RUSSIAN MARITIME REGISTER OF SHIPPING

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RULES

FOR THE CLASSIFICATION AND CONSTRUCTION OF NUCLEAR SUPPORT VESSELS

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Rules for the Classification and Construction of Nuclear Support Vessels (NSV Rules) have been approved in accordance with the established approval procedure and come into force on 1 April 2017.

The Rules set the requirements specific for the nuclear support vessels and supplement the requirements of the Rules for the Classification and Construction of Sea-Going Ships and Rules for the Classification and Construction of Nuclear Ships and Floating Facilities of Russian Maritime Register of Shipping.

The present edition of the Rules is based on the Rules for the Classification and Construction of Nuclear Support Vessels, 2007, taking into account the amendments and additions developed immediately before publication.

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As compared to the previous edition, the fifth edition of the Rules (2017) contains the following additions.

PART I. CLASSIFICATION

1. Part I "Classification" has been introduced in the Rules.

2. Chapter 1.1: in para 1.1.1 the application has been specified, and the text of footnotes has been amended. Para 1.1.2 has been supplemented with references to the Rules for the Equipment of Sea-Going Ships, Rules for the Cargo-Handling Gear of Sea-Going Ships, Load Line Rules for Sea-Going Ships, the text of footnotes has been amended.

3. Chapter 1.2: in para 1.2.1 the definitions "Spent-fuel assemblies", "Radioactive wastes" and "**A** nuclear support vessel" have been amended.

4. Section 1 have been supplemented with Chapter 1.4 "Equivalents" and para 1.4.1.

5. Section 2 and Chapter 2.1 have been replaced by Section 2 "Class Notation";

new para 2.1 has been amended regarding descriptive notation **Nuclear support** vessel in class notation, and the requirement to provide the radioactivity symbol on the vessel side has been deleted.

6. Chapter 2.2 has been replaced by Section 3 "Classification Surveys".

7. Chapter 2.3 has been deleted.

8. Chapter 2.4 has been replaced by Section 4 "Plan Approval Documentation".

9. Editorial amendments have been made.

PART II. HULL

1. Section 3 has been replaced by Part II "Hull".

2. Editorial amendments have been made.

PART III. STABILITY. SUBDIVISION

1. Section 4 has been replaced by Part III "Stability. Subdivision".
2. Editorial amendments have been made.

PART IV. FIRE PROTECTION

1. New Part IV "Fire Protection" has been introduced in the Rules.

PART V. NEW FUEL ASSEMBLIES, IRRADIATED FUEL ASSEMBLIES AND RADIOACTIVE WASTE STORAGE FACILITIES

1. Sections 5 — 7 have been replaced by Part V "New Fuel Assemblies, Irradiated Fuel Assemblies and Radioactive Waste Storage Facilities".
2. Editorial amendments have been made.

PART VI. ELECTRICAL EQUIPMENT

1. Section 8 has been replaced by Part VI "Electrical Equipment".
2. Editorial amendments have been made.

PART VII. RADIATION SAFETY

1. Section 9 has been replaced by Part VII "Radiation Safety".
2. Editorial amendments have been made.

PART VIII. PHYSICAL SECURITY

1. The Rules have been supplemented with new Part VIII "Physical Security".

CONTENTS

PART I. CLASSIFICATION

PART II. HULL

PART III. STABILITY. SUBDIVISION

PART IV. FIRE PROTECTION

PART V. EQUIPMENT OF STORAGE SPACES FOR NEW FUEL ASSEMBLIES, IRRADIATED FUEL ASSEMBLIES AND RADIOACTIVE WASTE

PART VI. ELECTRICAL EQUIPMENT

PART VII. RADIATION SAFETY

PART VIII. PHYSICAL SECURITY

PART I. CLASSIFICATION

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the Rules for the Classification and Construction of Nuclear Support Vessels[1] of Russian Maritime Register of Shipping[2] apply to purpose-built or refitted self-propelled or non-self-propelled vessels for operational support and technical servicing of nuclear propulsion plants of sea-going ships and floating facilities.

1.1.2 The Rules for the Classification and Construction of Sea-Going Ships[3], Rules for the Classification and Construction of Nuclear Ships and Floating Facilities[4], Rules for the Equipment of Sea-Going Ships, Rules for the Cargo-Handling Gear of Sea-Going Ships, Load Line Rules for Sea-Going Ships fully apply to the nuclear support vessels[5], in so far as they do not contradict the NSV Rules.

1.1.3 The NSV Rules set forth the requirements only for special equipment and vessel structures which shall be provided in view of the special purpose of the vessel to ensure the safety of the attending personnel and the environment.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 Definitions and explanations concerning general terms of the NSV Rules are given in Part I "Classification" of the Rules for Classification.

For the NSV Rules, the following definitions specific for the NS vessels have been adopted.

Decontamination equipment means the equipment intended for radioactive contamination removal from different surfaces.

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[1] Hereinafter referred to as "the NSV Rules".

[2] Hereinafter referred to as "the Register".

[3] Hereinafter referred to as "the Rules for Classification".

[4] Hereinafter referred to as "the NS Rules".

[5] Hereinafter referred to as "the NS vessels".

Controlled area means a number of spaces where exposure to a higher level of ionizing radiation and/or radioactive contamination may occur during normal operation, access therein is controlled.

Monitored area means a number of spaces where radioactive contamination may occur and ionizing radiation is likely to increase in case of variations from normal operation of the equipment.

New fuel assemblies mean fuel elements assemblies before they are used in a nuclear reactor.

Irradiated fuel assemblies mean fuel assemblies irradiated in the nuclear reactor, removed from it, and containing spent nuclear fuel.

Radioactive waste equipment means equipment intended for radioactive waste collection, treatment and storage.

Personnel (occupationally exposed persons) means part of the crew occupationally exposed to ionizing radiation.

Radioactive waste are materials and substances, as well as equipment, products (including the spent sources of ionizing radiation) containing radionuclides in amounts exceeding the values established by the Government of the Russian Federation, and not subject to further use.

Radioactive waste can be solid, liquid and gaseous. Radioactive waste grading by their level of radioactivity is established by the Fundamental Sanitary Rules for Radiation Safely Enforcement.

A nuclear support vessel (NS vessel) means a cargo vessel intended for the following:

storage of new and spent fuel assemblies of nuclear reactor cores;

operations on unloading of spent fuel assemblies and loading of new fuel assemblies into reactors;

reception, decontamination, repairs and storage of equipment for nuclear steam supply system;

reception, treatment and transfer of gaseous, liquid and solid radioactive wastes.

In addition, the NS vessel can fulfil the following functions not associated with radioactivity:

supply of nuclear ships and floating facilities with working media and their reception on board (fresh water, high purity water, compressed air (gas));

supply of nuclear ships and floating facilities with electrical and heat energy;

other functions of operational support of nuclear ships and floating facilities.

The NS vessel can provide the whole complex of operational support or individual types of such support for nuclear ships and floating facilities, which

determines the design of the NS vessel, of the equipment installed thereon and its nomenclature.

1.3 EQUIVALENTS

1.3.1 In the case of design solutions and means on board an NS vessel, alternative to those provided by the Rules for Classification, technical analysis shall be submitted to the Register for approval with justification of the fact that such alternative design solutions and means provide the equivalent level of safety.

2 CLASS NOTATION

2.1 Where a vessel complies with the appropriate requirements of the Rules for Classification, NS Rules and NSV Rules, the descriptive notation **Nuclear support vessel** is added to the class notation referred to in Part I "Classification" of the Rules for Classification.

Operational capabilities of the NS vessel according to its purpose are shown, where necessary, as additional characteristics in Section "Other Characteristics" of the Classification Certificate (e.g., "treatment of liquid radioactive waste").

3 CLASSIFICATION SURVEYS

3.1 The Register performs survey of the NS vessels in compliance with the General Regulations for the Classification and Other Activity. It includes review and approval of technical documentation, technical supervision during manufacture of materials and products, as well as technical supervision during construction of the NS vessel and when in service.

3.2 Additional requirements for classification surveys of the NS vessels in service are given in the Guidelines on Technical Supervision of Nuclear Ships, Nuclear Floating Facilities and Nuclear Support Vessels in Service.

3.3 The following devices, equipment and systems included in special equipment of the NS vessels are subject to survey by the Register:

.1 cargo-handling machinery and gear;

.2 heat exchangers, pressure vessels and ion-exchange filters, loading vessels for sorbents;

.3 electrical equipment;

.4 special systems and pipes with fittings;

.5 drain tanks, tanks for collecting, storage and discharge of liquid radioactive waste;

.6 solid radioactive waste storage facilities;

.7 storage facilities for new fuel assemblies and irradiated fuel assemblies;

.8 gaseous radioactive waste storage facilities;

.9 machinery of special systems;

.10 systems and devices of automatic and remote control, signalling and monitoring;

.11 biological shielding;

.12 systems and devices of radiation monitoring and process radiation monitoring;

.13 liquid radioactive waste treatment equipment;

.14 handling equipment of cores and fuel assemblies.

Technical supervision of the above equipment is carried out in accordance with the requirements of the NSV(Rules, Rules for Classification, Rules for the Cargo Handling Gear of Sea-Going Ships as well as with the provisions of the Guidelines on Technical Supervision during Construction of Nuclear Ships and Nuclear Floating Facilities, Nuclear Support Vessels, and Manufacture of Materials and Products and the Guidelines on Technical Supervision of Nuclear Ships, Nuclear Floating Facilities and Nuclear Support Vessels in Service.

3.4 At the discretion of the Register, the list of items of technical supervision of special process equipment may be increased.

4 PLAN APPROVAL DOCUMENTATION[1]

4.1.1 Safety of the NS vessel shall be ensured by implementing the protection-in-depth concept based on using a system of physical barriers against distribution of ionizing radiation and radioactive materials to the environment and on protection of personnel, population and environment.

4.1.2 Safety classes of special equipment and systems of the NS vessel shall be defined by a designer according to the requirements of Section **4**, Part III "Safety Principles" of the NS Rules.

4.2 In addition to the technical documentation specified in Section **3**, Part I "Classification" of the Rules for Classification, the following technical documentation confirming compliance with the requirements of the NSV(Rules shall be submitted to the Register.

4.2.1 General:

.1 analysis of possible emergency situations connected with spillover of radioactive materials beyond the controlled area, methods of localization and liquidation of consequences**;

.2 list of allowable values for controlled parameters of nuclear material storage and handling system in all modes of operation for its elements*;

[1] Documentation marked with (*) is the documentation, which review results are documented by stamping as per 8.3.1 Part II "Technical Documentation" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships, and documentation marked with (**) is the documentation, which review results are documented by stamping as per 8.3.2, Part II "Technical Documentation" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

.3 plan of vessel's subdivision into radiation safety areas;

.4 general arrangement plan of controlled area spaces with their subdivision into categories and indication of all openings and their closures in hull structures bounding the controlled area*;

.5 structural arrangement of biological shielding*.

4.2.2 Hull documentation:

.1 side and bottom collision and grounding protective structure in way of new fuel assemblies and irradiated fuel assemblies storage facilities, and liquid radioactive waste tanks*;

.2 drawings of main structural members of the controlled area spaces and their attachments to hull members*;

.3 drawings of new fuel assemblies and irradiated fuel assemblies storage facilities with closures, liquid radioactive waste built-in tanks and their foundations*;

.4 arrangement plans for openings in bulkheads and decks bounding the controlled area and their closures*;

.5 drawings and strength calculations of liquid radioactive waste tanks with indication of distances between side and bottom shell plating and the tanks*;

.6 drawings of supports and other structures for securing built-in liquid radioactive waste tanks*;

.7 schemes of integrity and leak tightness tests of controlled area compartments*.

4.2.3 Radiation safety documentation:

.1 basic diagram, description and composition of radiation monitoring*;

.2 charts of anticipated radiation levels in the interior spaces of the vessel and on outer surfaces of hull structures with new fuel assemblies, irradiated fuel assemblies, liquid and solid waste storage facilities totally filled**;

.3 charts of anticipated radiation levels in the interior spaces of the vessel (accommodation and controlled area spaces) and in the vicinity of the vessel in the course of handling operations**;

.4 efficiency calculations of biological shielding for new fuel assemblies, irradiated fuel assemblies, liquid and solid radioactive waste storage facilities, spaces where personnel can stay, made or approved by a competent authority**;

.5 radiation conditions evaluation in case of the most serious designed accidents and charts and calculations of anticipated radiation levels in case of accidents in the interior spaces and in the vicinity of the vessel, approved by a competent authority**;

.6 description of decontamination procedures for spaces and equipment subject to radioactive contamination, for equipment and materials transferred from serviced ships as well as contaminated and decontaminated equipment and materials transfer routes. Description and arrangement plan of the main decontaminating equipment**;

.7 arrangement plans of the process radiation monitoring system equipment**;

.8 testing programme of the radiation monitoring system at the manufacturer's**;

.9 drawings of biological shielding of the controlled area spaces, special equipment, pipes for radioactive material transfer and special fittings.

4.2.4 Documentation on systems and piping:

.1 installation (location and mounting) of bottom and side fittings in the vessel controlled area**;

.2 diagrams of systems serving radioactive material storage facilities, and liquid radioactive waste reception and discharge systems*;

.3 diagrams of ventilation systems for radioactive waste storage facilities, and the spaces where they are located*;

.4 diagrams of fire fighting and signalling systems in the vessel controlled area*;

.5 diagrams of waste water and special bilge systems of the vessel controlled area spaces*;

.6 calculations on systems and piping of new fuel assemblies and irradiated fuel assemblies storage facilities, liquid radioactive waste tanks and liquid radioactive waste reception and discharge control station**.

The documents given in **4.2**.5.**2** — **4.2**.5.5 shall include pipe sizes (diameter and wall thickness), pipeline structure data (material, isolation, fabrication and mounting methods, arrangement, hydraulic testing, etc.), as well as material of the pipes, material of gaskets, and pipe connection types.

4.2.5 Documentation on electrical equipment:

.1 drawings of cable routing in the controlled area with cable penetrations of the biological shielding and divisions between the controlled and monitored areas*;

.2 arrangement and installation plans of electrical equipment of handling means*;

.3 diagrams of process and heat monitoring and signalling as well as alarm systems*;

.4 circuit diagrams of main and emergency electrical power supply to consumers (fixed and portable), directly associated with the vessel use for the intended purpose*;

.5 circuit diagrams of main and emergency electrical power supply to automation, monitoring and signalling devices*;

.6 calculation of the required electrical power capacity providing main operating conditions of the vessel;

.7 list of control, monitoring and signalling parameters of special systems*.

4.2.6 Documentation on physical security:

.1 plans of physical barriers and arrangement of engineering equipment of the secured areas*;

.2 circuit diagrams of (as applicable for a particular design)*:

intrusion protection system;

security alert system;

access monitoring and control system;

optoelectronic surveillance;

communication and address system.

PART II. HULL

1 GENERAL

1.1 Decks, platforms and deck covers, which can be used for permanent or temporary storage of heavy equipment (containers, trans-shipment appliances, etc.), shall be of adequate strength and fitted with fixed or detachable supports and fixing devices in compliance with the requirements of the Rules for Classification.

Deck covers of spaces for new fuel assemblies, irradiated fuel assemblies and solid radioactive waste storage shall have sectional structure allowing for their partial opening.

1.2 Provision shall be made for reliable securing of the biological shielding designed with regard to the acting inertia forces and potential design accidents.

1.3 The controlled area spaces shall be designed to allow for decontamination of the surfaces.

1.4 The bulkhead members shall be fitted on the side of the spaces with less probability of contamination.

1.5 The hull structure, including foundations, shall prevent stagnation areas in the course of decontamination.

1.6 Design of the foundations and machinery and equipment attachments shall allow for decontamination. The foundations inaccessible for decontamination shall be sealed.

2 STRUCTURAL PROTECTION

2.1 A vessel designed for reception and storage of new fuel assemblies and irradiated fuel assemblies and/or radioactive waste shall have collision, grounding or stranding protection, which shall meet the requirements in Part IV "Hull" of the NS Rules.

3 ARRANGEMENT OF NEW FUEL ASSEMBLIES, IRRADIATED FUEL ASSEMBLIES AND RADIOACTIVE WASTE STORAGE FACILITIES

3.1 Double-skin structure shall be provided in way of the spaces intended for storage of new fuel assemblies, irradiated fuel assemblies and radioactive waste. Longitudinal bulkheads shall be positioned at a distance equal to at least 1/5 of the vessel breadth from the vessel's side, except the cases where collision protection prevents the damage that deep. Proof shall be presented to the Register that penetration limit in case of collisions assumed in the design of the vessel will not be exceeded.

PART III. STABILITY. SUBDIVISION

1 GENERAL

1.1 The NS vessels shall comply with the requirements of Part IV "Stability" and Part V "Subdivision" of the Rules for Classification and Part V "Subdivision" of the NS Rules, having regard to the following.

1.2 An NS vessel designed for storage (transportation) of new fuel assemblies, irradiated fuel assemblies and/or medium radioactive waste shall remain afloat, and intact vessel's stability under all operational loading conditions corresponding to the purpose of the vessel shall be sufficient to meet the requirements of the NS Rules for damage stability in case of (side and/or bottom) damage at any place lengthwise.

1.3 Subdivision requirements for an NS vessel designed for other purposes than those referred to in **1.2** are subject to special consideration by the Register, having regard to the purpose, design and service area of the vessel, but, in any case, intact stability shall be sufficient to meet the requirements of the NS Rules for damage stability in case of side and/or bottom damage in any place lengthwise between two nearest bulkheads.

PART IV. FIRE PROTECTION

1 GENERAL

1.1 Fire safety of the NS vessels shall comply with the requirements of Part VI "Fire Protection" of the Rules for Classification and additional requirements of this Part.

2 STRUCTURAL FIRE PROTECTION

2.1 The new fuel assemblies, irradiated fuel assemblies and radioactive waste storage facilities shall be separated from adjacent spaces by cofferdams or "A-60" class bulkheads for protection against the external fires and explosions.

2.2 Structural fire protection of the controlled area spaces other than those referred to in **2.1** shall meet the requirements in **2.3**, Part VI "Fire Protection" of the Rules for Classification.

2.3 The trunks and ventilation ducts leading to the controlled area spaces shall be "A-60" class structures: inside these spaces — over whole length, and outside these spaces — at a length equal to the largest size of the duct's cross section.

Where trunks and ventilation ducts are equipped with self-closing fire dampers meeting the requirements of Part VIII "Systems and Piping" of the Rules for Classification, they may be of "A-0" class.

2.4 Double-bottom tanks located near new fuel assemblies, irradiated fuel assemblies or radioactive waste storage facilities shall not be used for fuel storage.

If double-bottom fuel storage tanks are provided forward and aft of the controlled area spaces, they shall be separated by cofferdams from double-bottom space of the controlled area spaces, which structural elements shall meet the requirements of Part II "Hull" of the Rules for Classification.

3 FIRE FIGHTING EQUIPMENT AND SYSTEMS

3.1 New fuel assemblies and irradiated fuel assemblies storage facilities shall be equipped with a fixed self-contained fire-extinguishing system.

3.2 In addition to the system specified in **3.1**, provision shall be made for supplying extinguishing medium by the vessel's fixed fire-extinguishing system.

3.3 Use of water as a fire-extinguishing medium in the new fuel assemblies, irradiated fuel assemblies and radioactive waste storage facilities is not allowed. The extinguishing medium shall not result in increase of the effective neutron multiplication factor (i.e. spontaneous nuclear chain reaction).

4 FIRE DETECTION ALARM

4.1 In addition to the requirements of Part VI "Fire Protection" of the Rules for Classification, fire alarm system shall be fitted in the controlled area spaces of the NS vessels.

Use of alarm detectors based on ionizing radiation in high-radiation spaces shall be avoided.

PART V. EQUIPMENT OF STORAGE SPACES FOR NEW FUEL ASSEMBLIES, IRRADIATED FUEL ASSEMBLIES AND RADIOACTIVE WASTE

1 GENERAL

1.1 Requirements of this Part apply to structures, equipment, machinery, systems connected with a special purpose of the vessel:

.1 facilities for safe reception, storage and discharge of new fuel assemblies and irradiated fuel assemblies of nuclear reactors, as well as facilities and equipment for irradiated fuel assemblies loading into transport containers;

.2 facilities for reception, storage and discharge of solid radioactive waste;

.3 systems and facilities for reception, storage, treatment and discharge of liquid radioactive waste;

.4 waste water and special bilge systems of the controlled area spaces;

.5 decontamination and spraying (washing) systems of process spaces and decks, intended for reception and storage of decontaminating solutions concentrated ingredients, solution preparation and supply to the areas of decontamination and subsequent spraying (washing) of decontaminated items or surfaces;

.6 ventilation system of the controlled area;

.7 compressed gas (air, nitrogen, etc.) systems for process needs;

.8 liquid radioactive waste tank cofferdams heating system;

.9 reception, decontamination and storage facilities for different nuclear steam supply system equipment.

1.2 Liquid radioactive waste reception, storage, treatment and discharge facilities and systems shall be provided for segregated reception and storage of liquid radioactive waste different in terms of their specific radioactivity, and their discharge to the shore or to another vessel. Liquid radioactive waste categorization by their specific radioactivity is regulated by the Fundamental Sanitary Rules for Radiation Safety Enforcement.

1.3 The NS vessels intended for handling cores and radioactive waste are recommended to be equipped with a treatment plant intended for decreasing specific activity level of liquid radioactive waste to be stored.

1.4 Liquid radioactive waste tanks, new fuel assemblies, irradiated fuel assemblies and solid radioactive waste storage facilities shall be located in special spaces complying with the requirements of the NSV Rules.

1.5 For spaces specified in **1.4** biological shielding shall be provided.

1.6 The irradiated fuel assemblies storage facilities and liquid radioactive waste tanks shall be of built-in design, welded and made of corrosion-resistant materials. Structural elements of the storage facilities and tanks shall meet the requirements of Part II "Hull" of the Rules for Classification. Their framing, strengthening in support locations, etc. shall be made on the outside. Water collectors fitted with efficient drainage arrangements shall be provided at the bottom of the tanks. The tank bottom slope to the water collector shall provide water discharge under any operating heel or trim of the vessel. Drainage pipe shut-down valves shall be installed either on the tanks directly or (in case biological shielding is provided) on the branch pipes of adequate strength. The storage facilities and tanks shall be surrounded by cofferdams. The possibility of using integral tanks for low radioactive liquid waste shall be proved and agreed upon with a competent authority, and approved by the Register.

1.7 Depending on the vessel area of operation, liquid radioactive waste tank cofferdams shall be provided with heating system. Where steam heating is used, condensate collection and storage shall be separated from vessel's general systems to the tank of collecting radioactive material leakages. The design of heating, collection and storage systems shall exclude the medium release into the vessel's spaces and environment. Corrosion-resistant materials shall be used for the manufacture of the heating system. Heating elements installation inside the tanks is not allowed.

1.8 Liquid radioactive waste tanks, irradiated fuel assemblies and solid radioactive waste storage facilities shall be arranged as far as possible from accommodation, service and machinery spaces.

It is recommended that accommodation and service spaces be segregated from the controlled area by process spaces.

1.9 Double bottom tanks located below irradiated fuel assemblies, liquid and solid radioactive waste storage facilities are not allowed to be used for potable and washing water storage. The said tanks can be used for storage of ballast water or fuel.

1.10 The controlled area spaces shall be equipped with system for collecting radioactive material leakages from the place of their possible formation and discharging to the special tank for collecting radioactive material leakages, equipped with water presence signaling devices of lower and upper levels.

1.11 The minimum equipment necessary shall be installed in the controlled area spaces. The arrangement of equipment, pipes, cable runs shall not prevent proper decontamination of hull structures and equipment itself. The number of transit pipes, cables and other services through these spaces and their length shall be kept to a minimum, and they shall be laid in sealed corridors, linings or conduits.

1.12 Bilge wells of the controlled area spaces shall be fitted with screens preventing the wells contamination by foreign matters and provided with indicators showing the presence of water therein.

The pipes in the sealed spaces to discharge water from the bilge wells shall be fitted with shut-down devices with position indicators, the information being displayed on a control panel in the main handling operations control room.

1.13 The controlled area spaces where aerosols might arise shall have closing devices capable to provide their tightness. The closing devices shall be fitted with "open-closed" position indicators, the information being displayed on a control panel in the main handling operations control room. Every opening shall be numbered.

1.14 No machinery of the vessel systems as well as bottom and side fittings serving the systems may be located in the controlled area. Where such machinery and equipment shall be placed outside the machinery spaces for serving the remote controlled area spaces, a special compartment shall be enclosed outside the controlled area. The compartment shall have a separate entrance from the upper deck and shall be provided with independent bottom and side fittings.

1.15 The NS vessels intended for reactor cores reloading, new fuel assemblies, irradiated fuel assemblies and radioactive waste transportation and storage shall have the main handling operations control room. The main handling operations control room shall be provided with the following:

.1 visual and audible water level indication in the irradiated fuel assemblies storages and tanks;

.2 thermal control instruments for irradiated fuel assemblies storages and heat-exchange equipment;

.3 position indicators for pipe fittings of special systems;

.4 means for operation signalling of electric pumps and heat exchangers of special systems and monitoring of their parameters;

.5 means for water presence signalling in the bilge wells of the special bilge system in the controlled area spaces;

.6 radiation monitoring information means for vessel spaces, open decks, ventilation exhaust outlets of the controlled area ventilation system and places of possible uncontrolled release of radioactive gases or aerosols;

.7 alarms operating in case of emergency in the new fuel assemblies and irradiated fuel assemblies storage spaces;

.8 alarm signals for personnel evacuation from the dangerous area (refer to **8.6**.4);

.9 information means for controlled area ventilation operation and vacuum in the spaces with indication of fan operation and valve positions;

.10 means for two-way communication with the vessel machinery space, valve control station, new fuel assembly preparation room and main work places in the controlled area, including positions from where cargo cranes operating with new fuel assemblies and irradiated fuel assemblies;

.11 means for two-way communication with the station from where repairs of the served ship are controlled;

.12 telemonitoring system for the controlled area spaces where potentially hazardous works are performed as well as for new fuel assemblies and irradiated fuel assemblies storage spaces.

All control, monitoring and signalling equipment in the main handling operations control room shall be combined on special panels which, in addition to the main electrical power supply, shall be fed from emergency sources of electrical power to be automatically connected.

1.16 Cargo-handling facilities in the controlled area spaces shall be of an enclosed design and meet the requirements of the Rules for the Cargo-Handling Gear of Sea-Going Ships.

When performing crane operations with new fuel assemblies and irradiated fuel assemblies, cargo-handling gear designed for nuclear material shall be used. The cargo-handling gear shall ensure safe movement of cargo within speeds, accelerations, and vertical and horizontal movements as per its design.

Access to the cabin shall be from a space outside the controlled area.

1.17 Provision shall be made for reception of pure process media (water, steam, gases) from the outside and their discharge to the served ship or to the shore.

1.18 Equipment of the special spaces (special-purpose sanitary spaces, laboratories, workshops) is subject to the Register technical supervision in terms of energy supply thereto and safe operation of pressure vessels, lighting, communication, signalling, ventilation, strength of equipment securing, fire protection, space drainage, decontamination.

1.19 Integrity and leak tightness testing shall be designed for systems and facilities without putting the NS vessel out of service.

1.20 Vessels intended for reactor cores loading/unloading or only for irradiated fuel assemblies and new fuel assemblies reception, storage and discharge shall be fitted with trim and cross-flooding systems and fittings to maintain equilibrium of the vessel during handling operations.

2 FUEL ASSEMBLIES AND SOLID RADIOACTIVE WASTE STORAGE FACILITIES

2.1 NEW FUEL ASSEMBLIES STORAGE FACILITIES

2.1.1 Where provision for new fuel assemblies storage is made on board the NS vessel, an appropriate space shall be fitted with racks for new fuel assemblies storage in the position and in the state required by the manufacturer's specifications and Nuclear Safety Rules, as well as with fittings for installation and secure fastenings of transport containers with new fuel assemblies.

2.1.2 Racks and transport container fixing devices with new fuel assemblies shall exclude a possibility of their movement due to lists or trims of the vessel, including capsizing.

2.1.3 It is not recommended to lay pipes through the storage spaces for new fuel assemblies if those pipes do not serve these spaces. If laying of such pipelines is necessary, they shall not have detachable joints within the storages. Laying steam pipes in the new fuel assemblies storage spaces is not allowed.

The new fuel assemblies storage spaces shall be equipped with a bilge system. It is recommended that an independent bilge (stripping) system be installed.

2.1.4 The storage space for new fuel assemblies shall be provided with a properly equipped assemblies condition incoming control station and a station for preparation of new fuel assemblies for process operations. These stations shall have two-way communication with the handling operations control room and the station from where repairs of the served ship are controlled.

The equipment of incoming control station for new fuel assemblies shall check the compliance of new fuel assemblies with the manufacturer's specifications.

2.1.5 Transport-handling appliances in the storage spaces for new fuel assemblies shall prevent damage of containers with new fuel assemblies or the assemblies themselves in the course of handling operations.

2.1.6 Appliances to be used for heating of the storage spaces for new fuel assemblies shall prevent air temperature and humidity rising above the values specified in the requirements for new fuel assemblies storage conditions.

2.1.7 The storage space shall be equipped with a permanent spontaneous chain reaction alarm system and technical means of ensuring radiation and nuclear safety.

2.2 IRRADIATED FUEL ASSEMBLIES STORAGE FACILITIES

2.2.1 Where irradiated fuel assemblies might be stored on board a vessel, the following shall be provided:

.1 special storage facilities of adequate capacity, having fittings for fixing the covers. The main items of irradiated fuel assemblies storage facilities (covers, plugs, etc.) shall be unified, and these items shall be properly marked to identify the particular set they belong to. Closures of individual cells (boxes, holders) as well as those of every section and the whole storage facility shall be equipped with stoppers to prevent them from spontaneous opening in case of the vessel motions.

Storage facilities shall have radiation protection that reduces an equivalent dose power on exposed surfaces to the values set by the requirements of normative documents of the current sanitary legislation;

.2 devices for directing and accurate placement of each individual irradiated fuel assembly of the core in the box cell or storage facility holder;

.3 devices for irradiated fuel assemblies boxes safe loading and unloading from storage facilities and transfer thereof to the shore transport means or special vessels;

.4 an independent storage facility or section with appropriate equipment to receive and store emergency irradiated fuel assemblies. If storage of such irradiated fuel assemblies is provided, the storage facility shall be fitted with a separate exhaust ventilation duct. Design provisions shall be made to prevent such space from flooding it with water;

.5 a possibility to carry out radiation-hazardous handling operations with irradiated fuel assemblies in the vessel's (floating facility's) spaces isolated from the environment. It is recommended that an alarm for seal failure of the spaces be installed.

The design shall be such as to prevent any possibility of uncontrolled release of radioactive gases and aerosols during loading or unloading of irradiated fuel assemblies to/from storage facilities. Provision shall be made in storage facilities for local air sampling to measure specific radioactivity of radioactive gases or aerosols.

2.2.2 Irradiated fuel assemblies storage facility shall be suitable for storage of all core rods. Sectional storage facilities (for several sets of the core rods) are allowed.

The design of the top plates of the storage facility closures shall allow for their partial opening. Furthermore, to reduce a combined radiation level in the course of handling operations with irradiated fuel assemblies, provision shall

be made inside the storage facility for a cover for each individual irradiated fuel assembly or groups of irradiated fuel assemblies in case several irradiated fuel assemblies are supposed to be kept in one box.

The design of irradiated fuel assemblies storage facilities shall provide nuclear and radiation safety and prevent spontaneous nuclear chain reaction under any possible conditions of irradiated fuel assemblies storage. Biological shielding of storage facilities shall provide radiation protection in case they are loaded with the irradiated fuel assemblies of the highest radioactivity.

2.2.3 Irradiated fuel assemblies storage facilities shall be made of stainless steel. The interior surface coatings of storage spaces and equipment shall allow for multiple decontamination thereof.

The design of irradiated fuel assemblies storage facilities and their equipment shall provide a possibility for their drainage, periodical internal examinations and necessary repairs.

2.2.4 Where irradiated fuel assemblies shall be stored under continuous residual heat dissipation conditions, a triple-circuit cooling system shall be provided. The first and second cooling loops shall be closed. In case of sectional storage facilities, heat dissipation shall be provided from each section separately. High-purity process water shall be used as a heat-dissipation medium in the irradiated fuel assemblies cooling circuit and intermediate circuit. The intermediate circuit heat carrier may be cooled in heat exchangers cooled with sea water by vessel's general-purpose means.

Standby heat dissipation means shall be provided in the irradiated fuel assemblies cooling circuit and intermediate circuit. Both main and standby heat dissipation means for the irradiated fuel assemblies cooling circuit shall be supplied with electrical power from the main and emergency sources of electrical power. Continuous monitoring of heat carrier radioactivity in the irradiated fuel assemblies cooling circuit and at least periodical monitoring of heat carrier radioactivity in the intermediate circuit and sea water at the heat exchanger outlet shall be provided.

Means shall be provided in the heat dissipation system for water cleaning from mechanical impurities and radioactive contamination. Fittings installed directly on storage facilities shall be remote controlled and have position indicators with displaying the information on their position in the main handling operations control room and in the valve control station. Where provision is made for local control of the fittings, they shall have an appropriate biological shielding. The fittings used shall have signal devices and local indicators of their position.

2.2.5 Irradiated fuel assemblies storage facilities shall be provided with a process water sectional flooding system, a bilge system and an independent ventilation system with air intake from under the closures (upper plates) of the storage sections to prevent water from being entrained into the ventilation system (refer to 3.5.5).

2.2.6 The capacity of the equipment (pumps, heat exchangers, etc.) serving the systems of the irradiated fuel assemblies storage facilities shall be based on the calculation with regard to possible design accidents. The storage flooding or emptying rates shall be proved.

2.2.7 Where irradiated fuel assemblies are loaded directly into the storage facility (section, container) filled with water, the storage facility shall be fitted with an overflow system for water excess being overflowed into a special overflow tank to be installed according to the requirements of 1.**6** and equipped with air pipes of an adequate cross-sectional area and continuously operating remote level indicators with information being displayed in the main handling operations control room. The overflow tank capacity shall be proved by calculation. The tank may be located outside the storage space. In such case, the overflow pipes and the tank shall have biological shielding.

It is allowed to provide one overflow tank for all sections of the irradiated fuel assemblies storage facility. In this case, however, its capacity shall be increased, and any possibility of water overflow from one section to another through the overflow tanks shall be prevented.

Air pipes of the overflow tank shall comply with the requirements of 3.1.1.**8**.

2.2.8 The water shall be pumped out of the irradiated fuel assemblies storage facility (or section thereof) or overflow tank by means of electrically driven pumps of watertight construction or other means preventing radioactive water leaks. Where such means can operate only if filled with water, provision shall be made for interlock of their starting in case no water is available in the pumps and stopping upon reaching the lower water level in the irradiated fuel assemblies storage facilities.

A possibility of inadvertent process water drainage and storage facility emptying in case of any pipe damage because of process water ejection shall be prevented.

2.2.9 Every section of the irradiated fuel assemblies storage facility (in case of a sectional design) shall be fitted with a heat monitoring system and continuously operating remote process water level indicator with entire level range visual, and upper and lower level audible signalling with information led to the main handling operations control room and the valve control station.

The heat-monitoring system and level-indication system shall be designed so as to allow for repairs and component replacement without emptying the section.

For direct supervision of the handling operations a properly shielded position fitted with two-way communication with the main handling operations control room and the station from where repairs of the served ship are controlled shall be provided in the storage facility space.

2.2.10 Upon manufacture and installation on board, the overflow tank of the irradiated fuel assemblies storage facility and systems serving the tank shall be tested for integrity and leak tightness.

Trays made of stainless steel or an appropriate barrier on the deck plating shall be placed under the fittings installed. All pipe connections and fitting-to-pipe connections shall be welded.

2.2.11 Irradiated fuel assemblies shall be loaded into a storage facility (section) through a special arrangement enabling to coordinate and mate the axes of the transfer container and holders (box cells) in the storage facility plates.

2.2.12 Provision shall be made for an expansion tank for priming of the heat dissipation system of irradiated fuel assemblies storage facilities, replenishing the leaks and heat expansion compensations.

2.2.13 The sea cooling water for heat dissipation from the secondary circuit coolant of the storage facility cooling system shall be supplied from at least two independent sea valves. Provision shall be made for sea cooling water supply when the vessel is docked. In order to prevent the secondary-circuit coolant from supercooling at low sea water temperatures, provision shall be made for its recirculation, i.e. partial discharge of the sea water into the intake sea valve trunk.

Twin mechanical strainers, one of which shall be in operation, shall be provided in the sea water system.

Use may be made of the sea cooling water from the ship system, provided it meets the requirements of this para and has an adequate capacity reserve.

2.2.14 A special container properly protecting the personnel against penetrating radiation shall be provided for irradiated fuel assemblies transfer from the nuclear reactor into the irradiated fuel assemblies storage facility on board the NS vessel. The container shall be designed so as to allow for its control during irradiated fuel assemblies unloading from the nuclear reactor and prevent irradiated fuel assemblies from open transfer.

2.2.15 The design of non-fixed handling equipment working in conjunction with vessel's machinery and arrangements (containers, temporary

storage facilities, essential rigging, etc.) is subject to review by the Register during design and manufacture from the perspective of its operational and radiation safety. Places for permanent or temporary storage of heavy handling equipment shall be adequately strengthened, provided with arresting or other fixing devices and biological shielding, where necessary.

2.3 SOLID RADIOACTIVE WASTE STORAGE FACILITIES

2.3.1 Solid radioactive waste shall be stored in special storage facilities of stationary type (safe cabinets) and of non-stationary type (containers), which shall be located in specially designed spaces.

A special-purpose fixed or transport container shall be provided for storage of changeable or temporarily removable large-sized equipment, if it is required by the core repair or re-loading technology. The container shall be equipped with devices for fixing the transferred equipment inside the container, and heat dissipation and power supply means shall be provided, where necessary.

2.3.2 The storage space shall have a trunk for loading and unloading containers by outside cargo-handling gear or a properly equipped lift. The cargo platform (cabin) of the lift shall be designed so as to prevent the containers or individual loads from sliding when the vessel is rolling, loads from dropping into the trunk or creating obstacles for lift platform movement.

Provision shall be made for access into the lift trunk for its decontamination and repairs.

The requirements of the Rules for the Cargo-Handling Gear of Sea-Going Ships are fully applicable to the lifts.

The storage space shall be fitted with a cargo-handling gear for moving the containers inside the space.

2.3.3 Stationary storage facilities (safe cabinets) shall be located to minimize the vessel list effect on solid radioactive waste handling operations, and their doors, when opened, shall not obstruct the passages in the space. The doors or other closing appliances of the spaces shall be fixed in the open position and locked when closed. It is recommended that the doors be fitted in such a way as to be an additional protective shield when works with open storage facilities are in process. Use of guillotine or folding-down doors is not allowed.

It is recommended that higher activity solid waste be stored separately from lower activity waste.

Where solid radioactive waste types are segregated according to their activity level, different biological shielding of the storage facilities is allowed. The dosage rate on the storage facilities outer surfaces shall not exceed the values required by the applicable sanitary rules and regulations.

2.3.4 Each container or box for storage of solid radioactive waste shall bear identification number affixed to the outer surface. Entrance door of the waste storage space shall be fitted with a position indicator, information being displayed in the main handling operations control room.

2.3.5 The storage facilities and equipment shall be designed to make decontamination possible.

2.3.6 Solid radioactive waste storage facilities and spaces where they are located and where such waste might develop aerosols or radioactive gases, shall have closing appliances capable of providing their tightness. The ventilation system of such storages and spaces, where it is a part of the special ventilation system (refer to **3**.5), shall be fitted with aerosol filters.

2.3.7 Portable containers shall be used for radioactive waste collection, temporary storage and transfer to the shore or other vessels. The containers shall have reliable fittings for their gripping and carriage, the size of the containers shall allow for their transportation along the routes to be used in the course of handling operations. The container covers shall be securely locked, their design and strength shall provide their integrity under storage conditions.

The containers shall be painted with a warning coating and marked with the standards radioactivity symbol.

Provision shall be made for safe securing of the containers to prevent arbitrary movement and damage of the containers themselves and equipment of the spaces.

Where provision is made for storing the containers on open decks of the vessel, any possibility of moisture penetration inside the containers or radioactive particle escape out of them shall be structurally prevented. This refers both to the container structure and structural design of their storage places on board (shelters for the case of bad weather, etc.).

3 SPECIAL SYSTEMS

3.1 SYSTEMS AND FACILITIES FOR LIQUID RADIOACTIVE WASTE RECEPTION, STORAGE, TREATMENT AND DISCHARGE

3.1.1 Liquid radioactive waste storage facilities.

3.1.1.1 Special built-in tanks located in the controlled area spaces specially intended for this purpose shall be provided for liquid radioactive waste reception and storage. Supports (foundations) shall enable access for inspection and repairs of tank bottom.

The structural strength of the liquid radioactive waste tanks shall be ensured, in case of their filling up to the top of air or overflow pipes, with a safety factor equal to 1,5.

3.1.1.2 For liquid radioactive waste storage, tanks shall be provided with mandatory allocation of tanks for keeping medium radioactive water. Communication between the medium and low radioactive water storage tanks is not allowed.

3.1.1.3 Tanks for storage of medium radioactive water shall be made of corrosion-resistant materials suitable for multiple decontamination and washing. Such tanks are to have the necessary biological shielding. Where concrete is used for this purpose, the outer surfaces of the shielding shall be lined with a material allowing its decontamination or replacement.

3.1.1.4 Tanks for low radioactive water storage may be made of ordinary constructional materials with subsequent application of anti-corrosive coatings; vessel structures and spaces may be used as biological shielding. The efficiency of their protective properties, however, shall be checked by filling the tanks up to the upper level with liquid waste, having the maximum volumetric radioactivity permitted by the national sanitary rules for low radioactive waters.

3.1.1.5 Liquid radioactive storage facilities shall have:

.1 at least two manholes giving access inside the tanks for cleaning, inspection and repairs;

.2 system for supply inside the tanks and distribution of decontaminating solutions and steam for their heating;

.3 system for washing and discharge of decontaminating solutions and washing water;

.4 collecting wells to minimize non-removable residue of liquid radioactive waste;

.5 remote level gauging and audible alarms of the upper and lower levels with information led to the main handling operations control room and valve control station;

.6 sampling device;

.7 tank ventilation system (air pipes);

.8 system for liquid radioactive waste overf ow from the tanks;

.9 devices to prevent inadmissible pressure increase in the tanks, where necessary;

.10 systems and/or means of removing sediments upon emptying the tanks.

The tanks shall be protected from spontaneous emptying in case of filling or other pipes damage because of process water ejection due to a "syphon" effect.

3.1.1.6 Fittings shall be installed directly on the tanks in readily accessible places; they shall be of bellows type with branch connections to be welded, and shall be remote controlled. Stainless steel trays shall be provided in the fitting installation area or barriers shall be fitted on the deck (platform) plating to collect leaks in case of bellows damage.

Where valves are locally controlled, they shall have biological shielding.

The valves shall be provided with local position indicators and signal devices with extreme position indicators in the main handling operations control room and valve control station.

3.1.1.7 Tanks permanently or periodically operating under internal pressure shall be subjected after manufacture and then again after installation on board the ship and connection of pipes to a hydraulic test according to the requirements of Part X "Boilers, Heat Exchangers and Pressure Vessels" of the Rules for Classification.

The tanks operating under hydrostatic pressure shall be subjected after manufacture and then again after installation on board and connection of pipes to hydraulic tests as required by Part II "Hull" of the Rules for Classification.

3.1.1.8 Liquid radioactive waste storage tanks shall be fitted with air pipes made of corrosion-resistant materials. The air pipes from medium radioactive waste tanks shall be led from the top part of the tanks to the space where they are located or to a higher category space (in terms of the existing or anticipated radioactive contamination), if any. The air pipes from low radioactive waste tanks may be led to the open deck. In this case, the ends of the pipes shall be as high and as far as possible from the accommodation and service spaces, from control station, machinery spaces and air intakes of the vessel's ventilation system. Where special ventilation system is installed, the air pipes of the tanks

shall be led to the ventilation mast. Several air pipes may be combined into one pipe, the diameter of which shall be increased accordingly. In such case, however, any possibility of liquid radioactive waste overflow from one tank into another shall be prevented. An exception is made for a special overflow tank, if any, which is covered by the requirements of 3.1.1.8 and 3.1.1.**9**. Air pipes of medium and low radioactive waste storage tanks shall not be combined. Connections of air pipes with tanks and air pipes between themselves shall be welded. Pressure/vacuum valves shall be fitted on the outlets of the air pipes of liquid radioactive waste storage tanks, irrespective of their volumetric radioactivity, and adequate radiation monitoring shall be provided. Low radioactive liquid radioactive waste storage tanks, provided their air emissions, in the opinion of the competent sanitary authorities, are not unacceptable for the environment, may be exempted from the latter requirement. No shut-off means (except the cases referred to in 3.1.1.**10**) are allowed on the air pipes.

3.1.1.9 In addition to the air pipes, liquid radioactive waste storage tanks operating only under hydrostatic pressure shall be fitted with an overflow system for liquid radioactive waste collection and discharge when the main tanks are overfilled. The system shall comply with the requirements of Part VIII "Systems and Piping" of the Rules for Classification.

Several overflow pipes may be combined into one pipe with an appropriate increase of the diameter. In this case, however, liquid radioactive waste overflow from one tank to another through the overflow system, when one of the tanks is overfilled or at a heavy list of the vessel, is not allowed. A separate tank shall be available and provided with biological shielding, where necessary, for medium radioactive waste overflow from the tanks through an independent system. It can be located in the same space where the medium radioactive waste storage tank is arranged. Air pipes of different radioactivity liquid waste overflow tanks located within one watertight compartment may be combined with air pipes of the appropriate tanks.

The overflow system from each liquid radioactive waste storage tank shall be provided with a device signalling the waste overflow. The device shall be of adequate strength or shall be protected from possible damages. In addition to the signalling means required by Part VIII "Systems and Piping" of the Rules for Classification, the overflow tank shall be provided with a low-level alarm for the case referred to in 3.1.2.5 of the NSV Rules. All indications and alarms shall be led to the main handling operations control room and valve control station.

3.1.1.10 Shut-off valves of a bellows type having remote control and local position indicators with the information being displayed in the main handling

operations control room and valve control station shall be fitted on the air pipes of liquid radioactive waste storage tanks where an excessive pressure is likely to arise. The valves shall be permanently open and to be closed only in the course of handling operations that involve a pressure increase in the tanks.

It is recommended that these valves be interlocked with fittings for compressed air (gas) supply to the tanks to squeeze liquid radioactive waste out of the tanks, thus preventing air (gas) supply into the tanks when the valves on the air pipes are open. The excessive air shall be discharged either into the space where the tanks are located or directly into the exhaust part of the special ventilation system equipped with filters providing the required cleaning effect.

The tanks shall be properly protected against an inadmissible pressure increase. Where the tank structure and protection device (refer to **3.1.1.5.9**) fail to prevent active water ejection in the course of handling operations, the excessive air (or air-water mixture) shall be discharged into a special drain tank or another insulated tank.

3.1.1.11 The requirements of Part VIII "Systems and Piping" of the Rules for Classification, where they are not in conflict with the NSV Rules, are also applicable to the liquid radioactive waste storage tanks and their air and overflow pipes.

3.1.2 Liquid radioactive waste systems.

3.1.2.1 Pipes of liquid radioactive waste reception, treatment and discharge systems shall be independent of other piping and made of corrosion-resistant steels. Pipe connections with other pipes and fittings shall be welded. Fittings of these systems shall be of the bellows type with branches to be welded.

Independent pipes shall be provided for reception, transfer and discharge of medium and low radioactive liquid radioactive waste.

3.1.2.2 Fittings of process systems dealing with liquid radioactive waste pumping shall be positioned in an enclosure provided with biological shielding and controlled from the valve control station adjacent to the fitting enclosure.

The valve control station shall be fitted with information means referred to in 1.15.1, 1.15.3 to 1.15.5. The fitting enclosure shall have a coating suitable for multiple decontaminations.

The length of the pipes and the number of fittings shall be minimized, all pipe joints and pipe connections with fittings shall be welded (except for detachable pipes). The fittings shall have bellows seals. The pumps for liquid media shall be electrically driven and have watertight construction. All special-purpose systems of the NS vessels shall not be connected with vessel's general-purpose systems.

In spaces where sea water can fall on pipes and fittings made of not stainless steel, such pipes and fittings shall have efficient protective coatings.

3.1.2.3 Liquid radioactive waste reception on board, transfer from one tank into another or for treatment and discharge shall be only forced (except overflow or leak collection systems). Liquid radioactive waste may be conveyed either by electric pumps of watertight construction or by compressed air (gas) supply directly to the liquid radioactive waste storage tanks of a nuclear ship or NS vessel. In the latter case, the system supplying compressed air (gas) to the liquid radioactive waste storage tanks shall provide a working medium supply both from the vessel's own sources and from the outside sources.

3.1.2.4 Where electric pumps are used for liquid radioactive waste reception and discharge, provision shall be made on board for at least two pumps of watertight construction, preventing radioactive water leaks in the course of treatment. A bypass system automatically preventing a pressure increase in the pipes (in case of operation of quick-closing devices on the discharge pipe, etc.) shall be provided for each pump.

The pumps shall be installed in a special pump room. At least two pumps totally independent of the liquid radioactive waste systems with low volumetric radioactivity of the pumped media shall be provided for medium radioactive waste pumping. These pumps shall be either installed in specially protected rooms or have additional biological shielding.

The pumps shall be started and stopped, and their operation shall be controlled from the control station located outside the pump room (at the valve control station) and from the main handling operations control room, which shall have two-way communication between them, with the ship served and with the shore.

The equipment and arrangement of the pump room shall comply with the requirements of Section **1**.

3.1.2.5 Where electric pumps for liquid radioactive waste transfer are designed in such a way that their operation requires priming with working medium, their start shall be interlocked with an indicator showing availability of water in the pumps, and their stopping – with a low level alarm for liquid radioactive waste storage tanks.

3.1.2.6 The liquid radioactive waste system shall provide waste reception and discharge on either side, using both the served ship's facilities and vessel's own facilities. The waste discharge outside the vessel shall prevent contamination of the vessel itself and the environment. Liquid radioactive waste reception and discharge fittings shall be combined in common reception-discharge stations located on either side, shall be local- and remote-controlled

and shall have position indicators. Liquid radioactive waste fittings and pipes on their entire length shall have biological shielding, where necessary. Removable lines of an approved design shall be used for liquid radioactive waste reception and discharge from one ship to another and to the shore. The station equipment shall prevent liquid radioactive waste spillage in the course of transfer or in emergencies involving damage of the lines. Provision shall be made for quick-closing isolating devices for prompt isolation of the pipes in case of breaks or spontaneous disconnection of removable lines. It is recommended that such devices shall automatically operate when an alarm on pressure drop in the system operates.

The liquid radioactive waste reception-discharge station shall have:

.1 tight closure of all openings in the vessel's outside structures (sides, upper deck);

.2 connection of pipes for washing and decontamination of the station room, its equipment and systems;

.3 connections for compressed air supply for purging and emptying of liquid radioactive waste systems and removable lines;

.4 heating system preventing icing where leaks are likely to occur in the course of handling operations carried out in winter time and freezing of the systems themselves;

.5 twin mechanical filters on waste reception-discharge pipe;

.6 coamings in side openings so high as to prevent liquid radioactive waste from flowing overboard in case of leakages or damages or spontaneous disconnection of removable lines. The places for removable line connection shall be away from outside openings; means shall be provided for fixing the lines and preventing them from dropping overboard;

.7 handling devices for lines transfer outside and their reception back;

.8 local barriers (trays) to contain likely spillages of liquid radioactive waste, the barriers shall be of adequate height, which, however, shall not impede the personnel;

.9 connection of vacuum drying system;

.10 means for measuring activity of received and discharged liquid radioactive waste;

.11 necessary biological shielding where equipment and systems are arranged;

.12 communication with the main handling operation control room and valve control station.

All detachable equipment shall be kept in special spaces located next to the stations. All materials used in the station structures and equipment installed

or coatings used therein shall be resistant to corrosive media and be suitable for multiple decontamination.

3.1.2.7 Provision shall be made for removable lines flushing and drying by supplying flushing water and compressed air to the liquid radioactive waste discharge system after the last bellows valve.

Fittings of the flushing water and compressed air supply systems shall be of non-return shut-down type and shall be installed directly on the liquid radioactive waste pipeline. All connections of removable lines shall be of quick-release type, but preventing any liquid radioactive waste leaks.

A possibility shall be available to test the removable lines for leak tightness upon their assembly before operations begin.

3.1.2.8 In order to reduce contamination of pipes and storages, mechanical filters or other water cleaning means shall be installed in the suction and discharge parts of the liquid radioactive waste transfer system.

Provision shall be made for safe replacement of mechanical filters and their transportation to the storage.

3.1.3 Equipment for liquid radioactive waste treatment.

3.1.3.1 In addition to the tanks and pipes with fittings indicated in **3.1.1** and **3.1.2**, referred to the equipment of liquid radioactive waste treatment are separators, mechanical and ion-exchange filters, evaporators, cementing tanks and pumps with their fittings, instrumentation and control devices.

3.1.3.2 Tanks used as supply, collecting and other tanks in the liquid radioactive waste treatment system shall have rounded corners, conical or elliptical bottoms, medium agitators and mechanical appliances for cleaning bottom surfaces from residues.

3.1.3.3 Equipment for treatment of liquid radioactive waste containing radioactive media shall be isolated with shields to prevent direct streaming of radiation. The shields shall be easily detachable and shall not interfere with control and maintenance of the equipment.

3.1.3.4 Equipment for liquid radioactive waste treatment refers to the third class of safety and third class of design according to Section 5, Part VIII "Nuclear Steam Supply Systems" of the NS Rules.

3.1.3.5 Equipment for liquid radioactive waste treatment shall withstand loads with acceleration **3***g*, remain in operation with a heel up to **15°** either side and a trim 5°.

3.1.3.6 Fittings of the systems and equipment for liquid radioactive waste treatment shall be of the bellows type, made of corrosive-resistant materials, have local manual control as well as local position indicators and symbols in

line with those on the control panel. Identification plates with font not less than 10 shall be made of a corrosive-resistant metal.

3.1.3.7 Liquid radioactive waste treatment pipe joints shall be welded joints, and appropriate measures shall be taken to ensure full penetration of the weld root. Other types of joints are subject to special consideration by the Register.

3.1.3.8 Evaporators used in liquid radioactive waste treatment shall be capable of providing the quantity and purity of the condensate produced as required by the technical documentation approved by the Register. The outer surfaces of the evaporators with operating temperature of 60 °C and over shall be thermally insulated.

3.1.3.9 Design of equipment for liquid radioactive waste treatment shall provide the performance of internal survey using remote control means.

3.1.3.10 Pumps used in liquid radioactive waste treatment shall be made of corrosion-resistant metals and have waterproof construction.

3.1.3.11 Tanks for keeping cementing components shall provide their storage in a dry and bulk condition.

Connecting elements for filling the tanks and cementing tanks shall ensure tightness of connections.

3.1.3.12 The construction of the cementing tanks and agitators shall allow for their cleaning from cementing mortar.

3.1.3.13 The complex of liquid radioactive waste treatment equipment shall include laboratories for chemical and radiological analyses.

3.1.3.14 The design of liquid radioactive waste treatment equipment complex shall include a document on analysis of likely emergency situations and failures of the equipment, their consequences and measures of response.

3.2 SPECIAL BILGE SYSTEM

3.2.1 A special bilge system, independent of the vessel's systems shall be provided for drainage of the controlled area spaces.

3.2.2 Special and bilge systems of controlled area spaces shall be provided with means capable to ensure an appropriate sealing level of the spaces.

Used as such means may be shut-down valves installed on suction pipes of the bilge system of the sealed spaces. The valves shall have local and remote position indicators with information displayed in the main handling operations control room and valve control station. It is recommended that these valves be remote controlled (the drive shall be located outside the sealed space).

3.2.3 The bilge system in the controlled area spaces shall be of a closed-circuit type and shall be equipped with special built-in tanks for waste radioactive water collection and storage, and scuppers provided with a valve and its closed position indicators. Waste water bilge wells in the controlled area spaces shall be fitted with water-presence indicators, information being displayed in the main handling operations control room.

Waste water drainage by gravity is allowed into the spaces of the same category (in terms of ionizing radiation and radioactive contamination) located below, provided the decks (platforms) of those spaces are not watertight. Otherwise the pipes for water intake from the bilge wells shall be equipped with non-return shut-off valves.

3.2.4 The throughput of the bilge pipes and scuppers shall provide fast water removal from the spaces. The scuppers shall be arranged so as to prevent stagnant areas formation in any operating position of the vessel hull.

3.2.5 The spaces located above the bilge tank level may be drained by gravity. To prevent bilge water from flowing back and its discharge into other spaces through scuppers in case the tanks are overfilled, non-return valves shall be installed on the bilge pipes or valves on the scuppers shall be of non-return shut-off type.

3.2.6 For drainage of the controlled area spaces located at the level of the bilge tanks or below, vacuum-drainage or another method of total bilge water removal shall be used. Vacuum drainage is also recommended for the spaces above the controlled area. For vacuum drainage of the spaces provision shall be made for a vacuum pump of the type approved by the Register with a suitable tank for vacuum creation. The pump shall be controlled, its operation and vacuum in the vacuum tank shall be monitored from the local station and main handling operations control room. For drainage of concealed areas use shall be made of hoses with slot nozzles, and places for their connection shall be provided. Provision shall be made for vacuum drainage of boxes, containers and other facilities for irradiated fuel assemblies individual storage and transportation.

3.2.7 Waste water of different radioactivity level, as well as alkaline and acid decontamination water shall be segregated. Bilge collecting tanks for medium radioactive water storage shall be shielded.

Medium radioactive water tanks and pipes shall be concentrated in places most distant from accommodation and service spaces, control stations, and machinery spaces.

3.2.8 The design of bilge collecting tanks shall comply with the requirements of **3.1.1**.

The bilge collecting tanks and vacuum tank shall be fitted with level indicators with low level light signalling, and upper level light and sound signalling led to the main handling operations control room, washing and entire drainage facilities, and sampling devices. Besides, the bilge tanks shall be provided with air pipes in compliance with **3**.1.1.8 and **3**.1.1.11.

Air pipes may be combined only within one watertight compartment and only for tanks of bilge water of the same specific radioactivity category.

Where controlled area spaces are drained by gravity, the air pipes of the bilge tanks shall be led above the deck of the uppermost drained space. In case of vacuum drainage, the air pipes of the bilge tanks shall be led to the deck where the drainage vacuum pump tank is installed.

3.2.9 The bilge tanks shall be drained by electrically driven pumps of watertight construction, having the adequate capacity, or by squeezing the water with compressed air (gas) or other means approved by the Register.

Where compressed air (gas) is used, inadmissible pressure increase shall be prevented in the bilge tanks (refer to **3**.1.1.10).

3.2.10 The vacuum pump tank shall be drained into a special bilge system or directly into the liquid radioactive waste tank. Where the vacuum tank is drained with compressed air, a safety device shall be provided preventing inadmissible pressure increase therein.

3.3 DECONTAMINATION SYSTEMS

3.3.1 Technical means shall be provided on board the **NS** vessels for radioactive contamination removal as well as for containment and immobilization of not easily removable radioactive contaminants. The means to be used depend on the particular purpose of the vessel and are subject to special consideration by the Register.

3.3.2 For decontamination and washing of the spaces, tanks, handling equipment and vessel's structures where radioactive contamination might arise, decontamination and washing systems shall be provided.

The decontamination system shall include:

storage tanks for concentrated ingredients of decontaminating solutions;

solution-making stations;

pipes to supply solutions, washing water, high-purity water and steam to decontaminated objects;

pipes for decontaminating water drainage into collecting tanks, different for acid and alkaline waters.

3.3.3 For needs associated with preparation of decontaminating solutions and washing of decontaminated surfaces, process water supply system shall be provided to supply water to the solution-making stations and appropriate process spaces. Washing water may be drained to a bilge tank of the special bilge system.

3.3.4 Decontaminating water (alkaline and acid) bilge tanks shall be of the built-in type. Their design shall comply with the requirements of **3**.1.1. Besides, they shall be provided with fittings and pipes for spraying water supply thereto and internal spraying means.

3.3.5 The system of reception and supply of acids and alkalis to the decontaminating solution-making station shall be safe in operation and shall prevent their spillage. Liquid components shall be supplied to the storage tanks by a closed-circuit method. The liquid component and ready solution storage tanks shall be of the built-in type, and their design shall comply with the requirements of **3**.1.1. The tanks shall be made of materials suitable for aggressive alkaline and acid media storage and shall be located in isolated spaces equipped with spraying system and exhaust ventilation.

Where dry components are used for making decontaminating solutions, they shall be kept in watertight package in special storerooms equipped with exhaust ventilation and located in the vicinity of the solution-making station. Acid and alkaline components shall be kept separately. They shall be supplied to the solution-making tanks from outside.

3.3.6 The decontaminating solution-making station and associated store rooms and storage facilities shall be located outside the controlled area. Where many equipment items shall be decontaminated, provision shall be made on the NS vessels for a special decontamination space located within the controlled area and equipped with baths, racks and local decontamination stations, where decontaminating solutions, process water, steam and compressed air supply shall be provided. Besides, local cargo-handling gear, grips, stoppers, platforms and similar items necessary for large-sized equipment transportation and handling shall be provided.

The nomenclature of decontamination space equipment is decided by the vessel's designer and is subject to approval by a competent authority.

The decontamination space and equipment installed therein shall have a corrosion-resistant coating or shall be made of appropriate materials.

The decontamination space shall be equipped with facilities of communication with the main handling operations control room and exhaust ventilation from all local decontamination stations and baths, which is capable to provide the necessary number of air changes. Filters shall be provided for

exhaust air cleaning capable to clean the air up to the standards required by the sanitary rules and norms.

3.3.7 The components and ready decontaminating solutions shall be pumped with special facilities to be controlled from the local stations.

3.4 COMPRESSED AIR AND GAS SYSTEMS

3.4.1 For process needs provision shall be made on the **NS** vessel for special compressed air or gas supply systems segregated from the vessel's similar systems. In order to supply compressed air to the system, an independent air compressor of appropriate parameters and capacity shall be provided and installed outside the controlled area. Compressed air from the compressor shall be supplied through a non-return shut-off valve to an intermediate air receiver installed in the controlled area. The non-return shut-off valve shall be installed directly on the bulkhead bounding the controlled area and shall be located outside the controlled area.

For redundancy purposes and in case of small compressed air consumption for process needs, it is allowed to supply the air from the vessel's system. In this case, the air shall also be supplied to an intermediate air receiver installed in the controlled area through a non-return shut-off valve (for its installation, refer to above). **A** reducing valve and a safety valve shall be installed directly before the non-return shut-off valve (outside the controlled area), where necessary.

The equipment and installation of the intermediate air receiver shall comply with the requirements of Part X "Boilers, Heat Exchangers and Pressure Vessels" of the **R**ules for Classification.

3.4.2 Connections of compressed air and gas pipes with other pipes and with fittings within the controlled area shall be welded. The pipes and air receivers shall be made of materials allowing multiple decontamination or they shall have an appropriate coating. **A**part from shut-down valves, non-return valves shall be installed on the open ends of the pipes.

Provision shall be made for a branch pipe (pipe connection) for compressed air or gas delivery from the outside. The branch pipe (connection) shall be installed before the non-return valve outside the controlled area.

3.4.3 Compressed air (gas) in contact with radioactive compounds, upon being used, shall be removed through air ducts of the special ventilation system.

3.4.4 Gas bottles of non-explosive process gases (nitrogen, helium) shall be installed in specially equipped spaces in special groups connected to the

appropriate pipes. Connection to standard transport cylinders is allowed. The space where the gas bottles are installed shall provide their protection against heating from foreign sources. The location of such spaces and exits therefrom shall be such that personnel can quickly leave the space in case of oxygen-replacing gases spontaneous release therein. The space shall be located outside the controlled area.

3.4.5 Where provision is made for gas (nitrogen, helium) storage in fixed gas bottles, their equipment and installation shall comply with the requirements of Part X "Boilers, Heat Exchangers and Pressure Vessels" of the Rules for Classification.

3.4.6 Provision shall be made for periodical surveys and hydraulic tests of fixed air and gas bottles without dismantling thereof.

3.4.7 The equipment necessary for process gases (nitrogen, oxygen, acetylene, etc.) generation and storage as well as for gas and electric welding shall be located outside the controlled area. The equipment installation on board the NS vessel is subject to special consideration by the Register.

3.4.8 Process gases shall be supplied through independent pipes to independent and segregated stations and then directly to work areas through removable pipes.

3.4.9 Provision shall be made for receiving of non-explosive process gases (nitrogen, helium) from the outside or their transfer to the serviced ship or to the shore through separate detachable pipes.

The gas transfer shall be forced. Installation of vessel's gas compressors shall comply with the requirements of the NSV Rules and Part IX "Machinery" of the Rules for Classification.

3.5 SPECIAL VENTILATION SYSTEM

3.5.1 An independent special ventilation system shall be provided for spaces where radioactive contamination might occur. In addition to the requirements of this Chapter, the system shall comply with the requirements of Part VIII "Systems and Piping" of the Rules for Classification as far as they are not in conflict with these requirements.

3.5.2 The special ventilation system in spaces where radioactive contamination might occur, shall be made of materials suitable for multiple decontamination. The number of flanged connections in the system within the controlled area shall be minimized. No flanged connections, holes, etc. are allowed outside the controlled area.

3.5.3 The special ventilation system may be either a combined system (exhaust and supply) or a purely exhaust system. In any case, however, the ventilating air shall flow in the direction of the spaces with higher airborne contamination by creating appropriate vacuum therein.

The special ventilation system of the NS vessel may not be combined with other vessel's ventilation systems, including a space heating system where air heaters are used.

3.5.4 Air intakes shall be provided with filters to prevent dust or foreign particles penetration into the controlled area spaces. After cleaning, the air shall be discharged through a special ventilation mast which effective emission height is specified by the sanitary regulations.

In any case, however, air discharged from the special ventilation system shall be prevented from re-entry into air intakes of the vessel's ventilation.

Devices for continuous monitoring of the discharged air volume and radioactivity shall be provided at the ventilation mast outlet.

3.5.5 The categories of spaces equipped with supply and exhaust ventilation, pressure and vacuum in the spaces, and the number of air changes shall comply with the applicable sanitary rules for the NS vessels.

Ventilation ducts of the controlled area spaces of different categories in terms of radioactive contamination or ionizing radiation levels shall be segregated.

The ventilation system of the spaces where irradiated fuel assemblies storage facilities are located, where high radioactive waste is or may be kept shall be capable to maintain an air temperature in these spaces not in excess of 55 °C, unless other requirements for irradiated fuel assemblies and high radioactive waste storage conditions are specified.

3.5.6 When the ventilation system is not in operation, the air shall be prevented from flowing through the ventilation ducts from spaces of higher contamination to those of lower contamination.

3.5.7 Where necessary, the special ventilation system shall be fitted with twin filters for discharged air cleaning from aerosols and other radioactive particles. In this case, any possibility of air discharge bypassing the filters shall be prevented.

3.5.8 Redundancy of supply and exhaust ventilation fans and heat exchangers of the special ventilation system shall be provided. It is recommended that stand-by fans shall start automatically in case of failure of running fans. Ventilation system outlet closures shall be remotely controlled from spaces outside the controlled area.

3.5.9 Exhaust duct filters of the special ventilation system shall be provided with spare filtering cartridges, shall be readily accessible and provided with appliances for their safe replacement.

3.5.10 General control of the special ventilation system shall be effected from the main handling operations control room. Local control stations shall be provided to control separate parts of the systems.

It is recommended that provision be made for interlocking of electric fans start and stop with opening and closing of the appropriate fittings.

3.5.11 In spaces intended for high-activity materials storage or treatment as well as in places of likely release of gases or aerosols, local air extraction directly from work places shall be arranged. In this case, the first cascade of aerosol filters may be located in the same space.

3.5.12 All ventilation system components (ventilation ducts and pipes, filter bodies, etc.) shall not hinder decontamination of the adjacent structures and equipment.

3.5.13 Upon its manufacture and installation on board, the special ventilation system shall be tested for leak tightness.

3.5.14 Emergency ventilation system shall be provided for radioactive gases and aerosols concentration quick reduction in enclosed spaces of the vessel. As the emergency ventilation mobile filtering unit or another arrangement of the type approved by the Register may be used. The capacity and number of air changes to be provided by the emergency ventilation system as well as its filters resolving power are governed by the volume of the controlled area largest enclosed space where the highest concentration of radioactive gases or aerosols might occur. The emergency ventilation system shall be started from the main handling operations control room. Where a mobile unit is used as an emergency ventilation system, it shall be local and remote controlled.

3.6 FUEL ASSEMBLIES HANDLING EQUIPMENT COMPLEX

3.6.1 The requirements of this Chapter cover the handling equipment for new fuel assemblies and irradiated fuel assemblies of the reactor plant.

3.6.2 For each type of the reactor plant, handling equipment shall be developed, fitted with the technical means excluding possibility of nuclear or radiation accident in the course when dismantling and installing the reactor equipment, when unloading and loading the fuel.

The complex shall include the following equipment:

.1 operating floor;

.2 machine tool for cutting core rod liner welds, resistance thermal elements, thermo-electrical and core rod liner cutting converters;

.3 three-operation handling container;

.4 movement control mechanism with a support;

.5 gripping device for extraction of compensation group rod lengtheners and pins;

.6 device for locking a compensating group;

.7 device of unloading of ionization chamber suspensions;

.8 device for tightening and untightening nuts for the pressure flange securing and shifting of the flange and reactor cover;

.9 pumping station;

.10 device for checking compensating group travels and forces;

.11 gripping device for placing and fixing rod-type fuel assemblies;

.12 gripping device for loading new fuel assemblies;

.13 measuring device;

.14 device for welding of core rod liners, resistance thermometers and platinum thermometers;

.15 inspection device;

.16 control and monitoring system of machinery actuator drives;

.17 container for storage, transportation and placement of a neutron source.

3.6.3 Technical design of the handling equipment complex for irradiated cores of irradiated fuel assemblies shall be approved by the Register.

The following items shall be defined and justified in the technical design of the handling equipment complex:

.1 handling procedures;

.2 technical means and measures to ensure nuclear and radiation safely;

.3 condition of safety-related systems.

3.6.4 The technical design of the handling equipment complex to be submitted to the Register shall include the following documentation:

.1 performance specification for delivery of complex, including machinery, electrical equipment, remote control system;

.2 drawings of individual articles of the complex with sections, indication of dimensions on the drawings, materials, welding, welding consumables, roughness and smoothness of surfaces;

.3 specification of the complex equipment;

.4 list of the complex articles with indication of their main characteristics and information on approval by the Register;

.5 list of deviations from the requirements of the RS rules with supporting information;

.6 electrical schematic and circuit diagrams of the complex articles;

.7 electrical schematic and circuit diagrams of remote control systems;

.8 description of handling equipment complex;

.9 strength and reliability calculations;

.10 biological shielding diagram and calculation;

.11 thermal design of cooling system;

.12 drawing and calculations of cargo-handling gear;

.13 testing program;

.14 list of spare parts, tools and accessories.

3.6.5 Prior to commencement of the handling equipment manufacture, working drawings shall be approved by the Register according to the list agreed.

3.6.6 The handling equipment shall ensure safety of personnel and environment when handling irradiated cores or removable shield itself and irradiated fuel assemblies. The current radioactive irradiation norms shall not be exceeded in the course of handling operations. Integrity of the cores and fuel assemblies shall be maintained during handling.

3.6.7 In the course of handling, core or fuel assemblies heat shall be removed.

3.6.8 Provision shall be made in the handling equipment for reliable gripping of the removable shield with the core or without it or fuel assemblies, their extraction out of the reactor, sealing of the shield with or without the core in the container and sealing of the container with irradiated fuel assemblies.

3.6.9 Cargo-handling gear of the handling equipment complex shall comply with the requirements of the Rules for the Cargo-Handling Gear of Sea-Going Ships.

Duplication of electrical power supply and redundancy of the control channels shall be provided.

3.6.10 Strength calculations of handling equipment shall be made with regard to the specifics of the equipment.

Materials, welding, weld quality testing shall comply with the requirements of Part VIII "Nuclear Steam Supply Systems"of the NS Rules (safety class **2**).

3.6.11 The materials used for handling equipment components affected by radioactive contamination shall be suitable for multiple decontaminations.

3.6.12 The instrumentation used in handling equipment shall meet the requirements of Part VII "Machinery Installations" of the Rules for Classification.

3.6.13 Hydraulic tests of handling equipment shall be carried in accordance with the requirements approved by the Register.

3.6.14 Survey of equipment during manufacture shall be effected in compliance with the provisions of the Guidelines on Technical Supervision during Construction of Nuclear Ships and Floating Facilities, Nuclear Support Vessels and Manufacture of Materials and Products.

PART VI. ELECTRICAL EQUIPMENT

1 GENERAL

1.1 These requirements cover electrical units and equipment of the NS vessels and are additional to the requirements of Part XI "Electrical Equipment" of the Rules for Classification and Part X "Electrical Equipment" of the NS Rules.

1.2 Electrical equipment installed in the controlled area spaces shall have protective enclosure not lower than IP 56, and radiation monitoring sensors — IP 57.

2 EMERGENCY SOURCES OF ELECTRICAL POWER

2.1 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 **2.2**.

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 radiation monitoring stations, special-purpose sanitary stations, etc.) as well as on self-propelled ships of restricted service, not having nuclear fuel, liquid or solid radioactive waste (fioating warehouses, heating vessels, etc.), a necessity to provide an emergency source of electrical power, its type and capacity is subject to special consideration by the Register.

2.2 In addition to the consumers referred to in Part XI "Electrical Equipment" of the Rules for 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 according to the requirements of the NSV Rules;

.6 radiation monitoring 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.

3 ELECTRICAL POWER DISTRIBUTION

3.1 Power to consumers in the controlled area spaces shall be supplied from special distribution boards located outside the controlled area.

3.2 Power to consumers providing heat extraction from the irradiated fuel assemblies storage facilities, their condition signalling and monitoring systems, including radiation monitoring, shall be supplied from two feeders, one of which is supplied through the emergency switchboard.

3.3 Starting arrangements of electric drives of cooling circuits of the irradiated fuel assemblies storage facilities shall ensure automatic re-start of electric motors when voltage is restored after power supply interruption.

3.4 Each consumer serving the controlled area spaces and arrangements, which is supplied from two different sources of electrical power or from two feeders, shall be fitted with an automatic power switch located outside the controlled area.

3.5 Provision shall be made for power supply to the vessel's electrical system from an outside source of electrical power, for that purpose a switchboard for shore power connection shall be installed on board. In addition to the devices required by Part XI "Electrical Equipment" of the Rules for Classification, minimum voltage and phase failure protection devices shall be provided on the switchboard. Additional shore power switchboards may be installed, where necessary, location of which relative to each other shall be governed by the vessel's basing conditions.

3.6 Starting arrangements of electric drives located in the controlled area spaces shall be installed outside the controlled area. It is allowed to install push-buttons in the controlled area spaces.

4 CABLING

4.1 Electric cable penetrations of the controlled area spaces shall be as close to electrical equipment as possible. Cables shall be laid on the shortest routes possible.

4.2 Transit cables are not allowed to run through the controlled area spaces. Where, however, it will 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.

4.3 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.

4.4 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.

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

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

4.7 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.

5 LIGHTING

5.1 Controlled area spaces shall have at least two lighting groups fed from separate feeders.

5.2 Group boards of main lighting for controlled area spaces shall have remote on/off switching with appropriate signalling.

5.3 Emergency lighting fixtures shall be installed for lighting of the following:

.1 radiation monitoring stations;

.2 valve and handling operations control rooms;

.3 irradiated fuel assemblies and new fuel assemblies storage spaces;

.4 special-purpose sanitary space;

.5 main passages in the controlled area spaces.

6 INTERNAL COMMUNICATION AND SIGNALLING

6.1 Provision shall be made for two-way loudspeaking and telephone communication of the main handling operations control room with the following spaces/stations:

.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 radiation monitoring station;

.8 special-purpose sanitary room.

6.2 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.

6.3 All closures in ship structures 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 radiation monitoring station. It is recommended that local audible signalling of door or other closure opening be installed.

6.4 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 or radiation monitoring station.

7 POWER SUPPLY OF RADIATION MONITORING SYSTEM

7.1 Electrical power supply to fixed components of the radiation monitoring 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.

7.2 Power supply of the radiation monitoring components shall be automatically switched over to the emergency source.

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

7.4 Pilot lamp of voltage indication and power supply failure audible alarm shall be provided on the power supply switchboard of the radiation monitoring system.

7.5 Power supply system of the radiation monitoring components shall not be used for any purpose other than for intended use.

PART VII. RADIATION SAFETY

1 RADIOLOGICAL PROTECTION

1.1 In order to ensure radiation safety of the crew and environment, biological shielding of irradiated fuel assemblies, solid, liquid and gaseous waste storage facilities and other possible radiation sources (pipes, wires, machinery, equipment, etc.) shall be provided.

Biological shielding for spaces and individual equipment shall be calculated on the basis of the maximum radiation level possible for the particular space or equipment, using the magnitudes specified in the national sanitary rules and State radiation safety standards.

The design of the biological shielding shall efficiently provide a possibility of carrying out any docking operations on the vessel's hull and arrangements.

1.2 The controlled area shall be enclosed on board the vessel. Entrance to the controlled area shall be allowed only through the special-purpose sanitary space equipped with clothes changing facilities, dose rates recording facilities, washing equipment.

1.3 The controlled area spaces shall be subdivided into categories as regards probability and level of radioactive contamination.

Air vacuum in the spaces (or groups of spaces), air humidity, temperature and number of air changes shall be provided by the vessel's special ventilation system and shall be consistent with the national sanitary rules in force.

1.4 Where air flows from one space to another, the flow shall be from areas of lower potential airborne contamination to areas of higher potential airborne contamination.

1.5 Air discharged from the controlled area spaces shall be continuously monitored and shall pass through efficient filters.

The controlled area ventilation system shall be designed so as to prevent contamination of the space where people can stay, and accumulation of radioactive substances. Radioactivity of the special ventilation system emissions shall not exceed the rates specified in the national sanitary rules and safety radiation standards.

1.6 Personnel individual protection means and systems providing their use shall be available.

1.7 In order to prevent accumulation of radioactive contamination, provision shall be made for decontamination of all the controlled area spaces,

equipment installed therein as well as of the vessel's hull, including its outer surfaces. Coatings and paintings of the structures shall allow multiple decontamination.

1.8 The configuration of the controlled area spaces shall be simple, without recesses or projecting parts as far as practicable. Corners of the hull structures shall be rounded, as far as practicable, and surfaces and welded joints shall have roughness of not lower than Ra **3.2**.

1.9 Machinery and equipment not suitable for decontamination shall be easily replaceable.

It is recommended that a provision be made for covering this machinery and equipment in operation.

2 RADIATION MONITORING

2.1 The NS vessels shall be provided with radiation monitoring means.

2.2 Depending on the purpose of the NS vessel, radiation monitoring means may include:

.1 fixed centralized monitoring system;

.2 fixed monitoring units and instruments;

.3 portable radiometric and radiation monitoring instruments.

2.3 The number and nomenclature of the radiation monitoring instruments and their location on board the NS vessel shall be agreed with the Register.

2.4 Radiation monitoring means shall provide:

.1 monitoring of ionizing radiation dose rates on board;

.2 monitoring of equipment and spaces radiocontamination level;

.3 monitoring of radioactive emissions into the atmosphere through the NS vessel ventilation system;

.4 monitoring of volumetric radioactivity and quantity of liquid radioactive waste on board the NS vessel;

.5 environmental monitoring in irradiated fuel assemblies and new fuel assemblies storage facilities in the NS vessels intended for nuclear fuel handling;

.6 signalling on position of all closing appliances in the structures bounding the controlled area;

.7 individual radiation monitoring of the personnel.

2.5 Radiation monitoring means shall provide record and storage (depending on the purpose of the NS vessel) of the following:

.1 ionizing radiation levels on board;

.2 radioactive contamination levels for spaces;

.3 quantity and volumetric radioactivity of liquid radioactive waste stored on board the vessel and discharged from the vessel to the environment;

.4 individual dose magnitudes of the personnel radioactive irradiation.

2.6 Where the centralized radiation monitoring is available on board, the radiation monitoring station shall be located either in the vicinity of the main handling operations control room or shall be combined therewith.

PART VIII. PHYSICAL SECURITY

1 SCOPE OF TECHNICAL SUPERVISION

1.1 The engineering and technical facilities of physical security of the NS vessels are subject to the technical supervision of the Register.

1.2 Technical supervision of the Register is carried out during design, manufacture, on-board installation, commissioning tests, operation and modernization (upgrade) of physical security systems.

1.3 The scope of technical supervision for the equipment of physical security systems during their design, manufacture, on-board installation, commissioning and operation is established by the requirements of the present Part.

2 DEFINITIONS AND EXPLANATIONS

2.1 In addition to those specified in Part I "General", for the purpose of this Part, the following definitions and explanations have been adopted.

Physical security personnel means the persons who are in charge for physical security functions at the nuclear facility.

Physical security system control station means a specially equipped space (place) fitted with the engineering and technical facilities and intended for full/partial control of the physical security technical facilities in standard and emergency situations by the dedicated physical security personnel.

Physical security technical facility means a type of equipment intended for using by the physical security personnel to detect unauthorized actions, obtain information on performing or attempts to perform such actions, report on performing or attempts to perform such actions, and localize and delay violators.

Reader means a device intended for reading information from an identifier.

Physical barrier means a physical obstacle creating delay for violator's penetration into the controlled areas, to nuclear materials or vulnerabilities of the nuclear plant.

Protected area means open decks of the vessel/floating facility, access to which is restricted and monitored.

Interior area means an area located in the interior spaces of the vessel/floating facility and surrounded with physical barriers; access to this area is restricted and monitored.

Vital area means an area located in the interior area and surrounded with physical barriers; access to this area is restricted and monitored.

Secured area means protected, interior or vital area.

Identifier means an appropriated or inherent sign used for confirming authorization to pass into secured area.

Identification means recognition of a subject or an object based on a unique identification sign.

Violator means a person who has made or is trying to make an unauthorized action, as well as a person who aids in doing such an action.

Unauthorized action means performing or attempt to perform a sabotage/terror attack, theft of nuclear materials, nuclear plants, unauthorized access, bringing-in prohibited items, incapacitation or disturbing operation of physical security engineering and technical facilities.

3 GENERAL REQUIREMENTS

3.1 Operation of the NS vessels without physical security of nuclear materials, points (places) for storing nuclear materials and radioactive waste is forbidden.

3.2 No physical security measures shall prevent from immediate and safe entering/leaving of people to/from any space in case of an emergency (fire, flooding, etc.).

3.3 Physical security engineering and technical facilities include the engineering and technical ones.

3.3.1 Physical security engineering facilities include physical barriers and engineering equipment of secured areas. Physical barriers are hull and superstructure structures (decks, bulkheads, doors, hatch covers and specially developed structures (obstacles, gratings, strengthened doors)).

3.3.2 Physical security technical facilities usually include the following main functional systems:

.1 intrusion protection system;

.2 security alert system;

.3 access monitoring and control system;

.4 optoelectronic surveillance and situation assessment system;

.5 operational communication and address system (including wire and radio communication means);

.6 data protection system;

.7 power supply and lighting system.

3.3.3 Physical security engineering and technical facilities shall be controlled from the physical security system control stations. Devices for providing information to the operator shall display incoming signals and information not less than in two modes from three existing ones (visual, light and sound). Access to the control station spaces shall be provided using technical means of access control.

3.3.4 Technical documentation on the physical security engineering and technical facilities shall be submitted to the Register for review and approval prior to manufacture.

3.4 The electrical equipment for the physical security engineering and technical facilities shall comply with the requirements of Part XI "Electrical Equipment" of the Rules for Classification.

3.5 Secured areas and restricted areas on the NS vessels shall be allocated and documented, and spaces shall be categorized appropriately. Categories of spaces shall be determined during design.

3.6 When allocating secured areas, the vital area shall be placed inside the interior area, and the interior area inside the protected area.

3.7 All entrances/exits to/from the categorized spaces shall be fitted with technical means for detection, monitoring and access control and, where necessary, with surveillance and situation assessment means.

3.8 The failure of any element of physical security technical facilities shall not disrupt functioning of the physical security technical facilities in whole.

3.9 Separate physical security technical facilities can fulfill requirements imposed on one or several functional systems (i.e. integrated systems and devices).

3.10 Structural protection of the physical security system cables on open decks of the vessel shall be provided.

3.11 The computers and computer systems included in physical security engineering and technical facilities shall fully meet the requirements to such equipment given in Section **7**, Part XV "Automation" of the Rules for Classification.

3.12 Completeness of spare parts and accessories shall be determined by the manufacturer of the technical means and agreed with the shipowner.

4 PHYSICAL BARRIERS AND ENGINEERING EQUIPMENT

4.1 Physical barriers shall fully meet all the requirements of Section 7, Part III "Equipment, Arrangements and Outfit" and Section **2**, Part VI "Fire Protection" of the Rules for Classification, as well as the requirements of this Section.

4.2 Physical barriers shall provide the following:

.1 delay (slowdown) of violators' penetration;

.2 possibility to open doors from inside a secured space;

.3 possibility to urgently unblock doors (locking devices) from the control stations in emergency situations.

4.3 The engineering equipment of the secured areas shall provide difficulties for violators in attempts of unauthorized penetration and bringing prohibited items.

4.4 Check points shall provide protection for the checkers against small arms.

5 INTRUSION PROTECTION SYSTEM

5.1 The intrusion protection system shall provide detection of performing or attempts to perform unauthorized actions with submission of information to the personnel and issuing signals to other physical security functional systems.

5.2 For preventing possible tampering with the intrusion protection system, the following shall be provided:

.1 remote monitoring of the system elements condition from the physical security control stations;

.2 archiving all the events occurring in the physical security system.

5.3 In addition to the above requirements, technical facilities of the intrusion protection system shall meet the requirements in 7.**3**, Part XI "Electrical Equipment" of the Rules for Classification.

6 SECURITY ALERT SYSTEM

6.1 The security alert system shall provide informing the physical security personnel on unauthorized actions with determination of the alerting place.

6.2 Possible unauthorized switch-off of the security alert system devices shall be excluded.

6.3 The information received by the operator from the security alert system shall have a priority in comparison with other signals.

6.4 The security alert system shall generate alarm signals to the physical security control station by using the alarm buttons.

6.5 In addition to the above requirements, technical facilities of the security alert system shall meet the requirements in **7.3**, Part XI "Electrical Equipment" of the Rules for Classification.

7 ACCESS MONITORING AND CONTROL SYSTEM

7.1 The access monitoring and control system shall provide automatic and remote control of the lock (locking device) actuators according to the programmed algorithm and checking their condition.

7.2 The lock (locking device) actuator shall operate only after reading the identification sign allowing access to the secured space for the given time. In case of no power supply on the actuators, their locks (locking devices) shall be fixed in the "open" position.

7.3 Provision shall be made for protection of signals generated in the access monitoring and control system, protection against unauthorized access to technical facilities for changing system's operation conditions or theft/ destruction of information, check of the technical facility integrity.

7.4 In case of breaking/attempt of breaking the elements, which, if tampered with, may potentially allow for unauthorized pass or improper system operation, the alarm signal shall be generated.

7.5 Technical facilities and devices of the central control station for the access monitoring and control system shall provide the following:

.1 blocking and unblocking doors with automatic registration of these actions as events;

.2 monitoring of the authorized access for crewmembers (other persons) to the secured areas and obstructing attempts of unauthorized access within an established period of time;

.3 submission of information to the operator of the physical security system on attempts of unauthorized penetration or forced tampering with components of pass granting equipment;

.4 automatic saving of information (with date and time recording) on the current events, emergency situations, attempts of unauthorized passage, condition of devices and elements of access monitoring and control system.

7.6 When people are in lobbies of the vital area, the following shall be provided:

.1 possible fast escape in case of emergency;

.2 monitoring of people inside the lobby;

.3 maintenance of the microclimatic parameters inside the lobby suitable for possibly long staying.

7.7 In addition to the above requirements, technical facilities of the access monitoring and control system shall meet the requirements in 5.10, Part XI "Electrical Equipment" and Section 7, Part XV "Automation" of the Rules for Classification.

8 OPTOELECTRONIC SURVEILLANCE SYSTEM

8.1 The optoelectronic surveillance and situation assessment system shall monitor the situation in the secured areas and transmit visual information to the physical security system control station(s) and record the obtained data.

8.2 Protection against unauthorized access to the technical means shall be provided.

8.3 Failure monitoring for the system's technical means and appropriate reporting to the control station operator shall be provided.

8.4 In addition to the above requirements, technical means of the optoelectronic surveillance and situation assessment system shall meet the requirements in **7.14**, Part XI "Electrical Equipment" of the Rules for Classification.

9 SECURITY LIGHTING SYSTEM

9.1 Technical facilities of the security lighting system shall comply with the requirements of Section 6, Part XI "Electrical Equipment" of the Rules for Classification and requirements of this Section.

9.2 Security lighting shall be activated automatically when the intrusion protection system actuates.

9.3 The security lighting system of distributing devices shall be protected against unauthorized actions.

9.4 Automatic switching to standby electric power supply shall be carried out without lowering the illumination level of the monitored space.

10 OPERATIONAL COMMUNICATION SYSTEM

10.1 Operational communication system is intended for voice exchange between personnel of the physical security system by means of wire and radio communication.

10.2 The operational communication system shall meet the requirements in 7.2, Part XI "Electrical Equipment" of the Rules for Classification and the requirements of Part IV "Radio Equipment" of the Rules for the Equipment of Sea-Going Ships.

10.3 Operational communication shall be provided by a system independent from other ship communication systems and intended only for physical security.

10.4 Recording voice exchange in the operational communication system shall be provided, both in manual and in automatic modes, with indication of time and duration.

10.5 Equipment of the operational communication system shall be able to identify unauthorized connections.

11 POWER SUPPLY SYSTEM FOR PHYSICAL SECURITY FACILITIES

11.1 Power supply systems for physical security engineering and technical facilities shall comply with the requirements of Section 3, Part XV "Automation" of the Rules for Classification and requirements of this Section.

11.2 The space with a switchboard of the physical security system shall be equipped with technical means of access monitoring and control, as well as with the intrusion protection system.

11.3 Power supply systems for physical security engineering and technical facilities shall comply with the requirements of Section 3, Part XV "Automation" of the Rules for Classification and requirements of this Section.

11.4 The space with a switchboard of the physical security system shall be equipped with technical means of access monitoring and control, as well as with intrusion protection system.

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