape vessel, which consist of th central cylindrical vessel — reactor body designed to accommodate the reactor core and the steam generator piping system; and peripheral vessels — hydraulic chambers to accommodate primary circulating pumps. In this case, the reactor body and hydraulic chambers are interconnected by welding of their main branches made directly from forged elements of the reactor body and hydraulic chambers without additional piping in between.".

New definition " Steam generating unit case (SGU case)" is introduced reading as follows:

"Steam generating unit case (SGU case) is an assembly unit being the integrated case with the steam generator(s) cassettes installed. Forms a part of SGU.".

Definition "Steam generating unit (SGU)" is replaced by the following text:

"Steam generating unit (SGU) is a unit built on the basis of the nuclear reactor where the components forming main circuit loop of the primary coolant, reactor core, SG, ~~hydraulic chambers with~~ primary circulating pumps are located in one integral case. Intended for generation of overheated steam ~~as part of NSSS~~.".

Definition "Reactor plant" is replaced by the following text:

"Reactor plant is a component of NPP. The reactor plant comprises the nuclear reactor (SGU containing the nuclear reactor), systems and equipment directly related to the reactor to provide its normal operation, prevent and control accidents as well as reduce their effects.".

APPENDIX 3

NUCLEAR SHIP SAFETY INFORMATION

6 TECHNICAL SPECIFICATION OF DESIGN SOLUTIONS

Para 6.2.2.1 is amended as follows:

"**6.2.2** SSS:
.1 primary circuit:
reactor (SGU),
primary pumps,
safety valves,
primary pipelines,
SG or the SG piping system (for SGU of integral type),
pressure compensating system,
fittings;".

PART II. SAFETY STANDARDS

5 SAFETY CLASSES

Para 5.1 is replaced by the following text:

"**5.1** The NPP systems and equipment are subdivided into four safety classes according to their importance for the ship. These systems and equipment shall comply with design requirements, requirements to materials, manufacture, testing and operation.

Systems and equipment of the NS vessels affecting the ship safety may be assigned by the ship designer to the appropriate safety classes.".

Para 5.4.1. The **first paragraph** is amended as follows:

"**.1** reactors (SGU), core supporting structures, fuel assemblies, pressure vessels and other primary components, including the systems and piping, which failure may result in emergency states SC3 and SC4 (refer to 4.5 — 4.6).".

Para 5.4.3 is amended as follows:

"**.3** reactor emergency protection system (SGU), including the reactor CPS drives and monitoring system sensors, which generate emergency protection signal and also produce and implement the SSS control algorithm according to emergency protection signals;".

9 SSS ACCIDENT ANALYSIS

Para 9.9.1 is amended as follows:

"**.1** possible rupture of any primary pipe except for the reactor body branches (SGU case);".

PART III. HULL

3 REQUIREMENTS FOR SPECIAL STRUCTURES OF NUCLEAR SHIPS AND NS VESSELS

3.4 REACTOR FOUNDATIONS. FASTENERS OF CONTAINMENT AND BIOLOGICAL SHIELDING

Para 3.4.1 is amended as follows:

"**3.4.1** Reactor (SGU) foundations and fasteners of containment shall provide effective support under external conditions as specified in Section 8, Part II "Safety Standards".

The foundations shall be capable of keeping the reactor (SGU) and primary systems as well as containment at place in case of inclinations of the ship up to and including capsizing.".

PART VI. NUCLEAR STEAM SUPPLY SYSTEMS

2 SCOPE OF TECHNICAL SUPERVISION

Para 2.3.13 is replaced by the following text:

"**.13** SGU (integrated cases, covers with their fasteners, SG cassettes, primary circulating pumps, valve chests, piping attachments, internal removable and non-removable parts, safety devices and valves, supporting structures).".

New Section 7 is introduced reading as follows:

"7 STEAM GENERATING UNIT

"**7.1** Steam generating unit (SGU) is intended to generate overheated steam as a part of NSSS. Generation of thermal energy is carried out in the process of controlled self-sustaining nuclear fission chain reaction.

Within SGU, the SG piping system and reactor core are located in one case unlike the block arrangement where the SG piping system is located in a(the) separate SG case(s).

7.2 SGU shall meet the following requirements:

.1 SGU shall provide effective and stable operation under operating conditions stipulated by the design at all design loads;

.2 SGU strength shall be calculated according to the procedures approved by the Register;

.3 technical design documentation and detailed design documentation on SGU shall be approved by the Register;

.4 SGU load shall be increased and decreased at a rate to ensure requirements of operating model;

.5 SGU, actuating controls, adjusters and protective elements shall be designed to prevent unintended variation in reactivity in the event of roll, heel, capsizing, vibrations, shocks and other prescribed dynamic loads;

.6 SGU shall be capable of switching the reactor core to subcritical state from any power for all positions of the ship, including capsizing;

.7 SGU shall be designed to prevent free drainage of the coolant below the upper boundary of the core: all branches on the SGU case shall be arranged above the upper boundary of the core;

.8 SGU shall meet the nuclear safety requirements in respect of marine reactors as agreed upon with the Register;

.9 SGU shall be designed to allow for safety handling of the core;

.10 SGU equipment under pressure of the primary, secondary and tertiary circuits shall be adapted for hydraulic tests;

.11 SGU shall be designed to allow for visual internal survey and survey by means of remote/non-destructive testing according to the SGU operational documentation;

.12 SGU components separating boundaries of the primary and secondary circuits, the secondary circuit and atmosphere shall be tightly connected. Sealing procedures for main connectors shall be approved by the Register. Structure, welding and testing of welded joints of the SG cassettes, integrated case, SGU case shall be performed according to the welding provisions and regulations for testing of welded joints approved by the Register. All welded joints shall be subjected to non-destructive testing;

.13 SG shall be divided into at least two SG piping systems as independently operated and deactivated in case of steam and feed water;

.14 SG piping systems shall be designed as to provide replacement and/or repair of non-tight components. The SG cassettes shall be replaced upon opening-up of the cover of the reactor main connector. Repair (modules' shutdown) of non-tight components shall be provided without opening-up of the cover of the reactor main connector at shutdown cooled reactor under atmospheric pressure of the primary and secondary circuits.

7.3 Generally, composition of the SGU equipment shall include:

.1 integrated case;

.2 SG piping system;

.3 reactor internals, which, depending on the reactor core type, generally, consist:

for cassette-type core: of internal core barrel/basket intended to load the core and of pipe-and-device assembly containing engaging devices which form controls of compensating groups during engagement with absorbers of fuel assemblies;

for channel-type core: of internal unit intended to load the core and containing the controls consisting of the required number of compensating groups;

other internals intended to arrange the coolant loop;

.4 reactor core;

.5 primary circulating pump with a valve chest, fasteners of the primary circulating pump on the hydraulic chamber;

.6 reactor cover;

.7 main connector gasket;

.8 set of control and protection system drives (drives of compensating groups and emergency protection);

.9 set of instrumentation (resistance thermal elements, thermo-electrical converters) to be fitted on the reactor cover;

.10 assembly components and parts, SGU assemblies, including those designed to secure SGU to the metal-water shielding tank and to form biological shielding (protection ring).

7.4 Upon manufacture, SGU with all the components (or their dummies) and accessories shall undergo test assembly at the firm (manufacturer):

.1 instead of the SGU components such as fuel assemblies of the reactor core, primary circulating pump with the valve chest, standard instrumentation on the reactor cover, during test assembly their dummies may be used;

.2 during test assembly, the following shall be performed:

check of the integral reactor assemblability;

alignment and adjustment of internal centering elements;

check of free movement of movable parts of compensating groups actuators. For fuel assemblies of the cassette-type reactor core the check shall be performed using absorber simulators as a part of dummy fuel assemblies; it shall also be checked whether the engage/disengage operations of the absorbing rods are performed when forming the actuators of compensating groups;

.3 during test assembly technological brass or bronze fasteners may be used instead of the standard austenitic steel fasteners.

7.5 Pressure tests of the SGU equipment during manufacture and installation:

.1 upon manufacture at the firm (manufacturer), SGU case (with the SG cassettes) shall be subjected to:

hydraulic pressure and tightness tests by the primary cavity;

hydraulic or pneumatic pressure and tightness tests by the secondary cavities.

Upon agreement with the Register, in a justified case (e.g. impossible subsequent drainage of the secondary cavities of the SG cassettes at the firm (manufacturer), impossible pneumatic testing at the firm (manufacturer)), the pressure and tightness tests of the secondary cavities may be conducted (upon agreement) at the builder by conducting hydraulic pressure and tightness tests of the secondary circuit, with additional non-destructive testing of welded joints of the SG cassettes with the integrated case at the firm (manufacturer);

.2 upon manufacture at the firm (manufacturer), the SG cassettes shall be subjected to hydraulic pressure and tightness tests in the primary cavity;

.3 upon manufacture at the firm (manufacturer), the reactor cover shall be subjected to:

hydraulic pressure and tightness tests from outside and in the pressure cavities of the primary circuit;

hydraulic tests for strength and tightness of supports cooling system by the tertiary circuit;

pneumatic tests for tightness of a pebble bed cavity;

.4 upon manufacture at the firm (manufacturer), the primary circulating pumps shall be subjected to hydraulic pressure and tightness tests on the primary and tertiary circuits;

.5 upon manufacture at the firm (manufacturer), the drives of compensating groups shall be subjected to hydraulic pressure and tightness tests in the primary cavity;

.6 upon manufacture at the firm (manufacturer), the emergency protection drives shall be hydraulically tested for strength and tightness of the cavity exposed to the primary circuit pressure during safety depressurization of sleeves of emergency protection rods;

.7 upon installation and assembly of SGU with NSSS, SGU shall be subjected to hydraulic pressure and tightness tests on the primary, secondary and tertiary circuits;

.8 components (including welds) of SGU equipment which are subject to gas or vacuum tightness shall be checked for tightness during manufacture and (or) installation by methods corresponding to the specified leak-tightness class. Checking of tightness by the hydraulic method using luminescent indicator coating may be combined with hydraulic tests for strength and tightness.

7.6 Materials used to manufacture SGU equipment:

.1 the materials to be applied during manufacture of the SGU equipment shall be approved by the Register and manufactured under the Register technical supervision;

.2 base metal and welding consumables of integrated case shall have a set of physical and chemical, mechanical and processing properties for: radiation resistance, brittle-to-ductile transition temperature, resistance to thermal embrittlement, strength, ductility, workability during melting, forging, heat treatment and welding, development in industrial production, providing specified service life under safe operation taking into account the following operating factors: pressure, temperature, radiation exposure, mechanical, static, thermal, cyclic, vibration and impact loads, including a technological cycle of manufacturing;

.3 basic metal and welding consumables of the SGU internals shall have a set of physical and chemical, mechanical and processing properties for: corrosion resistance in the primary, secondary and tertiary media, including resistance to intergranular corrosion and cracking corrosion, radiation resistance, strength, ductility, weldability, providing specified service life under safe operation condition taking into account the operating factors: mechanical, static, thermal, cyclic, vibration and impact loads. The SGU internals made of austenitic class steels (including welded joints) affected by technological heat treatment during the SGU manufacture shall have resistance to intergranular corrosion (shall pass sample tests) upon technological heat treatment;

.4 corrosion-resistant deposit materials of the SGU case components (made of perlite class steel) shall have a set of physical and chemical, mechanical and processing properties for: corrosion resistance in the primary, secondary and tertiary media, including resistance to

intergranular corrosion, resistance to hot cracking, radiation resistance, strength, ductility, providing specified service life under safe operation taking into account the operating factors: temperature, radiation exposure, mechanical, static, thermal, cyclic, vibration and impact loads. Materials for corrosion-resistant deposition of products subject to heat treatment (tempering) after deposition shall have resistance to intergranular corrosion (shall undergo testing, including, inter alia, of mechanical properties on the heat-treated samples);

.5 in case of a new design, cobalt content in basic metal and welding consumables of the SGU internals as well as in materials of corrosion-resistant deposits contacting with the primary coolant shall not exceed 0,05 %.

7.7 Provision of cleanliness:

.1 cleanliness of the cavities and surfaces in contact with the primary, secondary and tertiary coolants shall be provided and monitored in accordance with the technical requirements of the standard approved by the Register and specified in the design documentation for manufacture and installation of the SGU equipment;

.2 cleanliness shall be provided at all stages of the SGU manufacture, assembly and installation, taking into account the appearance during manufacture, assembly and installation of the cavities and surfaces inaccessible and difficult to access for further cleaning and cleanliness monitoring;

.3 SG cassettes fitted inside the SGU case become inaccessible for further cleaning and cleanliness monitoring. Provision of their cleanliness and monitoring shall be carried out at the manufacturing stage, further operations on the SGU assembly and installation shall be performed by taking organizational and technical measures to prevent ingress of contamination and foreign objects into cavities of the SG cassettes. The ultimate cleanliness shall be provided upon the final installation by flushing cavities of the primary and secondary circuits with hot water according to the builder's procedure developed in accordance with the cleanliness standard approved by the Register.

7.8 The SGU equipment shall be designed to maintain operability on Safety Class 1 under conditions complying with Section 8, Part II "Safety Standards". Requirements for external conditions of the SGU operation may be specified by the customer in technical statement on NS taking into consideration the NS operating conditions.".

Existing Sections 7 — 14 and references thereto are renumbered **8 — 15**, accordingly.

8 (NEW SECTION 9) SECONDARY COOLANT SYSTEM

Para 8.4 (new para 9.4) is replaced by the following text:

"**9.4** Each reactor shall be provided with at least two SG or one SG with two separate sections capable of being switched off.

The SG cassettes inbuilt into the SGU reactor body shall be combined by the secondary circuit (steam and feed water) as independent SG piping systems (at least two per one SGU) and deactivated in case of steam and feed water.".

PART VIII. ELECTRICAL AND AUTOMATION EQUIPMENT

15 ALARM, INDICATION AND PROTECTION SYSTEMS

Table 15.1. The **Note** is amended as follows:

"N o t e s : 1. Parameters in items 1 — 26 are subject to cyclic recording during the reactor normal operation at power.

2. Monitored parameters for SGU of integral type:

under para 8 — water temperature at the reactor core outlet;

under para 9 — water temperature at the reactor core inlet.".

Russian Maritime Register of Shipping

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