THE NINTH
NATIONAL REPORT
OF THE RUSSIAN FEDERATION
ON THE FULFILLMENT OF
COMMITMENTS RESULTING FROM
THE CONVENTION ON NUCLEAR
SAFETY

To the Joint Eighth/Ninth Review Meeting of the Contracting Parties under the Convention on Nuclear Safety

Moscow, 2022

The Ninth National Report of the Russian Federation on the fulfillment of commitments resulting from the Convention on Nuclear Safety for the period from August 2016 to June 2022 (hereinafter referred to as the Report) has been prepared in compliance with Article 5 of the Convention on Nuclear Safety.

This Report has been prepared with the account taken of the fundamental provisions and principles of the Convention on Nuclear Safety (INFCIRC/449); the recommendations given in the IAEA guidelines on preparation of national reports ("Guidelines Regarding National Reports under the Convention on Nuclear Safety", INFCIRC/572/Rev.6), the Summary Report of the 7th Meeting of the Contracting Parties under the Convention on Nuclear Safety (CNS/7RM/2017/08/Final), the Vienna Declaration on Nuclear Safety of February 9, 2015 (INFCIRC/872), the draft Country Review Report (Russian Federation) to the 8th Meeting of the Contracting Parties.

This Report has been prepared by the Federal Environmental, Industrial and Nuclear Supervision Service (Rostechnadzor) and the State Atomic Energy Corporation “Rosatom” (ROSATOM).

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List of Acronyms

AEP	- Atomenergoproekt, Joint Stock Company
AER	- Atomenergoremont, Joint Stock Company
AMB	- peaceful atom, large (reactor)
APCS	- automated process control system
ARMS	- automated radiation monitoring system
ASSET	- Analysis of Safety Significant Events Team (IAEA)
ATCS	- automated turbine control system
ATE	- Atomtekhenergo, Joint Stock Company
AZ	- emergency protection
BCP	- back-up control post
BDBA MG	- Beyond Design Basis Accident Management Guide
BN	- sodium-cooled fast neutron reactor
BREST-OD-300	- Pilot Demonstration Lead-Cooled Fast Neutron Reactor
BRU-K	- turbine bypass valve
CC	- Crisis Center of Rosenergoatom Concern JSC
CFD	- computational fluid dynamics
CPF	- common plant facilities
CPS	- control and protection system
ECCS	- Emergency Core Cooling System
ED	- emergency drills
EGP	- graphite-moderated loop-type power reactor
EIA	- Environmental Impact Assessment
EMDGS	- emergency mobile diesel generator station
EMERCOM of Russia	- Russian Federation Ministry for Civil Defense, Emergency Management and Response to Natural Disasters
EPJ	- expansion pipe joint
EPSS	- Emergency Power Supply System
ESL	- extended service life
ETC	- emergency technical center
EUR	- European Utility Requirements
FEP	- SFA fragmenting and encapsulation department
FSR	- federal standards and regulations in the field of the use of atomic energy
FSUE	- federal state-owned unitary enterprise
GOST	- Russian national standard
HES	- hydrogen evacuation system
HP	- high pressure
HSC	- hardware and software complex
I&C&A	- instrumentation, controls and automation

IAC	- Information and Analytical Center of Rostechnadzor
IAEA	- International Atomic Energy Agency
IBRAE RAS	- Nuclear Safety Institute of the Russian Academy of Sciences
ICRP	- International Commission for Radiological Protection
ICS	- Integrated Control System of Rosenergoatom Concern JSC
INES	- International Nuclear Event Scale
IRRS	- Integrated Regulatory Review Service (IAEA)
IRS	- International Reporting System for Operating Experience (IAEA/NEA)
ISA	- in-depth safety assessment
ISAR	- in-depth safety analysis report
ISO	- International Standardization Organization
ITD	- Interregional Territorial Department
JSC	- joint stock company
LMS	- leak monitoring system
LP	- low pressure
M&R	- maintenance and repair
M&RS	- maintenance and repair system
MCR	- main control room
MFCC	- multiple forced circulation circuit
MM	- mass media
MNUP-fuel	- mixed nitride uranium-plutonium fuel
NCMC	- National Crisis Management Center
NEA	- Nuclear Energy Agency of the Organization for Economic Cooperation and Development
NF	- nuclear facility
NF	- nuclear fuel
NFME	- neutron flux monitoring equipment
NIKIET	- N.A. Dollezhal Research and Development Institute of Power Engineering, Joint Stock Company
NP	- nuclear plant
NPP	- nuclear power plant
NPP QAP	- NPP Quality Assurance Program
NRI&FS	- nuclear, radiation, industrial and fire safety
NRNU MEPhI	- National Research Nuclear University “Moscow Engineering Physics Institute”
NRS	- nuclear and radiation safety
OE	- operating experience
OJSC	- open-type joint stock company
OKB GP	- Experimental Design Bureau “Gidropress”, Joint Stock Company (OKB Gidropress)
OKBM	- I.I. Afrikantov Experimental Mechanical Engineering

	Bureau, Joint Stock Company (OKBM Afrikantov)
OKChS	- Sectoral Commission for Emergencies of ROSATOM
OO	- operating organization
OPAS	- group for urgent support of nuclear plants
OSART	- Operational Safety Review Team (IAEA)
OSChS	- Industry-level System for Prevention and Management of Emergencies (ROSATOM)
PDPC	- pilot demonstration power complex
PORV	- pilot-operated relief valve
PPM	- planned preventive maintenance
PSA	- probabilistic safety analysis
PU	- power unit
QAP	- quality assurance program
QMS	- quality management system
RAW	- radioactive waste
RBMK	- large-power pressure-tube reactor
RCC	- Regional Crisis Center of WANO MC
RCP	- reactor coolant pump
RD	- regulatory documentation
RDAS	- reactor department auxiliary systems
RFNC	- Russian Federation Nuclear Center
RI	- reactor installation
RMS	- radiation monitoring system
ROSATOM	- State Atomic Energy Corporation “Rosatom”
Rosenergoatom	- Russian Concern for the Production of Electrical and Thermal Energy at Nuclear Plants, Joint Stock Company
Rostechnadzor	- Federal Environmental, Industrial and Nuclear Supervision Service
RS	- radioactive substances
RS	- reactor space
RSChS	- National System for Prevention and Management of Emergencies
SAI OE	- System for Analysis and Use of Information on Operating Experience of Nuclear Power Plants (Rosenergoatom)
SAMG	- Severe Accident Management Guide
SAR	- Safety Analysis Report
SCC	- Situation and Crisis Center of ROSATOM
SCC JSC	- Siberian Chemical Combine, Joint Stock Company
SEC NRS	- Scientific and Engineering Centre on Nuclear and Radiation Safety, Federal Budgetary Establishment (STSO of Rostechnadzor)
SFA	- spent fuel assembly

SFP	- spent fuel pool
SG	- steam generator
SG	- safety guide
SLE	- service life extension
SNF	- spent nuclear fuel
SPTA	- spare parts, tools and accessories
SRC	- scientific and research center
SRW	- solid radioactive waste
STSO	- scientific and technical support organization
TD	- technical documentation
TG	- turbine generator
TSC	- technical support center
UCR	- unit control room
UHC	- unified hardware complex
VNIIAES	- All-Russian Research Institute for Nuclear Power Plants Operation, Joint Stock Company
VNIITF	- Russian Federal Nuclear Center - Zababakhin All-Russia Research Institute of Technical Physics
WANO	- World Association of Nuclear Operators
WANO MC	- Moscow Center of the World Association of Nuclear Operators
WWER	- water-cooled water-moderated power reactor
WWER-TOI	- standard optimized and informatized water-cooled water-moderated power reactor

Introduction

The Russian Federation signed the Convention on Nuclear Safety on 20 September 1994 (Ordinance of the Government of the Russian Federation No. 1069 of 20 September 1994) and approved it on 12 July 1996 (Ordinance of the Government of the Russian Federation No. 377 of 3 April 1996). The Convention on Nuclear Safety became effective in Russia on 24 October 1996.

The national policy of the Russian Federation in the area of the nuclear power plant safety is based on:

- provisions of Article 71 of the Russian Federation Constitution, according to which the Russian Federation has nuclear power and fissionable materials in its jurisdiction; and
- the federal laws “On the Use of Atomic Energy”, “On the Radiological Safety of the Public”, “On the Environmental Protection”, “On the Fire Safety”, and “On the Industrial Safety of Dangerous Production Facilities”.

These laws are intended to guard human life and health and protect the environment in the course of activities associated with the use of atomic energy; they are meant to encourage further development of science and technology, and help consolidate the international regime of safe uses of atomic energy.

The State Atomic Energy Corporation “Rosatom” performs the functions of the government control of the use of atomic energy.

The Federal Law “On the Use of Atomic Energy” stipulates that the Operating Organization shall bear full responsibility for the safety of NPPs.

In the Russian Federation there are two Operating Organizations of NPs, Joint Stock Company “Russian Concern for the Production of Electrical and Thermal Energy at Nuclear Plants” (Rosenergoatom) and Joint Stock Company “Siberian Chemical Combine” (JSC SCC).

According to the Federal Law “On the Use of Atomic Energy” of 21 November 1995 (with amendments) and Resolution of the Government of the Russian Federation No. 88 of 17 February 2011, Rosenergoatom and JSC SCC are recognized capable of operating nuclear facilities, i.e. nuclear plants.

The nuclear power development in the Russian Federation is defined by the governmental program “Development of Nuclear Power and Industry Complex” as read in the Russian Government Ordinance dated 29 December 2021. The program states as one of the main goals the stable and secure provision of energy resources for the country’s economy based on safe use of atomic energy for sustainable economic growth and improvement of quality of living of the country’s population.

The Federal Environmental, Industrial and Nuclear Supervision Service (Rostechnadzor) exercises the state-level regulation of safety in the uses of atomic energy and is the Regulatory Body according to the Convention on Nuclear Safety. The Ordinance of the Government of the Russian Federation of 11 October 2012 “Regarding Amendments to the Statute of the Federal Environmental, Industrial and Nuclear Supervision Service” defines Rostechnadzor as the authorized body for the state-level regulation of safety in the use of atomic energy. Rostechnadzor reports directly to the Government of the Russian Federation and is independent of the state bodies for control over the uses of atomic energy.

According to the Ordinance of the Government of the Russian Federation of 03.07.2006 “Regarding Federal Executive Bodies and Authorized Organizations which Execute State-level Control of the Uses of Atomic Energy and State-level Regulation of Safety in the Uses of Atomic Energy”, besides Rostechnadzor, the state-level regulation in the uses of atomic energy is exercised by:

- the Ministry of the Russian Federation for Civil Defense, Emergency Management and Response to Natural Disasters (as part of the state-level regulation of fire safety);
- the Ministry of Natural Resources and Environment of the Russian Federation (as part of the state-level monitoring of radiation situation in the territory of the Russian Federation);
- the Federal Service for Supervision of the Use of Natural Resources (as part of the state-level supervision of the use of natural resources);
- the Federal Service for Supervision of Protection of Consumers’ Rights and Human Wellbeing (as part of the state-level sanitary and epidemiological control);
- Federal Medical and Biological Agency (as part of the supervision of radiation safety of nuclear facility workers and population).

Fulfillment of the Russian Federation's commitments resulting from the Convention on Nuclear Safety is discussed below article-by-article in accordance with the provisions and principles of the Convention on Nuclear Safety and the Vienna Declaration on Nuclear Safety as well as requirements and recommendations for preparation of the National Report.

Due to merging of the 8th and 9th National Reports of the Russian Federation on the Fulfilment of Commitments Resulting from the Convention on Nuclear Safety, a list of articles of this 9th Report is given below indicating information updated as compared with the 8th Report.

The list of articles of the 9th NR of the Russian Federation indicating information updated as compared with the 8th NR.

Article		Changes
Introduction		Information on a new operating organization – JSC SCC – is added.
Article 6	Existing Nuclear Installations	Information is updated as of June 2022.
Section 6.1	Brief Information on Nuclear Installations	Information is added on power units under construction, operation and shutdown for decommissioning as of June 2022.
Section 6.2	Measures Taken by Russian NPPs in the Light of Lessons Learned from the Fukushima Daiichi Accident, Including Measures Taken or Planned to Counter Hazardous Natural Phenomena	Information is updated as of 30.06.2022.
Section 6.3	Upgrading of NPP Units	Information is updated as of June 2022.
Section 6.4	Service Life Extension of Nuclear Units	Information is updated as of June 2022.
Section 6.5	Operation-Related Issues of Existing Nuclear Units	Information is updated as part of preparation of finally shutdown units for decommissioning as of June 2022.
Article 7	Legislative and Regulatory Framework	Information is updated as of June 2022.
Article 8	Regulatory Body	Information is updated as of 30.06.2022 as part of organization of scientific and technical support of the Regulatory Body.
Article 9	Responsibility of License Holder	Information is updated as of 01.01.2022 as part of legal liability insurance.
Article 10	Priority to Safety	Information about OO JSC SCC is added.
Article 11	Financial and Human Resources	Information for the period 2019-2021 is added.
Section 11.1	Financial Resources of the Operating Organization	Information for the period 2019-2021 is added as part of provisions of Rosenergoatom.
Section 11.2	Human Resources of the Operating Organization	Information about JSC SCC is added.
Section 11.3	Training, Education and Maintenance of the Personnel Qualifications	Information is updated as of 01.01.2022.
Article 12	Human Factor	Information about JSC SCC is

		added.
Article 13	Quality Assurance	Information is updated as of 01.01.2022. Information about JSC SCC is added.
Article 14	Assessment and Review of Safety	Information is updated as of 2022.
Section 14.1	Safety Review in the Course of Licensing	No changes as compared to the 8th NR.
Section 14.2	Internal Audits and Inspections during NPP Operation by Operating Organization	New section. Information is given about inspections during NPP operation by an Operating Organization
Section 14.3	Assessment of the Plant's Equipment Aging during Operation	No changes as compared to the 8th NR.
Section 14.4	Operational Safety Assessment at NPPs	Information is updated as of 01.01.2022.
Section 14.5	Accomplishment of PSAs, ISARs, Periodic Safety Reviews of NPP Power Units	Results of probabilistic safety analyses (PSA-1, PSA-2) of operating NPP units is updated as of 01.01.2022
Section 14.6	International NPP Operational Safety Peer Reviews	New section. It contains information for the period of 2019-2021 as regards IAEA OSART missions, WANO peer reviews and support missions as well as international insurance inspections
Section 14.7	NPP Safety Inspections by Rostechnadzor	No changes as compared to the 8th NR.
Article 15	Radiation Protection	Information is updated as of 01.01.2022.
Section 15.1	Radiation Protection Laws, Standards and Regulations	No changes as compared to the 8th NR.
Section 15.2	Radiation Impact on Nuclear Power Plant Personnel	Information is updated as of 01.01.2022 as part of collective exposure doses.
Section 15.3	Radiation Impact on the Public and Environmental Monitoring	No changes as compared to the 8th NR.
Section 15.4	Supervision over Radiation Protection of the NPP Personnel, Public and Environment	Information is updated as of 01.01.2022.
Article 16	Emergency Preparedness	Information is added for the period 2019-2021 as regards of emergency drills.
Article 17	Siting of Nuclear Plants	Information is added as regards a power unit with RI BREST-OD-300
Article 18	Design and Construction	Information is added as regards a power unit with RI BREST-OD-300 as part of the use of tested solutions.

Article 19	Operation of Nuclear Plants	Information is updated as of 01.01.2022, information is added as regards a power unit with RI BREST-OD-300
Section 19.1	Getting Operating Permits for NPP Units after Construction	Information is updated as of 01.01.2022 as part of commissioning of Unit 2 of Leningrad NPP-2
Section 19.2	Current System for Updating Safe Operation Limits and Conditions	No changes as compared to the 8th NR.
Section 19.3	Current System for Scheduling Maintenance and Repairs, as well as Inspections and Tests of Nuclear Installations	No changes as compared to the 8th NR.
Section 19.4	Actions of the Personnel in Accidents and Emergencies	No changes as compared to the 8th NR.
Section 19.5	Engineering, Technical and Scientific Support to Nuclear Plants	Information is added as regards a power unit with RI BREST-OD-300.
Section 19.6	Procedure for Accounting of Safety Significant NPP Events	Information is updated as of 30.06.2022 as part of accounting of operating experience
Section 19.7	Programs for Collection and Analysis of Information on NPP Operating Experience. System for the Use of Operating Experience of Russian and Foreign NPPs	Information is updated as of 30.06.2022 as part of participation in the work of WANO sectoral working groups
Section 19.8	Management of Radioactive Waste and Spent Nuclear Fuel on NPP Sites and Measures Taken to Reduce Their Volumes	Information is added for the period 2019-2021.
Appendix 1	List of NPP power units in the Russian Federation which have licenses for siting, construction, operation and decommissioning	Information is updated as of 30.06.2022.
Appendix 2	Implementation of Recommendations of the 7th Meeting of the Contracting Parties	Information is updated regarding implementation of SAMGs at NPPs with pressure-tube and fast neutron reactors
Appendix 3	Implementation of the Vienna Declaration of Nuclear Safety	Information is updated as of 30.06.2022.
Appendix 4	Major Performance Indicators of Russian NPPs in 2016-2021	Indicator values for the period 2019-2021 are added.
Appendix 5	Measures Taken in the Light	Information is updated as of

	of Lessons of Fukushima-Daiichi Accident	30.06.2022.
Appendix 6	Major Safety and Reliability Activities Undertaken as Part of Upgrading Some of the Russian NPP Units in 2016 – 2021	Information is added on measures performed in the period 2019 - June 2022.
Appendix 7	List of Federal Standards and Regulations in the Field of the Use of Atomic Energy (Covering Nuclear Plants) Endorsed by Rostechnadzor since the seventh National Report	Information is updated as of 30.06.2022.
Appendix 8	List of Administrative Regulations and Safety Guides in the Use of Atomic Energy Endorsed and Put into Force by Rostechnadzor since the seventh National Report	Information is updated as of 30.06.2022.
Appendix 9	Financing of Rostechnadzor from the Federal Budget of the Russian Federation in 2016-2021	Information for the period 2019-2021 is added.
Appendix 10	Qualitative Risk Assessments (PSA-1) for Nuclear Units with Pressure-Tube and Fast Neutron Reactors	Information is updated as of 01.01.2022.
Appendix 11	Probabilistic Safety Analyses (PSA-1) Results for Nuclear Units with WWER Reactors at Power Operation	Information is updated as of 01.01.2022.
Appendix 12	Probabilistic Safety Analysis Level 2 (PSA-2) Results of Nuclear Power Units of Existing NPPs with RBMK-1000, BN-800, BN-600, EGP-6 Reactors Done for Internal Initiating Events at Power Operations	Information is updated as of 01.01.2022.
Appendix 13	Probabilistic Safety Analysis Level 2 (PSA-2) Results of Nuclear Power Units of Existing NPPs with WWER Reactors Done for Internal Initiating Events at Power Operations	Information is updated as of 01.01.2022.
Appendix 14	Operational Events at	Information is added about NPP

	Russia's NPPs in the Period 2016-01.05.2022	operational violations for the period of 2019-01.05.2022.
Appendix 15	Departures at Russia's NPPs Which are not Reportable to Rostechnadzor but Accountable in Rosenergoatom in 2016 – 01.05.2022	Information is added about number of NPP departures for the period 2019-01.05.2022.
Appendix 16	Respond Measures to COVID-19 Pandemic	New appendix

Executive Summary

This Section briefly describes main trends in the development of nuclear power in the Russian Federation, in the regulatory bases of uses of atomic energy, recommendations and proposals formulated by the 7th Review Meeting of the Contracting Parties. It gives references to sections of this Report that contain detailed information about implementation of the said recommendations and proposals, conducted IAEA missions (IRRS, OSART) and WANO peer reviews, measures taken in the light of lessons of the Fukushima Daiichi accident, and implementation of principles of the Vienna Declaration on Nuclear Safety.

1. Nuclear Power Development

The nuclear power development in the Russian Federation today remains a state priority and is carried out in accordance with the governmental program of the Russian Federation “Development of Nuclear and Power Complex” as read in the Resolution of the Government of the Russian Federation of 29 December 2021.

As of the beginning of 2022, in the Russian Federation there are thirty five NPP units at 10 NPP sites in commercial operation. These include 22 units with water-water reactors, 11 units with pressure-tube boiling-water reactors, and two sodium-cooled fast neutron reactors. Total installed capacity of Rosenergoatom’s power units is 29.507 GW. All power units have at-reactor SNF storages; four NPP sites have additionally constructed stand-alone SNF storage facilities.

Since the seventh National Report the Russian Federation has performed:

- the first criticality (06.12.2017), the first power (02.02.2018) and commissioning of Rostov-4 with WWER-1000 reactor;
- the first criticality (23.05.2016), the first power (05.08.2016) and commissioning (27.02.2017) of Unit 1 of Novovoronezh NPP-2 with WWER-1200 reactor;
- the first criticality (07.12.2017), the first power (09.03.2018) and commissioning (29.10.2018) of Unit 1 of Leningrad NPP-2 with WWER-1200 reactor;
- the first criticality (19.02.2019), the first power (02.05.2019) and commissioning (31.10.2019) of Unit 2 of Novovoronezh NPP-2 with WWER-1200 reactor;
- the first criticality (19.07.2020), the first power (12.10.2020) and commissioning (22.03.2021) of Unit 2 of Leningrad NPP-2 with WWER-1200 reactor.

Units 1 and 2 of Novovoronezh NPP are being decommissionined in accordance with obtained Rostechnadzor’s licenses.

Over the time passed since the seventh National Report Unit 1 of Bilibino NPP, Units 1 and 2 of Leningrad NPP, Unit 3 of Novovoronezh NPP and Unit 1 of Kursk NPP have been shut down for decommissioning.

Units 1 and 2 of Kursk NPP-2 (WWER-TOI) are under construction.

A pilot demostration power unit with a lead-cooled fast neutron reactor BREST-OD-300 (Operating Organization is JSC SCC) is under construction.

The activity to enhance safety of Russian NPPs is carried out as planned.

2. Evolution of Regulatory Bases of the Use of Atomic Energy

The Federal Environmental, Industrial and Nuclear Supervision Service (Rostechnadzor) exercises the state-level regulation of safety in the use of atomic energy, reports to the Government of the Russian Federation, and is independent of the state bodies for control over the use of atomic energy.

Since submission of the seventh National Report, a number of changes have been introduced to the federal laws regulating issues of the use of atomic energy. They are briefly described in Subsection 7.1 of this Report. Also, a number of changes have been introduced in earlier legal regulatory acts of the President of the Russian Federation and the Government of the Russian Federation (see Subsections 7.2 and 8.1).

The Regulatory Body implements a Plan of Implementation of the Concept of Improvement of the Safety Regulatory Environment and Standardization in the Field of the Use of Atomic Energy until 2015-2023. It aims, among other, at harmonization with provisions of the IAEA safety standards. In the reporting period, a number of new federal standards and regulations in the field of the use of atomic energy have been written, and a number of safety guides of the Regulatory Body has been developed or revised (see Subsections 7.3, 7.4, Appendices 7 and 8).

The exercised activity aims at developing the effective regulatory framework which regulates issues related to ensuring and regulating safety of nuclear plants.

3. Challenges, Recommendations and Proposals Formulated by the 7th Meeting of the Contracting Parties to the Convention on Nuclear Safety

Based on the results of the review of the seventh National Report of the Russian Federation by the 7th Meeting of the Contracting Parties on review of National Reports (including a detailed discussion at the Country Group 4), the following challenges, recommendations and proposals for the Regulatory Body and the Operating Organization have been formulated:

Challenge 1: *Basing on modern risk-oriented approaches and equipment monitoring to implement timely the measures aimed at modernizing systems and equipment to achieve the safety goals at operating NPPs.*

The detailed information about solution to this problem is given in Subsection 6.3 and Appendices 2, 6 to this Report.

Challenge 2: *To effectively manage lifetime of equipment, including electrical equipment, I&C, wiring during extended operation of NPPs.*

The detailed information about solution to this problem is given in Subsection 14.3 and Appendix 2 to this Report.

Challenge 3: *To implement NPP cyber security programs to meet requirements of new rules.*

The detailed information about solution to this problem is given in Appendix 2 to this Report.

Proposal 1: *SAMGs should be implemented at all Russian NPPs.*

The detailed information about implementation of SAMGs at Russian NPPs is given in Section 16 and Appendix 2 to this Report.

Proposal 2: *The Russian Federation should send Lithuania corresponding information that confirms that the site assessment of Baltic NPP, which is built in Kaliningrad Region, was carried out in accordance with provisions of the IAEA Safety Standards.*

The detailed information about this issue is given in Section 17 and Appendix 2 to this Report.

4. The IAEA Missions (OSART), WANO Peer Reviews

Recognizing that international missions on independent peer review involving participation of experts from other countries play an important role in the achievement and support of high safety level of nuclear installations, over the past period the Russian Federation has continued cooperating with the IAEA on OSART missions and with WANO on technical support missions and peer reviews at NPPs.

The detailed information about main results of OSART missions and WANO peer reviews is given in Subsection 14.6 of this Report.

5. Measures in the Light of the Fukushima-Daiichi Accident, Including Improvement of Emergency Preparedness and Response Measures

This Report describes the progress in the implementation of measures based on lessons learned from the Fukushima-Daiichi accident. The detailed information about measures taken and ongoing at Russian NPPs is given Subsection 6.2, sections on Articles 16, 17 and 18, as well as in Appendix 5 to this Report.

6. Implementation of the Vienna Declaration on Nuclear Safety

The Russian Federation implements the principles adopted by the Contracting Parties in the Vienna Declaration on Nuclear Safety:

– to prevent accidents with radiological consequences and to mitigate such consequences the federal standards and regulations on the uses of atomic energy establish relevant criteria, principles and safety targets which are used in design, siting and construction of nuclear power plants;

– safety evaluations of operating NPPs are carried out on a regular basis; large-scale safety improvement programs are implemented based on their findings; and;

– the Regulatory Body has approved and implements the Plan of Implementation of the Concept of Improvement of the Safety Regulatory Environment and Standardization in the Field of the Use of Atomic Energy until 2015-2023 which aims, among other, at harmonization with the IAEA safety standards.

The specific information about the ongoing and planned measures and their outcomes is given in Subsection 6.2 and Appendix 3 to this Report.

7. Major Common Issues Specified in the Summary Report of the President of the 7th Meeting of the Contracting Parties

Safety Culture

The information about progress in developing approaches to oversight of the operator’s safety culture in regulatory body processes is given in Sections 10.2 and 10.3 of this Report.

International Peer Reviews

The information about participation in international peer reviews and information exchanges is given in Sections 14.2, 16.3 and 19.6, correspondingly, of this Report.

Legal Framework and Independence of Regulatory Body

The information about legal and regulatory framework meeting commitments under the Convention is given in Section 7 of this Report. The information about effective division of functions of the Regulatory Body and functions of any other bodies or organizations, which facilitate the use or use nuclear energy, is given in Section 8.1 of this Report.

Financial and Human Resources

The information about provision of resources to the Regulatory Body is given in Section 8.1 of this Report. The information about funding of the Regulatory Body is given in Appendix 9 to this Report.

The information about provisions of resources and funding to the Operating Organization is given in Sections 11.1 and 11.2 of this Report.

Knowledge Management

The information about provision of suitably qualified and experienced persons to the Regulatory Body and Operating Organization is given Sections 8.2 and 11.3, correspondingly, of this Report.

Supply Chain

The information about prevention of supply of non-conforming equipment and ensuring its quality, selecting suppliers certified to operate in nuclear sector, accessing manufacturers of equipment is given in Section 13 of this Report.

Managing the Safety of Ageing Nuclear Facilities and Plant Life Extension

The information about safety systems improvements and determination of scope of necessary upgrades to support decisions on extended operation is given Section 14.3 of this Report.

Emergency Preparadness

The information about measures resulting from the Fukushima Daiichi accident, emergency preparedness and response taking account of occurrences at multi-unit sites and events due to external hazards is given in Section 16 and Appendix 5 to this Report.

The information about measures to manage severe accidents set forth in severe accident management guides and procedures is given in Section 6.2 and Appendix 2 to this Report.

Stakeholder Consultation & Communication

The information about openness and transparency of the Regulatory Body is given in Section 8.1 of this Report.

The information about outreach activities of the Operating Organization and NPPs is given in Section 9 of this Report.

Implementation of the NPP Cyber Security Program

The information about implementation of NPP Cyber Security Program to meet the requirements of new rules is given in Appendix 2 of this Report.

Article 6. Existing Nuclear Installations

6.1. Brief Information on Nuclear Installations

At the beginning of 2022 the Russian Federation has in commercial operation 35 units at 10 nuclear power plants sites, including 22 units with water-cooled water-moderated reactors, 11 units with pressure-tube boiling-water reactors, and 2 units with sodium-cooled fast neutron reactors. Total installed capacity of operating nuclear units of Rosenergoatom is 29.507 GW. All units have at-reactor SNF storage facilities; separate SNF storage facilities are additionally built at four NPP sites.

Over the time passed since submission of the seventh National Report, the Russian Federation has commissioned for commercial operation: Unit 4 of Rostov NPP with WWER-1000 reactor, Units 1 and 2 of Novovoronezh NPP-2 with WWER-1200 reactors, and Units 1 and 2 of Leningrad NPP-2 with WWER-1200 reactors.

Units 1 and 2 of Novovoronezh NPP are under decommissioning according to received Rostechnadzor's licenses.

Units 1 and 2 of Beloyarsk NPP, Unit 3 of Novovoronezh NPP, Units 1 and 2 of Leningrad NPP, Unit 1 of Bilibino NPP and Unit 1 of Kursk NPP are shut down for preparation of their decommissioning.

Units 1 and 2 of Kursk NPP-2 (WWER-TOI) are under construction.

The pilot and demonstration power unit with lead-cooled fast neutron reactor BREST-OD-300 (Operating Organization is JSC SCC) is under construction.

A list of Russian NPPs having licenses for construction, operation and decommissioning is given in Appendix 1.

Main performance indicators of operating NPPs in the Russian Federation in 2016-2021 are given in Appendix 4.

6.2. Measures Taken by Russian NPPs in the Light of Lessons Learned from the Fukushima Daiichi Accident, Including Measures Taken or Planned to Counter Hazardous Natural Phenomena

Based on the analysis of robustness of Russian NPPs to extreme external impacts and preparedness of NPPs to manage beyond design basis accidents, including severe ones, Rosenergoatom has fulfilled in the full scope the short-term and mid-term measures which are listed in Appendix 5 to the seventh National Report. Appendix 5 to this Report lists long-term measures implemented over the period 2016 – June 2022. At the present time, the measures due to 2023 are being fulfilled. The following measures are at the stage of completion:

– additional research and developments to ensure hydrogen explosion safety at all NPP power units with WWER reactors, including development of requirements concerning the mandatory analysis of generation, propagation and burning processes of air-hydrogen mixtures in enclosure rooms during longtime loss of power at the NPP power unit; implementation of hydrogen monitoring and evacuation systems in reactor containments;

– implementation of accident and post-accident monitoring features ("emergency" monitoring and metering instruments designed to operate in beyond design basis accidents, including severe accidents) at all power units;

– development (revision/update) and implementation of beyond design basis accident management guides as regards to the management of severe accidents (SAMGs), including for NPP units with RBMKs and BNs.

6.3. Upgrading of NPP Units

The strategic goal of upgrading systems and equipment at operating NPPs of the Russian Federation is enhancement of the NPP safety level as well as an increase in electricity generation at NPPs.

Upgrading solves the following problems:

– enhancement of nuclear, radiation, technical, industrial, environmental and fire safety of operating NPP power units in accordance with requirements of the federal atomic energy standards and regulations and recommendations of the IAEA safety standards;

– management of NPP equipment lifetime performance during design and extended service life of power units;

– increasing reliability and stability of NPP equipment operation; and

– improvement of economic efficiency of NPP power units operations during extended service life.

The conducted NPP upgrades are divided into current and targeted upgrades. The current upgrade is performed at each power unit every year independently of its service life. The targeted upgrades are carried out to prepare NPP power units which exhaust their design service life to their service life extension for an additional period.

In the framework of the risk monitoring, NPP personnel analyze equipment defect and failure flow, availability of SPTA etc. at all NPPs. Based on the said analysis and taking account of failure probability, the Operating Organization reveals problems of operation and makes decision on the necessity of its replacement or upgrading. To assess NPP unit upgrading efficiency, the target indicators are set up to account for:

– a trend in reduction of a number of NPP operational events and equipment failures;

– conformance of the actual condition of the unit to requirements of regulatory documents;

– timely replacement of equipment (components) exhausted its operating lifetime;

– reduction (or keeping at the initial level) of production cost of electricity and heat; and

– improvement of labor conditions of personnel.

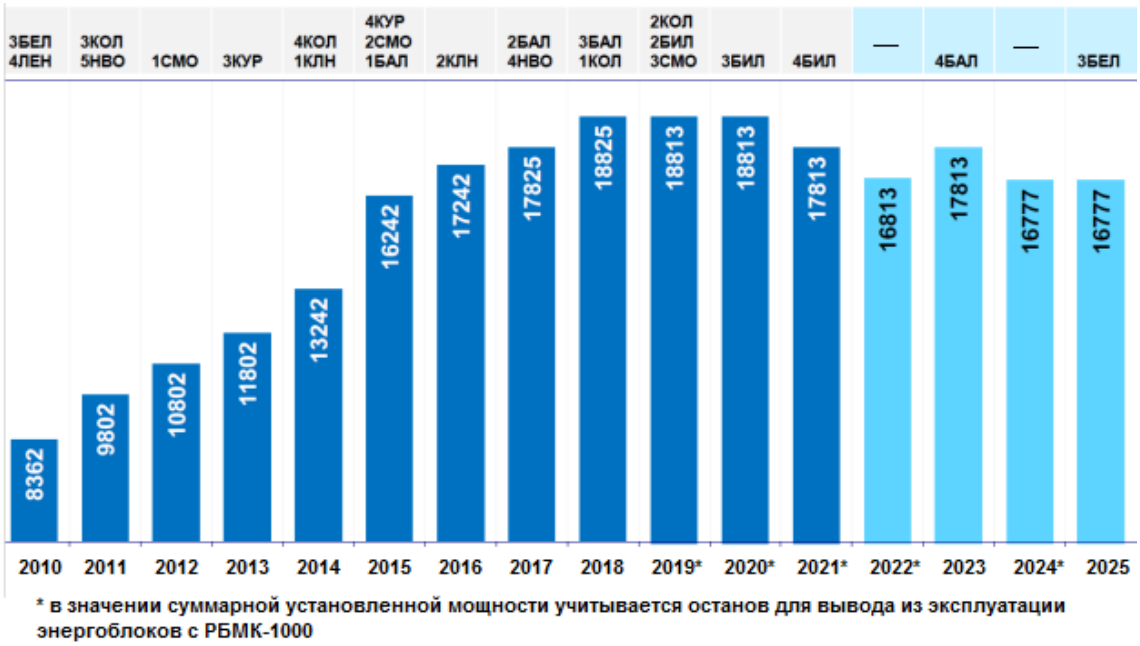
Over the period of 2016-2021, Rosenergoatom fulfilled a lot of upgrading measures at NPP power units; some of them are listed in Appendix 6 to this Report.

6.4. Service Life Extension of Nuclear Units

Service life extension of power units of Rosenergoatom's operating NPPs after exhaustion of their assigned service lives remains one of topical tasks and most effective area of financial investments in increasing NPP safety and preservation of generating capacities.

In accordance with the governmental program "Development of Nuclear Power and Industry Complex", as amended by the Resolution of the Government of the Russian Federation of 29 December 2021, Rosenergoatom carries out the work to prepare power units to extended operation.

As of 30.06.2022, service life was extended of 28 power units of Russia which have total installed capacity of about 18 GW (see Fig. 6.1; the upper part shows power units with extended service life). Fig. 6.1 shows changes in physical and planned contribution of power units, which service life was extended in the period 2010-2021 or will be extended in the period 2022-2025, in total installed capacity. The decrease in the contribution to total installed capacity starting from 2019 is conditioned by final shutdown of power units with RBMK-1000 reactors for decommissioning (in December 2019 – Unit 1 of Leningrad NPP; in November 2020 – Unit 2 of Leningrad NPP; in December 2021 – Unit 1 of Kursk NPP; it is planned to finally shut down Unit 2 of Kursk NPP in January 2024).



*the total installed capacity value takes account of shutdown for decommissioning of RBMK-1000 power units

Fig. 6.1. Actual and planned preservation of NPP generation capacities as the result of service life extension of NPP power units

In the period of 2016-2021, SLE activities were completed at 10 NPP power units and operating licenses were obtained for an extended period of operation (see Table 6.1).

Table 6.1. NPP power units granted Rostechnadzor's licenses for extended period of operation in 2016-2021.

Year/NPP	Power unit	Reactor	Date of commissioning, year	N, MWe	Rostechnadzor's license	
					Date of issue	Date of expiry
2016						
Kalinin	2	WWER-1000	1986	1000	25.11.2016	30.11.2038
2017						
Balakovo	2	WWER-1000	1987	1000	13.10.2017	13.10.2043
Novovoronezh	4	WWER-440	1972	417	29.12.2017	29.12.2032
2018						
Kola	1	WWER-440	1973	440	06.07.2018	06.07.2033
Balakovo	3	WWER-1000	1988	1000	28.12.2018	28.12.2048
2019						
Smolensk	3	RBMK-1000	1990	1000	14.12.2019	14.12.2034
Kola	2	WWER-440	1974	440	20.12.2019	20.12.2034
Bilibino	2	EGP-6	1974	12	31.12.2019	31.12.2025
2020						
Bilibino	3	EGP-6	1975	12	25.12.2020	31.12.2025
2021						
Bilibino	4	EGP-6	1976	12	28.12.2021	31.12.2025

6.5. Operation-Related Issues of Existing Nuclear Units

Hydrogen explosion safety

The problem of hydrogen explosion protection within RI containments of WWER reactors pointed out in Section 6.6 of the seventh National Report is solved in the framework of the "Integrated R&D Program and Measures Ensuring Hydrogen Explosion Safety and Severe Accident Management at NPPs with WWERs" in the light of lessons learned in the accident at Fukushima Daiichi NPP. Engineering and organizational measures to manage BDBAs (SAs) and reduce their consequences in terms of hydrogen safety of NPPs with WWERs are developed with the account taken of deterministic and probabilistic safety analyses of generation, propagation and burning of air-hydrogen mixtures in the containment rooms.

A methodology for the hydrogen explosion hazard analysis in containment enclosures of RI with WWER reactors has been developed as part of the Integrated Program. It uses precision 3D computer codes of CDF class which allow for realistic evaluation of accumulation and propagation processes of hydrogen-containing gas-vapor mixtures between enclosures and inside enclosures of the containment (including assessment of local concentrations of mixture components), as well as the assessment of a possibility of burning of the mixture and its detonation for different

accident scenarios with hydrogen emission. Computation analysis is performed with the account taken of hydrogen recombiners operation modeling. The methodology was tested for calculation of accident scenarios for some NPP power units with WWER reactors (Unit 1 of Novovoronezh NPP-2, Unit 1 of Leningrad NPP-2 etc.).

Verification of 3D computer codes of CDF class in use was carried out as part of the Integrated Program, including with the use of experimental data obtained during tests of hydrogen recombiners in VNIITF.

SG components reliability and lifetime ensuring problem

The problem of improving reliability and lifetime of steam generators of NPPs with WWER-1000 reactors pointed out in Section 6.6 of the seventh National Report is solved by replacement of the copper-containing heat-exchanging equipment of the secondary circuit with the equipment manufactured of titanium and stainless steel alloys. Replacements of this equipment carried out in 2018 allowed to implement in the reactor's secondary circuit the progressive water chemistry with increased pH to reduce erosion-corrosion damages of equipment made of carbon steel. This allowed increasing residual service life of steam generators which did not have substantial corrosion damages of heat exchange tubes and provided for safe transition of power units to 18-months period between repairs.

Preparation to decommissioning of finally shutdown power units

The Operating Organization, Rosenergoatom, has produced the "Roadmap of Nuclear Power Development until 2035" and "Concept of Preparation and Decommissioning of Nuclear Power Units". According to these documents, it is planned to finally shut down 13 power units with total capacity of 8.3 GW.

The NPP Power Unit Decommissioning Concept contains:

– a description and comparison of decommissioning options of a NPP power unit showing projection of the radiation situation at the NPP power unitoп after its shutdown and projected end states after NPP power unit decommissioning;

– the decommissioning option of NPP power unit selected by the Operating Organization, its criteria and justification of the choice.

Engineering and administrative measures to manage preparation for decommissioning of finally shutdown power units are worked out taking account of complexity of both the technological process conditioned by uniqueness of NPP power unit structures, their high potential radiation hazard and necessity of an economic analysis in selection of decommissioning options considering determination of their specific implementation technologies.

One of the key problems is unavailability of reference technologies for management of irradiated reactor graphite, dismantling, fragmenting and handling of highly activated reactor installation components.

To solve the task of disposal of irradiated graphite in the course of decommissioning of power reactors and consider the obligation under the "Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management" in the Russian Federation the "Development Strategy of a Deep Geological Radioactive Waste Disposal Facility" has been worked out and is implemented.

The provisions of Article 6 of the Convention on Nuclear Safety are fulfilled for all operating nuclear power units.

The engineering and organizational measures being implemented allow ensuring acceptable operating safety level of existing Russian NPPs in accordance with the provisions of the Convention on Nuclear Safety and the principles of the Vienna Declaration on Nuclear Safety.

Article 7. Legislative and Regulatory Framework

Regulation of safety in the area of the use of atomic energy is carried out on the basis of the Russian Federation Constitution as the Basic Russian Law that has the supreme legal effect and direct action in the entire territory of the Russian Federation.

Part 4 of Article 15 of the Russian Federation Constitution establishes the top priority of the international agreements concluded by the Russian Federation over other documents in the national legislative system (including the Convention on Nuclear Safety, Vienna Convention on Civil Liability for Nuclear Damage, Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, Convention on Early Notification of a Nuclear Accidents, Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, Convention on the Physical Protection of Nuclear Material, and other international agreements) adopted by the Russian Federation provided they do not contradict to the Russian Federation Constitution.

Legal regulation of safety in the field of the use of atomic energy is carried out on the basis of federal laws and by-laws: regulatory legal acts of the President of the Russian Federation and the Government of the Russian Federation, federal standards and regulations in the field of the use of atomic energy, which are approved by the state safety regulatory body in the uses of atomic energy, as well as regulations of the bodies which exercise control over the uses of atomic energy.

7.1. Federal Laws

The following laws constitute the legal basis for atomic energy regulation of legal relations in the Russian Federation:

- Federal Law “On the Use of Atomic Energy”;
- Federal Law “On the Radiological Safety of the Public”;
- Federal Law “On the Environmental Protection”;
- Federal Law “On the Fire Safety”;
- Federal Law “On the Industrial Safety of Hazardous Industrial Facilities”.

Certain provisions associated with the use of atomic energy are regulated by laws which list with main provisions is given in the seventh National Report of the Russian Federation.

Since the seventh National Report, the Federal Law “On the Use of Atomic Energy” was amended as follows.

Article 21 “State Control over the Radiation Situation in the Territory of the Russian Federation” has been supplemented by a directive that the federal executive bodies authorized by the Government of the Russian Federation and the State Atomic Energy Corporation “Rosatom”

shall be the organizations performing the state-level monitoring of radiation situation in the territory of the Russian Federation.

Article 21 states that the executive bodies of Russian Federal Subjects shall have the right to participate in the state-level monitoring of radiation situation in the territories of the Russian Federal Subjects, including building and maintaining territorial subsystems of the unified national automated radiation monitoring system in the territory of the Russian Federation.

Instead of "control bodies of the use of atomic energy and (or) operating organizations", Article 21 states the federal executive bodies authorized by the Government of the Russian Federation, the State Atomic Energy Corporation "Rosatom", as well as executive bodies of the Russian Federal Subjects which shall have the right to participate in the state-level monitoring of radiation situation.

Article 65 "The International Treaties and Agreements in the Sphere of the Use of Atomic Energy" has been supplemented by Part 2 according to which decisions of the multinational bodies adopted based on provisions of international treaties of the Russian Federation in their interpretation which contradicts the Russian Federation Constitution shall not be fulfilled in the Russian Federation. Such contradiction can be found out in accordance to the procedure determined by the federal constitutional law.

According to the amendment of Part 2 of Article 11 "The Powers of the Organs of Executive Power of the Subjects of the Russian Federation in the Use of Atomic Energy", the list of cities of federal significance (Moscow and Saint-Petersburg) where the powers, which attributed to the powers of local governments by this Federal Law, can be exercised has been supplemented by the city of Sebastopol.

Article 27 "Permits for the Right to Carry Works with the Use of Atomic Energy, Issued to the Workers of the Facilities Using Atomic Energy" has been supplemented by requirements of compulsory medical examinations of workers, including toxicology screening of narcotics, psychotropic substance and their metabolites in human body.

Article 26 was amended as regards the legal regulation of expert evaluation of software applied in safety justification of nuclear facilities and (or) activities in the field of the use of atomic energy. The new revision of the law states that the design justification of nuclear facilities shall use only verified and expertly evaluated (certified) software that complies with requirements of the Russian legal framework and recommendations of the IAEA safety standards.

Article 49 makes specific the list of bodies engaged in physical protection of nuclear facilities. In addition to the Ministry of Internal and the Federal Security Service forces, it lists the troops of the Russian National Guard Service and in-house security force of the federal executive bodies and the State Atomic Energy Corporation "Rosatom".

Article 52 bars individuals from working at NPPs who have an unexpunged or unspent conviction for the commission of a premeditated crime as well as involved in extremism or terrorism.

Since the seventh National Report the Federal Law "On the Radiological Safety of the Public" has been amended as follows.

Paragraph 10 was dropped out of Article 5 "Powers of the Russian Federation in the Field of Ensuring Radiation Safety". Thereby, the powers of organizing and performing the state-level supervision in the field of ensuring radiation safety were also dropped out. According to Article 6 of this Federal Law, these powers have been delegated to Russian Federal Subjects;

In Article 10 "Licensing of Activities in the Field of Use of Ionizing Radiation Sources" and throughout the body text of the law the term "state supervision" have been replaced with the term "assessment of compliance with mandatory requirements". Article 10.1 states that the assessment of compliance with mandatory requirements in the field of radiation safety assurance is implemented as part of the federal state sanitary and epidemiological oversight (supervision) and federal state supervision in the field of use of atomic energy. The previous revision of the law treated the organization and implementation of the state-level supervision in the field of radiation safety as the authority of the Russian Federation in the person of authorized federal executive bodies.

Article 2 has been supplemented with Paragraph 4 which reads: "Decisions of the multinational bodies adopted based on provisions of international treaties of the Russian Federation in their interpretation which contradicts the Russian Federation Constitution shall not be fulfilled in the Russian Federation. Such contradiction can be found out in accordance to the procedure determined by the federal constitutional law".

7.2. Regulatory Legal Acts of the President of the Russian Federation and of the Government of the Russian Federation

In the reporting period, a number of amendments have been introduced in the legislative and regulatory acts of the President of the Russian Federation and the Government of the Russian Federation.

The Order of the President of the Russian Federation dated 13 October 2018 has approved the "Basics of the Governmental Policy in the Field of Nuclear and Radiation Safety of the Russian Federation until 2025 and for the Future Prospects", which implementation includes the following, in particular:

– the improvement of the legal regulatory framework in the field of radioactive waste management as well as in the field of decommissioning of facilities which operation for functional use has been terminated;

– the operative, scientific, engineering and expert support of the unified governmental system for prevention and elimination of emergencies in emergencies with the radiation factor.

The Order by the President of the Russian Federation dated 7 July 2020 'On Amendments to Order of the President of the Russian Federation No. 556 dated 27 April 2007 "On the Restructuring of the Atomic Energy and Power Complex of the Russian Federation"' supplements the list of Russian legal entities which may own nuclear materials (excluding nuclear materials which exclusively may be in the federal ownership) approved by the Order of the President of the Russian Federation dated 27 April 2007.

The Order by the President of the Russian Federation of 02.07.2021 "On the National Security Strategy of the Russian Federation" regulates the level of enhancing anti-terrorist protection of the nuclear power and industry complex and prevention of environmental contamination by contaminants carried in from territories of other states.

The ordinances of the Government of the Russian Federation have been adopted:

– on 15 June 2016: "The Rules of compliance assessment of products for which the safety requirements in the field of the use of atomic energy are set forth as well as processes of their design (including surveys), production, construction, installation, adjustment, operation, storage, shipment, utilization and disposal" which approves "The Provisions for specific features of compliance assessment of products for which the safety requirements in the field of the use of atomic energy are set forth as well as processes of their design (including surveys), production, construction, installation, adjustment, operation, storage, shipment, utilization and disposal";

– on 30 September 2016: "On Amendment of the List of Positions of Nuclear Facility Employees Who Shall Obtain Permits of the Federal Environmental, Industrial and Nuclear Supervision Service for the Right to Work in the Field of Atomic Energy". The said ordinance supplements the List of Positions with positions of employees who carry out decommissioning activities of nuclear facilities;

– on 15 March 2017: «On Amendment of the Provision for the State Regulation of Tariffs for Radioactive Waste Disposal". The Provision is supplemented with the requirement to forecast generation and disposal volumes of radioactive waste with their information sent to the Regulatory Body.

Resolutions of the Government of the Russian Federation dated 18 May 2017 and 5 July 2018 introduce changes in the Rules of physical protection of nuclear materials, nuclear installations and nuclear material storage facilities. Powers of federal executive bodies and ROSATOM have been expanded, new requirements to categorization and siting of physical protection objects in a nuclear facility have been approved.

The Resolution of the Government of the Russian Federation dated 26 June 2018 “On the Guidelines of Permissible Radioactive Substance Releases and Guidelines of Permissible Radioactive Substance Discharges as Well as on Issuance of Permits for Releases of Radioactive Substances and Permits for Discharges of Radioactive Substances” has been adopted. The Resolution determines the procedure for drawing out guidelines of permissible releases and discharges.

The Resolution of the Government of the Russian Federation of 12 February 2020 “On Amending Certain Acts of the Government of the Russian Federation Related to Execution of the Government Functions by the Federal Environmental, Industrial and Nuclear Supervision Service” (hereinafter referred to as Resolution of the Government of the Russian Federation No. 129) amends several by-laws which determine authorities of Rostechnadzor in the field of mobilization arrangements and countering nuclear terrorism.

The Directive of the Government of the Russian Federation dated 4 May 2017 approves the list of nuclear facilities – branches of Rosenergoatom – for which zones with special conditions of territory usage (safety zones with a special legal regime) are established to improve the anti-terrorism security.

7.3. Federal Standards and Regulations in the Field of the Use of Atomic Energy

Rostechnadzor has approved the Implementation Plan of the Concept of Enhancing the Legal and Regulatory Framework of Safety and Standardization in the Field of the Use of Atomic Energy designed for 2021-2031.

Since the preceding National Report, federal standards and regulations setting forth requirements for NPP safety have been updated, in particular:

– “Rules of Compliance Assessment of products for which the safety requirements in the field of the use of atomic energy as well as processes of their design (including surveys), production, construction, installation, adjustment, operation, storage, shipment, scrappage and disposal”. The updated document substantially expands the list of compliance assessment forms. In addition to incoming inspection and trials, the following forms have been added: review of engineering documentation, control, decision to use imported equipment at nuclear facility, mandatory certification of the product, and registration;

– “Requirements to Safety Important Control Systems of Nuclear Plants”. The updated document states the new type of safety important control systems related to special engineering features which are used to manage beyond design basis accidents and formulates requirements to them. The classification requirements of control system components by

functional groups and designations of functional groups have been changed;

– "Rules of Safety Ensuring in Decommissioning of a Nuclear Power Unit". The updated document introduces new terminology "immediate elimination" and "delayed elimination" of a NPP power unit. It defines the term "a decommissioning concept of a nuclear plant unit". It establishes the requirements for the content of NPP power unit decommissioning concept and requirements for completion of work to decommission a nuclear plant unit. It details requirements for the scope and procedure of an integrated engineering survey of a NPP power unit shutdown for decommissioning;

– "Requirements for the Content of the Safety Analysis Report of a Nuclear Plant unit with a WWER reactor". It introduces requirements to the scope of provision of information in SAR depending on the stage of the licensing process. It adds requirements to the content of an exemplary list of beyond design basis accidents in SAR;

– "Main Requirements for Service Life Extension of a Nuclear Power Unit". The requirements for integrated inspection of a nuclear power unit during its preparation to service life extension, including beyond the project assigned service life, have been supplemented. The list of factors the Operating Organization takes account of when deciding on further operation of a NPP power unit has been expanded;

– "Accounting of External Impacts of Natural and Man-induced Origin on Nuclear Facilities". The list of engineering and geological processes which should be considered in engineering surveys and studies of the nuclear facility siting region and site has been expanded;

– "Welding and Overlaying of Equipment and Pipelines of Nuclear Power Installations";

– "Rules of Control of Metal of Equipment and Pipelines of Nuclear Power Installations during Manufacture and Installation" and other.

New federal standards and regulations in the field of the use of atomic energy have been issued:

– "Main Requirements to Justification of Strength of WWER Reactor Internals", which contains requirements for strength and service life of WWER reactor internals at all stages of the NPP power unit lifecycle;

– "Nuclear Plant Site. Safety Requirements", which establish basic safety criteria and requirements for siting of nuclear plants, evaluation of a NP site with the account taken of processes, phenomena and factors of natural and man-induced origin of the region and NP site which affect NP safety, as well as monitoring of environment components and accounting of NP impact on the population and environment.

– "Basic Rules of Control and Accounting of Nuclear Materials", which establishes main principles, requirements and criteria of state level control and accounting (hereinafter referred to as control and accounting) of nuclear materials in any chemical compounds, physical forms and aggregate states which are mandatory for all legal entities irrespectively of their organizational and legal form and form of ownership of nuclear materials which produce, use, process, store, transport, export, import and transfer of nuclear materials across the State Border of the Russian Federation.

– "Rules of Layout and Safe Operation of Reactor Unit Vessel, Equipment, Pipelines and Internals of a Lead-Cooled Nuclear Power Installation", which establishes main requirements for layout and safe operation of reactor unit vessel, equipment, pipelines and internals of a lead-cooled nuclear power installation.

– "Requirements for Justification of Strength of Reactor Unit Vessel, Equipment, Pipelines and Internals of a Lead-Cooled Nuclear Power Installation", which establishes requirements for justification of strength of equipment, pipelines, internals and reactor unit vessel as well as their components which are constantly and periodically in contact with lead coolant and (or) shielding gas up to the first isolation valve or hydraulic seal from the reactor unit vessel, as well as secondary steam-water circuit equipment and pipelines from the steam generator to the second valve (isolation or check valve) on the side of the steam generator.

The IAEA safety recommendations were taken into account when revising and producing federal standards and regulations which set forth requirements for NPP safety ("Fundamental Safety Principles. Safety Fundamentals" (SF-1), "Design of Instrumentation and Control Systems for Nuclear Power Plants" (SSG-39), "Decommissioning of Facilities" (GSR, Part 6), "Format and Content of the Safety Analysis. Report for Nuclear. Power Plants" (GS-G-4.1), "Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants" (SSG-48), "External Events Excluding Earthquakes in the Design of Nuclear Power Plants" (NS-G-1.5), "Evaluation of Seismic Safety for Existing Nuclear Installations" (NS-G-2.13), "Protection Against Internal Fires and Explosions in the Design of Nuclear Power Plants" (NS-G-1.7), "Protection against Internal Hazards other than Fires and Explosions in the Design of Nuclear Power Plants" (NS-G-1.11).

The full list of the federal standards and regulations covering nuclear plants and put into force after submission of the seventh National Report is given in Appendix 7.

7.4. Documents of the Regulatory Body

Since submission of the seventh National Report, Rostechnadzor has issued the following orders:

– "On Approval of the Lists of Enactments Containing Mandatory Requirements which Observance is Evaluated in Control Measures Conducted in the Framework of Execution of the Governmental Control (Supervision) Attributed to Exclusive Competence of the Federal Environmental, Industrial and Nuclear Supervision Service" (dated 17 October 2016);

– "On Approval of the Methodology for Development of Guidelines of Permissible Radioactive Substance Discharges in Water Reservoirs of Water Users" (dated 22 December 2016);

– "On Approval of the Procedure for Expert Evaluation of Codes for Electronic Computing Machines Used for Building Calculation Models of Processes Affecting Safety of Nuclear Facilities and (or) Activities in the Field of the Use of Atomic Energy" (dated 30 July 2018);

– "On Amending the List of Products Subject to Mandatory Certification and which is Subject to Requirements Related to Safety Ensuring in the Field of the Use of Atomic Energy Approved by Order of the Federal Environmental, Industrial and Nuclear Supervision Service No. 277 of 21 July 2017" (dated 08 October 2019);

– "On Amending the List of Products Subject to Mandatory Certification and which is Subject to Requirements Related to Safety Ensuring in the Field of the Use of Atomic Energy Approved by Order of the Federal Environmental, Industrial and Nuclear Supervision Service No. 277 of 21 July 2017" (dated 19 April 2021);

– "On Approval of the Rules of Drafting Safety Guides in the Field of the Use of Atomic Energy in the Federal Environmental, Industrial and Nuclear Supervision Service" (dated 25 June 2021).

Over the period passed after submission of the seventh National Report, Rostechnadzor has produced and endorsed safety guides in the use of atomic energy which relate to application of risk-oriented solutions, maintaining safety culture, emergency monitoring and monitoring of service life parameters of systems and components, compilation of the list of beyond design basis accidents accountable in the design:

– "Recommendations for the Use of Risk-information Method in Justification of Risk-information Solutions Related to the Nuclear Power Unit Safety";

– "Recommendations for Building and Maintaining Safety Culture at Nuclear Plants and Operating Organizations of Nuclear Plants";

– "Identification of Service Life Characteristics of Electrical Equipment of Nuclear Plants and Their Monitoring Methods";

– “Emergency Monitoring Systems of Nuclear Plants with Water-Water Power Reactors. General Recommendations and a List of Monitored Parameters”;

– “Recommendations for Compiling the Final List of Beyond Design Basis Accidents Accountable in Designs of Nuclear Plants with WWER Reactors”;

– “Recommendations for the Contents of an In-depth Safety Report of Existing Nuclear Plant Units”;

– “Recommendations for Drafting of Quality Assurance Programs for Operation of Nuclear Plants and Research Nuclear Installations”;

– “Recommendations for Level 1 Probabilistic Safety Analysis of a NPP Power Unit Covering Initiating Events Due to External Impacts”;

– “Radiation and Thermal Physics Characteristics of Spent Nuclear Fuel of Water-Water Power Reactors and Large Power Pressure-tube Reactors”;

– “Recommendations for Planning and Justification of Reduction of Scope of Maintenance, Putting out of Operation of Certain Systems and Components, Change in Operating Personnel of a Nuclear Power Unit Shut Down for Decommissioning”;

– “Recommendations for a Comprehensive Engineering and Radiation Examination of a Nuclear Facility”;

– “Recommendations for Assessment of Errors and Uncertainties of Safety Calculation Analysis of Nuclear Plants”;

– “Recommendations for Justification of Residual Service Life of Nuclear Facility Structures”;

– “Accounting of Fast Neutron Fluence at Vessels and Witness-Specimens of WWER for Future Forecasting of Vessel Radiation Residual Life”.

On December 19, 2018, the new Administrative Procedure regarding provision by the Federal Environmental, Industrial and Nuclear Supervision Service of the governmental service of granting permits for the right to work in the field of the use of atomic energy to employees of nuclear facilities has come into force.

On May 6, 2020, the new Administrative Procedure regarding provision by the Federal Environmental, Industrial and Nuclear Supervision Service of the governmental service of granting permits for releases and discharges of radioactive substances in the environment..

A full list of Safety Guides and Administrative Procedures in the use of atomic energy developed and put into force by Rostechnadzor over the period passed from submission of the seventh National Report is given in Appendix 8.

7.5. Licensing Procedure and Organization of Expert Review of Nuclear Installation Safety Justification Documents

In its licensing activity Rostechnadzor is guided by provisions of the Federal Law "On the Use of Atomic Energy" and "Provision on Licensing of Activity in the Field of the Use of Atomic Energy" endorsed by Resolution of the Government of the Russian Federation, which describes, among other, requirements for licensing procedures.

Activities in the field of the use of atomic energy subject to licensing are set forth in Article 26 of the Federal Law "On the Use of Atomic Energy" and include siting, construction, operation and decommissioning of nuclear installations, radiation sources, nuclear material and radiation substance storage facilities, radioactive waste storage facilities, closure of radioactive waste disposal facilities, management of nuclear material and radioactive substances, including exploration and extraction of uranium ores, production, use, processing, transportation and storage of nuclear material and radioactive substances, management of radioactive waste in their storage, processing, transportation and disposal, use of nuclear material and (or) radioactive substances in research and development, design and engineering of nuclear installations, radiation sources, nuclear material and radioactive substance storage facilities, radiative waste storage facilities, design and manufacture of equipment for nuclear installations, radiation sources, nuclear material and radioactive substance storage facilities, radioactive waste storage facilities, safety expert reviews (safety justification expert reviews) of nuclear facilities and (or) activities in the field of the use of atomic energy.

The procedure of provision of the public service of licensing the activity in the field of the use of atomic energy is established in the "Administrative Regulation on Provision by the Federal Environmental, Industrial and Nuclear Supervision Service a Public Service of Licensing an Activity in the Field of the Use of Atomic Energy", which is described briefly in Section 7.4 of the seventh National Report.

The procedure of conducting an expert review during licensing is describe in the "Provision of Conducting an Expert Review of Safety (Expert Review of Safety Justification) of Nuclear Facilities and (or) Activities in the Field of the Use of Atomic Energy". A decision on granting or denial of the license is made based on results of verification of completeness and confidence of information submitted for obtaining the license, as well as an expert review of safety of the nuclear facility and (or) licensed activity. The license is granted for the period during which the license applicant justifies the safety of the activity and facility and the safety is confirmed by the result of the safety justification expert review.

To carry out the expert review of NPP safety for the purposes of licensing, Rostechnadzor involves the scientific and technical support

organization of the Regulatory Body in accordance with the Federal Law "On the Use of Atomic Energy".

Engagement of the Public and Other Stakeholders in the Licensing Process

The engagement of other stakeholders in licensing is regulated by the "Administrative Regulation on Provision by the Federal Environmental, Industrial and Nuclear Supervision Service a Public Service of Licensing an Activity in the Field of the Use of Atomic Energy", which determines procedure, time and sequence of administrative procedures (actions) of Rostechnadzor and its territorial departments, interaction procedure with license applicants/licensees, and other governmental bodies in licensing.

According to the requirements of the said regulations, the document set to be submitted to Rostechnadzor along with a license application, Operating Organizations, depending on licensed activity, shall include, inter alia:

- a report on availability of NPP fire protection;
- information about approval of the positive statement made by the governmental environmental expert review. When making a governmental environmental expert review statement, statements of the public environmental review, as well as well-grounded proposals regarding ecological aspects, economic or other activities, which are subject to an environmental expert review submitted by local authorities, public organizations (associations) and citizens, and materials justifying their accounting in the state environmental expert review are prepared;
- results of the environmental impact assessment (EIA). The goal of the environmental impact assessment is the prevention or mitigation of impact of this activity on the environment and associated social, economic and other consequences. Public hearings on the issue of NPP siting are carried out as part of the EIA procedure;
- information about obtaining a sanitary and epidemiological statement concerning the activity in the field of handling nuclear material and radioactive substances.

Presence of requirement to submit to Rostechnadzor the said documents to obtain the license in the "Administrative Regulation on Provision by the Federal Environmental, Industrial and Nuclear Supervision Service a Public Service of Licensing an Activity in the Field of the Use of Atomic Energy" ensures engagement of other stakeholders and the public in the licensing process.

The Russian Federation has an effective legislative and regulatory framework, which regulates the issues related to the

provision and regulation of the safety of nuclear plants in accordance with the requirements of the Convention on Nuclear Safety and the principles of the Vienna Declaration on Nuclear Safety.

Article 8. Regulatory Body

8.1. Authorities and Duties of the Regulatory Body

According to the Ordinance of the Government of the Russian Federation No. 401 of 30 July 2004 (with amendments of 17 January 2015), the Federal Environmental, Industrial and Nuclear Supervision Service (Rostechnadzor) is the federal executive body for the state regulation of nuclear and radiation safety in the uses of atomic energy. This ordinance of the Government of the Russian Federation also approved "The Provision on the Federal Environmental, Industrial and Nuclear Supervision Service".

At this time, Rostechnadzor is:

– the regulatory body (as per the Convention on Nuclear Safety and the Joint Convention on the Safe Management of Spent Fuel and on the Safe Management of Radioactive Waste) and the competent authority of the Russian Federation (as per the Amendment to the Convention on the Physical Protection of Nuclear Material);

– the authorized body of the federal state supervision in the field of the use of atomic energy; and

– the body of the federal state building supervision with regard to nuclear plants.

Rostechnadzor has the following authorities:

– brings in to the Russian Federation Government draft federal laws, draft legal acts of the President of Russia and the Government of Russia, and other documents on issues related to Rostechnadzor's activity area;

– endorses legal regulatory acts related to the uses of atomic energy:

- ✓ federal standards and regulations;
- ✓ the procedure for granting licenses for the right to work to nuclear facility employees in accordance with the Uniform Qualification Handbook of Job Positions of Managers, Specialists and Officers (Section "Qualification Characteristics of Job Positions of Employees of Nuclear Power Organizations") endorsed by the Order of the Ministry of Health and Social Development of the Russian Federation of 10 December 2009;
- ✓ requirements for the composition and contents of documents justifying safety of activities in the field of the use of atomic energy, as well as the review procedure of the said documents;
- ✓ the procedure for submission by the Operating Organization to Rostechnadzor of documents containing results of nuclear

facilities safety assessment and justifying safety of their operation, as well as requirements to content and composition of these documents;

- ✓ the procedure for safety review of NPPs and (or) activities;
- ✓ procedure for organization and conduct of supervision over the system for the state control and accounting of nuclear material;
- ✓ methodologies of developing guidelines of maximum permissible releases of radioactive substances into the atmospheric air and guidelines of maximum permissible discharges of radioactive substances in water reservoirs;
- ✓ the procedure for the compliance assessment of products, as well as processes of their design (including surveys), manufacture, construction, installation, adjustment, operation, storage, shipment, sale, utilization, and disposal;
- ✓ the procedure for expert evaluation of codes for electronic computing machines used for building calculation models of processes affecting safety of NPPs and (or) activities in the field of the use of atomic energy;

– licenses activities in the field of the use of atomic energy, in compliance with the legislation of the Russian Federation;

– grants permits to work in the field of the use of atomic energy to nuclear facilities personnel;

– establishes guidelines of maximum permissible releases of radioactive substances into the atmospheric air and guidelines of maximum permissible discharges of radioactive substances in the water reservoirs;

– audits (inspects) the observance by legal entities and physical persons of the requirements of the Russian law, legal regulations, rules and regulations in the field of the use of atomic energy;

– adjusts qualification reference books for managers and specialists (officers);

– ensures oversight of emergency preparedness and response of nuclear facilities in emergencies;

– directs activities of the functional subsystem for control of nuclear- and radiation-hazardous facilities within the common state system for prevention and elimination of emergencies;

– applies constraining and preventive measures as provided by the law of the Russian Federation;

– participates in accreditation work in the field of the use of atomic energy;

– oversees:

- ✓ adherence to the rules and regulations in the field of the use of atomic energy;

- ✓ observance of the terms and conditions of licenses for the right to carry out activities in the field of the use of atomic energy;
- ✓ fulfillment of international commitments of the Russian Federation in the field of the safety ensuring in the use of atomic energy.

According to the Ordinance of the Government of the Russian Federation "On the Cooperation in Issues of Development of National Regulatory Frameworks for Regulating Nuclear and Radiation Safety in the Peaceful Uses of Atomic Energy in States Which are Customers of Building Nuclear Facilities to Russian Designs", Rostechnadzor, jointly with scientific and technical support organizations (SEC NRS and VO Safety), supports regulatory bodies in the development of legal regulatory framework, enhancement of licensing and supervision, as well as arranges for the personnel training of foreign regulatory bodies, carries out working meetings, scientific and technical consultations and seminars on experience in NPP safety regulation. Foreign specialists participate in inspections held by Rostechnadzor at operating and constructed NPPs in the territory of Russia as observers.

In the reporting period, Rostechnadzor signed the Agreement between the Government of the Russian Federation and the Government of the Federative Republic of Nigeria on Cooperation in Regulation of Nuclear Radiation Safety in the Peaceful Use of Atomic Energy, as well as other interagency agreements on cooperation and memoranda of understanding with regulatory bodies of the Republic of Zambia (Radiation Protection Authority), the Republic of Indonesia (Nuclear Energy Regulatory Agency (BAPETEN)), the Kingdom of Morocco (Agency for Nuclear and Radiological Safety and Security), the Republic of Uzbekistan (State Committee on Industrial Safety), the Republic of Korea (Nuclear Safety and Security Commission), the Plurinational State of Bolivia (Electricity and Nuclear Technology Supervisory Authority), Philippines (Philippine Nuclear Research Institute (PNRI) under the Department of Science and Technology), and the Federative Republic of Nigeria (Nigerian Nuclear Regulatory Authority).

In the reporting period, Rostechnadzor continued to interact with regulatory bodies of the countries which develop their nuclear power programs both on bilateral and multilateral basis.

A series of working meeting was held with the safety regulatory body of Hungary (HAEA).

Rostechnadzor's inspectors held working meetings with inspectors from Finnish regulatory body (STUK) at Leningrad NPP and Kola NPP. In April 2018, Rostechnadzor's specialists took part in the fire safety inspection at Loviisa NPP in Finland.

Multilateral interaction is carried out jointly with SEC NRS, including in the framework of:

– the Committee of Nuclear Regulatory Activities of OECD/NEA and its working groups;

– the Multinational Design Evaluation Program (MDEP) under the auspices of OECD/NEA (in particular its working group on WWER reactors in the following areas: accounting of lessons learnt after Fukushima Daiichi NPP accident; reactor pressure vessel and equipment strength; safety analysis in transients and accidents; safety analysis and management of severe accidents);

– the Forum of the regulatory bodies of the countries operating WWERs (WWER Forum) and its working groups: on reactor physics (chaired by the Russian Party); on NPP ageing management (chaired by the Russian Party); and on probabilistic safety analysis.

In accordance to provisions of the Federal Law “On the Use of Atomic Energy”, in its activity, Rostechnadzor takes measures to enhance openness and transparency of fulfillment of the commitments resulting from the Convention on Nuclear Safety.

Rostechnadzor continuously informs the stakeholders on the goals and results of its activities, by this facilitating enhancement of its transparency and openness.

Rostechnadzor carries out and will develop focused and systematic action to implement mechanisms of openness and transparency of results of the performed functions in the field of safety regulation in the use of atomic energy, building up the dialogue with citizens on safety in the field of the use of atomic energy through implementation of the following measures:

– most significant complex scientific and technical problems of nuclear and radiation safety regulation are discussed at meetings of the Scientific and Technical Board with involvement of a broad circle of specialists from scientific organization and enterprises of the nuclear sector;

– the official website has a special section which reflects issues of nuclear and radiation safety regulation;

– the official website and website of its scientific and technical support organization contain a list of federal standards and regulations in the field of the use of atomic energy which are in competence of Rostechnadzor;

– detailed topical information on different aspects of nuclear and radiation safety, on a status of draft federal standards and regulations, safety guides and national standards is posted on the corporate web-portal and websites of scientific and technical support organizations;

– draft legal regulatory acts, including federal standards and regulations, are widely discussed by nuclear specialists and the public before their adoption and putting into force;

– the press service continuously works with mass media on issues of objective coverage of current problems of nuclear and radiation safety regulation;

– most topical problems of nuclear and radiation safety, drafts and approved federal standards and regulations are published in the official quarterly publication of Rostechnadzor, the journal “Nuclear and Radiation Safety”;

– topical issues of the state-level regulation of safety are covered in methodological guides intended for both nuclear specialists and wide range of the public.

The Public Council regularly reviews the results of activity of Rostechnadzor and its scientific and technical support organizations in main areas of nuclear and radiation safety regulation.

The Community Liaison Office has been set up and functions to process mailed citizen appeals, through the official website as well as personal reception of citizens on any issues related to Rostechnadzor’s activities, including regulation of nuclear and radiation safety.

The official website of Rostechnadzor has the section “Open Rostechnadzor”, which posts annual reports on results and main activity areas of Rostechnadzor, annual plans of Rostechnadzor and reports on fulfillment of those plans. The Community Liaison Office has been set up though which each citizen can send his/her appeal and (or) file for a fact of corruption.

Rostechnadzor uses many tools like website and social networks to cover the target audience.

8.2. Organizational Structure of the Regulatory Body

Rostechnadzor executes the entrusted functions of control and supervision, as well as licensing activities in the field of the use of atomic energy through its Headquarters and territorial bodies. The organizational structure of Rostechnadzor’s Headquarters, territorial bodies and scientific and technical support organizations is shown in Fig. 8.1.

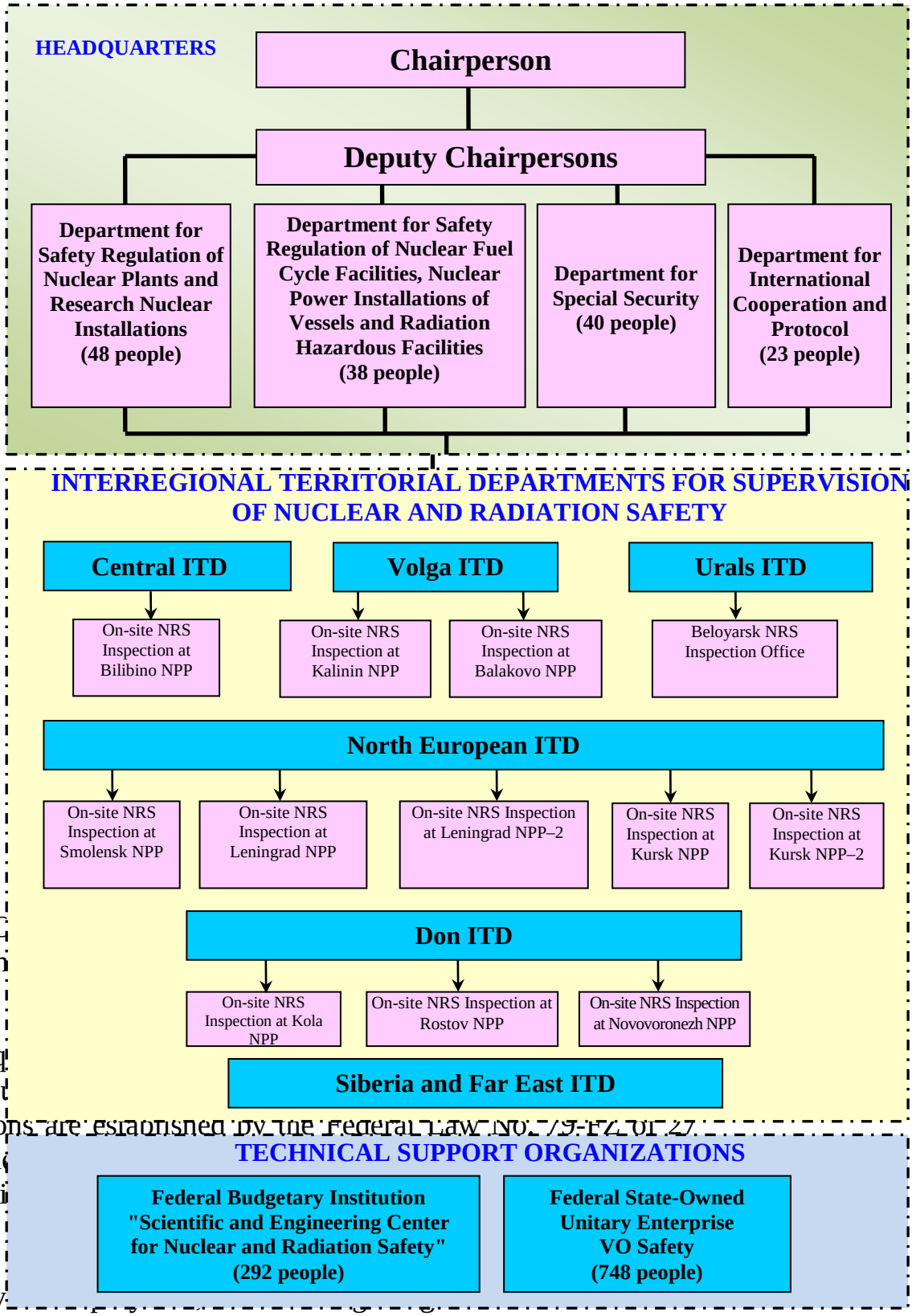


Fig. 8.1. The C
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departments for st
which qualifications are established by the Federal Law No. 79-FZ of 27 July 2004 "On th
President of Russi
Requirements for
Experience, Area
Federal Civil Serv

The qualifications of Rostechnadzor's state civil servants are maintained in the framework of a proficiency enhancement system in place in Rostechnadzor as necessary but at least once in three years. The Headquarters specialists of Rostechnadzor, with experts of scientific and technical support organizations, conduct educational seminars for

employees of the interregional territorial department for supervision over nuclear and radiation safety.

According to the Federal Law “On the State Civil Service in the Russian Federation”, the state civil servants of Rostechnadzor have the right for extra professional education, which is carried out throughout their civil service period. Type, format and duration of extra professional education are established depending on a group and category of the civil service position.

Information about the size of the salary fund of the interregional territorial departments for supervision of nuclear and radiation safety of Rostechnadzor for 2017-2021 is given in Appendix 9.

8.3. Technical Support Organizations for the Regulatory Body

Rostechnadzor has in its jurisdiction two scientific and technical support organizations in the field of nuclear and radiation safety: Federal Budgetary Institution “Scientific and Engineering Center for Nuclear and Radiation Safety” (SEC NRS) and Federal State-Owned Unitary Enterprise - Foreign Trade Organization “Safety” (VO Safety).

The status of scientific and technical support organizations in the state regulatory system is statutory prescribed by Article 37.1 of the Federal Law “On the Use of Atomic Energy”, which states that scientific and technical support organizations conduct their activities for the purposes of:

- scientific and technical support of the state regulation of safety, including execution and coordination of research and development, conduct of expert reviews, including safety reviews;
- development and enhancement of the legal regulatory framework in the field of the use of atomic energy.

SEC NRS provides scientific and technical support to Rostechnadzor in the field of the use of atomic energy in the following areas:

- development of draft legal regulatory acts;
- drafting and revising federal legal regulatory acts in the field of the use of atomic energy as well as safety guides in uses of atomic energy;
- organization and conduct of expert reviews (safety justifications);
- research regarding principles and criteria of nuclear and radiation safety;
- organization and conduct of software expert reviews;
- participation in international activities of Rostechnadzor.

As of 30.06.2022, the SEC NRS staff is 323 employees, including 287 employees having higher education; of them 55 people are Ph.Ds.

SEC NRS has developed a full-text electronic database of regulatory documents on the use of atomic energy applicable in the Russian Federation.

As assigned by Rostechnadzor, specialists of SEC NRS collect, analyze, and store information on operational occurrences at Russian NPPs, and, for these purposes, they operate and compile the electronic database on NPP operational violations “ISI-Nadzor”. Besides, SEC NRS continuously assesses the current state of safety ensuring of Russian NPP power units based on the analysis of data submitted to Rostechnadzor by the Operating Organization, Rosenergoatom.

Software expert review is organized by SEC NRS specialists to meet the requirements of Article 26 of the Federal Law of 21 November 1995 “On the Use of Atomic Energy”, which states that in preparation of documents justifying safety of nuclear facilities, for building calculation models of processes affecting safety of the said objects, the software shall be used that passed an expert review in a scientific and technical support organization of the authorized state-level regulatory body.

SEC NRS reviews software in the following topical areas:

– nuclear reactor physics and systems with nuclear materials; nuclear safety;
– thermal hydrodynamics and multi-physical processes;
– transfer of ionizing radiation, radiation protection, propagation (migration) of radiative substances;
– strength, residual life of components, equipment, systems;
– strength and reliability of building structures of buildings and structures;
– probabilistic safety analysis, reliability of systems and objects;
– physical chemistry, geochemistry and hydrogeology.

Requirements for the contents and composition of a verification report are defined in RD-03-34-2000. Results of a software expert review are reflected in a software certificate which is issued by SEC NRS. As of the end of 2021, 295 software items had such certificates (a list is posted on the website http://www.secnrs.ru/expertise/software-review).

SEC NRS has a quality management system which is certified for compliance with the requirements of the international standard ISO 9001:2015 and the national standard of the Russian Federation GOST R ISO 9001-2015. The Quality Management System is used in:

– research on safety principles and criteria;
– drafting of regulatory documents in safety regulation;
– assessment of software applicability in safety justification;
– safety expert reviews of nuclear facilities and (or) activities.

SEC NRS specialists are engaged as working group experts of Information and Analytical Center (IAC) of Rostechnadzor (a description of Rostechnadzor’s IAC is given in the section on Article 16 of this Report).

SEC NRS is an associate member of the European Technical Safety Organizations Network (ETSON). SEC NRS takes part in activities of steering bodies of ETSON and different topical working groups. Membership in ETSON allows SEC NRS exchange results of research, experience in regulation of nuclear and radiation safety of nuclear installations, results of safety assessments for harmonization of Russian and European approaches. SEC NRS takes part in activities of steering bodies of ETSON and different topical working groups.

VO Safety renders scientific and technical support to Rostechnadzor in:

– assessments of conformance of the equipment, component parts, materials and semi-finished products, which are supplied to NPPs;

– drafting of legal regulatory acts in the field of the use of atomic energy;

– drafting of legal regulatory acts related to supervision of nuclear material physical protection, control and accounting, and training of inspectors;

– organization and conduct of safety expert reviews in the field of the use of atomic energy;

– research in methodology of safety assessment in the uses of atomic energy;

– participation in activities to organize training of personnel of the public safety regulation bodies in the use of atomic energy of other countries as directed by Rostechnadzor, as well as fulfillment of contractual commitments of the Company towards foreign regulatory authorities.

VO Safety specialists carry out assess compliance of products for power units and nuclear plants abroad that are under operation and construction as well as for Russian NPPs under operation and construction.

The Russian Federation has an independent Regulatory Body – the Federal Environmental, Industrial and Nuclear Supervision Service, which is fitted with human, financial and technical resources in accordance with the provisions of the Convention on Nuclear Safety.

Article 9. Responsibility of License Holder

In accordance with Article 26 of the Federal Law "On the Use of Atomic Energy," any activity in the area of the use of atomic energy subject to licensing by the state safety regulatory authorities is prohibited if there is no a permit (license) for conduct of this activity.

The Convention on Nuclear Safety and the Federal Law "On the Use of Atomic Energy" (Article 35) set out that the full responsibility for the safety of a nuclear installation as well as for the proper management of nuclear material and radioactive substances rests with the Operating Organization (the license holder).

As the Operating Organizations, Rosenergoatom and JSC SCC bear full responsibility for the safety of Russian NPPs. The Operating Organizations are not relieved of this responsibility in connection with activities of other enterprises and organizations performing works or giving services to the Operating Organizations.

In accordance with requirements of the federal standards and regulations in the field of the use of atomic energy, the Operating Organizations set up structural divisions to carry out immediately on the NPP site the activity on construction and safe operation of NPP. The said structural divisions are given necessary rights, finances, materiel and human resources, regulatory documents and scientific and technical support. The Operating Organization defines their responsibility for this activity and controls this activity. Directors of the operating NPPs are delegated the right to manage the production, financial and economic activities of NPPs. With that, they are responsible for NPP safety.

The Operating Organization informs Rostechnadzor on all cases of operational events falling under the classification attributes "incidents" or "accidents" as established in the federal standards and regulations in the field of the use of atomic energy, including on violation of safe operation limits and conditions.

The Operating Organization must have a financial provision of limit of liability for damage and harm caused by NPP radiation impact. The financial provision consists of the state guarantee or other guarantee, availability of own financial resources and an insurance policy (contract). Availability of documented confirmation of the said financial provision is the necessary condition for getting a Rostechnadzor's license for operation of a nuclear installation by an operating organization. Terms and conditions and the procedure of civil liability insurance for losses and harm caused by radiation impact, the procedure and sources of the insurance fund, as well as a procedure of paying social guarantees are defined in the legislation of the Russian Federation and the Vienna Convention on Civil Liability for Nuclear Damage of 1963 (hereinafter referred to as the Vienna Convention).

The insurance covers the territory of the Russian Federation and territories of other Contracting Parties to the Vienna Convention, which may suffer transboundary nuclear damage. The insurance is carried out by the Russian Nuclear Insurance Pool with participation of the International Pooling System with insurance sums which ensure fulfillment of conditions of the Vienna Convention.

Thus, in the field of civil liability for nuclear damage, Rosenergoatom fulfills and JSC SCC is ready to fulfil the international commitments taken by the Russian Federation in this area.

Rosenergoatom's efforts to enhance openness and transparency are defined in the Policy Statement on Communications and Public Reporting. Rosenergoatom has set up an information and public relations department which is fitted with technical and financial resources to inform the general public on conditions at nuclear plants, including any INES significant event.

Information about operation of nuclear power plants and radiation situation in the host cities is available on the official website of Rosenergoatom and websites of nuclear power plants. They promptly publish press releases and information items. The website of Rosenergoatom is http://www.rosenergoatom.ru. On the website http://www.russianatom.ru, in real time, there is information about radiation monitoring at Russian nuclear plants. Besides, at all nuclear plants, answering machines operate round-the-clock which daily post fresh information on current operation of NPPs and radiation situation.

JSC SCC has set up a Public Relations Department which is fitted with technical and financial resources for public information on the state of construction of the power unit with RI BREST-OD-300.

Information about the radiation situation, as well as about construction progress of the power unit with RI BREST_OD-300 in the city of Seversk is accessible on the official website of JSC SCC, which promptly posts press releases and information messages. The website of JSC SCC is http://www.shk.ru.

If abnormal situations arise in NPP operation, there is a system of prompt information transmission which includes printed media of NPP host cities and regions, municipal and regional TV and radio channels, information agencies, press services of governors and regional governments, and press services of regional departments of EMERCOM and MOI. The information transmission system is used not only when abnormal situations arise, but also in attempts of information attacks and cases of circulation of allegedly false and negative information. Traditional practice is press tours and visits to nuclear power plants for representatives of Russian and international mass media.

In the Russian Federation the responsibility of the Operating Organizations for NPP safety is established by law and defined in the regulatory requirements, which meet provisions of the Convention on Nuclear Safety.

Article 10. Priority to Safety

10.1 Safety Policy

In the Russian Federation, the activities in the field of the use of atomic energy are based on the statutory regulation principles formulated in Article 2 of the Federal Law “On the Use of Atomic Energy”, such as:

– safety ensuring in the uses of atomic energy: protection of individuals, general public and environment against radiation hazard;

– delineation of responsibility and functions of the state safety regulatory bodies, bodies for control over the use of atomic energy, the authorized body for control over the uses of atomic energy and that of organizations, which carry out activities in the field of the use of atomic energy;

– independence of state safety regulatory bodies in their decision-making and exercising their authority from the bodies for control over the use of atomic energy and organizations performing activities in the field of the use of atomic energy;

– observance of international obligations and safeguards of the Russian Federation in the field of the use of atomic energy.

As per Article 34 of the Federal Law “On the Use of Atomic Energy”, the interference with the Operating Organization’s activities as regards operation of a nuclear installation, radiation source or storage facility is not permitted.

It is the priority task of Rosenergoatom and JSC SCC to ensure safety of a NPP at all stages of its lifecycle.

To solve this task, Rosenergoatom and JSC SCC consistently formulate measures aimed at appropriate fulfillment of requirements of the Russian Federation law in the field of the use of atomic energy. At this, Rosenergoatom and JSC SCC persistently fulfil commitments under the Convention on Nuclear Safety and follow recommendations of the IAEA safety standards.

In its activity related to operation of NPPs Rosenergoatom implements the following principles:

– ensuring nuclear, radiation, industrial, fire and environmental safety and occupational safety;

– observance of the legislation of the Russian Federation; observance of requirements of federal standards and regulations in the field the use of atomic energy; observance of national standards;

– control for the purposes of safety in such a way that processes and actions to ensure fulfilment of the NPP safety requirements are established taking accordance of other requirements, including economic requirements, requirements for managers, personnel, occupational safety,

environmental protection, control and accounting of nuclear material, physical protection, quality, so that these requirements and requests produce no adverse impact on NP safety;

– ensuring economic efficiency of generation of electricity and heat;

– improvement of the safety culture.

Operating Organizations ensure nuclear and radiation safety of NPPs through:

– implementation of the science, technology and economic policy, while observing the priority to safety;

– activities to improve NPP safety with the account taken of results of safety analyses and operating experience;

– maintenance of appropriate qualifications and competences of the personnel;

– building up committed attitudes to the principles of the safety culture of the NPP personnel and staff of organizations, which execute works and render services to the Operating Organization, principles of safety culture;

– dissemination of the best practices;

– implementation of accident prevention measures at NPPs; and

– preparedness of the management and personnel of the Operating Organization and NPP personnel for emergency response.

Thus, Rosenergoatom and JSC SCC fulfil obligations resulting from the Convention on Nuclear Safety, take account of recommendations of the IAEA's NPP safety standards, as well as provisions of the International Nuclear Safety Advisory Group (INSAG) set out in the documents "Basic Safety Principles of NPPs" and "Safety Culture".

10.2. Safety Culture and Its Efficiency Assessment

The work to build up safety culture is carried out in accordance with requirements of the federal standards and regulations and with the account taken of recommendations of the IAEA and WANO safety standards.

The Operating Organization maintains safety culture taking account of the following principles:

– safety priority of NPP over economic and production objectives;

– leadership of managers: managers of all levels show by personal example their adherence to safety and observance of safety requirements, build up the atmosphere of openness and trust in the team;

– selection, professional education and maintenance of qualification of managers and personnel in each area of activity which affects safety;

– strict observance of discipline with clear-cut delineation of powers and personal responsibility of managers and performers;

– drafting and strict observance of requirements of quality assurance programs, production procedures and process regulations, their periodical updating considering the accumulated experience;

– building up the trust and such approaches to collective work, as well as social and amenity conditions of the NPP personnel living which form inherent positive attitude to safety by managers of all levels;

– understanding by each employee of how his/her activities affect NPP safety and consequences which may be entailed by non-observance or poor quality of fulfillment of requirements of quality assurance programs, production and job procedures, and process regulations;

– self-control of employees of their activity affecting safety;

– understanding by each manager and employee of inadmissibility of hiding errors in their activities, the necessity of revealing and eliminating their causes, the necessity of continuous self-improvement, studying and implementing the best practices, including foreign ones;

– establishing the system of incentives and punishments by results of the production activity, which motivate openness of employees' actions and does not facilitate concealment of errors in their work.

When evaluating the safety culture, the safety culture indicators are used as defined in Rosenergoatom's internal documents.

Self-assessments of safety culture are carried out once in two years. The latest self-assessment of safety culture was carried out in 2020. Its goal was to identify a state of safety culture, its development dynamics, timely detection of negative trends, strong points and best practices in the field of safety culture to make managerial decisions aimed at development of safety culture. Based on the self-assessment results, the areas of improvement were identified, including:

– the system of incentives for voluntary reports by personnel on deficiencies and own errors revealed by them;

– the presence of the atmosphere of trust and openness which excludes concealing of safety important information.

The next self-assessment of safety culture is planned for 2022.

Annually Rosenergoatom holds the Summary Safety Culture Days where NPPs present their activity results to maintain and develop the safety culture.

To enhance the safety culture at the corporate level, Rosenergoatom has the Safety Culture Board led by the Director General of Rosenergoatom and safety culture boards at each NPP led by NPP managers.

Biannual Safety Culture Development Programs are developed based on results and self-assessments and monitoring of safety culture. The

program updating is done annually considering results of independent WANO's peer reviews at all NPPs and Rosenergoatom.

Self-assessment of JSC SCC personnel is carried out according to requirements of the sectoral standard. Safety culture self-assessment measures are carried out regularly based on the JSC SCC Safety Culture Enhancement and Development Plan and an order of the General Director.

So the main goal of safety culture self-assessment in JSC SCC in 2021 is the identification of problem areas and best practices in organization of activities to enhance the safety culture level through direct engagement of personnel in the process of critical analysis and improvement of their activity.

The assessment of safety culture level was carried out based on the safety culture model which consists of a number of attributes, indices and indicators.

The safety culture model used for the 2021 research included a list of five attributes:

- "Safety as a clearly perceived value";
- "Self-learning organization: use of business process experience";
- "Safety ensurance leadership";
- "Personnel working conduct";
- "Safety in all activity areas";
- "Team spirit: openness and trust".

To enhance safety culture, JSC SCC employs the Board on Safety Culture led by the General Director of the Combine; safety culture officials have appointed in each structural division.

10.3. Role and Value of Rostechnadzor

Rostechnadzor, as an independent authority, pursues the state policy on the safety regulation of nuclear installations.

All activities of Rostechnadzor are meant to ensure safety priority, provide conditions ensuring the protection of personnel, the public and the environment against unacceptable radiation impacts, and preventing uncontrolled proliferation and use of nuclear materials.

Rostechnadzor checks the state of safety culture at NPPs during inspections, as well as in safety case reviews for licensing purposes. As per the requirements of "General Safety Provisions of Nuclear Power Plants", all employees and organizations associated with siting, construction, operation and decommissioning of NPP, design, engineering and manufacture of their systems and components should build up and maintain safety culture.

Rostechnadzor has developed the safety guide “Recommendations for Building up and Maintaining Safety Culture at Nuclear Plants and in Operating Organizations”.

10.4. Priority to Safety in the Regulatory Body’s Activities

In 2018, Rostechnadzor adopted the “Safety Culture Policy Statement in the Field of the State Safety Regulation in the Use of Atomic Energy” where it stated principles of building up safety culture of the regulatory body:

– the leadership in issues related to safety of Rostechnadzor’s managers of all levels;

– individual responsibility of employees, including responsibility for behavior where safety issues have priority;

– openness and transparency of supervision;

– continuous analysis of experience and enhancement of regulation;

– incentives and rewards of employees.

In 2019, SEC NRS carried out a pilot self-assessment of safety culture which demonstrated satisfactory safety culture in SEC NRS and produced recommendations for its further enhancement. Besides, the proposals were drawn out for the implementation of regular safety culture self-assessments in Rostechnadzor and its scientific and technical support organizations.

In the Russian Federation, the Operating Organizations and Rostechnadzor carry out the policy of safety priority, which includes, among other, the activity to build up and maintain safety culture which aims at safety ensuring of nuclear plants in accordance with the provisions of the Convention on Nuclear Safety.

Article 11. Financial and Human Resources

11.1. Financial Resources of the Operating Organization

To support the performance of duties of the Operating Organization, which carries out activities in the field of the use of atomic energy, annually the monetary funds required for safe operation of nuclear power plants are allocated.

In accordance with the Ordinance of the Government of the Russian Federation "On Approval of the Rules of Making Provisions, by Enterprises and Organizations That Operate Nuclear and Radiation Hazardous Productions and Facilities (Nuclear Power Plants), for Monetary Amounts to Generate Reserves Intended for NPP Safety Ensuring at All Stages of Their Lifecycle and Development", the operating organization makes provisions to:

– the reserve intended for financing of expenditures for ensuring nuclear, radiation, industrial and fire safety during operation of nuclear plants, equipment of emergency rescue teams, payment for their works (services) in an amount of not greater than 10 % of revenues gained by the Operating Organization through sales of products (works, services) associated with the use of atomic energy;

– the reserve intended for financing of expenditures to ensure nuclear material physical protection, control and accounting at the plants in an amount of not more than 2 % of revenues gained by the Operating Organization;

– the reserve intended for financing of expenditures for NPP development as per the list of capital projects on the Operating Organization's investment program, which are financed in the next fiscal year. The said list is annually approved by ROSATOM in coordination with the Ministry of Economic Development of the Russian Federation, the Ministry of Energy of the Russian Federation and the Federal Antimonopoly Service of the Russian Federation;

– the reserve intended for financing of expenditures to decommission the nuclear power plants and to carry out research and development in an amount of not greater than 3.2 % of revenues gained by the Operating Organization; and;

– the reserve intended for financing of expenditures to dispose of radioactive waste proceeding from the projection of an amount of radioactive waste transferred by the Operating Organization to the national operator, as well as proceeding from the tariffs for disposal of radioactive waste in an amount of not greater than 1.5 % of revenues gained by the Operating Organization.

The target funds allow the Operating Organization to generate sufficient money to exercise corresponding functions and ensure safety of nuclear plants at all stages of their lifecycle and development while observing all guidelines and requirements of the Russian law. Sizes of the provisions of Rosenergoatom to the reserves made in accordance with the Ordinance of the Government of the

Russian Federation "On the Approval of the Rules of Provision by Enterprises and Organizations Operating Radiation-Hazardous and Nuclear-Hazardous Productions and Facilities (nuclear plants) if Funds to Make Reserves intended for NPP Safety Ensuring at all Stages of Their Lifecycle and development" are given in Table 11.1.

Table 11.1. Sizes of provisions to the reserves of Rosenergoatom in 2016-2021 (RUB mln)

Reserve	2016	2017	2018	2019	2020	2021	2022 (target)
Reserve for safety ensuring NRI&FS	8 366	8 864	9 192	9 564	10 050	10 389	11 853
Reserve for nuclear material physical protection, control and accounting	4 247	3 555	3 515	3 817	4 010	4 146	4 291
Reserve for decommissioning of NPP	8 274	10 794	11 343	13 408	13 615	15 124	14 995
Reserve for NPP development	47 333	40 741	39 109	22 993	1 973	1 345	0*
Reserve for disposal of radioactive waste	0	430	1 188	976	843	910	910

* *due to reduction in the investment program volume, there is no need in making the reserve for development; financial sources are sufficient.*

Sizes of financing of measures for NPP upgrading, which is provided from the funds of the Rosenergoatom's long-term investment program, are given in Table 11.2.

Table 11.2. Financing of NPP upgrading measures by Rosenergoatom in 2016-2022 (RUB mln)

Financing of Rosenergoatom's NPP upgrading measures in 2016-2022 (RUB mln)						
2016	2017	2018	2019	2020	2021	2022 (target)
24 460	21 424	23 508	32 531	26 837	37 216	29 152

The civil liability for nuclear risks provides necessary funding in case of a radiation accident. This mechanism is described in more detail in the section on Article 9 of this Report.

11.2. Human Resources of the Operating Organization

According to Article 35 of the Federal Law "On the Use of Atomic Energy", the Operating Organization shall recruit, train and maintain qualifications of NPP employees.

In the Operating Organization the system of staffing and training is based on requirements of standards of the Operating Organization for essential NPP human resources activities:

- personnel recruitment and hiring procedure;
- training for the position;
- maintenance of qualification; and;
- professional training and advanced training.

As of the end of 2021, the total NPP staff schedule of the Operating Organization was 10,900 people. The number of the NPP contractor personnel who perform repairs, adjustments, transportation works, general labor activities and other services is about 19,000 people.

Total staff who perform repairs and adjustments of the power unit with RI BREST-OD-300 of JSC SCC, as well as render transportation and general labor services are determined in the established staff schedule.

11.3. Training, Education and Maintenance of the Personnel Qualifications

Training of the nuclear power plant personnel is carried out in accordance with the Russian law requirements and includes:

- building up qualification-related knowledge, skills and expertise before the NPP employee is allowed to work independently;
- keeping up and developing qualification-related knowledge and shop-floor skills in the course of working practices, including when the production conditions change.

The qualification and expertise level is defined basing on requirements of the Uniform Qualifications Handbook of Positions of Managers, Specialists and Servants; Qualification Handbook of Positions of Managers, Specialists and Other Servants; and Uniform Handbook of Rates and Qualifications of Works and Working Professions or Professional Standards.

Approaches applied to the training, education and maintaining qualifications of Rosenergoatom's personnel are described in detail in the previous National Reports.

The main suppliers of external educational services for Rosenergoatom are:

- ANO CVE "ROSATOM TECHNICAL ACADEMY" (ROSATOM Tech);
- National Research Nuclear University MEPhI (NRNU MEPhI);
- National Research Tomsk Polytechnic University;

- Ivanovo State Power Engineering University;
- National Research University “MEI”;
- Ural Federal University;
- Sebastopol State University.

According to the standards of the Operation Organization, education and training units (ETU) operate at nuclear power plants. ETU NPP undergo the qualification procedure (ETU of all NPPs have been qualified). ETU NPPs have training equipment and aids sufficient for training and maintaining qualifications of the NPP personnel. The buildings and rooms of ETU NPP have fitted classes for training in theory, specialized training, laboratories and workshops. Classes are fitted with modern training equipment: full-scope and analytical simulators (FSS and AS), simulator training systems, and training racks.

At NPPs there are psychological and physiological support laboratories (PPSL), which are to solve practical complex tasks of enhancement and maintenance of human factor reliability to ensure safe and efficient operation of the NPP and include psychological and pedagogical follow-on of processes of training, maintenance and advancement of the personnel qualifications (in-house training).

The personnel are trained in groups or individually. These include:

– the theoretical training;
– the on-the-job internship (if required for the given position);
– the practical training with training equipment (if required for the given position);
– the initial knowledge check.

The NPP personnel maintain their qualifications annually using qualification maintenance programs and are aimed at keeping up professional knowledge and practical skills required for their job duties.

Qualifications are maintained at ETU NPPs, NPP structural divisions, and educational organizations. The qualification maintenance programs for the NPP personnel are developed in accordance with requirements of the standard of the Operating Organization “Programs of Training for a Position (Profession) and Maintaining Qualifications of the Personnel of Nuclear Power Plants. Basic Requirements”.

The Operating Organization establishes the criteria for assessment of NPP personnel qualifications.

Annual total volume of qualification maintenance hours for NPP personnel is not less than 20 hours. Total volume of qualification maintenance of NPP operators who obtain Rostechnadzor’s permits is not less than 96 hours, including 40 hours of the practical simulator training. Rosenergoatom’s personnel continuously advance their qualifications; this is done as necessary, but not less than once in five years during the entire employment.

In 2021, total number of education hours of employees of existing nuclear plants was more than 4.7 million man-hours.

Rosenergoatom checks knowledge of its NPP personnel (initial (before an employee is allowed to work independently), routine and out-of-schedule).

The scope of knowledge subject to check is defined in job descriptions, occupational safety procedures, and radiation and fire safety precautions. Employees who substitute for superiors should undergo knowledge checks also in the scope of job descriptions of the positions they are supposed to substitute.

Rosenergoatom has a system for keeping critical knowledge which allows for identifying employees who hold this critical knowledge, preserving and transferring knowledge to young NPP employees, and introducing this knowledge in the personnel professional training system.

The operating experience feedback in training, maintaining and advancing qualifications of the NPP personnel is ensured by:

– inclusion of operating experience topics in the subject schedules of the training and qualification maintenance programs, including operating experience information, investigation reports of NPP operational events, investigation records of occupational injuries, and information about other events;

– annual training of Rosenergoatom's employees in educational establishments using the programs "NPP Event Causes and Work on Investigation Commissions for Event Causes at NPPs" and "The Analyses and Use of NPP Operating Experience";

– inclusion of topics related to analyses of NPP operating experience in education of trainers;

– putting into force in Rosenergoatom "The Training Program of the Personnel Involved in Investigation and Analysis of Causes of Safety and Reliability Significant Events at Nuclear Plants";

– conduct of monthly classes for the personnel on critique of NPP operational events in NPP process divisions;

– ensuring psychological support of the operating personnel who make fateful decisions; to this end organizing lectures, practices and role play.

The work continues to update the personnel training programs, expand training equipment, including fitting new classrooms, upgrade and make new training equipment, and produce training aids considering commissioning of new power units.

JSC SCC uses Rosenergoatom's experience in training and maintaining qualifications of NPP personnel to ensure safety of the NPP under construction.

According to the Convention on Nuclear Safety, the Operating Organizations have the necessary financial resources to enable safe operation of existing NPPs, as well as training of NPP personnel and maintenance of their qualifications. All nuclear plants are staffed with highly qualified personnel.

The qualifications of NPP personnel are maintained employing up-to-date technical training tools, including full-scale and analytical simulators.

Article 12. Human Factor

12.1. Ways to Prevent Human Errors

Rosenergoatom

A continued effort is made to prevent human errors and hence ensure safe operation of nuclear plants. To detect and analyze causes of operational violations at the plants and to draw out corrective and preventive measures, Rosenergoatom has developed and implemented commencing 2011 the "Methodological Guidelines for Analyzing the Causes of Safety-Reliability-Related Events, Fires, Injuries, Damages to Buildings and Structures at Nuclear Plants". The Guidelines were developed taking into account the IAEA ASSET methodology (IAEA-TECDOC-632) and methodology of the Institute of Nuclear Power Operations (INPO), USA (INPO 90-004).

During event investigation at NPPs the psychologist analyses of causes of erroneous actions of personnel from the viewpoint of human performance on an event-specific basis. This helps identify the causes that have led to the human errors and factors (organizational, psychological) that triggered them. The ergonomic characteristics of workplaces at MCR, CCB and other control boards and panels at NPP have been analyzed. The findings are used to make recommendations to enhance lighting, improve the main control room mimic panels, ventilation and the general arrangement of the work places.

The NPPs have an operating experience feedback system in place. All significant upsets in operation of plant systems and components are investigated by a commission. The findings of analysis of the cases that led to the occurrence serve to develop corrective and preventive actions to preclude the recurrence of such events in future. The NPP production divisions conduct monthly debriefings of personnel to discuss operational events that have occurred at the plants.

There is the Information Operating Experience Feedback System of Nuclear Power Plants (IOEFS NPP) to ensure collection, processing, storage, analysis and dissemination of various operating information about Russian and foreign NPPs. The following arrangements have been made at all NPPs:

– training of operating and maintenance personnel using state-of-the-art technical education aids;

– periodic training courses for operating and maintenance personnel to keep their qualifications;

– psychological support to operators making critical decisions (lectures, drills and role playing);

– debriefing on operating failures in NPP equipment and systems with operating personnel;

– workplaces of the personnel, in the first place, control boards (UCR, ESP, CCP etc.) taking account of ergonomic requirements and sanitary guidelines to create comfortable conditions for work;

– layout of equipment to ease operating, maintenance and repair procedures;

– training to develop professionally important personal qualities, such as “Team Work”, “Stress Management in Emergency Situations”, “Self-control Management. Use of STAR Principles (Stop, Think, Act, Review)”, “Building Critical Attitudes and Personal Motivation Targets on Safety Priority”;

– generation of teaching and learning aids.

The personnel carry out the said self-assessment regularly in the framework of activities to prevent and exclude violations and departures at NPPs due to human errors, as per the methodological guidelines “Self-assessment of Operating Safety of Nuclear Plants”.

JSC SCC

To prevent human errors at the stages of design and construction and the further stage of operation of the power unit with RI BREST-OD-300, human errors are accounted for by:

– implementing an automated process control system for operation of the power unit with RI BREST-OD-300;

– development of workplaces of the personnel, in the first place, control boards (UCR, ESP, CCP etc.) taking account of ergonomic requirements and sanitary guidelines to create comfortable conditions for work;

– layout of equipment to ease operating, maintenance and repair procedures and its safety.

To ensure safe operation of the power unit with RI BREST-OD-300 and prevention of human errors during its commissioning and operation, JSC SCC implements the project of the “JSC SCC Training and Information Center”. The Center purpose is:

– the training of operative and maintenance personnel using state-of-the-art engineering aids and effective teaching methods;

– periodic courses for operating and maintenance personnel to maintain their skills;

– the psychological support of operating personnel who make critical decisions;

– the analysis of operation of Russian and foreign NPPs base on oncoming information, including best practice cases as part of international

information systems.

12.2. Administrative, Managerial and Organizational Decisions related to Human Factor

Rosenergoatom has developed and put into force the "Procedure for Organization of Work to Prevent Erroneous Actions of the Personnel", which sets out requirements for organization and conduct of measures aimed at preventing erroneous actions of the nuclear plant personnel, which provide, in particular, for:

– emergency drills of the operating personnel of the plant's essential shops with involvement of psychologists;

– fitting workplaces of the operating and maintenance personnel with visual aids on key principles of STAR (Stop, Think, Act, Review); training in application of STAR principles;

– the use at NPPs standard formats of targeted briefings when executing works under work permits, walk-downs of the equipment and workplaces by operating, maintenance and managerial personnel of the plant with inclusion thereof, among other, the information on potential consequences of wrong or poor quality execution of a given work.

12.3. Role of the Regulatory Body with Regard to Human Performance

In accordance with Article 27 of the Federal Law "On the Use of Atomic Energy", some activities in the field of the use of atomic energy can be performed by employees if they have permits issued by the state safety regulatory bodies.

By its Ordinance, the Russian Federation Government have endorsed a list of plant job positions of nuclear facility employees, for which the staff shall obtain work permits in the area of the use of atomic energy from the Federal Environmental, Industrial and Nuclear Supervision Service. ROSATOM issued an Order endorsing the unified list of positions of nuclear power plant employees who must get permits from the Federal Environmental, Industrial and Nuclear Supervision Service for carrying out works in the field of use of atomic energy.

Job descriptions of positions of nuclear power workers are defined in the Unified Qualification Handbook of Positions of Managers, Specialists and Servants.

One of the mandatory conditions for getting a permit is the absence of medical, in particular, psycho-physiologic contra-indications. The Russian Federation Government endorsed a list of medical contra-indications and a list of job positions, for which the contra-indications are relevant.

According to the “Administrative Regulation on Providing the State Service of Granting Permits to Execute Works in the Field of the Use of Atomic Energy by the Federal Environmental, Industrial and Nuclear Supervision Service”, the permit granting procedure for NPP employees, which allow for introducing proper quality control over NPP personnel training, includes:

- submission of an application to Rostechnadzor and review of the application materials by Rostechnadzor;
- knowledge check of NPP personnel, including practical skills of running the process at full-scope simulators in training centers.

Supervision of activities in the area of the personnel qualifications is regulated by the “Provision on the Federal State Supervision in the Field of the Use of Atomic Energy” endorsed by the Ordinance of the Government of the Russian Federation.

The proficiency level of the plant personnel is assessed through continuous supervision, target and comprehensive inspections of NPPs, analyses of plant operational event investigation reports and annual operational safety assessment reports of nuclear units, corrective measures to prevent reoccurrence of human error. The findings of the above analyses are presented in the annual reports produced by Rostechnadzor.

According to the provisions of the Convention on Nuclear Safety, the Operating Organizations continuously prevents erroneous actions of the personnel that is one of the important measures of safety improvement at NPP.

The Russian Federation has established, at a governmental level, procedures and requirements applied by the Regulatory Body to organize oversight over professional skills of the managerial, operating and other personnel of nuclear plants.

Article 13. Quality Assurance

Rosenergoatom

Given the IAEA Safety Standard (GSR Part 2 “Leadership and Management for Safety”) and FSR (NP-001-15 “General Provisions of Safety Ensuring of Nuclear Plants”) requirements, Rosenergoatom has implemented an integrated control system (ICS). It unites (integrates) as a unified control system all subsystems (functional areas/elements): safety, production, economy, quality, labor protection, environmental protection, physical protection, social responsibility, energy efficiency and other subsystems. ICS is the system for control of the operating organization which purpose is to ensure priority to safety as well as consistency and coherence of actions inside the operating organization. ISU is build up on the quality management principles according to the requirements of ISO 9001:2015 “Quality Management Systems. Requirements”, including the continuous process improvement cycle – the Deming Cycle (PDCA («Plan-Do-Check-Act»)), which is the basis for the process approach. Thus, the system of quality is an ICS basic subsystem.

Rosenergoatom has implemented a process control model. It is a set of interrelated documented and controlled processes aimed at achieving target indicator levels which are achieved when the requirements established for organizations operating nuclear facilities are met. Rosenergoatom’s indicators are divided into 2 groups: safety activity indicators and operating effectiveness indicators. Safety indicators are the priority in making managerial decisions. Annually, the indicators are posted on info-centers of the General Director of Rosenergoatom and NPP directors. Prompt meetings are held and managerial decisions are made based on indicator analysis results. Rosenergoatom’s activities to implement all ICS features and to scale the indicator monitoring system to fit nuclear plants was mentioned in 2018 by experts of the IAEA Corporate OSART Mission as an “encouraged action”. In 2020, this work was completed that was confirmed by IAEA experts during a follow-up visit of the OSART Mission.

In 2021, during the WANO Corporate Peer Review in Rosenergoatom, the well-managed and effective forming up the management system with the use of the Integrated Management System was pointed out as a strong point. It was noted that IMS implemented in Rosenergoatom is a strategic decision of the company for merging all management systems and processes in one system. Owing to it the company performs its mission and achieves goals, especially the main one that is nuclear safety ensuring.

Rosenergoatom has drafted and implemented 11 Policy Statements concerning business areas, including the Policy Statement on quality as well as the Policy Statement on IMS.

The Federal Law “On the Use of Atomic Energy” sets forth responsibility of the Operating Organization for development and implementation of quality assurance programs (QAP NPP) at all stages of the NPP life cycle.

The federal rules and standards “Requirements for Quality Assurance Programs for Nuclear Facilities”, which set forth requirements for structure, content and procedure for drawing out QAP NPP for nuclear facilities are in effect in the Russian Federation. The quality assurance programs are reviewed by Rostechnadzor when it decides on granting licenses for activities in the field of the use of atomic energy. The said programs can be amended only provided the license holder applies to Rostechnadzor for making changes to conditions of the granted license. Conduct of an activity in accordance with the developed QAP NPP is also subject to oversight in frames of inspections and checks conducted by Rostechnadzor.

Once in two years Rosenergoatom carries out scheduled inspections of the fulfillment and performance assessment of fulfillment of QAP NPP of NPP. Also, during inspections, the compliance of NPP activities with the documents “Requirements for Quality Assurance Programs for Nuclear Facilities”, GOST R ISO 9001-2015 “Quality Management Systems. Requirements” and IAEA GSR Part 2 “Leadership and Management for Safety” is found out. The procedure of inspections is set forth in the document “Quality Assurance Programs of Rosenergoatom Concern JSC. Procedure of Drafting, Putting into Force, Audit of Compliance and Accomplishment Performance Assessment”.

Rosenergoatom carries out audits of accomplishment performance assessments of quality assurance programs (QAP) of entities which perform works and render services to the Operating Organization – Rosenergoatom – according to the audit schedule. The audit procedure is set forth in the document “Procedure of Agreement, Audit Conduct and Performance Assessment of Quality Assurance Programs of Organizations Performing Works and Rendering Services to Rosenergoatom Concern JSC”.

In 2020, Rosenergoatom passed re-certification of the quality assurance system. The adherence to the certificate of compliance with ISO 9001:2015 “Management of Nuclear Facilities Design and Construction. Management of Production and Supply of Electric Energy. Production and Supply of Electric Energy” (the certificate expiration date is 25.12.2023). The Certification Authority is DQS – the limited liability company for certification of management systems. DQS Ltd. is the Russian

representation office of the German authority for certification of management systems DQS which is accredited by German authority for accreditation of certification bodies Deutsche Akkreditierungsstelle GmbH (DAkkS). In 2021, the first compliance audit confirmed the valid certificate of Rosenergoatom. Also, in 2021, the certification scope of Rosenergoatom was expanded to cover “Management of Decommissioning and Decommissioning of Nuclear Facilities”.

Quality control (compliance assessment) of NPP equipment important to safety is carried out by an Operating Organization with involvement of specialized organizations according to the federal standards and regulations “Rules of Compliance Assessment of Products for which Requirements Associated with Safety Assurance in the Use of Atomic Energy are Established”. Rosenergoatom regularly performs QAP performance audits of producers of NPP safety important equipment and audits of incoming inspection organizations at NPP sites. An Operating Organization has the right to recall a QAP concurrence following the results of the audit. The producers with recalled QAP concurrence cannot sign contracts for manufacture and supply of products for NPPs in the framework of tenders held by ROSATOM’s organizations in the interests of Rosenergoatom. NPP construction quality audits check for fulfillment of quality assurance programs of the General Contractor in the NPP construction.

To enhance efficiency of measures preventing supplies of products that bear signs of illegal origin to NPPs, Rosenergoatom has put into force the “Provision on Activity to Reveal and Prevent Supply of Products that Bear Signs of Illegal Origin” as well as has worked out measures which ensure timely and objective informing Rosenergoatom’s management about facts which may evidence of illegal origin of the equipment proposed for supply planned to be used at NPP.

For timely information exchange on revealed fake product cases and its rogue suppliers, Rosenergoatom has signed the “Agreement on Cooperation in the Field of Protection of Nuclear Plants from Threats of Fake Product Supplies” with a number of organizations which manufacture and supply equipment intended for NPP needs.

JSC SCC

The management of quality assurance activity at JSC SCC in construction and commissioning of nuclear facilities is carried out in the framework of the existent system of quality management (hereinafter referred to as QMS) which scope of application is set forth in the JSC SCC order.

JSC SCC annually works out measures aimed at enhancing quality and improving QMS to achieve its goals and objectives in quality assurance.

According to the requirements of the Federal Law “On the Use of Atomic Energy”, the Operating Organization (JSC SCC) arranges for drafting and implementing quality assurance programs (hereinafter referred as QAP) at all stages of life cycle of the power unit with RI BREST-OD-300.

According to the requirements of NP-090-11 “Federal Standards and Regulations. Requirement for Quality Assurance Programs for Nuclear Facilities”, the “General Quality Assurance Program for Nuclear Facilities (Power Unit with a Fast Neutron Reactor, On-site Unit for Processing Spent Nuclear Fuel, Fabrication and Re-fabrication of MNUP Fuel) as Part of the Pilot Demonstration Power Complex” QAP(O) 110-08-001-2020 was developed. QAP(O) defines requirements for quality assurance in performance of works in the framework of creation of PDPC facilities which affect PDPC safety as an object of the use of atomic energy at all stages of its life cycle.

Requirements for quality assurance in performance of works and rendering services affecting safety of the power unit with RI BREST-OD-300 at its certain life cycle stages are contained in the worked out local QAPs issues for separate stages of construction and commissioning.

The applicable QAPs have been worked out according to the requirements of:

– NP-090-11 “Federal Standards and Regulations. Requirement for Quality Assurance Programs for Nuclear Facilities”;

– IAEA Safety Guide No. GS-R-3 “The Management System for Facilities and Activities”;

– other fundamental RD and TD for carried out activities.

JSC SCC carries out QAP management according to requirements of:

– P 08-009-2021 “Provisions. Management Procedure of Quality Assurance Programs for Nuclear Facilities in JSC SCC”;

– STO 154-2017 “Integrated Management System. Document Management. Technical Documentation of the Combine. Types. General Requirements”.

The check of QAP for compliance with applicable legislative, legal regulatory acts, regulatory, technical and organizational and administrative documentation and its updating (if necessary) is carried out not less than once a year.

The audit of QAP fulfillment and performance assessment is carried out in accordance with the provision P 08-114-2021 “The Audit

Procedure of Fulfilment of Quality Assurance Programs of JSC SCC and Assessment of Performance of Their Fulfillment".

To provide for quality of performed works and rendered services for OO, JSC SCC carries out audits of fulfillment and assessment of performance of fulfillment of QAPs of contractors.

OO carries out quality assurance of products which are important to safety of the power unit with RI BREST-OD-300 as part of:

– compliance assessment of equipment, complete items, materials, semi-finished products in the scope of federal standards and regulations in the use of atomic energy NP-071-18 "Rules of Compliance Assessment of Products for which Requirements Associated with Safety Ensuring in the field of the Use of Atomic Energy are set forth as well as for their design (including surveys), production, construction, installation, adjustment, operation, storage, transportation, sale, and disposal";

– conduct of incoming inspection of products supplied for JSC SCC in accordance with the requirements of STO 352-2021 "Integrated Management System. Incoming Inspection of Equipment Incoming to JSC SCC. General Requirements";

– conduct of verification of purchased in the scope of the requirements of GOST 24297 "Verification of Purchased Products. Organization of Conduct and Inspection Methods" and (or) supply contracts.

Management of inconsistences found out in performing activities at all life cycle stages of the power unit with RI BREST-OD-300 is carried out in accordance with the Unified Sectoral Procedure for Management of Inconsistences which is approved by the ROSATOM's order with the use of the Unified Sectoral Information System for Management of Quality "EOS-Kachestvo".

Rosenergoatom and JSC SCC pay serious attention to quality assurance issues at all stages of NPP lifecycle being guided by the policy aimed at achieving economically efficient generation and reliable supply of consumers with electric and thermal energy with unconditional observance of nuclear and radiation safety requirements in accordance with the provisions of the Convention on Nuclear Safety.

Article 14. Assessment and Review of Safety

14.1. Safety Review in the Course of Licensing

According to the Federal Law “On the Use of Atomic Energy”, the Operating Organization shall apply for a license to Rostechnadzor at the stages of siting, construction, operation and decommissioning of NPP for the right to carry out said activities.

In the course of the licensing of a certain activity, or making changes to the license conditions, the Operating Organization submits to Rostechnadzor the documents, which justify nuclear and radiation safety of the plant. The composition of the safety justification document package is determined by the “Administrative Regulation on Providing the State Service of Licensing the Activity in the Field of the Use of Atomic Energy by the Federal Environmental, Industrial and Nuclear Supervision Service”. The procedure of safety reviews by Rostechnadzor is described in the sixth National Report.

According to the Federal Law “On the Use of Atomic Energy,” the periodic safety reviews of the plant shall be carried out each 10 years until the plant decommissioning. The Operating Organization has approved a schedule of the periodic safety reviews of the nuclear units, corresponding programs drawn out. Basing on outcomes of the review of the periodic safety analysis report of the NPP power unit, Rostechnadzor confirms (or not confirms) a possibility to continue safe operation of the NPP and the corresponding changes are made to the license conditions for the power unit operation.

14.2. Audits and Inspections during NPP Operation

Pursuant to the requirements of Article 35 of the Federal Law “On the Use of Atomic Energy”, the Operating Organization carries out continued monitoring of the safe operation of nuclear plants. Safety systems and other safety important systems performance is checked periodically.

The Operating Organization and NPPs carry out comprehensive and targeted (risk-oriented) inspections and process audits which main objectives are:

– the assessment of NPPs for compliance with criteria of the IAEA and WANO, comparison with the best foreign practices;

– the assessment of fulfillment of requirements of safety standards, regulations, norms and procedures;

– the performance assessment of measures to ensure and improve safety of NPPs, including those drawn out based on findings of audits of

NPPs by the state oversight and control bodies, international review missions, and based on investigation results of NPP events;

– the assessment of efficiency of the system for NPP safety management, preparation of recommendations to improve the system efficiency;

– the informing of the top management of the Operating Organization and NPPs on safety assessments.

A schedule of NPP audits by commissions of the Operating Organization is compiled annually considering the main goals.

Over the reporting period, inspections were conducted at all NPPs.

To meet the requirements of the "Rules of Nuclear Safety of Reactor Installations of Nuclear Plants" (NP-082-07), the Operating Organization provides for safety inspections of the operation of NPPs not less than each 2 years; comprehensive safety ensurance inspections are carried out at each NPP once in 4 years; targeted safety ensurance inspections are carried out in two years after a comprehensive inspection at each NPP.

Procedures for NPP operating safety assessments and audits are carried out systematically during the entire life cycle of NPP.

14.3. Assessment of the Plant's Equipment Aging during Operation

In the end 2015, the federal standards and regulations "Requirements for Lifetime Performance Management of Pipelines and Equipment of Nuclear Power Plants. Basic Provisions" were put into force. This document sets forth the requirements for lifetime performance management of equipment and pipelines of nuclear plant attributed to Safety Classes 1, 2 and 3. In elaboration of this document, Rostechnadzor in 2017 has produced and approved five safety guides:

– "Identification of Lifetime Performance Characteristics of Valves of Nuclear Plants and Their Monitoring Techniques";

– "Identification of Lifetime Performance Characteristics of Equipment and Pipelines Operating Under Pressure of Nuclear Plants and Their Monitoring Techniques";

– "Identification of Lifetime Performance Characteristics of Pumps of Nuclear Plants and Their Monitoring Techniques";

– "Identification of Lifetime Performance Characteristics of Electrical Equipment of Nuclear Plants and Their Monitoring Techniques"; and

– "Identification of Lifetime Performance Characteristics of Instrumentation, Controls and Automation of Nuclear Plants and Their Monitoring Techniques".

In 2018, Rosenergoatom has worked out the provision "Management of Obsolescence of Structures, Systems and Components of Nuclear

Plants". On the basis of this document, every year NPPs compile lists of components of systems and elements susceptible to obsolescence. Based on the lists, the obsolescence management program is formulated. In particular, the program contains an assessment of effectiveness of measures for the preceding year.

In 2018, "Program of Work to Manage Lifetime Performance Characteristics of Non-metallic Materials Used in Equipment of Nuclear Plants" was put into force. In accordance with the said program, accelerated life tests were conducted to find out ultimate states and lifetime performance characteristics of standard components of electrical equipment and cables. Based on the work results, the methodology of accelerated tests was proven for inclusion in regulatory and methodological documents.

As of the beginning of 2019, the service life management programs were developed for all NPP power units.

In 2022, a new safety guide in the use of atomic energy "Recommendations for Selection of Reference Units of Standards Elements of Electrical Equipment of Nuclear Plants for Performance of Residual Life Management Measures", which establishes the requirement to hold residual life tests to identify limiting states and residual life characteristics for reference (standard) elements of electrical equipment of nuclear plants.

In the period from 2016 until 30.06.2022, Rosenergoatom implemented a number of measures enhancing the equipment lifetime performance management system, including electrical equipment, I&C, cables at the stages of power unit operation, its extended operation and decommissioning. The implementation of the lifetime performance management system is carried out in accordance with the Plan of Organizational and Engineering Measures to Bring NPP Power Units in Compliance with the "Requirements for Lifetime Performance Management of Pipelines and Equipment of Nuclear Power Plants. Basic Provisions".

14.4. Operational Safety Assessment at NPPs

Rosenergoatom has been carrying out, on an annual basis, the operational safety assessments (monitoring) of all operating NPPs in Russia in accordance with the sectoral standard "Provisions for Annual Reports on Assessment of Safe Operation of Nuclear Power Units", specifically:

- the condition of safety systems and other systems and equipment important to safety of NPP;
- the condition of physical safety barriers (including sealed enclosure of the reactor installation);
- radiation situation at the nuclear plant and in the environment;

– implementation of the system and component upgrading programs and assessing the impact of these activities on the power unit safety;

– the level of nuclear, radiation, industrial and fire safety at NPPs;

– operational events and human errors that have occurred at NPPs;

– measures to improve safety and reliability of the NPP power unit for further operation.

Annual NPP operational safety assessment reports approved by Rosenergoatom are submitted to Rostechnadzor for review.

Based on the approved annual reports of the plants, VNIIAES issues summary annual reports on the operational safety of Russia's nuclear units. Such reports are sent to Rosenergoatom and Rostechnadzor. The reports contain results of the analysis of safe operation of all NPPs, trends in changes in safety indicators of NPP power units, and conclusions and recommendations. Based on the reports' information, the Operating Organization arranges for the development and putting into force corrective measures at NPPs (if necessary) to improve efficiency of the activity to achieve Rosenergoatom's strategic safety goals and enhancement of the safety culture level.

The safety assessments of the NPP power units performed in 2016-2021 have shown that the safety of all operating plants is maintained at an acceptable level and measures are in place to further improve plant safety and reliability.

14.5. Accomplishment of PSAs, ISARs, Periodic Safety Reviews of NPP Power Units

In-depth safety assessment reports (ISARs) of NPP units are drawing out as part of service lives extension of reactors in accordance of the requirements of the safety guide in the field of the use of atomic energy "Recommendations for the Content of In-depth Safety Assessment Report for Operating Nuclear Power Plant Units" (RB-001-15). In-depth safety assessments have been done for all NPPs with RBMK-1000, BN-600, EGP-6 reactors, as well as for 11 power units with WWER reactors.

As part of drawing out ISARs, the NPP safety concept is analyzed along with the characteristic of the NPP site, conformance with requirements of standards and regulations, as well as established design bases of safety important systems and components, operational safety issues and safety improvement program of NPP. Also, deterministic analyses of design basis and beyond design basis accidents and probabilistic safety analyses are performed.

Results of Level 1 probabilistic safety analyses (PSA-1) for power units of at-power operating NPPs are updated as of 01.01.2022 and given

for that with pressure-tube and fast neutron reactors in Appendix 10, and that with WWER reactors – in Appendix 11..

Results of Level 2 probabilistic safety analyses (PSA-2) have been updated as of 01.01.2022 for power units of at-power operating NPPs with pressure-tube and fast neutron reactors and are given in Appendix 12, and that with WWER reactors – in Appendix 13.

The additional technical solutions on achieving the safety targets, i.e. total probability of a large emergency release, have been worked out and implemented for power units which feature exceedance of total probability of large emergency release for each NPP power unit in one year equivalent to 10^{-7}, according to the requirements of the federal standards and regulations "General Safety Provisions of Nuclear Power Plants".

According to the provisions of the Federal Law "On the Use of Atomic Energy", the Operating Organization carries out periodic safety assessments of NPP power units. In the reporting period, according to the "Advance Schedule of Performance of Safety Assessment of Nuclear Facilities and Storage Facilities", as of 30.06.2022, the work on periodic safety assessment has been done for Units 3 and 4 of Leningrad NPP, Unit 2 of Kursk NPP, Unit 1 of Rostov NPP and Unit 4 of Balakovo NPP. The assessment of documents containing results of periodic safety assessment of the said power units done by Rostechnadzor has shown that their operating safety was confirmed considering occurred changes in characteristics of the NPP site, ageing processes of the NPP components (including equipment and building structures), carried out upgrades, operating experience, current state of development of science, technology and production as well as changes in requirements of regulatory documents.

14.6. International Independent Peer Reviews of NPP Operation Safety

IAEA OSART Missions

OSART missions are invited based on a long-term OSART missions plan (until 2023) agreed with the IAEA. In 2019, as agreed with the IAEA, this long-term plan was extended until 2031.

In the reporting period (August 2016 – June 2022), the Russian Federation accepted three OSART missions and three OSART follow-up visits. Information on conducted OSART missions is given in the table below.

	Mission type	Dates	Results
Novovoronezh NPP	follow-up visit	May 2017	Problem solved – 5 Adequate progress – 5
Leningrad NPP	mission	November 2017	Recommendations – 0 Proposals – 7

			Good practice – 4
Leningrad NPP	follow-up mission	May 2019	Problem solved – 5 Adequate progress – 2
Rosenergoatom (corporate)	mission	November 2018	Recommendations – 1 Proposals – 5 Good practice – 3
Rosenergoatom (corporate)	follow-up mission	October 2021	Problem solved – 4 Adequate progress – 2
Kalinin NPP	mission	November 2021	Recommendations – 1 Proposals – 7 Good practice – 2

Based on the OSART mission, Leningrad NPP has developed and put into force a plan of measures to implement the mission proposals. This plan was completed by the time of the follow-up visit in May 2019. This also confirmed full implementation of five proposals of the OSART mission and adequate progress in implementation of other two. The similar approach was applied for implementation of the recommendation and proposals of the OSART mission held at Kalinin NPP in November 2021.

Following the results of each OSART mission, the revealed deficiencies are analyzed, and necessary improvements are carried out in the entire fleet of NPP but not only at the plant where they were revealed.

In November 2018, Rosenergoatom received an OSART corporate mission. The OSART mission experts studied performance indicators of the Operating Organization and visited three nuclear power plants. Following the mission results, they formulated one recommendation and five proposals as well as pointed out three good practices.

The recommendation concerned the implementation of severe accident management guides and additional I&C&A operable in conditions of severe accidents at all NPPs.

Proposals concerned, in particular, more critical consideration of the current state of things and securing the management expectations, increase in number of indicators for M&R performance assessment and development of additional measures for operating experience feedback for prevention of event recurrence.

The OSART team noted as good practice examples the use of a computerized information simulator for training of communication service workers, early publication of the procurement plan, and the use social networks in crisis situations.

As a result of the corresponding OSART follow-up visit of October 2021, it was found out that the Operating Organization comprehensively analyzed the recommendation and proposals, and drew out and implemented corresponding plans of corrective actions. In some cases the coverage of such corrective actions was large than the initial

recommendations and proposals of the OSART Corporative Mission. It was determined that the Operating Organization fully solved four issuers of concern associated with independent oversight of the Operating Organization, management of M&R indicators, improvements of the operating feedback program and procurement of products and services related to nuclear production. The OSART follow-up visit team also found out adequate progress in solution of two other issues of concern associated with critical review of current state of things and securing management expectations, as well as implementation of severe accident management guides and emergency I&C&A at all NPPs.

According to the long-term plan of OSART missions, the next OSART mission is planned at Beloyarsk NPP (BN-800) in 2023.

WANO Peer Reviews and Support Missions

WANO peer reviews are carried out in accordance with the schedule of the WANO Moscow Center based on 4-year cycle. Two years after a peer review at a plant the second peer review is conducted. Thus, in the reporting period all operating plants underwent the full cycle of WANO peer reviews. In addition, at commissioned power units WANO carries out pre-startup peer reviews.

Information on WANO peer reviews carried out in the reporting period and planned for near term is given in the table below.

Place	Year		
	Peer review	Follow-up peer review	Pre-startup peer review
Balakovo NPP	2019	2017 2021	
Bilibino NPP	2019	2017 2021	
Beloyarsk NPP	2016 2021	2018	
Kalinin NPP	2018 2022*	2017 2020	
Kursk NPP	2017 2022	2019	
Kola NPP	2017 2021	2019	
Leningrad NPP	2018	2016 2020	2017 (Unit 1 LNPP-2)

	2022*		2020 (Unit 2 LNPP-2)
Novovoronezh NPP	2016 2021	2018	2018 (Unit 2 NVNPP-2)
Rostov NPP	2018 2022*	2020	2017 (Unit 4)
Smolensk NPP	2017 2021	2019	
Rosenergoatom (corporate)	2021		

** - the peer review is planned for the second half of a year 2022.*

Following the results of peer reviews conducted in the reporting period, the most areas for improvement (AFI) were identified in the following business areas: maintenance and repair, operation, production improvement, personnel training, focus to operation, and reliability of equipment.

With this, most of strong and weak points were found out in the following areas: maintenance and repair, engineering and technical support, operation and effective organization.

Based on the results of WANO pre-startup peer reviews in the reporting period, most of AFI were found out in productions: operations, organizational structure and administrative management, and fire protection.

Following the results of each peer review and based on an Operating Organization's directive, the following is done:

– drafting and performance of corrective actions for NPPs aimed at elimination of root causes and factors facilitating AFIs;

– self-check at all Russian NPPs to prevent similar AFIs at NPPs; the development of preventive corrective actions (as necessary);

– control of fulfillment and performance assessment of corrective actions by OO.

The Corporate Peer Review (CPR) of Rosenergoatom carried out in 2021 included a pre-study visit to Beloyarsk NPP (2019) and a visit of a team of experts of the Headquarters of Rosenergoatom and eight NPPs (off-line) to Bilibino NPP (by videoconferencing).

By results of CPR WANO, four AFIs were revealed in corporate governance (2 AFIs), corporate oversight and monitoring, corporate support, as well as two strong points in corporate leadership, corporate management of human resources and development of leaders. Rosenergoatom has developed a plan of corrective measures aimed at eliminating these deficiencies in the areas for improvement with total time of fulfillment until 2024 (until the WANO CPR follow-up visit).

In the reporting period, Rosenergoatom held 111 WANO support missions. Most of support missions were requested by plants to help eliminating deficiencies revealed during peer reviews, and the rest of them as a result of self-assessment of its operating state by NPP.

International Insurance Inspections

The International Insurance Inspections (IIIs) of Russian NPPs are carried out by the Russian Nuclear Insurance Pool jointly with nuclear insurance pools of other countries in the framework of the International Pooling System. The IIIs evaluate insurance risks of Russian NPPs and risks of follow-up re-insurance of property risks and risks of civil liability for nuclear damage of Rosenergoatom in foreign nuclear insurance pools.

In the reporting period, international insurance inspections conducted by engineering teams the International Pool in accordance with the Insurance Inspection Schedule approved by the governance bodies of the International Pooling System. Also, at the plants the fulfillment of recommendations of previous inspections at these NPPs was checked. The recommendations are not mandatory and point out way of reducing potential insurance risks.

A list of international insurance inspections carried out in the reporting period is given in the table below.

NPP	Date
Novovoronezh	October 2016
Rostov	October 2017
Smolensk	October-November 2017
Beloyarsk	October 2016
Kalinin	October 2018
Balakovo	August 2019
Leningrad	September 2019
Kola	August 2021
Kursk	September 2021

International Independent Expert Reviews

In the reporting period, the expert review of the Russian design of WWER-TOI for its compliance with the requirements of European operators (EUR) was completed. Correspondence of approaches to

justification of safety of the WWER-TOI design to these requirements was confirmed by the international certificate of compliance EUR issued in 2019.

14.7. NPP Safety Inspections by Rostechnadzor

According to the "Provisions on the Federal State Supervision in the Field of the Use of Atomic Energy", two kinds of scheduled audits (inspections) are provided: comprehensive inspections of NPPs organized by Rostechnadzor's Headquarters and targeted inspections of NPPs which are carried out by ITD for supervision of nuclear and radiation safety of Rostechnadzor. Comprehensive inspections of NPPs are organized by Rostechnadzor's Headquarters and, in accordance with the approved schedules, are carried out once in three-four years at each NPP. In time between comprehensive inspections, interregional territorial departments for supervision of nuclear and radiation safety conduct targeted inspections of separate issues following the results of current level of NPP safety.

In the period 2016-2021, Rostechnadzor conducted the following inspections:

- in 2016: Rosenergoatom, at Balakovo NPP, Beloyarsk NPP;
- in 2017: Leningrad NPP, Kursk NPP, Kalinin NPP;
- in 2018: Novovoronezh NPP, Rostov NPP, Smolensk NPP;
- in 2019: Kola NPP, Beloyarsk NPP, Bilibino NPP;
- in 2020: Balakovo NPP, Leningrad NPP, Rosenergoatom;
- in 2021: Kalinin NPP, Kursk NPP.

Comprehensive inspections are planned at Bilibino NPP, Novovoronezh NPP and Smolensk NPP for 2022.

In the reporting period, along with scheduled inspections of NPPs, the following off-the-schedule inspections of NPPs were conducted:

- in 2016: an off-the-schedule inspection of preparedness to the first criticality of Unit 1 of Novovoronezh NPP-2;
- in 2017: an off-schedule inspection of preparedness to the first criticality of Unit 1 of Leningrad NPP-2 and an off-schedule inspection of preparedness to the first criticality of Unit 4 of Rostov NPP;
- in 2018: an off-schedule off-site inspection of preparedness to the first criticality of Unit 2 of Novovoronezh NPP-2; three off-schedule inspections to check the fulfillment of the previously given notice to Rosenergoatomв;
- in 2020: an off-schedule targeted inspection of JSC SCC preparedness to conduct the declared activity and an off-schedule targeted inspection of preparedness of Rosenergoatom to the first criticality of the reactor of Unit 2 of Leningrad NPP-2;

– in 2021: three off-schedule targeted inspections of Rosenergoatom aimed at inspecting fulfillment of points of previously issues notices.

Following the results of inspections, a record and report are generated where found out violations are described. The information on inspection findings is put in the federal state information system “Unified Register of Inspections”, which is operated by the Prosecutor General's Office of the Russian Federation. The specialized Internet website posts the publicly accessible information from the Unified Register of Inspections.

The Ordinance of the Government of the Russian Federation endorsed the “Provisions for Continuous State Supervision Regime at Nuclear Facilities”. The continuous state supervision regime assumes continuous presence of authorized officers from Rostechnadzor at nuclear facilities and conduct of safety monitoring there by them at all times. In accordance with the Ordinance of the Government of the Russian Federation, heads of organizations (branches) which operate higher hazard facilities (nuclear facilities) should give such persons unhindered access to the facility, documents and safety controls.

The operational safety assessments of nuclear plants in the Russian Federation, including international reviews, regular comprehensive and targeted inspections conducted by Rostechnadzor, as well as the control measures as part of the continuous supervision, confirm proper safety level of nuclear power plants and meet the requirements of the Convention on Nuclear Safety and principles of the Vienna Declaration on Nuclear Safety.

Article 15. Radiation Protection

15.1. Radiation Protection Laws, Standards and Regulations

The following federal laws and legal regulatory documents govern the radiation protection of the nuclear plant personnel, the public and the environment in the Russian Federation:

- Federal Law “On the Use of Atomic Energy”;
- Federal Law “On the Radiation Safety of the Public”;
- Federal Law “On the Environmental Protection”;
- Federal Law “On Sanitary and Epidemiologic Well-Being of the Public”;
- “Radiation Safety Standards”;
- “Basic Sanitary Rules for Ensuring Radiation Safety”;
- “General Safety Provisions of Nuclear Power Plants”;
- “Sanitary Rules for Design and Operation of Nuclear Plants”;
- “Rules of Radiation Safety in Operation of Nuclear Power Plants”;
- other regulatory documents in the field of radiation safety.

The Federal Law “On the Radiation Safety of the Public” sets forth the basic principles of radiation safety ensuring:

- the principle of dose limitation: the doses of human exposure to all ionizing radiation sources shall not exceed the allowable individual dose limits;
- the principle of justification: any activity involving the use of ionizing radiation sources, in which the benefit for humans and the society does not exceed the risk of potential harm due to the exposure in excess of the natural background levels, shall be prohibited;
- the principle of optimization: the individual exposure doses and the number of individuals exposed to any ionizing radiation source in use shall be kept as low as reasonably achievable given economic and social factors.

The values of the major exposure dose limits regulated by the Federal Law “On the Radiation Safety of the Public” do not include doses from the natural radiation and technologically changed radiation background, as well as doses received by individuals (patients) subjected to medical X-ray examination procedures and therapy.

According to the Federal Law “On the Environmental Protection”, the radioactive releases and discharges into the environment shall be permitted in the limits set by standards based on Rostechnadzor’s permits.

The “Radiation Safety Standards” and “Basic Sanitary Rules for Ensuring Radiation Safety” formulate principles of radiation safety ensuring, general requirements for organizations and conduct of health

physics monitoring of the personnel exposure, requirements and guidelines of ionizing radiation impacts.

As required by the "Radiation Safety Standards", the annual exposure dose limits during normal operation are specified based on the following values of individual lifetime risk: $1.0 \cdot 10^{-3}$ for personnel and $5.0 \cdot 10^{-5}$ for the public that corresponds to recommendations of competent international organizations (ICRP, IAEA). To justify the protection against the potential exposure during the year, the following values are assumed as the generalized risk limits (the product of the probability of an event leading to exposure and the probability of lethality caused by exposure): $2.0 \cdot 10^{-4}$ 1/year for personnel and $1.0 \cdot 10^{-5}$ 1/year for the public.

15.2. Radiation Impact on Nuclear Power Plant Personnel

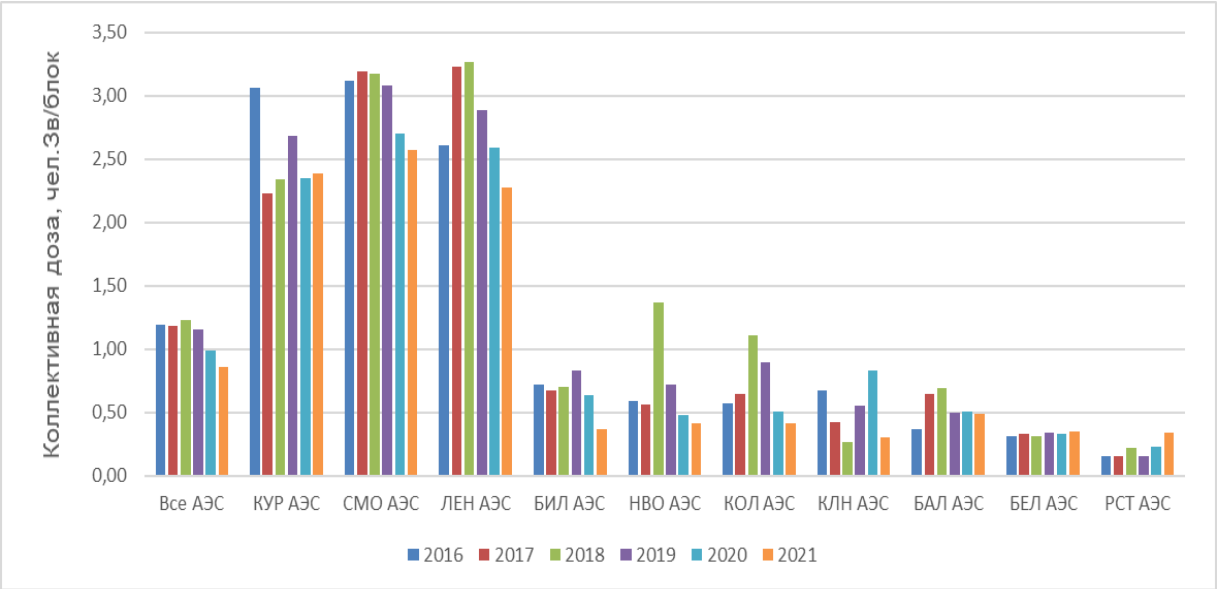
The radiation safety ensuring of the NPP personnel, as well as the prevention of radioactive contamination of the environment above permissible guidelines regulated by radiation safety standards, are the priority tasks in the field of the use of atomic energy.

Proceeding from the principles of ensuring radiation safety adopted by international community, Rosenergoatom coherently pursues at nuclear plants the policy of introducing and implementing the radiation safety optimization methodology which consists of keeping the exposure doses for personnel and the number of exposed persons as low as reasonably achievable given economic and social factors.

The organizational and engineering measures undertaken at nuclear plants have resulted in the trend of reduction of the personnel exposure at NPPs.

Over the recent 10 years, the decrease in 1.4 times has been achieved at all NPPs.

The results obtained to date have been achieved in the conditions of significant increase in scope of radiation-hazardous works related to service life extension of power units at most of Russian NPPs and recovery of lifetime characteristics of graphite stack at NPPs with RBMKs (see Fig. 15.1).



Collective exposure dose, man·Sv/unit
All NPPs; KUR NPP; SMO NPP; LEN NPP; BIL NPP; NVO NPP; KOL NPP; KLN NPP; BAL NPP; BEL NPP; RST NPP

Fig. 15.1. Collective exposure doses at Russia's NPPs 2016-2021

An increase in collective exposure dose at Novovoronezh NPP in 2018 was due to work to extend service life of Unit 4 and two intermediate repairs at Units 5 and 6. An increase in collective exposure dose at Kola NPP in 2018 was due to works to extend service life of Unit 1. An increase in collective exposure dose at Kursk NPP in 2019 was due to work to restore lifetime characteristics of the reactor plants of Units 1, 2 and 3. An increase in collective exposure dose at Kalinin NPP in 2020 was due to work to extend service life of Unit 1. An increase in collective dose at Rostov NPP in 2021 was due to radiation-hazardous work at all power units (Unit 2 IWP and intermediate repairs of Units 1, 3 and 4).

Basic dose limits equal 50 mSv per year and 100 mSv for any successive five years were not exceeded at any of NPPs. Individual exposure doses of 90% of NPP personnel do not exceed 5 mSv per year.

In the period 2016-2021, like in preceding years, Russian NPPs did not suffer incidents with radiation consequences. There were not cases of unauthorized inflow of radionuclides into the environment.

For the purposes of enhancing radiation safety level at NPPs in conditions of increasing the radiation-hazardous work volume, the Program for Optimization of the NPP Personnel Radiation Protection is implemented. The program provides for implementation of a set of measures to improve the organization of conduct of radiation-hazardous works, improve the radiation situation at NPP equipment and in rooms, reduce the personnel exposure time to ionizing radiation fields, and

improve the instrumental and methodological support to radiation monitoring.

15.3. Radiation Impact on the Public and Environmental Monitoring

Main factors of radiation impact of nuclear plants on the public and environment include radioactive releases from NPPs to the atmospheric air and discharges of man-made radionuclides in water reservoirs. The radiation impact of releases and discharges on the public and environment is limited to guidelines of permissible releases of radioactive substances in the atmospheric air and guidelines of permissible discharges of radioactive substances in water reservoirs established by Rostechnadzor for each NPP. Releases and discharges of radioactive substances are carried out within the limits for the said guidelines based on Rostechnadzor's permits for releases and discharges of radioactive substances in the environment. Radiation safety departments of nuclear plants carry out continuous monitoring of observance of the guidelines.

To optimize the public exposure doses due to releases and discharges in the environment from NPPs, in 2016-2021 the plans of measures were implemented to improve guideline setting, control and accounting of releases and discharges of radioactive substances in the environment:

– Plan of Measures on Guideline Setting, Control and Accounting of Releases of Radioactive Substances in the Atmospheric Air at NPPs; and

– Plan of Measures on Guideline Setting, Control and Accounting of Discharges of Radioactive Substances to Water Reservoirs from NPPs.

In the framework of the said plans the following have been done: the input data for calculation of release (discharge) guidelines and lists of rated radionuclides were updated, the planned revision of release and discharge guidelines was conducted, and the radiation monitoring system of releases and discharges at all NPPs was modernized.

Radiation monitoring of the environment is a mandatory constituent of radiation monitoring at NPP. Arrangements for radiation monitoring (volume, frequency, monitoring points, employees, accounting of results) at NPP are defined in the corresponding regulations agreed upon with regional departments of FMBA of Russia. Besides, an independent random radiation monitoring of the environmental objects and locally produced food is carried out by regional departments of FMBA of Russia.

Radiation monitoring of environmental objects includes:

– monitoring of the gamma radiation dose rate and the annual dose on the terrain (carried out continuously in the territories of the controlled area and surveillance zone of NPP);

– monitoring of contamination of the atmospheric air, soil, vegetation and surface water reservoirs; and;

– monitoring of local food and fodder contamination.

Fixed monitoring posts are predominantly based in settlements or at locations accessible for maintenance throughout the year. Monitoring posts are deployed relative to the NPP with regard to the wind directions prevailing in this locality. Samples of the environment are taken in the controlled area and surveillance zone of NPP.

Environmental monitoring is carried out in automated mode using the automated radiation monitoring system (ARMS). Information is transmitted to the Unified State Automated Radiation Monitoring System in the territory of the Russian Federation.

NPPs continuously monitor radiation protection of NPP personnel, and population and inflow of radioactive substances in the environment. Monthly, quarterly and annual reports of NPPs on monitoring results are submitted to regulatory bodies and operating organization.

There are no cases of unauthorized ingress of radionuclides in the environment at NPPs. The actual gas-aerosol releases and discharges of radioactive substances during normal operation of the NPP units were much below the permissible release and discharge guidelines both in the reporting period and in the previous years. Such releases and discharges of radionuclides from NPPs into the environment create insignificant exposure of the population in hosting regions of nuclear plants. Radiation risks for the public due to scheduled off-site radionuclide releases during normal operation are acceptable and lead to an exposure dose of less than 10 μSv/year (a risk of less than 10^{-6} 1/year).

The analysis results of regular radiation situation monitoring in the nuclear plant hosting regions and measurements of activity of radionuclides in air, water, soil, bottom sediments, vegetation, animal organisms and foodstuffs confirm absence of adverse effects of NPP operation on the health of people and the state of the environment.

15.4. Supervision over Radiation Protection of NPP Personnel, Public and Environment

According to the Ordinance of the Government of the Russian Federation of 03.07.2006 “On the Federal Executive Bodies and Authorized Organizations, which Exercise the State-Level Control of the Uses of Atomic Energy and the State-Level Regulation of Safety in the Use of Atomic Energy”, the state-level safety regulation in the use of atomic energy is exercised by Rostechnadzor (as part of licensing of activities in the use of atomic energy and supervision of nuclear and radiation safety of nuclear plants), EMERCOM of Russia (as part of the state-level regulation

of fire safety), Minprirody of Russia and Rosprirodnadzor (as part of the state-level monitoring of radiation situation in the territory of the Russian Federation), Rospotrebnadzor (as part of the state-level sanitary and epidemiological control) and FMBA of Russia (as part of the supervision of radiation safety of nuclear facility workers and the public).

According to the Ordinance of the Government of the Russian Federation 23.07.2004 "On the Federal Hydrometeorological Service and Monitoring of the Environment", Rosgidromet (is a subordinate organization of Minprirody of Russia in accordance with para. 2 of the Ordinance of the Government of the Russian Federation of 11.11.2015 "On the Approval of the Provision on the Ministry of Natural Resources and Ecology of the Russian Federation and on Amendment and Revocation of Certain Acts of the Government of the Russian Federation) carries out the state-level monitoring of radiation situation in the territory of the Russian Federation.

According to the "Provision on the Federal State Sanitary and Epidemiological Control (Supervision)" approved by the Ordinance of the Government of the Russian Federation of 30.06.2021, the federal state sanitary and epidemiological control (supervision) is exercised by Rospotrebnadzor; with that, in organizations of certain sectors of industry featured specially hazardous labor conditions and in territories of the Russian Federation according to the list established by the Directive of the Government of the Russian Federation of 21.08.2006, the supervision if exercised by FMBA of Russia. NPPs are included in the said List and, as a consequence, are subject to control by FMBA of Russia. In the reporting period, territorial bodies of FMBA of Russia carried out:

- in 2019 – 10 scheduled inspections of NPPs;
- in 2020 – 7 scheduled inspections of NPPs;
- in 2021 – 8 scheduled inspections of NPPs.

Scheduled inspections included, in particular, control of contamination with radioactive substances of working rooms and individual protection equipment of personnel and dose rate at working places, as well as radioactive substances and adverse chemicals control in the air the working area, in the atmospheric air, water and soil of the controlled area and surveillance zone, including gamma background monitoring. The scheduled inspections conducted did not revealed cases of exceeding main dose guidelines to the personnel and public.

Rostechnadzor and FMBA of Russia have concluded an agreement on interaction in the field of the state-level regulation of radiation safety in the use of atomic energy (hereinafter referred to as the Agreement), which divide their authorities:

– FMBA regulates radiation safety of nuclear workers and the public. At this, radiation safety of the personnel and public is understood as the state of their protection against adverse impact of ionizing radiation;

– Rostechnadzor regulates nuclear, radiation and industrial safety of nuclear facilities. At this, radiation safety of nuclear facilities is understood as a property, achievable by engineering features and administrative measures, of a nuclear facility in normal operation and operational violations (including accidents) to limit radiation impact on the personnel, public and environment by established guidelines.

In the Russian Federation the supervision of radiation safety of nuclear plant personnel, which is conducted by Rostechnadzor, is based on provisions of legal regulatory acts included in Section II “The State Regulation of Safety in the Uses of Atomic Energy” of the List of Legal Regulatory Acts and Regulatory Documents Related to Activities of the Federal Environmental, Industrial and Nuclear Supervision Service, which was approved by the Order of Rostechnadzor of 04 February 2022.

According to the Provision on the Federal State Supervision in the Use of Atomic Energy approved by the Ordinance of the Government of the Russian Federation of 15.12.2012, while conducting the state-level supervision in the field of the use of atomic energy, Rostechnadzor shall verify, inter alia, the observance of the requirements of the federal standards and regulations in the field of the use of atomic energy which establish goals and main criteria of nuclear plant safety, as well as basic principles and requirements to engineering and administrative measures aimed at achieving safety.

For example, when exercising the supervision in the field of the use of atomic energy, Rostechnadzor verifies compliance with requirements of the federal standards and regulations in the field of the use of atomic energy of radiation monitoring systems and ventilation systems of NPPs, engineering and administrative measures in the management with radioactive waste that is an important aspect of radiation safety ensuring of the personnel, population and environment.

Also, the federal standards and regulations in the field of the use of atomic energy set forth as NPP safe operation criteria the observance of the guidelines for maximum permissible releases of radioactive substances in the atmospheric air and maximum permissible discharges in water reservoirs established for each NPP by permits issued by Rostechnadzor. The guidelines are established for radionuclides included in the List of Contaminants which are Subject to Measures of the State Regulation in the Field of Environmental Protection approved by the Ordinance of the Government of the Russian Federation of 08.07.2015.

According to the provisions of the Federal Law “On the Protection of the Atmospheric Air” and the “Rules of the Development and

Establishment of Permissible Radioactive Substance Release Guidelines, Permissible Radiative Discharge Guidelines, as well as Granting Permits for Releases of Radiative Substances and Discharges of Radioactive Substances" approved by the Ordinance of the Government of the Russian Federation of 26.06.2018 (hereinafter referred to as the Rules), Rostechnadzor approves methodologies for development of guidelines for permissible releases and guidelines for permissible discharges.

The procedure for development of radioactive substance releases and discharges guidelines is regulated by the Methodology of Development and Establishment of Guidelines for Maximum Permissible Releases in the Atmospheric Air approved by the Order of Rostechnadzor of 07.11.2012 (hereinafter referred to as the Methodology PDV-2012) and Methodology of Development and Establishment of Guidelines for Maximum Permissible Discharges in Water Reservoirs for Water Users approved by the Order of Rostechnadzor of 22.12.2016 (hereinafter referred to as the Methodology DS-2016), which are mandatory for application based on para. 3 of the Rules.

According to the Rules, permits for releases and discharges of radioactive substances are valid for 7 years. With that, if conditions affecting the radiation situation change and/or the technology changes as provided by the Methodology PDV-2012 and the Methodology DS-2016, the guidelines, and consequently, the permits for releases (discharges) of radioactive substances are subject to off-schedule revision.

Information about actual annual releases and discharges of NPPs is given in yearly annual reports on the assessment of the state of safe operation of NPP power units, as well as annual reports on radiation situation in the territory of the Russian Federation issued by FSBI "SPA Taifun" and posted on the official website of the organization at (https://www.rpatyphoon.ru/).

According to the provisions of the Convention on Nuclear Safety, radiation protection of the NPP personnel, the pubic and the environment during normal operation of nuclear plants is ensured in the Russian Federation. The personnel exposure doses do not exceed the specified standard values. The additional radiation risk that is created by radiation impact of NPPs on the public and the environment during normal NPP operations due to gas and aerosol releases and liquid discharges is acceptable.

Article 16. Emergency Preparedness

16.1. Regulation of Emergency Preparedness on NPP Site and Beyond

The protection of the personnel and the public in the event of accidents at NPPs in Russia is regulated by a number of regulatory requirements. These regulatory requirements have been developed based on Russian and international experience and take into account the recommendations contained in the IAEA Safety Guide GSR Part 3, GSR Part 7 and ICRP Recommendations of 2007 (Publication 103).

The Russian Federation is a party to international agreements (conventions) that deal with issues of emergency preparedness, including accidents with transboundary effects:

– Convention on Environmental Impact Assessment in a Transboundary Context, 1991;

– Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency, 1987; and;

– Convention on Early Notification of a Nuclear Accident, 1986.

The issues of emergency preparedness on and outside the NPP sites are regulated by the following legal regulatory acts:

– Federal Law “On the Use of Atomic Energy”;

– Federal Law “On the Protection of the Public and Territories against Natural and Man-Induced Emergencies”;

– Federal Law “On the Radiation Safety of the Public”;

– “Regulation on the National System for the Prevention and Elimination of Emergencies”;

– “General Safety Provisions of Nuclear Power Plants”;

– “Regulation on the Declaring of Emergency, on Early Notification and on Organization of Urgent Assistance to Nuclear Plants in the Event of Radiation Hazards”;

– “Model Content of an Action Plan for the Personnel Protection in Case of a Nuclear Plant Accident”;

– “Radiation Safety Standards”;

– “Basic Sanitary Rules for Ensuring Radiation Safety”.

As noted in the earlier National Reports of the Russian Federation, the above regulatory documents have the aim of preventing the occurrence and progression of emergencies and reducing the associating damage.

16.2. Implementation of Emergency Preparedness Measures; Emergency Preparedness Plans of NPPs

In accordance with effective laws and regulations, a national system for prevention and management of emergencies (RSChS) has been

established in the Russian Federation, for which the standing management body is the Ministry of the Russian Federation for Civil Defense, Emergencies and Elimination of Consequences of Natural Disasters (EMERCOM of Russia). RSChS consists of functional and territorial subsystems and operates at the federal, interregional, regional, municipal and facility levels (see Fig. 16.1). It covers all territories (regions) of Russia. The RSChS daily management body is the National Crisis Management Center (NCMC) of EMERCOM of Russia.

Uniform National System for Prevention and Elimination of Emergencies (RSChS)

RSChS	=	Functional subsystems	+	Regional subsystems
Federal level		Top management of ministries, agencies, organizations of Russia		EMERCOM of Russia
		Emergency commissions		NCCM
		Emergency centers		EMERCOM forces (CD troops under Central Command)
Regional level		Management of regional divisions		GOChS regional center
		Emergency commissions		TsUKS
		Emergency centers		Forces of RC GOChS (CD troops)
Territorial level		Management of territorial divisions		EMERCOM's MD for Subject
		Emergency commissions		TsUKS
		Emergency centers		Governments of RF subjects
				Emergency and IS commissions
Facility level		Management of organizations (facilities)	Municipal level	Management of GOChS
		Emergency commissions		DDS

		Emergency centers		Administration of municipalities
				Emergency and IS commissions

Fig. 16.1. The structure of the Uniform National System for Prevention and Elimination of Emergencies

In keeping with the Federal Law “On the Protection of the Public and Territories against Natural and Man-Induced Emergencies”, the Ordinance the Government of the Russian Federation approved the classification of natural and man-induced emergencies. According to this classification, all emergencies, considering sizes of the emergency area, are divided into local, municipal, inter-municipal, regional, inter-regional and federal emergencies.

EMERCOM of Russia provides for the interfaces and coordinates the activities of force and capabilities of the state executive bodies (including Rostechnadzor), local administrations and organizations in eliminating consequences of NPP accidents and operational management off-site the plants. EMERCOM of Russia organizes the training and engagement of emergency response and rescuing squads for the early localization and elimination of consequences of emergencies.

To prevent and eliminate emergencies at nuclear plants and other facilities of the nuclear power complex, an industry-level system for prevention and elimination of emergencies (OSChS), which is a functional subsystem of RSChS (see Fig. 16.2), has been set up and is in operation within ROSATOM. As specified by the OSChS Provisions, the plant (site) systems for prevention and elimination of emergencies operate at all operating nuclear plants. The structure of the sectoral emergency prevention and elimination system at nuclear plants is given in Fig. 16.2.

The structure of the system of prevention and elimination of emergencies being built at the power unit with RI BREST-OD-300 in Seversk is constructed functionally in accordance with requirements to the subsystem for prevention and elimination of emergencies of ROSATOM. The Crisis Center at the level of the Operating Organization will be built at JSC SCC and will correspond to all regulatory requirements and Russian law.

ROSATOM's functional subsystem for prevention and elimination of emergencies

Common Information Space Video conferencing system and special data transfer system	ROSATOM	Sectoral level
	Situation and Crisis Center	+Sectoral Emergency and IS Commission
	Rosenergoatom	Operating Organization level
	Crisis Center	+ Emergency and IS Commission of Rosenergoatom
		+ OPAS Group
	NPPs	Nuclear plant level
	Shielded emergency action management posts in the territory of NPPs	NPP emergency and IS commission

Fig. 16.2. Sectoral emergency prevention and elimination system at nuclear plants

At the level of the Operating Organization, the Team for Emergency Assistance to Nuclear Plants (OPAS) coordinates activities with other organizations participating in response to radiation accident or radiation-hazardous situation, as well as in case of emergencies due to man-induced and natural factors, threat of terrorist acts which may entail a radiation accident (see Fig. 16.3).

Operating Organization level: force and capabilities of the emergency response system of Rosenergoatom

			Head of OPAS Team		Materiel and financial reserves		
					Centralized financial reserves, OPAS Group's equipment		
Expert teams			Management group		Centralized set of emergency stock		
Reactor installation	Radiation safety and protective measures	Engineering support and fire safety			Stocks at NPs		
ESC	ESC	ESC	Functional groups				
ESC	ESC	ESC	CC and OPAS fractioning support		Support group	Emergency rescue and other urgent operations	
…			Special safety		Interaction with regulators	RCC function support	Interaction with mass media
ESC	ESC	ESC					
Engineering support							

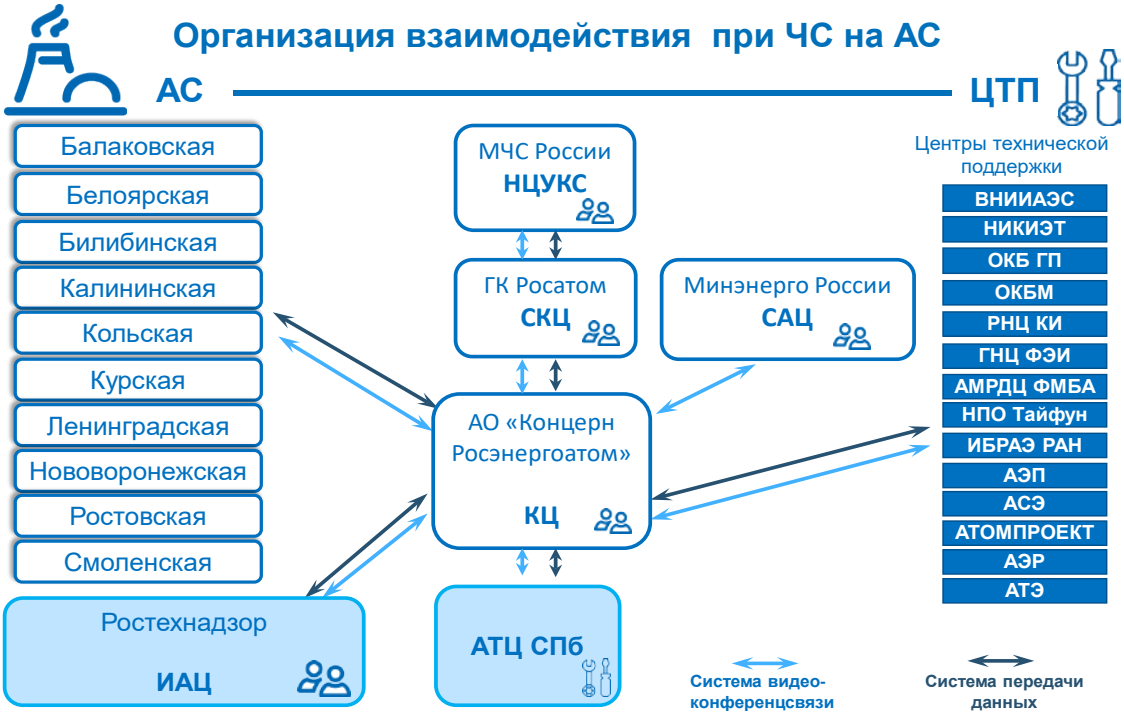
Fig. 16.3. The structure of the Team for Emergency Assistance to Nuclear Plants (OPAS)

The key elements in the system of the emergency support to NPPs are the Crisis Center (CC) of Rosenergoatom, the Situation and Crisis Center (SCC) of ROSATOM, the Information and Analysis Center (IAC) of Rostechnadzor, and Technical Support Centers (TSC) set up within design and development organizations and the leading Russian institutes and enterprises. Activities of SCC, CC, IAC and TSC are well coordinated. The centers operate round-the-clock.

The Crisis Center (CC) of JSC SCC is planned to be build up before the first criticality of the power unit with RI BREST-OD-300.

At the facility (plant) level, the nuclear plant director is responsible for the activities to prevent and eliminate emergencies within the plant's controlled area and for implementing the "Action Plan for the Personnel Protection in the Event of a Nuclear Plant Accident".

The procedures for taking measures to ensure the emergency preparedness of Russian NPPs and for putting into operation the "Action Plan for the Personnel Protection in the Event of a Nuclear Plant Accident" are defined in the federal standards and regulations in the field of the use of atomic energy the "Provision on the Declaring of Emergency, on Early Notification and on Organization of Urgent Assistance to Nuclear Plants in the Event of Radiation Hazards" which state values of dose rates in rooms and in the territory of a nuclear plant, controlled area and surveillance zone, at which the "Alert" and "Emergency" states at NPPs are declared. The scheme of information interaction in emergency at NPPs is given in Fig. 16.4.



Organization of interaction in emergency at NPP

NPP			ESC
Balakovo	EMERCOM of Russia		Engineering Support Centers
Beloyarsk	NEMC		VNIIAES
Bilibino			NIKIET
Kalinin	ROSATOM		OKB GP
Kola	SCC		OKBM
Kursk			NRC KI
Leningrad	Rosenergoatom		IPPE
Novovoronezh	CC		AMRDC FMBA
Rostov			SPA Taifun
Smolensk			IBRAE RAS
			AEP
			ASE

			ATOMPROEKT
			AEP
			ATE
Rostechnadzor	EEC SPb	Videoconferencing system	Data transfer system
IAC			

Fig. 16.4. The scheme of information interaction in emergency at NPPs

Improvement of emergency preparedness and response measures considering events at multi-unit sites due to external hazards

In the framework of the "Updated Measures to Reduce Consequences of Beyond Design Basis Accidents at NPP", Rosenergoatom foresaw and has performed work to improve safety of Russian NPPs in the following areas:

- protection from external extreme impacts of natural and man-made origin, including from impacts with intensity that exceeds NPP design bases as well as protection from combinations of external impacts;
- preparedness to manage beyond design basis accidents involving complete loss of in-house power of NPP;
- preparedness to manage accidents involving loss of the ultimate heat sink;
- preparedness to manage severe accidents at NPPs (accidents which involve fuel damage in excess of design limits).

Emergency procedures and beyond design basis (severe) accidents (see Appendix 2) are updated. The work to implement emergency and post-emergency monitoring features ("emergency" instrumentation and controls) designed to operate in beyond design basis accident conditions is completed for RBMK reactors and is in progress at WWER reactors.

Implementation of emergency measures at NPPs under design and construction

Measures to improve robustness to extreme external events of NPPs under construction and design are similar to measures implemented at operating NPPs in terms of the scope and content. They include:

- a robustness analysis of NPP facilities under extreme external impacts using the methodology close to the one adopted by the group of European nuclear regulators (ENSREG); and
- installation of additional mobile emergency equipment (diesel generators, mobile pumping units, monoblock pumps etc.).

At Unit 4 of Rostov NPP (WWER-1000) commissioned in 2018 the measures adopted for similar NPP power units in operation were replicated.

At commissioned Units 1 and 2 of Leningrad NPP-2 (WWER-1200), mobile high-pressure diesel-driven pumps for supply of cooling water to power units have installed.

At commissioned Units 1 and 2 of Novovoronezh NPP-2 (WWER-1200) and Kursk NPP-2 (WWER-TOI) under construction the project provides for additional engineered features of heat removal to the ultimate heat sink from the reactor and spent fuel pool as an alternative service loop with an air-cooled tower powered by an independent diesel generator.

The design of the power unit with RI BREST-OD-300 has been developed with the account taken of the principles, criteria and requirements of safety laid down in Russian regulatory documents on NPP safety and inherent safety features, which reduces a probability of a severe core damage in case of beyond design basis accidents, as well as excludes accidents requiring evacuation.

The project of the power unit with RI BREST-OD-300 provides for building a geodynamic test site to monitor parameters of processes, phenomena and factors of natural and man-induced origin, including monitoring of contemporary ground movements, seismological and geotechnical monitoring of ground of footing of buildings and structures.

The implemented additional emergency measures at NPPs under design and construction allow improving robustness of nuclear plants with regard to natural and man-induced impacts as relates to:

– prevention or mitigation of consequences of beyond design basis accidents, including severe accidents;

– significant extension of the time of independent operation of NPPs; and

– enhancement of efficiency of the emergency planning and accident management system.

16.3. Measures to Inform the Population and Competent Authorities of Neighboring States on Emergency Preparedness

At the federal level, informing of the population and emergencies is carried out in accordance with the interagency procedure of EMERCOM of Russia “On Organizing the Interaction of the Federal Executive Bodies and Other Stakeholders When Informing the Public via Mass Media on the Predicted or Occurred Emergencies, which Have Attracted a Great Attention of the Public, the Response Activities and the Life Support Measures for the Population”.

ROSATOM has produced the “Provision for Organizing the Preparation of Messages and Informing the Public in the Case of Events That Affect the Operational Safety of the Organizations Controlled by ROSATOM”.

In case of a threat or events affecting safety, as well as if an alert or emergency mode is declared, the overall coordination of access of citizens

and organizations to information about activities of ROSATOM, informing the public and interacting with mass media is carried out:

– at the federal level, by the commission for prevention and elimination of emergencies and fire safety of ROSATOM; and

– at NPPs, by the commissions for prevention and elimination of emergencies and fire safety of organizations.

Plans and programs of emergency measures as parts of international arrangements, including arrangements with neighboring states

To fulfill the international commitments of the Russian Federation in the field of nuclear and radiation safety, the Government of the Russian Federation on 23 November 2009 issued the Ordinance stating that ROSATOM was the competent authority and point of contact regarding obligations of the Russian Federation resulting from the Convention on Early Notification of a Nuclear Accident of 26 September 1986 and the Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency of 26 September 1986 (hereinafter referred to as "the Conventions").

In pursuance of the said Ordinance of the Government of the Russian Federation, a list of main tasks to ensure preparedness of the competent authority and point of contact for fulfillment of the obligations of the Russian Federation resulting from the Conventions and international agreements, which relate to the subject matter of the Conventions, was approved.

The Russian Federation has entered into bilateral international agreements in the form of the agreement on early notification on a nuclear accident and exchange of information about nuclear installations with the Kingdom of Norway, the Republic of Armenia, the Republic of Belarus, the Republic of Finland and the Kingdom of Sweden. The bilateral arrangements on early notification provide for information exchange on nuclear installations, regular consultations on different aspects of nuclear and radiation safety at civil nuclear facilities, joint emergency exercises and drills, and operative notification about a nuclear accident. International specialists are invited to:

– comprehensive emergency exercises with participation of OPAS Teams, as observers;

– international workshops, science and technology conferences, international nuclear forum on emergency response issues for exchange of experience;

– emergency drills of the regional crisis center to master teamwork and information exchange in accident situations at NPPs which are covered

by WANO MC which was set up after the accident at Fukushima Daiichi NPP in 2013.

The Regional Crisis Center operates round-the-clock and provides for expert, engineering and technical support (see Fig. 16.5)

ATC of ROSATOM	SCC of ROSATOM	
	CC of REA	VNIIAES ROSATOM
WANO Tokyo Center		OKB GIDROPRESS ROSATOM
WANO Tokyo Center		National Research Center Kurchatov Institute
WANO Paris Center	WANO London Office	WANO Moscow Center
	NPPs with WWER reactors of WANO MC	

Fig. 16.5 The scheme of the RCC common information space

In 2017-2021, RCC took part in 52 emergency drills at NPPs in Russia and abroad: Armenia, Belarus, Bulgaria, China, Czech Republic, Finland, Hungary, India, Iran, Slovenia, and Ukraine.

Emergency response upon receipt of a notification from another state or information from the IAEA about actual or potential transnational emergency which may affect the given state

According to the Ordinance of the Government of the Russian Federation, ROSATOM's SCC performs the function of the national point of information exchange, participates in implementation of prompt notification procedures in case of a nuclear accident as prescribed in international treaties (agreements), federal laws and legal regulatory acts of the Russian Federation.

The information exchange procedure is improved during periodic testing of communication channels with the Incident and Emergency Center (IEC) of the IAEA and with points of contact of the states that are parties to bilateral agreements on prompt notification about nuclear accidents, as well as in the course of international exercises and drills where SCC of ROSATOM participates.

Upon receipt of a notification about possible transboundary impact to the territory of the Russian Federation by ROSATOM's SCC, the National Crisis Management Center (NCMC of EMERCOM of Russia) is notified.

In case an accident which arose at a foreign NPP is able to cause a radiation impact on the territory and the population of the Russian Federation and in case where an accident at a Russian NPP may cause a radiation impact of territories of neighboring states, the inter-national interaction is carried out according to the requirements of the Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency and the Convention on Early Notification of a Nuclear Accident. The Governmental Commission for prevention and elimination of emergencies and fire safety ensuring takes on the management (coordination) of work to eliminate the accident and its consequences, when territories of several Russian Federal Subjects are affected by a radiation accident. In separate cases, a special Governmental Commission may be appointed for NPP radiation accidents. It commands the elimination of the accident and its consequences with engagement of RSChS force and capabilities.

Action plans for prevention and elimination of emergencies are developed for elimination of occurred radiation accident and its consequences; they are developed in advance at all RSChS levels.

Actions of control bodies, RSChS force and capabilities to respond to a radiation accident are divided into two stages, as a rule:

– stage one (organization and reconnaissance) covers the period from receipt of information about a radiation accident until determining its actual scale and taking population protection measures; and;

– stage two, which comprises actions to eliminate the radiation accident.

The force and capabilities of RSChS subsystems engaged in elimination of consequences of radiation accidents are based on teams of territorial subsystems of the Russian Federation which territories have been affected by a radiation accident.

16.4. Training and On-Site Emergency Drills

Emergency drills, tabletop exercises, comprehensive emergency exercises are carried out to train NPP personnel act in emergency conditions. CEEs are carried out once a year (or once in 10 years for each NPP) to check preparedness of all constituents of the emergency response system to abnormal situations at a specific NPP, improvements of organization and coordination of interaction with force and capabilities which are not part of the emergency response system of Rosenergoatom.

In 2017, the comprehensive emergency exercises were conducted at Rostov NPP; in 2018 – at Balakovo NPP. In 2019, the comprehensive emergency exercises were conducted at Smolensk NPP. In 2020, due to COVID-19 constraints the comprehensive emergency exercises were shifted to 2021.

In 2021, the comprehensive emergency exercises were carry out at Novovoronezh NPP (see Fig. 16.6).

To improve safety of NPPs (including when the accident is running at several power units of a multi-unit NPP), Rosenergoatom has taken measures aimed at enhancing effectiveness of emergency planning and response and has extended amount of scheduled emergency drills. The drills associated with the NPP personnel actions in emergencies of natural and man-made nature have a special place among emergency drills.

On-site emergency drills associated with beyond design basis accidents are carried out with the use of all emergency mobile machinery items (diesel generators, diesel-driven pumps, motor pumps), mobile control posts and mobile communications posts using emergency means of communication. The personnel who were trained correspondingly have been designated at NPPs to bear responsibility for deployment of mobile emergency equipment, connecting it and putting into operation.

Comprehensive emergency exercises (CEE) are carried out at NPPs according to scenarios close at maximum to actual accident conditions with engagement of force and capabilities necessary to eliminate its consequences. All participants of the exercises operate in the common information space in real time using videoconferencing and data transmission systems sending process and radiation parameters obtained at full-scope or analytical simulators. In addition to such large-scale exercises, nuclear plants regularly conduct emergency drills of the NPP personnel with involvement of the Crisis Center of Rosenergoatom, OPAS Group and engineering support centers.

For the purposes of expert support of decision-making by OKChS, ensuring the coordination of specialists of ROSATOM and subordinate organizations, the expert teams are created, which, as necessary, operate in ROSATOM's SCC or directly at their enterprises. Specialists of other federal executive bodies and organizations (EMERCOM of Russia, MOD of Russia, MOI of Russia, Rosgidromet and others) may be engaged in the work of expert teams.

Fig. 16.6 – Comprehensive emergency exercises at Novovoronezh NPP

Emergency drills are conducted ten times a year (once in a year at a NPP) involving representatives of the OPAS Team, CC, and NPP and ESC expert teams. The objectives of such drills are to:

– check the preparedness of the OPAS, CC, ESC and NPP experts and functional teams for emergency response;

– training of the OPAS, ESC and NPP expert and functional teams in particular aspects of emergency response;

– check on preparedness of the CC, all its hardware & software facilities, notification and communication systems to operate in the common information space in real time jointly with those involved in emergency response; and

– training in operational interaction and information exchange between the NPP, CC and ESC using different information transmission devices.

According to the IAEA recommendations for conduct of emergency drills, the controlling persons (observers) from representatives of NPPs, Rosenergoatom and TCS are involved to assess the NPP personnel, expert and functional teams of OPAS and TSC's actions. The task of observers includes also the assessment of correctness and promptness of participants' actions, adequacy of their reaction to external events under lead-in scenarios. Rostechnadzor also carries out its assessments of correctness and promptness of participants' actions in accordance with the "Methodological Recommendations for the Assessment of Efficiency of Emergency Exercises and Drills of the Operating Organization of Nuclear Plants" revised in 2017 considering the current recommendations of the IAEA Safety Standards.

A debriefing is held after each drill with a detailed analysis of its results, which also assesses how well the targets were achieved and pre-set tasks were fulfilled by the participants, as well as received comments and proposals on improvement of the emergency preparedness system of Rosenergoatom, and planned specific measures. Drill results and worked out measures are sent to all NPPs.

EPDs allow identifying and eliminating bottlenecks of the emergency response system, improve professional training of specialists and efficiency of emergency response on the whole, and exchange experience in emergency response issues between nuclear plants, CC, ESCs, Rostechnadzor's Information and Analytical Center and ROSATOM's SCC.

In EPDs, a hypothetical accident is modeled on the full-scope simulator (FSS). The data transfer from FSS of NPP power units to CC, ESC and Information and Analytical Center of Rostechnadzor has been implemented. Important tasks are to expand modes simulated by FSS to severe and beyond design basis accidents as well as conduct of training with simulation of multi-unit accidents using several FSSs.

16.5. Emergency Engineering Centers

In pursuance of the Russian Federation Government Ordinance "On the Establishment of Emergency Engineering Centers for the Elimination of Emergencies at Nuclear Facilities in the Russian Federation", full-time professional emergency rescue teams have been set up and operate at the federal level. These are the emergency engineering center (EEC) in Saint-Petersburg and its branch in Novovoronezh and Seversk.

The main goals of EEC activities are nuclear and radiation safety ensuring and as part of the preparedness for emergency response and operations to eliminate consequences of radiation accidents are:

– to ensure continued availability of force and capabilities of emergency rescue teams (ERT) of JSC “EEC Rosatom” to act as intended;

– to participate in emergency rescue and other urgent operations to eliminate consequences of radiation accidents in transporting of frights of radioactive materials and items thereof;

– to develop and master new technologies, specimens of machinery for emergency rescue and other urgent operations;

– to survey a radiation accident zone, collection of its results and their analysis;

– search and rescue operations in the emergency area;

– gas rescue operations in the emergency area;

– localization and elimination of spills oil, petrochemicals and other environmentally hazardous substances on shore and inland water;

– to provide the first aid to injured in emergency;

– radiation, chemical monitoring of personnel who participate in emergency rescue operations and external environment objects;

– decontamination and degassing in the emergency zone;

– handling of radioactive waste in its storage, processing, transportation and disposal;

– arrangement and conduct of emergency, emergency rescue, underwater engineering diving operations at nuclear facilities, including underwater welding and cutting.

To implement the above listed tasks, EECs are fitted with remotely controlled machines and mechanisms, robotics items, special machinery with emergency tooling, special purpose cars and machinery for cleaning of rubble. They also have special radio communications to operate in higher radiation fields and a whole fleet of instruments to measure and monitor radiation situation, including drones.

16.6. Governmental Safety Regulatory Activities in the Field of Emergency Preparedness of Nuclear Power Plants

In its activities to supervise of emergency preparedness Rostechnadzor is guided by the laws, provisions and other documents listed in Subsection 16.1 of this Report as well as “Provisions for Functional Subsystem of Control of Nuclear- and Radiation-Hazardous Facilities of the National System for Prevention and Elimination of Emergencies”. The said functional subsystem is part of national system for prevention and elimination of emergencies (RSChS) and merges force and capabilities of Rostechnadzor and its territorial bodies. The Provisions define the procedure for organizing and acting, composition of force and capabilities of the subsystem of RSChS at the federal and regional levels. RSChS objectives are:

– the control of preparedness of nuclear- and radiation-hazardous facilities for actions to confine nuclear and radiation accidents and eliminate their consequences;

– the finding out violations which may lead to initiation of emergencies at nuclear- and radiation-hazardous facilities, and taking measures to eliminate them; and;

– ensuring Rostechnadzor's preparedness to act in case of emergencies at nuclear- and radiation-hazardous facilities.

The overall command of the RSChS functional nuclear- and radiation-hazardous facilities control subsystem RSChS is exercised by the Head of Rostechnadzor. The direct management of the subsystem is exercised by the Deputy Chairperson who coordinates activities of the structural divisions of Rostechnadzor. The subsystem includes the coordinating body, standing management bodies, daily management bodies, force and capabilities. The coordinating body of the subsystem is the Commission for Prevention and Elimination of Emergency and Ensuring Fire Safety of the Federal Environmental, Industrial and Nuclear Supervisory Service. The standing management bodies of the subsystem are:

– at the federal level: structural divisions of Rostechnadzor authorized to control and supervise over nuclear and radiation safety at nuclear- and radiation-hazardous facilities; and

– at the regional level: divisions of interregional territorial departments for supervision of nuclear and radiation safety authorized to control and supervise over nuclear and radiation safety at nuclear- and radiation-hazardous facilities.

The daily management bodies of the RSChS subsystem are:

– at the federal level: the operations and dispatch office and office for organization and support of functioning the control system over nuclear facilities in case of accidents; and

– at the regional level: on-duty services and authorized offices of interregional territorial departments for supervision of nuclear and radiation safety.

For corresponding managing bodies and force of the RSChS subsystem, the Head of Rostechnadzor may decide to establish one of the following functional modes:

– alert, in case of threat of an emergency; and

– emergency, in case of initiation and elimination of emergencies.

Main measures conducted by the managing bodies and force of the RSChS subsystem are:

a) in the daily activity mode:

– scheduled and out-of-schedule inspections at nuclear- and radiation-hazardous facilities in the territory of the Russian Federation;

– collection, processing and exchange, in accordance with the established procedure, of information of the state of nuclear and radiation safety at nuclear- and radiation-hazardous facilities in the territory of the Russian Federation;

– planning actions of management bodies and force of the RSChS subsystem, organization of training and support to their activities;

– organization of training of Rostechnadzor's employees in protection techniques and actions in emergency;

b) in the alert mode:

– introduction, as necessary, round-the-clock duty of heads and officers of the RSChS subsystem in full or reduced staff;

– conduct of works to prepare the Information and Analytical Center of Rostechnadzor for functioning in the emergency response mode;

– projecting the emergency consequences;

– drawing out measures to ensure safety and functionality of Rostechnadzor's employees on sites of NPPs;

c) in the emergency mode:

– notification of the Head of Rostechnadzor about initiated emergencies;

– organization of operation of the Information and Analytical Center in the emergency response mode in the Rostechnadzor's Headquarters and emergency response groups in the interregional territorial departments for supervision of nuclear and radiation safety;

– control over the Operating Organization's implementation, in full scope, of measures to confine and eliminate the emergency, as well as to timely put into force and properly fulfill the personnel protection plan;

– interaction of managing bodies of all levels of the RSChS subsystem at all levels with bodies of EMERCOM of Russia and other concerned bodies and organizations;

– control of implementation of measures to ensure safety and functionality of Rostechnadzor's employees present in the emergency region.

Rostechnadzor reviews the emergency preparedness of the Operating Organization when licenses and inspects it. For example, as part of the supervision of observance of requirements of the federal standards and regulations in the field of the use of atomic energy related to emergency preparedness, Rostechnadzor checks availability of plans of measures to protect nuclear facility personnel which are worked out and ready for application, as well as availability of necessary resources to implement them, including emergency centers which are ready to function in conditions of accidents.

In accordance with the licensing procedure in the field of the use of atomic energy, the documents which justify nuclear and radiation safety of

operation of each nuclear power unit should include procedures for elimination of design basis accidents, a beyond design basis accident management guide, including severe accidents, and a personnel protection plan in case of an accident at nuclear plants. The justification documents should also include information about training and qualifications of the NPP personnel, including their preparedness to act in design basis and beyond design basis accidents.

One of the objectives pursued by Rostechnadzor in its inspection activities is to check the nuclear plant preparedness for elimination of accidents and their consequences. The following is checked and assessed during emergency preparedness inspections of NPPs:

– the documentation defining the NPP personnel actions during accidents (procedure for elimination of design basis accidents, beyond design basis accident management guide, personnel protection action plan);

– the arrangement of the personnel training in developing and maintaining their skills in controlling the NPP unit during accidents as well as control of knowledge and actions of the NPP management and personnel at different accident development stages;

– the preparedness of the emergency notification system, including the technical condition of communication channels;

– the condition of sheltered stations for control of emergency actions management, their equipment, and the availability of documentation;

– the arrangements for the plant personnel protection in the event of a radiation accident as regards the availability of the respective emergency engineering services and capabilities;

– the plans and programs for emergency drills and exercises at NPP, including interactions with the local and federal authorities to ensure preparedness for the public protection measures.

In case of NPP operational violations, Rostechnadzor’s procedure is defined in the federal standards and regulations in the field of the use of atomic energy the “Regulation on Investigating and Accounting Operational Events at Nuclear Plants”, which sets forth categories of accountable NPP operational events, procedure for notification and further informing on an accident, and event investigation procedure.

In case of an event featuring signs of radiation accidents, Rostechnadzor calls for the commissions for investigation of violations, except for the cases where the President of the Russian Federation or the Government of the Russian Federation make the corresponding decision to set up the Governmental Commission. .

Rostechnadzor has its own functional Information and Analytical Center (IAC). During drills or when accidents initiate at NPPs, IAC sets up the following expert groups:

– the management group;
– the group for assessment and projection of the technological state of a nuclear facility (OPTS);
– the group for assessment and projection of the radiation situation at a nuclear facility (OPRO);
– the engineered features support group;
– the group for liaison with mass media and the public; its actions are determined by the IAC Regulations.

The Order of the Head of Rostechnadzor sets out the composition of IAC working groups. They are to consist of the Rostechnadzor Headquarters' employees and specialists from the scientific and technical support organization, SEC NRS, who are engaged when accidents occur at NPPs, including in case of EEDs and CEEs. Rostechnadzor ITD's emergency response teams (in EED and CEE places) for supervision over nuclear and radiation safety are also engaged to participate in EEDs and CEEs.

To maintain preparedness of IAC and working groups, regular exercises and drills are conducted, with Rosenergoatom's plans taken into account (see Fig. 16.7).

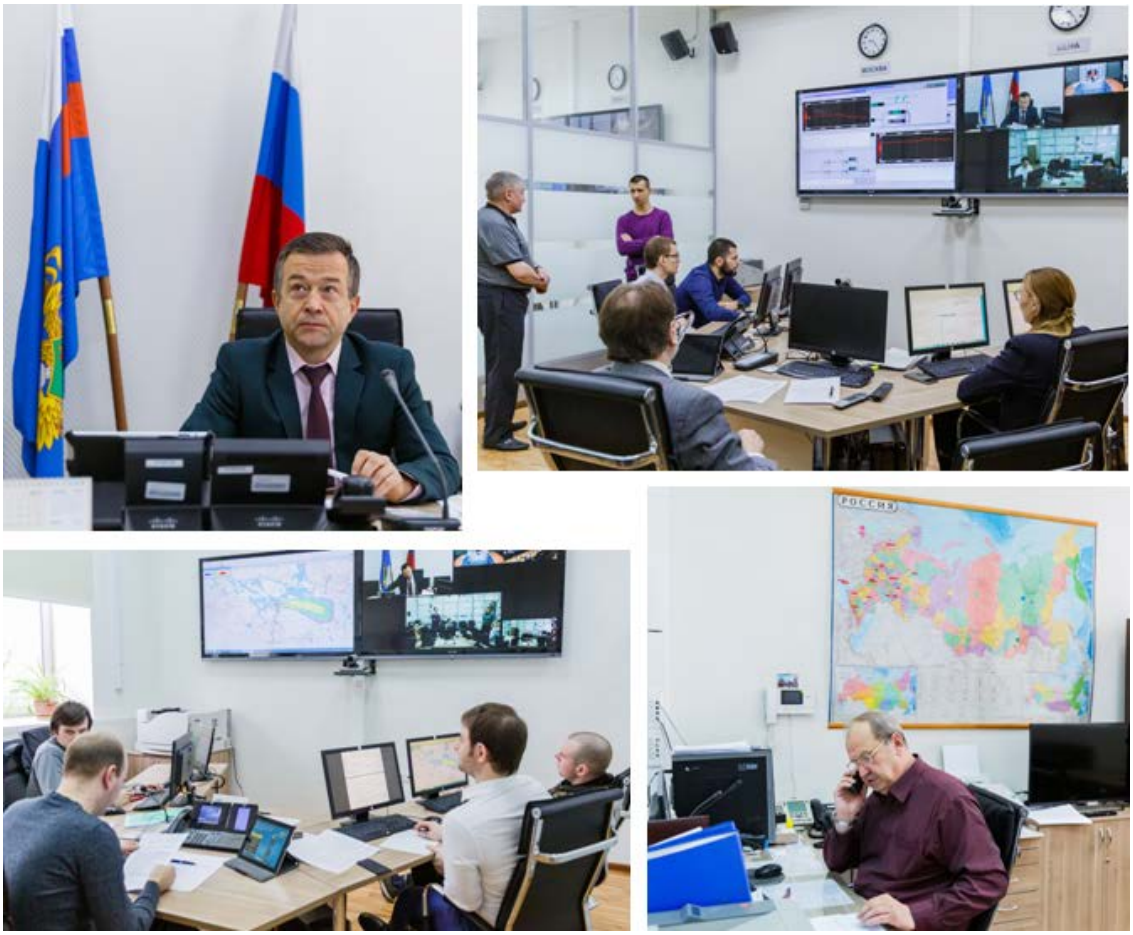


Fig. 16.7. Emergency drill in Rostechnadzor's IAC

According to the annual Action Plan of Rostechnadzor's functional subsystem within RSChS, as well as for the purposes of preparation to act in conditions of nuclear and radiation accidents, Rostechnadzor's officials take part in emergency drills (EDs) and comprehensive emergency exercises (CEEs) at NPPs conducted by the Operating Organization.

Rostechnadzor evaluates effectiveness of EDs and CEEs in accordance with the "Methodological Recommendations Regarding Evaluation of Effectiveness of Emergency Exercises and Drills Conducted by the Operating Organization of Nuclear Plants" which was revised in 2017 considering current recommendations of the IAEA Safety Standards. Rostechnadzor sends the assessment results to the NPP for it to take measures to improve emergency preparedness and response at the NPP. In the framework of emergency exercises and drills, Rostechnadzor assesses their efficiency in areas as follows:

– accuracy of a preliminary estimate of the operational violation category as per the International Nuclear Event Scale (INES);

– accuracy of categories attributed to NPP operational violations for the purposes of working out of measures to prevent recurrence of such violations;

– setting up by the Operating Organization the technical support centers for projection of radiation-hazardous situation consequences;

– timeliness of the local notification system startup;

– timeliness and sufficiency of actions to evacuate personnel from the nuclear plant site;

– timeliness and accuracy of nuclear plant personnel actions to prevent escalation of initiating events into design basis accidents and design basis accidents into beyond design basis accidents, as well as to mitigate consequences of beyond design basis accidents;

– timeliness and accuracy of actions carried out by the nuclear plant personnel to reduce and mitigate damage to systems involved in performing safety functions.

When conducting scheduled drills, the regulatory bodies of the participating countries regularly exchange experience in supervision of the state of emergency preparedness, including participation as observers. They are also invited as observers. In April 2016, a delegation from Rostechnadzor took part in the emergency exercise at Loviisa NPP in the STUK Crisis Center as an observer. In 2017, representatives of Rostechnadzor took part in the large-scale international emergency exercises at Paks NPP under the IAEA auspices Convex-3 (2017) in the Crisis Center of the Hungarian Atomic Energy Agency (HAEA) as observers. In September 2017, as part of the bilateral cooperation with the

Japan Nuclear Regulatory Agency, Rostechnadzor took part in the emergency drill at Genkai NPP (Japan). The Information and Analytical Center of Rostechnadzor is regularly visited by delegations from regulatory bodies of other countries. In 2016-2021, it was visited by representatives of Bangladesh, Belarus, Iran and Vietnam.

In accordance with the provisions of the Convention on Nuclear Safety, the Russian Federation has created an efficient system for the prevention and elimination of emergencies at NPPs. A major role in the emergency management activities is played by the Situation and Crisis Center of ROSATOM and the Crisis Center of Rosenergoatom. A functional subsystem of control of nuclear- and radiation-hazardous facilities within the national system for prevention and elimination of emergencies and the Information and Analysis Center operate within Rostechnadzor.

Emergency drills and exercises at different levels are conducted to keep the NPP personnel prepared for actions in emergencies on a regular basis.

Article 17. Siting of Nuclear Plants

Selection of a nuclear plant site suitable for construction and safe operation of the nuclear plant is regulated by federal laws, federal standards and regulations in the field of the use of atomic energy, as well as by other documents, which contents and composition are described in the earlier National Reports of the Russian Federation. The natural and man-induced conditions in the NPP siting region are studied in keeping with requirements of the following standards and regulations in the field of the use of atomic energy:

- "General Safety Provisions of Nuclear Power Plants";
- "Site of a Nuclear Plant. Safety Requirements";
- "Accounting of Natural and Man-Induced External Impacts on Nuclear Facilities"; and
- "Design Standards of Seismic Nuclear Plants".

In accordance with federal standards and regulations in the field of the use of atomic energy, the NPP site is considered to be suitable for the NPP deployment if it is possible to ensure safe operation of the NPP, safety of the population and environment taking into account natural and man-induced impacts. In justifying the NPP site suitability, the following should be taken into account:

- influence on NPP safety of natural and man-induced impacts;
- radiation impact of NPP on the population and the environment in normal operation, operational violations, including design basis and beyond design basis accidents;
- features of the NPP site and siting region, which may contribute to migration and accumulation of radioactive substances (topographic, meteorological, aerologic, hydrological, hydrogeological, geochemical);
- possibility of fulfilling requirements to emergency planning.

It is not permitted to site NPPs on:

- sites which are located directly on active faults;
- sites where seismic activity at a safe shutdown earthquake exceeds 8 point as per MSK-64 scale (with maximum acceleration of 4 m/s^2 and greater);
- in regions featuring development of sulfate and salt karst, thermokarst;
- areas where NPPs are prohibited by the environmental legislation;
- sites susceptible to impacts from eruption of volcanoes (including mud ones) as volcanic bombs, lava flows, pyroclastic flows, glowing ash flows and toxic gases, mud flows.

Siting of new NPPs requires prediction of the NPP impacts on the environment, changes in the ecological systems and their consequences

Siting of new NPPs requires forecasting of the NPP impacts on the environment, changes in the ecological systems and their consequences.

The said forecasts for the NPPs under design are fulfilled in the course of engineering surveys (when implementing the procedure of environmental impact assessment).

In the reporting period, according to the requirements of the above said federal standards and regulations in the field of the use of atomic energy, the engineering surveys were carried out on the site of Units 1 and 2 of Kursk NPP-2, as well as necessary justifications have been developed to allow recognizing this site suitable for siting of a NPP. Siting activities are carried out for Units 3 and 4 of Kursk NPP.

At the present time, the revision has been completed of the federal standards and regulations in the field of the use of atomic energy which regulate issues of external impacts of natural and man-induced origin and siting of a NPP. When revising, the accumulated experience, provisions of newly introduced and being introduced the IAEA Safety Standards, as well as lessons learned from the accident at Fukushima Daiichi NPP are taken into account.

Reassessment of external factors during NPP lifecycle

To ensure NPP safety under external impacts, in accordance with the requirements of the federal standards and regulations in the field of the use of atomic energy, NPPs compile and update databases on processes, phenomena and factors of natural and man-induced origin on the site and vicinity. Monitoring of natural processes and phenomena, included in the design bases at all stages of the NPP lifecycle is mandatory.

During the NPP lifecycle, the update and reassessment of the NPP siting conditions is mandatorily carried out given the external factors. In accordance to provisions of the Federal Law “On the Use of Atomic Energy”, the assessment of changes in conditions in the vicinity of the nuclear power unit site and the current state of the NPP site is carried out within the periodic safety review each 10 years of a nuclear unit operation.

In reassessment of parameters of potential external impacts, results of monitoring of processes and phenomena of natural origin and periodic monitoring of parameters of factors of natural origin and periodic monitoring of parameters of factors of man-induced origin are used, as well as additional engineering surveys and studies are carried out in vicinity and on site of the NPP. Thus, in the period 2016 - 2018, as part of implementation of the “Updated Measures to Reduce Consequences of Beyond Design Basis Accidents at NPPs”, the assessments of seismic hazard level for all NPP sites were confirmed.

Mechanisms of consultations with other Contracting Parties (countries) which may be affected by an installation

In the Russian Federation, when selecting a site for NPP, the attention is paid to both natural and man-induced factors affecting NPPs and effects of NPPs on the environment. In accordance with the environmental protection law of the Russian Federation, the environmental impact assessment (EIA) is envisaged when producing the design documents for all types of planned economic and other activity, which may directly or indirectly affect the environment (the Federal Law "On the Environmental Protection"). The goal of the environmental impact assessment is to prevent or mitigate the impact of this activity on the environment and related social, economic and other consequences. The EIA procedure includes public hearings on the NPP siting.

At this time, the Russian Federation does not have special international arrangements with neighboring countries concerning selection of sites for construction of new plants. Current arrangements of the Russian Federation with regulatory bodies of other countries on exchange of information and experience serve as a mechanism for a constructive dialogue. Thus, the Russian Federation has the basis for such information exchange with neighboring countries.

Overview of provisions of NPP designs that help withstand natural and man-induced external events such as fire, explosion, aircraft crash, external flood, severe weather conditions and earthquake, and consequences of related and consequential natural external events (for example, tsunami, earthquake, landslide due to heavy rains)

In accordance with the requirements of the federal standards and regulations, the natural factors, processes and phenomena considered in the NPP design bases are determined within the interval of 10,000 years. Factors of man-induced origin with a probability of 10^{-6} a year and greater should be considered in the context of the design bases. Results of probabilistic safety analyses of NPPs under external impacts should be considered in designing and operating NPPs.

The federal standards and regulations in the field of the use of atomic energy "Accounting of Natural and Man-Induced External Impacts on Nuclear Facilities" establish the list of natural and man-induced factors, which should be studied and included in the design bases of the nuclear plant. Such factors include hydro-meteorological, geologic, engineering and geologic processes as well as man-induced factors in the NPP vicinity:

- hydrological and meteorological processes and phenomena:
  - ✓ flood;

- ✓ tsunami;
- ✓ watercourse icing (ice jams, ice gorges);
- ✓ coastal situations (positive and negative setups, storms);
- ✓ seiches;
- ✓ tides;
- ✓ changes in water resources: extremely low flow, abnormal decrease in water level;
- ✓ tornado;
- ✓ wind;
- ✓ tropical cyclone (typhoon);
- ✓ atmospheric precipitation;
- ✓ extreme snowfalls and snowpacks;
- ✓ air temperature;
- ✓ snowslides;
- ✓ glaze-ice;
- ✓ lightning stroke.

– geological and engineering-geological processes and phenomena:
  - ✓ fissure seismic and tectonic displacements, seismic dislocations, seismic and tectonic upswelling and downswelling of crustal blocks;
  - ✓ modern differential crust movements, including tectonic creep;
  - ✓ residual seismic deformations of crust;
  - ✓ earthquakes (of any genesis);
  - ✓ volcanic eruption;
  - ✓ mud volcanism;
  - ✓ soil slips;
  - ✓ earthfalls and earth slip-falls;
  - ✓ mudflows;
  - ✓ snow and stone avalanches, crushed and block avalanches;
  - ✓ erosion by water of shores, slopes and streams;
  - ✓ sinks and subsidence;
  - ✓ underground erosion including karst formation;
  - ✓ congelation and geologic (cryogenic) processes;
  - ✓ deformation of specific soils (karst, thermokarst, dilution, solifluction, suffusion processes).
- – man-induced factors:
  - ✓ air craft and other projectile crash;
  - ✓ fire due to external causes;
  - ✓ on-site explosion;
  - ✓ release of explosive, flammable and toxic vapors, gases and aerosols into the atmosphere, drifting cloud explosion;
  - ✓ corrosive liquid discharged into surface and groundwater;
  - ✓ electromagnetic radiation;

- ✓ spills of oil and oil products at the coastal aquifer surface areas of seas, rivers and oceans;
- ✓ break of natural and artificial reservoirs.

In most of new NPPs of recent years:

– the NPP systems and components of the 1st category of responsibility for nuclear and radiation safety and the 1st seismic category are designed considering the following external impacts of natural and man-induced origin:

- ✓ a safe shutdown earthquake with estimated frequency once in 10,000 years and design basis earthquake with estimated frequency once in 1,000 years;
- ✓ a seismic impact featuring maximum horizontal ground acceleration exceeding SSE accelerations by 40%. This seismic impact is accounted for as beyond design basis;
- ✓ extreme wind and snow loads with recurrence once in 10,000 years;
- ✓ extreme temperature with estimated frequency once in 10,000 years;
- ✓ tornadoes with estimated frequency once in 10,000 years;
- ✓ flooding and underflooding of the site with estimated frequency once in 10,000 years;
- ✓ aircraft crash;
- ✓ external air shock wave;

– architectural, planning and design solutions of buildings ensure protection against above said natural and man-induced impacts, namely: building structures of NPP constructions, as well as process piping, other utility systems and equipment are designed robust towards earthquakes with the following parameters:

- ✓ for DBE (6 points as per MSK-64 scale) - maximum horizontal acceleration of a free-field surface equal 0.06 g;
- ✓ for SSE (7 points as per MSK-64 scale) – maximum horizontal acceleration of a free-field surface equal 0.12 g;
- ✓ beyond design basis seismic impact featuring maximum horizontal ground acceleration exceeding SSE accelerations by 40%;

– weather impacts near the NPP site are taken into account, in particular: air temperature, wind, tornado, snow cover, glaze ice;

– potential floods near the NPP site with probability of 0.01% are taken into account with consideration of hydraulic structures break. The extreme ground water level is taken at the site planning level;

– a potential crash of Phantom RF-4E aircraft of 20 t in weight on 1st category buildings and structures is taken into account;

– 1st category building structures are designed for an impact of external horizontal air shock wave with from pressure of 30 kPa and duration of compression phase of less than 1 s.

In the Russian Federation, NPP site selection is carried out taking into account possible natural and man-induced impacts that is in line with requirements of the Convention on Nuclear Safety and principles of the Vienna Declaration on Nuclear Safety.

Article 18. Design and Construction

18.1. Defense-in-Depth

Safety of NPPs under design is ensured through consistent implementation of defense-in-depth.

At the first level of defense-in-depth in WWER-1200 design (in particular, power units of Novovoronezh NPP-2), the following measures are provided:

– robustness of NPP towards external impacts;

– minimization of size of the potential radiation impact zones of NPP on the population during normal operation and accidents; the radius the mandatory population evacuation planning zone does not exceed 800 m and that of emergency measure planning zone does not exceed 3,000 m;

– development of the design basing on the conservative approach with mature intrinsic safety of the reactor installation (these include self-control of reactor power and maintaining primary pressure at the expense of negative reactivity and pressure feedback, possibility to remove heat from the core of the shutdown reactor to the ultimate head sink by natural circulation of coolant, large inventory of water in horizontal steam generators and others); and

– effective system of maintenance and repair.

As part of the second level of defense-in-depth, the NPP design provide for engineered features (means of diagnostics, automatic controllers, interlocks, automatic protection features and others) which allow timely revealing and eliminating departures from normal operation, as well as exercise control in case of operation with departures.

At the third level of defense-in-depth, the WWER-1200 design has both active and passive safety systems.

The active safety systems include the emergency reactor protection system, protection systems of the primary and secondary circuit against overpressure (these systems remain functional when the power is lost), system for emergency and scheduled cooldown of the primary circuit and cooling of spent fuel pool, emergency boron injection system, emergency steam generator cooldown system, emergency power supply system, ventilation system, service water and cold supply system, spray system, and emergency gas evacuation system.

The passive safety systems include the passive heat removal system from SG and passive core flooding system (8 accumulators 120 m^3 each). Joint operation of the said systems provides for cooling of the core during, as minimum, 24 hours when active safety systems fully fail and the primary pipeline suffers a guillotine break. The passive safety systems also include double-walled containment and hydrogen explosion protection systems.

In the NPP design, the fourth level of defense-in-depth includes engineered features and organizational measures to manage beyond design basis accidents (including severe accidents), which are designed to restore NPP to controlled state, prevent propagation of beyond design basis accidents and mitigate their consequences, protect the containment from collapse and maintain its performance. To meet the said purposes, the design includes the following systems in addition to that used at Level 3:

– the core (fuel) catcher;

– mobile devices (packaged fan cooling tower with necessary piping, mobile diesel generator and others) which help make up the primary circuit and spent fuel pool, as well as heat removal from the reactor and SFP, and the primary circuit and spent fuel pool make-up; and

– emergency monitoring instrumentation and controls.

The use of various engineered features at different levels of defense-in-depth facilitates independence of defense-in-depth levels from each other.

In the framework of implementation of the first defense-in-depth level, the design of the power unit with RI BREST-OD-300 provides for the following measures:

– evaluation and selection of the site suitable for placing the power unit;

– arrangement of the controlled area and surveillance zone around the NP where the protection measure planning is carried out;

– development of the design based on the conservative approach with well-developed intrinsic safety of RI at the expense of:

✓ the use of large coolant volume which provides for low temperature growth rates in violations of normal operation;

✓ the use of the lead coolant which is high-boiling (~ 2,000ºK) radiation-resistant, low-activated and inflammable when contacting with water and air;

✓ the existence of negative coefficients of reactivity in regard of fuel temperature and reactor power, as well as a total coefficient of reactivity in regard of coolant temperature and fuel temperature over the entire range of changes in the said parameters in normal operation and operational events, including design basis accidents;

✓ the existence of flow feedback which ensures introduction of negative reactivity at decrease in the coolant flowrate;

✓ the use of the integral layout of the primary circuit in the multilayer metal-and-concrete shell localizing emergency leaks of the coolant;

✓ the presence of low pressure in the primary circuit which minimizes reactivity egress beyond the primary circuit boundary in accident loss of integrity;

✓providing for natural circulation for residual heat removal at the expense of geometric and hydraulic characteristics of the primary circuit, including hydraulic pressure arrangement, absence of isolation valves and the use of canless FAs in the core;

✓providing for emergency heat removal from the primary circuit by natural circulation of atmospheric air through heat exchangers placed directly in the primary circuit.

As part of implementing the second level of defense-in-depth, the design of the power unit with RI BREST-OD-300 provides for the following measures:

– timely finding out and elimination of deviations from normal operation;

– control of operation with deviations (in the design of BREST-OD-300, non-exceedance of the design limits and safe operation conditions under deviations and violations is ensured by the system performing control functions (control system) including by starting up back-up equipment, as well as personnel actions in accordance with the equipment operation regulation and procedures).

In the framework of implementation of the third level of defense-in-depth, the design of the power unit with RI BREST-OD-300 provides for the following measures:

– the use of safety systems (emergency reactor protection system, emergency reactor cooldown system, steam generator protection system, emergency power supply system, control safety systems) to prevent aggravation of initiating events into design basis accidents and the design basis accidents into beyond design basis accidents;

– the use of systems that limit egress of radioactive substances in the environment (sealed enclosure, steam generator leak confinement system (SGLCS) which include bubble-condenser rooms lined with stainless steel and a housing enclosure at discharge piping SGLCS, as well as ventilation system of SGLCS rooms) to mitigate consequences of accidents which could not prevent, through confinement of released radioactive substances.

In the framework of implementation of the forth level of defense-in-depth, the design of the power unit with RI BREST-OD-300 provides for the following measures:

– prevention of development of beyond design basis accidents and mitigation of their consequences;

– protection of the sealed enclosure from collapse in beyond design basis accidents and maintaining its performance;

– return of the power unit in controlled state where the chain fission reaction is stopped, continuous cooling of nuclear fuel is ensured and radioactive substances are retained within the established limits.

In the framework of the fifth defense-in-depth level the design of the power unit with RI BREST-OD-300 provides for measures of emergency response on the NPP site and beyond. “Plan for Personnel Protection in Case of Accidents” and “Beyond Design Basis Accident Management Plan at the Power Unit” are worked out basing on results of the analysis of accidents and requirements of regulatory documents.

Enhanced safety features and additional improvements to protect against external impacts and prevent accidents, as well as mitigate accident consequences and prevent off-site radiation contamination

In new NPP designs (in particular, in the design of Novovoronezh NPP-2 units) the safety systems and their components ensure fulfillment of their functions under all external impacts considered in the NPP design. The safety systems are protected from on-site impacts (fires, floods, steaming, steam-water jets, projectiles, pipe whipping in NPP rooms).

Protection from human error is carried out due to the use of passive safety systems and high level of automation that controls active safety systems, including at the expense of the use of automatic systems for initialization of protective actions and interlocking control manipulations of the operator which interfere with implementation of safety functions.

Active safety systems are powered from independent sources (diesel generators) made in accordance with requirements for support safety systems. There is a possibility to power, as necessary, consumers of active safety systems from extra diesel generators which do not pertain to support safety systems (from normal operation diesel generators or mobile diesel generator which pertain to special engineered features to manage beyond design basis accidents).

Safety systems are arranged so that the minimum necessary part of the piping, valves and equipment is placed within the containment and does not require maintenance and repairs during power operation; the main part of the piping, valves, and equipment is placed outside the containment. The equipment placed outside the containment is accessible for maintenance and repairs during power operation. The systems for service water, ventilation and air conditioning keep up the parameters necessary for operation of the equipment.

The passive heat removal system (PHRS) is designed for a prolonged removal of residual heat of the reactor to the ultimate heat sink in conditions where all power sources are lost with absence of leaks and in conditions of primary leaks.

PHRS represents closed natural circulation circuits for residual heat removal from the reactor by condensation of steam removed from SG and return of condensate to SG. Each circuit includes two heat-exchanging modules, steam condensate pipelines with valves, air ducts which supply

and exhaust air, air gates and regulators. The system removes residual heat directly to the outside air in heat exchanger condenser. If all power sources are lost and the primary circuit is broken, the passive heat removal system operates jointly with accumulator tank system of second stage.

There are confining safety systems to prevent or limit propagation of radioactive substances and radiation emitted during accidents beyond boundaries established by the design and release them into the environment.

The spray system is intended to reduce pressure and temperature inside the containment and bind radioactive iodine which contains in steam and air of the sealed enclosure. This system ensures automatic injection of borated water into the air of the containment when pressure under containment exceeds 0.03 MPa. Boron solution is supplied in the containment until pressure under it decreases down to minus 2 kPa. When this value is achieved, the system switches off and the pumps operate for recirculation.

The sealed enclosure of the reactor installation ensures:

– preventing or limiting propagation of radioactive substances beyond the accident localization zone (ALZ) boundaries;

– protecting systems and components, which failure may lead to a release of radioactive substances in excess of the design value of the release, from external impacts; and

– limiting the release of ionizing radiation beyond ALZ boundaries.

As the sealed enclosure of the reactor installation, the WWER-1200 design uses the double-walled containment in which the equipment and pipelines with high-temperature coolant are placed.

The inner containment is made of pre-stressed reinforced concrete with a sealing steel lining; it designed for design basis and beyond design basis accidents in combination with a safe shutdown earthquake and is capable of limiting a release of radioactive substances.

The outer containment is made of reinforced concrete and is designed for an external air shock wave impact, aircraft crash and natural external impacts. The outer containment ensures leak-tightness of the annulus. According to the Rules of Layout and Operation of Localizing Safety Systems of Nuclear Power Plants, the design leak into the environment exceeds 10% of design leak through the inner containment.

An integral leak through the sealed enclosure of the accident localization zone (ALZ) is not more than 0.3% of the volume of the medium in ALZ per day at pressure equal to design emergency pressure.

The concentration monitoring system and emergency hydrogen evacuation system are designed to monitor hydrogen and other gases concentrations in ALZ and prevent forming explosive mixtures.

The emergency hydrogen evacuation system uses passive catalytic hydrogen recombiners, which are located in places of possible accumulation of hydrogen.

The hydrogen concentration monitoring system consists of the primary and secondary equipment (probes, information processing and display units), communication lines and equipment for metrological qualification, certification and adjustment of instruments. The hydrogen concentration monitoring system can measure hydrogen in the range of 0 up to 30 vol.% in vapor-air-hydrogen mixture, and continuously monitors the parameters.

In the design of RI BREST-OD-300 the safety systems and their elements provide for performance of their functions in all external impacts considered in the NPP design, which are developed taking account of design experience and operation of equipment for RIs with heavy liquid metal coolant. To prevent operational violations of the power unit with RI BREST-OD-300, the design solutions are implemented that ensure reliability, ability for diagnostic and reparability of RI components.

Start-up of standby equipment and personnel actions ensure non-exceedance of safe operation limits and conditions. With that, the personnel perform corrective actions in accordance with regulation and operating procedures. The prevention of beyond design basis accidents is achieved by a set of organizational and engineering measures.

The engineered features used in the design of the power unit with RI BREST-OD-300 allow ensuring that the safety requirements for NPs with the new generation reactors are observed:

– for reducing a probability of severe core damage in beyond design basis accidents;

– for no evacuation or resettlement of the population beyond the power unit site limits in any technically potential accidents.

Beyond design basis accident accounting approach

Provisional lists of beyond design basis accidents for each reactor type are set forth in the federal standards and regulations.

Final lists of beyond design basis accidents (including severe accidents) are set up in accordance with the safety guide “Recommendations for Formulating the Final List of Beyond Design Basis Accidents Accountable in Design of Nuclear Plants with WWER Reactors” and given in SAR NPP. The said lists cover all operational states of NPPs and consider all NPP locations where nuclear material, radioactive substances and RAW are present where a NPP operational event may arise, and include representative scenarios to define measures to manage such accidents. Representativeness of scenarios is ensured by taking into account the severity degrees of the NPP state and, in addition, possible

states of availability or non-availability of safety systems and special engineered features for managing beyond design basis accidents. SAR NPP presents a realistic (non-conservative) analysis of the said beyond design basis accidents which contains assessments of probabilities of development paths and consequences of beyond design basis accidents. The said analysis is the basis for compiling action plans to protect the personnel and population in case of accidents, as well as to produce a beyond design basis accident management guide.

The similar approach to accounting of beyond design basis accidents is used at the power unit with RI BREST-OD-300.

Measures to maintain integrity of the containment under natural and man-induced events with intensity above the design value

In accordance with the requirements of the federal standards and regulations, the safety systems and components are designed to withstand the following natural and man-induced impacts:

– the safe shutdown earthquake (SSE) with design recurrence of once in 10,000 years and the design basis earthquake (DBE) with design recurrence of once in 1,000 years. In particular, design calculations of WWER-TOI have demonstrated that design and layout solutions ensure seismic stability of NPPs to higher seismic loads (DBE – up to 8 points; SSE – up to 9 points (0.25 g and 0.41 g, correspondingly);

– extreme wind and snow loads with recurrence of once in 10,000 years;

– extreme temperature with design recurrence of once in 10,000 years;

– tornadoes with design recurrence of once in 10,000 years;

– flood and flooding of then site with design recurrence of once in 10,000 years;

– aircraft crash. The design of power units of Novovoronezh NPP-2 (WWER-1200 design) considers, as the baseline event, the crash of light airplanes (weight of 5.7 tons) at a speed of 100 m/s. The design of power units of Kursk NPP-2 (WWER-TOI design) considers, as the baseline event, the crash of aircraft of 20 tones at a speed of 215 m/s. The WWER-TOI design considers as a beyond design basis accident the aircraft crash of 400 tones at a speed of 150 m/s, if a probability of its crash equals or exceeds 10^{-6} a year;

– other natural external impacts with a design recurrence of 10^{-4} a year and man-induced external impacts with a probability of occurrence of 10^{-6} a year typical of the NPP site.

The design of the power unit with RI BREST-OD-300 considers the following external natural and man-induced impacts:

– earthquakes. Seismic stability of building structures at the level of the structure footing is not less than 0.17 g that corresponds to SSE of 8 points as per MSK-64 scale for I category structures at accelerations at the level of the structure footing not less than 0.1 g that corresponds to DBE of 7 points as per MSK-64 scale for II category structures;

– wind (hurricane). A gust of wind is 48 m/s, speed is 42 m/s, load is 0.76 kPa. Regulated values of hurricane wind speed, which is exceeded once in 5 years on average, as well as extreme speed, which is exceeded once in 10,000 years on average, equal 30 m/s and 56 m/s, correspondingly;

– tornado – the class is not higher than 2.4 as per Fujita scale with occurrence frequency of $4.4*10^{-4}$. Maximum vortex rotation speed is 69.0 m/s. Pressure differential between the periphery and the center is 0.58 kPa. The loads due to wind pressure equal to $4.8*10^{3}$ N/m^2 and loads due to pressure differential equal $9.6*10^{3}$ N/m^2 are taken into account Maximum translational speed of tornado is 24 m/s, pressure differential between the periphery and the tornado vortex center is 110 GPa. Regulated value of the tornado intensity class at a probability of going through the territory of a NPP once in 10,000 years is 3.60 as per the Fujita scale;

– flood. To avoid flood and underflooding, the grade elevation of NPP buildings is selected above the absolute elevation of the maximum break wave level; this ensures that the I safety category structures are not to be flooded at external impacts of a probability of occurrence once in 10,000 years;

– extreme snowfall and snowdrifts. Maximum snow load value is 3.1 kPa with a recurrence of 10^{-4}. Designed snow load corresponds to the snow load of IV Region of the Zoning Map of the Russian Federation Territory with regard to climatic characteristics with a coefficient 2.0;

– a crash of aircraft with a mass of 5.7 t at a speed of 100 m/s is considered as a design basis event;

– an external air shock wave of 10 kPa at the duration of a compression phase up to 1 second;

– other external natural impacts with a design recurrence of 10^{-4} a year and man-induced impact of a probability of occurrence of 10^{-6} a year typical of the NPP hosting site.

According to the requirements of the federal standards and regulations in the field of the use of atomic energy for NPP units under design the probabilistic safety analysis are carried out, which take into account, among other, external impacts with intensity in excess of the design intensity.

Improvement of designs of existing (operating) NPPs based on deterministic and probabilistic safety assessments in the period elapsed from the previous National Report

For operating NPPs, basing on results of new safety assessments (including by results of deterministic and probabilistic safety analyses) the following measures have been fulfilled:

– commissioning of the reactor seismic protection in the pilot commercial operation at all operating power units;

– placement and connection of mobile emergency machinery and monitoring systems and hydrogen explosion safety in the RI sealed enclosure at NPPs with WWER and RBMK reactors;

– implementation of emergency and post-accident monitoring equipment ("emergency" instrumentation and controls design to operate in conditions of beyond design basis accidents) for NPPs with WWER and RBMK reactors.

Following the results of the NPP Fukushima Daiichi accident, the additional heat removal systems to the ultimate heat sink from the reactor installation and spent fuel pool – the alternative service loop with air fan cooling tower powered by an independent diesel generator – have been introduced into designs of units under construction at Novovoronezh NPP-2 (WWER-1200 design) and Kursk NPP-2 (WWER-TOI design).

So, CDF for Novovoronezh NPP-2 design was $2.8 \cdot 10^{-7}$ per reactor per year that is significantly lower that CDF for Balakovo NPP ($1.3 \cdot 10^{-5}$ per reactor per year).

Based on results of the robustness analysis of Leningrad NPP-2 (WWER-1200 design), additional measures which are implemented during construction have been included in the design, for example:

– a make-up pump for tanks of emergency heat removal and spent fuel pool with corresponding piping (pipelines, valves etc.) has been added;

– for each unit a mobile diesel generator has been provided.

At WWER-440 power units of the first generation (Unit 4 of Novovoronezh NPP and Units 1 and 2 of Kola NPP) the following major upgrades have been made as part of recurrent service life extension:

✓ for Unit 4 of Novovoronezh NPP:

- introduction of the passive emergency core cooling system (installation of four water tanks);
- introduction of the active emergency core cooling system of low pressure;
- building up 2 additional high pressure emergency make-up channels of the primary circuit of Unit 4 with the use of Unit 3 equipment;
- building up 4 SS channels controlled at MCR-4 with the use

of Unit 3 equipment (two additional SS channels);
- upgrading of control safety systems of Unit 4;
- upgrading of the emergency power supply system.

The CDF value was $2.2 \cdot 10^{-5}$ (in 2017 – $5.1 \cdot 10^{-5}$).

✓ for Units 1 and 2 of Kola NPP:
- implementation of the 3-channel active system of ECCS HP and ECCS LP;
- introduction of water-tank based passive ECCS;
- upgrading of CPS-CTSS which significantly increased reliability of EP and ECCS protections actuation;
- upgrading of the essential consumers' service water system;
- replacement of oil circuit breakers of safety systems with more reliable SF6 circuit breakers;
- replacement of storage batteries EPPS of Group 1.

The CDF value was:
- for Unit 1 – $4.80 \cdot 10^{-6}$ (in 2017 – $8.62 \cdot 10^{-6}$);
- for Unit 2 – $2.94 \cdot 10^{-6}$ (in 2017 – $8.58 \cdot 10^{-6}$).

18.2. Application of Tested Solutions

According to the requirements of the federal standards and regulations, the engineered and organizational solutions made to ensure safety of NPPs should be tested by previous experience, trials, research, and operating experience of prototypes.

Designs of new Russian NPPs (in particular, WWER-1200 and WWER-TOI designs) implement the strategic approach: maximum borrowing of tested, well-proven systems, equipment, engineered solutions with simultaneous integration of engineered achievements and evolutionary improvements which take place in other current WWER designs and resulting from operating experience of existing units.

The engineered and layout solutions used in the WWER-1200 and WWER-TOI designs are based on the available experience in design, WWER NPPs operation, and calculation and experimental justifications. The practice-proven solutions are the design of the reactor installation, which includes the WWER reactor, steam pressurizer, four-loop main circulation circuit, and horizontal steam generators. The available design solutions and operating experience of NPP with WWER reactors are considered in developing the design of the reactor core. The special focus areas were the design solutions associated with passive safety systems, core catcher and other.

To study the joint operation of passive systems of NPPs of WWER-1200 design – the passive heat removal system and passive core flooding system in conditions of primary leaks, which accompanied with failure of

active safety systems – a full-sized test rig was developed at SRC RF IPPE. This test rig was used to study impacts of non-condensing gases capable of accumulating in steam generators in conditions of primary leaks on performance of passive safety systems. Results of the experiments confirmed operability of passive systems of the WWER-1200 design under beyond design basis accidents during more than 24 hours.

To reduce a probability of the safety function failure as a result of a failure of control safety systems due to a common cause error because of accidental or intentional errors, in the NPP design software there is a diversity principle which uses a diverse protection system which does not use programmable digital devises. In case of a postulated failure of AZ-CSST due to a common cause error, the additional diverse system ensures safety in all accident modes provided by design, given the passive safety systems are in operation.

In designing NPPs, the international experience and modern requirements to NPP safety are widely used. So when justifying NPP safety in conditions of violations of normal operation up to design basis accidents, the categorization of initiating events and assigning the corresponding design limits to each category of initiating events are carried out with the use of the approach similar to one used by EUR. The expert evaluation of the WWER-TOI design by EUR confirmed the correspondence of approaches to safety justification to international requirements. In 2019, the WWER-TOI design was certified by EUR.

The engineering and layout solutions used in the design of the power unit with RI BREST-OD-300 are based on available design and operation experience in existing fast neutron reactors.

The safety concept of the power unit is based on exclusion of severe “reactivity” accidents with loss of RI cooling and other accident states requiring evacuation and resettlement of the population.

The following engineering solutions have been implemented in the design of the power units with RI BREST-OD-300:

– MNUP fuel, as compared to the most commonly used oxide fuel, has high density and thermal conductivity. Justification of performance and integrity of fuel rods and FAs of RI BREST-OD-300 was done in several areas:

– technological: the building up of experimental productions of MNUP fuel and fuel rods with MNUP fuel;

– in-pile tests of fuel rods with MNUP fuel in RI BOR-60 and BN-600 with post-reactor examinations (including to specify computer models and codes);

– pressure tests of fuel rod assemblies in water and lead;

– rig tests with justification of vibration strength;

– studies of fretting corrosion and general corrosion in lead.

When designing the metal-and-concrete structure of reactor vessel of the power unit with RI BREST-OD-300, the experience of JSC KBSM in design of metal-and-concrete containers for SNF was used along with NIKIET's experience in monitoring of RBMK metal structures.

As relates to the technology for handling the coolant, in the design of RI BREST-OD-300 the longstanding positive experience in operation of test-rigs with lead and lead-bismuth coolants was taken into account.

Performance of CPS actuators was confirmed by results of the calculations done in the framework of the engineering design, results of acceptance tests of the pilot specimen, which confirmed compliance with the design requirements, as well as results of comprehensive tests simulating departures from normal operation conditions. Results of lifetime tests confirmed compliance with all design requirements set forth to CPS actuators, in the first place, observance of the requirements to actuation time in AZ mode – no more than 5 s. Compliance with reliability and failure-free operation indicators was also confirmed.

The use of tested solutions in the design of RI BREST-OD-300 allows ensuring the fulfillment of more stringent safety requirements set forth to NPs with the new generation reactors.

18.3. Licensing Related to Design and Construction of Nuclear Plants

The licensing process in the field of the use of atomic energy is defined in the Ordinance of the Government of the Russian Federation "On the Licensing of Activities in the Field of the Use of Atomic Energy" and was described in Section 7.5 of this National Report.

To obtain a license for construction of a NPP unit, the Operation Organization submits to Rostechnadzor an application and set of documents justifying safety of the NPP. According to the established requirements, the set of documents should include:

- a safety analysis report of the nuclear power plant (SAR NPP);
- an overall quality assurance program QAP NPP(Q);
- a quality assurance program of NPP construction QAP NPP(C);
- design documents (including reactor installation (RI) design, safety important systems as well as physical protection systems), facility vulnerability analysis reports and physical protection efficiency analysis reports, research and development reports and test reports referred to in SAR NPP;
- Level 1 and 2 probabilistic safety analyses (PSA) of a nuclear plant unit;
- commissioning programs of a NP power unit and pre-startup adjustment (the documents are submitted by the license applicant six months prior to pre-startup adjustment).

A decision to grant or cancel a license to construct a NPP power unit is made basing of results of verification of completeness and credibility of information submitted for obtaining the license and safety peer review. According to the “Provision on Procedure of an Expert Review of Safety (Safety Justification Review) of Nuclear Facilities and (or) Activities if the Field of the Use of Atomic Energy”, Rostechnadzor sends the set of justifying documents to a scientific and technical support organization for an expert review.

In the reporting period, Rostechnadzor has granted License No. ГМ-02-101-3990 of 10.02.2021 to JSC SCC for the right to build a pilot demonstration power unit with a lead-cooled fast neutron reactor (BREST-OD-300). Construction of Units 1 and 2 of Kursk NPP-2 (WWER-TOI with RI WWER-1200 design) is progressed under earlier granted licenses.

In accordance with the current international requirements in the field of the use of atomic energy, safety of NPPs under design and construction in the Russian Federation is ensured through implementation of multi-level defense-in-depth and the use of tested engineering and organizational solutions, which are justified in the process of licensing that complies with the requirements of the Convention on Nuclear Safety and the principles of the Vienna Declaration on Nuclear Safety.

Article 19. Operation of Nuclear Plants

19.1. Getting Operating Permits for NPP Units after Construction

The procedure of getting operating licenses for nuclear units established by the "Provisions for Licensing of Activities in the Field of the Use of Atomic Energy" has seen no changes since submission of the seventh National Report.

To get an operating license for a NPP power unit commissioned after construction, the Operating Organization submits to Rostechnadzor an application and a set of documents justifying safety of NPP. According to the established requirements, the set of documents should include:

- a Final (preliminary draft) Safety Analysis Report of a NPP Power Unit;
- a Quality Assurance Program for Operation – QAP NPP(O);
- a Process Regulation of Operation of a NPP Power Unit;
- a Certificate for Reactor Installation of a NPP Power Unit;
- a Procedure for Elimination of Accidents at a NPP Power Unit;
- a Beyond Design Basis Accident Management Guide, Including Severe Ones, for a NPP Power Unit;
- a Plan of the Personnel Protection Measures in Case of an Accident at NPP;
- information about selection, training, qualification maintenance and permit to work independently of a NPP power unit workers;
- a Statement of Compliance with License Conditions for Construction of a NPP Power Unit;
- a Quality Assurance Program of NPP Commissioning QAP NPP(C);
- a NPP Power Unit Commissioning Program;
- a Pre-startup and Adjustment Work Program;
- a First Criticality Program of a NPP Power Unit;
- Experiment Methodologies in the Course of the First Criticality;
- a First Power Program of a NPP Power Unit;
- a Pilot Commercial Operation Program of a NPP Power Unit;
- a Nuclear Safety Procedure for Storing, Transporting and Refueling of Nuclear Fuel;
- Measures Compensating Departures from Requirements of Standards and Regulations in the Field of the Use of Atomic Energy;
- a Program of Activities to Eliminate Departures from Requirements of Standards and Regulations in the Field of the Use of Atomic Energy;
- Statements on ensuring control and accounting;
- a Statement of ensuring physical protection;

– results of surveillance of buildings and structures of Safety Categories I and II for all the time of observations (subsidence, tilting etc.).

When the unit is commissioned, the Operating Organization submits to Rostechnadzor reports and records containing results of the work fulfillment at each of the stages (pre-startup and adjustment works, first criticality, first power, pilot commercial operation) of the NPP commissioning. Besides, after completion of the tests all changes and deviations of the actual state of the unit from the design characteristics are considered in the final update of the safety justification report and operating documentation.

The first criticality and first power of the nuclear power unit are carried out after Rostechnadzor carries out an inspection of actual preparedness of the power unit to each of these stages.

In accordance with the described procedure, in 2016-2021, the work has been carried out to commission Unit 4 of Rostov NPP, Units 1 and 2 of Novovoronezh NPP-2, and Unit 1 of Leningrad NPP-2.

A decision to issue an operating license for a nuclear power unit is made by Rostechnadzor after review of documents justifying safety of operation as well as results of inspections.

19.2. Current System for Updating Safe Operation Limits and Conditions

Changing a NPP power unit operating modes (transition to larger interval between repairs, uprating etc.) may require correction of safe operation limits and conditions. Corrected safe operation limits and conditions of NPP power units are justified in the design and reflected in safety analysis reports (TSAR, ISAR, SAR) and operating documentation. The said documents are reviewed by Rostechnadzor's scientific and technical support organization in accordance with the established order. Following the review results, Rostechnadzor makes a decision on introducing changes to the operating license conditions of the NPP power unit.

19.3. Current System for Scheduling Maintenance and Repairs, as well as Inspections and Tests of Nuclear Installations

The nuclear power industry of Russia has a common system for in-service maintenance and repairs (M&R), which is reflected in the OO standard covering all power units and that takes into account the design features of reactors and major NPP equipment.

The complete list of documents to be available at an NPP unit during its operation, including those on maintenance, repairs, inspections and tests, is defined by the Operating Organization's Standard "Basic

Safety Rules of Operation of Nuclear Plants". The maintenance and repair documentation includes long-term and annual plans of the NPP unit repair, plans of expenditures for supporting the repair campaign, repair network schedules and other documentation. The documents are approved by the NPP management.

All NPP maintenance works and repairs are carried out by NPP repair personnel and by contractors licensed by Rostechnadzor. The scheduled repair is carried out independently of actual technical condition of the equipment with intervals and in scope established by maintenance and repair regulations. The necessity of scheduled repair of equipment and systems is carried out following the results of checking up their condition or when a failure is detected. The advance repair planning period of NPP power units is ten years. The experience in operation of NPP power units confirms performance of the existing maintenance and repair system.

To reveal and prevent failures of NPP systems (components), confirm their performance and compliance with design characteristics, the tests and inspections of safety important NPP systems (components) are carried out. Safety important NPP systems (components) are tested and inspected at commissioning, after repair and periodically during the entire service life of NPP. Regulatory requirements for tests and inspections of safety important NPP systems and components are given in the federal standards and regulations in the field of the use of atomic energy "General Safety Provisions of Nuclear Power Plants" and "Rules of Nuclear Safety of Reactor Installations of Nuclear Plants".

To confirm orderly condition and possibility of further operation of equipment and components of safety systems and safety important systems, the Operating Organization carries out technical examinations, which include hydraulic (pneumatic) tests of equipment and pipelines. The technical examination is carried out in accordance with established frequency; its results are formalized in accordance to the established procedure.

Involvement of NPP personnel in drafting regulations for operation, maintenance and repair of systems and equipment of nuclear plants

In accordance with the requirements of regulations, the Operating Organization produces process regulations for operation of power units jointly with participation of RI and NPP designers in accordance with the NPP design and safety analysis report.

Regulations for maintenance, repairs, inspections and tests of safety important systems are developed by the NPP administration based on the standard of the Operating Organization "Rules of Organization of Maintenance and Repair of Systems and Equipment of Nuclear Plants".

The process regulations for operation, maintenance and repair of systems and equipment of nuclear plants are developed with the involvement of NPP engineering and technical support unit personnel and operating and maintenance personnel.

19.4. Actions of the Personnel in Accidents and Emergencies

The procedure for training of the NPP personnel to act in accidents is described in detail in Subsection 16.4 of this Report.

In accordance with the requirements of the federal standards and regulations, in case emergencies arise, as well as design basis and beyond design basis accidents, the NPP personnel actions are regulated by the following documents:

– the Design Basis Accident Elimination Procedure;
– the Beyond Design Basis Accident Management Guide, including severe accidents (BDBA MG-S); and
– the Action Plan for Protection of the Personnel in Case of an Accident at a Nuclear Power Plant.

The Design Basis Accident Elimination Procedure defines actions of the operating personnel of the NPP to eliminate violations of normal operation up to design basis accidents inclusive. For each initiating event of a violation of normal operation (accident), the conditions of its initiation and accident development paths, measures to prevent aggravation of the design basis accident in beyond design basis accident are considered in the said procedure.

The Beyond Design Basis Accident Management Guide considers actions to manage beyond design basis accidents and mitigate their consequences. The Beyond Design Basis Accident Management Guides consider both the accidents that have not developed into a severe accident and severe accidents.

The personnel actions indicated in the Design Basis Accident Elimination Procedure and the Beyond Design Basis Accident Management Guide are based on signs of evolving events and conditions and states of RI and NPP as a whole, as well as projections of expected accident development.

19.5. Engineering, Technical and Scientific Support to Nuclear Plants

Throughout the life cycle of an NPP, the required engineering and scientific support is provided to the NPPs by Rosenergoatom both on its own and with the aid of third party organizations. During the OSART Mission of 12-27 November 2018, the IAEA experts assessed compliance of the corporate engineering support to operation of Rosenergoatom to the

IAEA safety standards. The mission resulted in high appreciation of the engineering support level. The Operating Organization has worked out a best practice implementation program regarding lessons learned in the mission.

ROSATOM includes design, research and development organizations as well as repair, adjustment, construction & installation companies and other organizations that have substantial experience in nuclear power. They are:

– JSC Experimental Design Bureau Gidropress (OKB Gidropress);

– JSC N. A. Dollezhal Research and Development Institute of Power Engineering (NIKIET);

– JSC I. I. Afrikantov Experimental Design Bureau of Machine Engineering (OKBM Afrikantov), Nizhniy Novgorod;

– JSC Atomenergoproekt (AEP), Moscow;

– JSC Engineering Company ASE (JSC EC ASE);

– JSC State Research Center of the Russian Federation A. I. Leipunsky Institute of Physics and Power Engineering (IPPE);

– JSC Research and Development Institute of Installation Technology – Atomstroy (NIKIMT – Atomstroy);

– JSC Atomtekhenergo (ATE);

– JSC Atomenergoremont (AER).

The Scientific Supervisor of NPP operation is the All-Russian Research Institute for Nuclear Power Plants Operation (VNIIAES). NRC Kurchatov Institute renders scientific support to Rosenergoatom and NPPs.

The Architect General of the project of the power unit with RI BREST-OD-300 is JSC Atomenergoproekt (AEP); its Chief Designer is JSC Research and Development Institute of Power Engineering name after N. A. Dollezal (NIKIET). The Scientific Supervisor of the project of the power unit BREST-OD-300 is JSC State Research Center of the Russian Federation A. I. Leipunsky Institute of Physics and Power Engineering (IPPE).

The Operating Organizations engage specialized research, design, engineering, repair, adjustment and other organizations, producers of equipment for NPPs at different stages of lifecycle – design, construction, commissioning, and operation of NPPs – and for engineering and scientific support on contractual basis.

19.6. Procedure for Accounting of Safety Significant NPP Events

The activities to analyze and account of the events significant in terms of safety are regulated by the following regulatory documents:

– the federal standards and regulations “General Safety Provisions of Nuclear Power Plants”;

– the federal standards and regulations “Regulation on Investigating and Accounting Operational Events at Nuclear Plants”;

– “Organization of Investigation of Safety and Reliability Significant Events at Nuclear Plants of Rosenergoatom Concern JSC. Provision”.

The regulatory framework for activities in the analysis and accounting of events was developed with due regard for the IAEA recommendations set forth in the relevant Safety Guides and technical documents, and was based on the many-year experience of Russia's participation in the IAEA/NEA International Reporting System for Operating Experience (IRS) as well as in WANO's Operating Experience Program.

The federal standards and regulations in the field of the use of atomic energy “Regulation on Investigating and Accounting Operational Events at Nuclear Plants” establish:

– the categories of the NPP operational evets to be reported and investigated;

– the procedure for accounting of and reporting on violations;

– the procedure for investigation of violations.

Categories of NPP operational events are divided into:

– “accidents” classified by the extent of on-site and off-site radiation impacts; and

– “incidents” classified by the degree to which the defense-in-depth is impaired.

All safety significant events revealed at an early stage of departure from the normal operation as well as events which not reportable to the Regulatory Body (departures at NPPs) are investigated in accordance with the “Organization of Investigation of Safety and Reliability Significant Events at Nuclear Plants of Rosenergoatom Concern JSC. Provision”.

All on-site events having the signs of an operational event are reported by the NPP management to the Operating Organization and Rostechnadzor in the form of an early notification within one hour of their occurrence or detection, and further as a preliminary report within 24 hours of their occurrence or detection.

During the next 15 days the event will be investigated by a commission, whereupon the NPP sends to Rostechnadzor and the Operating Organization its report on the investigation and the proposed corrective and preventive measures aimed at preventing similar occurrences in future. Each event is rated according to the International Nuclear and Radiological Event Scale (INES).

Procedures for identifying direct and root causes as well as factors facilitating initiation of operational events at NPPs are set forth in the

"Methodological Guidelines for Analyzing the Causes of Safety-Reliability-Related Events, Fires, Injuries, Damages to Buildings and Structures at Nuclear Plants". The "Methodological Guidelines" take account of the IAEA ASSET methodology (IAEA-TECDOC-632), as well as to that of the U.S. Institute of Nuclear Power Operation (INPO 90-004), which proved their practical worth in many countries operating nuclear plants.

Information about events significant in terms of safety is placed in the database IRS IAEA and is sent to WANO in accordance with recommendations of safety standards of the IAEA and WANO.

The Operating Organization and NPPs account the safety significant events and near misses in electronic form in accordance with the "Organization of Investigation of Safety and Reliability Significant Events at Nuclear Plants of Rosenergoatom Concern JSC. Provision".

Information, regulatory and administrative documents on violation analyses at Russian and foreign NPPs contain guidance for managerial, operating and maintenance personnel on how to prevent similar events, and are sent to all existing NPPs and that under construction, structural divisions of the Headquarters and branches of Rosenergoatom, technical support organizations of NPP operation.

The NPP operational event reports are kept at the plant unit the time of the NPP decommissioning. Rosenergoatom uses a set of information systems for automated accounting of operating experience, information storage, analyses of NPP events and assessment of efficiency of corrective measures in accordance with requirements of federal laws, regulatory acts of the Russian Federation, as well as recommendations of the IAEA and WANO. The system integration is provided by the information system for accounting of operating experience «NPP Experience».

Rosenergoatom arranges and provides for the issue of quarterly and annual reports with a survey of all NPP operational events including those with safety implications, which identify the direct and root causes and the factors contributing to such events and indicate the corrective actions taken to avoid their recurrence.

Each NPP analyzes information about all events at Russian NPPs and foreign NPPs, including information incoming from WANO as well as that placed in IRS IAEA/NEA. Event information is used for NPP operating and maintenance personnel training and maintaining their skills and is used during briefings before conducting work "Just-in-time".

Data on violations at NPPs with assessments under the INES scale for 2016 – 1st half of 2022 are given in Appendix 14. Data on departures at NPPs for 2016 – 1st half of 2022 are given in Appendix 15.

19.7. Programs for Collection and Analysis of Information on NPP Operating Experience. System for the Use of Operating Experience of Russian and Foreign NPPs

Rosenergoatom has developed a system for analysis and use of NPP operating experience to take account of operating experience during the entire lifecycle of a NPP. This system employs sectoral databases on issue-related areas of operation.

The Operating Organization uses the operating information feedback system. Examples of the use of safety significant events at foreign NPPs are discussed at meetings and other events in the framework of the programs IRS IAEA/NEA and WANO.

Mechanisms for transfer of important experience to other operating organizations

The information exchange on operating experience with foreign operating organizations is carried out in accordance with the requirements set out in the regulatory documents as part of events under the auspices of the IAEA and WANO.

The Operating Organization annually develops and implements the "Rosenergoatom's Cooperation Program with the World Association of Nuclear Operators (WANO)". The program provides for various forms of Russian NPP operating experience transfer to foreign partners, including the organization and participation in peer reviews, technical support missions, seminars and working meetings, events with comparison of models and techniques of operation with world patterns ("benchmarking").

The Operating Organization uses examples of good practices revealed by various reviews (including peer reviews of WANO, IAEA OSART missions, and other international events).

The standard "Analysis and Use of Operating Experience of Nuclear Plants. Basic Provisions" sets forth main requirements to the procedure of use of best practices at NPPs and procedure for benchmarking. The set forth requirements include working out the corrective measures following the benchmarking results and best practices analysis.

In the framework of the "Rosenergoatom's Cooperation Program with the World Association of Nuclear Operators (WANO)", Rosenergoatom, jointly with WANO, arranges operations of the Regional Crisis Center which sends information about operation of NPPs (including about events, process and radiation parameters of operation) and conducts international emergency preparedness and response exercises.

In the framework of the WANO program "NPP Performance Indicators", the input data on Russian power units are transmitted to the

WANO Atlanta and Moscow Centers to calculate NPP performance indicators used in WANO.

Rosenergoatom's representatives take part in the work of WANO sectoral working groups.

Information about NPP operational violations subject to FSR "Regulation on Investigating and Accounting Operational Events at Nuclear Plants" is to be sent to Rostechnadzor. All NPP operational violations are investigated and evaluated by the INES scale. Rostechnadzor assesses sufficiency of compensatory measures developed OO and oversees their fulfillment, as well as exerts regulatory impact on the Operating Organization to prevent recurrence of similar violations.

19.8. Management of Radioactive Waste and Spent Nuclear Fuel on NPP Sites and Measures Taken to Reduce Their Volumes

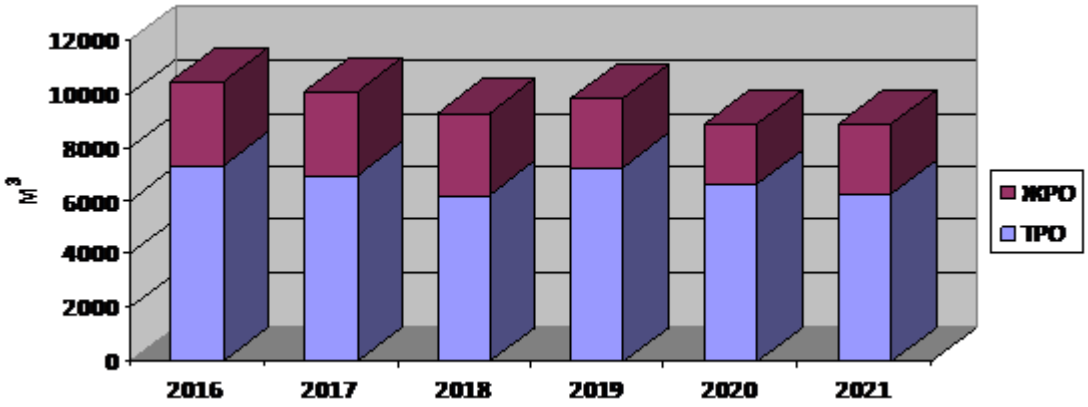
The State policy of the Russian Federation in the field of radioactive waste (RAW) management envisages the consistent activity to prevent radiation impact on humans and environment at all stages of waste management (generation, collection, transportation, reprocessing, storage, and ultimate disposal).

Radioactive waste at NPPs is managed in accordance with the Federal Laws "On the Use of Atomic Energy" and "On the Management of Radioactive Waste and On Introducing Changes in Certain Legal Acts of the Russian Federation" as well as with the federal target program "Nuclear and Radiation Safety for 2016-2020 and until 2030" and the Concept of Spent Nuclear Fuel Management of ROSATOM.

RAW and SNF management at Rosenergoatom's NPPs, including processing and interim storage of RAW on NPP sites, are carried out in strict compliance with Rostechnadzor's operating license conditions for power units. No violations and departures in SNF and RAW management that led to violation of the safe operation conditions and limits have been recorded in the reporting period.

To reduce volumes of RAW generation, the plans for processing, conditioning and transfer for disposal of RAW are worked out. Measures to reduce generation volumes are implemented. Administrative and directive documents of Rosenergoatom establish once in 2 years the limits of annual generation of liquid and solid RAW for each operating NPP, as well as carry out quarterly monitoring of actual volumes of RAW generation and an analysis of risk of exceeding the established limits. In the period 2016 until 2021, no cases of exceedance of operational RAW generation above the established limits were reported.

Fig. 19.1 shows the data on RAW generation in the reporting period.



– LRW; - TRW

Fig. 19.1. Generation of RAW in the reporting period

The implemented measures do not allow increasing of RAW generation even when new power units are commissioned, service life is extended as well as measures are carried out to decommission shutdown power units.

In 2016-2021, 71,800 m^3 RAW (LRW+SRW) were reprocessed that constituted 125% of the RAW volume generated in the said period. In the said period, 22,747.52 m^3 of RAW was transferred to the National Operator for final disposal.

Rosenergoatom regularly takes away SNF in accordance with planning schedules. Rosenergoatom takes away SNF from NPP sites for processing or long-term storage in the centralized storage facility with plans of further processing, specifically:

– SNF of NPPs with WWER-440, BN-600 and, since 2021, BN-800 reactors is taken to FSUE PA Mayak;

– SNF of NPPs with WWER-1000 reactors is sent for processing to FSUE PA Mayak and handed over to the centralized storage facility at FSUE Mining and Chemical Combine;

– at Leningrad, Kursk NPP and Smolensk NPPs there are cutting and shipment preparation complexes for SNF of NPPs with RBMK-1000 reactors. SNF of Leningrad is taken to the dry storage facility at FSUE MCC and processing at FSUE PA Mayak. SNF of RBMKs reactors of Kursk and Smolensk NPPs is taken to the dry storage at FSUE MCC from 2012, 2013 and 2019, correspondingly. Commencing the start of exportation, total number of SFAs reduced at Leningrad, Kursk, and Smolensk NPPs by 34%, 29% and 9.7%, correspondingly.

– SNF of the EGP-6 reactors at Bilibino NPP is stored in the at-reactor cooling pools with prospects of further exportation of SNF to FSUE PA Mayak in accordance with ROSATOM’s decision to prepare Bilibino NPP units for decommissioning;

– In the period 2016-2019, 125 assemblies with SFAs AMB were removed from at-reactor spent fuel pools of shutdown reactors of Units 1 and 2 of Beloyarsk NPP to FSUE PA Mayak. At the present time, there are 115 SFAs AMB in the main building of the first stage of Beloyarsk NPP, which are planned to be removed in 2019 (after commissioning of SDP in 2027 and start of reprocessing of already available SFAs AMB at FSUE PA Mayak).

Since the start of operation of equipment for cutting and preparation for removal of SFAs from NPPs with RBMK-1000 reactors, there has been consistent reduction of SFAs quantities at each nuclear plant.

Exemption guidelines for radioactive waste

The Ordinance of the Government of the Russian Federation No. 1069 dated 19.10.2012 sets forth the classification of radioactive waste based on its radiation characteristics measurable in accordance with qualified methodologies. The waste which are beyond the RAW category are not accounted in the state control and accounting system of radioactive waste and, depending on the level of radiation contamination, rendered either as industrial waste category or as the category of industrial waste that contains man-induced radionuclides as per the sanitary rules.

The system of regulation of nuclear power plants operation, including maintenance and repair, inspections and tests, analysis and accounting of NPP operational events, as well as handling of radioactive waste and spent nuclear fuel existing in the Russian Federation, allows ensuring safe operation of NPPs in accordance with the provisions of the Convention on Nuclear Safety and the principals of the Vienna Declaration on Nuclear Safety.

The continuous science and technology support of the Operating Organizations and NPPs rendered by research, design and engineering institutions, use of sectoral information and analytical system for operating experience of NPPs, including operating experience of foreign NPPs, facilitates safe operation of NPPs.

Major Findings and Conclusion

1. In the Russian Federation, the legislative framework has been developed and functions to govern issues of ensuring and regulating safety of nuclear plants.
2. The independent Regulatory Body – the Federal Environmental, Industrial and Nuclear Supervision Service – functions in the Russian Federation. It is in jurisdiction and reports directly to the Government of the Russian Federation. The Regulatory Body has staff, finance and engineering resources that allow it to perform imposed functions, while retaining its independence.
3. The safety priority of nuclear plants is enshrined in the laws and implemented in practice. In accordance with the norms of the national and international law, the Operating Organizations are fully responsible for the safety of nuclear plants, and have all necessary financial, human and other resources for this purpose.
4. The Operating Organizations pay serious attention to the quality assurance issues at all stages of the NPP lifecycle while being guided by the policy aimed at achieving economically efficient generation and secure provision of electricity and heat to consumers with unconditional observance of nuclear and radiation safety requirements.
5. Checks and assessments of safety level of all NPP power units are carried out regularly during the entire lifecycle of nuclear plants. Results of these assessments and safety justifications are accounted for by Rostechnadzor in licensing.
6. In the Russian Federation, the radiation safety of the NPP personnel, population and environment in normal operation of nuclear plants is ensured. The personnel exposure doses are low and do not exceed established guidelines. Additional risk from radiation impact of NPPs on the population and environment in normal operation of NPPs due to gas-aerosol releases and liquid discharges is unconditionally acceptable.

7. In the Russian Federation, the effective system for prevention and elimination of emergencies at NPP has been created. An important role in operation of this system belongs to the Situation and Crisis Center of ROSATOM and the Crisis Center of Rosenergoatom. In Rostechnadzor, there is a functional subsystem of control of nuclear- and radiation-hazardous facilities of the uniform state system of prevention and elimination of emergencies and the Information and Analytical Center. Emergency drills and exercises of different level are consistently carried out to prepare the NPP personnel to act in emergency.
8. In the Russian Federation, the selection of sites for NPPs is carried out with consideration of possible impacts of natural and man-induced origin.
9. In accordance with the current international requirements of international organizations in the field of the use of atomic energy, safety of designed and constructed NPPs in the Russian Federation is ensured by the implementation of the multi-layer defense-in-depth and the use of proven engineered and organizational solutions, which validity is confirmed by licensing.
10. The system of regulations of nuclear plants operation existing in the Russian Federation, including maintenance and repairs, inspections and tests, accounting and analysis of NPP operational events, as well as the management of radioactive waste and spent nuclear fuel, allows ensuring an acceptable level of safe NPP operation.
11. The sectoral system of analysis and use of internal and external NPP operating experience existing in the Russian Federation facilitates NPP safety enhancement and effective exchange of operating experience with foreign countries and organizations in the framework of international information systems.
12. The Regulatory Body and Operating Organizations act in the mode of openness consistently striving for enhancing transparency of their activity.

Conclusion

The article-by-article review of implementation of the Convention on Nuclear Safety presented in this National Report demonstrates that the Russian Federation fulfills all its obligations resulting from the Convention on Nuclear Safety and follows the principles adopted in the Vienna Declaration on Nuclear Safety.

Director General of the State Atomic Energy Corporation “Rosatom”	Head of the Federal Environmental, Industrial and Nuclear Supervision Service
A. E. Likhachev	A. V. Trembitskiy

Appendix 1

List of NPP Power Units in the Russian Federation Having Licenses for Siting, Construction, Operation and Decommissioning

List of Operating NPP Power Units in the Russian Federation

NPP, unit number	Reactor type	Rated power, MW(e)	Unit operation license No.
Balakovo, Unit 1	WWER	1000	GN-03-101-3116
Balakovo, Unit 2	WWER	1000	GN-03-101-3422
Balakovo, Unit 3	WWER	1000	GN-03-101-3588
Balakovo, Unit 4	WWER	1000	GN-03-101-2395
Beloyarsk, Unit 3	BN	600	GN-03-101-3812
Beloyarsk, Unit 4	BN	800	GN-03-101-2837
Bilibino, Unit 2	EGP-6	12	GN-03-101-3768
Bilibino, Unit 3	EGP-6	12	GN-03-101-3974
Bilibino, Unit 4	EGP-6	12	GN-03-101-3314
Kalinin, Unit 1	WWER	1000	GN-03-101-2897
Kalinin, Unit 2	WWER	1000	GN-03-101-3442
Kalinin, Unit 3	WWER	1000	GN-03-101-3717
Kalinin, Unit 4	WWER	1000	GN-03-101-4122
Kola, Unit 1	WWER	440	GN-03-101-3530
Kola, Unit 2	WWER	440	GN-03-101-3751
Kola, Unit 3	WWER	440	GN-03-101-3160
Kola, Unit 4	WWER	440	GN-03-101-2940
Kursk, Unit 2	RBMK	1000	GN-03-101-2316
Kursk, Unit 3	RBMK	1000	GN-03-101-2839
Kursk, Unit 4	RBMK	1000	GN-03-101-3122
Leningrad, Unit 3	RBMK	1000	GN-03-101-2220
Leningrad, Unit 4	RBMK	1000	GN-03-101-2471
Leningrad NPP-2, Unit 1	WWER	1200	GN-03-101-3451
Leningrad NPP-2, Unit 2	WWER	1200	GN-03-101-3873
Novovoronezh, Unit 4	WWER	417	GN-03-101-3766
Novovoronezh, Unit 5	WWER	1000	GN-03-101-3079
Novovoronezh NPP-2, Unit 1	WWER	1200	GN-03-101-3189
Novovoronezh NPP-2, Unit 2	WWER	1200	GN-03-101-3616
Rostov, Unit 1	WWER	1000	GN-03-101-3769
Rostov, Unit 2	WWER	1000	GN-03-101-3716
Rostov, Unit 3	WWER	1000	GN-03-101-2949
Rostov, Unit 4	WWER	1000	GN-03-101-3452
Smolensk, Unit 1	RBMK	1000	GN-03-101-2693
Smolensk, Unit 2	RBMK	1000	GN-03-101-3031

NPP, unit number	Reactor type	Rated power, MW(e)	Unit operation license No.
Smolensk, Unit 3	RBMK	1000	GN-03-101-3747

NPP units of the Russian Federation shut down for preparation for decommissioning

NPP, unit number	Reactor type	Rated power, MW(e)	Start of construction	Commissioning for commercial operation	Shutdown
Beloyarsk, Unit 1	AMB	108	01.06.1958	26.04.1964	01.01.1983
Beloyarsk, Unit 2	AMB	160	01.01.1962	01.12.1969	01.01.1990
Bilibino, Unit 1	EGP-6	12	01.01.1970	01.04.1974	14.01.2019
Novovoronezh, Unit 3	WWER-440	417	01.07.1967	29.06.1972	25.12.2016
Leningrad, Unit 1	RBMK-1000	1000	01.03.1970	01.11.1974	22.12.2018
Leningrad, Unit 2	RBMK-1000	1000	01.06.1970	11.07.1975	11.11.2020
Kursk, Unit 1	RBMK-1000	1000	01.06.1972	19.12.1976	19.12.2021

NPP power units of the Russian Federation being decommissioned

NPP, unit number	Reactor type	Rated power, MW(e)	Commissioning for commercial operation	Shutdown	Unit decommissioning license No.
Novovoronezh, Unit 1	WWER	210	31.12.1964	16.02.1988	GN-04-101-2807 until 25.10.2023
Novovoronezh, Unit 2	WWER	365	14.04.1970	29.08.1990	GN-04-101-2808 until 25.10.2023

NPP units in the Russian Federation licensed for construction

NPP, unit number	Reactor type	Rated power, MW(e)	No. of license	Type of license
Kusk NPP-2, Unit 1	WWER	1200	GN-02-101-3213	construction
Kursk NPP-2, Unit 2	WWER	1200	GN-02-101-3269	construction
BREST-OD-300	BN	320	GN-02-101-3990	construction

Appendix 2
Implementation of Recommendations of the 7th Meeting of the Contracting Parties

Challenge 1. Basing on modern risk-oriented approaches and equipment monitoring to implement timely the measures aimed at modernizing systems and equipment to achieve the safety goals at operating NPPs

Rosenergoatom uses different approaches to safety analysis in modernization of NPP equipment. The use of risk-oriented approaches is carried out in accordance with the "Updated Program of Implementation of the Probabilistic Safety Analysis Techniques in Operation of Rosenergoatom Concern JSC's NPPs for up to 2020 and until 2025", specifically:

– the sectoral database on equipment and components reliability and human errors (SAI OE, SPAND, ACS M&R) is enhanced;

– models of power units for Level 1 and 2 PSA are improved to include all places of nuclear material presence;

– risk monitoring system at NPPs are developed.

Monitoring of performance of equipment is carried out in accordance with the NPP operation documentation through recording of equipment operating parameters and their departures from permissible operating values, analysis of the technical state of the equipment and restoring required parameters using corresponding corrective measures.

All safety significant parameters of equipment operation are archived in corresponding databases and are accessible for an independent analysis. The NPP personnel analyze equipment defect flow, availability of SPTA, analysis of equipment failures, analysis of similar equipment failures at other NPPs. The problems of equipment operation and probabilities of equipment failures are identified based on the said analysis. Also, a decision is made of the necessity to replace or upgrade it considering its safety impact, reliability, economics, and NPP operating risks.

The following safety systems have been upgraded based on risk-oriented approach after the 7th Meeting:

– the reactor monitoring, control and protection system and hardware & software complexes of control safety systems as well as the automated coolant leak detection system at Unit 3 of Smolensk NPP;

– the active emergency core cooling system (high and low pressure), water storage passive system of emergency core cooling, emergency make-up system of steam generators with diesel-driven pumps at Units 1 and 2 of Kola NPP and Unit 4 of Novovoronezh NPP.

Challenge 2: To effectively manage lifetime of equipment, including electrical equipment, I&C, wiring during extended operation of NPPs

The federal standards and regulations "Requirements for Lifetime Performance Management of Pipelines and Equipment of Nuclear Power Plants. Basic Provisions" have been developed and put into force in the Russian Federation for effective management of lifetime performance during extended operation. This document sets forth the requirements for lifetime performance management of equipment and pipelines of nuclear plant attributed to components of Safety Classes 1, 2 and 3. In elaboration of this document, Rostechnadzor in 2017 has produced and approved five safety guides:

– "Identification of Lifetime Performance Characteristics of Valves of Nuclear Plants and Their Monitoring Techniques";

– "Identification of Lifetime Performance Characteristics of Equipment and Pipelines Operating Under Pressure of Nuclear Plants and Their Monitoring Techniques";

– "Identification of Lifetime Performance Characteristics of Pumps of Nuclear Plants and Their Monitoring Techniques";

– "Identification of Lifetime Performance Characteristics of Electrical Equipment of Nuclear Plants and Their Monitoring Techniques"; and

– "Identification of Lifetime Performance Characteristics of Instrumentation, Controls and Automation of Nuclear Plants and Their Monitoring Techniques".

The said documents contain requirements for lifetime performance management, including extended period of operation. Based on the above listed documents, the Operating Organization, Rosenergoatom, has worked out a target engineering program "Lifetime Performance Management during Design and Extended Operation Period of Power Units". Its main requirement is working out Programs of Lifetime Performance Management of Systems and Equipment for each NPP power unit.

In 2017, the standard programs were worked out and put into force for lifetime performance management of equipment and pipelines of NPPs with WWER, RBMK, BN and EGP, including sections covering lifetime performance management of electrical equipment, I&C and cables.

In 2018, the lifetime performance management programs for equipment and pipelines of power units which included sections on lifetime performance management of electrical equipment, I&C and cables were worked out for all Russia's NPP power units.

In 2019-2021, following the results of implementation of lifetime performance management programs for NPP equipment and pipelines, annual reports were written. They contained analyses of efficiency of these

programs and, based on those analyses results, necessary amendments were made to the programs.

Challenge 3: To implement NPP cyber security programs to meet requirements of new rules

ROSATOM has created the sectoral methodological center on cyber security of APCS of nuclear facilities.

In Rosenergoatom the Competence Center on Cyber Security of APCS NPPs has been set up. The "Program of Work to Ensure Cyber Security of APCS NPPs for 2021-2023" has been put into effect. For methodological support of the work ensuring cyber security of NPPs, the following documents have been put into effect that regulate main issues of cyber security of APCS NPPs:

– "Cyber Security of APCS of Nuclear Plants. Threat Basic Model. Methodological Recommendations";

– "Methodological Recommendations for Cyber Security Ensuring when Making Changes in NPP Monitoring and Control Systems";

– "Methodological Recommendations for Organization and Conduct of Audits of Fulfillment of Information Security Requirements in Design, Completing and Supply of NPP Control and Monitoring Systems";

– "Methodological Recommendations for Conduct of Investigations of Cyber Security-related Events and Incidents in Monitoring and Control Systems of NPPs";

– "Methodological Recommendations for Building up Local Threat Models for NPP Monitoring and Control Systems";

– "Methodological Recommendations for Responding to Computer Incidents in NPP Monitoring and Control Systems"; and

– "Methodological Guidelines for Categorization of APCS NPPs".

According to the legislation of the Russian Federation, Rosenergoatom has performed the categorization (classification) of monitoring and control systems within APCS NPP to determine basic requirements for organizational and engineering measures aimed at ensuring sustainable functioning of APCS in conditions of cyber attacks.

The Competence Center on Cyber Security of APCS NPPs has started the audit of APCS NPPs.

Proposal 1:

Ensure implementing of SAMGs at all Russia's NPPs

Tables 1, 2 and 3 contain information about implementation of SAMGs at all Russia's NPPs.

Table 1. Information about implementation of SAMGs at NPPs with WWER reactors

NPP	Unit No.	Reactor	SAMG at power	SAMG for SFP and shutdown RI
Balakovo NPP	1	WWER-1000	+	+
	2		+	+
	3		+	+
	4		+	+
Kalinin NPP	1	WWER-1000	+	+
	2		+	+
	3		+	+
	4		+	+
Kola NPP	1	WWER-440	+	+
	2		+	+
	3		+	+
	4		+	+
Leningrad NPP-2	1	WWER-1200	+	+
	2		+	+
Novovoronezh NPP	4	WWER-440	+	+
	5	WWER-1000	+	+
Novovoronezh NPP-2	1	WWER-1200	+	+
	2		+	+
Rostov NPP	1	WWER-1000	+	+
	2		+	+
	3		+	+
	4		+	+

Table 2. Development and putting into force SAMGs at NPPs with pressure-tube reactors

NPP	Unit No.	Reactor	SAMG at power	SAMG for SFP and shutdown RI
Bilibino NPP	1	EGP-6	*	*
	2		**	**
	3		**	**
	4		**	**
Kursk NPP	1	RBMK-1000	*	2022
	2		2022	2022
	3		2022	2022
	4		2022	2022

Leningrad NPP	1	RBMK-1000	*	+
	2		*	+
	3		+	+
	4		+	+
Smolensk NPP	1	RBMK-1000	2022	+
	2		2022	+
	3		2022	2022

** - do not plan due to shutdown for preparation for decommissioning;*

*** - did not plan due planned shutdown for preparation of power units for decommissioning;*

+ - developed and put into force.

Note: SANG for RI, SAMG for SFP of Kursk and Smolensk NPPs have been developed and are under review in Rostechnadzor.

Table 3. Development and putting into force SAMGs at NPPs with fast neutron reactors

NPP	Unit No.	Reactor	SAMG at power	SAMG for SFP and shutdown RI
Beloyarsk NPP	3	BN-600	2022	2022
	4	BN-800	2022	2022

Note: SANG for RI, SAMG for SFP of Beloyarsk NPP have been developed and are under review in Rostechnadzor.

Proposal 2: The Russian Federation will send Lithuania the corresponding information that confirms that the assessment of Baltic NPP site being constructed in Kaliningrad Region was performed in accordance with provisions of the IAEA safety standards

In the reporting period for implementation of the given proposal there were no objective conditions due to the fact that the construction of major facilities of Baltic NPP was suspended and mothballing is under way. The assessments and engineering solutions made earlier lost their topicality.

Appendix 3
Implementation of the Vienna Declaration on Nuclear Safety

The Vienna Declaration on Nuclear Safety formulates the principles by which the Contracting Parties should be guided in implementing requirements of the Convention on Nuclear Safety for prevention and mitigation of accidents with radiological consequences.

Principle 1: New nuclear power plants are to be designed, sited, and constructed, consistent with the objective of preventing accidents in the commissioning and operation and, should an accident occur, mitigating possible releases of radionuclides causing long-term off site contamination and avoiding early radioactive releases or radioactive releases large enough to require long-term protective measures and actions.

Principle 2: Comprehensive and systematic safety assessments are to be carried out periodically and regularly for existing installations throughout their lifetime in order to identify safety improvements that are oriented to meet the above objective. Reasonably practicable or achievable safety improvements are to be implemented in a timely manner.

Principle 3: National requirements and regulations for addressing this objective throughout the lifetime of nuclear power plants are to take into account the relevant IAEA Safety Standards and, as appropriate, other good practices as identified inter alia in the Review Meetings of the Convention on Nuclear Safety.

Measures to improve design, siting and construction of new nuclear plants as part of implementation of Principle 1

The requirements for siting (site selection) of nuclear plants established in Russian federal standards and regulations in the field of the use of atomic energy meet Principle 1 of the Vienna Declaration on Nuclear Safety. They include a list of factors, phenomena, and processes, which, if present, do not permit siting of nuclear plants. The prohibiting factors, particularly, include active faults on the site and high seismicity level of the NPP site.

Also, the said regulations establish the list of natural and man-induced factors, which, if present, make unfavorable the NPP siting region. NPP siting is allowed only under the condition that engineered and organizational measures are in place to ensure safety of NPP. These factors include, for example, banks of water reservoirs which water line velocity exceeds 1 meter per year, slopes having an inclination of more than 15º and other.

According to the requirements of the federal standards and regulations, in the NPP design bases the natural factors, processes and phenomena considered in the NPP design bases are determined within the time interval of 10,000 years. Also, in the design bases should consider man-induced factors with the probability of 10^{-6} a year and more. Besides, acceding to the requirements of the regulations, probabilistic safety analyses under external impacts should be carried out and their results should be considered in ensuring robustness and safety of NPPs in design and operation of NPPs.

The federal standards and regulations in the field of the use of atomic energy also formulate requirements, which aim at preventing accidents in operation of NPPs and, in case the accident has occurred, reducing an RS release, preventing releases at an early stage, as well as preventing large releases. Thus, the federal standards and regulations “General Safety Provisions of Nuclear Power Plants” contain a requirement of the mandatory presence of sealed enclosure of the reactor installation among the physical barriers on the path of RS propagation in the environment. The following NPP safety targets have been set forth:

- non-exceedance of the total severe accident probability for each nuclear unit in the one-year interval, equal 10^{-5};
- non-exceedance of the total probability of a large accident release for each NPP unit in the one-year interval, equal 10^{-7}; and
- non-exceedance of the total severe accident probability for on-site nuclear fuel storage facilities (with are not part of NPP units) in the one-year interval, equal 10^{-5}.

If the estimated probability of a large accident release exceeds the said limiting value, the NPP design, in accordance with the said federal standards and regulations, should foresee additional engineered solutions (including special engineered features for beyond design basis accident management) aimed at prevention of accidents and mitigation of their consequences. The Russian NPP designs foresee the following engineering and organizational measurers aimed at preventing of accidents and mitigating of their consequences:

- special engineered features for beyond design basis accident management (including special engineered features to manage accidents involving blackouts of NPPs or loss of systems removing heat to the ultimate heat sink), which are intended for performance of fundamental safety functions in beyond design basis accidents, including simultaneous accidents at all units of a multi-unit NPP;
- measures to protect above said special engineered features from external impacts and accident affecting factors;

– engineered features for monitoring of RI and NPP condition under accidents, including severe accidents, as well as post-accident monitoring equipment in numbers sufficient for accident management;

– measures to ensure radiation safety of the population in case of a controlled RS release in severe accident; and

– the protective measures planning zone and mandatory population evacuation planning zone and their requirements (limitation of the population density, absence of difficult-to-evacuate groups of the population, availability of communication routes), which allow for fast evacuation of the population from the zones of radiation impacts, as necessary.

Improvement of NPP assessments system and safety checks as part of implementation of Principle 2

In accordance with the requirements of the Federal Law “On the Use of Atomic Energy”, for nuclear power units which have an operating license for more than ten years, the periodic safety review should be performed each 10 years considering changes in characteristics of the NPP site, aging processes of NPP equipment, building structures, upgrades, operating experience, as well as changes in regulatory framework. At the present time, according to the “Periodic Safety Assessment Schedule of Nuclear Installations and Storage Facilities”, the work has been done on periodic safety assessment of Units 3 and 4 of Leningrad NPP, Unit 2 of Kursk NPP, Unit 1 of Rostov NPP and Unit 4 of Balakovo NPP.

Annually, Roseneroatom performs safety condition assessment of all Russia’s NPPs in accordance with the sectoral standard “Provision on Annual Reports on Operating Safety Condition Assessment of Nuclear Power Units”. The assessment of the operating safety condition of nuclear power units in 2016-2022 has shown that all operating NPPs maintain acceptable safety level.

In addition to in-depth safety assessments of NPP power units, during operation Level 1 and 2 probabilistic safety analysis (PSA-1 and PSA-2) are performed to verify safety targets of NPPs.

Operating safety checks are carried out by the Operating Organization and Regulatory Body. The long-term OSART Mission Plan (until 2031) agreed with the IAEA is implemented. In the reporting period, there were:

– OSART missions to Leningrad and Kalining NPPs;

– OSART control visits to Novovoronezh and Leningrad NPP;

– OSART corporative mission to the Operating Organization, Rosenergoatom (for more detailed information see Section 14.6).

In the reporting period, the Regulatory Body conducted 27 different inspections of NPPs and Rosenergoatom's Headquarters.

The safety systems are improved following the results of safety assessments. Following the results of safety assessments done when extending operation of Units 1 and 2 of Kola NPP and Unit 4 of Novovoronezh NPP the following has been introduced:

– boric solution heat-up system in ECCS tanks and accumulators; ECCS automatic equipment has been upgraded;

– high pressure boron injection system which supplies boric solution to the primary circle under rated pressure;

– emergency feedwater supply system with three physically separated independent channels;

– additional channel of the emergency power supply system with placement of electrical equipment in a separate building; equipment of remaining channels of the said system which exhausted its service life has been replaced.

Improvement of legal regulation of nuclear and radiation safety as part of implementation of Principle 3

According to the Federal Law "On the Use of Atomic Energy", when developing federal standards and regulations in the field of the use of atomic energy, the recommendations of international organizations in the uses of atomic energy where the Russian Federation is involved should be mandatorily taken into account.

The Regulatory Body has approved the Implementation Plan of the Concept of Improvement of Safety and Standardization Regulatory Environment in the Use of Atomic Energy for 2015-2023 which aims, among other, at harmonization with the IAEA safety standards.

A list of federal standards and regulations in the field of the use of atomic energy worked out in the reporting period is given in Appendix 7 to this Report. The worked out documents take account of recommendations of the IAEA safety standards.

Appendix 4
Major Performance Indicators of Russian NPPs in 2016-2021

Major Performance Indicators of Russian NPPs in 2016-2021

NPP	Unit	RI type	Availability factor - Kav, %						Number of scrams per 7,000 hours of operation					
			2016	2017	2018	2019	2020	2021	2016	2017	2018	2019	2020	2021
Kola														
	1	WWER-440	78.45	78.62	30.33	80.56	84.11	87.16	0	0	0	0	0	0
	2	WWER-440	79.78	83.48	84.38	23.61	86.71	81.40	0	0	0	0	0	0
	3	WWER-440	86.28	84.70	85.30	86.49	82.80	82.91	1.06	0	0	0	0	0
	4	WWER-440	83.46	84.56	84.93	87.48	80.37	82.77	2.16	0.902	0	0	0	0
Novovoronezh														
	3	WWER-440	90.80	-	-	-	-	-	0	-	-	-	-	-
	4	WWER-440	88.11	93.92	0.40	86.32	90.37	90.51	0	0	0	0	0	0
	5	WWER-1000	86.13	79.36	87.77	74.67	84.60	87.84	0	0	0	2.01	0	0
Novovoronezh NPP-2														
	1	WWER-1200	-	63.03	83.44	77.97	81.97	80.41	-	0	0	0	0	0
	2	WWER-1200	-	-	-	-	83.64	79.27	-	-	-	-	0.91	0
Balakovo														
	1	WWER-1000	99.94	89.92	76.80	98.87	88.96	85.74	0	0	0	0	0	0
	2	WWER-1000	89.79	79.07	89.92	100.00	86.37	90.25	0	0	0.883	0	0	0
	3	WWER-1000	83.26	99.48	81.71	56.84	78.34	87.09	0	0	0	0	0	0
	4	WWER-1000	91.58	84.24	99.97	67.76	83.11	94.62	0	0	0	0	0	0
Kalinin														
	1	WWER-1000	78.17	89.63	98.21	75.10	30.56	89.49	0	0	0	1.04	4.94	0
	2	WWER-1000	75.75	84.71	93.86	87.05	90.80	97.24	0	0	0	0.89	0	0
	3	WWER-1000	62.43	91.11	85.67	83.76	100.00	83.78	0	0	0	0	0	0
	4	WWER-1000	80.15	86.52	99.76	87.66	86.28	98.71	0	0	0	0	0.91	0.81
Rostov														
	1	WWER-1000	99.63	89.24	87.98	99.52	87.29	86.89	0	0	0	0	0	0

Appendix 4. Major Performance Indicators of Russian NPPs in 2016-2021

NPP	Unit	RI type	Availability factor - Kav, %						Number of scrams per 7,000 hours of operation					
			2016	2017	2018	2019	2020	2021	2016	2017	2018	2019	2020	2021
	2	WWER-1000	90.69	88.31	77.90	98.72	90.79	85.85	0	0	0	0	0	0
	3	WWER-1000	73.43	77.90	90.77	89.97	90.36	90.67	0	0	0	0	0	0
	4	WWER-1000				88.19	97.45	89.52				0	0	0
Kursk														
	1	RBMK-1000	67.46	82.54	58.92	66.51	65.06	76.26	1.12	0	0	0	0	1.02
	2	RBMK-1000	69.57	90.92	56.48	62.17	66.89	69.35	0	0	1.217	0	0	0
	3	RBMK-1000	85.12	66.59	77.41	61.19	80.58	73.85	0	0	0	0	0.93	0
	4	RBMK-1000	90.08	83.71	86.70	80.03	89.46	77.33	0	0	1.819	0	0	0
Leningrad														
	1	RBMK-1000	80.20	57.83	72.61	-	-	-	1.029	0	0	-	-	-
	2	RBMK-1000	67.85	78.83	70.20	74.94	72.20		0	0	0	0	0	0
	3	RBMK-1000	87.94	84.96	72.21	84.85	70.53	72.94	0	0.929	0	0	1.11	0
	4	RBMK-1000	85.45	85.58	84.83	75.83	84.21	73.22	0	0.885	0	0	0	0
Leningrad NPP-2														
	1	WWER-1200	-	-	22.28	74.93	83.44	92.65	-	-	0	1.02	0	0
	2	WWER-1200				-	-	91.18				-	-	-
Smolensk														
	1	RBMK-1000	79.44	80.44	80.92	75.51	73.96	87.17	0.99	0	0	0	0	0
	2	RBMK-1000	82.32	74.29	87.42	70.31	87.85	83.91	0.94	0	0	0	0	0
	3	RBMK-1000	83.35	93.49	40.84	74.46	83.22	84.13	0	0	0	1.03	0	0
Beloyarsk														
	3	BN-600	84.66	85.36	75.27	82.21	81.59	82.22	0.92	0	0	0	0	0
	4	BN-800	-	73.12	62.30	69.65	82.99	44.44	-	0	0	1.09	0	3.30
Bilibino														
	1	EGP-6	84.40	73.49	22.30	-	-	-	0	0	0	-	-	-
	2	EGP-6	74.73	84.40	84.28	84.45	73.18	84.39	1.06	0	0	0	0	0
	3	EGP-6	84.39	84.22	75.64	89.60	84.01	79.36	0	0	0	0	0	0
	4	EGP-6	82.78	84.42	84.38	76.54	81.90	79.25	0.97	0	0	0	0	0

Appendix 4. Major Performance Indicators of Russian NPPs in 2016-2021

Appendix 5
Measures Taken in the Light of Lessons of Fukushima Daiichi Accident

The short-term and mid-term measures developed by Rosenergoatom in the light of lessons of Fukushima Daiichi accident were fulfilled in the full scope are listed in Appendix 5 to the seventh National Report of the Russian Federation. The following long-term measures have been done:

1) Design solutions of setting and connecting emergency mobile machinery have been implemented at all NPP power units,

2) Design solutions of implementing hydrogen explosion safety systems have been implemented at all NPP power units,

3) Development and updating of emergency documentation in accordance with new design solutions have been done,

4) At all NPPs, the charts of the personnel actions to connect emergency mobile machinery to supply water to the reactor and SFP in case of a beyond design basis accident have been developed and corresponding changes have been made to emergency documentation,

5) At NPPs with RBMK and BN reactors, the new sections BDBA MG (S) have been developed in BDBA MGs (the drafting and implementing progress is indicated in Appendix 2),

6) Rosenergoatom has developed and implemented the “Plan of Measures for Development (Revision/Updating) and Implementation at NPPs of Rosenergoatom Concern JSC the Beyond Design Basis Accident Management Guides as Part of Severe Accident Management (RUZA(T))”,

7) Implementation is carried out of accident and post-accident monitoring features (“emergency” instrumentation and controls designed to operate in conditions of beyond design basis accidents);

8) The following measures of enhancing emergency preparedness have been implemented:

– back-up digital communication channels between NPPs and shielded control post of Rosenergoatom have been arranged for;

– mobile control posts (mobile communication hubs) for emergency commanders at NPPs and the head of urgent assistance to nuclear plants have been set up and upgraded;

– at all NPPs, as well as in the Crisis Center of Rosenergoatom, uninterruptible power supply has been provided to daily communication hubs of NPPs, communication hubs of shielded emergency response control posts, in the city and the evacuation region;

– back-up of data transmitted by the hardware & software complex.

Appendix 6
Major Safety and Reliability Activities Undertaken as Part of Upgrading Some of the Russian NPP Units in 2016 – June 2022

Balakovo NPP

Unit	Activities
No. 1	Replacement of storage batteries with the discharge time of one hour for storage batteries with the discharge time of two hours (to manage BDBAs)
No. 2	Additional redundancy for AZ trains
No. 2	Upgrading of control hardware to exclude a common cause failure in software of control safety systems
Nos. 1, 2, 3	Implementation of automatic water chemistry monitoring of the primary circuit
No. 3	Upgrading of CRS equipment of the TVV-1000-4U3 generator excitation system
No. 3	Replacement of steam generator PGV-1000M
No. 3, 4	Upgrading of the CPS equipment (replacement of CPS rod drives and equipment of group and individual control and power supply system)
No. 4	Upgrading of neutron flux monitoring instrumentation (replacement of the equipment of two sets of NFMI at the main control room)

Beloyarsk NPP

Unit	Activities
No. 3	Replacement of electromagnetic pumps in auxiliary sodium systems
No. 3	Replacement of steam pressure governors in the separator header
No. 4	Replacement of the rotor of turbine generator TZV-890-2AUZ
No. 4	Introduction of emergency instrumentation and controls workable in conditions of beyond design basis accidents
SPF	Upgrading of ORU equipment under target programs of the Operating Organization: – replacement of oil-filled current transformers installed at ORU 150, 220 kV; – replacement of circuit breakers at ORU 110-750 kV; – replacement of relay protection and electric

	automation

Bilibino NPP

Unit	Activities
Nos. 1-4	Upgrading of emergency power supply system of Group I consumers as regards physical separation of EPSS-1 trains for protection of possible common cause failures
Nos. 2-4	Replacement of cut-off valves to the condenser and main boiler of power units Nos. 2÷4 to increase response of preventive protection from overpressure in the drum separator
Nos. 2-4	Upgrading of AB-48 V
SPF	Upgrading of the radiation monitoring system

Kalinin NPP

Unit	Activities
No. 1	Upgrading of steam generator level measurement system (ensuring independence of measurement channels and improvement of performance reliability
No. 1	Replacement of APCS equipment and cables
No. 2	Replacement of drive mechanisms of the reactor control and protection system
No. 2	Replacement neutron flux monitoring instrumentation
Nos. 1, 2	Replacement of armored cables SPN-1000 with armored bundles SPZO-M
Nos. 1, 2	Upgrading of RCP main joint seal
No. 3	Upgrading of hardware & software complex of higher level of the reactor internal monitoring system
No. 4	Upgrading of the automatic control and protection system of steam turbine K-1000-60/3000

Kola NPP

Unit	Activities
No. 1	Upgrading of emergency power supply system of Group I direct current consumers (replacement of storage batteries)
No. 1	Implementation of 3-channel active HP and LP ECCS system
No. 1	Introduction of ECCS water storage tanks

No. 1	Implementation of hydrogen explosion safety system
No. 2	Introduction of ECCS water storage tanks
No. 2	Upgrading of HP and LP ECCS
No. 2	Upgrading of RMS
No. 2	Implementation of LCS
No. 2	Replacement of auxiliary power generators GSR-3,4
No. 3	Upgrading of seismic metering and reactor protection systems (implementation of the new system consisting of 3 measurement channels for seismic impacts based on seismic sensor readings)
No. 3	Upgrading of turbine generator equipment (replacement of generator switches 20 kV TG-5, replacement of generator stator TVV-500 TG-6)
Nos. 1,2,3,4	Implementation of emergency monitoring and metering instruments, workable in conditions of beyond design basis accidents
Nos. 1, 2, 4	Replacement of generator switches V-TG in the power release scheme
Nos. 1,2,3,4	Upgrading of SG PORV

Kursk NPP

Unit	Activities
No. 3	Upgrading of turbine generator equipment (replacement of generator switches 20 kV TG-5, replacement of generator stator TVV-500 TG-6)
Nos. 2, 3, 4	Transition of RI cells with installed emergency pressure tube cooling devices to “dry option”
Nos. 1-4	Ensuring reactor graphite stack lifetime performance: - reducing amount of deflection of channels; - recovery of TJT gap size; - recovery of gap “KJ-GK”
Nos. 1-4	Implementation of emergency monitoring and metering instruments, workable in conditions of beyond design basis accidents
Nos. 1-4, SPF	Arrangement of power supply from mobile diesel generators to consumers of safety systems; Implementation of back-up H&S for data transmission to the Crisis Center of Rosenergoatom; Implementation of uniform radio communication system that uses TETRA standard on the Motorola IP Compact platform at NPPs and Crisis Center of Rosenergoatom

Leningrad NPP

Unit	Activities
Nos. 1-4, SPF	Implementation of cooling water supply to external outlets
Nos. 1-4	Arrangement of power supply from mobile diesel generators to consumers of safety systems
Nos. 1-4	Implementation of uniform radio communication system that uses TETRA standard on the Motorola IP Compact platform at NPPs and Crisis Center of Rosenergoatom
Nos. 1-4	Implementation of back-up H&S for data transmission to the Crisis Center of Rosenergoatom
Nos. 1-4	Ensuring reactor graphite stack lifetime performance: - reducing amount of deflection of channels; - recovery of TJT gap size; - recovery of gap “KJ-GK”
Nos. 3, 4	Implementation of emergency monitoring and metering instruments, workable in conditions of beyond design basis accidents
No. 4	Upgrading of the generator voltage scheme with replacement of generator switch G-8
No. 5	Upgrading of the power release system by replacement of the generator switch set with SF6 generator switchboard (EGRU) HEC-7B at Unit 1 of Leningrad NPP-2
No. 5	Upgrading of feed and bleed and boron monitoring system and clean condensate and borated water supply system as part of load-follow mode implementation

Novovoronezh NPP

Unit	Activities
No. 3	Implementation of MEDGS emergency power supply and connection scheme to outdoor networks
Nos. 3-5	Implementation of back-up H&S for data transmission to the Crisis Center of Rosenergoatom
No. 4	Implementation of emergency gas evacuation system from the reactor and steam generator headers
No. 4	Equipment of sealed enclosures with emergency hydrogen evacuation system
No. 4	Implementation of emergency monitoring and metering instruments, workable in conditions of beyond design basis

	accidents
No. 4	Implementation of boric acid solution supply system from emergency boric acid reserve tanks B-8/4 in the spent fuel pool in case of beyond design basis accidents
No. 5	Upgrading of equipment EC ASUT-500M of turbine sets EA-13 and TA-14
No. 6	Upgrading of bleed and draining system of steam generators with a change in the connection of regenerative heat exchanger 10LCQ10AC001
No. 7	Upgrading of the diverse protection equipment

Rostov NPP

Unit	Activities
No. 1	Implementation of diesel-driven pumps for water supply in steam generators and spent fuel pool under beyond design basis accidents
No. 1	Fitting pilot operated safety relief valves with the pilot operated valve diagnostic system
No. 1	Upgrading of ICS through implementation of modern H&S sets
No. 1	Replacement of generator switch KAG-24 with SF6 generator distributing device HEC
Nos. 1, 2	Replacement of armored wires of the containment
Nos. 1-3	Implementation of emergency monitoring and metering instruments, workable in conditions of beyond design basis accidents
No. 1-4, CPF	Implementation of back-up H&S for data transmission to the Crisis Center of Rosenergoatom

Smolensk NPP

Unit	Activities
No. 1	Upgrading of BRU-K
No. 1	Upgrading of localizing safety systems for exclusion of coolant going beyond ALZ in case of an accident with PT break near RC. Installation of draining piping from the reactor cavity to pressure suppression pool
Nos. 1-3	Supply of cooling water external connection points

Nos. 1-3	Implementation of emergency monitoring and metering instruments, workable in conditions of beyond design basis accidents
Nos. 1-3	Power supply from mobile diesel generators to consumers of safety systems
No. 1-3	Upgrading of MFCC of power units. Replacement of pressure gates and check valves at pressure pipelines DN 800
No. 3	Upgrading of the control and monitoring system of ECS, pressurizer, RAS of Unit 3
Nos. 1,3	Upgrading and restoration of service life of stators and rotors of turbine generators TG-2, TG-5
SPF	U[grading of ORU electrical equipment as per targeted programs of the operating organization: – replacement of high-voltage lead-ins; – replacement of high-voltage circuit breakers VNV-750 kV at ORU-750 kV; – replacement of relay protection devices and automation; – replacement of overpressure limiters
SPF	Implementation of back-up H&S for data transmission to the Crisis Center of Rosenergoatom

Appendix 7

List of Federal Standards and Regulations in the Field of the Use of Atomic Energy (Covering Nuclear Plants) Endorsed by Rostechnadzor since the seventh National Report

1. NP-006-16 Requirements for Contents of the Safety Analysis Report of a Nuclear Power Unit with WWER Reactor.
2. NP-012-16 Rules of Safety Ensuring in Decommissioning of a Power Unit of a Nuclear Plant.
3. NP-017-18 Basic Requirements for Extension of Service Life of a Nuclear Plant Unit.
4. NP-026-16 Requirements to Safety Important Controlling Systems of Nuclear Plants.
5. NP-043-18 Rules of Layout and Safe Operation of Lifting Machines and Mechanisms Used at Nuclear Facilities
6. NP-044-18 Rules of Layout and Safe Operation of Pressure Vessels for Nuclear Facilities.
7. NP-045-18 Rules of Layout and Safe Operation of Steam and Hot Water Pipelines for Nuclear Facilities.
8. NP-046-18 Rules of Layout and Safe Operation of Steam and Hot Water Boilers for Nuclear Facilities.
9. NP-053-16 Rules of Safety in Transporting Radioactive Materials.
10. NP-064-17 Accounting of External Events of Natural and Man-induced Origin to Nuclear Facilities.
11. NP-067-16 Basic Rules of Control and Accounting of Radioactive Substances and Radioactive Waste in an Organization.
12. NP-071-18 Rules of Compliance Assessment of Products for which Requirements Associated with Safety Ensuring in the field of the Use of Atomic Energy are set forth as well as for their design (including surveys), production, construction, installation, adjustment, operation, storage, transportation, sale, and disposal.
13. NP-086-18 Rules of Layout and Operation of Drive Mechanisms Influencing Reactivity.
14. NP-102-17 Basic Requirements for Strength Justification of WWER Reactor Internals.
15. NP-104-18 Welding and Overlaying of Equipment and Pipelines of Nuclear Power Installations.
16. NP-105-18 Rules of Monitoring of Equipment and Pipeline Metal of Nuclear Power Installations in Manufacture and Installation.
17. NP-032-19. Site of a Nuclear Plant. Safety Requirements.
18. NP-030-19. Basic Rules of Control and Accounting of Nuclear Material.

19. NP-107-21. Rules of Layout and Safe Operation of Reactor Vessel, Pipeline Equipment and Internals of a Lead-Cooled Nuclear Power Installation.
20. NP-108-21. Requirements for Justification of Strength of Reactor Vessel, Pipeline Equipment and Internals of a Lead-Cooled Nuclear Power Installation.

Appendix 8

List of Administrative Regulations and Safety Guides in the Use of Atomic Energy (Covering Nuclear Plants) Endorsed and Put into Force by Rostechnadzor since the seventh National Report

Administrative Regulations

1. Administrative Regulation on Providing the State Service of Granting Permits to Execute Works in the Field of the Use of Atomic Energy to Employees of Nuclear Facilities by the Federal Environmental, Industrial and Nuclear Supervision Service.
2. Administrative Regulation of the Federal Environmental, Industrial and Nuclear Supervision Service on the Provision of the State Service of Granting Permits for Releases and Discharges of Radioactive Substances to the Environment.

Safety Guides

1. RB-002-16. Water Chemistry of Nuclear Plants.
2. RB-101-16. Recommendations for Application of Risk-informed Method in Justification of Risk-informative Solutions Associated with Safety of Nuclear Power Unit.
3. RB-114-16. Recommendations for Development of Quality Assurance Programs in Decommissioning of Nuclear Facilities.
4. RB-121-16. Recommendations for the Structure and Content of a Technological Regulation on Operation of NP Unit with a WWER Reactor.
5. RB-124-16. Recommendations for Conducting a Final Survey of Decommissioned Nuclear Facility.
6. RB-065-17. Recommendations for Conducting a Nuclear Material Balance in Their Physical Inventory-taking in Material Balance Zones and Analysis of Its Results.
7. RB-116-17. Recommendations for Development of the Probabilistic Safety Analysis for Spent Nuclear Fuel Storage Facilities.
8. RB-118-17. Recommendations for the Structure and Content of the Provision on Control and Accounting of Nuclear Material in Organizations Handling Nuclear Materials and Procedures for Control and Accounting of Nuclear Materials in the Material Balance Zone.

9. RB-119-17. Recommendations for Conducting an Administrative Audit in Frames of the Control and Accounting System of Radioactive Substances and Radioactive Waste in Organizations.
10. RB-123-17. Basic Recommendations for Level 1 Probabilistic Safety Analysis for a Nuclear Power Unit with Initiating Events Conditioned by Seismic Impacts.
11. RB-127-17. The Content and Composition of the Radiation Protection Program in Transportation of Radioactive Materials.
12. RB-129-17. Recommendations for Forming and Maintaining Safety Culture and Nuclear Plants and Operating Organizations of Nuclear Plants.
13. RB-130-17. Provision on Setting up Physical Protection Levels of Radiation Objects.
14. RB-131-17. Identification and Monitoring Techniques of Lifecycle Performance Characteristics of Valves of Nuclear Plants.
15. RB-132-17. Identification and Monitoring Techniques of Lifecycle Performance Characteristics of Pressure Equipment and Pipelines of Nuclear Plants.
16. RB-133-17. Identification and Monitoring Techniques of Lifecycle Performance Characteristics of Pumps of Nuclear Plants.
17. RB-135-17. Recommendations for Techniques and Means of Monitoring of Releases of Radioactive Substances in the Atmospheric Air.
18. RB-136-17. Identification and Monitoring Techniques of Lifecycle Performance Characteristics of Electrical Equipment of Nuclear Plants.
19. RB-137-17. The Content and Composition Certificate of the Reactor Installation of a Nuclear Plant.
20. RB-138-17. Identification and Monitoring Techniques of Lifecycle Performance Characteristics of Instrumentation and Controls and Automation of Nuclear Plants.
21. RB-140-17. Emergency Monitoring Systems of Nuclear Plants with Water-Water Power Reactors. General Recommendations and List of Monitored Parameters.
22. RB-019-18. Assessment of Initial Seismic Activity of Nuclear Facility Siting Region and Site in Engineering Surveys and Studies.
23. RB-044-18. Recommendations for Development of Level 2 Probabilistic Safety Analysis for a Nuclear Plant Unit.
24. RB-142-18. Seismic Monitoring of Siting Regions of Nuclear- and Radiation-hazardous Facilities.
25. RB-143-18. Recommendations for Development of Quality Assurance Programs in Construction of Nuclear Facilities.

26. RB-145-18. Monitoring of Radiation Burden and Determining of Radiation Lifetime of WWER Equipment.
27. RB-148-18. Recommendations for Arrangement and Conduct of Administrative Audit of Control and Accounting of Nuclear Material.
28. RB-150-18. Recommendations for Compiling a Final List of Beyond Design Basis Accidents Accountable in the Design of Nuclear Plants with WWER Reactors.
29. RB-152-18. Comments to the Federal Standards and Regulations “General Safety Provisions of Nuclear Plants. (NP-001-15)”.
30. RB-153-18. Recommendations for Justification of Selection a Decommissioning Option of Nuclear Facilities.
31. RB-001-19. Recommendations for an In-Depth Analysis Report on Operating Nuclear Power Units.
32. RB-024-19. Recommendations for the Development of a Level 1 Probabilistic Safety Analysis of a Nuclear Plant Unit for Internal Initiating Events
33. RB-156-19. Recommendations for the Conduct of a Vulnerability Analysis of a Nuclear Facility.
34. RB-157-19. Recommendations for the Conduct of Physical Protection Systems Efficiency Assessment of Nuclear Facilities.
35. RB-158-19. Recommendations for the Planning and Justifying Reduction of Maintenance and Decommissioning of Certain Systems and Equipment Volume, and Change in Operating Personnel of a Nuclear Power Unit Shut Down for Decommissioning.
36. RB-159-19. Recommendations for the Conduct of a Comprehensive Engineering and Radiation Survey of a Nuclear Facility.
37. RB-160-19. Recommendations for the Development of a Comprehensive Engineering and Radiation Survey Program of a Nuclear Facility.
38. RB-076-20. Recommendations for the Development of a Level 1 Probabilistic Safety Analysis of a Nuclear Plant Unit for Initiating Events Conditioned by On-Site Fires and Floods.
39. RB-093-20. Radiation and Thermal Physics Characteristics of Spent Nuclear Fuel of Water-Water Power Reactors and Large-Power Pressure-Tube Reactors.
40. RB-162-20. Recommendations for Meeting Requirements for Physical Protection of Nuclear Facilities and Nuclear Material Storage Facilities in Their Design and Construction.
41. RB-166-20. Recommendations for the Assessment of Errors and Uncertainties of Nuclear Plant Safety Calculation Analyses.

42. RB-167-20. Recommendations for the Justification of Residual Service Life of Nuclear Facility Building Structures.
43. RB-005-21. Recommendations for Methods and Means of Monitoring of Radioactive Substance Discharges in Water Objects.
44. RB-008-21. Recommendations for the Development of a Nuclear Facility Decommissioning Concept.
45. RB-009-21. Recommendations for the Development of Quality Assurance Programs in Operation of Nuclear Power Plants and Research Nuclear Installations.
46. RB-021-21. Recommendations for the Development of a Level 1 Probabilistic Safety Analysis of a Nuclear Plant Unit for Initiating Events Conditioned by External Impacts.
47. RB-085-21. Recommendations for the Content of Documents Justifying Guidelines for Maximum Permissible Releases of Radioactive Substances into the Atmospheric Air and Guidelines for Permissible Discharges of Radioactive Substances in Water Bodies.
48. RB-106-21. Recommended Methods of Calculation of Parameters Necessary for Development and Establishment of Guidelines for Maximum Permissible Releases of Radioactive Substances in the Atmospheric Air.
49. RB-126-21. Recommended Methods of Calculation of Parameters Necessary for Development and Establishment of Guidelines for Permissible Discharges of Radioactive Substances in Water Bodies.
50. RB-007-22. Accounting of Fast Neutron Fluence at WWER Pressure Vessels and Witness Specimens for Further Projection of Radiation Lifetime of Pressure Vessels.

Appendix 9

Financing of Rostechnadzor from the Federal Budget of the Russian Federation in 2016-2021

Salary budget (including accruals) of the interregional territorial departments for supervision over nuclear and radiation safety of Rostechnadzor in 2016-2021

Year	2016	2017	2018	2019	2020	2021
Salary budget including accruals, RUB thousand	458 291.5	429 679.3	457 497.2	517 973.2	531 149.3	605 571.2
% to 2016	100.0	93.8	99.8	113.0	115.9	132.1
Staff schedule of ITD for supervision over NRS, people	847	846	846	846	846	770
Salary including accruals for one full-time equivalent in ITD for supervision over NRS, RUB thousand	541.1	507.9	540.8	612.3	627.8	786.5
% to 2016	1000	93.9	99.9	113.2	116.0	145.4

Appendix 10
Quantitative Risk Assessments of Total Severe Accident Probability (PSA-1) for Nuclear Units with WWER Reactors at Power as of 01.01.2022

NPP, Unit	Reactor type	Integral Severe Core Damage Frequency, 1/reactor·year
Kola, Unit 1	WWER-440	$4.8 \cdot 10^{-6}$
Kola, Unit 2	WWER-440	$2.9 \cdot 10^{-6}$
Kola, Unit 3	WWER-440	$3.9 \cdot 10^{-6}$
Kola, Unit 4	WWER-440	$3.8 \cdot 10^{-6}$
Novovoronezh, Unit 4	WWER-440	$2.2 \cdot 10^{-5}$
Novovoronezh, Unit 5	WWER-1000	$9.4 \cdot 10^{-6}$
Novovoronezh-2, Unit 1	WWER-1200	$2.8 \cdot 10^{-7}$
Novovoronezh-2, Unit 2	WWER-1200	$2.6 \cdot 10^{-7}$
Balakovo, Unit 1	WWER-1000	$1.3 \cdot 10^{-5}$
Balakovo, Unit 2	WWER-1000	$1.3 \cdot 10^{-5}$
Balakovo, Unit 3	WWER-1000	$1.3 \cdot 10^{-5}$
Balakovo, Unit 4	WWER-1000	$1.3 \cdot 10^{-5}$
Kalinin, Unit 1	WWER-1000	$2.6 \cdot 10^{-5}$
Kalinin, Unit 2	WWER-1000	$1.8 \cdot 10^{-5}$
Kalinin, Unit 3	WWER-1000	$1.0 \cdot 10^{-5}$
Kalinin, Unit 4	WWER-1000	$4.9 \cdot 10^{-6}$
Leningrad-2, Unit 1	WWER-1200	$2.4 \cdot 10^{-6}$
Leningrad-2, Unit 2	WWER-1200	$2.4 \cdot 10^{-6}$

Rostov, Unit 1	WWER-1000	$3.3 \cdot 10^{-5}$
Rostov, Unit 2	WWER-1000	$2.6 \cdot 10^{-5}$
Rostov, Unit 3	WWER-1000	$1.6 \cdot 10^{-5}$
Rostov, Unit 4	WWER-1000	$1.6 \cdot 10^{-5}$

Appendix 11

Quantitative Assessments of Total Severe Accident Probability (PSA-1) for Nuclear Units with Pressure-Tube and Fast Neutron Reactors at Power as of 01.01.2022

NPP, Unit	Reactor type	Integral Severe Core Damage Frequency, 1/reactor·year
Beloyarsk, Unit 3	BN-600	$1.6 \cdot 10^{-6}$
Beloyarsk, Unit 4	BN-800	$1.3 \cdot 10^{-6}$
Bilibino, Unit 2	EGP-6	$2.51 \cdot 10^{-5}$
Bilibino, Unit 3	EGP-6	$2.51 \cdot 10^{-5}$
Bilibino, Unit 4	EGP-6	$2.51 \cdot 10^{-5}$
Kursk, Unit 2	RBMK-1000	$1.03 \cdot 10^{-5}$
Kursk, Unit 3	RBMK-1000	$8.89 \cdot 10^{-5}$
Kursk, Unit 4	RBMK-1000	$8.24 \cdot 10^{-5}$
Leningrad, Unit 3	RBMK-1000	$7.6 \cdot 10^{-6}$
Leningrad, Unit 4	RBMK-1000	$7.9 \cdot 10^{-6}$
Smolensk, Unit 1	RBMK-1000	$5.63 \cdot 10^{-5}$
Smolensk, Unit 2	RBMK-1000	$4.39 \cdot 10^{-5}$
Smolensk, Unit 3	RBMK-1000	$1.40 \cdot 10^{-5}$

Appendix 12

Quantitative Assessments of Total Probability of Large Emergency Release (PSA-2) of Nuclear Power Units with WWER Reactors Done for Internal Initiating Events when the Unit is at Power as of 01.01.2022

NPP, Unit	Reactor type	Probability value of large emergency release, 1/year
Balakovo, Unit 1	WWER-1000	$2.8 \cdot 10^{-7}$
Balakovo, Unit 2	WWER-1000	$2.8 \cdot 10^{-7}$
Balakovo, Unit 3	WWER-1000	$4.6 \cdot 10^{-6}$
Balakovo, Unit 4	WWER-1000	$4.6 \cdot 10^{-6}$
Kalinin, Unit 1	WWER-1000	$2.2 \cdot 10^{-6}$
Kalinin, Unit 2	WWER-1000	$1.8 \cdot 10^{-6}$
Kalinin, Unit 3	WWER-1000	$2.5 \cdot 10^{-6}$
Kalinin, Unit 4	WWER-1000	$3.5 \cdot 10^{-7}$
Kola, Unit 1	WWER-440	$3.0 \cdot 10^{-6}$
Kola, Unit 2	WWER-440	$1.6 \cdot 10^{-6}$
Kola, Unit 3	WWER-440	$2.5 \cdot 10^{-6}$
Kola, Unit 4	WWER-440	$2.6 \cdot 10^{-6}$
Leningrad-2, Unit 1	WWER-1200	$3.0\ 10^{-7}$
Leningrad-2, Unit 2	WWER-1200	$3.0\ 10^{-7}$
Novovoronezh, Unit 4	WWER-440	$1.1 \cdot 10^{-5}$
Novovoronezh, Unit 5	WWER-1000	$6.2 \cdot 10^{-6}$
Novovoronezh-2, Unit 1	WWER-1200	$1.1 \cdot 10^{-7}$
Novovoronezh-2, Unit 2	WWER-1200	$1.4 \cdot 10^{-7}$
Rostov, Unit 1	WWER-1000	$3.4 \cdot 10^{-6}$
Rostov, Unit 2	WWER-1000	$9.0 \cdot 10^{-7}$
Rostov, Unit 3	WWER-1000	$2.6\ 10^{-6}$
Rostov, Unit 4	WWER-1000	$1.8\ 10^{-6}$

Appendix 13

Quantitative Assessments of Total Probability of Large Emergency Release (PSA-2) of Nuclear Power Units with RBMK-1000, BN-800, BN-600, EGP-6 Reactors Done for Internal Initiating Events when the Unit is at Power as of 01.01.2022

NPP, Unit	Reactor type	Probability value of large emergency release, 1/year
Kursk, Unit 2	RBMK-1000	$6.73 \cdot 10^{-6}$
Kursk, Unit 3	RBMK-1000	$8.47 \cdot 10^{-6}$
Kursk, Unit 4	RBMK-1000	$1.35 \cdot 10^{-6}$
Leningrad, Unit 3	RBMK-1000	$1.82 \cdot 10^{-6}$
Leningrad, Unit 4	RBMK-1000	$1.02 \cdot 10^{-6}$
Smolensk, Unit 1	RBMK-1000	$3.25 \cdot 10^{-6}$
Smolensk, Unit 2	RBMK-1000	$4.36 \cdot 10^{-6}$
Smolensk, Unit 3	RBMK-1000	$2.4 \cdot 10^{-6}$
Beloyarsk, Unit 3	BN-600	$1,7 \cdot 10^{-7}$
Beloyarsk, Unit 4	BN-800	In process; due date – 2023
Bilibino, Unit 2	EGP-6	$5.15 \cdot 10^{-7}$
Bilibino, Unit 3	EGP-6	$5.15 \cdot 10^{-7}$
Bilibino, Unit 4	EGP-6	$5.15 \cdot 10^{-7}$

Appendix 14
Operational Events at NPPs of the Russian Federation from 2016 until 01.05.2022

NPP	INES Assessment																				
	2016			2017			2018			2019			2020			2021			4 months of 2022		
	Off-scale	«0»	«1»	Off-scale	«0»	«1»	Off-scale	«0»	«1»	Off-scale	«0»	«1»	Off-scale	«0»	«1»	Off-scale	«0»	«1»	Off-scale	«0»	«1»
Balakovo	3			2	1			2											1		
Beloyarsk	6	5		3			3			4	1		1	1		3	3		1		
Bilibino		2																			
Kalinin	6	7	1	1	4			6		2	7			8			3				
Kola	2	3		2	1		1	1								2				1	
Kursk		3		1	2		3	5	2	1	1			1		3	5				
Leningrad*	2	3		4	4		2	16		3	4			8	1	2	5			4	
Novovoronezh*	5	7		1	3	1	1	1		4	7			6		2				4	
Rostov	2	1		3	1		1	4			3		1	1		1	3				
Smolensk	4	3	1	1	2		1	2		3	3		1	1		1	1				
Total	30	34	2	18	18	1	12	37	2	17	27	0	3	26	1	14	20	0	2	9	0
	66			37			51			43			30			34			11		

** information is given for operating units of both stages*

Appendix 15
Departures at NPPs of the Russian Federation which are not Reportable to Rostechnadzor but Accountable in Rosenergoatom from 2016 until 01.05.2022

NPP	Number of departures at NPPs						
	2016	2017	2018	2019	2020	2021	4 months of 2022
Balakovo	18	33	15	14	9	13	4
Beloyarsk	32	32	29	26	13	18	5
Bilibino	9	10	4	6	5	2	1
Kalinin	73	25	19	15	32	22	6
Kola	38	36	30	30	34	27	8
Kursk	22	19	12	11	22	14	4
Leningrad*	41	52	50	38	41	42	7
Novovoronezh*	30	49	27	25	14	25	6
Rostov	16	14	10	9	16	20	2
Smolensk	23	24	20	17	21	15	7
Total	302	294	223	191	207	198	50

** - information is given for operating units of both stages*

Appendix 16
Measures Taken to Respond to COVID-19 Pandemic

Measures Taken by Rostechnadzor to Respond to COVID-19 Pandemic

Challenges facing Rostechnadzor in conditions of COVID-19 pandemic:

– the protection of life and health of both the employees of Rostechnadzor and its subordinate organizations and workers of operating organizations ensuring safe operation of nuclear facilities in conditions of COVID-19 pandemic;

– the arrangement of effective remote work to carry out remote checks for continuous monitoring of nuclear and radiation safety ensuring at supervised facilities.

Rostechnadzor has developed and implements the following measures:

– a number of Rostechnadzor's employees who fulfill their job duties directly at work places are reduced to a minimum possible numbers in definite periods. All employees are provided with personal protective equipment, their social distances are observed, and they are regularly tested for COVID-19;

– the remote work is arranged for other Rostechnadzor's employees where current digital communication equipment is used to get necessary information and access to databases for efficient fulfillment of job duties.

Territorial departments of Rostechnadzor have been authorized to:

– ensure conduct of necessary inspections and other measures to oversee of the safety of nuclear power plants;

– introduce oversight of fulfillment of additional measures worked out by Rosenergoatom to ensure safe operation of nuclear power plants in relation to introduction of the "ALERT" mode in the territory of the Russian Federation.

Rostechnadzor has recommended to the Operating Organizations:

– to ensure safe operation of nuclear power units in the condition of existing constraints;

– to draft additional measures to ensure safety in operation of nuclear power plants, including:

- ✓ increase in number and scrupulousness of walkdowns of process systems and equipment;

- ✓ conduct of off-schedule briefings for the staff on work in the ALERT mode;
- ✓ limit on numbers of planned junctions, switchovers and repairs of equipment;
- ✓ development of measures to have minimum of operating personnel justified by the project provided a part of workers are in hospital;
- ✓ in accordance to the established procedure, determining the operating mode of power units when it is impossible to ensure minimum operating personnel to be present;
- ✓ development of additional measures to ensure safety of operating and on-duty personnel of nuclear power plants as regards observance of sanitary and epidemiological requirements.

Measures Taken by ROSATOM in Response to COVID-19 Pandemic

To ensure safe operation of NPPs, protection of personnel in the conditions of the pandemic of a new coronavirus infection (COVID-19), crisis centers have been set up to prevent importation and propagation of the new coronavirus infection at the Operating Organization Rosenergoatom and at all Russian NPPs.

The Operating Organization has developed and implements a plan of measures to respond to situations associated to propagation of the coronavirus infection taking into account of international experience in response to COVID-19 (IAEA, WANO).

In accordance with the developed plan, Rosenergoatom and NPPs have implemented measures to protect health of employees and to organize work in new conditions, and to back-up operating personnel:

- the use of PPE;
- preventive disinfection of rooms;
- testing for CVD;
- daily monitoring of epidemiological situation;
- transfer to remote work of vulnerable employee categories;
- conduct of remote meetings, limiting of in-person meetings;
- ensuring isolation of MCR and LCP personnel;
- provision of necessary resources;
- forming a temporary staff of operating personnel and additional special staff in case individual workers are admitted to hospital.

In case the epidemiological situation aggravates, the measures to continue safe and reliable NPP operation include:

– compensation for temporary reduction of the number of personnel through revision of work schedules and inactivation of part of acting personnel;

– revision of operating and repair work scope;

– optimization of scheduled servicing in periods between repairs;

– optimization of PPM.

Effect of Coronavirus Infection (COVID-19) on Operation of Existing Nuclear Power Units and Implementation of New Power Units Construction Plans

The timeframe and duration of scheduled repairs did not change owing to high quality of planning and strict observance of measures to prevent propagation of the coronavirus infection.

Introduction of containment measures in the country did not affect the fulfillment of the electricity production schedule set forth by the system operator by NPPs.

In the situation of underproduction of electricity in 2020 due to general decrease in consumption in UES of Russia because of the pandemic, generation of electricity at Russia's NPPs exceeded target indices owing to effective managerial decisions of OO related to the optimization of the repair campaign.

In spite of reduction of personnel, the construction of power units was continued.

JSC SCC

To ensure safety of the power unit with RI BREST-OD-300 under construction and protection of personnel in the conditions of a new coronavirus infection (COVID-19) pandemic:

– an emergency operations center has been set up to prevent propagation of the new coronavirus infection;

– the plan of measures has been worked out and is implemented to respond to the situation associated with propagation of the coronavirus infection.

According to the plan, the measures have been implemented to protect health of the workers, organize work in new conditions, back-up operating personnel:

– the use of PPE;

– preventive disinfection of rooms;

– testing for CVD;

- daily monitoring of epidemiological situation;
- transfer to remote work of vulnerable employee categories;
- provision of necessary resources;
- conduct of remote meetings, limiting of in-person meetings;
- ensuring isolation of essential personnel;
- limiting of business travels of workers in the Russian Federation and abroad.