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

The Seventh Review Meeting
under the Convention on Nuclear Safety

Moscow 2016

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The Seventh National Report of the Russian Federation on the fulfillment of commitments resulting from the Convention on Nuclear Safety for the period from August 2013 to July 2016 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 and the Vienna Declaration on Nuclear Safety; 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.5, the Vienna Declaration on Nuclear Safety “On principles for the implementation of the objective of the Convention on Nuclear Safety to prevent accidents and mitigate radiological consequences” INFCIRC/872); the Summary Report of the President of the 6th Meeting of the Contracting Parties under the Convention on Nuclear Safety (including recommendations and proposals to the Russian Federation on problems/challenges formulated following the review of the sixth National Report of the Russian Federation in the Country Group 4); and in the Report of the IAEA Director General “The Fukushima Daiichi Accident”.

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
APCS	- automated process control system
ARMS	- automated radiation monitoring system
ASSET	- Analysis of Safety Significant Events Team (IAEA)
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
BOP	- balance of plant
CA	- controlled area
CA	- Central Administration
CC	- Crisis Center of Concern Rosenergoatom
CCB	- central control board
CD	- civil defense
CF	- capacity factor
CICE&T	- Central Institute for Continuing Education and Training
CJSC	- close-type joint stock company
CNS	- Convention on Nuclear Safety
CPS	- control and protection system
DG	- diesel generator
DITD	- Don Interregional Territorial Department (for supervision of nuclear and radiation safety)
ED	- emergency drills
EGP	- graphite-moderated loop-type power reactor
EIA	- Environmental Impact Assessment
EMERCOM of Russia	- Russian Federation Ministry for Civil Defense, Emergency Management and Response to Natural Disasters
EP	- engineering support
EPSS	- emergency power supply system
EROUO	- emergency rescue and other urgent operations
ESC	- engineering support center
ETC	- emergency technical center
FA	- fuel assembly
FNP	- federal standards and rules
FS	- fire safety
FSUE	- federal state-owned unitary enterprise
GD	- guidance document
GOST	- Russian national standard

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
IEC	- International Electrotechnical Commission
INES	- International Nuclear Event Scale
INSAG	- International Nuclear Safety Advisory Group
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
JSC SO UPS	- System Operator of the United Power System, Joint Stock Company
LPR	- Lifetime Performance Recovery
M&R	- maintenance and repair
M&RS	- maintenance and repair system
MCC, FSUE	- Mining and Chemical Combine, Federal State Unitary Enterprise
MCR	- main control room
MTR	- material and technical resources
NCMC	- National Crisis Management Center
NEA	- Nuclear Energy Agency of the Organization for Economic Cooperation and Development
NF	- nuclear facility
NF	- nuclear fuel
NIAEP	- Nizhniy Novgorod Engineering Company of the JSC Atomstroyexport, Joint Stock Company
NIKIET	- N.A. Dollezhal Research and Development Institute of Power Engineering, Joint Stock Company
NM	- nuclear material
NP	- nuclear plant
NPP	- nuclear power plant
NRB	- Radiation Safety Standards
NRNU MEPhI	- National Research Nuclear University “Moscow Engineering Physics Institute”
NRS	- nuclear and radiation safety
ODS	- outdoor switchyard
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	- ROSATOM's Commission for Management of Emergencies
OO	- Operating Organization
Ops	- operations
OSART	- Operational Safety Review Team (IAEA)
OSChS	- Industry-level System for Prevention and Management of Emergencies (ROSATOM)
OSPORB	- Basic Sanitary Rules of Radiological Safety
PM	- protective measures
PRIS	- Power Reactors Information System (IAEA)
PSA	- probabilistic safety analysis
PSR	- periodic safety review
PSAR	- Preliminary Safety Analysis Report of a nuclear power plant
QAP NPP	- Quality Assurance Program of Nuclear Power Plant
R&A	- relaying and automation
RAW	- radioactive waste
RBMK	- large-power pressure tube reactor
RC	- research center
RCC	- regional crisis center
RCP	- reactor coolant pump
RI	- reactor installation
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
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
SB	- storage battery
SCC	- Situation and Crisis Center of ROSATOM
SChSK	- Utility-level System for Prevention and Management of

	Emergencies (Rosenergoatom)
SChSO	- Plant-level System for Prevention and Management of Emergencies at a Facility (including nuclear plants)
SDGS	- stand-by diesel generator station
SEC NRS	- Scientific and Engineering Centre on Nuclear and Radiation Safety, federal budgetary establishment (STSO of Rostechnadzor)
SERCP	- Sheltered Emergency Response Command Post
SFA	- spent fuel assembly
SFP	- spent fuel pool
SG	- steam generator
SG	- safety guide
SLE	- service life extension
SNF	- spent nuclear fuel
SRW	- solid radioactive waste
SSF SNF	- separate storage facility for spent nuclear fuel
SZ	- surveillance zone
TC	- training center
TF	- training facility
TFP	- turbo feeding pump
TG	- turbine generator
UCR	- unit control room
VITD	- Volga Interregional Territorial Department (for supervision of nuclear and radiation safety)
VNIIAES	- All-Russian Research Institute for Nuclear Power Plants Operation, Joint Stock Company
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 safety is governed by:

- 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 Federal Law No. 170-FZ of 21 November 1995 “On the Use of Atomic Energy” stipulates that the Operating Organization shall bear whole responsibility for the safety of a nuclear installation as well as for the safe management of nuclear material and radioactive waste.

In the Russian Federation there is one Operating Organization of NPPs, Joint Stock Company “Russian Concern for the Production of Electrical and Thermal Energy at Nuclear Plants” (Rosenergoatom), which incorporates 10 operating nuclear power plants. According to the Federal Law “On the Use of Atomic Energy” and ROSATOM’s resolution of 27 November 2009, Rosenergoatom has been recognized fit for operating nuclear facilities, i.e. nuclear power plants.

The nuclear power development in the Russian Federation is defined by the program “Development of Nuclear Power and Industry Complex” endorsed by the Russian Government Ordinance No. 506-12 of 2 June 2014. The program states the main goals, in particular, as:

– ensuring stable development of the nuclear power and industry complex in the interests of innovative development of Russian economy and safe utilization of atomic energy; and

– keeping the geopolitical positions of Russia under conditions of observance of non-proliferation regime of nuclear materials and technology.

In the Russian Federation there is the Regulatory Body – the Federal Environmental, Industrial and Nuclear Supervision Service (Rostechnadzor). It exercises the state-level regulation of safety in the uses of atomic energy. 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.

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, and with consideration of the recommendations of the 6th Review Meeting of the Contracting Parties held in March-April 2014 and the “Program of Measures for Participation of the Russian Organizations Concerned in the Implementation of the IAEA Action Plan on Nuclear Safety” developed by Rostechnadzor and ROSATOM early 2012 and adopted at the 55th General Conference of the IAEA on 19-23 September 2011.

Executive Summary

This Section briefly describes main changes in the development of nuclear power in Russia, in the regulatory bases of uses of atomic energy, recommendations and proposals formulated by the 6th Review Meeting of the Contracting Parties and 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 today remains a state priority in the Russian Federation. In 2014, a new state program “Development of Nuclear Power and Industry Complex” until 2020 was adopted. The dynamic development of the sector is one of conditions for ensuring energy security of the State and stable growth of the country’s economy.

Thirty four NPP units of total installed capacity of 26.242 GW are in commercial operation. Over the time passed since the sixth National Report the following has been achieved: the first criticality, first power and commissioning for the commercial operation of Rostov-3 with WWER-1000 reactor; the first criticality and first power of Beloyarsk-4 with BN-800 fast neutron reactor; as well as the first criticality of Unit 1 at Novovoronezh NPP-2 with WWER-1200 reactor.

Additional (in excess of design) service life has been justified for a number of Russian nuclear units.

The activity to enhance safety at Russian NPPs is carried out as scheduled.

In the Russian Federation nuclear power is based on the state-of-the-art achievements of science and technology and uses the potential of leading research, engineering and industrial organizations.

The Russian nuclear power sector companies exercise activities that cover all spheres starting from research and design through equipment manufacture, construction, installation, start-up and adjustment, the entire nuclear fuel cycle (uranium extraction, enrichment, fuel fabrication, SNF recycling), radioactive waste management, and decommissioning of nuclear units.

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 sixth 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 has approved and implements a plan of improvement of the regulatory environment of safety and standardization of the use of atomic energy designed for 2015-2023. It aims, among other, at harmonization with the IAEA safety standards. In the reporting period, a number of new federal standards and regulations in the uses of atomic energy have been written, and a number of administrative regulations and safety guides of the Regulatory Body has been developed (see Subsections 7.3 and 7.4, Appendices 7 and 8).

The exercised activity aims at developing the effective regulatory bases which regulates issues related to ensuring and regulation of safety of nuclear installations.

3. Challenges, Recommendations and Proposals Formulated by the 6th Review Meeting

Based on the results of the review of the sixth National Report of the Russian Federation by the 6th 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 has been formulated:

Challenge 1: *The state-level efficient supervision of safety in conditions of the nuclear power development in Russia:*

- *Drafting and putting into force a financing mechanism aimed at attraction additional number of experienced employees to Rostechnadzor.*

The detailed information about solving this problem is given in Section 8 and Appendix 2 of this Report.

Challenge 2: *Keeping and transfer of knowledge given NPP construction outside Russia to Russian designs:*

- *Development of an effective system of training and retraining*

of Rostechnadzor and Rosenergoatom's personnel.

The detailed information about solving this problem is given in Subsection 11.3 and Appendix 2 of this Report.

Challenge 3: *An assistance in working out necessary frameworks in the countries which start developing nuclear power ("nuclear newcomers"):*

- *Giving Rostechnadzor powers and financial resources necessary to assist national regulators in the Russian nuclear technology recipient-countries.*
- *Facilitating the sufficient development of the national infrastructure which ensures proper regulatory control, as well as emergency preparedness and response.*

The detailed information about solving this problem is given in Subsection 8.1 and Appendix 2 of this Report.

Challenge 4: *Shipping off RBMK spent nuclear fuel from the sites to ensure safe SNF storage on sites.*

The detailed information about solving this problem is given in Subsection 19.8 and Appendix 2 of this Report.

Challenge 5: *The expanded monitoring and lifetime performance management of RBMK graphite stack.*

The detailed information about solving this problem is given in Subsection 6.6 and Appendix 2 of this Report.

Proposal 1: *Before starting a NPP construction near its state border, the Russian Federation shall carry out a site evaluation in accordance with the IAEA standards and invite the relevant IAEA mission on site and design evaluation with respect to external events (SEED).*

In the reporting period, no nuclear power plants have been started to be built near the state border of the Russian Federation.

Proposal 2: *In the National Report describe the progress in the implementation of recommendations of IRRS missions and other international peer reviews.*

Information on the progress in implementing recommendations of IRRS missions, OSART missions and WANO peer reviews is given in Subsections 8.1 and 14.2 of this Report.

4. The IAEA Missions (IRRS, 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, the Russian Federation continues cooperating with the IAEA on IRRS and OSART services, and with WANO on peer reviews at NPPs.

The detailed information about conducted IRRS missions, main findings of OSART missions and WANO peer reviews is given in Subsections 8.1 and 14.2 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. This goes in line with the recommendations contained in para. 35 of the Summary Report of the President of the 6th Meeting of the Contracting Parties. 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 of this Report.

6. Implementation of the Vienna Declaration on Nuclear Safety

The Russian Federation has started work to implement 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 if the accident occurs, the federal standards and regulation 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;
- the Regulatory Body has approved and implements 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.

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

7. Measures to Improve Openness and Transparency of All Concerned Parties

The information about the progress of the Regulatory Body and the Operating Organization in the implementation of the recommendation on improvement of openness and transparency of all concerned parties that is common for all Contracting Parties is given in Subsections 8.1, 9 and 16.3 of this Report.

Article 6. Existing Nuclear Installations

6.1. Brief Information on Nuclear Installations

The Russian Federation has in commercial operation 34 units at 10 nuclear power plants, including 18 units with water-cooled water-moderated reactors, 15 units with pressure-tube boiling-water reactors, and 1 unit with a sodium-cooled fast neutron reactor. Total installed capacity of operating nuclear units of Rosenergoatom is 26.242 GW. All units have at-reactor SNF storage facilities; separate SNF storage facilities are built at four NPP sites.

Over the time passed since submission of the sixth National Report, the Russian Federation has carried out:

- the first criticality (07.12.2014), the first power (27.12.2014) and commissioning for the commercial operation (16.09.2015) of Rostov-3 with WWER-1000 reactor installation;
- the first criticality (27.06.2014) and the first power (10.12.2015) of Beloyarsk-4 with BN-800 reactor installation; and
- the first criticality (24.03.2016) of Unit 1 at Novovoronezh NPP-2 with WWER-1200 reactor installation.

Units 1 and 2 of Beloyarsk NPP are at the stage of preparation for decommissioning; their SNF has been discharged from the reactors into at-reactor storage facilities. Units 1 and 2 of Novovoronezh NPP have been shut down; their SNF has been removed from the NPP site; Rostechnadzor's decommissioning licenses have been granted. According to ROSATOM's decision, dates have been set for several nuclear units to stop their operations as energy generators:

- Unit 3 of Novovoronezh NPP - 29.12.2016; and
- Unit 1 of Bilibino NPP - 31.12.2018.

The units under construction are:

- Unit 4 of Rostov NPP (RI WWER-1000/V-320); and
- Unit 2 of Novovoronezh NPP-2 (AES-2006 with RI WWER-1200/V-392M), Units 1 and 2 of Leningrad NPP-2 (AES-2006 with RI WWER-1200/V-491).

At the present time, construction of Baltic NPP (AES-2006 with RI WWER-1200/V-491) has been suspended.

A construction license has been granted for Unit 1 of Kursk NPP-2 and a siting license for Unit 2 of Kursk NPP-2 (WWER-TOI with RI WWER-1200/V-510K) has been granted.

A list of operating NPPs in the Russian Federation is given in Appendix 1.

Main performance indicators of operating nuclear units in 2013-2015 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 Which are More Serious than That Considered in the Design Bases

Rosenergoatom fulfills on due dates the measures to be fulfilled in 2012-2021 based on the analysis of robustness of Russian NPPs from extreme external impacts and preparedness of NPPs to manage beyond design basis accidents, including severe ones. Appendix 5 contains measures that have been fulfilled. The following measures are at the stages of implementation and completion:

1) an additional analysis of seismic impacts with intensity exceeding design values affecting reactor installations, spent fuel ponds, on-site SNF storage facilities, safety important equipment, buildings and structures;

2) ensuring hydrogen explosion safety as all NPP units with WWER reactors, which provide for implementation of hydrogen monitoring and evacuation systems in reactor containments;

3) implementation of equipment for emergency and post-emergency monitoring (“emergency” instrumentation and controls designed for operation in the conditions of beyond design basis accidents, including severe ones) at each NPP unit with WWER and RBMK reactors;

4) updating probabilistic safety analyses of NPP units considering extreme external impacts;

5) development of new and updating of existing emergency documents in accordance with additional design solutions; and

6) improvement of NPP emergency preparedness.

The measures to increase capabilities to withstand extreme external impacts at NPPs under construction (at the stage of commissioning) and under design are similar to measures taken at existing NPPs in terms of volume and content. They include:

- a robustness analysis of NPP facilities under extreme external impacts done using the methodology proposed by Rostechnadzor;
- the program for implementation of additional design solutions to reduce consequences of beyond design basis accidents at NPPs; and
- installation of additional mobile emergency equipment (diesel generators, mobile pumps, motor pumps etc.).

The NPP robustness analyses done have demonstrated that there are design-specific organizational and engineering features in implementation of measures to improve robustness of NPP units. For example, when building Rostov-4 and Beloyarsk-4, the measures to improve robustness there adopted for similar operating NPP units were repeated nearly in full scope. At Units 1 and 2 of Novovoronezh NPP-2, as well as planned units

of Kursk NPP-2, the NPP project has been added with the engineered features to manage beyond design basis accidents, which allow for heat removal from the reactor installation and spent fuel pond, as well as monitoring the NPP parameters.

6.3. Upgrading of NPP Units

Rosenergoatom's document "The Concept of Upgrading of Operating NPPs for the Period 2013-2017" defines the concept of modernization of Russian NPPs. It strategic goal is maintenance and enhancement the required NPP safety level, as well as an increase in electricity generation at operating NPPs. Upgrading solves the following problems:

- ensuring nuclear, radiation, technical, industrial, environmental and fire safety of operating NPPs in accordance with requirements of the federal atomic energy standards and regulations;
- management of NPP equipment lifetime performance during design and extended service life of units;
- reduction of the number of NPP operational events and scrams of units; and
- improvement of economic efficiency of units operations during extended service life.

Current upgrades are carried out annually at each NPP unit irrespectively of its service life. Special upgrades are carried out as part of programs to prepare nuclear units for extended service life. In the course of special upgrades at nuclear units the large-scale work is carried out aiming at safety ensuring of the NPP unit during its extended service life.

An algorithm of the current upgrades at NPP units is given at Fig. 6.1.

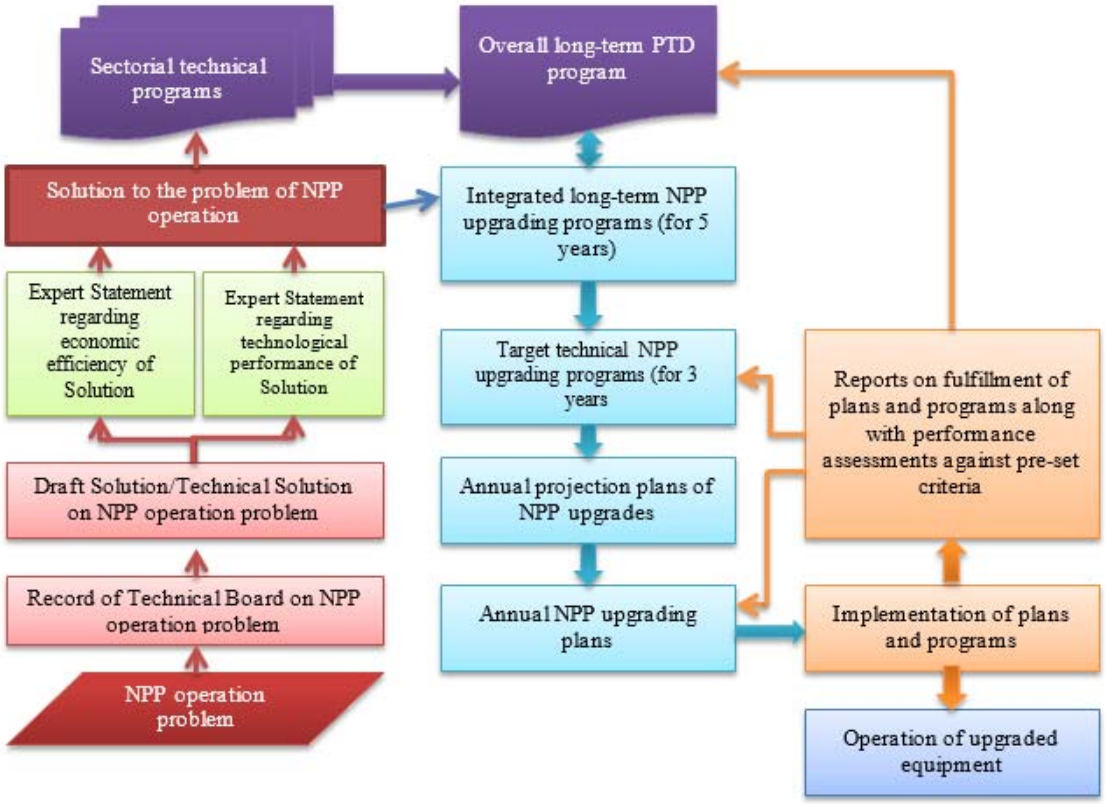

Fig. 6.1. An algorithm of the current upgrades at NPPs

A detailed description of the management algorithm is given in the previous National Report of the Russian Federation.

According to requirements of regulatory documents, for each nuclear power plant, Rosenergoatom formulates plans of short-term, mid-term and long-term measures for upgrading of units and facilities at NPPs, as well as provides necessary funding and control of implementation of plans. To assess NPP unit upgrading efficiency, the target indicators are set up. Integral upgrading efficiency indicators of the equipment and systems at NPP units are:

- a positive trend in reduction of a number of NPP operational events and equipment failures;
- conformance of the actual condition of the unit to requirements of newly introduced or updated safety regulations;
- 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 the personnel.

Over the period of 2013-2015 Rosenergoatom fulfilled a lot of upgrading measures at NPPs; some of them are listed in Appendix 6.

Until 2020, earlier adopted plans and measures to improve safety at NPPs are planned to continue, namely:

- "Updated measures for reduction of consequences of beyond design basis accidents at NPPs" (following the results of analysis of events at Fukushima-Daiichi NPP);
- "The plan of measures to ensure hydrogen safety during normal operation of NPP units with WWER reactors";
- "Programs on improvement of reliability, efficiency and safety of operation of thermal mechanical equipment of NPPs";
- "Programs of measures to improve reliability of electrical equipment of NPPs";
- "Integrated program of measures to prevent destruction and to improve operational erosion-corrosion resistance of pipelines and equipment of NPPs";
- "Plan of measures to extend lifetime performance of the cores of RBMK-1000 reactor installations";
- "Programs of conversion of WWER-1000 units to operate in the 18-month period between repairs"; and
- "Overall program of energy saving and improvement of energy efficiency of operation NPPs".

Implementation of adopted NPP safety improvement plans and measures will allow raising a degree of protection of Russian NPPs against extreme external impacts and preparedness of nuclear plants to manage beyond design basis accidents, including severe accidents.

6.4. Service Life Extension of Nuclear Units

Extending service lives of Rosenergoatom's nuclear units after they have ended their assigned service lives remains one of the topical tasks and most efficient financial investment in NPP safety enhancement and retention of the generating capacities.

According to the "Long-Term Activity Program of the State Atomic Energy Corporation 'Rosatom' (2009-2015)" endorsed by the Russian Government Ordinance No. 705 of 20 September 2008, Rosenergoatom has performed in full scope the work to prepare units for SLE and obtain licenses for their further operation.

As of 31.07.2016, the service life extension work was carried out at 24 units of Russian NPPs with the total installed capacity of 16,242 MW (see Fig. 6.2).

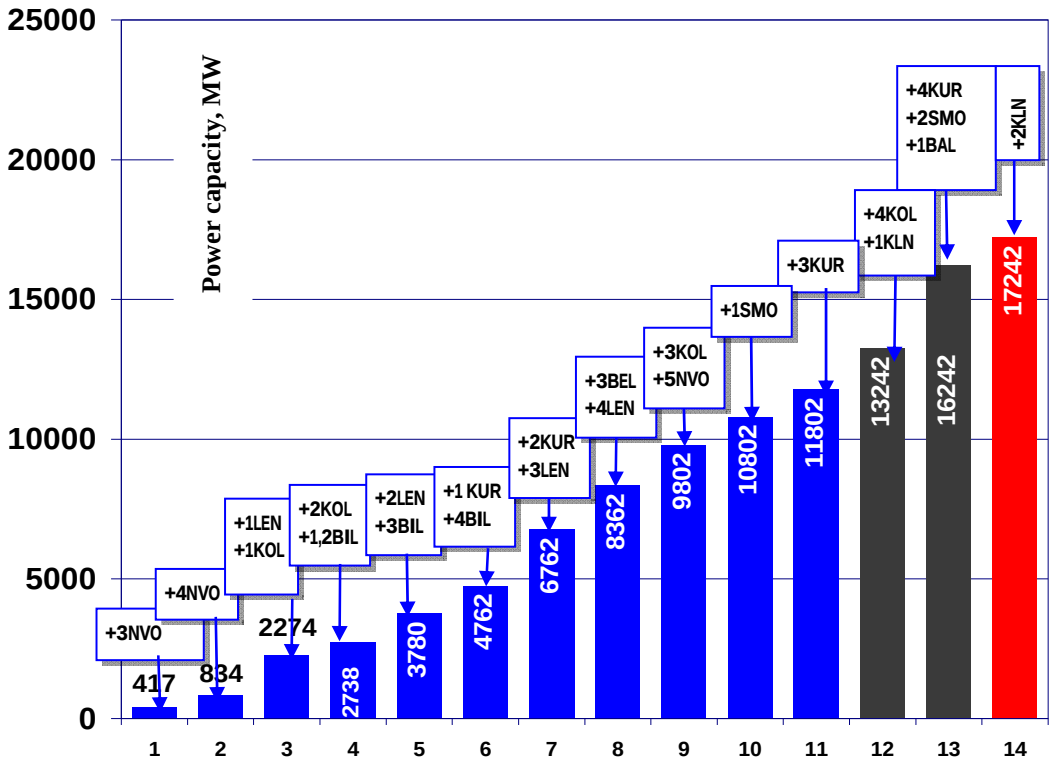

Fig. 6.2. Retaining generating capacities by SLE at NPPs

In 2013-2015, SLE was completed at six nuclear units and licenses were obtained for their operation in the additional period (see Table 6.1).

Table 6.1. Nuclear units which were granted Rostechnadzor's SLE licenses in 2013-2015

Year/NPP	Unit	Type of reactor	Nominal power, MWe	Rostechnadzor's license	
				Date of issue	Expiration date
2013					
Kursk	3	RBMK-1000	1000	27.12.2013	27.12.2023
2014					
Kalinin	1	WWER-1000	1000	27.06.2014	28.06.2025
Kola	4	WWER-440	440	08.10.2014	07.12.2039
2015					
Smolensk	2	RBMK-1000	1000	29.05.2015	29.05.2025
Balakovo	1	WWER-1000	1000	18.12.2015	18.12.2045
Kursk	4	RBMK-1000	1000	21.12.2015	21.12.2030

6.5. Uprating of Operating Nuclear Units

Starting from 2008, Rosenergoatom has put efforts to uprate operating nuclear units.

Each time a safety case was prepared prior to the uprating to evaluate the impact of reactor uprating on the performance of safety important systems and components of the unit, on the normal operation and operational events, including accidents. The findings and conclusions of this analysis were used to draw up a list of modernizations to be made in the unit systems and components, and a list of amendments to be made in the operating documentation of the plant.

The safety case was developed under general coordination of Rosenergoatom with contributions from appropriate design and engineering companies and equipment manufacturers. Also, integrated uprating programs were developed for each power unit (the programs included tests and measurements intended to confirm that the actual parameters of the unit in modes of operation at the higher power level conform with the design values, including studies of the unit operation in the steady-state and transient modes).

The plant safety cases and reports on the uprate trials of the units are submitted to Rostechnadzor to obtain a permit for operation at a higher power level. Table 6.4 shows the units in commercial operation at a higher power level rendered so in the period 2013-2015.

Table 6.4. Nuclear units operated at a higher power level in 2013-2015

NPP, Unit	RI type	RI power, % N_{nom}
Balakovo, No. 1	V-320 (WWER-1000)	104
Balakovo, No. 4	V-320 (WWER-1000)	104
Rostov, No. 1	V-320 (WWER-1000)	104
Kola, No. 4	V-213 (WWER-440)	107
Kalinin, No. 1	V-338 (WWER-1000)	104
Kalinin, No. 4	V-320 (WWER-1000)	104
Rostov, No. 2	V-320 (WWER-1000)	104
Kola, No. 3	V-213 (WWER-440)	107
Rostov, No. 3	V-320 (WWER-1000)	104

6.6. Operation-Related Issues of Existing Nuclear Units

Additional measures to eliminate earlier revealed hydrogen explosion protection problem, which exists within containments of WWER reactor installations, are implemented as part of the program of measures in the light of the Fukushima-Daiichi accident (see Subsection 6.2).

Also, the measures are implemented that relate to the problem (challenge) of ***Expanded monitoring and lifetime performance management of graphite stack of RBMK reactors***. The problem was noted in the course of the review of the sixth National Report of the Russian Federation for RBMKs of Generation I. It is the graphite stack form change

under radiation. Tested in 2012-2013 at Leningrad-1, the RI lifetime performance recovery (LPR) technology was applied at Kursk-2 and Leningrad-2 in 2014. In 2015, the second LPR work cycle was carried out at Leningrad-1 and in 2016 the first LPR work cycle was carried out at Kursk-1. The LPR technology is to make vertical longitudinal cuts in graphite columns and to force them change to reduce bowing of pressure tubes. Based on positive results of the safety review after graphite stack repair, Rostechnadzor introduced changes to the license conditions which permitted further operation of RBMK-1000 of Generation I at energy power levels provided the geometry of graphite stack and pressure tubes of reactors were in-pile monitored annually.

To improve reliability and extend lifetime performance of steam generators at WWER-1000 NPPs, copper-containing tube systems have been replaced with that made of titanium and stainless steel alloys. In 2013-2015, the said activities were carried out at five units; this also improved vacuum in condensers with total power increment of 12.5 MW.

In 2015, NPPs operated a large number of high-voltage electrical equipment which exhausted its 25-year design life established by GOST and producers. To improve reliability of electrical equipment, the program for replacement of air-cooled circuit breakers and oil-filled transformers with SF6 ones and replacement of relay protection and automation with microprocessor equipment.

Additional information on fulfillment of the principles of the Vienna Declaration on Nuclear Safety is given in Appendix 3.

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

The Operating Organization timely carries out planned measures based on results of the robustness analysis of Russian NPPs against extreme external impacts and preparedness of nuclear plants to manage beyond design basis accidents, including severe accidents.

The engineering and organizational measures allow ensuring acceptable operating safety level of existing Russian nuclear units in accordance with the principles of the Convention on Nuclear Safety and provisions 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 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 adopted by the Russian Federation, and 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 the Physical Protection of Nuclear Material, and other international agreements) ratified by the Russian Federation.

Legal regulation of safety in the field of the use of atomic energy is carried out on the basis of federal laws of the Russian Federation 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 in the Russian Federation:

- Federal Law No. 170-FZ of 21 November 1995 “On the Use of Atomic Energy”;
- Federal Law No. 3-FZ of 9 January 1996 “On the Radiological Safety of the Public”.

Besides, the following laws regulating various aspects of the atomic energy uses should be observed:

- Federal Law No. 7-FZ of 10 January 2002 “On the Environmental Protection”;
- Federal Law No. 68-FZ of 21 December 1994 “On the Protection of the Public and Territories against Natural and Man-Induced Emergencies”;
- Federal Law No. 184-FZ of 27 December 2002 “On the Technical Regulation”;
- Federal Law No. 162-FZ of 29 June 2015 “On Standardization”;
- Federal Law No. 13-FZ of 5 February 2007 “On the Specifics of Management and Handling of Assets and Shares of the Organizations Performing Activities in the Field of Nuclear Energy and on Making Amendments in Some Legal Acts of the Russian Federation”;

- Federal Law No. 294-FZ of 26 December 2008 “On Protecting the Rights of Juridical Bodies and Individual Entrepreneurs in the Context of State Control (Supervision) and Municipal Control”;
- Federal Law No. 317-FZ of 1 December 2007 “On the State Atomic Energy Corporation “Rosatom”;
- Federal Law No. 318-FZ of 1 December 2007 “On Amending Certain Legal Acts of the Russian Federation in Connection with the Adoption of the Federal Law “On the State Atomic Energy Corporation “Rosatom”;
- Federal Law No. 159-FZ of 2 July 2013 “On Amending Articles 25 and 26 of the Federal Law “On the Use of Atomic Energy”;
- Federal Law No. 74-FZ of 30 March 2016 “On Amending Certain Legal Acts of the Russian Federation in Connection with the Safety Regulation if n the Field of the Use of Atomic Energy”;
- Federal Law No. 52-FZ of 30 March 1999 “On the Sanitary and Epidemiological Well-Being of the Public”;
- Federal Law No. 190-FZ of 29 December 2004 “City Development Code of the Russian Federation”;
- Federal Law No. 190-FZ of 11 July 2011 “On the Management of Radioactive Waste and on Amending Certain Legal Acts of the Russian Federation”;
- Federal Law No. 63-FZ of 13 July 1996 “The Criminal Code of the Russian Federation”;
- Federal Law No. 195-FZ of 30 December 2001 “The Russian Federation Code of Administrative Offences”;
- Federal Law No. 74-FZ of 3 June 2006 “The Water Code of the Russian Federation”;
- Federal Law No. 2395-1 of 21 February 1992 “On Mineral Resources”;
- Federal Law No. 174-FZ of 23 November 1995 “On Environmental Expert Review”;
- Federal Law No. 35-FZ of 26 March 2003 “On the Electric Power Industry”;
- Federal Law No. 384-FZ of 31 December 2009 “Technical Regulation on Safety of Buildings and Structures”;
- Federal Law No. 116-FZ of 27 July 1997 “On Industrial Safety of Dangerous Production Facilities” (as amended as of 30 December 2008);
- Federal Law No. 117-FZ of 21 July 1997 “On Safety of Hydraulic Structures”;
- Federal Law No. 69-FZ of 21 December 1994 “On Fire Safety”; and
- Federal Law No. 123-FZ of 22 July 2008 “Technical Regulation on Fire Safety Requirements”.

The basic provisions of the federal laws “On the Use of Atomic Energy”, “On the Radiological Safety of the Public”, “On the Technical Regulation”, “On the Environmental Protection”, “On the Radioactive Waste Management and On

Amendment of Certain Legislative Acts of the Russian Federation", the Criminal Code of the Russian Federation and the Russian Federation Code on Administrative Offences as regards to regulation of relations in the field of the use of atomic energy were discussed in the previous National Reports of the Russian Federation.

Some amendments have been made to the federal laws regulating and controlling the uses of atomic energy since the submission of the sixth National Report of the Russian Federation. They are briefly described herein below.

Federal Law No. 170-FZ of 21 November 1995 "On the Use of Atomic Energy"

Article 3 of the law introduces terms "nuclear fuel" and "spent nuclear fuel". The term "spent nuclear fuel" is given in accordance with provisions of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

Amendments to Article 20 add the selection of leading scientific organizations, leading engineering organizations and leading design organizations to jurisdiction of bodies that control uses of atomic energy.

Amendments introduced to Article 37 establish that the body that controls the uses of atomic energy which is an organization which renders services in the field of the use of atomic energy selects leading scientific organizations, leading engineering organizations and leading design organizations by its decision in the order established by the said body.

The new revision of the law specifies the order of conduct of and financing expert reviews of safety justifications of facilities and (or) activities in the field of the use of atomic energy. The functions of issuing assignments to conduct expert reviews and adopting (not adopting) prepared expert statements are given to the state bodies for safety regulation.

It is established that an expert review is carried out at the expense of the license applicant or licensee. With that, an expert review of nuclear facilities, which are under continuous state supervision (all nuclear units pertain to such facilities), is carried out by scientific and technical support organizations of the authorized state body for safety regulation.

Federal Law No. 294-FZ of 26 December 2008 "On Protecting the Rights of Juridical Bodies and Individual Entrepreneurs in the Context of State Control (Supervision) and Municipal Control"

The text of the law is added with Article 8.1 "Application of Risk-Oriented Approach in Organization of State Control (Supervision)". Implementing this approach, the selection of intensity (format, duration,

frequency) of control (supervision) measures is carried out proceeding from a risk category or a certain class (category) of hazard of the facility.

Federal Law No. 162-FZ of 29 June 2015 "On Standardization"

The newly introduced federal law establishes legislative bases of standardization in the Russian Federation and regulates relations arising in the development (carrying out), approval, change (updating), revocation, publication and application of documents on standardization. Article 6 of the law establishes that the order of standardization regarding the products associated with safety ensuring in the field of the use of atomic energy is established by the Government of the Russian Federation.

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

A number of amendments have been introduced in the earlier existing legislative and regulatory acts of the President of the Russian Federation and the Government of the Russian Federation.

Over the reporting period, the Ordinance of the Government of the Russian Federation No. 612 of 20 July 2013 "On Accreditation in the Field of the Use of Atomic Energy" has been endorsed. It establishes the accreditation procedure for certification authorities and test laboratories (centers), which perform works to confirm the conformity of the products associated with safety ensuring in the field of the use of atomic energy with mandatory requirements, and the procedure for qualification, recruitment and screening of technical experts for doing the accreditation work.

The Ordinance of the Government of the Russian Federation No. 129 of 20 February 2014 "On Amendment of Some Acts of the Government of the Russian Federation" introduces changes to the list of organizations which operate especially radiation- and nuclear-hazardous productions and facilities endorsed by the Directive of the Government of the Russian Federation No. 1311-r of 14 September 2009; to the list of organizations covered by the Federal Law "Disciplinary Regulations of Workers of Organizations, Which Operate Especially Radiation- and Nuclear-hazardous Productions and Facilities in the Field of the Use of Atomic Energy" endorsed by the Ordinance of the Government of the Russian Federation No. 597 of 20 July 2011 "On the List of Operating Organizations"; and to the list of nuclear facilities which are subject to the continuous state supervision regime endorsed by the Directive of the Government of the Russian Federation No. 610-r of 23 April 2012.

The Ordinance of the Government of the Russian Federation No. 339 of 15 April 2014 "On the Cooperation in Issues of Development of National Systems for Regulating Nuclear and Radiation Safety in the Peaceful Uses of

Atomic Energy in the States Which are the Customers of Construction to Russian Designs of Nuclear Facilities" establishes that the Federal Environmental, Industrial and Nuclear Supervision Service is the body authorized to cooperate with the state powers of the states, which are the customers of construction to Russian designs of nuclear facilities, in issues of development of national systems for regulating nuclear and radiation safety in the peaceful uses of atomic energy, including the development of a legal regulatory framework, a licensing system and a system of supervision in the said area, as well as in issues of training of the personnel of nuclear and radiation safety authorities of these states.

The Ordinance of the Government of the Russian Federation No. 636 of 10 July 2014 "On Qualification of Experts Involved by Bodies Authorized to Exercise State Control (Supervision), Municipal Controlling Bodies for Conduct of Control Measures" endorses "Rules of Qualification of Experts Involved by Bodies Authorized to Exercise State Control (Supervision), Municipal Controlling Bodies for Conduct of Control Measures in Accordance with the Federal Law "On Protection of Rights of Legal Entities and Private Entrepreneurs While Exercising the State Control (Supervision) and Municipal Control".

The Ordinance of the Government of the Russian Federation No. 894 of 4 September 2014 "On Amendment of the Rules of Payment by Enterprises and Organizations Which Operate Especially Radiation- and Nuclear-Hazardous Productions and Facilities (Nuclear Plants) of Funds to Form Reserves for Nuclear Plant Safety Ensuring at All Stages of Their Lifecycle and Development" specifies the purpose of the reserve, which is formed by organizations operating nuclear plants, namely, it is indicated that it is intended not only for financing costs of nuclear, radiation, industrial and fire safety ensuring in operation of nuclear power plants but also to finance costs of maintaining and fitting emergency rescue teams, pay for their works (services) on prevention and elimination of emergency consequences.

The Ordinance of the Government of the Russian Federation No. 544 of 15 June 2016 endorses "Provisions of Peculiarities of Compliance Assessment of Products Subjected to Requirements of Safety Ensuring in the Field of the Uses of Atomic Energy and Their Design (Including Surveys), Manufacture, Construction, Installation, Adjustment, Operation, Storage, Shipment, Sale, Utilization and Disposal". It is established that the products before they are delivered (applied at) to the nuclear facility, as well as in their operation, are subject to compliance assessment as per this Provisions.

The compliance assessment is carried out as:

- tests;
- monitoring;
- acceptance;
- decision to use imported products at the nuclear facility;

- registration;
- expert review of the engineering documentation;
- mandatory certification of products;
- federal state nuclear supervision; and
- other formats provided in technical regulations.

The Provisions contain requirements for the compliance assessment procedure for each of the indicated formats.

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

Rostechnadzor has approved a plan of enhancing the legal and regulatory framework of safety and standardization regulation in the field of the use of atomic energy designed for 2015-2023.

Several new federal standards and regulations in the field of the use of atomic energy have been developed since the submission of the sixth National Report.

In 2015, a new revision of the federal standards and regulations “General Safety Provisions of Nuclear Power Plants” (NP-001-15) were endorsed. The comparative analysis of requirements of applicable Russian regulations with provisions of the IAEA safety standards SSR-2/1 and SSR-2/2 has demonstrated that Russian NPP safety requirements on the whole correspond to requirements of the said IAEA safety standards. At the same time, the areas have been identified where the Russian regulations should be corrected to achieve fuller harmonization with the IAEA safety standards.

In the new revision of the “General Safety Provisions of Nuclear Power Plants”:

- the notion “nuclear power plant safety” has been brought in accordance with the upper level IAEA safety standards SF-1;
- requirements to the volume and procedure of the analysis of design basis accidents and beyond design basis accident have been formulated;
- rules of classification of NPP systems and components, including with the account taken of the IAEA safety standards SSR-2/1, have been specified;
- the formulation of NPP safety target probabilistic indicators has been changed;
- a new category of NPP systems and components has been introduced; in addition to earlier considered categories of “normal operation system and components” and “safety systems and components” the new revision of the “General Safety Provisions of Nuclear Power Plants” considers also the category of “special engineered features to manage beyond design basis accidents”. A number of requirements for the said engineered features have been introduced;

- the definition of the notion “safety culture” takes account of its interpretation given in INSAG-4;
- requirements for defense-in-depth implementation at a nuclear plant have been specified. In particular, a requirement has been introduced to necessarily make all reasonably achievable measures ensuring independence of defense-in-depth levels from each other as well as measures aimed at prevention of damage of one physical barriers due to damage of another physical barriers or damage of several physical barriers by one impact;
- the notion of “NPP unit decommissioning concept” has been introduced;
- the notion of “management of safety” has been introduced (as provided in the IAEA safety standards SSR-2/1); and
- requirements for analysis of operating experience have been broadened; in particular, the notion of “severe accident precursor” has been introduced and additional procedure of consideration of precursor events possessing a significant probability of transition to the severe stage has been given.

Since the submission of the previous National Report the federal standards and regulations in the field of the use of atomic energy have been endorsed that regulate safe operation of NPP equipment and pipelines, in particular:

- “Requirements for Lifetime Performance Management of Equipment and Pipelines of Nuclear Plants. Basic Provisions” (NP-096-15);
- “Rules of Layout and Safe Operation of Equipment and Pipelines of Nuclear Power Installations” (NP-089-15); and
- “Rules of Monitoring of Base Metal, Welds and Overlays in Operation of Equipment, Pipelines and Other Components of Nuclear Plants” (NP-084-15).

To supersede earlier regulations, new federal standards and regulations in the field of the use of atomic energy have been issued that regulate radioactive waste management: “Safety Rules for Management of Radioactive Waste of Nuclear Plant” (NP-002-15), “Collection, Reprocessing, Storage and Conditioning of Liquid Radioactive Waste. Safety Requirements” (NP-019-15), “Collection, Reprocessing, Storage and Conditioning of Solid Radioactive Waste. Safety Requirements” (NP-020-15), “Gaseous Radioactive Waste Management. Safety Requirements” (NP-021-15).

New federal standards and regulations “Basic Requirements for Justification of Strength and Thermal Mechanical Behavior of Fuel Assemblies and Fuel Rods in Cores of Water-Cooled Water-Moderated Power Reactors” (NP-094-15) have been issued.

As per the “Policy Statement on the Application of the Probabilistic Safety Analysis and Risk-Informed Methods to Nuclear Plants” made public by Rostechnadzor in 2012, the federal standards and regulations in the field of the use of atomic energy “Main Requirements to the Probabilistic Safety Analysis” (NP-095-15) have been written and put into force.

The federal standards and regulations in field of the use of atomic energy continue to be revised as planned in the light of lessons learned from the Fukushima-Daiichi accident. In particular, the following is revised: the rules of seismic NPPs design; the safety requirements for siting of nuclear plants; the federal standards and regulations on accounting of external impacts; and the federal standard and regulations, which regulate emergency response issues. A new revision of the federal standards and regulations in the field of the use of atomic energy "Provisions on the Procedure of Declaring an Emergency, Operative Information Transmission and Organization of Urgent Assistance to Power Plants in Cases of Radiation-Hazardous Situations" (NP-005-16) has been released.

A list of the federal standards and regulations in the field of the use of atomic energy which cover nuclear plants and put into effect after the submission of the sixth National Report is given in Appendix 7.

7.4. Documents Approved by the Regulatory Body

Since submission of the sixth National Report, Rostechnadzor has continued drafting administrative regulations, i.e. documents which regulate the procedure of execution of functions attributed to Rostechnadzor's jurisdiction and the procedure of rendering state services by Rostechnadzor.

The Rostechnadzor's Order of 8 October 2014 approves the new "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" to supersede the earlier regulation. The said Administrative Regulation defines the procedure, due time and sequence of administrative procedures (actions) of Rostechnadzor and its territorial bodies, the interaction procedure with license applicants/licensees, other state bodies in the course of licensing.

Orders of Rostechnadzor of 27 November 2014 and 22 September 2015 have introduced amendments to the "Administrative Regulation on Performance of the State Function of the Federal State Supervision in the Field of the Use of Atomic Energy":

- the actions which may be taken following the results of an audit (inspection) have been specified. They include the issue of a notice to eliminate revealed violations and its due date, as well as, where necessary, taking other measures to stop revealed violations and instituting an administrative action as per the Russian law, including the suspension or annulling licenses issued by Rostechnadzor;
- the subjects of pre-trial (out-of-court) appeal of actions (failure to act) of Rostechnadzor's officials have been specified; and
- the procedure of license suspension and annulling has been described.

The Rostechnadzor's Order of 8 April 2014 introduces amendments to the "Administrative Regulation on Providing the State Services of Establishing Guidelines of Maximum Permissible Releases of Radioactive Substances in the Atmospheric Air and Guidelines of Maximum Permissible Discharges of Radioactive Substances in Water Reservoirs, Issue of Permits for Releases and Discharges of Radioactive Substances into the Environment by the Federal Environmental, Industrial and Nuclear Supervision Service". These amendments relate to establishing the guidelines of maximum permissible releases of radioactive substances in the atmospheric air and the guidelines of maximum permissible discharges of radioactive substances in water reservoirs, as well as issuing permits for releases and discharges of radioactive substances into the environment.

Over the period passed after the submission of the sixth National Report, Rostechnadzor's orders have also endorsed:

- the safety review (review of safety case) procedure of nuclear facilities and (or) activities in the field of the use of atomic energy;
- the methodology of determining the fee for the safety review (review of safety case) of nuclear facilities and (or) activities in the field of the use of atomic energy and the maximum fee for the review of one topical issue included in the review terms of reference;
- the procedure for supervision over the system for the state control and accounting of nuclear material in other area of safety regulation;
- the criteria applied to qualification of experts involved by Rostechnadzor in supervision at nuclear facilities; the rules of forming and maintaining the register of expert qualification information; expert qualification application forms; and a list of types of reviews for which experts are required; and
- a new revision of the "Provisions of Functional Subsystem for Control of Nuclear- and Radiation-Hazardous Facilities of the Common State System of Prevention and Elimination of Emergences".

Over the period passed after the submission of the sixth National Report, Rostechnadzor has drafted and endorsed the following safety guides in the use of atomic energy:

- "Basic Recommendations to Writing the Probabilistic Safety Analysis Level 1 for a Nuclear Unit under Initiating Events due to External Impacts of Natural and Man-Induced Origin" (RB-021-14);
- "Recommendations to the Procedure of Conducting Reliability Analysis of Safety Important Systems and Components of Nuclear Plants and Their Functions" (RB-100-15);
- "Recommendations to the Structure and Content of a Beyond Design Basis Accident, Including Severe Accident, Management Guide" (RB-102-15);
- and others.

A list of Administrative Regulations and Safety Guides in the field of the use of atomic energy related to nuclear plants written and introduced by

Rostechnadzor over the period since the submission of the sixth National Report is given in Appendix 8.

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.

Article 8. Regulatory Body

8.1. Authorities and Duties of the Regulatory Body

According to the Convention on Nuclear Safety, the Regulatory Body is "any body or bodies given the legal authority by that Contracting Party to grant licenses and to regulate the siting, design, construction, commissioning, operation or decommissioning of nuclear installations".

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. 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 body of the federal state supervision in the field of the use of atomic energy; and
- the body of the federal state building supervision (including with regard to nuclear plants).

Rostechnadzor has the following authorities in the field of the use of atomic energy:

- 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 giving work licenses in accordance with the list of job positions endorsed by the Government of Russian Federation;
  - requirements for the composition and contents of documents related to ensuring safety of nuclear installations, radioactive sources, nuclear material and radioactive substance storage facilities, radioactive waste storage facilities and (or) 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 of documents containing results of nuclear facility safety assessment and justifying safety of their operation, as well as requirements to content and composition of these documents, by the operating organization to Rostechnadzor;
  - the procedure for safety review (review of safety case) of nuclear facilities and (or) activities in the field of the use of atomic energy;
  - 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;
  - procedures for issue and format of permits for releases and discharges of radioactive substances;
  - 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;
  - legal regulatory acts on other issues except for issue which legal regulation is carried out by exclusively federal constitutional laws, federal laws, legal regulatory acts of the President of the Russian Federation and the Government of the Russian Federation;
- 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 fulfillment by legal entities and physical persons of the requirements of the Russian legislation, 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 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 legislation of the Russian Federation;
- develops, approves and puts into force atomic energy safety guides (within its jurisdiction);
- 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; fulfillment of the terms and conditions of permits (licenses) for carrying out activities in the field of the use of atomic energy;
  - nuclear, radiation, industrial and fire safety (at nuclear facilities);
  - physical protection of nuclear installations, radioactive sources, storage facilities for nuclear material and radioactive substances;
  - control and accounting of nuclear material, radioactive substances and radioactive waste;
  - fulfillment of international commitments of the Russian Federation in the field of the safe use of atomic energy.

According to the Ordinance of the Government of the Russian Federation No. 339 of 15 April 2014, Rostechnadzor is a body authorized to carry out, in accordance with the established procedure, cooperation with the state governmental bodies of the states which are customers of nuclear facilities built to Russian designs. In the reporting period, Rostechnadzor has signed cooperation agreements with regulatory bodies of:

- the People's Republic of Bangladesh (Ministry of Science and Technology);
- the Republic of Belarus (Ministry for Emergency Situations);
- the Socialist Republic of Vietnam (Vietnam Agency for Radiation and Nuclear Safety);
- the Republic of Turkey (Turkish Atomic Energy Authority);

and memoranda of understanding with regulatory bodies of:

- the Hashemite Kingdom of Jordan (Energy and Mineral Regulatory Commission);
- the Arab Republic of Egypt (Egyptian Nuclear and Radiological Safety Regulatory Authority).

Interagency agreements concerning the cooperation with the regulatory body of the Federal Republic of Nigeria (Nigerian Nuclear Regulatory Authority) are prepared for signing. In the framework of said agreements the assistance is rendered to the above said regulatory bodies in

the development of national nuclear safety regulatory systems in part related to:

- the legal regulatory framework;
- licensing;
- safety oversight; and
- training of the personnel.

Seminars, working meetings and technical visits to Russia are carried out regularly for specialists of the regulatory bodies of the countries that have ordered Russian design NPPs. In the framework of experience exchange, foreign specialists are invited to participate as observers in inspections held by Rostechnadzor at operating and constructed NPPs in the territory of Russia.

In its activity Rostechnadzor uses the quality control system in accordance to requirements of the "Provisions on the Quality Control System in the Field of the State Regulation of Safety in the Use of Atomic Energy of the Federal Environmental, Industrial and Nuclear Supervision Service" updated in 2014.

In accordance to provisions of the Federal Law No. 170-FZ "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.

In the reporting period, Rostechnadzor has adopted the Policy Statement "Openness and Transparency of the State Regulation of Safety in the Uses of Atomic Energy".

The official website of Rostechnadzor has the section "Open Rostechnadzor", which posts annual reports of the Service on results and main activity areas of Rostechnadzor, annual plans of Rostechnadzor and reports on fulfillment of those plans.

The Community Liaison Office, Public Council, Public Relations Group in the Information and Analytical Center of Rostechnadzor operate.

In November 2013, in accordance with the procedure established by the IAEA, the follow-up IRRS IAEA mission was conducted to check on Rostechnadzor's fulfillment of recommendations and suggestions of the preceding IRRS mission in Russia in 2009. The follow-up mission included also the evaluation of Rostechnadzor's activities as regards emergency preparedness and response, as well as taking into account the lessons of the Fukushima-Daiichi accident. The follow-up IRRS mission found out that:

- 10 out of 25 recommendations and 17 out of 34 suggestions of the 2009 IRRS mission had been implemented and thus could be considered done;
- 8 out of 25 recommendations and 6 out of 34 suggestions of the 2009 IRRS mission could be considered done proceeding from the progress and certainty in their effective implementation.

Besides, additional recommendations and suggestions were received, as well as 5 good practices were noted, as part of the 2013 follow-up mission.

Following the results of the 2013 follow-up IRRS IAEA mission, the "Action Plan of the Federal Environmental, Industrial and Nuclear Supervision Service on Implementation of Recommendations and Proposals of the Follow-up Mission of the International Atomic Energy Agency "Integrated Review of Regulatory Activities in the Russian Federation" was developed and approved by the order of Rostechnadzor, which covers the period from 2014 till 2017. The Action Plan contains 3 sections and 24 measures which implementation is planned in 2014-2018. These measures foresee, in particular:

- bridging the gap between salaries of Rostechnadzor's employees and workers of the operating organizations to have the possibility of attracting competent personnel, especially inspectors;
- the development of the systems approach to training of Rostechnadzor's personnel;
- the improvement of interaction with other federal executive bodies;
- the development of the necessary legislative and regulatory framework for supervision over rehabilitation of past activity facilities;
- harmonization of emergency preparedness and response requirements with requirements of the IAEA safety standards; and
- practices of evaluating emergency exercises not only at NPPs but also at other nuclear facilities.

Joint inspections with foreign partners at nuclear facilities are effective format of exchange of experience in regulatory activities.

In September 2013, representatives of the Finnish regulatory authority STUK were present during inspections at Novovoronezh NPP-2 and in September 2015 at Leningrad NPP-2. In June 2014, representatives of Rostechnadzor were present during the STUK inspection of Olkiluoto-3 NPP.

As part of the international cooperation, in July 2014 specialists from the French regulatory authority (ASN) took part as observers in the emergency drill at Kola NPP, which was observed by Rostechnadzor's employees. In August the same year, the top officials of the National Nuclear Regulator of the RSA took part as observers in the emergency drill at Kola NPP.

In September 2015, specialists of STUK and the Iranian Nuclear Regulatory Authority (INRA) took part as observers in the emergency drill at Leningrad NPP.

In April 2016, a representative of Rostechnadzor took part in the emergency exercise at Loviisa NPP, Finland.

In 2015, a series of joint seminars with the French Nuclear and Radiation Safety Regulatory Authority (ASN) were completed. The seminars were on information exchange about stress tests and reviews of reports prepared upon their results. The said “2+2” events (both representatives of regulators and operators of Russia and France participated), which have been held since 2012, allowed discussing in detail the methodology of doing the additional robustness analysis of Russian and French NPPs against extreme external impacts of natural and man-induced origin.

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.

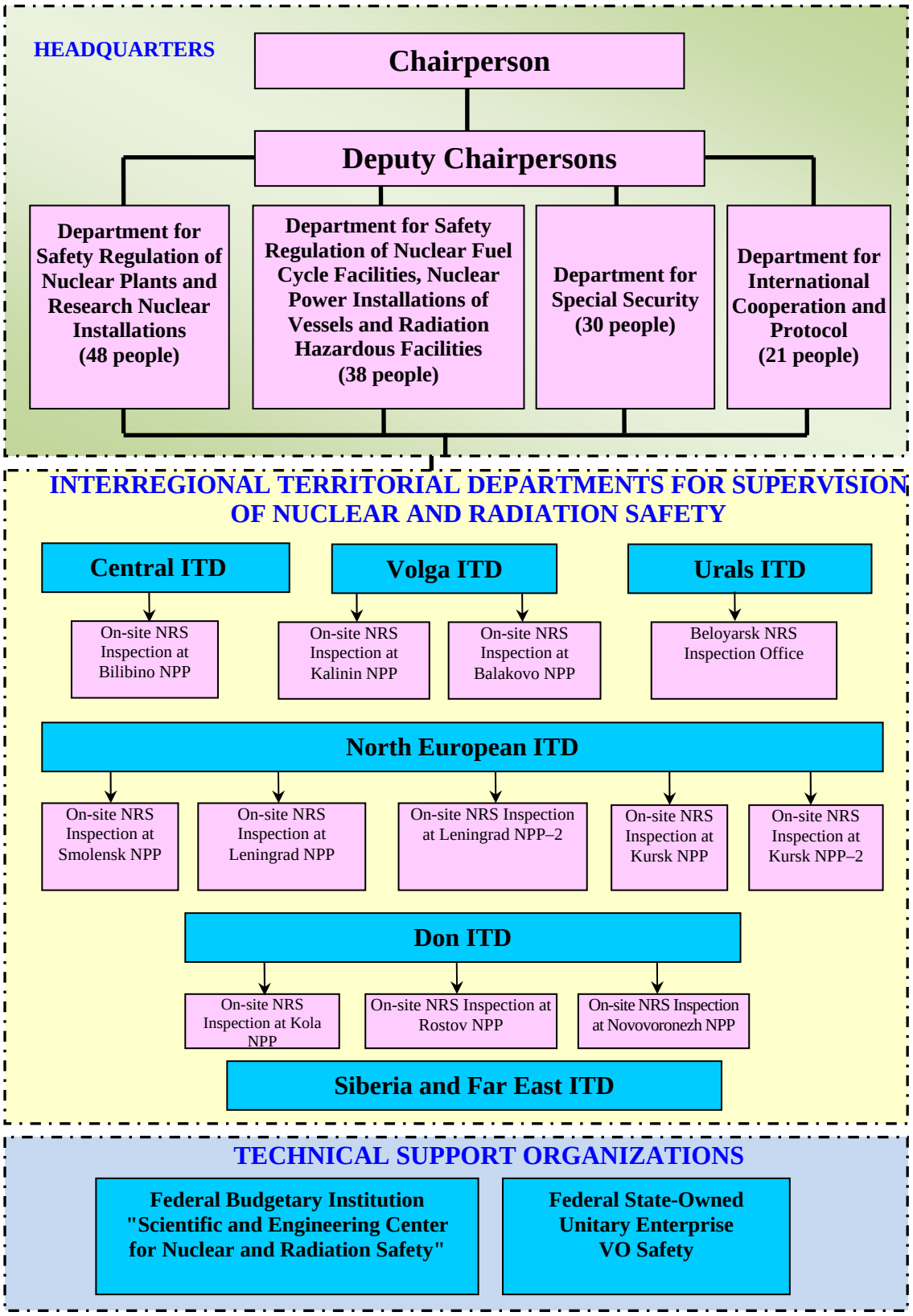

Fig. 8.1. The Organizational Structure of the Federal Environmental, Industrial and Nuclear Supervision Service (in part related to regulation of nuclear and radiation safety at NPPs)

The Headquarters of Rostechnadzor and interregional territorial departments for supervision of nuclear and radiation safety have the staff, which qualifications are established by the Federal Law No. 79-FZ of 27 July 2004 “On the State Civil Service in the Russian Federation”, the President of Russia’s Decree No. 1131 of 27 September 2005 “On Qualification Requirements for State Civil Service Experience (or Other Civil Service) or Professional Experience for Federal State Civil Employees”, and other legal regulations.

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.

According to the Federal Law No. 79-FZ “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 2013-2016 is given in Appendix 9.

Rostechnadzor has 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).

8.3. Licensing Procedure, Technical Reviews of Nuclear Installations Safety Documentation

Being a regulatory authority on licensing nuclear facilities, Rostechnadzor takes guidance in the Federal Law No. 170-FZ “On the Use of Atomic Energy” and in the “Regulation on Licensing Activities in the Field of the Use of Atomic Energy” endorsed by the Government of Russia Ordinance No. 280 of 29 March 2013.

In its activities Rostechnadzor makes use of the “Administrative Regulation on Implementation of the State Function of Licensing Activities in the Field of the Use of Atomic Energy by the Federal Environmental, Industrial and Nuclear Supervision Service” approved by the Order of Rostechnadzor of 8 October 2014. A brief description of this Administrative Regulation is given in Subsection 7.4 of this Report.

The “Administrative Regulation on Implementation of the State Function of Licensing Activities in the Field of the Use of Atomic Energy by the Federal Environmental, Industrial and Nuclear Supervision Service” establishes requirements for licensing procedures.

The "Provisions on Safety Review (Review of Safety Case) of nuclear facilities and (or) activities in the field of the use of atomic energy" was approved by the Order of Rostechnadzor of 21 April 2014.

8.4. Technical Support Organizations for the Regulatory Body

To organize and conduct safety reviews of nuclear installations subject to continuous supervision (these include, in particular, all nuclear power plant units), Rostechnadzor involves scientific and technical support organizations of the Regulatory Body, as per the Federal Law No. 170-FZ "On the Use of Atomic Energy".

The status of scientific and technical support organizations in the state regulatory system is stipulated by Article 37.1 of the Federal Law No. 170-FZ "On the Use of Atomic Energy", which states that scientific and technical support organizations carry out their activities for the purposes of:

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

A legal entity is referred to as a scientific and technical support organization in accordance with the procedure established in the "Provision for Attribution of a Legal Entity as the Scientific and Technical Support Organization of the Authorized Body for the State Regulation of Safety in the Use of Atomic Energy" endorsed by Ordinance of the Government of the Russian Federation No. 387 of 30 April 2013. SEC NRS and VO Safety are referred to as scientific and technical support organizations of Rostechnadzor.

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

- development of legal regulatory documents;
- development and revision of federal standards and regulations in the field of the use of atomic energy, as well as safety guides in uses of atomic energy;
- organization and conduct of safety reviews (justifications of safety);
- research related to principles and criteria on nuclear and radiation safety;
- organization and conduct of the software certification process; and
- training of the atomic energy safety regulatory personnel of other countries.

SEC NRS has the staff of 289 employees, including:

- specialists with higher education – 261; and
- Ph.D. – 57.

Based on results of the expert activities in SEC NRS in 2013-2015, the institution produced 816 reports (review statements, reports etc.), including in 2013 – 234, in 2014 – 259, and in 2015 – 323.

In 2014-2016, Rostechnadzor approved 18 federal standards and regulations in the field of the use of atomic energy and 22 safety guides in the uses of atomic energy produced by SEC NRS. Also, SEC NRS reviews drafts of the IAEA safety standards. In 2013-2015, SEC NRS reviewed 25 draft IAEA safety guides, including in 2013 – 10 drafts, in 2014 – 6, and in 2015 – 9.

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

Upon terms of reference of Rostechnadzor, SEC NRS analyzes operational events occurred at NPPs and prepares annual summary analytical reports for Rostechnadzor. These reports evaluate safety in operation of nuclear units in the Russian Federation based on analyses of data provided to Rostechnadzor by the Operating Organization, Rosenergoatom. SEC NRS maintains an electronic database on operational events at NPPs “ISI-Nadzor” used by Rostechnadzor.

In accordance with the recommendations of para. 3.58 of the IAEA Guide GS-G-1.2 “Review and Assessment of Nuclear Facilities by the Regulatory Body”, the state safety regulatory bodies in the field of the use of atomic energy have to assess applicability of software used in calculation justification of nuclear facility safety. The corresponding requirement related to software verification and qualification is stipulated in Russian federal standards and regulations in the field of the use of atomic energy.

Qualification of software used in safety substantiation is carried out by the Expert Council in the following topical areas:

- neutronics calculations;
- thermal hydraulic calculations;
- equipment strength calculations;
- radiation safety calculations;
- calculations as part of probabilistic safety analyses;
- building structures strength calculations; and
- calculations of physical and chemical processes.

Software applicability is assessed based on its verification reports provided by developers of the software. Highly qualified specialists from more than 30 scientific and technical organizations (including enterprises and organizations within nuclear sector, leading higher education establishments, and institutes of the Russian Academy of Sciences) take part in software applicability assessments.

A software qualification certificate contains information on the

purpose and scope of application of software, as well as calculation errors the software features and their confirmation by verification.

In 2013, the qualification certificates valid for 10 years were issued for 18 software packs, in 2014 – for 25 software packs, and in 2015 – for 18 software packs. Twelve qualification certificates for software packs were extended (also for 10 years). As of the beginning 2016, 208 software packs have the applicable qualification certificates (a list is posted on the website: http://www.secnrs.ru/expertise/software-review), about 40 software packs are at different stages of qualification process.

SEC NRS has a quality management system which meets requirements of the international standard ISO 9001:2008 and the interstate standard GOST ISO 9001-2011. The quality management system is used in:

- research dealing with safety principles and criteria;
- development of regulatory documents on safety regulation;
- assessment of applicability of software used in justifications of safety; and
- safety reviews of nuclear facilities and (or) activities.

SEC NRS publishes the official journal of Rostechnadzor "Nuclear and Radiation Safety", which contains drafts and official texts of regulations and scientific (scientific and engineering) articles written by employees of Rostechnadzor, its scientific and technical support organizations and by other authors on the vital issues of nuclear and radiation safety regulatory issues.

SEC NRS specialists are involved in expert working groups of the Information and Analytical Center (IAC) of Rostechnadzor (a description of IAC of Rostechnadzor is given in the section on Article 16 of this Report).

SEC NRS is a member of the European Technical Safety Organizations Network (ETSON) which includes 15 organizations from 15 world countries. The membership in ETSON allows SEC NRS exchanging, on a regular basis, outcomes of research, experience in supervision of nuclear and radiation safety of nuclear installations, as well as information on conducted 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.

Since 2013, in the framework of the Association ETSON, the special committee (ETSON AWARD) awards annual prizes to young specialists for joint works in the field of nuclear power. Young engineers of SEC NRS were among prize winners of this content in 2014 and 2015.

In the reporting period, SEC NRS participated in working groups of the Multinational Design Evaluation Program (MDEP), including:

- the Working Group on WWER reactors (WWER WG); and

– the Working Group on Instrumentation and Controls (I&C WG).

Also, in the reporting period, representatives of SEC NRS took part in the activities of the working groups of the Nuclear Energy Agency of the Organization for Economic Cooperation and Development (OECD/NEA), including:

– the Working Group on Operating Experience (WGOE);
– the Working Group of Regulation of New Reactors (WGRNR); and
– the Working Group on Assistance to Regulators in the countries which develop fast reactors (GSAR).

Representatives of SEC NRS work as members of committees, observers in the committees for drafting IAEA safety standards, joint committee of the IAEA and Generation IV International Forum on fast reactor safety.

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 regulations related to supervision of nuclear material physical protection, control and accounting, and training of inspectors in this area;
– arranging and conducting safety reviews in the field of the use of atomic energy;
– research in the area of safety assessment methodology as regards the uses of atomic energy; and
– training of the personnel of the state nuclear safety regulatory body of other countries.

220 people of VO Safety staff deal with NPP safety reviews.

In 2013-2015, VO Safety took part in rendering scientific and technical support to Rostechnadzor, including in:

– drafting regulatory documents, including the draft Ordinance of the Government of the Russian Federation regarding features of compliance assessment of equipment, component parts, materials and semi-finished products delivered to NPPs to the imposed requirements;
– expert safety justification of nuclear facilities subject to the continuous state supervision; and
– compliance assessment of equipment delivered to NPPs.

In the reporting period, VO Safety took part in working groups of the Multinational Design Evaluation Program (MDEP), including:

– the Working Group on Inspection of Suppliers;
– the Working Group of Codes and Standards (C&S WG); and
– the Working Group on Instrumentation and Controls (I&C WG).

VO Safety cooperates with the state bodies of the states which are customers of nuclear facility construction to Russian designs, on issues of development of national regulatory frameworks, including development of legal regulatory bases, licensing and supervision systems in the said area, as well as on issues related to organization of training of the personnel of nuclear and radiation safety regulatory bodies of these states.

VO Safety employs the quality management system for reviews, inspections, checks, quality and safety assessments, engineering and consulting in the field of the use of atomic energy; the system is certified as conforming to the standard GOST ISO 9001-2011.

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.

Article 9. Responsibility of License Holder

In accordance with Article 26 of the Federal Law No. 170-FZ “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 Federal Law “On the Use of Atomic Energy” (Article 35) sets 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, i.e. the license holder.

The Operating Organization bears full responsibility for the safety of Russian NPPs and for the proper management of nuclear material and radioactive substances in its possession. The Operating Organization is not relieved of this responsibility in connection with activities of other enterprises and organizations performing works or giving services to the Operating Organization.

In accordance with requirements of the federal standards and regulations in the field of the use of atomic energy “General Safety Provisions of Nuclear Power Plants” (NP-001-15), the Operating Organization sets up structural divisions to carry out immediately on the NPP site the activity on construction and safe operation of NPP, giving them necessary rights, finances, materiel and human resources, regulatory documents and scientific and technical support. It defines their responsibility for this activity and controls this activity. According to the Operating Organization’s Charter, the Deputies of the Director General of Rosenergoatom – directors (managers) of the operating NPPs (branches of Rosenergoatom) – are delegated the right to manage the production, financial and economic activities of the branches. 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 submits periodic reports on the state of nuclear and radiation safety at NPPs.

The Operating Organization's ability to be responsible for the safety of nuclear installations is verified by the Regulatory Body in the framework of the licensing procedure, and also when conducting inspections (audits).

A description of the mechanism of provision to the license holder of appropriate resources (technical, human, financial) for efficient management of an accident on the site and mitigation of its consequences is given below in the section on Article 16 of this Report.

To obtain an operating license for a nuclear installation, the Operating Organization must submit to Rostechnadzor a financial coverage of its liability (a financial guarantee of the possibility to compensate for nuclear damage) certified by relevant documents. Terms and procedure of civil liability insurance for losses and harm caused by radiation impact, a 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. The insurance covers the territory of the Russian Federation and territories of other Contracting Parties of the Vienna Convention on Civil Liability for Nuclear Damage, which may suffer transboundary nuclear damage. The insurance is carried out by the Russian Nuclear Insurance Pool with insurance sums which ensure fulfillment of conditions of the Vienna Convention. To ensure the insurance payments, since 2009 the Russian Nuclear Insurance Pool involves the International Pooling System (IPS) as reinsurers. The participation of the International Pooling System in insurance of the civil liability for nuclear damage of Rosenergoatom has become possible after international insurance inspections were conducted at Russian NPPs. Under the insurance policy concluded for 2015-2016, the insurance risk of 76.4 % was placed in national nuclear insurance pools of 16 countries which are parts of the International Pooling System. Thus, Rosenergoatom fulfills international commitments undertaken by the Russian Federation in the field of civil liability for nuclear damage.

Implementing the principle of active dialogue with the stakeholders, Rosenergoatom seeks to ensure the highest level of openness and transparency of its activity. The Operating Organization supports active communications with all stakeholders by timely giving them material information on all aspects of its activity and responding to their requests and wishes. Rosenergoatom’s top management consistently implements principles of the information policy: timeliness, accessibility of disclosed information, its credibility and completeness while maintaining reasonable balance between openness and commercial interests of the Operating Organization. All forms of communication available today are used to successfully achieve the transparency policy: interactive public annual report, Internet website, press conferences, public dialogues and consultations, stakeholders’ site visits and many others.

Information support of operation of nuclear power plant is coordinated by information and public relations departments acting at each NPP. Production- and social-related reports are posted on Rosenergoatom’s website, published in corporate and regional periodicals, shown on local and federal TV, in blogs etc.

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 www.rosenergoatom.ru. On the website www.russianatom.ru, in real time mode, there is information about radiation monitoring at Russian nuclear power plants. Besides, at all nuclear power plants answering machines operate round-the-clock, which contain fresh information on current operation of the plant and radiation situation.

If an abnormal situation arises in NPP operation, there is a system of prompts 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 case 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 Organization for NPP safety is established by the legislation and defined in the regulatory requirements, which meets the requirements of Article 9 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 No. 170-FZ “On the Use of Atomic Energy”, such as:

- safety ensuring in the uses of atomic energy: protection of individuals, 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
- 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 No. 170-FZ “On the Use of Atomic Energy”, the interference with the Operation 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 to ensure safety of NPP at all stages of its lifecycle.

To solve this task, Rosenergoatom consistently formulates measures aimed at appropriate fulfillment of requirements of the Russian Federation law in the field of the use of atomic energy. At this, Rosenergoatom persistently fulfills commitments under the Convention on Nuclear Safety and follows recommendations of the IAEA.

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

- ensuring nuclear, radiation, industrial, and fire safety;
- observance of the legislation of the Russian Federation; observance of requirements of federal standards and regulations in the field of the use of atomic energy; observance of institutional standards;
- decision-making on the basis of tested good practices and technical and economic reason which observing safety principles;
- ensuring economic efficiency of generation of electricity and heat; and
- improvement of the safety culture.

According to provisions of the Convention on Nuclear Safety, as well as the Federal Law No. 170-FZ “On the Use of Atomic Energy”,

Rosenergoatom bears full responsibility for nuclear and radiation safety at all stages of the nuclear power plants' life cycle and ensures nuclear and radiation safety of Rosenergoatom through:

- implementation of the consistent science, technology and economic policy, while observing the priority to safety;
- activities to improve NPP safety in accordance with plans compiled with the account taken of results of safety analyses and operating experience to achieve NPP safety targets established in the federal standards and regulations in the field of the use of atomic energy;
- maintenance of appropriate qualifications and competences of the personnel;
- building up committed attitudes to the principles of the safety culture of the plant personnel and staff of organizations, which execute works and render services to the Operating Organization;
- dissemination of the best practices;
- implementation of accident prevention measures at NPPs; and
- of preparedness of the management and personnel of the Operating Organization and plant personnel for emergency response.

Thus, Rosenergoatom fulfills obligations resulting from the Convention on Nuclear Safety, takes 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.

According to requirements of the federal standards and regulations in the field of the use of atomic energy "Basic Safety Provisions of Nuclear Power Plants" (NP-001-15), the Operating Organization builds up and maintains safety culture taking account of the following principles:

Setting up the NPP safety priority over economic and production objectives

NPP safety ensuring at all stages of its lifecycle is of priority over economic and production objectives of the Operating Organization. This is stipulated in the Safety Policy Statement of Rosenergoatom, Provisions of the Operating Organization, and requirements of guiding documents and standards of the Operating Organization.

Professional education and keeping qualifications of managers and personnel in each activity area affecting safety

The "Rules of Organization of Work with the Personnel at Nuclear

Power Plants" establish main requirements for formulation and keeping the necessary qualification level of Rosenergoatom's personnel. When selecting candidates for a position, education, work experience, attitudes to NPP safety ensuring are taken into account. For some key positions, psychological and physiological testing (examination) is mandatory.

Strict observance of discipline with clear-cut delineation of powers and personal responsibility of managers and performers

Relations linked with observance of labor discipline by employees of organizations operating radiation- and nuclear-hazardous productions and nuclear facilities are regulated by the Federal Law No. 35-FZ "Statute of the Discipline of Employees of Organizations Operating Radiation- and Nuclear-Hazardous Productions and Nuclear Facilities". Delineation of powers and personal responsibility of employees is specified in provisions of organizations, provisions of structural divisions of organizations, and job descriptions of employees.

Strict observance of requirements of quality assurance programs, production procedures and process regulations, their periodical updating considering the accumulated experience

Rosenergoatom has worked out a set of documents necessary for effective functioning of the quality management system, including the Quality Policy Statement, general quality guides of the Operating Organization Concern Rosenergoatom, general quality assurance programs at NPPs (QAP NPP(Q), QAPs NPP for lifecycle stages: QAP NPP(O), QAP NPP(D), QAP NPP(C), QAPs NPP for licensed activities for which the Operating Organization is responsible.

Process regulations and other regulations have been produced for all NPP units; operating procedures have been worked out for NPP systems and components. NPP personnel actions are defined also by job descriptions and labor protection procedures. Knowledge in production and operating documentation of the personnel are checked on a regular basis.

Building up the atmosphere of trust and approach to team work and social and living conditions of the NPP personnel which shape the internal need in positive attitudes to safety

NPP safety priority is demonstrated by top management of Rosenergoatom in their daily activities, including by visits to nuclear power plants and meetings with personnel. The Awareness Days are regularly held. Rosenergoatom and plant top management focuses attention of the personnel on most important aspects of activities and answers employees' questions during these days.

Interaction of Rosenergoatom and the personnel on social issues is stipulated by the labor agreement between the administration and

employees. The labor agreement provides for the following assistance to employees: zero-interest loans for improvement of housing conditions, compensation of interest on mortgage, and welfare assistance to those in difficult financial situation. Support is also provided as regards health resort treatment of employees and their families.

Rosenergoatom has organized a possibility for direct (including anonymous) address of any worker to top management of NPP and Operating Organization through a system of mailboxes and electronic mail. Director General's blog has been organized and maintained where any Internet user may ask questions, not only employees of Rosenergoatom.

Understanding by each employee of how his/her activity affects NPP safety and consequences which may arise from a failure to observe or poorly observe requirements of quality assurance programs, production procedures and job descriptions, and process regulations

The employees are informed on possible consequences for NPP safety of their erroneous actions and failure to act, on how equipment they service or control affects NPP safety, on cases of violations and deviations in NPP operation that have taken place, including due to erroneous actions of the personnel, in the course of training, maintaining and advance training of the NPP personnel. Afterwards, an audit of received knowledge is carried out.

Employees' self-control of their safety relevant activities

At NPPs, the training and methodological, video aids on self-control in the conduct of work have been developed and applied.

Understanding by each manager and employee of inadmissibility of hiding errors in their activities, necessity of revealing and eliminating their causes, necessity of continuous self-improvement, learning and introduction of best practices, including foreign ones

The position training and qualification maintaining programs for NPP employees include the course on safety culture. The task of the course is to form the understanding, by each employee, of how his/her activity affects NPP safety and consequences which may arise from a failure to observe or poorly observe requirements of quality assurance programs, production procedures and job descriptions, and process regulations. In organization of NPP operation, a special focus is placed on measures aimed at accounting human factor in safety ensuring, measures to prevent errors of the operating personnel, operating experience feedback, with taking into account requirements of the Operating Organization's documents "Procedure for Organizing Work to Prevent Erroneous Actions of the Personnel" and "Analysis and Use of Nuclear Power Plant Operating Experience".

Establishing the system of incentives and punishments by results of the production activity, which motivate openness of employees' actions

The system of incentives and punishments is regulated by the following documents:

- Standard Remuneration Procedure of Employees of Rosenergoatom;
- Provisions on the Final Safety Culture Day in Rosenergoatom.

At NPP, NPP management non-punishment statements for unintentional mistake have been adopted.

According to the above principles, Rosenergoatom has formed the Safety Culture Board led by the Director General of Rosenergoatom; also safety culture boards have been set up at each NPP led by NPP managers.

The "Action Plan to Improve Safety Culture at NPPs" has been developed and fulfilled. This plan aims at developing safety culture with NPP personnel.

In 2015, NPPs of Rosenergoatom were subjected to an out-of-schedule self-assessment of effectiveness of application of safety culture fundamentals. At NPPs, the out-of-schedule self-assessment was carried out by a working group or commission consisting of managers and specialists of separate divisions of NPPs.

The out-of-schedule assessment of safety culture helped identify areas for improvement, namely:

- the identification of factors affecting safety in the course of equipment walk-downs by the operating and managerial personnel; and
- motivation of voluntary communications by the personnel about revealed deficiencies, own mistakes, occurred and not occurred events, creation of the atmosphere of trust and openness.

The result of the out-of-schedule self-assessment was the development of plant-specific and corporate measures to improve safety culture, which are duly fulfilled.

10.3. Role and Value of Rostechnadzor

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

Rostechnadzor has clearly declared the goals of the nuclear and radiation safety regulation in its Policy Statement "On the State Regulation of Nuclear and Radiation Safety in the Territory of the Russian Federation". This Policy Statement says that 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.

As part of safety case reviews for licensing purposes, as well as inspections and supervisions, Rostechnadzor carries out analyses of safety culture. Requirements to building up and maintaining safety culture are contained in the federal standards and regulations “General Safety Provisions of Nuclear Power Plants” (NP-001-15). As per the requirements of this document, “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”.

Main requirements on building up safety culture regulated by the above said regulatory document are given in the previous subsection of this Report.

To fulfill the above said requirements, Rostechnadzor develops the safety guide “Recommendations on Building up and Maintaining Safety Culture at Nuclear Plants”.

In the Russian Federation, the Operating Organization 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 power plants.

Article 11. Financial and Human Resources

11.1. Financial Resources of the Operating Organization

To support operations and fulfillment of responsibility of the Operating Organization, which carries out activities in the field of the use of atomic energy, the Federal Antimonopoly Service of Russia (FAS of Russia) annually sets out an amount of monetary funds required for safe operation of nuclear power plants.

In accordance with the Ordinance of the Government of the Russian Federation of 30 January 2002 “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” (considering amendments made by the Ordinance of the Government of the Russian Federation of 19 November 2012), the operating organizations make provisions to:

- the reserve intended for financing of expenditures for ensuring nuclear, radiation, industrial and fire safety during operation of nuclear power plants, equipment of emergency rescue teams, payment for their works (services) in an amount of not greater than 10 % of revenues gained by Rosenergoatom 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 Rosenergoatom;
- the reserve intended for financing of expenditures for NPP development as per the list of capital projects on the Rosenergoatom’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 Rosenergoatom; 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 Rosenergoatom 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 Rosenergoatom.

The target funds allow Rosenergoatom to generate sufficient money to exercise functions of the Operating Organization and ensure safety of nuclear power plants at all stages of their lifecycle, and develop observing all guidelines and requirements of the Russian law. Sizes of the provisions to the reserves made in accordance with the Ordinance of the Government of the Russian Federation of 19 November 2012 are given in Table 11.1.

Table 11.1. Sizes of provisions to the reserves of Rosenergoatom in 2013-2015 (RUB mln)

Reserve	2013	2014	2015
Reserve for safety ensuring (NRI&FS)	7701	8091	8411
Reserve for nuclear material physical protection, control and accounting	3853	4627	4732
Reserve for decommissioning of NPP	6214	7533	7916
Reserve for NPP development	49796	47755	47688
Reserve for disposal of radioactive waste	2890	2570	2187

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 2013-2015 (RUB mln)

Financing of the program of measures to ensure safe and sustainable operation of existing nuclear units		
2013	2014	2015
23387	24421	24104

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 No. 170-FZ “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 regulatory documents for essential human resources activities:

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

Similar requirements are set by the Operating Organization for the personnel of organizations rendering NPP services in design, maintenance, adjustment and testing of the power equipment.

Total staff schedule of Rosenergoatom is about 39,000 people, as of 31.07.2016.

At the present time, all NPPs in Russia have highly qualified personnel required for operation, maintenance and repair of essential and auxiliary equipment, as well as the conduct of managerial, business and other functions. Total number of operators at NPPs is about 9,000 people, as of 31.07.2016.

The number of contractors at NPP who perform repairs, adjustments, transportation, business and other services are about 18,500 people.

The personnel sufficiency assessment at NPP is carried out:

- for operators, based on the number of working places, projected shop-floor workforce size and shift schedule; and
- for the maintenance personnel, based on the work labor input assessment methodology and considering basic economic costing standards of the work done.

Methods used to analyze the competence, accessibility and sufficiency of the personnel required for activities in case of a severe accident

The emergency support is described in detail in the section on Article 16 of this Report.

Competence of the personnel of NPP and contractor companies, which are part of NPP emergency elimination teams of NPPs, is assessed:

- during interviews or testing after CD and emergency classes for the personnel of NPPs and contractor companies annually according to the Exemplary Training Programs produced by EMERCOM of Russia;
- during exercises and drills ate NPPs; and

– during inspections of freelance rescue teams of NPPs by qualification commissions of NPPs or sectoral commission of Rosenergoatom, and Rostechnadzor.

Availability and sufficiency of the listed force and capabilities are assessed in the course of exercises and drills at NPPs (for example, comprehensive emergency exercises with the OPAS team at NPPs, command-post exercises conducted by an NPP according to the plans of EMERCOM of Russia and MOD of Russia).

Rostechnadzor assesses emergency exercises run by the Operation Organization using a special methodology.

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; and
– 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. The professional standards with requirements for the qualification necessary to perform labor functions affecting safety have been put into force commencing 1 July 2016.

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:

– Central Institute for Continuous Education and Training (CICE&T);
– National Research Nuclear University MEPhI (NRNU MEPhI);
– Training and Methodological Center (TMC) of VNIIAES;
– St. Petersburg Power Engineering Advance Training Institute (PEIPK);
– Novovoronezh and Smolensk Training Centers (TC) of Atomtekhenergo.

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 NPP has training equipment and aids sufficient for training and maintaining qualifications of the NPP personnel. The buildings and room of ETU NPP have fitted classes for specialized training, laboratories and workshops. Classes are equipped with 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.

The personnel are trained in groups or individually. This includes:

- 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); and
- the primary knowledge check.

Persons from the personnel perform certain activities in the field of the use of atomic energy if they have permits issued by Rostechnadzor.

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 STO 1.1.1.01.004.0441-2008 “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.

Rosenergoatom’s personnel advance their qualifications continuously. The advancement training is carried out as necessary but at least once in five years during the entire employment.

In 2015, the total training hours of employees at operation nuclear power plants were 4,064,148 hours, including the internal training – 3,106,682 hours and external training – 957,466 hours. On average, each employee of the operating nuclear power plant spent for training 117.4 hours (89.7 hours of internal training and 27.7 hours of external training).

In 2015, Rosenergoatom spent 325,903,000 rubles for external (with regard to TCs and ETU NPPs) training of its employees.

Periodically, 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.

Results of knowledge checks are put on the qualification certificate.

An out-of-schedule knowledge check of NPP employees is carried out when:

- new equipment is installed, the equipment or process schemes are reconstructed or modernized;
- the NPP employee breached rules, standards and procedures;
- this is required by the state supervisory bodies, the state labor inspectorate, the Operating Organization (when there are breaches of occupational safety of insufficient knowledge);
- the results of the work of commissions investigated an occupational injury, fire or NPP operational event require so;
- the pause in work in the position (trade) over 6 months occurs;
- new or revised standards and regulations come into force; and
- the employee is transferred to other position requiring additional knowledge.

The out-of-schedule knowledge check does not cancel the dates of the routine knowledge check.

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 Power Plants";

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

Traditionally, Rosenergoatom pays great attention to improvement of training equipment in the utility, which is carried out by both the Operating Organization and nuclear power plants.

Rosenergoatom's plans for maintenance and advancement of qualifications of the personnel of new units foresee:

- revision and renewal of training aids taking into account requirements of the federal legislative and regulatory documents of operating experience;
- introduction of the functional module of the distributed automated technical documentation management system;
- commissioning of the training center's building at Leningrad NPP-2;
- training of the personnel of Leningrad NPP-2 and Novovoronezh NPP-2 units under construction at full-scope simulators;
- commissioning of the full-scope simulator for the personnel training at Rostov NPP Units 3 and 4; and
- conduct of preparatory works to build TC building at Beloyarsk NPP.

Rosenergoatom has 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-scope and analytical simulators.

Article 12. Human Factor

12.1. Ways to Prevent Human Errors

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 “Methodological Guidelines for Analyzing the Causes of Safety-Reliability-Related Events, Fires, Injuries, Damages to Buildings and Structures at Nuclear Plants” (RD EO 1.1.2.09.0095-2010). 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 the psychologist analyses the 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, and develop appropriate measures to eliminate these causes.

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 nuclear plants have an operating experience feedback system in place. All significant upsets in the 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 production divisions of the plant conduct monthly debriefings of personnel to discuss operational events that have occurred at the plants.

Rosenergoatom has been maintaining an Industry-level Information and Analysis System for Operating Experience of Nuclear Power Plants (OIS OE) to ensure effective use of operating experience feedback. The system provides collection, processing, storage, analysis and dissemination of information on the operation of nuclear plants in Russia and other countries. The following arrangements have been made at all Russian nuclear plants to prevent, reveal and correct human errors:

- high-quality training of operating and maintenance personnel using state-of-the-art technical aids and efficient educational techniques;
- periodic training courses for operating and maintenance personnel to keep their qualifications;

- psychological support to operators making critical decisions, in particular, through lectures, drills and role playing on relevant topics;
- analysis of the operating experience of Russian and foreign plants using the received information, including the good practices, among others, in the framework of international information systems; and
- mandatory debriefing sessions with the operating personnel to discuss abnormal performance of plant systems and equipment.

Human factors include both the human errors and design errors. In design the human factor is accounted for by:

- optimization of distribution of control functions between the human and automation;
- design 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;
- check of the project quality when verifying design solutions, including at analytical and full-scope simulators; and
- involvement of the personnel who have practical experience at NPPs and adjustment organizations in the design process to achieve optimal arrangement of the equipment to ease operation, maintenance and repair of the plant systems and equipment.

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

The work to prevent, reveal and correct human errors is carried out on the basis of appropriate administrative, managerial and organizational decisions.

The accumulated operating experience feedback is used to develop and update operational documentation describing professional activities of personnel providing operation and maintenance of the plant process equipment and systems.

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.

The following measures to prevent erroneous actions of the personnel have been additionally adopted and implemented:

- 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 with inclusion thereof, among other, the information on potential consequences of wrong or poor quality execution of a given work; and
- introduction into the plant's regulations the compulsory development of specific formats (check lists) of walk-downs of the equipment and workplaces by operating, maintenance and managerial personnel of the plant.

To improve quality of organization and management of the work aimed at considering human factor, Rosenergoatom periodically holds self-assessments and uses their results for draw out and implement corrective measures.

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

In accordance with Article 27 of the Federal Law No. 170-FZ "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 receive work permits in the area of the use of atomic energy from the Federal Environmental, Industrial and Nuclear Supervision Service.

The unified qualification handbook of positions of managers, specialists and servants "Qualification Characteristics of Employees' Positions at Organizations of Nuclear Industry" has been drawn out.

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.

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, a list of job positions, for which the contra-indications are relevant, and requirements for pertinent medical and psycho-physiologic examinations.

Rostechnadzor has developed and approved 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". According to the above said Administrative Regulation, the permit granting procedure for NPP employees includes:

- submission of an application to Rostechnadzor;
- review of the application documentation by Rostechnadzor;
- operating personnel's knowledge check in training centers and full-scope simulators; and
- making decision by Rostechnadzor regarding granting or refusal to grant the permit.

The availability of the personnel licensing system enables a proper quality control of NPP personnel training.

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 supervision of the personnel qualifications is focused on the following issues:

- organization of the system of personnel recruitment and training, knowledge check and issue of permits to work;
- observance of conditions of permits to work in the field of the use of atomic energy, which are granted to employees of nuclear facilities; and
- implementation of measures to prevent accidents and preparedness of the supervised individuals for elimination of their consequences.

In the supervision framework, the proficiency level of the plant personnel is assessed through an analysis of their performance results, which uses the plant operational event investigation reports and annual operational safety assessment reports of nuclear units. The findings of the above information analyses are presented in the annual reports produced by Rostechnadzor. The analysis takes account of human error statistics of the plants, information about the managerial weaknesses; description of poor safety culture examples; causes of errors. Rostechnadzor also analyses corrective actions developed by the Operating Organization to prevent human error recurrence; proposals for improving competences of managerial, operations and maintenance personnel are produced.

Rostechnadzor takes account of issues related to human activity also in regulatory activity. As an example, there are the personnel qualification requirements, building up safety culture, operation of the plant in accordance with technical regulations, procedures and guides, which are contained in the federal standards and regulations "General Safety Provisions of Nuclear Power Plants" (NP-001-015). The "Recommendations for Structure and Content of the Beyond Design Basis Accident Management Guide, Including Severe Accidents" endorsed in 2015 pays special attention to decrease a probability of human error.

The analysis of plant personnel performance in recent years has shown that there is a trend to decrease the number of cases pointing to deficiencies in personnel training that have led to operational events at

NPPs subject to investigation in accordance to requirements of the federal standards and regulations in the field of the use of atomic energy.

Prevention of the personnel erroneous actions, analyses of deficiencies in the personnel training are of vital importance in NPP safety improvement activities.

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

Article 13. Quality Assurance

The Federal Law No. 170-FZ “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 Operating Organization pays great attention to issues of quality assurance at all stages of NPP development and operation. The federal rules and standards “Requirements for Quality Assurance Programs for Nuclear Facilities” (NP-090-11), 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 NPP operation quality assurance programs are reviewed by Rostechnadzor when it decides on granting a NPP operating license and licenses for other 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. NPP operation in accordance with the developed quality assurance programs is also subject to oversight in frames of inspections and checks conducted by Rostechnadzor.

Quality assurance requirements are contained also in the following federal standards and regulations in the field of the use of atomic energy:

- “General Safety Provisions of Nuclear Power Plants” (NP-001-015);
- “Collection, Reprocessing, Storage and Conditioning of Liquid Radioactive Waste” (NP-019-15);
- “Collection, Reprocessing, Storage and Conditioning of Solid Radioactive Waste” (NP-020-15); and
- “Gaseous Radioactive Waste Management. Safety Requirements” (NP-021-15).

Over the time elapsed since the sixth National Report, Rostechnadzor has developed and put in force the safety guide in the field of the use of atomic energy which touches upon quality assurance “Recommendations for Development of Quality Assurance Programs for Transportation of Radioactive Materials” (RB-110-16).

The NPP quality management system foresees overall and local QAP NPPs for all stages of the plant life cycle. QAP NPPs set forth organizational, technical and other measures to ensure and achieve required quality indicators.

According to requirements of the federal standards and regulations in the field of the use of atomic energy, Rosenergoatom:

– selects organizations, which perform works and render services associated with licensed activities in the field of the use of atomic energy;
– establishes requirements for QAP NPPs of organizations, which perform works and render services;

- controls fulfillment of QAP NPPs of organizations, which perform works and render services;
- conducts internal audits of fulfillment of the overall and local quality assurance programs for NPPs (QAP NPP(C) – QAP NPP for commissioning, QAP NPP(O) – QAP NPP for operation, QAP NPP(D) – QAP NPP for decommissioning);
- collects and analyzes information on quality of executed works and rendered services; and
- revises and updates QAP NPPs, for which the Operating Organization bears responsibility.

To assess efficiency of QAP NPPs, Rosenergoatom conducts scheduled inspections and audits of QAP NPPs of each operating and constructed NPP in accordance to the national standard GOST ISO 9001-2011, QAP NPP(Q), QAP NPP(O). Since 2015, the inspection program has included, as the criterion, the IAEA Safety Guide GS-R-3 “The Management System for Facilities and Activities”. Fulfillment of requirements of QAP NPP(Q), QAP NPP(O), GOST ISO 9001-2011, GS-R-3 of all NPPs is checked each two years.

To assess performance of overall and local QAP NPPs, Rosenergoatom has developed the regulatory guide “Procedure for Performance Assessment of Quality Assurance Programs by Nuclear Power Plants”, which contains the following main assessment criteria:

- fulfillment of established requirements of the federal standards and regulations in the field of the use of atomic energy, requirements of international organizations, sectoral regulatory documents, documents of the Operating Organization, local regulatory documents of NPP;
- fulfillment of corrective actions which eliminate causes of revealed inconsistencies; and
- achievement of main indicators of NPP operation in the reporting period.

The organizational and technical measures to eliminate inconsistencies and to implement recommendations for QAP NPP fulfillment revealed in 2013-2015 have been recognized effective, all measures planned from 2013 till 2015 have been fulfilled in full scope.

Rosenergoatom continues the work to improve and certify the quality assurance system. Rosenergoatom has received the certificate of compliance with the requirements of GOST ISO 9001-2011 No. TIC 15 100 128018 (period of validity - 23.05.2015-22.05.2018) with an expanded scope “Control of Design and Construction of Nuclear Facilities Where Atomic Energy is Used for Peaceful Purposes, As Well As Production and Delivery of Electric Energy” for its quality assurance system to replace “Control of Production and Delivery of Electric Energy” (Certification Authority TÜV Thüringen (Germany).

In near future, to further develop the quality assurance system, Rosenergoatom is challenged with the integration of different management systems of Rosenergoatom (safety, quality, environmental protection, physical security, economy, social responsibility, energy efficiency) into the Integrated Control System in accordance with requirements of GS-R-3.

Safety and operational reliability of NPPs are determined to a greater extent by conformance of the equipment in use to requirements of federal standards and regulations applicable in nuclear power. Quality control (verification of conformance) of the equipment important for safety for NPPs is conducted by authorized organizations of ROSATOM and Rostechnadzor. Rosenergoatom monitors quality of the safety important equipment at all producers and sites of plants under construction. Hence, along with QAP NPP fulfillment inspections, Rosenergoatom carries out audits of producers of the equipment important for safety and incoming inspection divisions on sites of the plant under construction. During audits of the producers of the equipment important for NPP safety, utmost attention is paid to checks of fulfillment of requirements of the quality assurance programs for development of the equipment, items and systems important for safety of NPPs (QAP NPP(D) and quality assurance programs for manufacture of the equipment, items and systems important for safety of NPPs (QAP NPP(M).

To improve efficiency of measures preventing deliveries of products having signs of illegal origin to NPP, Rosenergoatom, jointly with authorized organizations, carries out:

- collection, processing, analysis of advance information about bad producers and suppliers, which manufacture and offer products having signs of illegal origin, including counterfeit and falsified products;
- updating databases containing information about documented facts of falsification of products for NPPs;
- control of legitimacy of documents provided during procurement procedures, accompanying documents of product deliveries to NPPs; and
- corresponding preventive and compensating measures to confine threats.

The said activity is carried out in accordance with the “Provisions for Response Measures upon Receipt of Information about Possible Deliveries/Application of Products Which Have Signs of Illegal Origin at NPPs”.

Rosenergoatom conducts quality checks of construction of NPPs by principal contractors. During quality checks of construction of NPPs carried out by principal contractors, the fulfillment of quality assurance programs for NPP construction QAP NPP(C) is checked.

Rosenergoatom pays 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.

Article 14. Assessment and Review of Safety

It has become a practice in Russia to perform, on a regular basis, safety assessments and reviews throughout the entire life cycle of a plant, as stipulated in the Convention on Nuclear Safety.

Safety assessments and reviews are performed by:

- the Operating Organization with involvement of scientific, research, design and architect-engineering organizations, which are designers of NPP and RI, and other independent organizations; and
- Rostechnadzor with involvement of scientific and technical support organizations.

International organizations (IAEA, WANO, etc.) play a prominent role in safety assessments and reviews by conducting missions such as OSART, peer reviews, technical visits and technical support missions.

14.1. Safety Review in the Course of Licensing

According to the Federal Law No. 170-FZ “On the Use of Atomic Energy”, the Operating Organization shall obtain licensing from Rostechnadzor at the stages of siting, construction, operation and decommissioning of NPP.

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.

All operating units of Russian nuclear power plants have operating licenses granted by Rostechnadzor. The plant operating license is granted for the period of time, during which the plant operation safety is justified and confirmed by results of the safety justification review.

Information on valid licenses for operation of NPP units of Rosenergoatom is given in Appendix 1.

According to the Federal Law No. 170-FZ “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 review of the periodic safety review report, a relevant decision is made by Rostechnadzor.

14.2. Audits and Inspections during NPP Operation

Internal Audits by Operating Organization

Pursuant to the requirements of Article 35 of the Federal Law No. 170-FZ “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 are 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 fulfillment of requirements of safety standards, regulations, norms and procedures;
- the fulfillment check and 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; and
- the check of efficiency of system for NPP safety management, preparation of recommendations to improve the system efficiency.

In 2013-2015, the Operating Organization’s commissions carried out 14, 10 and 13 inspections at NPPs, respectively.

The plant-level and corporate corrective measures have been developed and introduced using results of all audits; a check of whether similar inconsistencies are present at other NPPs has been organized, and the development of expedient corrective and preventive measures has been started.

Since 2015, the assessment of safety culture has been carried out during regular inspections at NPPs and in Operating Organization.

In case of worsening of NPP operating safety, increase in the number of equipment failures or growth of NPP operational events, targeted inspections are carried out aimed at in-depth study of causes for worsening in specific areas of operation.

The Operating Organization has conducted:

- in 2013: 23 process audits, including 8 peer reviews at NPPs to assess quality of repair arrangements at nuclear units;
- in 2014: 15 process audits; and
- in 2015: 16 process audits.

In 2015, the Operating Organization has initiated conduct of out-of-schedule targeted self-assessments: “Conditions and Quality of Operation of Electrical Equipment at NPPs” and “Efficiency of the Application of

Basic Constituents of Safety Culture". The necessary corrective measures have been worked out based on self-assessment results.

IAEA OSART Missions

In the period November 10-27, 2014 an independent international peer review of operating safety, the IAEA OSART mission, was carried out at Units 3 and 4 of Kola NPP. Based on the review results, the OSART experts formulated one recommendation, nine suggestions and found out seven good practices.

The only recommendation dealt with the area "Management, Organization and Administration" and meant that the plant should timely implement the integrated management system.

The mission suggestions were as follows: in the area "Operation" – to improve efficiency of actions performed by operators at MCR; in the area "Maintenance and Repair" – to improve M&R targeted to prevention of foreign matter to the reactor cooling circuit; in the area "Technical Support" – the improve on-plant oversight of compliance of the current condition of the plant and processes, as well as corresponding documentation, to the design requirements; in the area "Radiation Protection" – to improve the system for monitoring of radioactive releases/discharges; in the area "Chemistry" – to monitor additional chemical parameters to avoid adverse impacts to the plant systems; and in the area "Severe Accident Management" – to implement at NPPs the severe accident management guides.

The following was noted among the good practices:

- the cutting-edge technology for clean-up from radionuclides, which are used at the plant as part of the LRW reprocessing facility, significantly reduces volumes of RAW and helps use a special type of containers suitable for long-term safe storage, transportation and subsequent final disposal;
- rendering to the plant personnel the assistance in control of stresses by professional psychologists; and
- fast system for display of reactor state information, which ensure perception and assessment of information in conditions of time deficit and stress.

All recommendations and suggestions of the mission were thoroughly analyzed. Early 2015 an action plan of Kola NPP based on outcomes of the OSART mission was approved and implementation of measures has started.

On June 20-24, 2016, a follow-up IAEA OSART mission was held at Kola NPP. The mission statement noted that 80 % of recommendations and suggestions had been implemented, 20 % required long implementation

time (they were assessed as the “adequate progress”) and Kola NPP has taken necessary measures for their fulfillment.

In the period November 9-26, 2015 an IAEA OSART mission on operating safety of Unit 5 was held at Novovoronezh NPP.

Based on results of the work done, the OSART team formulated one recommendation, nine suggestions and seven good practices in their report. Like Kola NPP, the recommendation dealt with the area “Management, Organization and Administration” and related to timely implementation of the integrated management system at the NPP.

The OSART team’s suggestions dealt with:

- improvement of monitoring and sanctioning the implementation of the operator’s aids;
- motivation of the operators to produce low-level events; and
- improvement of the on-line water chemistry monitoring system.

By the present time, specialists of Novovoronezh NPP have developed a plan of measures to eliminate deficiencies recorded by the OSART team.

Both plants that hosted OSART missions in the reporting period feature the fact that two different OSART teams recorded large work done regarding self-assessments of NPP and benefits of OSART process in their final reports.

The Operating Organization has analyzed outcomes of OSART missions on a regular basis. OSART mission technical reports are disseminated to all Russian NPPs.

The OSART missions are invited on the basis of the long-term OSART missions plan (until 2023) approved by the IAEA; the mission frequency is one plant each two years. In 2015 the Government of the Russian Federation turned to the IAEA with a request to render services in conducting the IAEA OSART Corporate Mission which is to review the corporate-level functions of the Operating Organization. In December 2015 the consent from the IAEA to conduct such mission in Rosenergoatom in 4 quarter of 2018 was received.

WANO’s Peer Reviews

Over 2013-2015 WANO’s peer reviews were carried out at NPPs of Rosenergoatom:

- in 2013 three full-scope peer reviews (Smolensk, Rostov and Kursk NPPs) and three follow-up peer reviews (Novovoronezh, Bilibino and Balakovo NPPs) were carried out;

- in 2014 two full-scope peer reviews (Leningrad and Kalinin NPPs), two follow-up peer reviews (Kola and Beloyarsk NPPs), and 2 pre-start-up peer reviews (Beloyarsk and Rostov NPPs) were carried out; and
- in 2015 two full-scope peer reviews (Balakovo and Bilibino NPPs), 3 follow-up peer reviews (Rostov, Smolensk and Kursk NPPs), and 1 pre-start-up peer reviews (Novovoronezh NPP-2) were carried out.

The following deficiencies at Russian NPPs were revealed by WANO's full-scope peer reviews:

- the applicable beyond design basis accident, including severe accidents, management documentation fails to analyze all range of beyond design basis accidents;
- insufficient preparedness of mobile emergency machinery in "Stand-by" mode;
- insufficient detail in the personnel actions when doing radiation monitoring;
- lack of full compliance of the personnel actions in the higher radiation hazard zone to the procedures of conduct of radiation-hazardous works and health physics work permits;
- departures of water chemistry indicators of essential and auxiliary safety important systems from the design values; and
- repairs of unsealed equipment do not fully guarantee that foreign matter gets into it.

In the course of the WANO's pre-start-up peer reviews at Novovoronezh NPP-2 the following deficiencies were revealed: insufficient qualification of the personnel; unclear requirements and standards; lack of preparedness and engineered features (equipment, FSS); deficiencies of oversight and monitoring; insufficient initiative and responsibility of the personnel. To eliminate revealed deficiencies, the individual corrective measures are implemented in accordance with the prescribed procedure.

In the period 2013-2015, Rosenergoatom nuclear power plants received 40 WANO technical support missions.

International Insurance Inspections

International Insurance Inspections of Russian NPPs are carried out by the Russian Nuclear Insurance Pool (RNIP) jointly with nuclear insurance pool (NIPs) of other countries in frames of the International Pooling System (IPS). The inspections are aimed at evaluating insurance risk of Russian NPPs and subsequent re-insurance of civil liability for nuclear damage of Rosenergoatom in foreign NIPs.

International Insurance Inspections were carried out in accordance with the Insurance Inspection Schedule approved by the steering bodies of IPS. In August 2014 representatives of the Russian and Ukrainian Nuclear Insurance Pools held International Insurance Inspection at Balakovo NPP. This inspection was the third one at this NPP of those conducted by RNIP (the initial inspection was held in 2009, the recurrent inspection was held in 2012). As the result, the insurance risks in the field of nuclear safety and operation, civil liability for nuclear damage and property damage were updated.

On the whole, International Insurance Inspection members rated the operating conditions and materiel supply of all units of Balakovo NPP as good. The plant has achieved significant successes in implementing recommendations made in the course of preceded insurance inspections.

In September 2014 representatives of the Russian, British, Japanese NIPs and Swiss Re-insurance Pool conducted International Insurance Inspection of Leningrad NPP. This inspection was the third one of those conducted by RNIP at this NPP (the initial inspection was conducted in 2009; the recurrent inspection was conducted in 2011). Nuclear risks in the field of civil liability for nuclear damage, nuclear safety and operation insurance risks, fire protection and property damage were updated.

In October 2014 the engineering group of the Russian, British and Ukrainian NIPs carried out the recurrent International Insurance Inspection at Units 1-3 of Beloyarsk NPP. This inspection was the second one of those conducted by RNIP at this NPP (the initial inspection was carried out in October 2011). In the course of the inspection it was demonstrated that Beloyarsk NPP had implemented the substantial part of recommendations made during the initial International Insurance Inspection. The existing third party nuclear liability risk in operations of Unit 3 is commensurate with the risks of nuclear units of moderate risk for Generation II NPPs.

The International Insurance Inspection of Unit 4 at Beloyarsk NPP was also carried out. The unit was at the stage of the first criticality program of its BN-800 reactor. This inspection was carried out upon the directive of RNIP. Members of the inspection team evaluated the level of operational conditions and materiel supply of Unit 4 of Beloyarsk NPP.

In October 2015 the engineering team of the Russian, Chinese and Ukrainian NIPs carried out International Insurance Inspection of Units 1-4 at Kursk NPP by the directive of RNIP. This inspection was the third one of those conducted by RNIP at this NPP. The inspectors updated the assessment of insurance risks in the field of nuclear safety and operation, civil liability for nuclear damage, fire protection and property damage. In the course of the inspection it was demonstrated that the personnel had implemented the substantial part of recommendations made during the preceding International Insurance Inspections.

Cooperation of Rosenergoatom and Électricité de France in Safety Inspections

As part of the cooperation of Rosenergoatom and Électricité de France, their representatives participate in safety inspections at NPPs as observers.

In 2013 representatives of Rosenergoatom took part in the safety inspection at Blayais NPP and in 2015 in the safety inspection at Unit 3 of Flamanville NPP.

In 2014 representatives of Électricité de France took part in the safety inspection of units under construction at Novovoronezh NPP-2.

Based on results of Russian and international inspections (by state safety regulatory authorities, ROSATOM, IAEA, WANO, International Nuclear Insurance Pool), the conclusion were made that existing Russian NPPs conform to the requirements of the federal standards and regulations in the field of the use of atomic energy, as well as international requirements and standards.

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

Requirements for development of aging management and lifetime performance of the equipment are defined in the federal standards and regulations "Requirements for Lifetime Performance Management of Pipelines and Equipment of Nuclear Power Plants. Basic Provisions" put into force in November 2015 and the Operating Organization's standard "Management of Lifetime Performance of Components of NPP Power Units". The changes were made in the sectoral standard to bring the situation into conformance with the federal standards and regulations, as well as the "Standard Program of Lifetime Performance Management of NPP Components" has been drawn out and approved.

In 2013-2015 VNIIAES updated "Sectoral Database on Lifetime Performance Management of NPP Components".

The management of lifetime performance includes:

- restoration of the lifetime through replacement and upgrades of components; and
- creation of operating conditions that reduce the risk of damage to the equipment, pipelines, cables, etc.

One of the priority tasks of lifetime performance management is the classification of all components of units by their significance in terms the maintenance of their lifetime characteristics in the process.

Because of coming into force the new federal standards and regulations in the field of the use of atomic energy, at the present time all NPPs revise “Programs of Lifetime Performance Management of NPP Components”. Implementation of the lifetime management program allows:

- ensuring the monitoring of the lifetime characteristics in accordance with requirements of regulatory, design and engineering documentation; and
- forecasting residual lives of components and equipment.

14.4. Operational Safety Assessment at NPPs

Rosenergoatom has been carrying out, on an annual basis, the operational safety assessments of all operating NPPs in Russia in accordance with the “Provisions for Annual Reports on Assessment of Safe Operation of Nuclear Power Units” (STO 1.1.1.04.001.0143-2015) for the purpose of:

- checking actual condition of safety and other systems and components important for safety of NPP;
- analyzing the condition of physical safety barriers (including sealed enclosure of the reactor installation);
- assessing radiation levels on the site and in the environment;
- checking implementation of the system and component upgrading programs and assessing the impact of these activities on the unit safety;
- checking the level of nuclear, radiation, industrial and fire safety at the plant;
- reviewing and assessing the operational events and human errors that have occurred at the plant; and
- identifying actions to improve safety and reliability of the unit further operation.

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

Summarizing the annual safety assessment reports of the plants, VNIIAES issues summary annual reports on the operational safety of Russia’s nuclear units, which analyze and assess the safety of all NPPs of the nuclear industry. Such reports are sent to Rosenergoatom, Rostechnadzor and NPPs.

Using as input the findings of the review of operational events at the plants and the annual assessment reports on the operational safety of the plants, SEC NRS also issues annual analytical reports, which analyze the trends in the key safety indicators of plant performance and make proposals for using the operating experience feedback in regulatory activities. These reports are sent to the Rostechnadzor Headquarters.

The safety assessments of the plants performed in 2013-2015 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. During this period, an average number of operational events at NPPs have dropped: from 1.27 (in 2013) to 1.0 per unit a year (2015). Also, there is a drop of an average number of scrams per year per one reactor (from 0.3 to 0.15 scrams). The gaseous and aerosol releases to the atmosphere and radionuclide discharge with effluents do not exceed the prescribed levels. The radionuclide content in soil, vegetation, agricultural products, water reservoirs are at “zero” background level. Personnel exposure does not exceed the prescribed levels (for personnel exposure data please refer to Section 15 of this Report).

Rosenergoatom monitors NPP safety in the following main areas:

- control of fulfillment of measures based on results of audits (inspections) by the federal executive bodies, including by the Regulatory Bodies, ROSATOM, Rosenergoatom;
- assessment of the current state of safety and reliability of nuclear units operation using the system of operational safety indicators of operated NPPs;
- control of fulfillment of measures aimed at NPP safety improving and measures to prevent operational event recurrence;
- control of investigations of violation and deviations at NPPs;
- accounting and analysis of failures of and damages to equipment at NPPs; and
- accounting and analysis of low-level events.

Based on results of safety monitoring, quarterly reports are prepared. They contain results of analysis of information over all monitored areas, including the analysis of indicators of operational safety of nuclear units and their comparison with similar indicators applied by WANO for NPPs of foreign countries, identify areas for improvement and give recommendations to improve those areas.

14.5. In-Depth Safety Assessment of NPP 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 NPP with RBMK-1000, BN-600, EGP-6 reactors, as well as for 10 nuclear units with WWER reactors.

As part of drawing out in-depth safety assessment reports, the NPP safety concept (including design criteria and safety principles, safety

system architecture, design limits and conditions, robustness with regard to external factors of natural and man-made origin, emergency preparedness issues) 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 analysis of design basis and beyond design basis accidents and probabilistic safety analysis are performed. The fulfilled in-depth safety assessment, which is reviewed as part of the licensing procedure by Rostechnadzor, confirms safety of operating nuclear units.

Results of Level 1 probabilistic safety analyses (PSA-1) for units of operating NPPs with pressure-tube and fast neutron reactors are given in Appendix 10, that with WWER reactors – in Appendix 11. The estimated frequencies of a beyond design basis accident correspond to the target for operating nuclear power plants ($< 10^{-4}$ per reactor per year, as per the Publication INSAG-12).

Level 2 probabilistic safety analyses (PSA-2) have been done for operated units of NPPs with WWER reactors. Appendix 12 contains results of the said analyses.

The work on Level 2 probabilistic safety analyses for NPP units with pressure-tube and fast neutron reactors are carried out in the framework of the “Program of Measures to Implement Methods of Probabilistic Safety Analysis in Operation of NPPs of Rosenergoatom for the period until 2020”.

The Operating Organization performs periodic safety review (PSR) of nuclear units in accordance with the provisions of the Federal Law No. 170-FZ “On the Use of Atomic Energy”, federal standards and regulations in the field of the use of atomic energy “General Safety Provisions of Nuclear Power Plants” (NP-001-15), the safety guide “Guide for Periodic Safety Review of the Nuclear Plant Unit”, “Primary Schedule of Periodic Safety Review of Nuclear Installations and Storage Facilities” and “Advance Schedule of Periodic Safety Review of Nuclear Installations and Storage Facilities”.

At the present time, the work on periodic safety review has been started for Rostov-1 (completion in 2018), Balakovo-4 (completion in 2019) and Kalinin-4 (completion in 2020).

14.6. NPP Safety Inspections by Rostechnadzor

Organization of supervisory activities over nuclear and radiation safety is defined in Article 24.1 of the Federal Law No. 170-FZ “On the Use of Atomic Energy”. This article sets out the notions of the “authorized

federal executive body", "federal state supervision in the field of the use of atomic energy" and the "regime of the continuous state supervision." It also defines the grounds for audits, as well as requirements for coordination of inspection plans with the Prosecutor General's Office of the Russian Federation.

For nuclear power plants, the inspection planning procedure and constraints on timeline and number of inspections are defined by the Federal Law "On Protecting the Rights of Juridical Bodies and Individual Entrepreneurs in the Context of State Control (Supervision) and Municipal Control" and the Federal Law "On the Use of Atomic Energy".

According to the "Provisions on the Federal State Supervision in the Field of the Use of Atomic Energy", two kind of scheduled audits are provided: comprehensive inspections organized by Rostechnadzor's Headquarters and targeted inspections which are carried out by ITD for supervision of nuclear and radiation safety of Rostechnadzor. Also, 20 main subjects of inspections are assumed.

Inspections of all (majority) of the said issues are carried out during comprehensive inspections organized and conducted by Rostechnadzor's Headquarters.

In the course of the targeted inspections, one-two inspection subjects are checked, including those uncovered by a comprehensive inspection.

According to well-established practice, comprehensive inspections of nuclear power plants are carried out once in three-four year, while 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 between comprehensive inspections.

In 2013-2016 Rostechnadzor's Headquarters conducted the following inspections:

- in 2013: the scheduled comprehensive inspection of Rostov NPP (with participation of observers from the Regulatory Body of Iran), the scheduled comprehensive inspection of Kursk NPP, the scheduled comprehensive inspection of Rosenergoatom's Headquarters, the out-of-schedule inspection of the first criticality preparedness of Beloyarsk-4;
- in 2014: the scheduled comprehensive inspections of Kalinin NPP, Leningrad NPP and Smolensk NPP, the recurrent out-of-schedule inspection of Rosenergoatom's Headquarters regarding elimination of revealed violations, the out-of-schedule inspection of the first criticality preparedness of Rostov-3;
- in 2015: scheduled comprehensive inspections of Kola NPP and Bilibino NPP;
- in 2016: out-of-schedule inspection of the first criticality preparedness of Unit 1 at Novovoronezh NPP-2; and

– comprehensive inspections at Rosenergoatom's Headquarters, at Balakovo NPP and Beloyarsk NPP are planned.

Since 01.07.2015 the information on inspection findings are 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 places the publicly accessible information from the Unified Register of Inspections.

The Ordinance of the Government of the Russian Federation of 23 April 2012 endorsed the "Provisions for Continuous State Supervision Regime at Nuclear Facilities". A list of nuclear facilities subject to continuous state supervision regime is defined by the Directive of the Government of the Russian Federation (the said list includes all nuclear units).

The continuous state supervision regime assumes continuous presence of authorized officers from Rostechnadzor at nuclear facilities and conduct of safety monitoring there by them. Lists of authorized officers at each facility subject to the continuous state supervision regime assumes are approved by heads of corresponding interregional territorial departments for supervision over nuclear and radiation safety of Rostechnadzor. In accordance with the Ordinance of the Government of the Russian Federation, heads of organizations (branches) which operate higher hazard facilities should, upon delivery of service certificates by authorized officers, give them unhindered access to facilities of higher hazard, including documents and safety controls.

Information about conducted operative inspections and separate measures in frames of the continuous state supervision regime are entered by authorized officers in the continuous state supervision logbook. In case the violations of mandatory requirements are revealed, the authorized offers take measures to stop them as per Russian law.

The operational safety reviews of nuclear power 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 the 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 NPP personnel, the public and the environment in the Russian Federation:

- Federal Law No. 170-FZ “On the Use of Atomic Energy”;
- Federal Law No. 3-FZ “On the Radiation Safety of the Public”;
- Federal Law No. 7-FZ “On the Environmental Protection”;
- Federal Law No. 52-FZ “On Sanitary and Epidemiologic Well-Being of the Public”;
- “Radiation Safety Standards” (NRB-99/2009);
- “Basic Sanitary Rules for Ensuring Radiation Safety” (OSPORB-99/2010);
- “General Safety Provisions of Nuclear Power Plants” (NP-001-15);
- “Sanitary Rules for Design and Operation of Nuclear Plants” (SP AS-03);
- “Rules of Radiation Safety in Operation of Nuclear Power Plants” (PRB AS-99);
- other regulatory documents in the field of radiation safety.

The said documents establish the major principles of ensuring the radiological safety as follows:

- 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; and
- 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 Federal Law “On the Radiation Safety of the Public” establishes the following major hygienic guidelines (permissible dose limits) for human exposure in the territory of the Russian Federation resulting from uses of ionizing radiation sources:

- the average annual effective dose for the public is equal to 0.001 Sv, and the lifetime effective dose (70 years) is equal to 0.07 Sv; the effective dose may be greater in certain years (0.005 Sv) provided that

the average annual effective dose, as calculated for five consecutive years, does not exceed 0.001 Sv; and

– the average annual effective dose for personnel is equal to 0.02 Sv, and the effective dose over the service period (50 years) is equal to 1 Sv; the annual effective dose may reach 0.05 Sv provided that the average annual effective dose, as calculated for five consecutive years, does not exceed 0.02 Sv.

The regulated values of the major exposure dose limits 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.

As specified in 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.

Main safety principles and criteria of NPPs as the source of radiation impact on the personnel, population and environment are formulated in the “General Safety Provisions of Nuclear Power Plants” (NP-001-15).

The “Radiation Safety Standards” and “Basic Sanitary Rules for Ensuring Radiation Safety” formulate 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. 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.

The “Basic Sanitary Rules for Ensuring Radiation Safety” establish requirements for protection of humans against harmful radiation impact.

Given the technologically achieved safety level of NPPs during normal operation (when the actual nuclear plant release and discharge lead to the public exposure dose of not less than 10 μSv/year for each impact factor), the radiation risk for the public during the NPP operation is surely acceptable ($< 10^{-6}$ per year).

The “Sanitary Rules for Design and Operation of Nuclear Plants” regulate meeting the sanitary and hygienic requirements of radiation safety of the personnel and population, environmental protection not only in operation of NPPs but also in design of nuclear power plants.

The “Rules of Radiation Safety in Operation of Nuclear Power Plants” regulate, first of all, organizational, sanitary and hygienic radiation safety requirements for the personnel in operation of NPPs.

15.2. Radiation Impact on Nuclear Power Plant Personnel

Based on the principles of ensuring radiation safety adopted by international community, Rosenergoatom coherently pursues a policy of introducing and implementing at nuclear plants the radiation safety optimization methodology which consists in 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 reduced personnel exposure. Over the period 1995-2015, the exposure of the personnel decreased by more than three times. The number of personnel with the exposure doses of above the reference level of 18 mSv a year (20 mSv/year before 2010, inclusive) has been minimized.

To improve radiation protection of the personnel at NPPs in the conditions of an increase in radiation-hazardous works, optimization of individual exposure doses of the personnel and the number of exposed persons at NPPs, in 2010-2014 Rosenergoatom implemented the Radiation Protection Optimization Program for the Personnel of Rosenergoatom's NPPs.

At the present time, the current dose burden on the personnel of NPPs with WWER and BN reactors has practically achieved the optimal level comparable to similar indicators of foreign NPPs. Because of design features, NPPs with RBMK reactors still have a high level of the personnel dose burden, which exceeds the personnel dose burden at NPP units with other types of reactor installations.

At the same time, further reduction of dose burden at NPPs with RBMK reactors, as well as maintaining the personnel exposure doses at NPPs with WWERs and BNs at the achieved level is limited, because of both the achieved level and an increase in volume of radiation-hazardous works necessary because of safety improvements measures, operational efficiency of existing nuclear units and decommissioning of individual units.

To further optimize the NPP personnel radiation protection, in 2015 the "Radiation Protection Optimization Program for the NPP Personnel", which is to be implemented in 2015-2019, has been put into force. It provides for implementation of a set of measures to improve organization of execution of radiation-hazardous works, improvement of the radiation situation at equipment and in rooms of NPPs, reduction of time of the personnel stay in ionizing radiation fields, and improvement of instrumental and methodological monitoring.

Fig. 15.1 shows annual collective exposure doses averaged over sequential three-year periods.

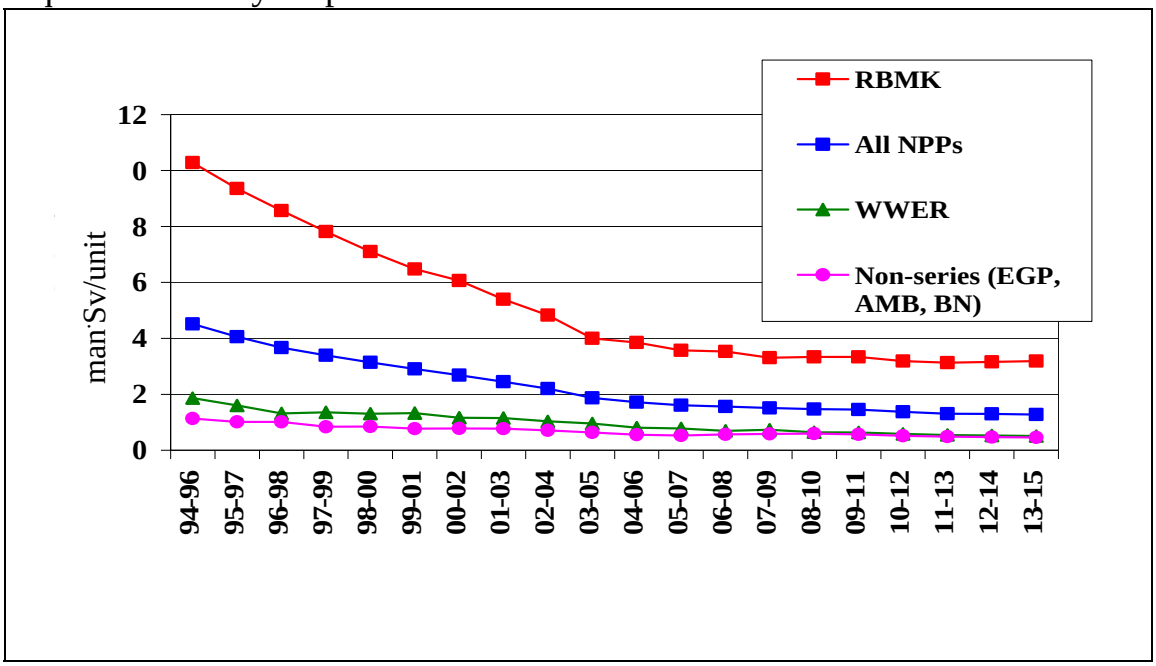

Fig. 15.1. Annual collective exposure doses at Russian NPPs for NPPs with different reactor designs (man.Sv/unit)

Values of collective exposure doses of the personnel in 2015 are comparable with similar indicators of the preceding year and are determined, mainly, by volumes of scheduled repairs done at nuclear power plants in 2015 (see Fig. 15.2).

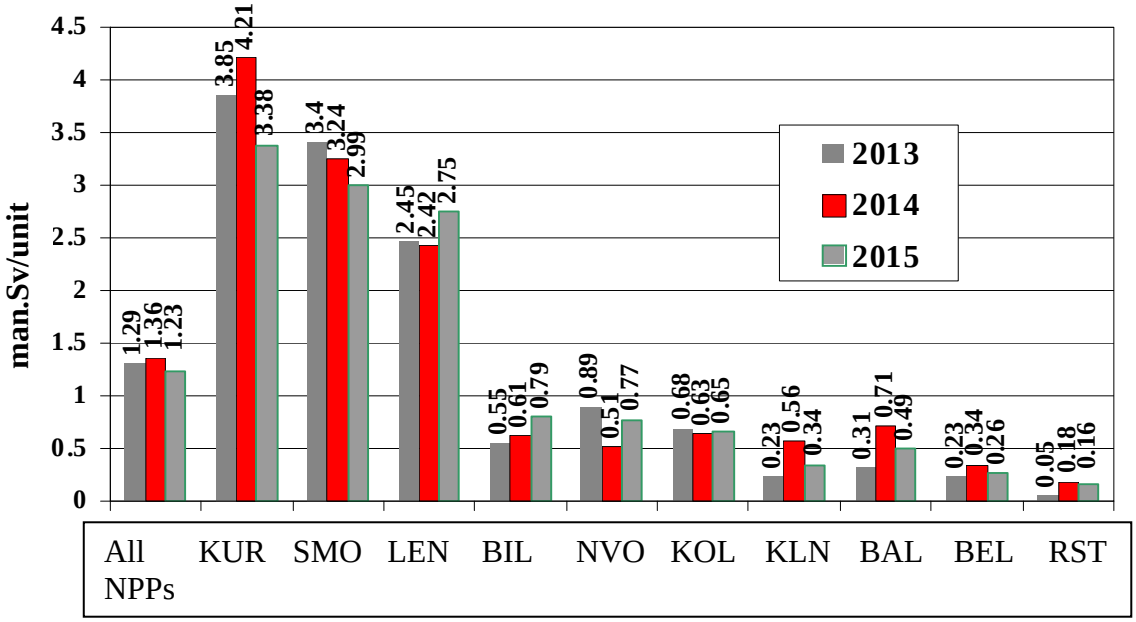

Fig. 15.2. Collective exposure doses at Russian NPPs in 2013-2015 (man.Sv/unit)

Basic dose limits of 50 mSv per year and 100 mSv over any subsequent five years have not been exceeded at none of the NPPs over the reporting period (2013-2015). The numbers of the personnel whose individual exposure doses do not exceed 1 mSv (basic dose limit for the population) were more than 80 % on the employees subject to by health physics monitoring.

In the period 2013-2015, like in preceding years, Russian NPPs have not suffered incidents accompanied by radiation consequences. There have not been cases of unauthorized inflow of radionuclides into the environment.

15.3. Radiation Monitoring of the Environment

All Russian NPPs are equipped with systems for cleaning up exhaust air of radionuclides in gaseous and aerosol forms.

As specified in para. 6.6.2 of SP AS-03, the environment monitoring includes:

- monitoring of the gamma radiation dose rate and the annual dose on the terrain;
- monitoring of the atmospheric air, soil, vegetation and surface water contamination; and
- monitoring of local food and fodder contamination.

Samples of the environment are taken in the NPP CA and SZ. Fixed control posts are predominantly based in settlements or at locations accessible for motor vehicles and for maintenance throughout the year. Control posts are deployed relative to the NPP with regard to the wind directions prevailing in this locality.

An integral part of environmental radiation monitoring (ERM) is measurement of the gamma background in the NPP deployment locality. The locality gamma background should be measured within the NPP’s CA and SZ.

ERM is carried out in an automated mode by the ARMS with data transmission to the Unified State ARMS (USARMS). The requirements for the transmission of the ARMS data are defined by the USARMS regulatory and legal documentation.

With the achieved level of the NPP safety, the actual gas/aerosol releases and discharges during normal operation of the NPP units were much below the permissible release and discharge amounts both in the reporting period and in the previous years. Such entry of radionuclides into the environment makes the radiation risks for the public, in the event of routine radionuclide release to beyond the NPP during normal operation,

acceptable and lead to an exposure dose of less than 10 μSv/year (a risk of less than 10^{-6} 1/year).

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

The supervision over the radiation protection of NPP personnel, the public and the environment in the NPP site vicinity is carried out by the State Sanitary and Epidemiologic Supervision Department of the Federal Medical and Biological Agency (FMBA) under the Ministry of Health of the Russian Federation, and by its regional bodies.

The full list of legal regulatory acts in the field of radiation safety of the plant personnel, population and environment, including institutional, is accessible on the FMBA official website (www.fmbaros.ru). The staff number of employees of Russian FMBA territorial bodies who are involved in oversight of radiation safety at nuclear power plants is about 50 people.

According to the requirements of legal regulatory documents, frequency of scheduled inspections at NPPs carried out by FMBA is once in two years.

In the period 2012-2015, territorial bodies of FMBA of Russia have carried out scheduled inspections at all operating NPPs.

The number of out-of-schedule inspections at NPPs carried out by territorial bodies of FMBA of Russia over the reporting period is 4-5 inspections a year. The out-of-schedule inspections have been carried out to:

- control implementation of previous notices;
- respond to written requests of citizens, MPs, and non-government organizations;
- respond to notices of suspicions of occupational diseases and investigation of injuries; and
- fulfill requirements of the prosecutors, directives of a superior body.

Rostechnadzor issues permits for releases and discharges of radioactive substances into the environment and establishes guidelines of maximum permissible releases in the atmospheric air and guidelines of permissible discharges of radioactive substances in water reservoirs. Systematically, Rostechnadzor and bodies of the state sanitary and epidemiological oversight carry out comprehensive and targeted inspections to assess safety at specific NPPs. They issue relevant notices and recommendations based on the inspection results.

At NPP, there is a continuous monitoring of the state of radiation protection of the personnel, population and inflow of radioactive substances into the environment. The monitoring results are submitted to

the Regulatory Bodies and Operating Organization as monthly, quarterly and annual reports.

In the framework of the Agreement signed in 2010 between Rostechnadzor and the Federal Medical and Biological Agency on Interaction in the Field of the State Regulation of Radiation Safety in the Field of the Use of Atomic Energy, Rostechnadzor and bodies of the state sanitary and epidemiological oversight carry out comprehensive and targeted inspections to assess safety at specific NPPs. Based on the inspection results, they issue relevant notices and recommendations.

Radiation protection of the NPP personnel, the pubic and the environment during normal operation of nuclear power plants is ensured in the Russian Federation. The personnel exposure doses are at a low level and 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 absolutely 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 current Russian legal regulatory documents that deal with the issues of emergency preparedness on and outside the NPP sites include:

- 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”;
- “Regulation on the Declaring of Emergency, on Early Notification and on Organization of Urgent Assistance to Nuclear Plants in the Event of Radiation Hazards” (NP-005-16);
- “Model Content of an Action Plan for the Personnel Protection in Case of a Nuclear Plant Accident” (NP-015-12);
- “Radiation Safety Standards”;
- “Basic Sanitary Rules for Ensuring Radiation Safety” and others.

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 damage from these.

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.

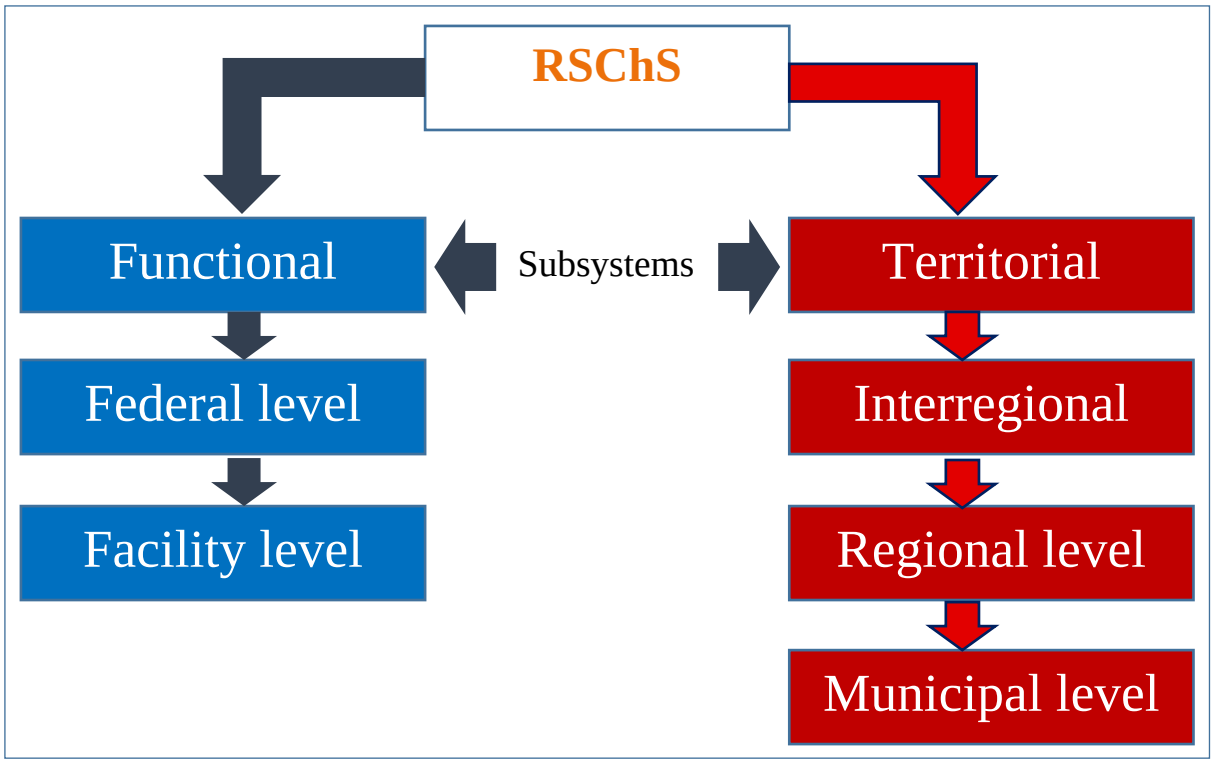

Fig. 16.1. Structure of the National System for Prevention and Management of Emergencies

In keeping with the Federal Law “On the Protection of the Public and Territories against Natural and Man-Induced Emergencies”, by its Ordinance the Government of the Russian Federation approved the classification of natural and man-induced emergencies. The classification of emergencies serves the basis for the formation and timely preparation of the forces and capabilities to eliminate emergencies and their consequences. The classification of natural and man-made emergencies is given in Table 16.1 of the sixth National Report.

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, 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 RSChS structure is described in Section 16 of the sixth National Report.

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. 16.2).

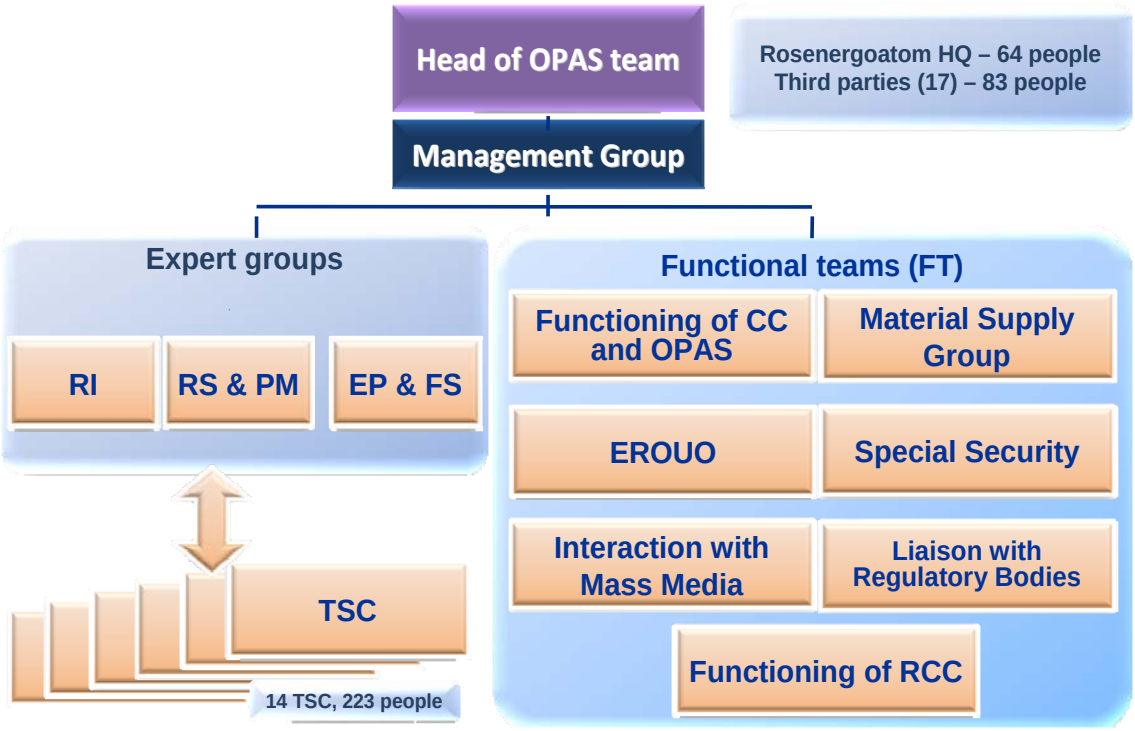

Fig. 16.2. Team for Emergency Assistance to Nuclear Power Plants

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. The arrangement of the communication between the

organizations involved in the emergency response system is given in Section 16 of the sixth National Report. Actions of SCC, CC, IAC and TSC are well coordinated, the centers operate round-the-clock.

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" (NP-005-16). This regulation establishes the criteria for declaring the "Alert" and "Emergency" states at NPPs.

Improvement of emergency preparedness and response measures, including the measures at multi-unit sites, approaches and methods of source term evaluation

Rosenergoatom has drawn out short-, mid- and long-term measures based on outcomes of protection analysis of Russian NPP from extreme external impacts and analysis of preparedness of nuclear power plants to manage beyond design basis accidents, including severe accidents. Short- and mid-term measures have been fulfilled in the full scope and are given in Appendix 5 of this Report. Long-term measures are fulfilled in due time. All NPPs and the Crisis Center of Rosenergoatom complete implementation of the following measures to improve emergency preparedness:

- creation and upgrading of mobile control posts (mobile communication posts) of the emergency operations commanders and the head of the Team for Emergency Assistance to Nuclear Plants (OPAS);
- setting up back-up digital communication channels between NPPs and Sheltered Emergency Response Command Post (SERCP), as well as the Crisis Center of Rosenergoatom; and
- the project to ensure guaranteed and uninterruptible power supply of NPP communication posts, communication posts of Sheltered Emergency Response Command Post at NPPs, in the city and evacuation region has been implemented.

As part of emergency preparedness ensuring, methodologies of determining accident release parameters, which are input data for assessing accident radiation consequences, have been developed and put into force. When determining radiation consequences of an accident, the provisions of

the design and operating documentation, databases on possible radiation accidents, calculations using specialized software, outcomes of monitoring of process and radiation parameters, as well as expert judgments, have been taken into account.

The federal standards and regulations in the field of the use of atomic energy "General Safety Provisions of Nuclear Power Plants" (NP-001-15) has been introduced by the requirement to envisage, in the action plans for the personnel and population protection, measures for the in case of simultaneous initiation of beyond design basis accidents at several nuclear power units and other nuclear facilities located on one NPP site, which are accompanied breaches of the off-site infrastructure (for example, blockage of access roads, breaches of NPP power supply, breaches of communications).

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 suggested by Rostechnadzor; and
- a program of implementation of additional design solutions to reduce consequences of beyond design basis accidents at NPPs, including installation of additional mobile emergency equipment (diesel generators, mobile pumping units, monoblock pumps etc.).

The robustness analysis of NPPs has shown the presence of organizational and technical peculiarities of the measures to improve robustness of nuclear units depending on a specific NPP design. So at Rostov-4 and Beloyarsk-4 under construction the measures adopted for similar operating nuclear units were duplicated nearly in full scope. At Novovoronezh NPP-2 (AES-2006 design) and Kursk NPP-2 (WWER-TOI design) the project provides for additional engineered features of heat removal for 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 implementation of additional emergency measures at NPP under design and construction allows improving robustness of nuclear power 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 Non-Alien Population and Competent Authorities of Neighboring States on Emergency Preparedness

Procedure for informing the population on emergency planning and emergency situations

At the federal level, informing is carried out in accordance with the interagency procedure "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 the facility level (in organizations and in their branches), 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 issued the Ordinance No. 949 of 23 November 2009 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 resolution 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, has been 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 Austria, Denmark, Finland, Germany, Norway, Poland, Romania, Sweden, Turkey, and the United Kingdom. In the reporting period, such agreements have been signed with the Republic of Belarus, Ukraine, and the Republic of Armenia.

Also, bilateral and multilateral international treaties (agreements) in the field of the use of atomic energy have been concluded. They contain provisions (standalone articles), which foresee fulfillment of the obligations of the Russian Federation and foreign states related to the implementation of the Convention on Early Notification of a Nuclear Accident, including:

- with the states of the Commonwealth of Independent States (CIS) “On the Main Principles of Cooperation in the Field of the Use of Atomic Energy” (Article 10); and
- with Japan “Agreement between the Government of Japan and the Government of the Russian Federation on Cooperation in the Field of the Use of Atomic Energy for Peaceful Purposes” (Article 6).

The bilateral arrangements on early notification provide for practical measures to fulfill provisions of the said agreements, procedures for early notification of a nuclear accident, exchange of information about nuclear installations, regular consultations on various aspects of nuclear and radiation safety at civilian nuclear facilities, as well as joint emergency drills and exercises. An example of such arrangements is the international interagency agreement “Protocol between the State Atomic Energy Corporation “Rosatom” and the Norwegian Radiation Protection Authority on Implementation of Practical Measures to Fulfill Obligations under the Agreement between the Government of the Kingdom of Norway and the Government of the Russian Federation on Early Notification of a Nuclear Accident and Exchange of Information about Nuclear Installations of 10 January 1993”, that was signed on 16 September 2015.

In the framework of implementation of arrangements for provision to other states the information which is necessary for development of their own emergency preparedness to respond to an emergency situation, the nuclear power plants:

- invite foreign specialists, including from the IAEA, as observers to emergency exercises of OPAS team, ministries and agencies of the Russian Federation;
- invite foreign specialists on exchange of experience in emergency planning and emergency response to international seminars, international scientific and technical conferences, and international nuclear forum on emergency response;
- ensure round-the-clock expert, consultancy, engineering and technical support in emergencies and accidents at NPPs with WWER reactor installations, which are parts of WANO MC, by the Regional Crisis Center (RCC). RCC was established in 2013 after the accident at Fukushima Daiichi NPP by the resolution of WANO MC's Board of Governors at the Crisis Center of Rosenergoatom; and
- conduct joint emergency drills of RCC with foreign nuclear power plants, which are parts of WANO MC, to train interaction and information exchange in emergencies at NPPs.

The main tasks of RCC NPP with WWER reactors of WANO MC (see Fig. 16.3) are:

- expert (consultancy), engineering and technical support in case of an accident on the industrial site of the NPP or overall accident at a NPP with WWER reactor installation;
- dissemination among its members of the information about NPP safety important events; and
- building up the common information and expert space.

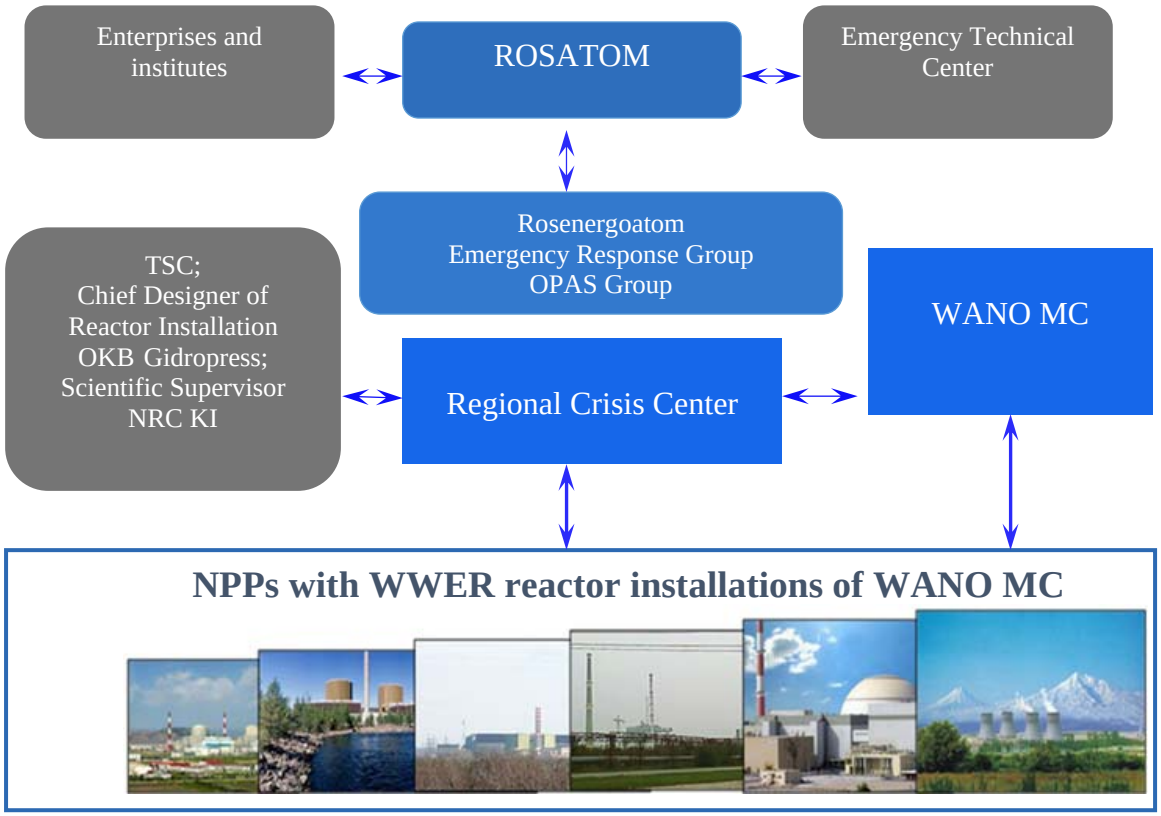

Fig. 16.3. Functioning of RCC NPP WANO MC

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 (for example, a series of the IAEA information exercises CONVEX).

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. These plans are developed on the basis of risk assessments of emergencies for the corresponding territory, including radiation risks, and drawn out possible work solutions.

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.

The National System for Prevention and Elimination of Emergencies functions in accordance with the international obligations of the Russian Federation.

16.4. Training and On-Site Emergency Drills

Emergency training of the nuclear plant personnel includes training courses at TSC, emergency drills, command posts, and field training.

Training of the Operating Organization staff, nuclear plant personnel and the staff of organizations which provide support in the field of CD, and in prevention and management of emergencies is based on the requirements of the Russian Federation Government Ordinance No. 547, dated 4

September 2003, “On Training the Public in the Protection Against Natural and Man-Induced Emergencies”.

The procedures for training the Operating Organization staff, the nuclear plant personnel and their family members, and the staff of supporting organizations for actions in emergencies are specified in “Guidelines on Preparing and Implementing Measures for Civil Defense, Prevention and Elimination of Emergencies at Nuclear Plants”. The training is based on dedicated programs at educational establishments for extra vocational training, civil defense and emergency training centers of the Russian Federal Subjects, and municipal civil defense courses.

To ensure the continuous and efficient preparedness of SChSK as a whole and the expert teams of TSC in particular, the CC regularly conducts emergency drills and exercises. For the expert support of the OKChS decision-making and to enable the coordination of actions at the federal level, expert teams are set up composed of experts of ROSATOM and subordinate organizations, who, where required, work at ROSATOM’s SCC or immediately at the centers of their respective organizations. The expert teams may involve professional staff of other federal executive bodies and organizations (EMERCOM of Russia, Russian Ministry of Defense of the Russian Federation, Ministry of Interior of the Russian Federation, Rosgidromet and others).

In terms of the tasks being solved and of the participants, emergency drills and exercises are divided into:

- comprehensive emergency exercises (CEE) conducted at one NPP based on a realistic accident scenario with the involvement of forces and capabilities necessary to eliminate the accident consequences; and
- regular emergency drills at NPPs with the participation of the OPAS team, TSC and the Novovoronezh ETC.

CEEs are conducted once a year (or once in ten years for each NPP) to check the preparedness of all constituents of the emergency planning and emergency response system to nonstandard situation at a given NPP, and to improve the organization of interaction with the forces and capabilities, which are not part of Rosenergoatom’s emergency response system. CEE held by one NPP involve more than 1,500 people and about 130-150 special machinery items.

In 2014, the comprehensive emergency exercises were held at Kola NPP, and in 2015 at Leningrad NPP (see Figs. 16.4-16.7).

Fig. 16.4. Comprehensive emergency exercises at Leningrad NPP (2015). Training in connection of the mobile pumping unit

Fig. 16.5. Comprehensive emergency exercises at Leningrad NPP (2015). Training in connection of mobile diesel generator

Fig. 16.6. Comprehensive emergency exercises at Leningrad NPP (2015). Training in decontamination of vehicles during evacuation of the personnel

Fig. 16.7. Comprehensive emergency exercises at Kola NPP (2014). Training in connection of the pump to supply cooling water to Units 1-4 of Kola NPP

Emergency drills are conducted four or five times a year at different NPPs (approximately once in two years for a separate NPP) involving representatives of the OPAS team, CC, and NPP and TSC expert teams. The objectives of such drills are to:

- check the preparedness of the OPAS, CC, TSC and NPP experts and functional teams for emergency response;
- training of the OPAS, TSC and NPP expert and functional teams in particular aspects of emergency response;
- check on preparedness of the CC, all its hardware & software facilities, notification systems and communication systems to operate in the common information environment in real time jointly with those involved in emergency response; and
- training in operational interaction and information exchange between the NPP, CC and TSC using different information transmission devices.

A working group of the plant specialists, Rosenergoatom and VNIIAES experts is set up to prepare and conduct EPDs.

According to the IAEA recommendations for conduct of emergency drills, the controlling persons (observers) 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.

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.

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 power plants.

In EPDs, a hypothetical accident is modeled on the full-scope simulator (FSS). At the present time, the data transfer project from FSS of NPP units to CC, TSC and Information and Analytical Center of Rostechnadzor has been implemented. An important task is to expand modes simulated by FSS to the beyond design basis accidents. In 2015 FSS were used to test beyond design basis accident management procedures at Rostov, Balakovo, and Novovoronezh NPPs.

16.5. Emergency Technical Centers

In pursuance of the Russian Federation Government Ordinance "On the Establishment of Emergency Technical Centers for the Elimination of Emergencies at Nuclear Facilities in the Russian Federation", several Emergency Technical Centers (ETC) have been set up in Russia, including in St. Petersburg, Moscow, Novovoronezh (Voronezh Region), and Seversk (Tomsk Region). ETCs in Moscow, Novovoronezh and Seversk have been integrated with the St. Petersburg ETC as branches. The Novovoronezh ETC is the nuclear industry's emergency technical center for assisting NPPs in emergencies.

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.

In pursuance of the Federal Law "On Amending the Federal Law "On Protection of the Population and Territories Against Natural and Man-Induced Emergencies" and Ordinance of the Government of the Russian Federation "On the Uniform State System of Prevention and Elimination of Emergencies", in 2015 Rostechnadzor endorsed the new "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 RSChS subsystem is exercised by the Chairperson of Rostechnadzor. The direct management of the RSChS subsystem is exercised by the Deputy Chairperson who coordinates

activities of the structural divisions of Rostechnadzor, which regulate safety in the field of the use of atomic energy.

The RSChS subsystem includes the coordinating body, standing management bodies, daily management bodies, force and capabilities.

The coordinating body of the RSChS 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 RSChS subsystem are:

- at the federal level: structural divisions of Rostechnadzor authorized to control and supervise 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 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 pertaining to the Special Security Department of Rostechnadzor;
- 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 Chairperson of Rostechnadzor may decide to establish one of the following functional modes:

- alert, in case of an emergency threat; 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 managing bodies and force of the RSChS subsystem, organization of training and support to their activities; and
- organization of training of Rostechnadzor’s employees in the ways of protection 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; and
- drawing out measures to ensure safety of Rostechnadzor's employees (who are directly present at nuclear- and radiation-hazardous facilities) and their sustainable activities;

c) in the emergency mode:

- notification of the Chairperson 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 and forces of the RSChS subsystem at all levels with bodies of EMERCOM of Russia and other concerned bodies and organizations; and
- control of implementation of measures to ensure safety of Rostechnadzor's employees in the emergency region.

Besides, Rostechnadzor reviews the emergency preparedness issues when it licenses and inspects the activities.

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 unit should include procedures for elimination of design basis accidents, a beyond design basis accident management guide, and a personnel protection plan in case of an accident at nuclear power 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. The said documents are reviewed when the license application is received, and scientific and technical support organization are involved for conducting the review.

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 state of 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 organization of the personnel training in developing and maintaining their skills in controlling the NPP unit during accidents;
- the availability of the emergency notification system, including the technical condition of communication channels;
- the condition of sheltered stations for control of the accident management operations, their equipment, and the availability of appropriate documentation;
- the arrangements for the plant personnel protection in the event of a radiation accident as regards the availability of the respective emergency technical services and capabilities; and
- the plans and programs for emergency drills and exercises at the NPP, including interactions with the local and federal authorities to ensure preparedness for the public protection.

Where required, inspections also cover other, plant-specific aspects of emergency preparedness.

The Rostechnadzor's procedure in case of NPP operational events is described 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" (NP-004-08), which sets forth categories of accountable NPP operational events, which reports are sent, among other, to Rostechnadzor, procedure for notification and further informing on an accident, and event investigation procedure.

According to the said regulatory document, commissions are formed by Rostechnadzor in case of events that have signs and consequences of a radiation accident, which are to investigate into the operational events, unless the Russian Federation President or the Government of the Russian Federation take a decision to form a Governmental commission.

In case the "Alert" or "Emergency" declared at an NPP, a Rostechnadzor representative should be part of the Team for Emergency Assistance to Nuclear Plants (OPAS). The main responsibilities of the Regulatory Body's representative in the OPAS Team should be to:

- make sure that complete and timely measures are taken to bring the affected unit into a safe condition, including recovery of the critical safety functions, to remedy the accident aftermath, and to put into operation and implement the personnel protection plan within the appropriate time;

- check the correctness and timeliness of the published or transmitted information about the nature and consequences of the accident; and
- periodically report to Rostechnadzor officials on the current status of the nuclear and radiation safety at the NPP where the emergency has taken place and on the emergency management measures taken.

Acting as an independent body, Rostechnadzor informs, where required, the federal and local authorities on what has happened at the NPP, and on the measures that have been or are being taken, and organizes interaction with mass media.

Rostechnadzor has its own Information and Analytical Center (IAC), which includes the following working groups:

- the management group,
- the group for assessment and projection of the technological state of nuclear facility (OPTS);
- the group for assessment and projection of radiation situation at nuclear facility (OPRO);
- the engineered features support group; and
- the group for liaison with mass media and the public.

The Order of the Chairperson 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. 16.8).

Fig. 16.8. Emergency drill in Rostechnadzor's IAC

Specialists of foreign regulatory bodies are engaged in carrying out scheduled drills on a regular basis. For instance, in November 2013 there was an exercise at Novovoronezh NPP testing actions with emergency mobile machinery. Experts who visit Rostechnadzor among the follow-up IRRS mission of the IAEA participated in the exercise. In 2014, specialists from the regulatory bodies of France (ASN) and the RSA (NNR) took part in two drills at Kola NPP. In September 2015, specialists from STUK (Finland) and Iranian Nuclear Regulatory Authority took part in the drill at Leningrad NPP as observers.

The Rostechnadzor's IAC activities, including the methodology of assessment of emergency exercises and drill efficiency, were highly appraised by the IAEA experts in the framework of the follow-up IRRS mission held in November 2013. As a good practice example, the development and application in emergency exercises of the fast-acting computer codes for express assessment of accident development was singled out. The development allows projecting possible ways of emergency development in real time mode.

The exercises conducted by Rostechnadzor result in assessments of their efficiency and recommendations for improvement of emergency preparedness of the Operating Organization.

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 are operated 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 and its acceptance as suitable for construction and safe operation of the nuclear plant are regulated by federal laws, federal nuclear 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. The natural and man-induced conditions in the NPP siting region are investigated in keeping with the following standards and regulations in the field of the use of atomic energy:

- "General Safety Provisions of Nuclear Power Plants" (NP-001-15);
- "Siting of Nuclear Power Plants. Basic Safety Criteria and Requirements" (NP-032-01); and
- "Accounting of Natural and Man-Induced External Impacts on Nuclear Facilities" (NP-064-05).

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:

- natural and man-induced impacts on the NPP safety (including it should be demonstrated that the NPP site is lacking of the factors, which prohibit NPP siting, as well as there should be a possibility of taking engineered and organizational measures to ensure nuclear and radiation safety of NPP in zones and regions unfavorable for NPP siting);
- NPP radiation impact on the public and the environment;
- features of the NPP site and siting region, which may contribute to migration and accumulation of radioactive substances (topography, hydrogeology, stratification of air mass, rivers, other water bodies, etc.); and
- the sizes of the controlled area around the site, surveillance zone, emergency action planning zone and mandatory evacuation planning zones established in accordance with the requirements of the Federal Law "On the Use of Atomic Energy", as well as federal standards and regulations in the field of the use of atomic energy.

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

The said predictions for the NPPs under design are fulfilled in the course of engineering surveys (when implementing the procedure "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 Kursk NPP-2, as well as necessary justifications have been developed to allow recognizing this site suitable for siting of a NPP.

At the present time, the revision nears completion of the federal standards and regulations in the field of the use of atomic energy which regulate issues of NPP site selection, issues of taking into account external impacts of natural and man-induced nature. When revising, it is planned to take account of the accumulated experience, provisions of newly introduced and planned for introduction the IAEA safety standards, as well as learn from the accident at Fukushima-Daiichi plant.

Reassessment of external factors during the 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 mandatory carried out given the external factors. In accordance to provisions of the Federal Law No. 170-FZ “On the Use of Atomic Energy” and federal standards and regulations in the field of the use of atomic energy “General Safety Provisions of Nuclear Power Plants” (NP-001-15), the assessment of changes in conditions in the vicinity of the nuclear power unit site and the current state of the NPP sate is carried out within the periodic safety review (PSR), which is done each 10 years of the nuclear unit operation. The reassessment of external factors of processes and phenomena may also be carried out following results of targeted or peer reviews.

In reassessment of parameters of potential external impacts the results of monitoring of processes and phenomena 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 2012-2015, as part of implementation of the “Updated Measures to Reduce Consequences of Beyond Design Basis Accidents” a reassessment of seismic conditions of siting of Russian operating NPPs was carried out, which included:

- additional studies and analysis of materials of seismic microzoning of NPPs;
- calculation of actual seismic safety factors (assessment of a level of conservatism) of the units; and
- synthesis of accelerograms and response spectra for operating NPPs.

Based on received data, the assessment of the seismic safety level was confirmed for sites of operating units of Balakovo, Beloyarsk, Bilibino, Kalinin, Kola, Leningrad, Rostov and Smolensk NPPs. The obtained calculation estimations of seismicity of Kursk and Novovoronezh NPP sites were slightly increased as compared to the design estimations.

As part of the safety and robustness enhancement measures of NPPs with regard to external natural and man-induced the following is nearing completion:

- refining of the calculation analysis of seismic impacts on reactor installations, spent fuel pools, on-site SNF storage facilities, safety important equipment, buildings and structures; refining of seismic categories of components; and
- for each NPP the development of the plan of additional measures to improve robustness of components and systems towards seismic impacts.

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) when producing the design documents is carried out for all types of planned economic and other activity, which may directly or indirectly affect the environment (the Federal Law No. 7-FZ “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 NPP siting (the Order of the State Environmental Protection Committee of the Russian Federation of 16 May 2000). In case of a possibility of transboundary impact of the planned NPP, in accordance with the requirements of the United Nations Economic Commission for Europe’s (UNECE’s) Convention on Environmental Impact Assessment in a Transboundary Context of 25 February 1991 (Espoo, Finland), the consultations with other Contracting Parties are held.

When the siting and construction of the two-reactor Baltic NPP in Kaliningrad Region, which is bordering with Poland in the south and Lithuania in the east and the north was planned, the Environmental Impact Assessment of the NPP (EIA) (hereinafter referred to as “the EIA Materials”) was done and became part of the license application documents prepared by the Operating Organization. ROSATOM applied to the IAEA to conduct an international peer review of the Environmental Impact

Assessment of Baltic NPP for compliance with the IAEA's safety standards of radiation protection of the population and the environment. Having in mind that the Kaliningrad exclave is bordering with Poland and Lithuania, ROSATOM also asked to analyze the EIA Materials in terms of the Convention on Environmental Impact Assessment in a Transboundary Context (the Espoo Convention). Other purposes of the review included the facilitation of exchange of the best practices revealed during the peer review, provision of the information feedback for production of international guidelines and recommendations, and provision of recommendations on further development of radiological section of the environmental impact assessments.

In 2014-2015, the international peer review group carried out a number of meetings and negotiations with Russian experts, visited the site of Baltic NPP, reviewed the EIA Materials and other information that was provided voluntarily, and came to the conclusion that the EIA Materials of Baltic NPP, as added with answers to the questions of the review group, complied with requirements of the reference documents (the IAEA safety standards, the Espoo Convention). The international peer review group admitted that the Operating Organization (Rosenergoatom) provided the full set of the EIA Materials for Baltic NPP. Besides the evaluation of exposure doses in normal operation and due to accident releases, the analysis included a discussion of aspects of the environmental monitoring and transboundary impacts, as well as the transportation of radioactive materials and decommissioning of the facility, to the extent that deals with the radiation protection of the population. According to the request, the international peer review group defined and presented for review of the Operating Organization the areas of the EIA Materials where they can be further develop. In particular:

- Some important information on potential impact of Baltic NPP on the environment was presented as answers to the questions of the experts. The EIA Materials can be further developed through adding this information.

- The transboundary aspects of the EIA Materials can be further developed through:

  - the direct reference to the Espoo Convention;
  - inclusion of additional details about occurred and planned communications with neighboring countries;
  - a more detail discussion of the issue of transportation of radioactive waste (i.e. transportation techniques and routes).

- Aspects of decommissioning described in the EIA Materials can be further developed through a reference to a recent publication of the IAEA safety standards (General Safety Requirements, GSR Part 6 "Decommissioning of Installations", IAEA, Vienna, 2014).

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, as well as the 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. Besides, according to requirements of the regulations, probabilistic safety analyses of NPPs under external impacts should be carried out and their results should be taken into account in ensuring NPP robustness and safety 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" (NP-064-05) establish the following list of natural and man-induced factors, which should be studied in the NPP vicinity and which should be used for decision-making regarding their inclusion in the design bases of the nuclear power plant:

Hydrological and meteorological processes and phenomena:

- flood (flooding);
- 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, hurricane;
- 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 of any genesis;
- earthfalls and earth slip-falls;
- mudflows;
- snow and stone avalanches, crushed and block avalanches;
- erosion by water of shores, slopes and streams;
- sinks and subsidences;
- 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 cause;
- 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.

The analysis and assessment of natural and man-induced factors in the region and vicinity of Balakovo-1 have resulted in adoption of the following decisions regarding to inclusion of separate external events in the NPP design bases:

1) Aircraft and (or) its fragments crash

An analysis of the air traffic in the Balakovo NPP vicinity and an assessment of frequency of the aircraft or its fragments crash on the site of Balakovo NPP, have allowed concluding that the probability of aircraft crash over a year on the site of Balakovo NPP lies within the range 4.57-$9.53 \cdot 10^{-8}$ per year. Thus, in accordance with above described regulatory approach, aircraft crash was not required to be taken into account in the NPP design bases. At the same time, the verification analysis of the containment strength under an aircraft crash has demonstrated that the building structures of the dome and cylinder of the containment withstand an impact of an 8-ton aircraft which falls at a speed of 215 m/s and at an angle to the horizontal of 10-45 degrees.

2) Explosions at facilities in the vicinity of NPP

All external explosion-hazardous facilities are located at safe distances from buildings and structures of Balakovo NPP; the only explosion that can affect facilities of Balakovo NPP is the explosion of filled tank-truck close to the NPP site.

It was demonstrated that the pressure of the air shock wave (ASW) initiated by the explosion of the said tank-truck did not exceed 0.03 MPa. With that, the building structures of the reactor department are designed to withstand ASW with a pressure at the front of 0.03 MPa with duration of the compression phase of up to one second. The reactor department envelope is designed to withstand ASW having the equivalent static load on the front surface of the rigging equal 0.114 MPa. The metallic ventilation stack, which is in the roof of the rigging, is not designed to withstand the ASW impact, but the rigging roof structures and containment dome withstand load produced by stack drop. To avoid ingress of the shock wave inside the building, explosion-proof devices are installed in the air suction places. Outer doors and gates also are designed to withstand the external shock wave.

3) Extreme wind impact

Average annual wind speed for the Balakovo NPP region is 5.5 m/s. Design maximum wind speed of recurrence once in 10,000 years, which is considered in the Balakovo NPP design bases, is taken equal 40 m/s.

4) Water reservoir dam break

Saratov Water Reservoir is a source of service water supply for Balakovo NPP. In case of an accident at the hydraulic structures (dam) of the water reservoir, the maximum level of water in the water reservoir in the NPP site vicinity, when the break wave comes, comprises 33.2 m that is 1 meter below the site grade level (34.2 m). Calculating the maximum level of the break wave, the maximum possible water level in the water reservoir (including extreme atmospheric precipitation and water from thawing of snow) has been taking into account, as well as possible increase in wave height due to extreme wind impact.

5) Earthquakes

The NPP site seismicity has been estimated at 5 points as per MSK-64 in case of DBE (an earthquake with recurrence of once in 1,000 years) and 6 points in case of SSE (an earthquake with recurrence of once in 10,000 years). Given unfavorable soil conditions and results of seismic microzoning of the NPP site, the estimated seismicity value that is considered in the NPP design bases was subsequently increase by 1 point.

Additional information about fulfillment of the principles of the Vienna Declaration on Nuclear Safety is given in Appendix 3.

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 the Vienna Declaration on Nuclear Safety.

Article 18. Design and Construction

18.1. Defense-in-Depth

New Russian NPPs are designed in accordance with requirements of the federal standards and regulations in the field of the use of atomic energy, as well as with consideration of the requirements of the IAEA safety standards.

At the present time, the Russian Federation implements two new designs of NPPs with WWER reactors: AES-2006 and WWER-TOI.

AES-2006 units (in particular, units of Novovoronezh NPP-2) differ from WWER reactors of earlier designs operating in Russia:

- thermal power has been increased up to 3,200 MW and the unit (gross) efficiency enhanced up to 36.2 %;
- equipment in use has been unified, its material consumption has been reduced; and
- composition of safety systems has been changed; both passive and active safety systems are used.

Safety of the NPPs under design is ensured by consistent implementation of the defense-in-depth concept (DID).

At the first level of defense-in-depth in AES-2006 design (in particular, 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 size of the controlled area does not exceed 600-800 meters and the size of emergency measure planning zone does not exceed 3,000 meters;
- 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, 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 AES-2006 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 remove NPP to controlled state, prevention of propagation of beyond design basis accidents and mitigation of their consequences, protection of the containment from collapse and maintaining its performance. To meet the said purposes, the design includes the following system 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
- instrumentation and controls of emergency monitoring.

The use of various engineered features at different levels of defense-in-depth facilitates independence of defense-in-depth levels from each other.

Enhanced safety features and additional improvements to protect against external impacts and prevent accidents, as well as mitigate accident consequences and prevent off-site 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, the consumers of active safety systems from additional 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 laid out so that the minimum necessary part of the piping, valves and equipment is placed in 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 substance beyond the accident localization zone (ALZ);
- 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 AES-2006 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 non-pre-stressed 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.

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 prevent forming explosive mixtures in ALZ, prevent an explosion source in ALZ, ensure explosion protection in ALZ, and monitoring of hydrogen and other gases concentrations in ALZ.

In design basis accidents, the emergency hydrogen evacuation system prevents formation of explosive concentrations of hydrogen in the containment, which are accountable for deflagration burning. The emergency hydrogen evacuation system uses passive catalytic hydrogen recombiners, which are located in places of possible accumulation of hydrogen. At this, there is no need in mixing in the containment to create a homogenous atmosphere.

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.

Beyond design basis accident accounting approach

According to the requirements of the federal standards and regulations in the field of the use of atomic energy "General Safety Provisions of Nuclear Power Plants" (NP-001-15), provisional lists of beyond design basis accidents for each type of reactors are established in the federal standards and regulations in the field of the use of atomic energy.

Final lists of beyond design basis accidents (including severe accidents) are 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 and 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 the action plans to protect the personnel and population in case of accidents, as well as to produce a beyond design basis accident management guide.

Consideration of human factor in design

Consideration of human factor in design is achieved through:

- optimization of distribution of control functions between human and control systems, justification of information volume given to the operating personnel, which is necessary and sufficient to assess the state of the facility and make control decisions. The analysis of human actions is carried out when the tasks of control are solved, including the definition of probable behavior, the task is analyzed before it is tackled, the conditions are identified in which a probability of error raises, consequences and responses are discussed, and requirements to "man-machine" interface are generated;
- quality checks of the project in stage-by-stage verification and validation of design solutions, including at the analytical and full-scope simulators to confirm that the necessary action of the operator have been defined and can be correctly performed;
- involvement of the personnel who have practical experience in working at NPP and start-up & adjustment companies in the design process;
- optimum layout of the equipment to ease the operation, maintenance

and repair of NPP systems and equipment.

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;
- 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;
- other natural external impacts typical of the NPP site with design recurrence of once in 10,000 years;
- aircraft crash (of 5 tons, if a probability of an aircraft crash of larger mass equals or exceeds 10^{-6} a year, the crash of such aircraft is subject to consideration in the design bases);
- external air shock wave; and
- other man-induced external impacts with a probability of occurrence of 10^{-6} a year and greater.

The design of the units of Novovoronezh NPP-2 (AES-2006 design) considers crash of light aircraft like LearJet (weight is 57 kN) and Cessna (weight is 15 kN).

Also, the natural external impacts with the following characteristics are considered:

- wind: speed (at the level of 10 m above ground) which corresponds to a 10-minute averaging interval and is exceeded on average once in 5 years, equals 30 m/s, as well as extreme speed exceeded on average once in 10,000 years that equals 56 m/s; and
- tornado: the class of tornado intensity with a probability of occurrence in the NPP site territory once in 10,000 year – 3.60 as per the Fujita E-scale.

Maximum travelling speed of tornado is 24 m/s; pressure differential between periphery and center of funnel of tornado is 110 gPa.

To avoid flood and flooding of the site, the grade elevation of the NPP site has been selected above the absolute elevation of the maximum break wave level. Design solutions ensure that the structures of Safety

Category I remain unflooded under external impacts with recurrence of once in 10,000 years.

For NPPs of WWER-TOI design, the crash of an aircraft of 20 t flying at a speed of 215 m/s has been considered a design basis event. Optionally, a crash of an aircraft of 400 t flying at a speed of 150 m/s may be considered as a beyond design basis event.

Design calculations of WWER-TOI have demonstrated that structural and configuration solutions ensure seismic stability of NPP to increased seismic loads (SSE – up to 8 points, DBE – up to 9 points (0.25 g and 0.41 g, correspondingly).

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 the NPP design 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:

- supply of additional emergency equipment to NPPs (motor pumps, mobile diesel generators and pumps); it has been prepared for use;
- development of sets of design and operating documentation for prevention of severe accidents;
- commissioning of the reactor seismic protection in the pilot commercial operation at existing units of Kola, Kursk, Leningrad, Novovoronezh and Smolensk NPPs;
- placement and connection of mobile emergency machinery and monitoring systems and hydrogen explosion safety in the RI sealed enclosure at Balakovo 1÷4, Beloyarsk-3, Bilibino 1÷4, Kalinin-1, Kola 2÷4, Leningrad 1&3, and Novovoronezh-5;
- continuation of work to implement 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; and
- implementation of measures to improve emergency preparedness at all NPPs and in the Crisis Center of Rosenergoatom.

Following the results of the Fukushima-Daiichi accident, the additional heat removal system 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 – has been introduced into designs of units under construction at Novovoronezh NPP-2 (AES-2006 design) and Kursk NPP-2 (WWER-TOI design).

Based on results of robustness analysis of Leningrad NPP-2 (AES-2006 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 fuel pool with corresponding piping (pipelines, valves etc.) has been added; and
– for each unit a mobile diesel generator has been provided.

18.2. Application of Tested Solution

According to the requirements of para. 1.2.7 of the federal standards and regulations in the field of the use of atomic energy “General Safety Provisions of Nuclear Power Plants” (NP-001-15), 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, AES-2006 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 AES-2006 and WWER-TOI designs are based on the available experience in design, NPP operation, and calculation and experimental justifications.

The practice-proven solutions are the design of the reactor installation, which include 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 which had no sufficient reference (passive safety systems, core catcher etc.). Comprehensive calculation and experimental justification, including the use of available and newly built test rigs were applied for beta-testing (thus, to study the joint operation of passive systems of NPPs of AES-2006 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).

Design solutions based on programmable digital devices should be applied in monitoring and control systems with special caution. The NPP design was added with a diverse protection system which does not use programmable digital devises to ensure guaranteed fulfillment of main safety functions in case of a hypothetical failure of programmable devices due to common cause failure of software.

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.

18.3. Licensing Associated with Design and Construction of Nuclear Plants

Licensing process in the field of the use of atomic energy is defined in 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” and was described in the previous National Reports.

To get 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 preliminary safety analysis report of the nuclear power plant;
- an overall quality assurance program QAP NPP(Q);
- a quality assurance program of NPP construction QAP NPP(C);
- PSA Levels 1 and 2; and
- as necessary, by Rostechnadzor’s request, the design documents (including designs of RI, APCS, safety important systems and a description of the physical protection), test, research and development reports referenced in the preliminary safety analysis report of the NPP.

Design organizations (including, NPP and RI designers) should have Rostechnadzor’s licenses for design and engineering, in accordance with requirements of the Federal Law “On the Use of Atomic Energy”.

In 2013-2015, Rostechnadzor reviewed license applications for siting and construction of new nuclear units. The construction is under way of:

- Rostov-4 (with RI WWER-1000/V-320);
- Novovoronezh NPP-2, Unit 2 (AES-2006 with RI WWER-1200/V-392M);

– Leningrad NPP-2, Units 1&2 (AES-2006 with RI WWER-1200/V-491).

Rostechnadzor has granted the siting license for Kursk NPP-2, Unit 2 and construction license for Kursk NPP-2, Unit 1 (WWER-TOI design with RI WWER-1200/V-510K).

Additional information about fulfillment of the principles of the Vienna Declaration on Nuclear Safety is given in Appendix 3.

In accordance with the modern international requirements, 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 engineered 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 the "Provisions for Licensing of Activities in the Field of the Use of Atomic Energy" has seen no changes since submission of the sixth National Report.

The documents to demonstrate the nuclear and radiation safety of the unit to be commissioned after the construction are listed in 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".

Besides, 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-start-up 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 unit are carried out after Rostechnadzor holds inspection of actual preparedness of the unit to each of these stages at NPP.

In accordance with the described procedure, in 2014-2016 the work has been carried out to commission Rostov-3, Beloyarsk-4 and Novovoronezh NPP-2, Unit 1.

A decision to issue an operating license for a nuclear unit is made by Rostechnadzor after review of documents justifying safety of operation as well as conduct of necessary inspections.

19.2. Current System for Updating Safe Operation Limits and Conditions

In accordance with requirements of the "General Safety Provisions for Nuclear Power Plants" (NP-001-15), the NPP operation process regulation is the main document which defines the safe operation of a nuclear unit. The Process Regulation specifies the safe operation limits and conditions, which are justified at the design stage, given in the safety analysis report, and updated with regard to the results of start-up and adjustment, first criticality and first power activities at the nuclear unit. Besides, the Process Regulation defines the rules and major practices for

the safe operation of the plant, and the general procedure for carrying out operations relating to the NPP safety.

If it is necessary to amend safe operation limits and (or) conditions, the corresponding changes are justified in the NPP design, given in the safety analysis report of the nuclear unit in accordance with the established procedure, and reflected in the Process Regulation of operation of the NPP unit. Amendment of the safety analysis report of the NPP unit, as well as the process regulation of NPP unit operation, is carried out after Rostechnadzor has amended the license conditions for NPP unit operation in accordance with the established procedure (including taking into account results of the review of changes to SAR NPP and Process Regulation).

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) that is applicable to NPPs of different types and that takes into account the design features of reactors and major 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" (STO 1.1.1.01.0678-2015). Based on the current M&R documents, the management of each NPP develops a package of maintenance and repair documentation, including long-term and annual plans of the NPP unit repair, records of repair readiness inspections, long-term and yearly plans of the NPP unit repairs, annual equipment repair schedule, repair scope registers, plans expenditures for supporting the repair campaign, repair network schedules and other documentation. The documents are approved by the NPP management.

Maintenance of the NPP equipment and systems is carried out mainly by the plant personnel and covers monitoring of variations in the parameters of operating equipment aimed at early detection and elimination of deviations, performance of preventive activities and statutory tests of equipment, instruments and systems.

All repairs are carried out by the repair personnel and by contractors licensed by Rostechnadzor.

The management of the NPP equipment technical conditions is based on the scheduled statutory repair strategy. Scheduled repairs at NPPs are performed irrespective of the actual technical condition of equipment at the time of the repair commencement and at such intervals and in such scope as specified in the M&R regulations.

The intervals and scope of planned maintenance and repair for the NPP equipment and systems depend on the need for keeping such equipment and systems available as required by the safe operation conditions and operating limits set in the NPP design. The necessity for unplanned maintenance and repair of equipment and systems is determined by the results of checking up their condition or when a failure is detected.

In 2015, Rosenergoatom updated approaches to advance planning of repairs of units based on the international experience. The advance planning period was increased from four to five years.

The many-year experience proves that the employed repair strategy ensures safe operation of NPPs, including a minimum number of reactor scrams when the reactor is critical, as well as the sufficiently high level of equipment reliability in the period between repairs. This approach is suitable in terms of repair planning and preparation, including provision of logistical and financial resources, choice and timely checks of contractors for readiness and so on.

Rosenergoatom has worked out many repair-related documents (repair specifications, M&R Programs/Regulations, sets of process documentation), which give the information support to contractors in planning, preparing and conducting NPP repairs. The repair documents are produced both by the plant personnel and specialized organizations appropriately licensed by Rostechnadzor. The Operating Organization carried out periodic inventory-takings, formulates programs of development and revision of repair documents, which include drawing out the documentation for equipment of newly built units.

Regulatory requirements for tests and inspections of safety important systems and components of NPPs are set out in the federal standards and regulations in the field of the use of atomic energy “General Safety Provisions of Nuclear Power Plants” (NP-001-15) and “Rules of Nuclear Safety of Reactor Installations of Nuclear Plants” (NP-082-07).

To reveal and prevent failures of system (NPP components), confirm their performance and compliance with design characteristics, the tests and inspections of safety important systems (components of NPPs) are carried out. Safety important systems (components of NPPs) are tested and inspected at commissioning, after repair and periodically during the entire service life of NPP. Tests and inspections of systems (components of NPPs) are carried out in accordance with the corresponding procedures, programs and schedules produced by NPP administration based on the process regulation on safe operation of the nuclear unit and design of RI (NPP).

The procedure of Rostechnadzor’s inspections is described in Subsection 14.6 of this Report.

To confirm orderly condition and possibility of further operation of equipment and components of safety systems and safety important systems at parameters established by the design, 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 and drawn out procedures; its results are formalized in accordance to the established procedure.

Involvement of the NPP personnel in development of regulations for operation, maintenance, repair, inspections and tests

1. Development of process regulations for nuclear unit operations.

In accordance with the requirements of para. 4.1.2 of the federal standards and regulations in the field of the use of atomic energy “General Safety Provisions of Nuclear Power Plants” (NP-001-15), the NPP operating organization produces process regulations for operation of units jointly with participation of RI and NPP designers in accordance with the NPP design and safety analysis report.

2. Development of regulations for maintenance, repairs, inspections and tests of safety important systems.

In accordance with para. 4.1.6 of the “General Safety Provisions of Nuclear Power Plants” (NP-001-15), maintenance, repairs, tests and inspections of safety important systems are carried out as per corresponding procedures, programs and schedules drawn out by NPP administration. Maintenance, repairs, inspections and tests of safety important systems are carried out as based on the process regulation for operation and regulations for maintenance, repairs, inspections and tests.

Regulations for maintenance, repairs, inspections and tests of safety important systems are developed in accordance with the procedure drawn out at NPP based on standards of the Operating Organization STO 1.1.1.01.0069-2013 “Rules of Organization of Maintenance and Repair of Systems and Equipment of Nuclear Plants” and STO 1.1.1.01.003.0779-2014 “Operating Documentation. Drawing out and Management Procedure. Documents for Carrying Out Processes (Operating Procedures, Schemes, Books of Diagrams)”.

All above documentation (including the process regulation for operation) is developed with involvement of the NPP engineering and technical support unit personnel and operating personnel.

19.4. Actions of the Personnel in Accidents and Emergencies

The procedure for training of the NPP personnel to act in emergency conditions is described in detail in Subsection 16.4 of this Report.

In accordance with the requirements of the federal standards and regulations in the field of the use of atomic energy, 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 Action Plan for Protection of the Personnel in Case of an Accident at a Nuclear Power Plant;
- the Design Basis Accident Elimination Procedure; and
- the Beyond Design Basis Accident Management Guide.

If a pre-accident or accident arises at a nuclear power plant, the NPP shift supervisor immediately reports on that to the plant manager or chief engineer of NPP and notifies all necessary organizations and officials.

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. For each initiating event of violations of normal operation (accident), the conditions of its initiation and accident development paths 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 Guide considers both the accidents that have not developed into a severe accident and severe accidents.

In accordance with the requirements of the federal standards and regulations in the field of the use of atomic energy “General Safety Provisions of Nuclear Power Plants” (NP-001-15), the personnel actions are based on signs of evolving events and conditions of RI and NPP as a whole, as well as projections of expected accident development, in accordance with the Design Basis Accident Elimination Procedure and the Beyond Design Basis Accident Management Guide.

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 NPP by the Operating Organization both on its own and with the aid of third party organizations. The types and forms of engineering support vary at the construction, commissioning and operation stages, depending on the objectives faced by the Operating Organization and the particular nuclear plant.

Normally, for performing the required works and services, the Operating Organization and the NPPs engage on a contract basis specialized research, design, maintenance, adjustment and other organizations, as well as with nuclear component manufacturers.

In Russia, there are major design and research institutes, process development organizations, maintenance, construction, installation and

other organizations with an extensive experience in operation in nuclear power and the Rostechnadzor licenses for the respective activities. Of such organizations, the body which controls the uses of atomic energy, the State Atomic Energy Corporation “Rosatom”, selects, in accordance with the established procedure, the leading scientific organizations, leading design organizations and leading project organizations, which provide necessary and effective support to NPPs. They include:

- JSC “Experimental Design Bureau Gidropress” (OKB Gidropress);
- JSC “N.A. Dollezhal Research and Development Institute of Power Engineering” (NIKIET);
- JSC “I.I. Afrikantov Experimental Mechanical Engineering Bureau” (OKBM Afrikantov), Nizhniy Novgorod;
- JSC “Atomenergoproekt” (AEP), Moscow;
- JSC “Research, Design and Engineering Institute of Power Technologies” (ATOMPROEKT), St. Petersburg;
- JSC “Nizhniy Novgorod Engineering Company “Atomenergoproekt” (NIAEP);
- State Research Center of the Russian Federation “A.I. Leipunsky Institute of Physics and Power Engineering” (SRC RF IPPE);
- “Research and Design Institute of Installation Technology” (NIKIMT-Atomstroy);
- JSC “Atomtekhenergo” (ATE); and
- JSC “Atomenergoremont” (AER).

Rosenergoatom is provided with continuous scientific and technical support in problems of operation from JSC “All-Russian Research Institute for Nuclear Power Plants Operation” (VNIIAES).

The scientific support in a broad range of safety issues is provided to Rosenergoatom Concern and NPPs by National Research Center ”Kurchatov Institute” (NRC KI).

19.6. Procedure for Accounting of Safety Significant NPP Events

The work to analyze and account of the events significant in terms of safety is regulated by the following regulatory documents:

- the federal standards and regulations “General Safety Provisions of Nuclear Power Plants” (NP-001-15);
- the federal standards and regulations “Regulation on Investigating and Accounting Operational Events at Nuclear Plants” (NP-004-08);
- “Provision on the Procedure of Transmission of Prompt Information of Operation of Nuclear Plants to Rosenergoatom and Concerned Organizations” (RD EO 1.1.2.01.0331-2010);

- "Provision on Organization of Investigation of Safety and Reliability Significant Events at Nuclear Plants of Rosenergoatom" (RD EO 1.1.2.01.0163-2013);
- "Methodological Guidelines for Analyzing the Causes of Safety-Reliability-Related Events, Fires, Injuries, Damages to Buildings and Structures at Nuclear Plants" (RD EO 1.1.2.09.0095-2010);
- "Provision on the Development, Implementation and Assessment of the Effectiveness of Measures Taken in Analyzing and Using the Operating Experience" (RD EO 1.1.2.01.0798-2009); and
- internal documents of NPPs regulating the procedure for investigation and accounting of NPP events.

The regulatory framework for these activities 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" (NP-004-08) establish:

- the categories of the NPP operational evets to be reported and investigated;
- the procedure for accounting of and reporting on violations; and
- the procedure for investigation of violations.

In accordance with the requirements of this document, 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 and by the on-site radiation impact.

Operational events at NPPs include on-site events resulting in deviations from normal operation, the specified safe operation limits and/or conditions.

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).

The federal standards and regulations in the field of the use of atomic energy "General Safety Provisions of Nuclear Power Plants" (NP-001-15) put into force in 2016 includes the notion of "precursor of a severe accident", which is understood as a departure of the NPP from design characteristics revealed during operation or the event, which occurred during operation but has not led to a severe accident and evidences that there is a serious deficiency of the equipment design, NPP design or NPP operation or it is substantial part of the accident sequence which can lead to a severe accident. Para. 4.1.16 of the said standards and regulations establishes that in case the Operating Organization reveals a deviation (event) that is a precursor of a severe accident for which the conditional probability of becoming a severe accident is 10^{-3} or more, the Operating Organization should develop a plan of measures to prevent similar departures (events), as well as draw out a justification of the nuclear unit's power operation for the period till implementation of measures under the given plan. The given plan and justification are sent by the Operating Organization to Rostechnadzor for review.

The Provision RD EO 1.1.2.01.0331-2010 (a guidance document of the Operating Organization) seeks to bring the requirements of corporate documents in compliance with the industry-level and federal documents, which regulate the procedure of timely informing the relevant authorities and organizations about the current condition of units and contingencies[1] at nuclear plants.

The "Provision on Organization of Investigation of Safety and Reliability Significant Events at Nuclear Plants of Rosenergoatom" (RD EO 1.1.2.01.0163-2013) establishes requirements for the organization and conduct of different types of investigations of operational events by Rosenergoatom, including the categories of operational events at NPPs that are not subject to reporting to the Regulatory Body (deviations at NPPs). This provision has been developed for the purpose of establishing at Rosenergoatom a systemic approach to the investigation of operational events and early detection of deviations from normal operation which can potentially lead to more severe consequences.

[1] A contingency is a disruption of normal industrial, radiation, fire and chemical safety as well as social conditions at a nuclear plant.

The "Methodological Guidelines for Analyzing the Causes of Safety-Reliability-Related Events, Fires, Injuries, Damages to Buildings and Structures at Nuclear Plants" (RD EO 1.1.2.09.0095-2010) establishes the procedures for identifying the immediate, root causes for and the factors contributing to abnormal events at NPPs with the consequences thereof classified as NPP operational events, fires, occupational injuries, damage to buildings and structures, etc., with the aim of developing appropriate corrective actions as well as measures to prevent recurrence of such events.

The "Methodological Guidelines" has been developed with regard to 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.

The use of the "Methodological Guidelines" suggests that, besides using the recommended methods for analyzing the causes for abnormal events at NPPs, special methods should be employed, where required, to analyze the immediate causes for the system component failures (such metal inspection methods, water chemistry monitoring techniques, radiochemical methods to determining the dose received, methods for strength analysis of structural components, etc.).

The "Methodological Guidelines" RD EO 1.1.2.09.0095-2010 is used when the following types of NPP operational events are investigated and analyzed:

- operational events at NPPs (subject to investigation in accordance with NP-004-08);
- departures at NPPs;
- fires (ignitions);
- occupational injuries;
- damages to buildings, structures, their parts and structural elements;
- damages to engineered features of hazardous industrial facilities;
- overexposure of personnel; and
- increased contamination of the environment.

The "Methodological Guidelines" is also used during investigation of and analysis into the causes of events associated with improper management of various activities, such as violation of time schedules and infringement of work procedures, failures to supply materials and spare parts, and breaches of technological or financial discipline.

The "Provision on the Development, Implementation and Assessment of the Effectiveness of Measures Taken in Analyzing and Using the Operating Experience" (RD EO 1.1.2.01.0798-2009) sets forth the requirements for development, coordination, approval, implementation, control and assessment of corrective and preventive measures performance,

forming the feedback on the use of information documents on operating experience at the sectoral and plant level, as well as defines approaches to performance assessments of the analyses and use of operating experience.

The NPP operational event reports are kept at the plant unit the time of the NPP decommissioning. Rosenergoatom has a VNIIAES-supported computer database with information on accounting and analyzing operational events.

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.

The surveyed results of the operational events investigations are brought to the attention of managerial, operational and maintenance personnel of the NPP divisions. Besides, Russian NPPs review and analyze all accounts and reports on the events coming from other NPPs of the utility, from VNIIAES (including reports from the IAEA/NEA IRS), and from WANO. The safety problems identified in the accounts and reports are analyzed in terms of their significance for particular plants. Useful information is picked out from accounts and reports for the purpose of using it in the training of operational and maintenance personnel. It is analyzed by instructors of training points and centers and is further used in training and retraining the NPP personnel.

The accounts of and reports on operational events at Russian and foreign NPPs also contain additional recommendations for managerial, operating and maintenance personnel for seeking to prevent such events. These documents are sent out to all NPPs, to divisions of the Operating Organization’s Headquarters, to Rostechnadzor and to the organizations responsible for the scientific and engineering support of the NPP operation.

An analysis of the operational events at Russian NPPs occurred, for example, in 2015, has shown that out of 35 events that took place, 7 do not fall under INES criteria, i.e. are "out of scale" events and 25 are events of Level “0”. Three events out of the total number are safety significant, i.e. the events rated as Level “1” as per INES. It should be noted that one of the total number of events took place at Rostov-3, which was in the process of pilot commercial operation.

The distribution of NPP operational events by INES Levels for 2013 – 1st half of 2016 is given in Appendix 13, and the statistics on deviations at NPPs for 2013 – 1st half of 2016 are in Appendix 14.

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

In accordance with this Article of the Convention on Nuclear Safety, and the general technical principles of the NPP safety as specified by the IAEA in INSAG-12 “Basic Principles of Nuclear Plant Safety”, in Report No. 110 “Safety of Nuclear Installations”, Safety Guides SSR-2/2 “Safety of Nuclear Power Plants. Commissioning and Operation” and NS-G-2.11 “System for Feedback of Experience from Events at Nuclear Installations”, the Operating Organization, Rosenergoatom, organizes and coordinates activities to ensure proper operations of the Industry-level System for Analysis and Use of Information on the Operating Experience of NPPs (SAI OE) with scientific and technical support provided by VNIIAES.

The nuclear industry-wide system for the analysis and use of operating experience includes: a system of Rosenergoatom documentation; a system of organizing human resources; an industry-level information and analytical system for the NPP operation experience; a financing system; a control and monitoring system.

The organization of efficient data collection, storage, handling, analysis, exchange and distribution processes, as well as the formation of feedbacks on the operating experience is based on a systems approach. The key component in implementing this approach is the information system deployed at the industry and plant levels, which has a common information space and uses a common information medium. The industry-wide information and analytical system for operating experience of Rosenergoatom is intended for the collection, accumulation, storage, exchange and analysis of various structured information on the operation of NPPs and is part of the Corporate Information System of Rosenergoatom, including information on all operational occurrences at NPPs including potential precursors of severe incidents and accidents.

The operation of the OIS OE system is largely dependent on the development and implementation of procedures for the interaction between the participants in the information system and for the circulation of information within the system. To this end, the Operating Organization has developed a package of guidance and methodological documents. Such is, for example, the Operating Organization’s guidance document entitled “Organization of Rosenergoatom’s Industry-level Information and Analysis System on the Experience of Operating Nuclear Plants. Basic Provisions” (RD EO 1.1.2.01.0152-2013). The purpose of this document is to organize effective exchange and use of information on the operation of NPPs by the nuclear industry entities, including the nuclear plants in operation and under construction, companies and organizations of Rosenergoatom,

research and design organizations of ROSATOM, as well as to ensure safe, reliable and economically efficient operation of NPPs.

The document contains requirements for the organization of the OIS OE procedures, namely:

- the OIS OE composition and structure in terms of its subject area;
- organization of subject-based information processes and information resources of the OIS OE system at the industry and plant levels;
- organization of subject-based information processes of the OIS OE system at the inter-sectoral and international levels; and
- those responsible for the supervision, coordination and performance of activities, and for methodological support and proper operation of the OIS OE system.

An important addition to the “Basic Provisions”, RD EO 1.1.2.01.0152-2013 is a package of guiding and methodological documents developed by Rosenergoatom, which specify the procedures for the preparation (scope, form, etc.), transfer and use of various information on the operation of nuclear plants and companies (organizations) within the OIS OE system.

The information coming from nuclear plants is used by VNIIAES for maintaining industry-level databases on subject areas of the OIS OE system.

In order to specify the major basic requirements for the accumulation, analysis, use and dissemination of information on the experience of operation within the industry throughout the life cycle of NPPs for the purpose of improving the NPP operation quality, the Operating Organization has in operation a standard entitled “Analysis and Use of the Operating Experience of Nuclear Plants. Basic Provisions” (STO 1.1.1.01.002.0646-2012). This document contains the basic provision for organizing and operating the system for the analysis and use of Information on the operating experience of Russian and foreign NPPs at NPPs in operation or under construction, as well as within the divisions of Rosenergoatom. The “Basic Provisions” establish the major principles and rules as far as the following is concerned:

- organization of the system of analysis and use of the NPP OE information at the plant and industry levels;
- major sources of the NPP OE information;
- criteria for assessing and selecting information on the operating experience for in-depth analysis;
- development of and control for the implementation of corrective and preventive measures;

- analysis of OE, documentation, use and dissemination of its the analysis results; and
- quality control in the accumulation, analysis and efficiency of using the NPP OE information.

To make the basic provisions of this standard more detailed both at the industry and plant levels, Rosenergoatom introduced the standard "Administrative Instruction for the Analysis and Use of OE Information" (AI 1.3.2.06.014.0017-2014).

The Operating Organization has developed and has been implementing since 2005 a special program for training and retraining the staff at Rosenergoatom's Headquarters, NPPs and supporting organizations, who investigate and analyze the causes for events and use the OE information at the plant and industry levels.

VNIIAES, while supporting Russia's participation in the IAEA information systems (IRS, PRIS, INES) and being a member of WANO's Moscow Center, receives and distributes in the nuclear industry the following information on foreign experience:

- events at NPPs;
- NPP performance;
- NPP operating experience;
- experience of peer reviews at NPPs; and
- good practices.

The use of Russian and foreign plant operating experience allows preventing operational events at NPPs and enhancing the NPP safety.

Information on NPP operational events, deviations at NPPs, equipment malfunctions and failures received from NPPs is also used in accomplishing the following tasks:

- accumulation of statistical data for NPP probabilistic safety assessments;
- estimation of reliability indicators that characterize the reliability of equipment and safe operation of the NPP units;
- identification of trends in and comparative assessment of operations;
- detection of recurrent/similar events at NPPs and identification of causes for NPP operational events;
- optimization of design-basis algorithms as compared to those of real emergency modes;
- analysis of safety system operation modes; and
- development of recommendations for the prevention of operational events and other events at NPPs.

Based on the analysis of NPP operational events and other information resources received from nuclear plants, nuclear enterprises,

and international and foreign organizations, VNIIAES publishes information and analytical reports on the operating experience of Russian and foreign NPPs, which contain both generalized data and particular acts of a potential interest to specialists. These, for example, include:

- annual summary reports on the operational safety of NPP units in Russia;
- quarterly and annual reports on the analysis of major technical and economic performance data of Russian NPPs;
- quarterly and annual reports on the analysis of safe operation indicators for Russian NPPs;
- quarterly and annual reports on operational events at Russian NPPs describing the events, identifying their causes and safety implications, and assessing the personnel actions and the planned corrective measures for avoiding similar events in future;
- data sheets on the INES event rating;
- quarterly reviews of equipment failures and defects at Russian NPPs with recommendations for the improvement of the equipment operation;
- summary lists of engineering solutions adopted at Russian NPPs;
- NPP operational event reports;
- reports on incidents at foreign NPPs (from the IAEA/NEA IRS); and
- technical statements on the results of feedback on using Russian and foreign operating experience information documents by Russian and foreign nuclear plants.

VNIIAES' main information and analytical materials on the operating experience of Russian and foreign NPPs are distributed to over 35 addressees within different divisions of the Operating Organization, NPPs and technical support organizations, as well as ROSATOM and Rostechnadzor.

For the purpose of ensuring the effective exchange of the results of using the operating experience information by the SAI OE participants, the system of feedback on the operating experience information documents has operated in the Operating Organization, which is regulated by the "Provision on the Development, Implementation and Assessment of the Effectiveness of Measures Taken in Analyzing and Using the Operating Experience" (RD EO 1.1.2.01.0798-2009). A list of information documents to be supported in the feedback system, including the Operating Organization's information and generic letters, VNIIAES, IAEA/NEA IRS and WANO reports, and reports on the investigation of NPP operational occurrences. The operating procedure of the feedback system, examples of the use of information about safety significant events at foreign NPPs by Russian NPP and sectoral organizations, are regularly presented at

meetings and other events under the programs of IAEA/NEA IRS and WANO.

For the purpose of more rapid dissemination data and its subsequent use in the local computer networks of NPPs, these materials are sent out to all NPPs in an electronic format and are placed in the VNIIAES-supported system of the OIS OE internal web servers, the access to which is arranged for and maintained for several hundreds of officials at all NPPs, and other subsidiaries and divisions of Rosenergoatom.

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 and through international activities of Rosenergoatom as part of the IAEA and WANO programs.

Rosenergoatom closely interacts with WANO Moscow Center. Annually, the coordinated with WANO MC the "Action Plan of Rosenergoatom's Participation in Activities of the World Association of Nuclear Operators (WANO) in Frames of the Agreement with the WANO Moscow Center (WANO MC)" is developed and implemented. The plan includes various forms of Russian NPP operating experience transfer to foreign partners and operating organizations, 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).

To ensure compliance of the level of operation of Rosenergoatom to the world standards, the Operating Organization actively uses collection, analysis and implementation at NPPs the examples of good practices and strong points of activities revealed by various reviews (including peer reviews of WANO, IAEA OSART missions, and other international events).

As part of the Plan of Interaction with WANO MC, Rosenergoatom carries out activities to arrange for operations of the Regional Crisis Center, which transfers information about operation of NPP of Moscow Region pertaining to the WANO MC (including events, technological and radiation parameters of operation), preparation and conduct of international exercises in emergency preparedness and response.

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 exchanges reports on investigation of operational events at NPPs with WWERs of Russia and Ukraine under the existing agreement with NAEC Energoatom (Ukraine).

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 Law No. 190-FZ “On the Management of Radioactive Waste...”.

To reduce the amount of generated radioactive waste, Rosenergoatom sets twice a year the NPP radioactive waste generation guidelines. To ensure that the specified radwaste generation guidelines are complied with at each NPP, Rosenergoatom annually develops and implements organizational and technical arrangements to improve the modes of operation and technologies that have effect on the radioactive waste generation. To ensure the safe management of RAW in accordance with the federal target program “Nuclear and Radiation Safety for 2016-2020 and until 2030” and the “Activity Program for Management of Radioactive Waste at NPPs of Rosenergoatom for the Period 2016-2020” it is envisaged that the measures aimed at conditioning of radioactive waste and its transfer to disposal will be carried out.

The main direction in spent nuclear fuel management in the Russian Federation is to ensure safe management of SNF at NPPs and preparation of all SNF for removal from the NPP sites for processing or long-term storage at a centralized storage facility with further processing.

NPP SNF is managed in accordance with the federal target program “Nuclear and Radiation Safety for 2016-2020 and until 2030” endorsed by the Resolution of the Government of the Russian Federation No. 1248 of 19 November 2015 and the Concept of Spent Nuclear Fuel Management of ROSATOM approved by the Order of 29 December 2008.

Rosenergoatom annually analyzes the state of the NPP SNF management system’s safety level as determined by the adopted spent nuclear fuel storage technology, including storage of SNF in the at-reactor cooling pools and on-site storage facilities at NPPs, on-site transportation and SNF removal from the NPP for processing or long-term storage at a centralized facility. No operational occurrences or malfunctions of SNF management that led to violation of the safe operation conditions and limits

have been recorded in the reporting period.

At the present time, SNF is managed at NPPs as follows:

- SNF of NPPs with WWER-440 and BN-600 is removed from the NPP site to the nuclear fuel recycling facility following the cooling and intermediate storage in the at-reactor cooling pools to NF recycling company, FSUE "Production Association (PA) "Mayak";
- SNF of NPPs with WWER-1000 is transferred to the centralized storage facility at FSUE "Mining and Chemical Combine (MCC)" to be potentially further reprocessed following the cooling in the reactor cooling pools and at the Novovoronezh NPP at the separate storage facility;
- SNF of NPPs with RBMK-1000 is shipped for long-term storage in a water medium in detached pool-type spent nuclear fuel storage facilities at the NPP sites following the cooling in the reactor cooling pools.

  In the course of review of the sixth National Report of the Russian Federation, the following problem/challenge has been noted for NPPs with RBMK-1000: ***Taking out spent nuclear fuel of RBMK reactors from sites with the aim of safety ensuring of SNF storage on sites.***

  Leningrad and Kursk NPPs operate facilities for cutting and preparing for shipment of SFAs RBMK-1000 where SFAs are cut into fuel rod bundles and loaded into a transportation package TUK-109. Commissioning of the container storage and off-shipment facility at Smolensk NPP is planned for 2018.

  Since 2012 at Leningrad NPP and since 2013 at Kursk NPP SNF RBMK-1000 is regularly shipped off in transportation packages TUK-019 for dry storage at FSUE "MCC". The facilities are operated in accordance with the design characteristics and ensure that the quantity of off-shipped SNF exceeds the quantity of SNF unloaded from reactors;
- SNF of AMB reactors at shutdown Units 1 and 2 of the Beloyarsk NPP has been withdrawn from the reactors and is stored in the at-reactor cooling pools at the units or has been partially removed to the wet storage facility at FSUE "PA "Mayak". To ensure the safety of management of SNF of the AMB reactors, the "Program for Ensuring Safe Storage and Preparation for Removal for Processing at FSUE "PA "Mayak" of Spent Nuclear Fuel of the Beloyarsk NPP's AMB Reactors" is under implementation;
- SNF of the EGP-6 reactors at Bilibino NPP is stored in the at-reactor cooling pools. As resolved by ROSATOM, it is planned to remove all SNF from the NPP site for reprocessing at FSUE "PA "Mayak" for the purpose of preparing Bilibino NPP units for decommissioning.

Measures to enhance safety in operation of NPPs are laid down also in Section 6 of this Report.

The system existing in the Russian Federation for regulating the operation of nuclear plants, including their maintenance and repairs, inspections and tests, accounting and analysis of operational events, as well as radioactive waste and spent nuclear fuel management, provides for safe operation of NPPs.

The continuous scientific and technical support given to the Operating Organization and to NPPs by a number of research, design and architect-engineering institutes, and the availability of a system for analysis of information on the operating experience of nuclear plants, including foreign NPP operating experience, facilitate safe operation of NPPs.

Major Findings and Conclusion

Major Findings

1. In the Russian Federation, the legislative framework, which meets the requirements of the Convention on Nuclear Safety, 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 resources that allow it to perform imposed functions, while retaining its independence.
3. The safety priority of nuclear installations is enshrined in the laws and implemented in practice. In accordance with the norms of the national and international law, the Operating Organization is fully responsible for the safety of nuclear plants, and has all necessary financial, human and other resources for this purpose.
4. Inspections and assessments of safety of all nuclear units are carried out during the entire life cycle of nuclear plants in a regular manner. Results of these safety assessments and justifications are taken into consideration by Rostechnadzor when granting licenses.
5. 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.
6. 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 are 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.

7. In the Russian Federation, the selection of sites for NPPs is carried out with consideration of possible impacts of natural and man-induced origin that is consistent with the requirements of the Convention on Nuclear Safety and the principles of the Vienna Declaration on Nuclear Safety.
8. In accordance with the modern international requirements, 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.
9. 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.
10. 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.
11. The Regulatory Body and the Operating Organization act in the mode of openness consistently striving for enhancing transparency of their activity.
12. The Russian Federation follows the principles laid down in the Vienna Declaration on Nuclear Safety.

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.

APPENDICES

Appendix 1
List of Russian NPPs

NPP units in operation

NPP, unit number	Reactor type	Rated power, MW(e)	Unit operation license No.
Balakovo-1	WWER	1000	GN-03-101-3116
Balakovo-2	WWER	1000	GN-03-101-2332
Balakovo-3	WWER	1000	GN-03-101-2352
Balakovo-4	WWER	1000	GN-03-101-2395
Beloyarsk-3	BN	600	GN-03-101-2342
Beloyarsk-4	BN	800	GN-03-101-2837
Bilibino-1	EGP-6	12	GN-03-101-2253
Bilibino-2	EGP-6	12	GN-03-101-2237
Bilibino-3	EGP-6	12	GN-03-101-2473
Bilibino-4	EGP-6	12	GN-03-101-2297
Kalinin-1	WWER	1000	GN-03-101-2897
Kalinin-2	WWER	1000	GN-03-101-2333
Kalinin-3	WWER	1000	GN-03-101-2321
Kalinin-4	WWER	1000	GN-03-101-2551
Kola-1	WWER	440	GN-03-101-2273
Kola-2	WWER	440	GN-03-101-2272
Kola-3	WWER	440	GN-03-101-3160
Kola-4	WWER	440	GN-03-101-2940
Kursk-1	RBMK	1000	GN-03-101-2315
Kursk-2	RBMK	1000	GN-03-101-2316
Kursk-3	RBMK	1000	GN-03-101-2839
Kursk-4	RBMK	1000	GN-03-101-3122
Leningrad-1	RBMK	1000	GN-03-101-2249
Leningrad-2	RBMK	1000	GN-03-101-2250
Leningrad-3	RBMK	1000	GN-03-101-2220
Leningrad-4	RBMK	1000	GN-03-101-2471
Novovoronezh-3	WWER	417	GN-03-101-2285
Novovoronezh-4	WWER	417	GN-03-101-2284
Novovoronezh-5	WWER	1000	GN-03-101-3079
Novovoronezh NPP-2, Unit 1	WWER	1200	GN-03-101-3189
Rostov-1	WWER	1000	GN-03-101-2232
Rostov-2	WWER	1000	GN-03-101-2362
Rostov-3	WWER	1000	GN-03-101-2949
Smolensk-1	RBMK	1000	GN-03-101-2693
Smolensk-2	RBMK	1000	GN-03-101-3031

Smolensk-3	RBMK	1000	GN-03-101-2327

NPP units shut down for decommissioning

NPP, unit number	Reactor type	Rated power, MW(e)	Commencement of construction	Commissioning	Decommissioning
Beloyarsk-1	AMB	108	01.06.1958	26.04.1964	01.01.1983
Beloyarsk-2	AMB	160	01.01.1962	01.12.1969	01.01.1990

Decommissioned NPP units

NPP, unit number	Reactor type	Rated power, MW(e)	Commencement of construction	Commissioning	Decommissioning
Novovoronezh-1	WWER	210	01.07.1957	31.12.1964	16.02.1988
Novovoronezh-2	WWER	365	01.07.1964	14.04.1970	29.08.1990

NPP units licensed for deployment and construction

NPP, unit number	Reactor type	Rated power, MW(e)	License No.	Type of license
Balakovo, Unit 5*	WWER	1000	GN-02-101-2363	construction
Baltic, Unit 1*	WWER	1200	GN-02-101-2548	construction
Baltic, Unit 2*	WWER	1200	GN-01-101-2850	siting
Kursk, Unit 5*	RBMK	1000	GN-02-101-2317	construction
Leningrad NPP-2, Unit 1	WWER	1200	GN-02-101-2277	construction
Leningrad NPP-2, Unit 2	WWER	1200	GN-02-101-2276	construction
Leningrad NPP-2, Unit 3	WWER	1200	GN-01-101-2712	siting
Leningrad NPP-2, Unit 4	WWER	1200	GN-01-101-2713	siting
Nizhniy Novgorod, Unit 1	WWER	1200	GN-01-101-2479	siting
Nizhniy Novgorod, Unit 2	WWER	1200	GN-01-101-2480	siting
Novovoronezh NPP-2, Unit 1	WWER	1200	GN-02-101-2306	construction
Novovoronezh NPP-2, Unit 2	WWER	1200	GN-02-101-2305	construction
Rostov, Unit 4	WWER	1000	GN-02-101-2365	construction
Tver, Unit 1	WWER	1200	GN-01-101-2498	siting
Tver, Unit 2	WWER	1200	GN-01-101-2499	siting

NPP, unit number	Reactor type	Rated power, MW(e)	License No.	Type of license
Kursk NPP-2, Unit 1	WWER	1200	GN-02-101-3213	construction
Kursk NPP-2, Unit 2	WWER	1200	GN-01-101-3009	siting

* The unit is not constructed in fact.

Appendix 2
Implementation of Recommendations of the 6th Meeting of the Contracting Parties

Challenge 1: *The state-level efficient supervision of safety in conditions of the nuclear power development in Russia:*

- *Drafting and putting into force a financing mechanism aimed at attraction additional number of experienced employees to Rostechnadzor.*

The finding mechanism aimed at attracting additional experienced employees to Rostechnadzor is becoming. Appendix 9 presents data on funding of interregional territorial departments of Rostechnadzor in 2014-2016, as well as funding of applied research carried out in Rostechnadzor over the same period.

Rostechnadzor involves on a broad basis experienced specialists from scientific and technical support organizations of the Regulatory Body to render support to the governmental servants of Rostechnadzor in inspecting the NPPs, reviewing science and technology issues arising in the course of licensing of NPPs, international cooperation and execution of other functions.

Challenge 2: *Keeping and transfer of knowledge given NPP construction outside Russia to Russian designs:*

- *Development of an effective system of training and retraining of Rostechnadzor and Rosenergoatom's personnel.*

Rosenergoatom has led the establishment of the union of work contractors for training the personnel of the Foreign Customer and Supplier of NPP construction consisting of Rosenergoatom, CICE&T, Atomtekhenergo and VNIIAES. The union of contractors offers a complete package of services for training of the personnel of Russian and foreign NPPs, in particular:

- creation of the single training framework for foreign customer and supplier personnel of nuclear plants in the Russian Federation;
- preparation of proposals for signing contracts for rendering services to develop, on the turn-key basis, a system of the personnel training and a system to manage the foreign customer's knowledge and its implementation;
- turn-key training of the foreign customer and supplier personnel of nuclear plants built to Russian design abroad;
- maintaining qualification of the foreign customer and supplier personnel of nuclear plants;

- drawing out sectoral regulatory documents of the operating organization; and
- arrangements for establishing a training facility and follow-up of training center activities at NPPs of the foreign customer.

In 2015, Rosenergoatom, CICE&T, Atomtekhenergo and VNIIAES provided training to about 100 representatives of nuclear infrastructure organizations from 15 countries and about 200 operators from foreign NPPs (Iran, Belarus, China).

In accordance to Article 62 of the Federal Law No. 79-FZ of 27 July 2004 "On the State Civil Service in the Russian Federation", the governmental servants of Rostechnadzor receive additional education at least once in three years, which includes professional re-training and advancement of qualification. A type, form and duration of additional professional education, maintaining and advancement of qualification are established depending on a group and position category of the governmental service, which is occupied by the governmental servant, in accordance to the procedure defined by the President of the Russian Federation. Also, the qualification level of the governmental civil servants improves through seminars on exchange of experience in oversight in the field of the use of atomic energy, which are carried out jointly with the Interregional Territorial Departments for Supervision of Nuclear and Radiation Safety of Rostechnadzor, seminars on topical issues of supervision of nuclear and radiation safety, including overview seminars on the IAEA safety standard requirements, requirements of newly produced, as well as revised, federal standards and regulations in the field of the use of atomic energy.

Detailed information about development of the system for training and maintaining qualifications of the Rosenergoatom personnel is given in Subsection 11.3 of this Report.

Challenge 3: *An assistance in working out necessary frameworks in the countries which start developing nuclear power ("nuclear newcomers"):*

- *Giving Rostechnadzor powers and financial resources necessary to assist national regulators in the Russian nuclear technology recipient-countries.*
- *Facilitating the sufficient development of the national infrastructure which ensures proper regulatory control, as well as emergency preparedness and response.*

According to the Ordinance of the Government of the Russian Federation No. 339 of 15 April 2014, Rostechnadzor is the body authorized to exercise cooperation with the governmental bodies of the states, which

are customers of construction of nuclear facilities to Russian designs, on issues associated with the establishment of national systems for regulation of nuclear and radiation safety, including the development of the legal regulatory framework, licensing and oversight systems, arrangements for training of the personnel of regulatory bodies of these countries.

In the present time, Rostechnadzor has signed interagency cooperation agreements with regulatory bodies of the People's Republic of Bangladesh (the Ministry of Science and Technology), the Republic of Belarus (the Ministry of Emergency Situations), the Socialist Republic of Vietnam (the Vietnam Agency Radiation and Nuclear Safety), the Republic of Turkey (the Turkish Atomic Energy Authority), as well as the memorandum of understanding with the Regulatory Body of the Arab Republic of Egypt (the Egyptian Nuclear and Radiological Regulatory). The interagency cooperation agreements with regulatory bodies of the Hashemite Kingdom of Jordan (the Energy and Minerals Regulatory Commission) and the Federal Republic of Nigeria (the Nigerian Nuclear Regulatory Authority) have been prepared for signing.

Challenge 4: *Shipping off RBMK spent nuclear fuel from the sites to ensure safe SNF storage on sites.*

The SNF container storage and off-shipment facilities have been commissioned for SNF RBMK-1000 off-shipment at Leningrad NPP in 2012 and Kursk NPP in 2013. Thanks to the facilities, the number of places becoming vacant in spent fuel pools exceeds the quantity of SNF unloaded to spent fuel pool from the reactors during operation.

Commissioning of the SNF container storage and off-shipment facility at Smolensk NPP is planned for 2018.

Challenge 5: *The expanded monitoring and lifetime performance management of RBMK graphite stack.*

After getting a Rostechnadzor's permit, the technology of lifetime performance recovery (LPR) tested at Leningrad-1 in 2012-2013 was successfully used at Kursk-2 and Leningrad-2 in 2014. In 2015, the second cycle of LPR was carried out to the improved technology at Kursk-1.

The work results of 2012-2015 on lifetime performance recovery and management of RBMK-1000 allow the Operating Organization to make justified decisions to continue their operation.

Proposal 1: *Before starting a NPP construction near its state border, the Russian Federation shall carry out a site evaluation in accordance with the IAEA standards and invite the relevant IAEA mission*

on site and design evaluation with respect to external events (SEED).

In the reporting period, no nuclear power plants have been started to be built near the state border of the Russian Federation.

Proposal 2: *In the National Report describe the progress in the implementation of recommendations of IRRS missions and other international peer reviews.*

Information on the progress in implementing recommendations of IRRS missions, OSART missions and WANO peer reviews is given in Subsections 8.1 and 14.2 of this Report.

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 CNS.

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” (NP-001-15) 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-exceedence of the total severe accident probability for each nuclear unit in the one-year interval, equal 10^{-5};
- non-exceedence of the total probability of a large accident release for each NPP unit in the one-year interval, equal 10^{-7}; and
- non-exceedence 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.

In accordance with the requirements of the Russian federal standards and regulations, the NPP design should foresee the following engineered and organizational measures aimed at prevention of accidents and mitigation 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. If the said special engineered features are intended for accident management during first three days commencing the initiating event of the accident,

they, according to the federal standards and regulations, pertain to the safety important systems (components);
- 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 and safety checks system as part of implementation of Principle 2

In accordance with the requirements of the Federal Law No. 170-FZ "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 considering changes in characteristics of the NPP site, aging processes of NPP components (equipment, building structures), upgrades, operating experience, current level of development of science, technology and processes (reflected, among other, in the IAEA safety standards), as well as changes in regulatory framework.

Rostechnadzor and the Operating Organization:
- in 2014 adopted the perspective schedule of the periodic safety reviews of nuclear units in accordance with the provisions of the federal standards and regulations in the field of the use of atomic energy "General Safety Provisions of Nuclear Power Plants" (NP-001-15) and the safety guide in the use of atomic energy "Guide for Periodic Safety Review of the Nuclear Plant Unit" (RB-041-07);
- in 2015, to carry out the in-depth analysis of the safe operation of nuclear power plants of Rosenergoatom and a possibility of carrying out the comparative analysis with foreign NPPs, given the accumulated international experience (IAEA, WANO), the existing sectoral system of analysis of quantitative and qualitative indicators of NPP operation was revised; it was regulated by "Provisions for Annual Reports on Assessment of Safe Operation of Nuclear Units" (STO 1.1.1.04.001.0143-2015);

- carry out the in-depth safety assessments of NPP units, including probabilistic safety analyses of Levels 1 and 2 (PSA-1 and PSA-2) for units of existing NPPs;
- in 2014, developed and has been implemented in stages the action plan of the Regulatory Body regarding recommendations and proposals of the follow-up IAEA IRRS mission;
- have implemented the coordinated with the IAEA the long-term plan of OSART missions (until 2023) with a frequency of one NPP each two years; OSART missions were carried out at Kola and Novovoronezh NPPs; OSART missions are prepared at Leningrad and Kalinin NPP; IAEA OSART Corporate Mission to review centralized corporate functions of the Operating Organization is prepared to be held in 4th quarter of 2018; and
- starting from 2015, the findings of comprehensive inspections of NPP safety by the Regulatory Body are entered in the federal state information system.

Based on results of safety assessments, practically feasible or achievable improvements in the safety systems are timely introduced. Thus, based on results of safety assessment done when extending service life of Kola-3, large-scale work was done to reduce leak quantity from the sealed enclosure of the reactor installation (which is the confining safety system). Measures are implemented to fit sealed enclosures of reactor installations of Russian nuclear units with WWER reactors with hydrogen concentration monitoring systems and hydrogen evacuation systems to ensure integrity of the said sealed enclosures in accidents.

One more example of taking into account the results of done safety assessments is modernizations carried out when extending the service life of Novovoronezh-5:

- boric solution heating systems have been implemented in tanks and accumulators of ECCS; automation algorithms of ECCS have been modernized;
- the high-pressure boron injection system has been implemented to supply boric solution in the primary circuit under normal pressure;
- the new system of emergency feedwater with three physically separated independent channels has been implemented; and
- the new (additional) train of the emergency power supply system has been implemented with the electric equipment placed in a separate building; the equipment that exhausted its service life has been replaced in the remaining trains of the said system.

At nuclear units, the equipment of controlling safety systems is replaced with the modern equipment, where necessary. The large-scale modernization projects for controlling safety systems (installation of new

systems CPS-CCST) have been carried out at Kola 3&4. Based on results of safety assessments, at these units the measures to improve reliability of the supporting safety system have been carried out. They have covered the service water system of essential consumers (the system configuration was changed along with equipment locations, including pumps; this allowed for effective protection against common cause failures, for example, due to fire).

Also, an example of improvements introduced to the existing fleet of the system that perform safety functions at NPPs is the set of measures to outfit Russian nuclear units with additional mobile emergency equipment (diesel generators, mobile pumps and monoblock pumps) implemented in the light of the Fukushima-Daiichi accident.

Improvement of legal regulation of nuclear and radiation safety as part of implementation of Principle 3

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 number of new federal standards and regulations in the field of the use of atomic energy have been worked out:

- in 2016 the federal standards and regulations in the field of atomic energy “General Safety Provisions of Nuclear Power Plants” (NP-001-15) have been introduced to supersede the previous document, which take account of, in particular, provisions of new IAEA safety standards of “Specific Safety Requirements” related to nuclear plants: “Safety of Nuclear Power Plants. Design” (SSR-2/1) and “Safety of Nuclear Power Plants. Commissioning and Operation” (SSR-2/2). Also, NP-001-15 takes account of the provisions of INSAG publications (in particular, provisions of INSAG-4 on safety culture);
- in 2015 the federal standards and regulations “Basic Requirements for Probabilistic Safety Analysis” have been developed and put into force. They take account of provisions of the IAEA safety standards “Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants” (SSG-3) and “Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants” (SSG-4);
- in 2016 the federal standards and regulations in the field of the use of atomic energy “Requirements for Lifetime Management of Equipment and Pipelines of Nuclear Plants. Basic Provisions” (NP-096-15) have been developed and put into force. They implement requirements of the Russian federal standards and regulations “General Safety Provisions of

Nuclear Power Plants" (NP-001-15), as well as the IAEA safety standards SSR-2/1 regarding the necessity to manage aging of safety important systems and components;

- in 2016 the federal standards and regulations in the field of atomic energy "Rules of Layout and Operation of Confining Safety Systems of Nuclear Plants" have been revised and put into force. They take account, among other, of provisions of the IAEA safety standards SSR-2/1 and NS-G-1.10, as well as provisions brought to discussion by the IAEA Member States in the draft safety standard on containments of nuclear plants developed instead NS-G-1.10; and
- the revision continues of the federal standards and regulations in the field of atomic energy in accordance with the plan of revising in the light of lessons learned from the Fukushima-Daiichi accident, in particular, the rules of design of seismic NPPs, requirements for safety of siting nuclear power plants, federal standards and regulations for accounting of external impacts. Provisions of corresponding IAEA safety standards (both the existing safety requirements NS-R-3 and newly developed) are taking into account in revisions.

Appendix 4
Major Performance Indicators of Russian NPPs in 2013-2015

NPPs with WWER-440 reactors

Indicator	NPP	Kola				Novovoronezh		All WWER -440s
	Unit / year	1	2	3	4	3	4	
1. Operating time factor, %	2013	89.17	82.57	73.01	80.87	86.25	90.51	-
	2014	86.02	89.29	88.03	71.23	91.55	90.54	-
	2015	84.16	62.22	84.06	78.42	91.66	80.88	-
2. Capacity factor, %	2013	66.98	67.55	63.03	71.21	85.89	90.61	73.96
	2014	54.28	72.59	73.34	68.58	91.11	91.09	74.88
	2015	60.09	41.51	73.73	71.18	90.62	80.65	69.35
3. Availability factor, %	2013	83.98	82.80	73.85	83.47	86.65	92.25	83.73
	2014	86.19	90.24	87.84	72.32	92.29	92.25	86.76
	2015	84.21	85.34	85.79	88.70	91.55	82.01	86.26
4. Number of scrams per 7,000 hours of operation	2013	0.88	0	0	0.97	0	0	0.31
	2014	0	0	0	1.11	0	0	0.19
	2015	0	0	0	0	0	0	0

NPPs with WWER-1000 reactors

Indicator	NPP	Balakovo				Kalinin				Novo-voronezh	Rostov			All WWER-1000s
	Unit / year	1	2	3	4	1	2	3	4	5	1	2	3	
1. Operating time factor, %	2013	99.61	97.14	85.40	89.57	78.94	97.62	76.46	76.05	88.74	98.37	93.05	-	-
	2014	80.77	76.15	89.34	81.87	68.88	79.71	78.96	87.78	88.02	85.57	91.52	-	-
	2015	85.40	78.14	96.06	99.97	90.53	89.10	93.56	95.27	81.91	79.69	86.87	-	-
2. Capacity factor, %	2013	104.61	98.16	88.32	93.51	83.31	103.27	78.44	77.26	86.98	102.07	93.54	-	91.77
	2014	83.88	78.11	92.48	85.90	71.05	84.29	79.88	88.16	75.18	86.49	92.54	-	83.45
	2015	88.36	81.82	98.78	104.88	96.29	94.51	92.54	98.42	75.13	80.43	90.10	104.42	91.37
3. Availability factor, %	2013	104.61	100.22	89.22	93.81	83.33	103.87	78.44	77.47	87.26	103.65	96.03	-	92.54
	2014	84.39	78.91	93.01	86.12	71.54	84.54	80.52	89.36	75.27	88.72	94.95	-	84.30
	2015	89.18	82.12	100.21	105.66	96.69	94.85	93.72	98.65	75.30	80.69	90.82	104.42	91.96
4. Number of scrams per 7,000 hours of operation	2013	0.80	0	0	0	0.99	0	0	0	0	0	0	-	0.16
	2014	0	0	0	0	1.14	0	0.97	0.90	0	0.91	0	-	0.36
	2015	0	0	0	0	0	0	0	0.84	0	0	0	-	0.08

NPP with RBMK-1000 reactors

Indicator	NPP	Kursk				Leningrad				Smolensk			All RBMK-1000s
	Unit / year	1	2	3	4	1	2	3	4	1	2	3	
1. Operating time factor, %	2013	82.39	18.13	91.58	77.71	10.00	59.14	85.00	88.34	94.37	34.77	96.71	-
	2014	78.14	80.03	85.68	93.61	81.71	50.29	93.93	87.49	87.79	97.30	82.40	-
	2015	85.41	81.73	92.17	83.88	69.81	83.52	87.08	84.63	84.51	89.15	95.48	-
2. Capacity factor, %	2013	83.27	19.42	89.82	76.52	6.66	41.63	85.13	86.48	95.62	32.46	98.10	65.01
	2014	77.31	77.66	86.04	92.56	74.44	40.01	89.19	85.98	89.63	95.62	84.96	82.25
	2015	84.46	80.80	90.80	83.10	66.51	80.70	84.42	82.18	86.33	90.33	99.40	84.46
3. Availability factor, %	2013	83.65	19.42	90.35	76.97	6.87	42.40	85.87	87.65	96.16	33.12	98.72	65.56
	2014	77.81	79.63	86.69	93.06	75.39	40.81	91.56	87.71	89.90	96.95	85.18	82.25
	2015	85.89	82.02	91.54	84.88	69.87	82.97	88.30	87.19	86.46	90.53	99.40	86.28
4. Number of scrams per 7,000 hours of operation	2013	0.96	0	0	0	0	0	0.93	0.90	0.84	0	0.82	0.45
	2014	0	0	0	0.85	0.97	0	0	0.91	0.91	0	0	0.33
	2015	0	0	0	0	1.14	0	0	0	0	0.89	0	0.18

NPPs with BN-600 and EGP-6 reactors

Indicator	NPP	Beloyarsk NPP (BN-600)	Bilibino NPP (EGP-6)				All NPPs with EGP-6
	Unit / year	3	1	2	3	4	
1. Operating time factor, %	2013	84.45	72.21	78.81	84.88	85.30	-
	2014	85.09	80.02	73.71	75.52	82.04	-
	2015	84.63	79.80	72.27	83.76	72.00	-
2. Capacity factor, %	2013	78.39	45.43	51.46	52.73	55.43	51.26
	2014	86.06	53.28	49.01	53.09	54.11	52.37
	2015	86.10	49.31	46.85	60.76	48.43	51.34
3. Availability factor, %	2013	78.57	78.14	85.16	84.95	86.80	83.76
	2014	86.06	81.32	84.15	75.56	83.83	81.21
	2015	86.10	80.31	72.48	84.39	74.88	78.01
4. Number of scrams per 7,000 hours of operation	2013	0	1.08	0	0	0	0.27
	2014	0	0	0	0	0	0
	2015	0.92	0	1.09	0	0	0.27

Appendix 5
Measures Taken in the Light of Lessons of Fukushima-Daiichi Accident

Short-term measures

1) Additional mobile emergency equipment (diesel generators, mobile pumps, monoblock pumps) has been delivered to NPP and prepared for use. Its storage places have been arranged for; persons responsible for its operation have been appointed; periodic performance checks and maintenance are carried out.

2) The additional (as compared to the list of scenarios considered in safety analysis reports) analysis of scenarios of beyond design basis accidents taking account of lessons learned from the Fukushima-Daiichi accident has been carried out.

3) The analysis of plant emergency documentation, including sufficiency of the said documentation to regulate accident management actions of the NPP personnel related to external impacts has been carried out.

4) Changes have been made to the emergency documentation of NPPs; the maps of the personnel actions to manage beyond design basis accidents have been additionally developed.

5) The number of scheduled emergency drills to master the personnel actions in case of beyond design basis accidents has been increased twice.

6) The back-up (additional) sources of service water have been identified at each NPP to be used in case of beyond design basis accidents, including severe accidents.

7) Terms of reference for additional design solutions to improve robustness of operating Russian NPPs (the said additional solutions are implemented as part of mid-term and long-term measures) have been drawn out.

Mid-term measures

1) Sets of design documentation have been produced. They are aimed at implementation of additional design solutions at NPPs to prevent beyond design basis accidents, including severe accidents. These additional design solutions have been implemented, including the purchase of component parts and materials, construction, installation, start-up and adjustment works.

2) The analysis of accident impacts on hydraulic structures with overlapping failures has been performed for Balakovo and Novovoronezh NPP.

3) The analysis of beyond design basis accidents at NPPs under external impacts of higher intensity of natural and man-induced origin, including the analysis of SNF safety in at-reactor pools and SNF on-sire storages has been carried out.

4) The analysis (expanded regarding BDBAs presented in safety analysis reports) of beyond design basis accident development and their radiation consequences for units with the reactor installations WWER-440 and WWER-1000 has been carried out.

5) The additional analysis of severe accidents for operating nuclear units has been carried out.

7) The input data and technical requirements have been developed to design the emergency gas evacuation system from leak-tight rooms of NPPs with WWER, and the analysis of expediency of its deployment has been carried out taking account of the use of mobile emergency equipment.

8) At all NPPs and in the Crisis Center of Rosenergoatom the radio communication system of TETRA standard has been deployed.

9) The expediency analysis of implementation of outer cooling of WWER reactor vessel in beyond design basis accidents has been carried out.

10) The analysis of necessity of installation of hydrogen explosion safety systems for RBMK-1000 units, in rooms with possible release of hydrogen, has been carried out. The terms of reference for monitoring of the content and evacuation of hydrogen from ALS rooms are carried out.

11) Additional special machinery (crane trucks, tractor units, fuel trucks, caterpillars etc.) to be used in management and elimination of consequences of beyond design basis accidents, including severe accidents, has been procured and delivered to NPPs.

12) Additional independent pumps of high capacity “Bolshoi potok” for Kalinin and Smolensk NPP have been purchased and delivered to NPPs.

13) The facilities for cutting and storage of spent nuclear fuel at Leningrad and Kursk NPP have been commissioned. At Smolensk NPP this facility is commissioned and will be completed as scheduled. SNF is fragmented and shipped off from RBMK sites to FSUE “Mining and Chemical Combine”.

14) Spent nuclear fuel is shipped off from NPPs with WWER-440 reactors to the plant that recycles nuclear fuel; fuel from NPPs with WWER-1000 reactors is shipped off to FSUE “Mining and Chemical Combine” for long-term storage.

15) Additional studies of seismic microzoning of NPP sites have been performed; margin coefficients of seismic hazard have been calculated; accelerograms and response spectra under seismic impacts have been synthesized.

16) The reactor seismic protection system has been commissioned at units of Kola, Leningrad, Novovoronezh, Smolensk and Kursk NPP. This system was commissioned earlier at the rest of operating nuclear units, except for Bilibino NPP.

17) The design documentation has been drawn out to design an emergency and post-accident sampling system at NPPs with WWERs. This system has been installed and commissioned at units of Kola NPP.

18) List of beyond design basis accidents for nuclear power units with WWER-440 and WWER-1000 reactors have been added and justified.

19) Beyond design basis accident management guides have been developed for Balakovo, Kalinin, Kola, Novovoronezh and Rostov NPPs.

Appendix 6
Major Safety and Reliability Activities Undertaken as Part of Upgrading Some of the Russian NPP Units in 2013-2015

Balakovo NPP

Unit	Activity
Nos. 1, 2	Equipment of units with cranes KR-308D for M&R of pre-stressed containment components
Nos. 1-4, BOP	Implementation of additional design solutions to mitigate consequences of beyond design basis accidents in planned scope
BOP	Modernization of radiation monitoring posts in the 30-kilometer zone
Nos. 1, 3, 4	Modernization of turbine generator’s vibration protection
Nos. 4, 3	Outfitting steam generator’s pilot operated relief valve (PORV SG) with a diagnostic system
No. 3	Implementation of pulse unloading system at turbine K-1000-60/1500-2
No. 3	Replacement of copper-containing equipment in the feedwater system (replacement of TFP condenser)
No. 3	Implementation of the prompt operator’s information display system on current state of the reactor installation (RI) and NPP as a whole
No. 4	Replacement of generator circuit breaker with HF6 circuit breaker HEC-7

Beloyarsk NPP

Unit	Activity
Nos. 3, BOP	Implementation of additional design solutions to mitigate consequences of beyond design basis accidents in planned scope
No. 3	Modernization of the power system of vibration protection of bearings 4, 5, 6 TG
No. 3	Modernization of the system for keeping diesels in hot stand-by and emergency DG cooling system by diesel generator station No. 2
No. 3	Modernization of primary sodium clean-up system
BOP	Replacement of air-cooled circuit breakers 220 kV and protections at connections of ORU-220 kV
No. 3	Implementation of diagnostic and monitoring system of turbine generators TG-4,5,6
No. 3, BOP	Making service water pipelines of stages 1 and 2 seismically stable

Bilibino NPP

Unit	Activity
Nos. 1-4, BOP	Implementation of additional design solutions to mitigate consequences of beyond design basis accidents in planned scope
BOP	Replacement of fire trucks and fire equipment
No. 4	Replacement of circulation pump TsN-4B with a pump of higher production capacity
BOP	Replacement of oil-filled electric equipment in indoor switchyard (ZRU-110 kV) with similar HF6 equipment
BOP	Modernization of communication systems at NPP facilities

Kalinin NPP

Unit	Activity
Nos. 1-4, BOP	Implementation of additional design solutions to mitigate consequences of beyond design basis accidents in planned scope
No. 1	Modernization of the CPS storage battery
No. 3	Modernization of emergency and scheduled cooldown system's pumps
No. 3	Modernization of seals of PGV-1000
No. 1	Modernization of electric equipment of the reactor control and protection system (SUZ 110 V) at Unit 1
Nos. 1, 3	Replacement of copper-containing heat-exchanging equipment of the secondary circuit
No. 3	Modernization of shrouds of drive mechanisms of the reactor control and protection system CPS
No. 1	Modernization of containment testing system (CTS)
No. 1	Modernization of TG excursion protection
No. 2	Modernization of pilot operated relief valves of the pressurizer (replacement with Bopp & Reuther)
No. 2	At Unit 2 the implementation of the participation mode in the general primary control of the grid frequency (GPCF)

Kola NPP

Unit	Activity
Nos. 1-4, BOP	Implementation of additional design solutions to mitigate consequences of beyond design basis accidents in planned scope
Nos. 1-3	Implementation of the emergency primary coolant sampling system
No. 2	Implementation of reactor seismometric monitoring and protection system
No. 2	Implementation of hydrogen explosion safety system
No. 4	Loosening of primary equipment and pipelines
No. 1	Modernization of electric protections of diesel generators
No. 1	Implementation of the system for archiving parameters and malfunctions of electric equipment of CPS
Nos. 1-4	Modernization of the vibration monitoring system as regards introducing changes to the operating algorithm of protection from higher vibration of turbine generator
No. 1	Replacement of storage batteries of the emergency power

	supply system (SB EPPS) of the direct current consumers of Group I
No. 3	Modernization of containment components as relates to reconstruction of sealing lining and reconstruction of seals at doors and airlocks
No. 4	Modernization of the scheduled cooldown system of the primary circuit of Stage II with replacement of pumps (4RR10,30,50D01)

Kursk NPP

Unit	Activity
Nos. 1-2	Lifetime performance recovery of graphite stack at Units 1 and 2
Nos. 1-4, BOP	Implementation of additional design solutions to mitigate consequences of beyond design basis accidents in planned scope
No. 2	Modernization of pilot operated relief valves of main safety valves (MSV)
No. 2	Modernization of electrical equipment of ORU-330 kV (replacement of voltage transformers, air-cooled circuit breakers, disconnectors)
No. 2	Modernization of software and hardware complex of automated coolant leak detection system (ACLDS)
No. 2	Modernization of equipment of refueling machine of Unit 2
No. 3	Modernization of emergency reactor cooling system (ERCS) of Unit 3
Nos. 1-4	Implementation of seismic protection of reactor installations of the units

Leningrad NPP

Unit	Activity
Nos. 1-4, BOP	Implementation of additional design solutions to mitigate consequences of beyond design basis accidents in planned scope
Nos. 1, 2	Lifetime performance recovery of graphite stack at Units 1 and 2
No. 2	Modernization of fire alarm and fire-extinguishing systems with replacement of generators of fire-extinguishing aerosol
Nos. 1-4	Implementation of reactor seismic protection system
Nos. 3, 4	Implementation of vibration monitoring system of the essential rotor equipment of turbine generators
Nos. 1-4	Replacement of servo-drives CPS at Units 1,2,3,4

Novovoronezh NPP

Unit	Activity
Nos. 3-5, BOP	Implementation of additional design solutions to mitigate consequences of beyond design basis accidents in planned scope
No. 5	Replacement of reinforcement wires SPN-1000 at Unit 5 with reinforcement bundles SPZO-M
BOP	Modernization of ORU-500 kV with replacement of current and voltage transformers, air-cooled circuit breakers and their RPA units

Rostov NPP

Unit	Activity
Nos. 1-2, BOP	Implementation of additional design solutions to mitigate consequences of beyond design basis accidents in planned scope
No. 1	Modernization of sealing units of steam generators PGV-1000M
No. 1	Replacement of electric equipment of the reactor upper unit with the longer service equipment
Nos. 1, 2	Replacement of tubular electric heaters in pressurizer
No. 2	Replacement of shrouds of CPS drives ShEM-3 at Unit 2 with modernized ones
Nos. 1, 2	Modernization of sealing units of main expansion joints of

	pumps GTsN-195M

Smolensk NPP

Unit	Activity
Nos. 1-3, BOP	Implementation of additional design solutions to mitigate consequences of beyond design basis accidents in planned scope
No. 2	Replacement of delivery and check valves GTsN DN800
No. 2	Modernization of automatic control and protection system (ACPS)
Nos. 1-3	Implementation of emergency reactor seismic monitoring and protection system
No. 2	Implementation of fixed system of vibration monitoring and diagnostic of reactor coolant pumps
No. 2	Replacement of pilot operated relief valve (PORV) Tandem by Sebim with PORV Energomash (Chekhov) - ChZEM
Nos. 2, 3	Replacement of components of storage batteries VARTA installed at BDGS

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 sixth National Report

1. NP-001-15. General Safety Provisions of Nuclear Power Plants.
2. NP-002-15. Safety Rules for Management of Radioactive Waste of Nuclear Plant.
3. NP-005-16. Provisions on the Procedure of Declaring an Emergency, Operative Information Transmission and Organization of Urgent Assistance to Power Plants in Cases of Radiation-Hazardous Situations.
4. NP-010-16. Rules of Layout and Operation of Confining Safety Systems of Nuclear Power Plants.
5. NP-019-15. Collection, Reprocessing, Storage and Conditioning of Liquid Radioactive Waste. Safety Requirements.
6. NP-020-15. Collection, Reprocessing, Storage and Conditioning of Solid Radioactive Waste. Safety Requirements.
7. NP-021-15. Gaseous Radioactive Waste Management. Safety Requirements.
8. NP-083-15. Requirements for Physical Protection Systems of Nuclear Material, Nuclear Installations and Nuclear Material Storage Facilities.
9. NP-084-15. Rules of Monitoring of Base Metal, Welds and Overlays in Operation of Equipment, Pipelines and Other Components of Nuclear Plants.
10. NP-089-15. Rules of Layout and Safe Operation of Equipment and Pipelines of Nuclear Power Installations.
11. NP-091-14. Decommissioning Safety of Nuclear Facilities. General Provisions.
12. NP-094-15. Basic Requirements for Justification of Strength and Thermal Mechanical Behavior of Fuel Assemblies and Fuel Rods in Cores of WWER Reactors.
13. NP-095-15. Main Requirements to the Probabilistic Safety Analysis.
14. NP-096-15. Requirements for Lifetime Performance Management of Equipment and Pipelines of Nuclear Plants. Basic Provisions.

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 sixth National Report

Administrative Regulations

1. Administrative Regulation on Implementation of the State Function of Licensing Activities in the Field of the Use of Atomic Energy by the Federal Environmental, Industrial and Nuclear Supervision Service.

2. Administrative Regulation on Providing the State Services of Establishing Guidelines of Maximum Permissible Releases of Radioactive Substances in the Atmospheric Air and Guidelines of Maximum Permissible Discharges of Radiative Substances in Water Reservoirs, Issue of Permits for Releases and Discharges of Radioactive Substances into the Environment by the Federal Environmental, Industrial and Nuclear Supervision Service (the existing document has been amended).

3. Administrative Regulation on Performance of the State Function of the Federal State Supervision in the Field of the Use of Atomic Energy (the existing document has been amended).

4. 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 existing document has been amended).

Safety Guides in the Use of Atomic Energy

1. RB-021-14. Basic Recommendations to Writing the Probabilistic Safety Analysis Level 1 for a Nuclear Power Unit under Initiating Events due to External Impacts of Natural and Man-Induced Origin.
2. RB-087-13. Recommendations for Procedure of Ensuring Reliability of Nuclear Facilities.
3. RB-088-14. Unified Methodologies of Inspection of Base Materials Semi-Finished Products), Welds and Overlays of Equipment and Pipelines of Nuclear Power Installations. Eddy Current Testing.
4. RB-089-14. Unified Methodologies of Inspection of Base Materials Semi-Finished Products), Welds and Overlays of Equipment and Pipelines of Nuclear Power Installations. Visual and Instrumental Inspection.
5. RB-090-14. Unified Methodologies of Inspection of Base Materials Semi-Finished Products), Welds and Overlays of Equipment and Pipelines of Nuclear Power Installations. Dye Penetrant Testing.
6. RB-091-13. Assessment of Current Safety Level of Nuclear Facilities.
7. RB-093-14. Radiation and Thermal Physics Characteristics of Spent Nuclear Fuel of Water-Water Power Reactors and Large Power Pressure-Tube Reactors.
8. RB-094-14. Minimization of Radiation Consequences for the Population and Personnel in Elimination of Accident Consequences at Nuclear Power Units of Different Types. Methodology for Optimization of Population and Territories Protective Measures.
9. RB-095-14. Recommendations on Application of Seals in the System for Control and Accounting of Radioactive Substances and Radioactive Waste.
10. RB-096-14. Structure and Content of the Procedure for Control and Accounting of Radioactive Substances and Radioactive Waste in an Organization.
11. RB-097-14. Physical Inventory-Taking of Nuclear Material.
12. RB-098-14. Recommendations for Application of Seals in the System of Control and Accounting of Nuclear Material.

13. RB-100-15. Recommendations to the Procedure of Conducting Reliability Analysis of Safety Important Systems and Components of Nuclear Plants and Their Functions.
14. RB-102-15. Recommendations to the Structure and Content of a Beyond Design Basis Accident, Including Severe Accident, Management Guide.
15. RB-106-15. Recommended Methodologies for Calculation of Parameters Necessary for Development and Establishing Guidelines of Maximum Permissible Releases of Radioactive Substances in the Atmospheric Air.
16. RB-110-16. Recommendations for Development of Quality Assurance Programs in Transportation of Radioactive Materials.

Appendix 9
Financing of Rostechnadzor from the Federal Budget of the Russian Federation in 2013-2016

Salary budget (including accruals) of the interregional territorial department for supervision over nuclear and radiation safety of Rostechnadzor in 2013-2016

Year	2013	2014	2015	2016
Salary budget including accruals, RUB thou	370341.7	432333.8	414308.5	455719.5
% to 2013	100	116.7	111.9	123.1
Staff schedule of ITD for supervision over NRS, people	942	942	942	847
Salary including accruals for one full-time equivalent in ITD for supervision over NRS, RUB thou	393.1	459.0	439.8	538.0
% to 2013	100	116.7	111.9	136.9

Appendix 10
Qualitative Risk Assessments (PSA-1) for Nuclear Units with Pressure-Tube and Fast Neutron Reactors

NPP, unit	Reactor type	Integral Severe Core Damage Frequency, 1/reactor·year
Beloyarsk, Unit 3	BN-600	$3.6 \cdot 10^{-5}$
Beloyarsk, Unit 4	BN-800	$2.0 \cdot 10^{-6}$
Bilibino, Unit 1	EGP-6	$1.15 \cdot 10^{-5}$
Bilibino, Unit 2	EGP-6	$1.15 \cdot 10^{-5}$
Bilibino, Unit 3	EGP-6	$1.15 \cdot 10^{-5}$
Bilibino, Unit 4	EGP-6	$1.15 \cdot 10^{-5}$
Kursk, Unit 1	RBMK-1000	$9.85 \cdot 10^{-6}$
Kursk, Unit 2	RBMK-1000	$7.47 \cdot 10^{-6}$
Kursk, Unit 3	RBMK-1000	$7.77 \cdot 10^{-5}$
Kursk, Unit 4	RBMK-1000	$8.22 \cdot 10^{-5}$
Leningrad, Unit 1	RBMK-1000	$1.13 \cdot 10^{-5}$
Leningrad, Unit 2	RBMK-1000	$8.8 \cdot 10^{-6}$
Leningrad, Unit 3	RBMK-1000	$1.38 \cdot 10^{-5}$
Leningrad, Unit 4	RBMK-1000	$1.23 \cdot 10^{-5}$
Smolensk, Unit 1	RBMK-1000	$2.82 \cdot 10^{-5}$
Smolensk, Unit 2	RBMK-1000	$5.13 \cdot 10^{-5}$
Smolensk, Unit 3	RBMK-1000	$2.67 \cdot 10^{-5}$

Appendix 11
Qualitative Risk Assessments (PSA-1) for Nuclear Units with WWER Reactors

NPP, unit	Reactor type	Integral Severe Core Damage Frequency, 1/reactor·year
Balakovo, Unit 1	WWER-1000	$2.2 \cdot 10^{-5}$
Balakovo, Unit 2	WWER-1000	$2.2 \cdot 10^{-5}$
Balakovo, Unit 3	WWER-1000	$2.2 \cdot 10^{-5}$
Balakovo, Unit 4	WWER-1000	$2.2 \cdot 10^{-5}$
Kalinin, Unit 1	WWER-1000	$1.87 \cdot 10^{-5}$
Kalinin, Unit 2	WWER-1000	$4.9 \cdot 10^{-5}$
Kalinin, Unit 3	WWER-1000	$1.49 \cdot 10^{-5}$
Kalinin, Unit 4	WWER-1000	$7.39 \cdot 10^{-6}$
Kola, Unit 1	WWER-440	$8.62 \cdot 10^{-6}$
Kola, Unit 2	WWER-440	$8.58 \cdot 10^{-6}$
Kola, Unit 3	WWER-440	$7.46 \cdot 10^{-6}$
Kola, Unit 4	WWER-440	$8.32 \cdot 10^{-6}$
Novovoronezh, Unit 3	WWER-440	$3.00 \cdot 10^{-5}$
Novovoronezh, Unit 4	WWER-440	$5.10 \cdot 10^{-5}$
Novovoronezh, Unit 5	WWER-1000	$9.4 \cdot 10^{-6}$
Rostov, Unit 1	WWER-1000	$3.32 \cdot 10^{-5}$
Rostov, Unit 2	WWER-1000	$2.66 \cdot 10^{-5}$
Rostov, Unit 3	WWER-1000	$1.68 \cdot 10^{-5}$

Appendix 12
Qualitative Risk Assessments (PSA-2) for Nuclear Units with WWER Reactors

NPP, unit	Reactor type	Integral Severe Core Damage Frequency, 1/reactor·year
Balakovo, Unit 1*	WWER-1000	$4.6 \cdot 10^{-6}$
Balakovo, Unit 2*	WWER-1000	$4.6 \cdot 10^{-6}$
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	$2.28 \cdot 10^{-6}$
Kalinin, Unit 2	WWER-1000	$1.86 \cdot 10^{-6}$
Kalinin, Unit 3	WWER-1000	$4.7 \cdot 10^{-6}$
Kalinin, Unit 4	WWER-1000	$3.51 \cdot 10^{-7}$
Kola, Unit 1	WWER-440	$4.38 \cdot 10^{-6}$
Kola, Unit 2	WWER-440	$5.89 \cdot 10^{-6}$
Kola, Unit 3	WWER-440	$2.53 \cdot 10^{-6}$
Kola, Unit 4	WWER-440	$2.66 \cdot 10^{-6}$
Novovoronezh, Unit 3	WWER-440	**
Novovoronezh, Unit 4	WWER-440	**
Novovoronezh, Unit 5	WWER-1000	$6.22 \cdot 10^{-6}$
Rostov, Unit 1	WWER-1000	$3.4 \cdot 10^{-6}$
Rostov, Unit 2	WWER-1000	$9.01 \cdot 10^{-7}$
Rostov, Unit 3	WWER-1000	$2.2 \cdot 10^{-7}$

* Results of PSA were reviewed by Rostechnadzor.
** Assessment results will be provided later.

Appendix 13
Distribution of Operational Events at Russian NPPs, as per INES Scale, in 2013 - 1st Half of 2016

NPP	Number of NPP operational events by INES levels											
	2013			2014			2015			1st half of 2016		
	Out of scale	0	1	Out of scale	0	1	Out of scale	0	1	Out of scale	0	1
Balakovo	-	3	-	2	1	-	-	-	-	1	-	-
Kalinin	-	4	1	-	5	-	-	7	1	-	2	-
Kola	2	4	-	3	1	-	1	3	-	-	1	-
Novovoronezh	-	1	-	2	1	-	-	1	-	1	1+ 1***	-
Rostov	2	2	-	2+1*	2	-	1*	2	-	-	-	-
Kursk	2	5	-	2	7	-	1	2	1	-	2	-
Leningrad	3	5	-	2	2	-	1	7	-	-	2	-
Smolensk	-	4	-	4	1	-	2	2	-	-	3	-
Beloyarsk	1	1	-	1	2**	2**	1	-	1	2**	1+ 4**	-
Bilibino	1	1	-	-	-	-	-	1	-	-	-	-
Total	11	30	1	18+ 1*	20+ 2**	2**	6+1*	25	3	2+ 2**	12+ 4**+ 1***	-
	42			38+1*+4**			34+1*			14+6**+1***		

* Number of operational events at Rostov-3, which is in pilot commercial operation. Rostov-3 put in commercial operation on 17.09.2015.
** Number of operational events at Beloyarsk-4, which is at commissioning stages.
*** Number of operational events at Novovoronezh II/1, which is at the stage of commissioning (first criticality).

Appendix 14
Statistics on Deviations at Russian NPPs in 2013 – 1st Half of 2016

NPP	Number of deviations at NPPs			
	2013	2014	2015	1st half of 2016
Balakovo	37	38	37	8
Kalinin	67	46	39	30
Kola	23	23	28	21
Novovoronezh	23	22	22	14
Rostov	16	15	20	6
Kursk	29	36	21	6
Leningrad	52	58	31	21
Smolensk	34	38	26	11
Beloyarsk	34	56	61	14
Bilibino	29	19	17	4
Total	344	351	302	135