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

Sixth Review Meeting
under the Convention on Nuclear Safety

Moscow 2013

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The Sixth National Report of the Russian Federation on the fulfillment of commitments resulting from the Convention on Nuclear Safety for the period from May 2010 to July 2013 was prepared in compliance with Article 5 of the Convention on Nuclear Safety.

The Report was prepared taking into account the recommendations given in the Convention on Nuclear Safety, in the IAEA guidelines on preparation of national reports ("Guidelines Regarding National Reports under the Convention on Nuclear Safety", INFCIRC/572/Rev.4 with amendments made at the 2nd Extraordinary Meeting under the Convention on Nuclear Safety), and in the Summary Report of the 5th Meeting of the Contracting Parties to the Convention on Nuclear Safety held on 4-14 April 2011.

The Report was prepared by the Federal Environmental, Industrial and Nuclear Supervision Service (Rostechnadzor) and the State Atomic Energy Corporation "Rosatom" with contributions from:

- Russian Concern for the Production of Electrical and Thermal Energy at Nuclear Plants (Rosenergoatom Concern);
- All-Russian Research Institute for Nuclear Power Plants Operation (VNIIAES);
- Scientific and Engineering Centre for Nuclear and Radiation Safety (SEC NRS).

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List of Acronyms

AC	- analytical centre
Ac	- actuator
ACLDS	- automated coolant leak detection system
ACS	- automatic control system
AEP	- Atomenergoproekt, open joint-stock company
AER	- Atomenergoremont, open joint-stock company
AFA	- automatic fire alarm
AFAS	- automatic fire alarm system
AFES	- automatic fire-extinguishing system
AHCP	- affected half cooling pump
AHTG	- air-hydrogen-cooled turbine generator
APC	- automatic power controller
APCS	- automated process control system
ARMS	- automatic radiation monitoring system
ASSET	- Analysis of Safety Significant Events Team (IAEA)
ATE	- Atomtechenergo, open joint-stock company
AZ	- emergency protection
BDBA	- beyond design basis accident
BN	- sodium-cooled fast neutron reactor
Bq	- Becquerel (activity measurement unit)
CA	- controlled area
CCS	- centralized control system
CD	- civil defense
CF	- capacity factor
CICS	- centralized and individual control system
CITD	- Central Interregional Territorial Department (for supervision of nuclear and radiation safety)
CJSC	- closed-type joint stock company
CPS	- control and protection system
CSS	- controlling safety system
DCB	- direct current board
DITD	- Don Interregional Territorial Department (for supervision of nuclear and radiation safety)
ECS AHE	- emergency cool down system through air heat exchanger
EGP	- graphite-moderated loop-type power reactor
EI&C	- emergency instrumentation and controls
EMERGCOM of Russia	- Russian Federation Ministry for Civil Defense, Emergency Management and Response to Natural Disasters
EMRDC FMBA	- FMBA, Emergency Medical Radiation Dosimetry Centre
EPSS	- emergency power supply system

ERC - Emergency Response Centre (Rosenergoatom)
ERCS - emergency reactor cooling system
ERPPS - emergency reactor process protection system
ETC - emergency technical centre
EUPS - emergency uninterruptible power supply
FA - fuel assembly
FBE - federal budgetary establishment
FMBA - Federal Medical Biological Agency
FNHPP - floating nuclear heat-and-power plant
FSB - Federal Security Service of Russia
FSR - federal standards and rules
FSS - full-scope simulator
FSUE - federal state-owned unitary enterprise
GD - guidance document
GOST - Russian national standard
HD - heater drains
HPC - high-pressure cylinder
HPH - high-pressure heater
HWSG - horizontal water-cooled steam generator
I&C - instrumentation and controls
IAC - Information and Analytical Centre (Rostechnadzor)
IAEA - International Atomic Energy Agency
IBRAE RAS - Nuclear Safety Institute of the Russian Academy of Sciences
ICMS - in-core monitoring system
ICRP - International Commission for Radiological Protection
IMCPS - integrated monitoring, control and protection system
INES - International Nuclear and Radiological Event Scale
INPO - Institute of Nuclear Power Operations (USA)
INSAG - International Nuclear Safety Advisory Group
IRG - inert radioactive gases
IRS - International Reporting System for Operating Experience (IAEA/NEA)
ISA - in-depth safety assessment
ISAR - in-depth safety analysis report
ISO - International Standardization Organization
IT MOI - Interior Troops of the Ministry of Interior of Russia
ITD - Interregional Territorial Department
LC - license conditions
LPC - low-pressure cylinder
LRW SF - liquid radioactive waste storage facility
LTPR - life-time performance recovery
M&R - maintenance and repair
M&RS - maintenance and repair system

MCB	- main control board
MCR	- main control room
MDG	- mobile diesel generator
MFCC	- multiple forced circulation circuit
MM	- mass media
MOX-fuel	- mixed uranium-plutonium oxide fuel
MPS	- mobile pumping system
MSR	- moisture separator-reheater
NCMC	- National Crisis Management Centre
NEA	- Nuclear Energy Agency of the Organization for Economic Cooperation and Development
NEITD	- North European Interregional Territorial Department (for supervision of nuclear and radiation safety)
NF	- nuclear facility (see context)
NF	- nuclear fuel
NFMI	- neutron flux monitoring instrumentation
NHCP	- non-affected half cooling pump
NI	- nuclear installation
NIAEP	- Nizhniy Novgorod Engineering Company "Atomenergoproekt", open joint-stock company
NM	- nuclear material
NP	- nuclear plant
RPA "Typhoon"	- Research and Production Association "Typhoon"
NPP	- nuclear power plant
NRC KI	- Nuclear Research Centre "Kurchatov Institute"
NSC IPPE	- National Scientific Centre "A.I. Leipunsky Institute of Physics and Power Engineering", federal state-owned unitary enterprise
ODS	- outdoor switchyard
OE	- operating experience
OJSC	- open-type joint stock company
OKB GP	- Experimental Design Bureau "Gidropress", open joint-stock company (OKB Gidropress)
OKBM	- I.I. Afrikantov Experimental Mechanical Engineering Bureau, open joint-stock company (OKBM Afrikantov)
OKChS	- Rosatom's Commission for Management of Emergencies
OO	- Operating Organization
OPAS	- Team for Emergency Assistance to Nuclear Plants
OPB	- Basic Safety Rules for Nuclear Plants
OSART	- Operational Safety Review Team (IAEA)
OSChS	- Industry-level System for Prevention and Management of Emergencies (Rosatom)
OSPORB	- Basic Sanitary Rules of Radiological Safety
PCCS	- plant common compressor station

PCF	- plant common facilities
PCL	- power control and limitation
PCSS	- process control safety system
PEU	- plant electrolysis unit
POKAS	- quality assurance program
PP	- preventive protection
PRIS	- Power Reactor Information System (IAEA)
PSA	- probabilistic safety analysis
PSAR	- Preliminary Safety Analysis Report [of NP]
PT	- pressure tube
R&A	- relaying and automation
R&AD	- relay and automation device
RAW	- radioactive waste
RB	- reactor building
RB RPS	- reactor building reliable power supply
RBMK	- high-power channel-type reactor
RCP	- reactor coolant pump
RHE	- regenerative heat exchanger
RM	- refueling machine
RM	- resource management
Rosatom	- State Atomic Energy Corporation "Rosatom"
Rosenergoatom	- Russian Concern for the Production of Electrical and Thermal Energy at Nuclear Plants, open joint-stock company
Rostechnadzor	- Federal Environmental, Industrial and Nuclear Supervision Service
RS	- radioactive substances
RSChS	- National System for Prevention and Management of Emergencies
RSS	- Radiation Safety Standards
SAA	- spent additional absorbers
SAI OE	- System for Analysis and Use of Information on Operating Experience of Nuclear Power Plants
SAMG	- Severe Accident Management Guide
SCC	- Situation and Crisis Centre (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)
SCPG	- self-centering packing gland
SCS	- spray cooling system
SDGS	- stand-by diesel generator station
SEC NRS	- Scientific and Engineering Centre on Nuclear and Radiation Safety, federal budgetary establishment

	(STSO of Rostechnadzor)
SFA	- spent fuel assembly
SFEITD	- Siberia and Far East Interregional Territorial Department (for supervision of nuclear and radiation safety)
SFP	- spent fuel pool
SG	- steam generator (see context)
SG	- Safety Guide (see context)
SMPNF	- small and medium power nuclear facilities
SNF	- spent nuclear fuel
SNF SF	- spent nuclear fuel storage facility
SO-CDO NPS	- System Operator – Central Dispatcher Office of the National Power System, open joint-stock company
SPbAEP	- St. Petersburg Research and Design Institute "Atomenergoproekt", open joint-stock company
SPS	- seismic protection system
SRW	- solid radioactive waste
SRW SF	- solid radioactive waste storage facility
SS	- safety system
SSE	- safe shutdown earthquake
SSSV	- special spring-operated safety valve
STSO	- scientific and technical support organization
Sv	- Sievert (dose equivalent measurement unit)
SV	- safety valve
TC	- training centre
TFP	- turbo-feeding pump
TG	- turbine generator
TGV	- throttle governing valve
TH	- turbine hall
TSC	- technical support centre
TTMP	- target technical modernization programs
UEFS	- unified engineered features set
UITD	- Urals Interregional Territorial Department (for supervision of nuclear and radiation safety)
UPS	- uninterruptible power supply
VITD	- Volga Interregional Territorial Department (for supervision of nuclear and radiation safety)
VNIIAES	- All-Russian Research Institute for Nuclear Power Plants Operation, open joint-stock company
WANO	- World Association of Nuclear Operators
WWER	- 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 under its authority the federal energy systems, the nuclear power and fissionable materials;
- the federal laws "On the Use of Atomic Energy", "On the Radiological Safety of the Public", "On the Environmental Protection".

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 bears whole responsibility for the safety of a nuclear installation as well as for the safe management of nuclear material and radioactive waste.

Until recent there has been one Operating Organization – the Russian Concern for the Production of Electrical and Thermal Energy at Nuclear Plants (Rosenergoatom Concern) – which incorporates all 10 operating nuclear power plants.

In 2011 the company AKME-engineering was granted the status of an Operating Organization. The company's activities include development, construction and operation, in future, of small and medium nuclear power facilities ranging from 100 MW up to 600 MW in Russia and abroad.

Nuclear power development in the Russian Federation is defined by the "Long-Term Program of State Atomic Energy Corporation "Rosatom" Activities (2009-2015)" endorsed by the Russian Federation Government Ordinance No. 705 of 20 September 2008.

The main declared goals of the "Program…" include:

- energy security and guaranteed energy supply to the national economy and to the public with absolute fulfillment of nuclear and radiation safety rules established with regard to the use of atomic energy;

– innovative expansion of the nuclear industry, including design of nuclear reactor installations of a new generation and development of a closed fuel cycle technology.

In the Russian Federation for the purposes of regulation of safety of the use of atomic energy there is the Regulatory Body – the Federal Environmental, Industrial and Nuclear Supervision Service (Rostechnadzor). The Ordinance of the Government of the Russian Federation No. 1037 of 11 October 2012 "Regarding Amendments to the Statute of the Federal Environmental, Industrial and Nuclear Supervision Service" the Federal Service is defined as the authorized body for the state-level regulation of safety in the use of atomic energy (the federal state regulatory authority in the field of 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, as required by the Convention on Nuclear Safety and with consideration of the recommendations of the Fifth Review Meeting held in April 2011, the recommendations of the 2nd Extraordinary Meeting of the Contracting Parties held in August 2012, the "Program of Measures for Participation of the Russian Organizations Concerned in the Implementation of the IAEA Action Plan on Nuclear Safety", as well as the Sectoral Working Plan of Rosatom for the Implementation of the IAEA Action Plan on Nuclear Safety adopted at the 55th General Conference of the IAEA on 19-23 September 2011.

The content of the Sixth National Report fully complies with the recommendations of paragraphs 23-24 of the President's Final Summary Report of the 2nd Extraordinary Meeting as regards the fulfillment of measures planned as a result of lessons learned from the accident at Fukushima-Daiichi NPP. These measures are described in relevant sections of this Report.

Article 6. Existing Nuclear Installations

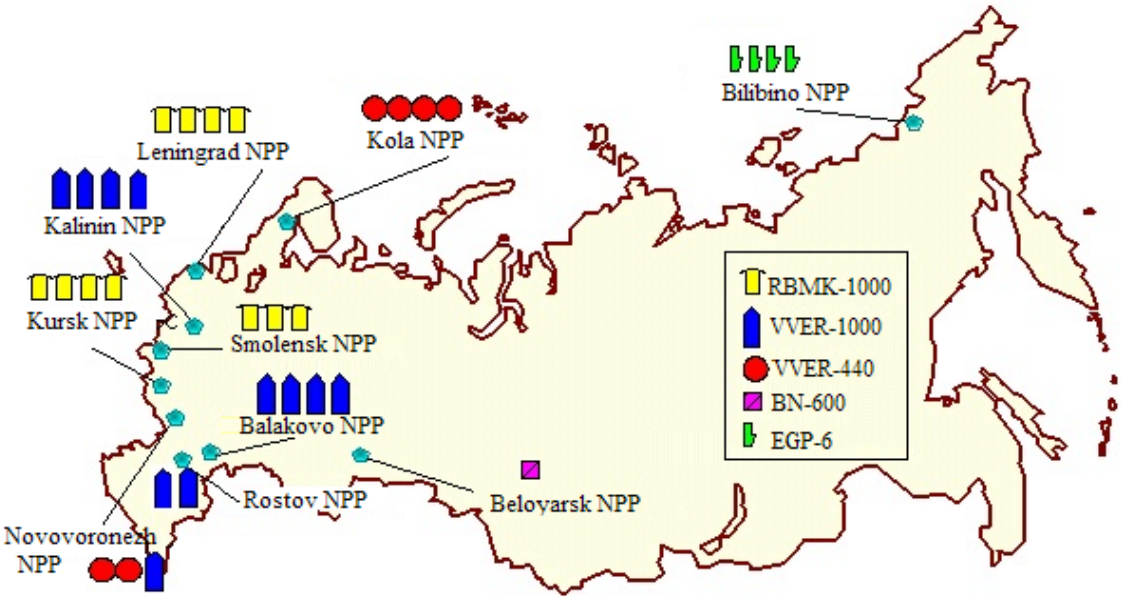
6.1. Brief information on nuclear installations

The Russian Federation has in operation 33 units at 10 nuclear power plants, including 17 units with water-cooled water-moderated reactors, 15 units with pressure-tube boiling-water reactors, and one unit with a sodium-cooled fast neutron reactor. All units have at-reactor SNF storage facilities; separate SNF storage facilities are built at four NPP sites. Over time since the Fifth National Report, the first criticality and first power were achieved at Unit 4 of Kalinin NPP and it was commissioned for commercial operation on 25 September 2012. The unit operates a WWER-1000 reactor.

Four units at two sites are prepared for decommissioning. These are Units 1 and 2 of Beloyarsk NPP, which were shut down and their SNF has been removed and loaded into at-reactor storages; and Units 1 and 2 of Novovoronezh NPP, which were shut down, with SNF removed from the site.

Construction of Units 3 and 4 with WWER-1000 reactors at Rostov NPP is in progress. Construction of Unit 4 with BN-800 reactor at Beloyarsk NPP nears completion. At the sites of Novovoronezh NPP-2, Leningrad NPP-2 and Baltic NPP six units with water-water reactors of 1,200 MWe power capacity each are constructed to AES-2006 design.

Location of operating nuclear plants in Russia



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

The key performance indicators of the operating Russian nuclear plants in 2010-2012 are given in Appendix 2.

6.2. Reassessment of robustness of the Russian plants in regard of extreme external impacts. Planned or implemented measures to ensure safety of plants following results of the analysis of the events at Fukushima-Daiichi NPP (Japan)

In July-August 2011 Rosenergoatom reassessed robustness of Russia's NPPs in regard of extreme external impacts, as initiated by Rostechnadzor.

Requirements for the scope and content of the additional robustness analysis of Russia's NPPs were developed by Rostechnadzor basing on the ENSREG methodology. The additional analysis considered natural and man-induced impacts that pose hazard to the Russian NPPs. In addition, combinations of external events, which by the expert judgment can occur in the NPP host regions, were analyzed.

Basic results of safety reassessment of Russia's NPPs

Seismic impacts

According to requirements of the federal standards and rules, magnitudes of the design basis earthquake (DBE) and safe shutdown earthquake (SSE) are established for each of 10 nuclear plant sites in Russia. The NPP safety important equipment, pipelines, structures and buildings, including safety system equipment, are subject to seismic categories. The analysis led to conclusions as follows.

1. Seismic robustness of NPP safety important components (equipment, pipelines, buildings and structures), including safety system equipment, was verified for:
   - components of seismic category I – under SSE-level seismic impacts;
   - components of seismic category II – under DBE-level seismic impacts.
2. In case of individual nuclear units, robustness with regard to an earthquake in excess of SSE of some plant buildings and structures was justified by calculations, for example:
   - reactor building of Leningrad-1, as well as safety system buildings of Leningrad-1-4;
   - structures of main buildings of Units 1, 2, 3 and SNF storage at Smolensk NPP;
   - structures of the emergency feedwater building housing diesel-driven pumps, LRW treatment building, stand-by diesel power station

building of Units 1 and 2, and controlling safety system building of Unit 3 at Kola NPP;

- containments of WWER-1000 at Balakovo NPP.

At the same time, not all nuclear units in Russia were found equipped with the seismic monitoring and alarm system linked to the reactor emergency protection system. At some plants (Bilibino, Kola, Kursk, Novovoronezh) the systems were introduced as information aid only, without leveraging the CPS rods.

Floods

Sites of all Russian plants are not susceptible to tsunami impacts. Extreme water levels in water bodies, abnormal situations at hydraulic structures as well as combinations of the said factors are incapable of causing flooding that would affect safety important systems and components.

At the same time, it was found out that abnormal situations (for example, a dam break) can lead to flooding of cooling towers make-up station of Units 3 and 4 of Novovoronezh NPP; however, they would not lead to disabling equipment of systems that remove heat to the ultimate heat sink.

Other external impacts

The outcomes of the additional analysis confirmed safety of the Russian NPPs under natural and man-induced external events featuring magnitudes subject to consideration in the design bases. As to factors, which are not considered in the design bases (for example, an aircraft crash), designs of specific Russian NPPs either provide a justification that such factors are impossible to occur at specific sites and/or demonstrate that a probability of their occurrence is less than the threshold value established in the federal standards and rules or their consequences do not exceed that of events considered in the designs.

At the same time, a number of issues were revealed, in particular:

- at Units 3 and 4 of Novovoronezh NPP robustness of the turbine hall roof is not ensured in case of extreme wind of speed over 35 m/s; robustness of ODS is not ensured in case of a tornado of class 3.2 as per the Fujita Scale;
- at Smolensk NPP insufficient robustness with regard to an impact of shock wave in excess of 1.5 kPa of some enclosing parts was revealed.

Preparedness to manage accidents caused by loss of in-house power (station blackout) at NPP

The assessments made confirmed that Russia's NPPs are protected against external events subject to consideration in the design bases of the plants. At the same time, at some operating plants heat removal from the reactor cores (as well as from spent fuel pools) cannot be maintained for an unlimited period of time in conditions of the total loss of in-house power at the plant. Exclusions are nuclear units of Bilibino NPP (which reactors feature low-power-density small power cores), as well as Kola and Novovoronezh NPPs, which are fitted with engineered features for management of severe accidents involving the plant blackout, specifically, the additional system with diesel-driven pumps for water supply to steam generators at Kola NPP and the mobile diesel generator station at Novovoronezh NPP.

Preparedness to manage accidents involving loss of the ultimate heat sink

At all Russian nuclear power plants heat removal to the ultimate heat sink from reactor cores, spent fuel pools, SNF storage facilities to the ultimate heat sink – the atmosphere or water body (sea, lake, cooling pond, river) – is ensured by designated systems, i.e. service water supply system, water recirculation system, systems for heat removal through the secondary circuit and other.

The analysis results revealed that in case of beyond design basis accidents involving loss of the function of heat removal from fuel to the ultimate heat sink is possible due to overheating of fuel rods and accident transition to the severe stage.

Preparedness to manage severe accidents

In the analysis of preparedness of Russian plants to manage severe accidents Rosenergoatom focused on the following aspects:

- sufficiency of engineered features and organizational measures available to the plant for the severe accident management, including:
  - for residual heat removal;
  - for controlled pressure reduction;
  - for controlled pressure relief from the sealed enclosure;
  - for concentration monitoring and removal of hydrogen from the sealed enclosure;
- performance of instrumentation and controls in conditions of beyond design basis accidents;
- availability of severe accident management guides (SAMG).

A number of Russian nuclear power units are fitted with engineered features for severe accident management, for example, such as systems for concentration monitoring and removal (afterburning) of combustible gases inside the containment (sealed enclosure) of the reactor installation.

Basing on results of the robustness analysis of the Russian plants with regard to extreme external impacts and the analysis of preparedness of plants to manage beyond design basis accidents, including severe accidents, Rosenergoatom planned measures and divided them into short-term, mid-term and long-term ones. A complete list of the measures is given in Appendix 3.

The following should be highlighted among the short-term measures slated for 2012-2014:

1. Updating DBE and SSE values for the sites of Novovoronezh, Bilibino, Kola and Beloyarsk plants through additional seismic studies, including seismic micro-zoning studies of the NPP sites.
2. Completion of additional justifying calculations of seismic resistance of a number of plant's safety important components (for example, on-shore pumping stations and channels for service water piping at the site of Kola NPP, separate structures of the main building, equipment of the feedwater and service water systems at Bilibino NPP), along with the development and implementation, as necessary, additional measures to ensure their seismic resistance.
3. Fitting all plants with engineering features for management of beyond design basis accidents caused by external events and leading to the plant blackout and/or loss of heat removal to the ultimate heat sink, namely, with: diesel generators, diesel-driven pumps, mono-block pumps in quantities that are sufficient to ensure safety of all nuclear power units of multi-unit plants.
4. Implementation of organizational and technical measures to prevent flooding of the cooling tower make-up station of Units 3 and 4 at Novovoronezh NPP.
5. Completion of the work to ensure robustness of separate structures:
   - the turbine hall roof in case of extreme wind of speed over 35 m/s; ODS in case of a tornado of class 3.2 as per the Fujita Scale at Units 3 and 4 of Novovoronezh NPP;
   - enclosing parts of nuclear units at Smolensk NPP with regard to an impact of shock wave in excess of 1.5 kPa.
6. Completion of introduction of systems for concentration monitoring and removal of hydrogen for the nuclear units where these systems were not envisaged in the design.
7. Updating of the emergency documentation, among other, to reflect scenarios where an operational event (accident) affects simultaneously several units of the multi-unit plant.

At the time of submission of the National Report to the Sixth Review Meeting of the Contracting Parties all short-term measures have been completed to the full extent.

In 2012 Rosenergoatom performed a robustness analysis with regard to extreme external impacts for units under construction. Rostechnadzor has not finished a comprehensive review of this analysis; however, it should be pointed out that designs of the plants under construction feature a high level of safety and increased safety margin under extreme external impacts owing to the use of a combination of passive and highly reliable active safety systems, redundancy of the equipment and separation of the safety important systems.

6.3. Upgrading of NPP units

The scheduled upgrading of systems and equipment is carried out on an annual basis to maintain reliable, safe and economically and technically efficient operation of all operating NPP units. These upgrades are carried out in accordance with requirements of applicable standards and rules in the field of the use of atomic energy and with consideration of the accumulated experience and the IAEA recommendations.

Upgrades at NPPs can be routine upgrades, which are carried out annually under target technical modernization programs of NPPs at each unit irrespectively of its service life, and special-purpose upgrades, which are carried out under target life extension programs of units.

The upgrade outcomes are assessed against established corresponding target indicators, which achievement evidences that financial investments are effective, while the safety priority is duly considered. Values of the target performance indicators of each program are calculated and set forth when specific measures of NPP upgrading are justified.

Rosenergoatom exercises overall management of formulation and implementation of NPP upgrading programs and plans in the framework of the uniform technical policy of Rosenergoatom. It also controls their progress and performance effectiveness through periodic inspections of NPP operation by commissions.

Upon the completion of the upgrading stage the NPP produces a report on accomplishment of the target technical programs and the NPP upgrading measures plan, which contains an efficiency assessment of the implemented upgrades, an analysis of actually achieved values of target indicators and dynamics of their changes. At the close of the stage of upgrading, the performance criteria of the target technical upgrading programs and the annual NPP upgrading measures plan are:

- absence of recurrent (similar) operational events during operation of the unit and the plant as a whole;

- decrease in a total number of operational events during the plant operation;
- elimination of safety gaps;
- growing economic performance indicators of the plant operation.

Main safety and reliability improvement measures implemented by Rosenergoatom in frames of upgrading individual nuclear units in Russia in 2011-2012 are given in Appendix 4.

6.4. Life extension of NPP units

Life extension of Rosenergoatom's operating nuclear units after they have exhausted their assigned service life period is one of topical tasks at the current stage of nuclear power development in Russia and the most effective area of financial investments in enhancing safety of the plants and maintaining the generating capacities.

"Long-Term Program of State Atomic Energy Corporation "Rosatom" Activities (2009-2015)" endorsed by the Russian Government Ordinance No. 705 of 20 September 2008" and "General Scheme of the Deployment of Electric Power Installations until 2030" approved at a session of the Government of the Russian Federation on 3 June 2010 provide for life extension of the operating nuclear units.

According to the current Russian regulations, life extension activities for a nuclear unit at the first stage include:

- comprehensive examination of the nuclear unit;
- evaluation of the technical feasibility of extending the life of unit components;
- safety assessment of the unit;
- cost-benefit analysis of unit life extension activity.

The outcome of the first stage effort is an investment project of the unit life extension and a decision on the expediency of extending the service life of the unit in question.

At the second stage of the life extension activities a program of the unit preparation for the extra operating life is produced and implemented. This program includes:

- justification for extending the life of non-replaceable components of the unit;
- implementation of a comprehensive program of upgrading the unit's equipment (components);
- testing of the unit systems and equipment;
- justification of the unit safety.

The outcome is submitted by Rosenergoatom to Rostechnadzor for an independent review and issue of a license for unit operation beyond its original lifetime (see Table 6.1).

Table 6.1. Nuclear units that were granted licenses by Rostechnadzor for operation beyond their design service lives in 2010-2012

NPP, Unit	Reactor type	Rated power, MWe	Date of license issue	Date of license expiry
Beloyarsk-3	BN	600	12.04.2010	31.03.2020
Bilibino-1	EGP-6	12	11.02.2010	14.01.2019
Bilibino-3	EGP-6	12	30.12.2010	27.12.2020
Bilibino-4	EGP-6	12	18.03.2010	28.12.2016
Kola-1	WWER	440	18.03.2010	06.07.2018
Kola-2	WWER	440	18.03.2010	20.12.2019
Kola-3	WWER	440	05.01.2011	07.02.2016
Kursk-1	RBMK	1,000	16.03.2010	19.12.2016
Kursk-2	RBMK	1,000	16.03.2010	31.01.2024
Leningrad-1	RBMK	1,000	03.02.2010	21.12.2016
Leningrad-2	RBMK	1,000	03.02.2010	11.11.2020
Leningrad-4	RBMK	1,000	29.12.2010	26.12.2025
Novovoronezh-3	WWER	417	24.02.2010	29.12.2016
Novovoronezh-4	WWER	417	24.02.2010	29.12.2017
Novovoronezh-5	WWER	1,000	24.03.2010	26.09.2015
Smolensk-1	RBMK	1,000	25.12.2012	25.12.2022

As of 07.05.2013, the life extension activities were carried out at 18 nuclear units of the total installed capacity of 10,848 MW.

The economically sound extra time of nuclear unit operation ranges from 15 to 30 years; it is defined case-by-case proceeding from technical and economic considerations.

The assigned service life of 11 units ends in the period from 2013 till 2023 (see Table 6.2). Of these, 9 units currently undergo programs of preparation for extended service life. Two investment projects on life extension are being developed to address Balakovo-4 and Smolensk-3.

Table 6.2. Nuclear units which assigned service life ends in the period from 2013 till 2023

NPP	Unit	Reactor type	Year of commissioning	ASL expiration year	Planned year of ESL expiration
Balakovo	1	WWER-1000	1985	2015	2045
	2	WWER-1000	1987	2017	2047
	3	WWER-1000	1988	2018	2048
	4	WWER-1000	1993	2023	2053
Kalinin	1	WWER-1000	1984	2014	2044
	2	WWER-1000	1986	2016	2046
Kola	4	WWER-440	1984	2014	2039
Kursk	3	RBMK-1000	1983	2013	2028
	4	RBMK-1000	1985	2015	2030
Smolensk	2	RBMK-1000	1985	2015	2030
	3	RBMK-1000	1990	2019	2034

The accomplished life extension activities ensure acceptable safety level of nuclear power during their operation beyond the assigned service life.

6.5. Uprating of operating NPP units

Starting from 2008, efforts have been under way to uprate Rosenergoatom's 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, comprehensive programs were developed for each unit to detail the procedure of unit start-up and power raising to the planned value that exceeds the rated one (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-steady and dynamic 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.

6.6. Issues related to operation of existing NPP units

The process of graphite stack form change is the main issue with the existing RBMK-1000 units of the first generations.

During the reactor operation, impacts of neutron flux and temperature induce changes in physical and mechanical properties of graphite that lead to the change in the strain-stress state of graphite blocks in the stack. Cracks occur in the graphite blocks and the graphite geometry changes. In turn, these changes induce changes in the geometry of pressure tubes and CPS channels.

Initiation of the form change of the graphite stack was recorded by instruments during the scheduled in-pile inspection at Unit 1 of Leningrad NPP in 2011. At that, the measurement results demonstrated that the form change had started earlier and its development rate turned out to be higher than the projected values adopted at the unit's service life extension (nearly correspond to the most conservative estimates). In this regard, an extended inspection of the graphite stack was carried out at all RBMK-1000 reactors. At the present time, at Leningrad-1 the work is carried out to test methods and select means of recovering life-time performance (LTPR) of the RBMK reactor.

In the third quarter of 2013 at Leningrad-1 it is planned to complete restoring the geometry of graphite stack cells. The technology of life-time performance recovery is planned to disseminate to other nuclear power units with RBMK-1000 reactors (as required). Upon completion of the work the produced safety case will be submitted to Rostechnadzor for review.

In November 2013 the LTPR program for all RBMK reactors will be available.

In conclusion, it should be pointed out that the provisions of Article 6 of the Convention on Nuclear Safety are fulfilled for all operating nuclear units.

The Operating Organization reassessed robustness of NPPs in regard of external impacts considering lessons learned from the Fukushima-Daiichi accident.

The technical and organizational measures that are being implemented at the plants allow maintaining acceptable safety level of existing Russian NPPs.

Article 7. Legislative and Regulatory Framework

Regulation of relations in the area of the use of atomic energy is performed 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 and taking precedence over the federal laws).

Legal regulation of safety in the field of the use of atomic energy relies on the 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 rules in the field of the use of atomic energy, regulatory documents of nuclear safety authorities, 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. 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. 52-FZ of 30 March 1999 "On the Sanitary and Epidemiological Well-Being of the Public";
- 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. 116-FZ of 27 July 1997 "On the Industrial Safety of Hazardous Production Facilities" (as amended as of 30 December 2008);
- Federal Law No. 190-FZ of 29 December 2004 "City Development Code of the Russian Federation";
- Criminal Code of the Russian Federation, No. 63-FZ of 13 June 1996;
- The Russian Federation Code of Administrative Offences, No. 195-FZ of 30 December 2001;
- Water Code of the Russian Federation, No. 74-FZ of 3 June 2006;
- The Russian Federation Law No. 2395-1 of 21 February 1992 "On Mineral Resources";
- Federal Law No. 174-FZ of 23 November 1995 "On Environmental Expert Review".

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" and of the Criminal Code of the Russian Federation and the Russian Federation Code on Administrative Offences 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 submittal of the Fifth National Report of the Russian Federation.

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

The title and content of Article 1 were changed. According to Article 1 "The Legislation of the Russian Federation in Field of the Use of Atomic Energy":

- the legislation of the Russian Federation in the field of the use of atomic energy is based on the Constitution of the Russian Federation, generally recognized principles and norms of the international law and international treaties in the field of the use of atomic energy concluded by the Russian Federation and consists of this Federal Law and other federal laws and other legal regulatory acts of the Russian Federation adopted in accordance thereof;
- provisions of federal laws and other legal regulatory acts of the Russian Federation, which establish industrial safety requirements for hazardous production facilities, fire safety requirements, safety requirements for hydraulic structures as relates to the scope of this Federal Law, shall apply to relations in the field of the use of atomic energy in part that does not contradict this Federal Law;
- activities associated with development, manufacture, testing, operation and disposal of nuclear weapons and military nuclear power installations shall not be subject to this Federal Law.

To improve the rules of the use of atomic energy, the main principles and functions of the statutory regulation of Article 2 "Principles and objectives of the statutory regulation in the field of the use of atomic energy" were supplemented as follows:

- delineation of responsibilities and functions of the state safety regulatory bodies, bodies for control over the uses of atomic energy, the authorized body for control of the use of atomic energy and organizations performing activities in the field of the use of atomic energy;
- independence of the state safety regulatory bodies as regards their decision-making and execution of their authority from the authorized body for control of the use of atomic energy and organizations performing activities in the field of the use of atomic energy;
- observance of international commitments and warranties of the Russian Federation in the field of the use of atomic energy.

Article 3 "Objects of this Federal Law" was supplemented with a definition of the life cycle of nuclear facilities. Depending on the facility category, the life cycle is understood as: siting; design (including surveys); engineering; manufacture; construction or building (including installation,

adjustment, commissioning); operation; renovation; major overhaul; decommissioning; transportation; handling; storage; isolation and disposal.

This article was also introduced with a new definition of radioactive waste, specifically:

- radioactive waste is materials and substances, which are not subject to further utilization, as well as equipment, items (including spent ionizing radiation sources), which radionuclide content exceeds levels set forth in accordance with the criteria established by the Government of the Russian Federation;
- the paragraph specifying facilities, which are not covered by this law, was introduced. These are facilities which contain or utilize nuclear material and radioactive substances in quantities and of activity (and (or) emit ionizing radiation with intensity or energy) less than the values established by the federal standards and rules in the field of the use of atomic energy, which are subject to permits from the state nuclear safety regulatory bodies for activities involving the said facilities, unless otherwise stated in the legislation of the Russian Federation.

In Article 4 "Activities in the field of the use of atomic energy" the activities covered by this Federal Law were specified (added):

- closure of radioactive waste storage facilities;
- conduct of safety reviews of nuclear facilities and (or) activities in the field of the use of atomic energy;
- state monitoring of radiation situation in the territory of the Russian Federation.

Article 5 "Ownership of nuclear material, nuclear installations, storage facilities, radiation sources and radioactive substances" was supplemented in its Part Twelve:

"Radioactive substances and radiation sources owned by the Russian Federation, Subjects of the Russian Federation, municipalities, legal entities shall be managed and operated by organizations, which have relevant permits (licenses) for execution of works in the field of the use of atomic energy or are registered in accordance with the procedure and in cases stipulated in Article 36.1 of this Federal Law".

Article 6 "Federal standards and rules in the field of the use of atomic energy" was revised as:

"The federal standards and rules (hereinafter referred to as the standards and rules) in the field of the use of atomic energy shall be legal regulatory acts that establish requirements for the safe use of atomic energy, including safety requirements of nuclear facilities, safety requirements of activities in the field of the use of atomic energy and

among them safety goals, principles and criteria, which observance is mandatory when exercising activities in the field of the use of atomic energy.

The standards and rules in the field of the use of atomic energy shall be written and approved in accordance with the procedure established by the Government of the Russian Federation".

Besides, this article introduces the provision on the Safety Guides, which are approved and put into force by the state nuclear safety regulatory bodies. The Safety Guides for the uses of atomic energy contain recommendations on meeting the requirements of standards and rules in the field of the use of atomic energy, including on execution techniques, methodologies, reviews and safety assessments, as well as clarifications and other recommendations concerning fulfillment of the safety requirements at the uses of atomic energy.

In Article 9 "Powers of the Government of the Russian Federation in the field of the use of atomic energy" new paragraphs were introduced:

- definition of functions, rules of procedure, rights and obligations of the bodies that control the uses of atomic energy and bodies (including the authorized body) of the state regulation of safety, as per the legislation of the Russian Federation;
- establishment of the procedure of accreditation in the field of the use of atomic energy;
- establishment of the rules of procedure regarding arrangements for and functioning of the national automated radiation monitoring system in the Russian Federation.

Also, this article was supplemented with the procedure of the organization and functioning of the national automated radiation monitoring system in the Russian Federation, which information support will be provided by the national fund of environmental monitoring data.

Article 20 "Bodies of the state control over the use of atomic energy" expands jurisdiction of the state control bodies as regards:

- the state control over observance of the state standards and rules of product conformance assessment in the field of the use of atomic energy;
- arrangements for the national radiation monitoring in the territory of the Russian Federation in the host regions of nuclear facilities, which are owned by operating organizations, and participation in its conduct;
- ensuring the unity of measurements in the field of the use of atomic energy;
- arrangements for and conduct of accreditation in the field of the use of atomic energy.

Article 21 "State monitoring of the radiation situation in the territory of the Russian Federation" is added with the section on "National radiation monitoring in the territory of the Russian Federation".

According to Article 21, the national radiation monitoring in the territory of the Russian Federation shall be carried out to timely detect changes in the radiation situation, assess, project and prevent potential adverse consequences of radiation impact on the public and the environment, as well as to supply relevant operative information to the governmental bodies, bodies for the control over the uses of atomic energy, state nuclear safety regulatory bodies and organizations needed for taking appropriate measures for prevention or mitigation of radiation impact.

The national radiation monitoring in the territory of the Russian Federation is part of the national ecological monitoring (national monitoring of the environment) and is carried out in the framework of the national automated radiation monitoring system (and its functional subsystems) in the territory of the Russian Federation.

The introduction of the national automated radiation monitoring system and its functional subsystems in the territory of the Russian Federation is carried out by the federal executive bodies authorized by the Government of the Russian Federation, and by the State Atomic Energy Corporation "Rosatom".

Article 23 "State safety regulation in the use of atomic energy" in part related to the areas of the state regulation of safety in the use of atomic energy was supplemented as described herein. The areas subject to state regulation now additionally include the activities associated with: accreditation; standardization; evaluation of conformance; supervision of safety; conduct of reviews and inspections; control over development and implementation of measures to protect employees of nuclear facilities and the public; environmental protection in case of an atomic energy use accident.

Article 24 "Federal executive bodies exercising state regulation of safety in the use of atomic energy" was revised as:

"The state regulation of safety in the use of atomic energy shall provide for activities of the relevant federal executive bodies and the State Atomic Energy Corporation "Rosatom", which are aimed at arranging for, approval of and putting into force the standards and rules in the field of the use of atomic energy, at granting permits (licenses) for the work in the field of the use of atomic energy, at conducting accreditation, standardization, evaluation of conformance, supervision of safety, reviews and inspections, supervision of development and implementation of measures to protect employees of nuclear facilities, public and the environment in case of an atomic energy use accident.

The state regulation of safety in the uses of atomic energy shall be exercised by the federal executive bodies, i.e. the bodies for the state regulation of safety, which regulate safety in the uses of atomic energy. The said bodies shall be independent of other governmental bodies, as well as organizations, which activities associate with the use of atomic energy.

The activities in the area of the safety regulation at the uses of atomic energy and division of authorities, rights, duties and responsibilities among the relevant bodies, as well as powers of officials of the said bodies shall be established in the statutes of the state safety regulatory bodies.

Measures, which are implemented by the state safety regulatory bodies to exercise the powers they are entitled, must be commensurate with potential hazard posed by nuclear facilities and activities in the field of the use of atomic energy.

Activities of the state safety regulatory bodies shall be financed out of the federal budget".

Article 24.1 "Federal supervision in the field of the use of atomic energy" was newly introduced.

The article defines the subject matter, grounds, timeframe and frequency of inspections, the procedure of notification on and coordination with the prosecutor’s bodies of off-schedule field inspections. This amendment relieved constraints imposed on the procedure and frequency of supervisory actions at nuclear facilities.

Also, Article 24.1 introduces the regime of continuous state supervision with regard to certain nuclear facilities, which list is established by the Government of the Russian Federation.

Article 25 "Powers of the state safety regulatory bodies" was added with powers of the state regulatory bodies extended to:

- arrangements for and (or) conduct of safety reviews (safety justification reviews) of nuclear facilities and (or) nuclear-related activities specified in the Federal Law, including with involvement of independent experts and (or) science and technology support organizations;
- conduct of inspections associated with execution of their powers;
- development, approval and putting into force safety guides on the uses of atomic energy;
- participation in the accreditation process in the field of the use of atomic energy.

In Article 26 "Permits (licenses) for execution of works in the field of the use of atomic energy" the activities subject to permits (licenses) are added with the conduct of reviews of safety justifications of nuclear facilities and (or) activities in the field of the use of atomic energy.

Article 26.1 was newly introduced to prescribe by law the conduct of periodic safety reviews of a nuclear installation or storage facility (each 10 years until decommissioning).

Article 37 "Organizations that execute works and render services to the operating organization" was added with the paragraph on the mandatory evaluation of conformance of the equipment, products and technologies intended for nuclear installations, radiation sources or storage facilities.

Federal Law No. 190-FZ of 11 July 2011 "On the Management of Radioactive Waste and on Amendment of Certain Legislative Acts of the Russian Federation" was adopted.

The new Federal Law "On the Management of Radioactive Waste" sets forth powers of the governmental bodies, local authorities and the State Atomic Energy Corporation "Rosatom" regarding regulation and control in the area of the management of radioactive waste; it establishes requirements for storage and disposal of radioactive waste, as well as oversight of the radiation situation and radiation monitoring. Besides, to reduce and prevent accidents in handling of radioactive waste in the territory of the Russian Federation, the waste generators are imposed with additional obligations to provide a financial coverage of activities associated with the management of radioactive waste.

The Federal Law "On the Management of Radioactive Waste" includes the types of entities and norms that are new for the Russian legislation:

- the national operator for the radioactive waste management, which powers include the implementation of measures of the safe disposal of radioactive waste;
- specialized organizations, which execute works and render services of collection, sorting, reprocessing, conditioning, shipment, storage and disposal of waste;
- generation of the targeted reserve to finance disposal of radioactive waste; the reserve is built up with allocations by waste generators.

Federal Law No. 3-FZ of 9 January 1996 "On the Radiation Safety of the Public" was amended as follows:

In Article 5 the powers of the Russian Federation in the field of radiation safety ensuring were added with:

- licensing of activities in the field of the management of ionizing radiation sources;
- organization and conduct of the state supervision in the field of

radiation safety.

Article 10 "Licensing of activities in the field of the management of ionizing radiation sources" was added with Subsection 10.1 "State supervision in the field of radiation safety".

The Federal Law No. 68-FZ of 21 December 1994 "On the Protection of the Public and Territories against Natural and Man-Induced Emergencies" was amended as follows:

Article 1 "Main definitions" now defines modes of functioning of the controlling bodies and forces of the unified state system for prevention and elimination of emergencies, and emergency response levels.

Article 4.1 "Functioning of the controlling bodies and forces of the unified state system for prevention and elimination of emergencies" was newly introduced to establish, in particular, modes of the system functioning:

- routine activities, when there is no a threat of emergency;
- emergency preparedness, when there is a threat of emergency;
- emergency situation, when an emergency has occurred and is eliminated.

When Emergency Preparedness or Emergency Situation are declared, depending on consequences of the emergency and other factors, one of the response levels listed below is introduced:

- on-site;
- local;
- regional (inter-municipality);
- federal response level.

In some cases where involvement of special force and capabilities of the Armed Forces of the Russian Federation, other troops and military formations are required for elimination of the emergency, a special response level is introduced by the decision of the President of the Russian Federation.

Article 11 "Powers of the governmental bodies of the Russian Federal Subjects and local authorities in the field of protection of the public and territories against emergencies" was supplemented with the powers to introduce one of the response levels set forth in Article 10.

Article 13 "Responsibilities of the federal executive bodies in the field of protection of the public and territories against emergencies" was added with obligations to declare Emergency Preparedness or Emergency

Situation modes for the controlling bodies and forces of the unified state system for prevention and elimination of emergencies.

In Article 14 "Responsibilities of organizations as regards protection of the public and territories against emergencies", responsibilities of the head of the organization where an emergency is likely or have occurred were added with the authority to declare Emergency Preparedness or Emergency Situation for the controlling bodies and force of the unified state system for prevention and elimination of emergencies and to make decisions on introduction of a response level and additional measures for protection of the employees of the given organization and other citizens present in its territory against the emergency.

Changes in the legislation of the Russian Federation that have been introduced since the submission of the Fifth National Report meet the obligations undertaken by the Russian Federation under the Convention on Nuclear Safety.

7.2. Regulatory legal acts of the President of the Russian Federation and of the Government of the Russian Federation

In the period after the submittal of the Fifth National Report, the President of the Russian Federation and the Government of the Russian Federation have endorsed several new legal acts on various aspects of the use of atomic energy. Also, a number of changes have been made in the earlier regulatory documents of the President of the Russian Federation and the Government of the Russian Federation:

- the Government of the Russian Federation Ordinance No. 377 of 3 April 1996 "On Adopting the Convention on Nuclear Safety" was amended to define Rostechnadzor the state nuclear safety regulatory body and Rosatom the state body for control over the uses of atomic energy, for the purposes of implementation of the Convention provisions;
- the Government of the Russian Federation by its Ordinance No. 373 of 23 April 2012 endorsed "Provisions on the continuous state supervision of nuclear facilities";
- the Government of the Russian Federation by its Directive No. 610-r of 23 April 2012 approved the list of nuclear facilities subject to the continuous state supervision;
- the Government of the Russian Federation by its Ordinance No. 1044 of 15 October 2012 introduced "Provision on the federal state supervision in the field of the use of atomic energy";
- the Ordinance of the Government of the Russian Federation No. 865 of 14 July 1997 "On approval of the Provision on the licensing of

activities in the field of the use of atomic energy" was amended, including to reinstitute a number of Rostechnadzor's licensing functions that had been transferred earlier to the Ministry of Natural Resources and Environment of the Russian Federation;

- the Ordinance of the Government of the Russian Federation "On the endorsement of the list of positions of nuclear facility employees who should obtain permits from the Federal Environmental, Industrial and Nuclear Supervision Service to work in the field of the use of atomic energy" was amended so that the authorized body for control over the uses of atomic energy is entitled to compile and approve corresponding lists of positions of employees who should obtain permits to work at a specific facility;
- the Government of the Russian Federation by its Ordinance No. 882 amended the Ordinance of the Government of the Russian Federation No. 412 of 3 July 2006 "On the federal executive bodies and authorized bodies, which exercise the state control over the uses of atomic energy and the state regulation of safety in the uses of atomic energy" by which the Federal Service for Supervision of Natural Resources (Rosprirodnadzor) was attributed to the bodies, which exercise the state supervision in the uses of atomic energy;
- changes were made to the Ordinance of the Government of the Russian Federation No. 456 "On endorsement of the rules of physical protection of nuclear material, nuclear installations and nuclear material storage facilities" as regards vesting the State Atomic Energy Corporation "Rosatom" with the authorities in the field of ensuring physical protection of nuclear material, nuclear installations and nuclear material storage facilities in the territory of the Russian Federation, which are mandatory for all legal entities, irrespectively of a form of ownership, which carry out activities in the field of production, utilization, shipment (transportation) of nuclear material and design, construction, commissioning, operation and decommissioning of nuclear installations and nuclear material storage facilities, as well as control and coordination in the said sphere of activity, ensuring and conduct of supervision of this activity;
- "Provision on the drafting and approval of the federal standards and rules in the field of the use of atomic energy" endorsed by the Ordinance of the Government of the Russian Federation was amended, among other, to state the waiver of the Government of the Russian Federation to approve the List of existing federal standards and rules in the field of the use of atomic energy;
- the Government of the Russian Federation by its Ordinance and in accordance with the Federal Law "On the Technical Regulation" Article 5 Paragraph 3 endorsed the "Provision on the specifics of standardization of products (works, services)", which sets forth the

requirements for ensuring safety of design (including surveys), production, construction, installation, adjustment, operation, storage, shipment, sale, disposition and disposal of the said products;

- for the purposes of implementation of the Federal Law No. 190-FZ "On the management of radioactive waste…" Article 5 Paragraph 5, the Government of the Russian Federation by its Ordinance endorsed the "Provision on the transfer of radioactive waste for disposal";
- the Government of the Russian Federation by its Ordinance endorsed the "Provision on attributing a legal entity as the Scientific and Technical Support Organization of the authorized body for the state regulation of safety in the uses of atomic energy";
- the Government of the Russian Federation by its Ordinance endorsed the provision "On specifics of technical regulation in part related to development and establishment by government customers, federal executive bodies authorized in the field of the state control over the uses of atomic energy and state regulation of safety in the uses of atomic energy…";
- the Government of the Russian Federation by its Ordinance introduced the new "Provision on the licensing in the field of the use of atomic energy". In the new Provision the paragraph, which established a license validity period, was changed. From now on the license is granted for the period of time, which is established proceeding from the period, during which an activity and facility safety, at which or in regard to which it is planned to carry out the activity subject to licensing, is justified by the license applicant and confirmed by results of the safety review. Licenses are granted for not more than 10 years to activities, which processes do not envisage nuclear and radiation hazardous works. Paragraph 20 of the new revision of the Provision was added with two new conditions of the review of the license application package, namely:
    - ability of the license applicant to ensure safe conduct of the activity subject to licensing, safety of the nuclear facility and works being executed, as well as to assure quality of works being executed and services being rendered that meet the federal standards and rules in the field of the use of atomic energy;
    - availability of the corresponding force and capabilities for elimination of emergencies in case of a nuclear and radiation accident at the nuclear facility.

  Paragraph 21 was introduced with a new provision concerning verification of information presented in the applicant's documents through safety reviews and inspection. In Paragraph 24 (sub-paragraphs б) and в) formulate in a more clear way the reasons for denial of a license, namely, in case:
    - the review statement concludes that the nuclear facility and (or)

licensed activity safety is not ensured and (or) the documents submitted by the license applicant that justify safety of the nuclear facility and (or) licensed activity do not conform with the legislation of the Russian Federation, do not meet requirements of the federal standards and rules in the field of the use of atomic energy;

– findings of the conducted inspection evidence that the actual state of the nuclear facility, its components and systems does not comply with the requirements of the federal standards and rules in the field of the use of atomic energy or facts were revealed that confirm that the applicant does not have a license for conduct of the licensed activity subject to the established requirements.

New paragraphs 28-31 were introduced to formulate the requirements for and procedure of formatting license conditions.

Paragraph 33 was introduced to outline grounds for the license suspension:

a) the licensee committed a major violation of the license conditions as revealed by the inspection of the licensee in the course of the federal state supervision in the field of the use of atomic energy;
b) the licensee failed to submit, or failed to submit in due time the outcomes of the periodic safety analysis report after the 10-year period of operation of the nuclear installation or storage facility;
c) results of the periodic safety analysis of the nuclear installation or storage facility evidence that the safety of the licensed activity, nuclear installation, storage facility and (or) works being executed is not supported by documents and is not ensured;
d) the licensee failed to rectify issues raised in the notices of the licensing authority as to elimination of revealed breaches of license conditions;
e) validity of the document that acknowledged the organization as capable of operation the nuclear installation, radiation source or storage facility and capable of conducting, on its own or with engagement of third parties, the activity related to siting, design, construction, operation and decommissioning of the nuclear installation, radiation source or storage facility, as well as the activity associated with the management of nuclear material and radioactive substances, was cancelled.

New Paragraphs 47-53 were introduced to define the procedure and maintenance of licensing files of applicants, including decisions on granting licenses, refusals to grant a license, license renewals, changes to the license conditions, suspensions, resumptions, terminations of licenses, cancellation of the license, and notifications on licensing in process.

7.3. Federal standards and rules in the field of the use of atomic energy

Several new federal standards and rules have been developed since the submittal of the Fifth National Report to bring the regulatory requirements in line with the existing science and technology level considering both Russian and international experience in the area of the use of atomic energy.

Over the recent several years, in the field of the legal regulation of the NPP safety the work has been carried out to harmonize the Russian regulatory framework with the IAEA documents. To this end in 2012 an article-by-article comparison of the Russian regulatory requirements with provisions of the IAEA's safety standards (SSR-2/1 "Safety of Nuclear Power Plants: Design" and SSR-2/2 "Safety of Nuclear Power Plants: Commissioning and Operation") was carried out. When developing new regulatory documents, the precondition is their comparison with the IAEA standards.

The accident at Fukushima-Daiichi NPP and the analysis of its consequences revealed the necessity to improve the legal regulatory basis of NPP safety. Rostechnadzor has carried out a completeness analysis of the Russian legal regulatory basis in the field of the use of atomic energy in the light of the lessons learned from the Fukushima-Daiichi accident. The regulatory documents revision plan has been produced as regards more thorough consideration of external impacts, which intensity exceeds design values, consideration of combinations of external impacts, progression of accidents at multi-unit NPPs etc. In particular, Rostechnadzor has formulated methodological recommendations for writing severe accident management guides.

A list of the federal standards and rules put into effect after the submittal of the Fifth National Report is given in Appendix 5.

7.4. Documents approved by Rostechnadzor

Over the time since the submittal of the Fifth National Report Rostechnadzor has consistently shaped a new legal regulatory framework aimed at implementing provisions of the Convention on Nuclear Safety. This activity presupposes a number of sequential steps, namely: introduction of changes to the Federal Law "On the Use of Atomic Energy" (see Section 7.1), formalization of these changes in by-laws (ordinances and directives of the Government of the Russian Federation etc.; see Section 7.2), introduction of corresponding changes to the federal standards and rules, writing of Safety Guides which contain recommendations on fulfillment of the Federal Standards and Rules in the Field of the Use of Atomic Energy. Using this approach, Rostechnadzor drafts administrative

regulations on execution of the state functions and services. In addition to the "Administrative Regulation on Implementation of the State Function of Licensing Activities in the Field of Nuclear Energy by the Federal Environmental, Industrial and Nuclear Supervision Service" described in the Fifth National Report the "Administrative Regulation on Rendering by Rostechnadzor of the State Service of Granting Permits for Execution of Works in the Field of the Use of Atomic Energy to Nuclear Facility Employees" was written and approved and the "Administrative Regulation on the Supervision in the Field of the Use of Atomic Energy" was written. By its order Rostechnadzor approved the "Procedure for submittal by Rosenergoatom to the authorized body of the state regulation of safety in the uses of atomic energy of the documents that contain results of a safety analysis of the nuclear installation, nuclear material and radioactive substances storage facility and justify safety of their operation, as well as the requirements for the content and composition of these documents". In particular, the following is being developed:

- the safety review procedure (safety justification review procedure) of nuclear facilities and (or) activities in the field of the use of atomic energy;
- the procedure of organization and conduct of supervision of the state system of nuclear material control and accounting in other areas subject to the safety regulatory activities.

A list of Administrative Regulations and Safety Guides written and introduced over the period since the submittal of the Fifth National Report is given in Appendix 6.

Thus, 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 installations. The evolutionary changes in this framework are meant to strengthen the Rostechnadzor's role and enhance its efficiency, as well as to improve the existing rules and regulations establishing requirements for the safe use of atomic energy taking into account the plans of the nuclear power development.

Article 8. Regulatory Body

8.1. Authorities and duties of the Regulatory Body

According to the Convention on Nuclear Safety, 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, 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, as well as the competent authority of the Russian Federation as per the Amendment to the Convention on the Physical Protection of Nuclear Material;
- the authorized body for the state regulation of safety in the uses of atomic energy (federal state regulatory authority in the field of the use of atomic energy);
- the federal state building regulatory authority, including for construction of nuclear facilities.

Rostechnadzor has the following authorities within the specified activity 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 subject to endorsement by the Russian Federation Government;
- acting upon and to execute the Russian Federation Constitution, federal constitutional laws, federal laws, acts of the Russian Federation President and the Russian Federation Government, establishes on its own the following types of legal regulatory documents in its area of activity:
    - federal rules and regulations in the field of nuclear energy, in compliance with the Russian legislation;
    - regulation on the procedure for giving work licenses in nuclear power to nuclear facilities personnel in accordance with the list of job positions endorsed by the Government of the Russian Federation;

  - requirements for the list and contents of documents related to ensuring safety of nuclear installations and/or activities in the field of the use of atomic energy required for licensing of activities in this area, as well as the review procedure of said documents;
  - regulation on organization and implementation of supervision over the national system of nuclear materials control and accounting;
  - legal regulations on other aspects of its area of authority, except for the issues which, according to the Russian Federation Constitution, federal constitutional laws, federal laws, the acts of the President of the Russian Federation and the Government of the Russian Federation, shall be regulated only by the federal constitutional laws, federal laws and legal acts issued by 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;
- audits (inspects) the fulfillment by the 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;
- approves qualification reference books for managers and experts (employees), which describe requirements for the qualifications of personnel seeking licenses for performing activities in the field of the use of atomic energy;
- organizes and ensures the functioning of the system of nuclear facilities oversight in emergencies (emergency response);
- being part to the national emergency prevention and management system, directs activities of the functional subsystems overseeing facilities presenting a nuclear and radiation hazard;
- takes constraining and preventive measures, as provided by the legislation of the Russian Federation, to preclude and/or suppress violation, by legal entities and citizens, of mandatory requirements within its domain; takes measures to mitigate the consequences of such violations;
- provides oversight and supervision of:
  - 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; national systems for control and accounting of nuclear material, radioactive substances and radioactive waste;
- fulfillment of international commitments of the Russian Federation in the area of the safe use of atomic energy;
- timely return of spent fuel assemblies of nuclear reactors and relevant reprocessing products to the supplier country, with which the Russian Federation has an international agreement on importing to the Russian Federation spent fuel assemblies of nuclear reactors for the purpose of temporary technological storage and reprocessing with the condition of sending back the reprocessing products (within the jurisdiction of the Federal Supervision Service).

Rostechnadzor performs its activities employing a quality assurance system that meets the requirements of the "Provision on the Quality Management System of the Federal Environmental, Industrial and Nuclear Supervision Service in the Field of the State Regulation of Safety in the Use of Atomic Energy".

8.2. Regulatory body organizational structure

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 (including interregional territorial departments for supervision of nuclear and radiation safety) formed by it in accordance with the established procedure. The organizational structure of Rostechnadzor’s Headquarters and territorial bodies is shown in Figure 8.1.

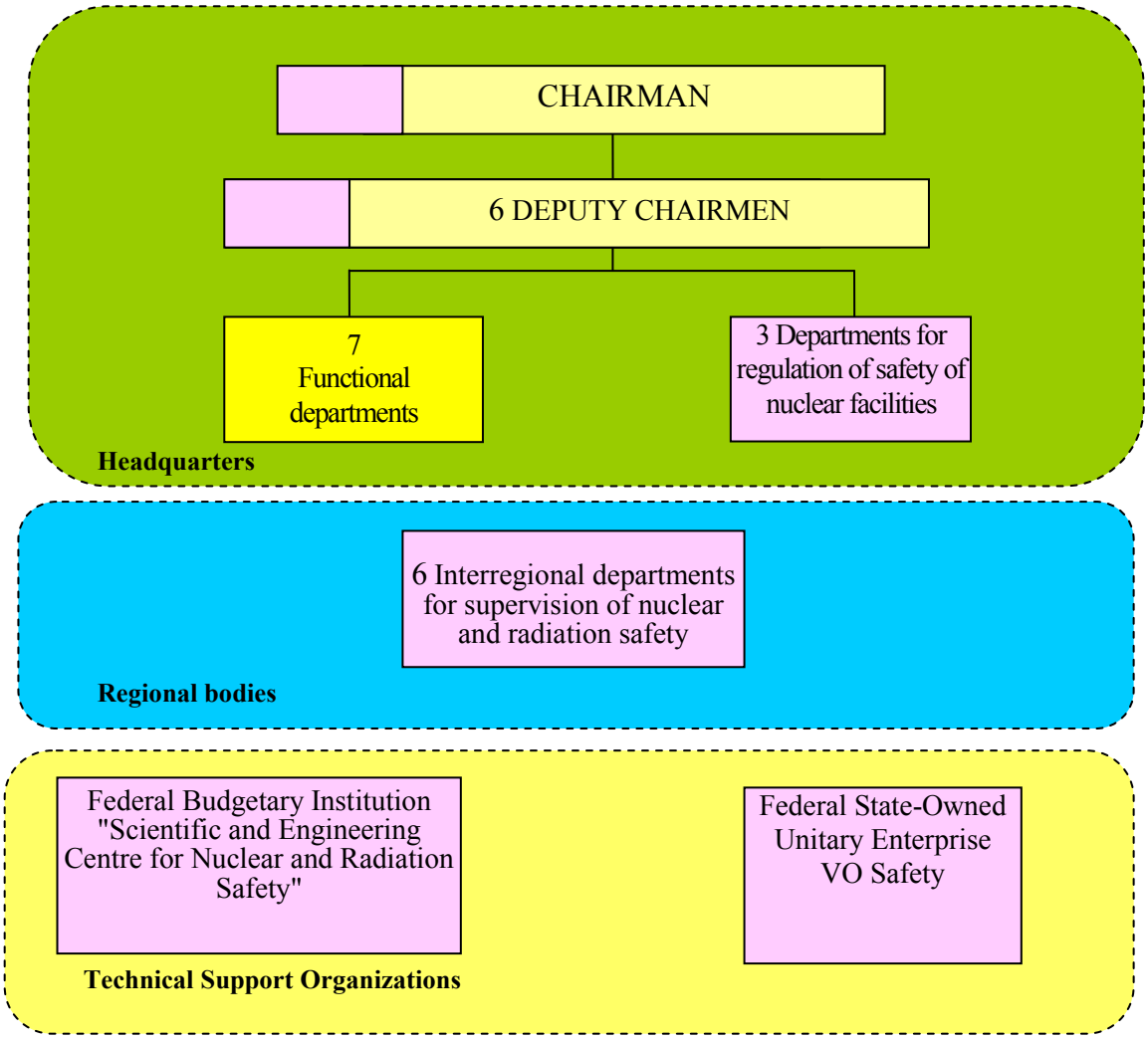


Figure 8.1. Organizational structure of the Federal Environmental, Industrial and Nuclear Supervision Service

The Headquarters departments, which regulate nuclear and radiation safety, as well as interregional territorial departments for supervision of nuclear and radiation safety with their on-site inspection offices for nuclear and radiation safety at nuclear plants, are shown on Figure 8.2.

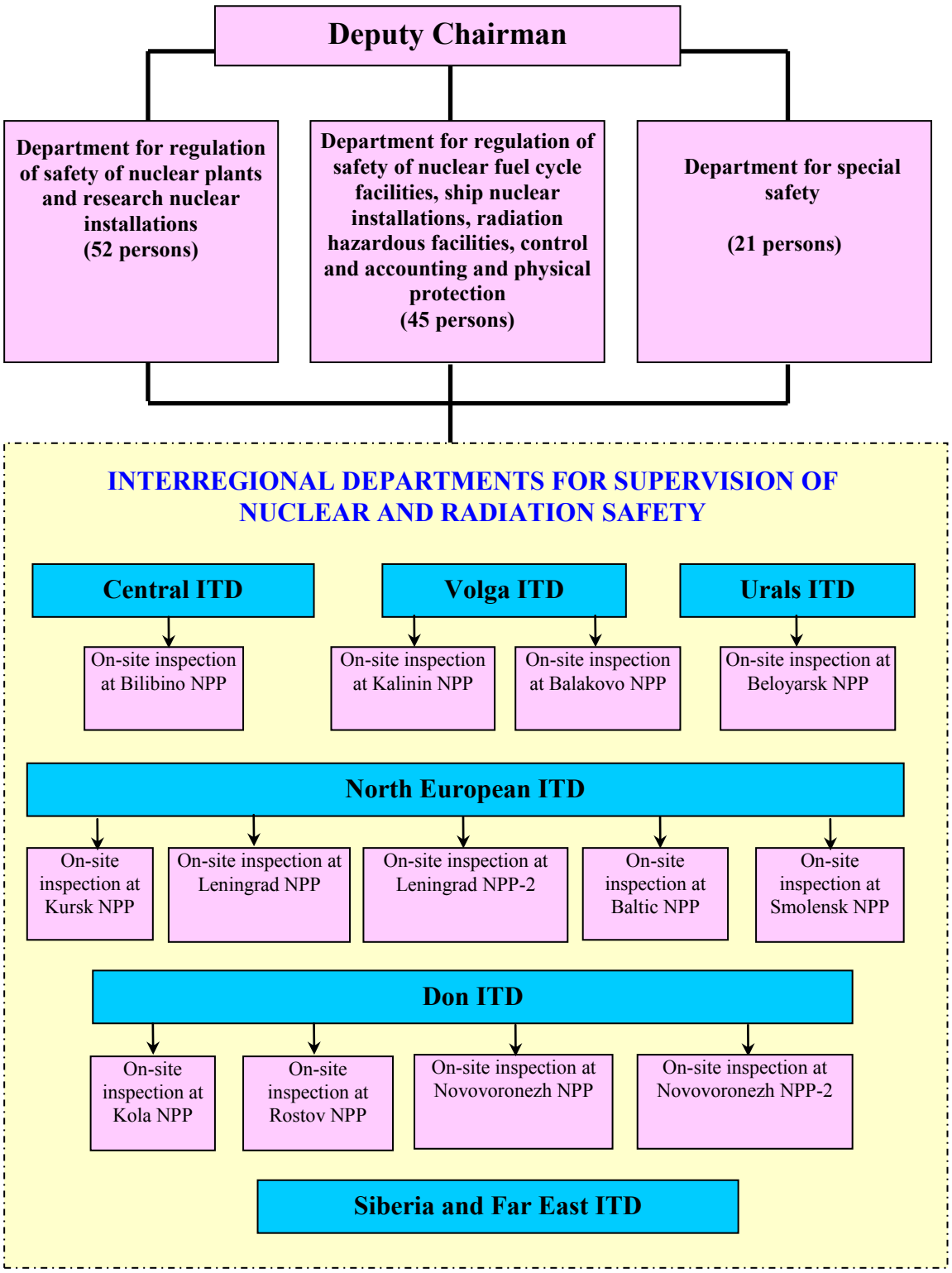


Figure 8.2. Divisions of Rostechnadzor, which regulate nuclear and radiation safety

The Headquarters of Rostechnadzor, as well as the interregional departments for supervision of nuclear and radiation safety, have the staff possessing appropriate qualifications, the requirements for which are set out in the Federal Law No. 79-FZ of 27 July 2004 "On the State Public

Service", in the President of Russia's Decree No. 1131 of 27 September 2005 "On Qualification Requirements for State Public Service Experience (or Other Public Service) or Professional Experience for Federal State Public Employees", and in other legal regulations.

The qualifications of Rostechnadzor employees are maintained on a regular planned basis, in the framework of a proficiency enhancement system in place in the Federal Supervision Service.

The data on the actual numbers of staff in the interregional departments for nuclear and radiation safety supervision of Rostechnadzor in 2013 is given in Appendix 7.

The information about the funding provided to Rostechnadzor for the nuclear supervision activities from the federal budget of the Russian Federation in 2010-2013 is given in Appendix 8.

Rostechnadzor has two scientific and technical support organizations: the Federal Budgetary Institution "Scientific and Engineering Centre for Nuclear and Radiation Safety" (SEC NRS) and the Federal State-Owned Unitary Enterprise Foreign Trade Organization "Safety" (VO Safety).

Following the Government of Russia's request, an international review team on nuclear and radiation safety visited Rostechnadzor on 16-27 November 2009 to render an Integrated Regulatory Review Service (IRRS).

The IAEA mission produced 25 recommendations and 34 proposals. Rostechnadzor prepared the report "Implementation of recommendations and proposals of the IAEA mission of the Integrated Regulatory Review Service in the Russian Federation".

According to the procedure established by the IAEA, a follow-up mission on the part of the IAEA to check on implementation of the 2009 mission's recommendations and proposals by Rostechnadzor is scheduled for December 2013. The IAEA's follow-up mission includes two new self-assessment questions modules ("Emergency Preparedness and Response" and "Lessons Learned by the Regulator from the Fukushima-Daiichi Accident"), which were not in the scope of the 2009 mission. To receive the mission, the Government of the Russian Federation issued a special directive No. 759-r of 8 May 2013.

According to articles of the Federal Law No. 170-FZ "On the Use of Atomic Energy", Rostechnadzor in its activities takes steps to enhance openness and transparency of fulfillment of its obligations proceeding from the Convention on Nuclear Safety. Information on Rostechnadzor's activities is freely accessible on the official website of Rostechnadzor. The Community Liaison Office, Public Council and the Public Relations Group within the Information and Analytical Centre of Rostechnadzor are functioning.

Following the results of the Russian NPPs protection analysis in the light of lessons learned from the accident at Fukushima-Daiichi NPP, in 2012 open discussions with representatives of the regulatory bodies of France (ASN) and Finland (STUK) were held. In June 2012 a team of ASN experts took part in the Rostechnadzor's scheduled inspection at Balakovo NPP. Rostechnadzor took part in the public hearings on the IAEA's follow-up mission upcoming in the end of 2013. Specialists of Rostechnadzor are members of the Effectiveness and Transparency Working Group established by the decision of the 2nd Extraordinary Meeting of the Contracting Parties to the Convention on Nuclear Safety held in Vienna in August 2012.

8.3. Licensing procedure and organization of the technical reviews of safety documentation for nuclear installations

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 the Russian Federation Ordinance No. 280 of 29 March 2013. In keeping with these legal documents, Rostechnadzor grants licenses to organizations operating nuclear facilities (for siting, construction, operation and decommissioning), handling radioactive substances, nuclear material and radioactive waste, and to organizations performing activities and rendering services in the field of the use of atomic energy (in particular, design, engineering and manufacture services for equipment) and also to the organizations performing reviews.

In its activities Rostechnadzor makes the 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. The Administrative Regulation is described in detail in the Fifth National Report.

The Ordinance of the Government of the Russian Federation No. 48 of 4 February 2011 re-established the right of Rostechnadzor to set forth procedures of credibility checks on the information contained in the documents submitted for obtaining a license, review procedure of the documents justifying nuclear and radiation safety of a nuclear installation, radiation source, storage facility and/or declared activity, and conduct of inspections.

To arrange and carry out safety reviews on nuclear installations in the framework of the licensing procedure, Rostechnadzor enlists the services of two expert organizations – SEC NRS and VO Safety.

In 2010 SEC NRS performed 204 reviews of the safety of nuclear installations and upgrades thereof; in 2011 – 216 reviews, and in 2012 –

298 reviews.

Currently, 76 people in SEC NRS are dealing with the organization and conduct of NPP safety reviews of nuclear power units in the framework of licensing procedure.

The actual number of VO Safety staff dealing with NPP safety reviews is 84 people, as of 01.05.2013.

8.4. Technical support organizations for the Regulatory Body

As discussed above, in 2011 the Federal Law No. 170-FZ "On the Use of Atomic Energy" was amended to incorporate new Article 37.1 "Scientific and Technical Support Organizations of the State Safety Regulatory Authority". This article for the first time legislatively set forth and fixed the status of scientific and technical support organizations in the state regulatory system.

The article states that scientific and technical support organizations of the authorized body of the state regulation of safety carry out their activities for the purposes of:

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

A legal entity is attributed 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.

Rostechnadzor receives the scientific and technical support in the field nuclear and radiation safety from two organizations: SEC NRS and VO Safety.

SEC NRS provides scientific and technical support to the national safety regulatory body in the field of the use of atomic energy in the following areas:

- development of legal regulatory documents in the field of the use of atomic energy;
- development and revision of federal rules and regulations in the field of the use of atomic energy;
- organization and conduct of safety reviews in the field of the use of atomic energy;

- scientific studies to justify nuclear and radiation safety principles and criteria;
- organization of the software certification process and its conduct;
- routine activities requested by Rostechnadzor Headquarters.

In 2010-2012 SEC NRS prepared and had approved by Rostechnadzor 13 Federal Standards and Rules and 28 Safety Guides. Also, SEC NRS reviewed the IAEA draft documents. In 2010-2012 twelve IAEA safety standards were reviewed, with resulted comments and issues sent to the drafters. For the state nuclear and radiation safety regulatory bodies SEC NRS has developed and maintains a full-text electronic database of documents in the field of the use of atomic energy existing in the Russian Federation.

Upon request from Rostechnadzor SEC NRS analyzes operational events occurred at NPPs and prepares annual summary analytical reports on the safety assessments of nuclear units in the Russian Federation for Rostechnadzor. These reports are prepared basing on the analysis of data submitted to the Regulatory Body by Rosenergoatom. SEC NRS maintains an electronic database on operational events at NPPs "ISI-Nadzor", which is used by the Federal Environmental, Industrial and Nuclear Supervision Service in its regulatory activities.

SEC NRS has a Software Certification Council which incorporates several topical sections (neutronics, thermal hydraulics, strength analysis, radiation safety, PSA, etc.). The Council consists of representatives of leading organizations that work in the field of the use of atomic energy, as well as representatives of Rostechnadzor and SEC NRS.

SEC NRS has a quality management system for research, development of regulatory documents, and reviews of safety and software in the field of the use of atomic energy, which meets requirements of standard ISO 9001:2008 and GOST R ISO 9001-2008 (ISO 9001-2008). This is confirmed by Certificate No. 75 100 70463 issued on 26 December 2011 by the certification authority TUV International RUS Ltd. and by certificate of conformance No. ROSS.RU.IS87.K00132 issued on 17 January 2012 by the Russian authority for certification of quality management systems: JSC SRC CD.

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

On June 28, 2012, in Helsinki (Finland), at a session of the General Assembly of the European Technical Safety Organizations Network (ETSON), SEC NRS officially became an associate member of this organization.

The membership in ETSON allows SEC NRS exchanging, on a regular basis, outcomes of research, experience in supervision of safety of operation of nuclear installations, as well as information on conducted safety assessments. Owing to the membership in ETSON, which lists 10 organizations from 10 countries, the grounds for harmonization of practices (approaches) to nuclear safety assessments has been established, which also fosters identification and implementation of research programs in Europe.

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, as prescribed by the "Rules of assessment of conformance of the equipment, component parts, materials and semi-finished products, which are supplied to nuclear facilities", while assuring quality of the equipment being supplied to NPPs;
- drafting of legal regulatory acts in the field of the use of atomic energy;
- drafting and revising federal standards and rules in the field of the use of atomic energy;
- arranging and conducting safety reviews in the field of the use of atomic energy as relates to development of design and engineering documentation;
- drafting of regulations related to supervision of nuclear material physical protection control and accounting and training of inspectors in this area;
- research in the area of safety assessment methodology as regards the uses of atomic energy;
- training of the personnel of the state nuclear safety regulatory body.

In 2010-2012, in the framework of implementation of Rostechnadzor’s action plan, which resulted from the IAEA mission held in 2009, VO Safety participated in drafting the Federal Law "On the State Regulation of Safety in the Uses of Atomic Energy", which provisions were endorsed by the State Duma of the Federal Assembly of the Russian Federation as part of Federal Law No. 347-FZ of 30 November 2011 "On Amendments to Certain Legislative Acts of the Russian Federation for the Purposes of Regulation of the Safety in the Use of Atomic Energy" as well as in a number of draft by-laws in pursuance of provisions of the said Federal Law.

Over the reporting period, VO Safety performed works related to participation in working groups of the Multinational Design Evaluation Program (MDEP), including:

- Vendor Inspection Cooperation Working Group;
- Codes and Standards Working Group;
- Digital Instrumentation and Controls Working Group.

Under the relevant international agreements of Rostechnadzor, VO Safety trains nuclear safety regulators from foreign countries where NPPs are being built to the Russian designs.

VO Safety employs the quality management system for reviews, inspections, checks, quality and safety assessments in the field of the use of atomic energy; the system is certified as conforming to standard ISO 9001:2008.

In conclusion, it should be pointed out that the Russian Federation has an independent Regulatory Body – the Federal Environmental, Industrial and Nuclear Supervision Service.

The Federal Environmental, Industrial and Nuclear Supervision Service has human, financial and technical resources that allow it to perform the assigned functions while maintaining its independence.

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 34) 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 has 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.

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 in compliance with the approved Subsidiary Regulations and their labor contracts, in the scope of authorities set out in warrants granted them by the Director General of Rosenergoatom Concern.

The Operating Organization must inform the Regulatory Body of all cases of violations of safe operation limits and conditions; submit systematized data on all operational events at NPP; and submit periodic reports on the level of NPP safety and on the state of nuclear and radiation safety as requested by the Regulatory Body (within its authority).

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 and reviewing the information presented by the applicant. Rostechnadzor conducts inspections of the fulfillment of the conditions of the granted licenses on a regular basis.

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. The financial coverage of liability can be provided in the format of the civil liability insurance.

Rosenergoatom operates 10 nuclear power plants in the Russian Federation and is a nuclear installation operator as per the Vienna Convention. Rosenergoatom concludes insurance policies regarding its

civil liability for nuclear damage. The insurance objects are Rosenergoatom's property interests associated with its obligation to compensate for damage caused by third parties as the result of a radiation accident (nuclear incident). The insurance protection covers the territory of the Russian Federation, the territories of other Contracting Parties to the Vienna Convention, which can be subject to a transboundary nuclear damage.

Insurance is done in the Russian Nuclear Insurance Pool by insurance sums that ensure fulfillment of the Vienna Convention. Security of the insurance compensation is ensured by the international pooling system, which the Russian Nuclear Insurance Pool involves as reinsurers.

Involvement of the international pooling system in insuring civil liability for nuclear damage of Rosenergoatom became possible after international insurance audits conducted at the Russian nuclear power plants. Commencing 2009 these inspectorates have carried out pre-insurance reviews of 8 out of 10 Russian plants. In 2013 it is planned to conduct international insurance audits at two remaining NPPs (Bilibino and Kursk).

Hence, in the area of civil liability for nuclear damage Rosenergoatom fully fulfills the international commitments of the Russian Federation in this regard.

In the Russian Federation the responsibility of the Operating Organization for NPP safety is established by the legislation, defined in the regulatory requirements, and is an essential principle of safety assurance, 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 is based on the statutory regulation principles formulated in Article 2 of the Federal Law "On the Use of Atomic Energy", such as:

- safety ensuring in the uses of atomic energy: protection of individuals, 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, 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;
- observance of international obligations and safeguards of the Russian Federation in the field of the use of atomic energy.

The Operating Organization by law is obliged to bear civil liability for damages caused to legal entities and physical persons by radiation impact, with such liability incurring irrespectively of whether the Operating Organization is guilty or not.

Proceeding from the above, Rosenergoatom sees its mission in providing the consumers with electricity and heat generated at its nuclear power plants, while ensuring safety as the highest priority of its activities.

The energy security of the Russian Federation, protectability and safety of citizens, and environmental protection are the core values for Rosenergoatom.

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

- ensuring nuclear, radiation, industrial, fire and environmental safety and labor protection;
- observance of the legislation of the Russian Federation; observance of requirements of federal standards and rules and safety regulations; observance of institutional standards;
- ensuring economic efficiency of generation of electricity and heat;
- improvement of the safety culture.

Being the Operating Organization, Rosenergoatom bears full responsibility for nuclear and radiation safety at all stages of the nuclear power plants' life cycle.

Rostechnadzor ensures nuclear and radiation safety in frames of respective responsibility set out in the legislation of the Russian Federation through:

- implementation of the consistent science and technology and economic policy, while observing the priority to safety;
- continuous investing in safety, improvement of design safety features of NPPs;
- dissemination of the best practices;
- continuous analysis of operation processes; studies of changes in structural material, hydrodynamic, neutronics characteristics and properties of nuclear installations and NPP as a whole during operation;
- development and implementation of NPP accident preventive measures;
- enhancement of preparedness of the plant management and personnel for emergency response;
- provision and 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.

At this, in its activities Rosenergoatom consistently and persistently fulfills obligations resulting from the Convention on Nuclear Safety, takes account of recommendations of the IAEA's NPP safety provisions and guides, as well as provisions and principles 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 assessment and improvement

The safety culture is a constituent of the overall culture of an organization, which includes common values, beliefs, behaviors that build up striking features of the organization (IAEA's document SRS No. 11).

At Rosenergoatom the assessment of safety culture effectiveness is mainly focused on three areas:

- plant safety indicators;
- analysis of causes of events or potential errors to learn lessons thereof;
- common strive of employees to improve safety, including actual control of this process by the superior governing body.

Russian nuclear plants attach great attention to the organization of activities encouraging safety culture awareness among personnel. The effort relies on the rules and regulations specifying requirements for the safe and reliable operation of the plants.

Special emphasis is placed on activities addressing the human factor as well as on measures aimed at prevention and correction of human errors.

Safety culture is evaluated against the safety culture indicators identified in the "Provision on the Safety Culture Awareness Day at Rosenergoatom".

Evaluation of safety culture helped identify areas for improvement to further enhance safe and reliable operation of the plants, in particular:

- improvement of operating and maintenance procedures;
- improvements in the training of operating and maintenance personnel;
- broader use of internal and external operating experience of the nuclear plants;
- improvement of guidelines addressing the self-assessment of operational safety;
- organizational activities related to repairs of unsealed equipment;
- improvement of the system for detection, accounting and analysis of root causes of failures and defects.

Some plants' activities are described below to illustrate this point:

- Balakovo NPP: the plan has developed a three-level safety culture model based on the safety culture model employed by OPG (Canada), which use allows to account of conditions of the equipment, documentation, technology, as well as common values, beliefs and behaviors;
- Beloyarsk NPP: the plant has installed a software database "Identification of hazards";
- Bilibino NPP: the plant has put in operation the "System of accounting, classification and analysis of low-level events"; feedback has been organized;
- Kalinin NPP: the plant uses interactive boards in training of the personnel at the plant's Training Centre;
- Kola NPP: the plant has designed and deployed the computer-based training course "Routine switching procedure; program-based operation" for training and maintaining skills of the operating personnel at the plant;
- Kursk NPP: interactive psychology and physiology trainings have been incorporated in the operating personnel training in the Training Centre. Upon the training completion, the trainees and managers answer questionnaires to evaluate the training done;
- Leningrad NPP: the plant has introduced the practice of analyses and assessments of equipment failures occurring during the plant's operational events; this practice involves the personnel who are skilled in the methodology of application of the code "Risk Spectrum/Risk Watcher" of the Swedish company Relcon Scandpower AB;
- Novovoronezh NPP: the plant has introduced a system of video

briefings on radiation safety, which are broadcasted on the group displays at all operating units;
- Rostov NPP: the plant developed programs for assessment of impacts of internal and internal factors on the plant operating personnel's performance efficiency;
- Smolensk NPP: in the area "Human factor management" the plant has developed the personnel work monitoring process aimed at reduction of errors for the plant managerial staff.

In the framework of the Safety Culture Awareness Day at Rosenergoatom, the utility annually identifies the best-performing plants from the viewpoint of safety culture.

Three major aspects are highlighted in the safety culture assessments at the operating plants. These are:
- ability to reveal hidden deficiencies and outstanding safety issues;
- ability to identify significance of events, safety issues and to adequately respond;
- ability to learn lessons and eliminate safety issues.

Safety culture effectiveness is also analyzed in the course of preparation of an annual summary report on safety of nuclear units. The report addresses also the state and main areas of improvement of the safety culture.

The measures developed at the plants to enhance safety culture are also meant to improve units' performance indicators and eliminate weaknesses revealed by the analysis of direct and root causes of operational events.

10.3. Role and value of Rostechnadzor

While performing the functions assigned to it by the Federal Law No. 170-FZ "On the Use of Atomic Energy" and by other acts and by-laws (described in Article 8 of this National Report), 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 Statement says that all activities of Rostechnadzor are meant to 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. To achieve this goal Rostechnadzor:

- sets out the safety criteria, rules and regulations in the field of the use of atomic energy;
- issues licenses (permits) for activities in the field of the use of atomic energy;
- develops and implements NPP inspection programs;
- imposes sanctions in case of a violation of nuclear and radiation safety requirements;
- supports and conducts independent research into nuclear and radiation safety;
- advises state authorities and the public on the changes in the situation with nuclear and radiation safety, including in case of pre-emergences and accidents.

In particular, over the reporting period Rostechnadzor has adopted the Policy Statement "Application of the Probabilistic Safety Analysis and Risk-Informed Methods for NPPs". It specifically points out that the accident at Fukushima-Daiichi NPP demonstrated that protectiveness of plants against external natural and man-induced impacts is an important aspect of NPP safety. In this connection Rosenergoatom was suggested to conduct, as part of its periodic safety assessment activities, and submit to Rostechnadzor refined probabilistic safety analyses, which will consider on-site fires and floods, as well as external natural and man-induced impacts.

Hence, in the Russian Federation, the authorities controlling the uses of atomic energy, the Operating Organization and Rostechnadzor implement the national policy which gives highest priority to safety ensuring of nuclear power plants.

Article 11. Financial and Human Resources

11.1. Financial resources of the Operating Organization

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

In accordance with the Ordinance of the Government of the Russian Federation No. 68 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 life cycle and development" (considering amendments made by the Ordinance of the Government of the Russian Federation No. 1189 of 19 November 2012, the operating organizations makes such provisions in accordance with the guidelines established as per cents of revenues gained by the operating organizations through sales of products (works, services) associated with the use of atomic energy, to generate:

- the reserve intended for financing of expenditures for ensuring nuclear, radiation, industrial and fire safety during operation of NPPs basing on the program of measures, 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.

In 2013 the 2012 reserve for ensuring nuclear, radiation, industrial and fire safety was additionally increased by 10 %, basing on results of the additional analysis of robustness of Russian NPPs carried out considering the lessons learned from the accident at Fukushima-Daiichi NPP:

- the reserve intended for financing of expenditures to ensure nuclear material physical protection, control and accounting at the plant, as based on the program of measures, in an amount of not more than 2 % of revenues gained by Rosenergoatom through sales of products (works, services) associated with the use of atomic energy (the reserve for 2011-2012 was in the amount of 1.0 % of revenues);
- the reserve intended for financing of expenditures to decommission the plant and to carry out research and development needed for the justification and improvement of safety of facilities being decommissioned, as based on the program of measures, in an amount of not greater than 3.2 % of revenues gained by Rosenergoatom through sales of products (works, services) associated with the use of atomic energy (the reserve for 2011-2012 was in the amount of 1.3 % of revenues);

- the reserve intended for financing of expenditures for NPP development as per the list of capital project facilities on the Rosenergoatom's investment program, which are financed in the next fiscal year for the purposes of implementation of the Rosatom's long-term activity program. 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 Tariff Service of the Russian Federation;
- the reserve intended for financing of expenditures to dispose of radioactive waste (this reserve has been made commencing 2013 due to coming into force the Federal Law No. 190-FZ of 11 July 2011 "On the Management of Radioactive Waste and the Amendment of Certain Legal Acts of the Russian Federation"), basing on an estimation of costs of radioactive waste disposal, which are calculated proceeding from the projection of an amount of waste transferred by Rosenergoatom for disposal to the national operator for radioactive waste management approved by Rosatom, 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 through sales of products (works, services) associated with the use of atomic energy.

Sizes of the provisions to the reserves made in accordance with the above said Ordinance of the Government of the Russian Federation are given in Table 11.1.

Table 11.1. Amounts of provisions to the reserves, thnd. rubles

Reserve	2011 (actual)	2012 (actual)	2013 (planned)
Reserve for safety ensuring (NRI&FS)	6023158	6608836	7758000
Reserve for nuclear material physical protection, control and accounting	1669695	1881385	4319228
Reserve for decommissioning of NPP	2444060	2552653	6957423
Reserve for NPP development	64445546	40783510	53755220
Reserve for disposal of radioactive waste*	-	-	3239421

* The reserve was made in 2013 due to coming into force the Federal Law No. 190-FZ of 11 July 2011 "On the Management of Radioactive Waste and the Amendment of Certain Legal Acts of the Russian Federation".

Sizes of financing 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

Financing of the program of measures to ensure safe and sustainable operation of existing nuclear units in 2011-2013 (mln. rubles)		
2011	2012	2013
9 607	16 923	23 387

11.2. Human resources of the Operating Organization

A total number of staff of Rosenergoatom is about 34,900 people. The payroll staff and structure of the production personnel of NPPs are in compliance with the existing regulatory documents.

At present all Russian nuclear plants are staffed, in accordance with the regulatory requirements, with skilled personnel necessary for the operation, maintenance and repair of major and auxiliary equipment of nuclear plants, and for implementation of the managerial, economic and other functions.

A total number of staff involved in operation of the plan equipment (operating personnel) is over 9,700 people.

In accordance with Article 35 of the Federal Law "On the Use of Atomic Energy" the Operating Organization shall provide recruitment, training and maintenance of the skills of nuclear plant personnel.

The system of staff recruitment and training in the nuclear power is based on the regulatory documents.

The said documents establish requirements for the following main activities related to the work with the NPP personnel:

- personnel selection and hiring procedure;
- pre-job training;
- training to maintain proficiency;
- vocational and skills improvement training.

These documents are applicable also to the staff of the organizations rendering design, engineering, maintenance, commissioning and testing services for power equipment to nuclear power plants.

11.3. Training, education, maintenance and advancement of the personnel's qualifications

The qualification maintaining and advancing is meant to improve the level of professional theoretical knowledge and to master skills of Rosenergoatom's personnel. These activities are carried out on the basis of the requirements of the legislative regulatory acts issued by the federal executive bodies, regulations of Rosatom and Rosenergoatom.

All staff of Rosenergoatom is subject to qualification advancement, which a continuous process; the level of qualification procedure takes place as frequent as once in five years during the entire employment of the personnel. With this, qualification advancement of the plant operating personnel is as frequent as regulated by the requirements of legislative regulatory acts issued by the federal executive bodies, regulations of Rosatom and Rosenergoatom.

The following categories of the employees are subject to qualification advancement process:

- managers and specialists of Rosenergoatom; at supplementary vocational education institutions;
- plant employees who do not pertain to the category of managers and specialists; at the plant divisions or training centers of NPPs.

The traditional suppliers of educational services to Rosenergoatom are the supplementary vocational education institutions such as the non-public supplementary vocational educational establishment Central Institute for Continuous Education and Training (CICE&T), National Research Nuclear University MEPHI (NRNU MEPHI), VNIIAES, federal state supplementary vocational education establishment St. Petersburg Power Engineering Advance Training Institute (PEIPK), and Atomtechenergo.

In 2012, the plant personnel education hours amounted up to 801,079 man-hours. On average, each employee of the operating plant spent 23 hours for education at the supplementary vocational educational institutions. In 2012 Rosenergoatom spent 283,101,000 rubles for employees' qualification advancement.

Rosenergoatom's employees are certified to determine whether a given employee is compliant to the position he/she holds, specifically, whether the factually fulfilled duties and qualifications of employees correspond to the requirements for qualification parameters and job descriptions. The certification is carried out once in five years; a decision to carry out the certification is made by the Director General of Rosenergoatom or Plant Manager. Following the certification results, an order of summing up its outcomes is issued and measures are developed to implement recommendations of the Certification Commission.

The Operating Organization has necessary financial resources to provide training and maintaining of qualifications of the plant personnel.

According to standards of the Operating Organization, the at-plant training centers are granted relevant certificates valid for a certain period of time. By 2013 training centers of all operating NPPs were granted such certificates.

The at-plant training centers possess training aids and equipment, which are sufficient for training and maintaining qualifications of the plant personnel. The training centre buildings and/or premises include classes for theoretical courses for the personnel, special education classes, laboratories and shops.

The training classes are fitted with state-of-the-art educational aids: full-scope and analytical simulators, simulator-based educational systems, educational boards.

Teaching and educational materials have been produced to support programs for pre-job training and maintaining qualifications of the personnel.

The at-plant training centers employ instructors, i.e. specialists who lead pre-job training and maintaining qualifications in accordance with the requirements established by Rosenergoatom. They possess high qualifications through the instructor training and annual qualification maintenance courses. The instructor training program includes:

- general training, including not less than 80 hours of psycho-physiological training;
- specialized training for a certain activity area (specialization) of a candidate in the scope of the pre-job training; not less than 80 hours.

A candidate does internship at the workplace of the training centre instructor, which is not less than 160 hours. The internship includes education in writing educational and training materials and a trial lesson.

Annually, instructors do compulsory internship of not less than 80 hours at workplaces of the personnel being trained.

The plants have psycho-physiological laboratories, which are meant to solve integrated problems of improvement and maintenance of appropriate level of human factor reliability to ensure safe and efficient performance of the plant. These problems also include psychological and pedagogical follow-up of the processes of training, maintaining and advancing qualifications of the personnel.

The successful functioning of the system of training, maintaining and advancing qualifications of Rosenergoatom’s personnel is one of the key factors that influence safe and efficient performance of NPPs.

The personnel pre-job training provides the employee with professional knowledge and skills and is carried out in accordance with the

pre-job training programs. The pre-job training includes the following stages:

- at-employment knowledge check;
- theoretical course;
- practical course with the use of training and education equipment (if required for a given job);
- on-the-job internship (if required for a given job);
- initial check of knowledge;
- job shadowing (if required for a given job);
- obtaining a permit to work in the field of the use of atomic energy (if required for a given job);
- admission to work independently.

Separate stages of the training process and fulfillment of the pre-job training program as a whole are controlled by the immediate supervisor of the employee who does the pre-job training.

The plant personnel qualifications are maintained annually in accordance with the qualification maintaining programs. This process is aimed at maintaining professional knowledge and skills required for fulfillment of job description.

The qualification maintenance process is carried out at the plant's training centers, plant's structural divisions and supplementary vocational educational establishments.

The qualification maintenance process includes the following formats:

- off-job training at supplementary vocational educational establishments;
- on-the-job education at the at-plant training centers and NPP structural divisions;
- targeted recurrent and off-schedule briefings;
- emergency, fire drills and emergency action drills;
- simulator training of the plant operating personnel;
- internship, including at related organizations; participation in seminars;
- education and periodic certification of the plant employees who service facilities or execute works supervised by the state supervisory authorities and other agencies, as requirements of the rules established by such bodies;
- independent learning by a plant employee of issues related to his/her professional activities.

The education under the qualification maintenance programs annually has been set at:

- for the plant's main control room operators: not less than 80 hours, including 36 hours of simulator drills;

– for other plant's staff categories: not less than 20 hours.

The qualification and on-the-job experience level necessary for the personnel can fulfill their duties is determined basing on the requirements established in the Standard Skills Reference Book of Positions of Managers, Specialists and Office Employees, section "Qualification characteristics of job positions of the nuclear industry organizations' employees" approved by Order of the Ministry of Public Health and Social Development of the Russian Federation No. 977 of 10 December 2009.

To monitor knowledge necessary for an employee to perform his/her job, Rosenergoatom periodically check on the personnel knowledge.

The checks include an initial check (before an employee is admitted for doing unaided job), planned and unplanned exams.

Personnel are checked for knowing:

– rules and regulations in the field of the use of atomic energy;
– rules and regulations on industrial safety;
– rules, regulations and instructions on labor protection;
– rules, regulations and instructions on radiation safety;
– rules, regulations and instructions on fire safety;
– basic rules of NPP operation;
– job and process regulations.

Examination frequency as regards knowledge of radiation safety rules and guidelines of the personnel admitted to handle radiation sources has been set as follows:

– managers and specialists belonging to operating personnel, workers belonging to operating personnel of the plant have exams once a year;
– other categories of plant personnel undergo examinations once every three years.

Examination of knowledge of employees admitted to unaided work at equipment and facilities supervised by the state regulatory authorities and other agencies is carried out in accordance with the requirements established by regulations issued by these bodies.

Personnel are checked for knowing:

– for managers, specialists and operating personnel of nuclear plants: job descriptions;
– for employees of other trades: labor protection instructions, radiation and safety instructions.

Employees whose duties include substitution of superiors are subject to the knowledge check also in the scope of job description requirements for the substituted position.

The check results are entered in the qualification certificate.

If an employee newly employed at the plant or transferred to another position does not have the required level of competence or his/her qualification level is lower that established requirements, the plant

administration can arrange for a supplementary vocational training (retraining). The plant specialists are retrained in the institutions that have licenses for the related educational activities.

Rosenergoatom spends its own funds for training of the personnel.

Operating experience feedback is taking account of in the process of training and maintaining qualifications of the plant personnel through:

- incorporation in topical plans of training and qualification maintaining programs the topics related to the operating experience feedback, including operating experience information, operational event reports, investigation records of occupational injuries and information about other events;
- education of the personnel involved in detection and analysis of causes of the plant operational events and in development of measures, methodology of analysis of abnormal event causes;
- conduct of monthly operational event briefings of the plant personnel at the plant production divisions;
- psychological support of the operating personnel who make essential through lectures, practices and role plays.

The work continues to update personnel training programs, expansion of the training aids, including fitting with equipment new classrooms, upgrading and development of training equipment, and writing educational methodological materials.

According to the Program of outfitting at-plant training centers with education and training aid until 2015, it is planned to equip specialized classrooms, laboratories and shops with training boards and simulator systems worth 50 million rubles.

Rosenergoatom's plans of improvement of the plant personnel training and qualification maintenance provide for:

- revision of regulatory documents of Rosenergoatom on training aids and certification of at-plant training centers;
- commissioning and acceptance for use of the analytical simulator at Beloyarsk NPP, as well as at Novovoronezh NPP-2 and floating nuclear co-generation plant under construction;
- upgrading of the full-scope simulator at Smolensk NPP, education and training equipment at Rostov and Kalinin NPPs;
- outfitting of training centers of Kursk and Kola NPPs with education and training equipment for maintenance personnel;
- revision and update of educational methodological materials to consider requirements of the federal legislative and regulatory documents and operating experience.

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 personnel having appropriate qualifications.

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 1 March 2011 "Methodological Guidelines for the Analysis of the Causes of Safety-Reliability-Related Events, Fires, Injuries, Damages to NPP 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 man-machine interface is reviewed as well. In particular, the work places in the main control room, main control board, other control boards and panels at the plant have been analyzed. The findings were 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 investigation reveals the causes of the event, in particular, those associated with work organization and human factor. The cause analysis findings serve to develop corrective and preventive actions to preclude the recurrence of such events.

The production divisions of the plant have monthly meetings of personnel to discuss the events that have occurred at the plant. During plant personnel examinations special emphasis is placed on ascertaining that the staff knows the symptoms of the initiation and progression of abnormal performance of the attended equipment and knows how to cope with abnormalities, including those caused by human errors.

Rosenergoatom set up and 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 information serves to analyze operational events and define the actions to prevent their recurrence.

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 for specific jobs (professions) using state-of-the-art technical aids and efficient educational techniques;
- periodic training courses for operating and maintenance personnel to keep their skills and competence at a level essential for the safe operation of the plant;
- 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 information received from various sources, including the best practices;
- mandatory debriefing sessions with the operating personnel to discuss abnormal performance of plant systems and components.

Implementation of these arrangements helps ensure and maintain the required knowledge and skills of the operating personnel.

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 continuous effort is taken to organize and implement personnel training and skill maintenance of the plant personnel. 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 on 31 May 2012 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 for the personnel to master

their self-control techniques, teamwork, prophylaxis of erroneous actions;
- 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;
- introduction of requirements for safe conduct of specific works in Rosenergoatom's regulations;
- the use at NPPs standard formats of targeted briefings when executing works under work with inclusion thereof, among other, the information on potential consequences of wrong or poor quality execution of a given work;
- introduction into the plant's regulations the compulsory development of specific formats (check lists) of walkdowns of the equipment and workplaces by operating, maintenance and managerial personnel of the plant to ensure safety and verification of walkdown performance efficiency.

12.3. Role of the Regulatory Body with regard to human performance

Rostechnadzor pays great attention to supervising the effort to take into account the impact of qualification, organizational and ergonomic causes of the plant personnel errors on NPP safety assurance.

In accordance with Article 27 of the Federal Law "On the Use of Atomic Energy", some categories of plant employees (management, operating personnel and personnel overseeing nuclear and radiation safety) may perform their functions only if having appropriate permits (licenses) granted by Rostechnadzor.

The Russian Federation Government endorsed a list of plant job positions, for which the staff shall have a work permits in the area of the use of atomic energy.

One of the mandatory conditions for getting a license 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 developed and approved by the Order of 21 December 2011 No. 721 the "Administrative Regulation for rendering by the Federal Environmental, Industrial and Nuclear Supervision Service of the governmental service of granting permits to execute works in the field of the use of atomic energy". According to the Administrative Regulation, the permit-granting procedure includes:

- submission of an application to issue a permit to the candidate to Rostechnadzor;
- review of the application documentation by Rostechnadzor;
- operating personnel's knowledge check in training centers and full-scope simulators;
- making decision by Rostechnadzor regarding granting or refusal to grant the permit;
- granting of 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 Ordinance of the Government of the Russian Federation No. 1044 of 15 October 2012. According to the "Provision…", 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;
- 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 power 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.

Analysis of plant personnel performance in recent years shows that the number of cases pointing to deficiencies in personnel training has decreased.

Hence, prevention of human errors, identification of training weaknesses and maintenance of high professional skills are of vital importance in NPP safety improvement activities.

The Russian Federation has established, at a governmental level, procedures and requirements for organizing supervision 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 at all stages of the NPP life cycle. Rostechnadzor pays great attention to issues of quality assurance at all stages of the nuclear power plant development and operation. The federal rules and standards "Requirements for Quality Assurance for Nuclear Power Plants" (NP-011-99), which regulate NPP activities subject to quality assurance, requirements for development and maintaining updated the quality assurance programs 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.

Over the time elapsed since the Fifth National Report Rostechnadzor has developed and put in force the following documents (Safety Guides) on quality assurance:

- RB-051-10 "Provision on development of quality assurance programs for design and engineering of items supplied to nuclear facilities", 2010;
- RB-055-10 "Provision on development of quality assurance programs for manufacture of items supplied to nuclear facilities", 2010;
- "Regulation on the Quality Control System of the Federal Environmental, Industrial and Nuclear Supervision Service in the Field of State Regulation of Nuclear Safety", 2012.

Also, GOST ISO 9001-2011 "Quality Management Systems. Requirements" and GOST ISO 90001-2011 "Quality Management Systems. Main Systems and Glossary" were put into effect.

Rosenergoatom in its activities is guided by the quality assurance policy aimed at achieving economically efficient generation and reliable provision of electricity and heat to consumers with unconditional observance of nuclear and radiation safety. In 2012 the Quality Assurance Policy was updated, i.e. Rosenergoatom produced the Quality Policy Statement, which is line with the Quality Assurance Policy of the State Atomic Energy Corporation "Rosatom" for the peaceful uses of atomic energy.

The NPP quality management system functioning is reflected in quality assurance programs (POKAS) for all stages of the plant life cycle.

A POKAS consists of a set of documents, which set forth the combination of organizational, engineering and other quality assurance measures meant to implement quality assurance principles established by regulatory documents and to achieve required quality indicators.

According to requirements of the federal standards and rules, Rosenergoatom:

- selects organizations, which perform works and render services;
- establishes requirements for POKAS of organizations, which perform works and render services;
- reviews POKAS of organizations, which perform works and render services, for their compliance with the established requirements;
- ensures fulfillment, oversees and conducts internal audits of fulfillment of the overall and local quality assurance programs for NPPs (POKAS(VE) POKAS for commissioning, POKAS(E) – POKAS for operation, POKAS(VvE) – POKAS for decommissioning);
- collects and analyzes information on quality of executed works and rendered services;
- revises and updates POKAS, for which the Operating Organization bears responsibility.

Rosenergoatom plans and carries out assessments of achieved results at all tiers of the quality management system.

All plants continuously revise and supplement POKAS, considering newly introduced regulatory documents in the field of the use of atomic energy.

To ensure functioning of POKAS and to assess its effectiveness, Rosenergoatom conducts checks and audits of corresponding POKAS for each operating plant and plant under construction. The checks outcomes are used to produce corrective measures, which are introduced in the operating practices and are continuously monitored by Rosenergoatom. The organizational and engineering measures to eliminate non-conformances and to implement recommendations on POKAS fulfillment revealed in 2011-2012 were recognized effective: all planned measures were fulfilled in full scope in 2011 and 2012.

In 2011, to support functioning of the "Quality assurance program for operation of nuclear power plants" and to assess its effectiveness, Rosenergoatom conducted inspections and audits of POKAS effectiveness at operating NPPs. Such audits were conducted in regards of POKAS(O), POKAS(E) at Bilibino, Novovoronezh and Rostov NPPs. In 2012 fulfillment of POKAS(O), POKAS(E) was audited at Balakovo, Beloyarsk, Kola, Kalinin, Kursk, Leningrad and Smolensk NPPs (audits of Beloyarsk, Kursk, Kola and Kalinin plants were conducted using a unified program:

verification of conformance NP-011-99 and GOST R ISO 9001-2008). Thus, over two years the fulfillment of requirements of POKAS(O) and POKAS(E) was inspected at all operating plants. In 2013 it is planned to inspect fulfillment of POKAS(O), POKAS(E), GOST R ISO 9001-2011 at five operating plants and one plant under construction.

Rosenergoatom has produced a special program for assessment of effectiveness of fulfillment of POKAS(O), POKAS(VE), POKAS(E), and POKAS(VvE). The program has the following main assessment criteria:

- certainty that requirements of the current rules and regulations on nuclear power safety are fulfilled;
- certainty that main provisions of the Quality Policy Statement are met;
- meeting customer's requirements as regards the quality of electricity and heat supply;
- provision and monitoring of conditions conducive to attaining optimum performance indicators of the plant.

To further develop the QA systems at nuclear plants and meet current requirements for such systems Rosenergoatom continues implementing an "Action Plan for Obtaining Certificates of Conformance with GOST R ISO 9000-2001, GOST R ISO 9001-2001, and GOST R ISO 14001-98 Requirements".

Along with Balakovo, Smolensk and Rostov NPPs, which already obtained certificates of conformance of the quality management system with requirements of GOST R ISO 9001 in 2005-2009, Rosenergoatom in 2012 obtained certificates of conformance for quality management systems of Rosenergoatom Headquarters, Balakovo, Smolensk, Novovoronezh, Leningrad, Kalinin, Kursk NPPs, Directorate of Novovoronezh NPP-2 under Construction, Design and Engineering Branch of Rosenergoatom. The near-term objective of Rosenergoatom is to cover all operating plants and those under construction with such certificates.

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 rules 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 POKAS 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 (POKAS(R) and quality assurance programs

for manufacture of the equipment, items and systems important for safety of NPPs (POKAS(I).

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 (POKAS(S) is checked.

Thus, the Russian Federation attaches prime importance to quality assurance at all stages of nuclear plant design, operation and decommissioning.

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 reactor installation, and other independent organizations;
- Rostechnadzor with involvement of independent scientific and technical support organizations and high-skilled experts.

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

14.1. Safety review in the course of licensing

According to the Federal Law No. 347-FZ of 30 November 2011, the Operating Organization shall obtain a Rostechnadzor's license for carrying out a certain activity (siting, construction, operation and decommissioning of the plant, design and manufacture of equipment for nuclear installations, review of justification of safety in the field of the use of atomic energy).

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 Implementation of the State Function of Licensing Activities in the Field of Nuclear Energy by the Federal Environmental, Industrial and Nuclear Supervision Service". In review of documents submitted for getting a license, Rostechnadzor determines:

a) the conformance of design, engineering and technological solutions with the legislation of the Russian Federation, requirements of standards and rules, as well as availability and conformance with the established requirements of conditions for the safe management of radioactive waste when carrying out the activity being licensed;

b) completeness of measures of organizational and technical nature for safety ensuring of the activity being licensed;

c) availability and conformance with the established requirements of the conditions for storage, control and accounting of nuclear material, radioactive substances and radioactive waste, physical protection of the nuclear installation, plans of measures to protect employees of the nuclear

facility and the public in case of an accident, as well as the quality assurance system and necessary engineering and technical support of the activity being licensed;

d) ability of the Operating Organization to ensure safe conduct of the activity being licensed, as well as assure quality of executed works and rendered services, which meet federal standards and rules in the field of the use of atomic energy;

e) availability and preparedness of the appropriate force and capabilities for elimination of emergencies in case of a nuclear and radiation accident at the nuclear facility;

f) ability of the Operating Organization to provide conditions for safe termination of the activity being licensed and for decommissioning of the nuclear facility, as well as availability of relevant project materials.

In the course of the review of documents that justify safety Rostechnadzor checks on credibility of the information contained therein through a peer review of the plant safety justification and (or) activity being licensed as well as through inspections.

Basing on the peer review and inspection results Rostechnadzor makes decision on whether to grant or not a license for the declared activity; in so doing the Federal Supervision Service formulates license conditions, which are an intrinsic part of the license.

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

All operating units of Russian nuclear power plants have operating licenses granted by Rostechnadzor. To obtain a plant operating license, the applicant shall, along with other documents (see Appendix 11) submit a document package to justify nuclear and radiation safety of the plant operation. The document package that justifies the unit safety at the stage of operation includes the final safety analysis report of the plant, which structure and content requirements are set out in the federal standards and regulations.

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 also 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. The procedure of documents submission to Rostechnadzor in case of the periodic safety reviews is determined by a Rostechnadzor’s order. Basing

on outcomes of review of the periodic safety review report a relevant decision is made.

14.2. Audits and inspection during NPP operation

Pursuant to the requirements of Article 35 of the Federal Law No. 170-FZ "On the Use of Atomic Energy", the Operating Organization provides continued monitoring of the safe operation of nuclear plants.

Availability of the safety and safety-important systems is checked periodically, as prescribed by relevant regulations.

Targeted and comprehensive safety inspections of the plants are integral parts of the safety monitoring by Rosenergoatom. These are focused on:

- detection of potential generic issues and problems during operation;
- development and implementation by Rosenergoatom of corporate-level measures and recommendations aimed at improving the plant safety;
- effective control over timely implementation of measures to improve the plant safety and robustness;
- identification and analysis of the best practices of effective safety improvement introduced at Rosenergoatom's plants.

Currently, Rosenergoatom introduces new approaches to safety audits at NPPs, which take account of the IAEA and WANO recommendations. The new approaches to the plant safety audits are based on the following principles:

- the audit object is Rosenergoatom represented by a certain plant rather than a separate plant;
- openness and trust during the audits, as the guarantee of the most complete identification of areas for improvement, lead to the plant interest in the audit outcomes;
- measures resulted from the audits are aimed at elimination of causes of the revealed issues and deficiencies.

Positive results of application of the new approaches to audits should be pointed out:

- efficiency improvement of the safety monitoring system;
- solutions to outstanding issues that are in jurisdiction of the Rosenergoatom's Headquarters revealed by the plant audits.

Basing on findings of the Russian and international audits (carried out by the state safety regulatory bodies, Rosatom, IAEA, WANO, International Nuclear Insurance Pool), it has been concluded that the operating NPPs in Russia meet the requirements of the federal standards

and rules in the field of the use of atomic energy, as well as international requirements and standards.

In the period from 9 till 22 April 2011 the first Corporate Peer Review of Rosenergoatom by WANO was carried out. The peer review was to assess the uses of WANO's international experience to improve Rosenergoatom and its branches' operations. The peer review involved four expert groups, which consisted of representatives of WANO, Rosenergoatom, Electricite de France and IAEA. In the course of the peer review the experts visited all Rosenergoatom's NPPs, except for Bilibino NPP, which were briefed through the videoconference.

In the course of the WANO's Corporate Peer Review the effects of organizational effectiveness of the utility on the plant operation was analyzed in five areas: corporate leadership and management, corporate monitoring and oversight, corporate support, human resources (personnel management) and communications. In frames of these areas six areas for improvement were identified. Specialists of Rosenergoatom developed and introduced corrective measures meant to eliminate the revealed issues and their causes. The measures include, among other, joint projects with WANO, such as technical support missions in part of NPP operation oversight, the use of best practices, and human factor; seminars to educate in peer reviews, in application of safe operation indicators for the plant safety assessments.

During the peer review the experts also identified strengths of Rosenergoatom, which can be used by other members of WANO, namely:

- emergency facilities, equipment and resources in possession of Rosenergoatom ensure fulfillment of emergency response actions. Members of the centralized group for assistance to NPPs (OPAS) provide corporate support and give recommendations in case of emergencies;
- Operating Organization has established continuous communication with the plants using videoconferencing and on-site meetings, which provide for active involvement of the plant managers in development of the corporate strategy and in decision-making.

In the period from 12 till 15 February 2013 the Follow-up Corporate Peer Review was conducted at Rosenergoatom by WANO. The peer review goal was to assess progress achieved in the areas for improvement (AFI) identified by the Corporate Peer Review conducted in April 2011.

The follow-up review pointed out that Rosenergoatom had taken effective measures in the areas for improvement identified by the Corporate Peer Review conducted in April 2011. Over the recent two years an apparent progress has been achieved in all areas for improvement.

From 5 till 22 September 2011 at Smolensk NPP an independent international Operational Safety Review Team's mission of the IAEA (OSART) was carried out.

The OSART mission at Smolensk NPP resulted in ten proposals, two recommendations, as well as ten examples of the best practices, including:

- involvement of psychologists in the personnel trainings at the full-scope simulator;
- availability of the fast-acting reactor information display system, which easy to perceive and which gives a possibility of making necessary assessments in time shortage and stress conditions.

In 2012 the Rosenergoatom's Safety Inspection Department conducted 4 comprehensive safety audits at the plants (Bilibino, Beloyarsk, Kursk and Leningrad NPPs) and a safety inspection at Smolensk NPP. In February 2013 a targeted safety inspection was carried out at Kalinin NPP.

In the period from 13 till 17 May 2013 the follow-up OSART IAEA mission was conducted at Smolensk NPP.

The mission concluded that 75 % of the recommendations and proposals had been implemented and 25 % of those required long time to implement; Smolensk NPP undertaken necessary measures to implement them.

Thus, the OSART programs are successfully used for objective peer review of safe operation of Russian NPPs with the use of the IAEA safety standards and the best international practices.

In May-April 2011 Rosenergoatom conducted audits of operating NPPs in Russia and off-schedule emergency drills of the personnel of all plants to master actions in conditions of accidents induced by external impacts, considering lessons learned from the accident at Fukushima-Daiichi NPP.

Rostechnadzor oversees the implementation of measures developed by Rosenergoatom basing on outcomes of the additional analysis of protectiveness of the Russian plants against extreme external impacts.

14.3. Assessment of the plant's equipment aging during operation

As required by requirements of the federal standards and rules, the Operating Organization develops programs for checking the operability of systems and components, evaluating their ageing processes and replacing equipment with expired lifetime.

At Rosenergoatom the requirements for development of programs for assessment of aging and management of equipment life time are defined in the standard STO 1.1.1.01.007.0281-2010 "Lifetime Management of Components of NPP Units".

The life-time management of units' components allows ensuring the required level of safety and reliability during operation of units throughout their assigned and, if necessary, extended period of operation, and includes:

- restoration of the lifetime through replacement of components and through upgrades;
- the use of justified scientific and technical, design and engineering, and other solutions aimed at mitigation of processes and effects of aging of materials and structures; creation of operating conditions that reduce the risk of damage to the equipment, pipelines, cables, etc.

At nuclear power plants the commissions are set up to solve problems of lifetime management of units' components.

Generally, such commissions include representatives of:

- Operating Organization;
- plant architect generals;
- RI chief designers;
- designers (manufacturers) of the equipment;
- other specialized organizations.

One of the commission's priority tasks is to organize the work to classify all components of NPP units by their significance in terms the maintenance of their lifetime characteristics in the process, ensuring safety and economic effectiveness, their coverage by the maintenance and repair systems used at NPPs, degree of aging processes influence on the operating characteristics, etc. The classification goal is to concentrate the monitoring on life-time characteristics of the most important, critical components.

In the period of 2011-2013, as per STO 1.1.1.01.007.0281-2010, Lifetime Management Programs (LTM) of nuclear units' components considering aging factors were developed for all operating NPP units. The Programs include the Monitoring Procedure of NPP Components Technical Conditions.

In 2011-2012 at VNIIAES, in accordance with STO 1.1.1.01.007.0281-2010, the Industry-wide Database of LTM of NPP Components was developed and now updated and used.

According to the requirements of the federal standards and rules, the Operating Organization develops:

- special lists of components, which lifetime characteristics management is exercised through examinations, technical condition assessments, clarification of residual lifetime;
- programs for lifetime characteristics management of systems and components of nuclear units;
- replacement schedules for the equipment that has exhausted its service life;

- annual reports on the lifetime characteristics management of components and systems of nuclear units.

The LTM program implementation allows for:

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

14.4. Operational safety assessment at NPPs

Rosenergoatom has been carrying on annual operational safety assessments of all operating NPPs in Russia. At the present time, such assessments are conducted in accordance with the "Regulation on Annual Operational Safety Assessment Reports for Nuclear Plants" (STO 1.1.1.04.001.0143-2009) and are documented in a special report.

The safety assessments of the plants are performed to:

- check actual condition of safety and other systems and components important for safety of NPP;
- analyze condition of physical safety barriers and accident localization systems;
- assess radiation levels at the site and in the environment;
- check implementation of the system and component upgrading programs and assess the impact of these activities on the unit safety;
- check the level of nuclear, radiation, industrial and fire safety at the plant;
- review and assess the operational events and human errors that have occurred at the plant;
- identify actions to further improve safety and reliability of the unit further operation.

Annual NPP safety assessment reports approved by the Operating Organization are submitted to Rostechnadzor for review and to be taken into account in the supervisory activities.

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, to Rostechnadzor and to nuclear power plants.

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 discuss the trends in the key safety indicators of plant performance, the situation with the most significant safety issues, and make proposals for using the operating experience feedback in regulatory activities. These reports are

sent to the Rostechnadzor Headquarters, to interregional territorial departments of Rostechnadzor and to Rosenergoatom.

The safety assessments of the plants performed in 2010-2013 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, there a steady average number of operational events at NPPs have been noted as compared to the past reporting period. A slight increase (from 0.3 up to 0.38) in the number of scrams per year per reactor is observed. This is explained by a large amount of the scheduled modernization activities in regard of systems important for safety and by introduction of new equipment during modernization of units, which operation period is 30 and more years. The gaseous and aerosol releases to the atmosphere and radionuclide discharge with effluents did not exceed the prescribed levels. The radionuclide content in soil, vegetation, agricultural products, water reservoirs was at a "zero" background level. Personnel exposure did not exceed the prescribed levels (for personnel exposure data please refer to Section 15 of this Report).

14.5. Probabilistic safety analyses of nuclear units

Safety analyses of Russian NPPs, along with findings of the deterministic safety analyses, use outcomes of the probabilistic safety analyses, i.e. quantitative risk assessments. Table 14.1 provides findings of the probabilistic safety analyses Level 1 for operating nuclear units with channel-type and fast neutron reactors. Table 14.2 provides findings of the probabilistic safety analyses Level 1 for operating nuclear units with WWER reactors.

Table 14.1. Findings of the probabilistic safety analyses (PSA Level 1) for power operation of nuclear units with channel-type reactors

Plant, Unit	Reactor type	Integral frequency of severe core damage, 1/reactor-year
Beloyarsk-3	BN-600	$3.6 \cdot 10^{-5}$
Bilibino-1	EGP-6	$1.151 \cdot 10^{-5}$
Bilibino-2	EGP-6	$1.151 \cdot 10^{-5}$
Bilibino-3	EGP-6	$1.151 \cdot 10^{-5}$
Bilibino-4	EGP-6	$1.151 \cdot 10^{-5}$
Kursk-1	RBMK-1000	$9.85 \cdot 10^{-6}$
Kursk-2	RBMK-1000	$7.47 \cdot 10^{-6}$
Kursk-3	RBMK-1000	$7.77 \cdot 10^{-5}$
Kursk-4	RBMK-1000	Preliminary assessment $8.5 \cdot 10^{-6}$ (PSA Level 1 completion in 2014)
Leningrad-1	RBMK-1000	$3.23 \cdot 10^{-5}$
Leningrad-2	RBMK-1000	$8.59 \cdot 10^{-6}$
Leningrad-3	RBMK-1000	$1.34 \cdot 10^{-5}$
Leningrad-4	RBMK-1000	$8.17 \cdot 10^{-6}$
Smolensk-1	RBMK-1000	$7.37 \cdot 10^{-5}$
Smolensk-2	RBMK-1000	$5.22 \cdot 10^{-5}$
Smolensk-3	RBMK-1000	$2.67 \cdot 10^{-5}$

Table 14.2. Findings of the probabilistic safety analyses (PSA Level 1) for operating nuclear units with WWER reactors

Plant, Unit	Reactor type	Integral frequency of severe core damage, 1/reactor-year
Balakovo-1*	WWER-1000	$2.0 \cdot 10^{-5}$
Balakovo-2*	WWER-1000	$2.0 \cdot 10^{-5}$
Balakovo-3*	WWER-1000	$2.0 \cdot 10^{-5}$
Balakovo-4*	WWER-1000	$2.0 \cdot 10^{-5}$
Balakovo-1**	WWER-1000	$1.7 \cdot 10^{-5}$
Balakovo-2**	WWER-1000	$1.7 \cdot 10^{-5}$
Balakovo-3**	WWER-1000	$1.7 \cdot 10^{-5}$
Balakovo-4**	WWER-1000	$1.7 \cdot 10^{-5}$
Kalinin-1*	WWER-1000	$5.04 \cdot 10^{-5}$
Kalinin-2*	WWER-1000	$4.9 \cdot 10^{-5}$
Kalinin-3*	WWER-1000	$1.49 \cdot 10^{-5}$
Kalinin-4*	WWER-1000	$3.0 \cdot 10^{-5}$
Kalinin-1**	WWER-1000	$4.02 \cdot 10^{-5}$
Kalinin-2**	WWER-1000	$3.69 \cdot 10^{-5}$
Kalinin-3**	WWER-1000	$2.95 \cdot 10^{-5}$
Kalinin-4**	WWER-1000	$6.6 \cdot 10^{-6}$
Kola-1*	WWER-440	$8.62 \cdot 10^{-6}$
Kola-2*	WWER-440	$8.58 \cdot 10^{-6}$
Kola-3*	WWER-440	$9.81 \cdot 10^{-6}$
Kola-4*	WWER-440	$1.28 \cdot 10^{-4}$
Kola-3**	WWER-440	$9.028 \cdot 10^{-6}$
Novovoronezh-3*	WWER-440	$5.61 \cdot 10^{-5}$
Novovoronezh-4*	WWER-440	$5.61 \cdot 10^{-5}$
Novovoronezh-5*	WWER-1000	$4.3 \cdot 10^{-5}$
Rostov-1*	WWER-1000	$1.64 \cdot 10^{-5}$
Rostov-2*	WWER-1000	$6.60 \cdot 10^{-6}$
Rostov-1**	WWER-1000	$3.88 \cdot 10^{-5}$
Rostov-2**	WWER-1000	$3.75 \cdot 10^{-5}$

* Integral frequency of severe core damage when unit operates at power.
** Integral frequency of severe core damage for outages.

For the majority of the Russian nuclear power units the estimated values of severe core damage frequency given in Tables 14.1 and 14.2 are in accordance with the target value for the operating NPPs ($<10^{-4}$ per reactor-year for severe core damage frequency as in the IAEA's INSAG-12). Efforts are in progress to update some of the obtained values.

14.6. NPP safety inspections by Rostechnadzor

Commencing 2009 the state oversight (supervision) of the Russian nuclear facilities has been regulated by the provisions of the Federal Law

No. 294-FZ of 26 December 2008 "On Protecting the Rights of Legal Entities and Physical Persons in the Context of State Control (Supervision) and Municipal Control". According to this Federal Law, conduct of inspections of the facilities subject to this law is set out not more frequently than once in three years; this limited regular scheduled inspections at the plants. Over the period passed since the Fifth Review Meeting Rostechnadzor has made significant efforts to leave the scope of this law.

The first step in this direction was the introduction into the Federal Law No. 170-FZ "On the Use of Atomic Energy" the above mentioned separate Article 24.1 "Federal State Supervisions in the Field of the Use of Atomic Energy". This article legislatively sets out the notions of the "federal state supervisions in the field of the use of atomic energy" and the "regime of the continuous state supervision". It also defines the procedure of planning, timelines, frequency and grounds for inspections.

The federal state supervisions in the field of the use of atomic energy is understood as the following activities:

- organization and conduct of audits (inspections) by the authorized federal executive body, which are aimed at preventing, detection and termination of violations of the established requirements by legal entities, their senior executives and other officials;
- taking of measures provided by the legislation of the Russian Federation to terminate the detected violations;
- regular monitoring of fulfillment of the mandatory requirements established by international agreements of the Russian Federation, federal laws and other legal regulatory acts of the Russian Federation in the field of the use of atomic energy, when the legal entities perform their activities;
- regular monitoring of observance of the license conditions of carrying out activities in the field of the use of atomic energy, as well as fulfillment of Rostechnadzor's notices;
- analysis and forecasting of the situation with observance by legal entities the mandatory requirements and license conditions when conducting activities in the field of the use of atomic energy.

Ordinance of the Government of the Russian Federation No. 1044 of 15 October 2012 endorsed the "Provision on the Federal State Supervision in the Field of the Use of Atomic Energy". This Provision sets out that the state supervision is executed by the Federal Environmental, Industrial and Nuclear Supervision Service, which is the authorized body for the state regulation of safety in the uses of atomic energy.

The state supervision is carried out by structural divisions of the Rostechnadzor's Headquarters and interregional territorial departments for supervision of nuclear and radiation safety with involvement, as necessary, experts and expert organizations. The supervision is exercised through

audits (inspections), which are divided into comprehensive and targeted depending on a number of safety issues being inspected. A comprehensive audit (inspection) is organized by Rostechnadzor Headquarters with involvement of representatives of its territorial departments. A targeted audit (inspection) is organized by a territorial department of Rostechnadzor and is focused on one or several safety issues. In accordance with an order (directive) issued by the head of territorial department of Rostechnadzor, targeted inspection can be carried out by both commissions of Rostechnadzor's territorial departments and individually by Rostechnadzor officials.

The Ordinance of the Government of the Russian Federation No. 373 of 23 April 2012 endorsed the "Provision on the Regime of Continuous State Supervision at Nuclear Facilities". The list of nuclear facilities subject to the regime of the continuous state supervision is defined by the Directive of the Government of the Russian Federation No. 610-r of 23 April 2012.

The regime of the continuous state supervision means permanent stay of authorized officials of Rostechnadzor at nuclear facilities and implementation of safety monitoring measures by those officials. Lists of authorized officials for each facility subject to the continuous supervision are approved by heads of the corresponding interregional territorial departments for supervision of nuclear and radiation safety of Rostechnadzor. According to the Ordinance of the Government of the Russian Federation No. 373, heads of organizations (branches) that operate higher hazard facilities shall ensure unrestricted access to the authorized officials to higher hazard facilities, including documents and safety monitoring features, upon submission by these authorized officials their service certificates.

The authorized officials enter the information on conducted operative audits and separate measures in frames of the continuous supervision to the logbook of continuous state supervision. If breaches of mandatory requirements are revealed, the authorized officials take measures to terminate such breaches as prescribed by the legislation of the Russian Federation.

During 2010-2012 comprehensive inspections were conducted at Smolensk, Kalinin, Leningrad, Kola, Bilibino, Beloyarsk, Balakovo and Novovoronezh NPPs. Also, the off-schedule targeted inspection before the first criticality was conducted at Kalinin NPP Unit 4. Besides, jointly with representatives of the Radiation and Nuclear Safety Authority of Finland (STUK), the inspection of safe operation was conducted at Kola NPP. In summer 2012, in the framework of the international cooperation, representatives of the French regulatory authority (ASN) took part in the scheduled comprehensive inspection at Balakovo NPP.

The regional structures of Rostechnadzor carried out inspections at the plants in accordance with the approved plans. In 2010-2012 the interregional territorial departments for supervision of nuclear and radiation safety conducted a total of 9,229 inspections at nuclear power plants of the Russian Federation.

The inspections conducted in 2010-2012 allowed for duly monitoring of nuclear plant safety and timely responding to deficiencies and violations that took place.

In connection with the events at Fukushima-Daiichi NPP and in pursuance of the directive of the Government of the Russian Federation, Rostechnadzor in March-April 2011 conducted targeted inspections of seismic protection, hydrogen explosion and fire safety and emergency preparedness at all Russian NPPs.

The additional analysis of protectability of Russian NPPs initiated by Rostechnadzor and carried out by Rosenergoatom in 2011 allowed identifying of measures, deadlines and necessary volumes of work to improve robustness of operating NPPs in Russia with regard to extreme external impacts of natural and anthropogenic origin.

Rostechnadzor controls the due dates and sequence of implementation of the developed measures meant to reduce consequences of external impacts, which are capable of entailing severe beyond design basis accidents at nuclear power plants.

It is evident from the above that the operational safety reviews of nuclear installations in the Russian Federation, including international assessments, and regular comprehensive and targeted inspections are meant to prevent operational events and to further enhance NPP safety, which is in line with the requirements of the Convention on Nuclear Safety.

Article 15. Radiation Protection

15.1. Radiation protection law, rules and regulations

The following federal laws and regulatory documents govern the radiation protection of the NPP personnel, the public and the environment 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 Radiation Safety of the Public";
– Federal Law No. 7-FZ of 10 January 2002 "On the Environmental Protection";
– Federal Law No. 52-FZ of 30 March 1999 "On Sanitary and Epidemiologic Well-Being of the Public";
– "Radiation Safety Standards" (NRB-99/2009) of 7 July 2009;
– "Basic Sanitary Rules for Ensuring Radiation Safety" (OSPORB-99/2010) of 26 April 2010;
– "General Safety Rules for Nuclear Plants" (NP-001-97 or OPB-88/97) of 14 November 1997;
– "Sanitary Rules for Design and Operation of Nuclear Plants" (SP AS-03) of 28 February 2003;
– other rules and regulations in the field of the use of atomic energy.

Federal Law No. 170-FZ "On the Use of Atomic Energy" establishes the legal framework and the regulation principles for relations arising in the use of atomic energy and is aimed at safeguarding the life and health of humans and at protecting the environment.

Federal Law No. 3-FZ "On the Radiation Safety of the Public" establishes the legal framework for ensuring the radiological safety of the public and personnel for the purpose of health protection. The law sets out the major notions, standards, and regulation procedures in the field of radiological protection, and identifies the measures required to ensure the radiological safety, the powers of the executive power bodies of the Russian Federation and the Russian Federal Subjects in the field of radiation protection. The federal law and the NRB-99/2009 federal regulations take into account the recommendations of the International Commission on Radiological Protection (ICRP).

The 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;
- 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.

Federal Law No. 3-FZ "On the Radiation Safety of the Public" establishes the following major hygienic limits (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 (5 mSv) provided that the average annual effective dose, as calculated for five consecutive years, does not exceed 0.001 Sv;
- 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.

The major principles and criteria of ensuring the safety of the NPP as the source of radiological impacts on personnel, the public and the environment, and the requirements to technical and organizational radiation safety measures are defined in OPB-88/97.

NRB-99/2009 establishes the requirements and standards for the ionizing radiation impacts, including:

- personnel and public exposure due to man-made sources of ionizing radiation during normal operation;
- planned increased exposure of personnel to prevent the progression of the radiation accident and to carry out respective response activities;
- exposure of industrial personnel and the public to natural sources of ionizing radiation;
- medical exposure of the public.

As required by NRB-99/2009, 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.

OSPORB-99 specifies requirements for the protection of humans against harmful radiation impacts.

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 μSv/year).

As specified in Federal Law No. 7-FZ "On the Environmental Protection", the radioactive release and discharge into the environment shall be permitted in the limits set by standards based on Rostechnadzor's permits. Standards are specified for the permissible radioactive release and discharge based on dedicated techniques that specify the restrictions, excluding non-exceeding of the permissible dose limits, for preventing the negative impacts on the environment.

15.2. Radiation impact on NPP 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. In 2012 the exposure of personnel decreased by more than three times as compared to 1996. The number of personnel with the exposure doses of above the reference level (20 mSv/year) has minimized.

At the present time, the current dose burden on the personnel of NPPs with WWER-type reactors has practically achieved the optimal level comparable to similar indicators for 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 reactor types by 4 to 5 times.

The measures, which contribute to reduced dose burdens at all Russian NPPs as the whole, include the adoption and implementation of the "Program for Optimizing the Radiation Protection of Personnel at NPPs of Rosenergoatom". The objectives of the Program are to:

– increase the level of the NPP personnel radiation protection in conditions of increased volume of radiation-hazardous operations;
– optimization of individual exposure doses for NPP personnel;
– optimization of the number of persons exposed at NPPs.

As experts estimate, the implementation of the Program will enable the following targets to be attained by 2015:

– individual dose: the individual dose of the NPP personnel exposure not to exceed 18 mSv/year;
– number of persons exposed: no NPP personnel with a cumulative individual dose received in 2010-2014 over 80 mSv and the total number of persons with an individual dose of over 1 mSv/year at all NPPs to be reduced to 3 %;
– collective dose: 0.2-0.8 pers.·Sv/unit for WWER NPPs and 3.5-4.0 pers.·Sv/unit for RBMK NPPs.

The collective exposure doses at Russian NPPs for 2011-2012 are shown in Figure 15.1.

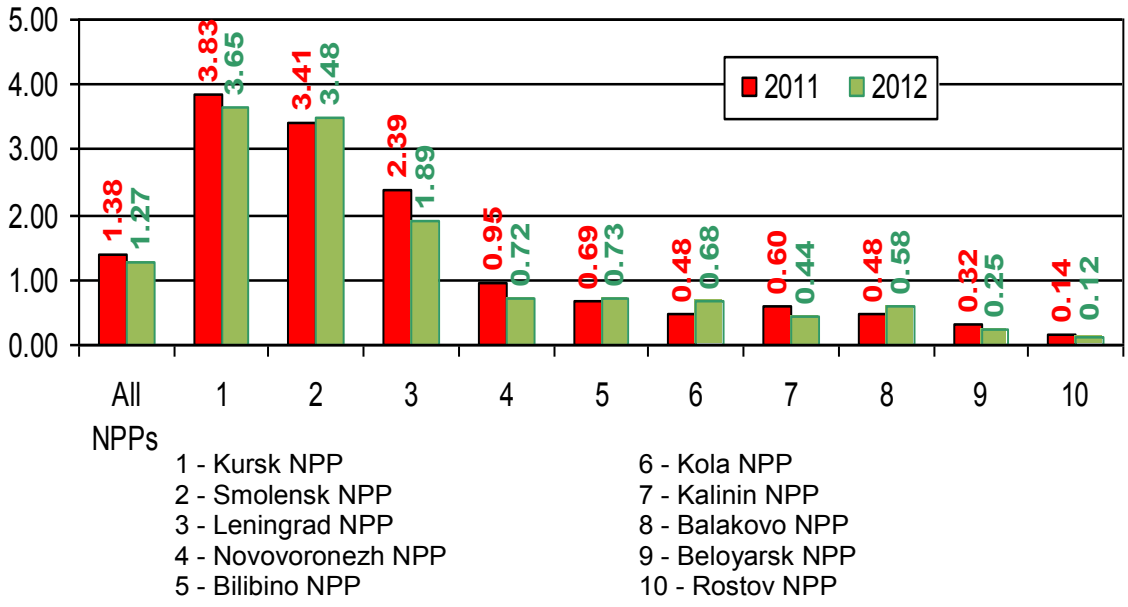


Figure 15.1. Collective exposure doses at Russian NPPs in 2011-2012 (pers.·Sv/unit)

No NPP has the basic dose limits equal to 50 mSv per year and 100 mSv for any five consecutive years (2010-2013) exceeded. The number of the personnel with individual exposure doses other than in excess of 1 mSv (the basic dose limit for the public) was over 60 % of the personnel subjected to health monitoring.

In 2010-2012, as in the previous years, no Russian NPP had an incident with radiological effects or cases of uncontrolled radionuclide release into the environment.

The average individual and collective doses for the NPP site or attached personnel in 2010-2012 are given in Appendix 12.

15.3. Monitoring of environmental contamination

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;
- 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 residential areas 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 nuclear plant personnel, the public and the environment

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

Rostechnadzor is responsible for supervising the observance of requirements in the nuclear safety regulatory and technical documentation and the conditions of licenses for the operation of NPP units.

The NPP radiation safety departments monitor continuously the state of the personnel radiation protection and the entry of radioactive material into the environment. The monitoring results are submitted by them as monthly, quarterly and annual reports to respective supervising bodies and to the Operating Organization.

Comprehensive and target inspections are carried out systematically by Rostechnadzor and the state sanitary and epidemiologic supervision bodies to evaluate the safety of any NPP. Respective directions and recommendations are issued based on results of these inspections.

It follows from the foregoing that the radiation protection of the NPP personnel, the pubic and the environment during operation of nuclear facilities is ensured in the Russian Federation.

The personnel exposure doses are at a low level and do not exceed the specified standard values. The NPP radiation impacts on the public and the environment (during normal NPP operations), due to gas/aerosol release and discharge, lead to an additional radiological risk which is absolutely acceptable (less than 10^{-6} per year).

Article 16. Emergency Preparedness

16.1. Regulation of emergency preparedness on NPP site and beyond

The protection of 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 "Preparedness and Response for a Nuclear or Radiological Emergency", GS-R-2, Vienna, 2004.

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

- Convention on Environmental Impact Assessment in a Trans-boundary Context, 1991;
- Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency, 1987;
- Convention on Early Notification of a Nuclear Accident, 1986.

The current Russian regulatory documents that deal with the issues of emergency preparedness on and outside the NPP sites include:

- Federal Law No. 170-FZ "On the Use of Atomic Energy";
- Federal Law No. 68-FZ "n the Protection of the Public and Territories against Natural and Man-Induced Emergencies"
- Federal Law No. 3-FZ "n the Radiation Safety of the Public"
- "Regulation on the National System for the Prevention and Elimination of Emergencies" (approved by Ordinance of the Government of the Russian Federation No. 794 of 30 December 2003, as revised in the Ordinances of the Government of the Russian Federation No. 335 of 27 May 2005 and No. 600 of 3 October 2006);
- "Basic Safety Rules for Nuclear Plants" (OPB-88/97);
- "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-005-98);
- "Model Content of an Action Plan for the Personnel Protection in Case of a Nuclear Plant Accident" (NP-015-12);
- "Radiation Safety Standards" (NRB-99/2009);
- "Basic Sanitary Rules for Ensuring Radiation Safety" (OSPORB-99/2009).

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 nuclear plants

In accordance with effective laws and regulations, a National System for Prevention and Management of Emergencies (RSChS) was 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). The system covers all territories (regions) in Russia. The RSChS daily management body is the National Crisis Management Centre (NCMC).

In keeping with the Federal Law "On the Protection of the Public and Territories against Natural and Man-Induced Emergencies", the Government of the Russian Federation, by its Ordinance No. 304 of 21 May 2007, approved the classification of natural and man-induced emergencies. This classification is outlined in Table 16.1.

Table 16.1. Classification of natural and human-induced emergencies

Emergency	Number of persons affected	Material damage (thousand rubles)	Emergency location
Local	up to 10	up to 100	Site
Municipal	up to 50	100-5000	Settlement or intercity territory of a federal-level city
Inter-municipal	up to 50	100-5000	Two or more settlements or intercity territories of a federal-city level
Regional	51-500	5000-500000	Does not exceed the territory of one Russian Federation entity
Interregional	51-500	5000-500000	Does not exceed the territories of two or more Russian Federation entities
Federal	over 500	over 500000	As resolved by the Russian Federation Government

The classification of emergencies serves the basis for the formation and timely preparation of the forces and capabilities to eliminate emergencies and their consequences.

EMERCOM of Russia provides for the interfaces and coordinates the activities of all ministries, agencies 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) was set up and is in operation within Rosatom. As specified by the OSChS regulations, plant (site) systems for prevention and elimination of emergencies have been established and organizationally tried out at all operating nuclear plants. Figure 16.1 presents the structure of the Industry-level System for Prevention and Elimination of Emergencies in the Russian Federation.

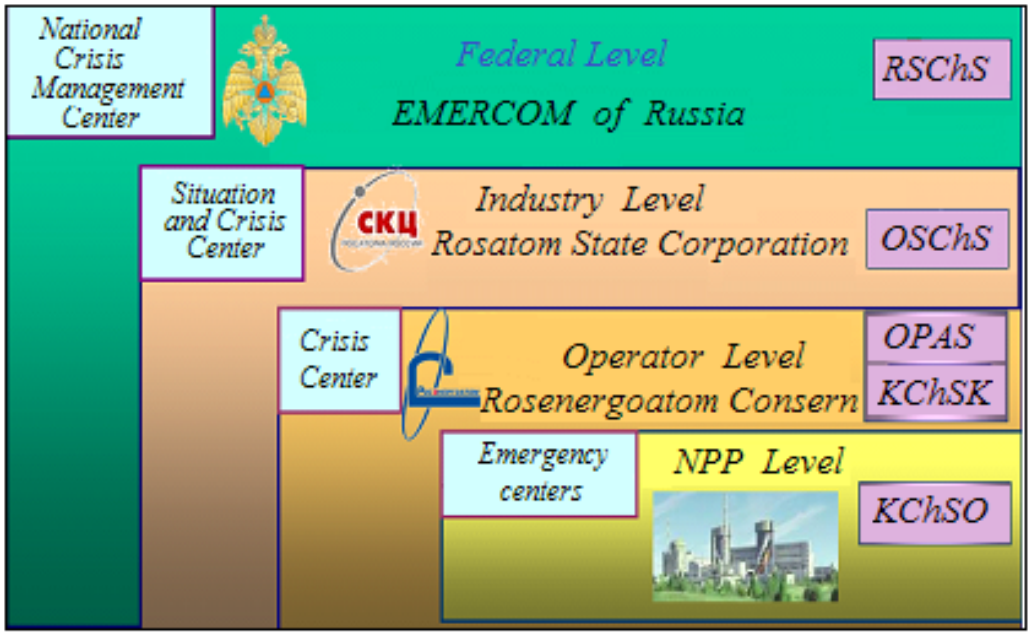


Figure 16.1. Industry-level system for prevention and management of emergencies

The Operating Organization and each nuclear plant have both the main and backup means of communication with Rosatom and other superior organizations, with state safety regulatory authorities, territorial departments for civil defense and emergencies of EMERCOM of Russia, and other executive bodies of the Russian Federal Subjects and local administrations. The existing communication systems enable early warning and exchange of required information with all organizations concerned in the event of an emergency at the NPP.

The key elements in the system of the emergency support to NPPs are the Crisis Centre of Rosenergoatom, the Situation and Crisis Centre of Rosatom, the Information and Analysis Centre (IAC) of Rostechnadzor, and Technical Support Centers (TSC) set up within design and development organizations and the leading Russian institutes and enterprises that provide scientific and engineering support to NPPs. At the present time, there are 14 Technical Support Centers in operation. The

arrangement of the communication between the organizations involved in the emergency response system is shown in Figure 16.2.

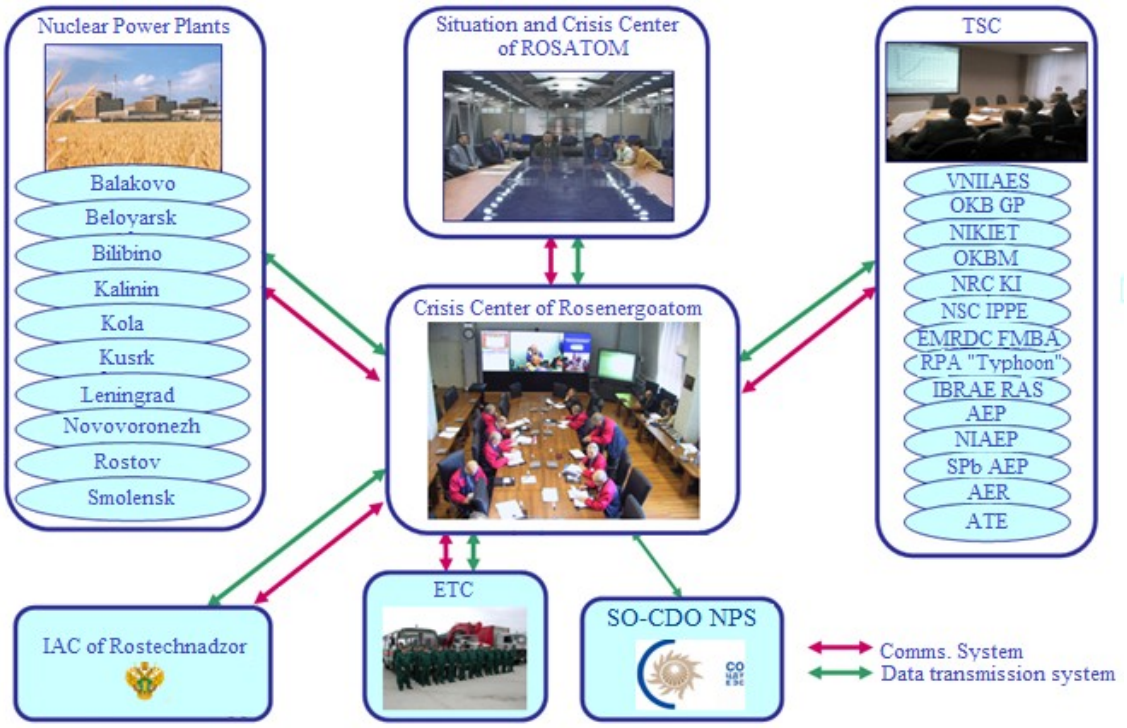


Figure 16.2. Operational information exchange among the organizations within the emergency response system

The role of these emergency response and technical support centers in improving the emergency preparedness of nuclear plants is defined in the "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-005-98) and in the "Procedures for Informing the Emergency Response Centre of Rosatom on the Current State of Nuclear Facilities and Abnormal Occurrences". This role consists in:

- ensuring the emergency preparedness of the emergency prevention and emergency action system;
- collecting objective technological and radiation information on the current state of nuclear units;
- continuous monitoring the process parameters and radiation parameters of NPPs;
- checking the preparedness of NPPs and the availability of communication systems for continuous information exchange;
- analyzing the situation based on the information acquired;
- prompt predicting the conditions on the NPP sites and in the surveillance areas;
- giving timely notification of emergencies;

- providing engineering support to the affected NPP; interacting with the Technical Support Centers;
- informing the organizations and agencies concerned about the situation at NPPs via operating communication channels;
- notification of the Nuclear Plant Emergency Assistance Team (OPAS);
- arranging for interfaces with the affected NPP, the ministries and agencies concerned, mass media and the general public;
- monitoring the progress of the measures taken.

The above centers have their activities coordinated and they operate on a round-the-clock basis.

At the site (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…" are defined in the "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-005-98). This Regulation establishes the criteria for declaring the "Emergency Preparedness" and "Emergency Situation" states at NPPs.

Emergency response after the receipt of the notification from another state or information from the IAEA on the actual or potential transnational emergency as may affect the given state

As specified by the Russian Federation Government Ordinance "On the Competent Authority and the Communication Point as Envisaged by the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency", the SCC of Rosatom performs the functions of a national warning point for exchange of information, participates in the implementation of the early notification procedures in case of a nuclear accident, as specified by international treaties (agreements), and the federal laws and legal regulations of the Russian Federation. The submission to the IAEA of ENATOM forms is tried out by experts of Rosatom and its SCC in the case of a radiological accident at an NPP using IAEA's special USIE Web-site.

The information exchange procedures are improved through periodic testing of communication channels and regular training sessions of communication with the IAEA's Incident and Emergency Centre (IEC) and the communication points of the parties to bilateral interstate agreements

on the early notification of nuclear accidents, as well as via international exercises and drills (e.g. the IAEA's CONVEX information exercises).

After the notification is received at the SCC of Rosatom as to the potentiality of a trans-boundary impact on the territory of the Russian Federation, the National Crisis Management Centre (NCMC of EMERCOM of Russia) is notified.

In the event of an accident at a foreign NPP with a radiological impact on the Russian Federation territory and the population and in the event that an accident at a Russian NPP in the Russian Federation may affect radiologically the territories of neighboring states, international interaction is based on the requirements of the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency and the Convention on Early Notification of a Nuclear Accident. When the territories of several Russian Federation entities are radioactively contaminated, the management and coordination of the emergency response activities are taken over by the Government Commission for Emergency Prevention and Response and Fire Safety Assurance. In some cases, a special Government Commission may be appointed when there is a radiological accident at an NPP. It is in charge of accident response activities with participation of the RSChS forces and means.

The basis for organizing the elimination of a radiological accident and its aftermath are plans of actions for the prevention and elimination of emergencies developed in advance at all RSChS levels, which define the radiological accident response activities. These plans are developed based on the emergency risk assessment for the respective territory, including for radiological emergencies, and generation of potential decisions for carrying out activities.

The response of the management bodies and the RSChS forces and capabilities during a radiological accident is normally divided in two steps:

- step 1 – organization of reconnaissance and reconnaissance as such, covers the span of time from the receipt of information on the radiation accident until its actual scope and measures to protect the public are identified;
- step 2 – radiation accident response activities.

The basis of the RSChS subsystems' forces and capabilities involved in elimination of consequences of radiation accidents is formed by squads of the Russian Federation territorial subsystems, which territories have been affected by the radiation accident.

The National System for Prevention and Management of Emergencies operates in accordance with the international commitments of the Russian Federation.

Improvement of measures to support the emergency preparedness in the light of lessons of the Fukushima-Daiichi NPP accident

The NPP safety improvement measures planned following the analysis of the Fukushima-Daiichi nuclear accident (including in the case of the accident simultaneously developing at more than one unit of a multi-unit NPP), Rosenergoatom suggests that the following measures should be taken to improve the efficiency, including that of the accident management:

- a twofold increase in the number of emergency drills conducted;
- improvement of the reliability of communications in conditions of beyond design basis accidents, including introduction of a unified radio communication system at NPPs;
- deployment of mobile backup ground satellite communication stations;
- upgrading/deployment of mobile control points for the emergency response leaders and the OPAS team leader.

The measures developed by Rosenergoatom to improve the protection of Russian NPPs include short-term and long-term measures. Rostechnadzor and Rosatom are in charge of supervising the timely implementation of these measures. To mitigate the effects of beyond design basis accidents (BDBA), short-term top-priority measures were implemented in full as of the end of February 2013, with medium-term measures implemented in part.

16.3. Measures to inform the public on emergency preparedness

To streamline at the federal level the system of interactions among the federal executive bodies and other stakeholders in informing mass media and the public on the predicted or occurred emergencies, which have attracted a great deal of public attention, the respective response activities and the measures taken to support the vital activities of the public, an interagency instruction was issued entitled "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".

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" was developed and put into force for the purpose of the public awareness to be arranged for by Rosatom using mass media and other channels on the predicted or occurred emergencies or fires, the measures to ensure the safety of the organizations within the control of Rosatom, the means and methods for the protection of

personnel, the public and the territories against emergencies, fire safety activities and the delivery of information about the event that has taken place.

16.4. Training and on-site emergency drills

Emergency training of the nuclear plant personnel includes training courses at the Technical Support Centers, emergency drills, command posts and special tactical exercises, and field training.

Training of the Operating Organization staff, nuclear plant personnel and the staff of organizations which provide support in the field of civil defense, and in prevention and management of emergencies is based on the requirements of the Russian Federation Government Ordinance No. 547 of 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" (RD EO 0074-97).

The staff of management bodies, and of the forces and capabilities within the emergency prevention and elimination system, the nuclear plant personnel and the staff of supporting organizations are trained 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 the 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 other).

At the Operating Organization level, interaction with other organizations involved in response to a radiation accident or radiation hazardous situation, as well as in case of an emergency caused by man-induced or natural factors, which may lead to a radiation accident, is coordinated by OPAS (Team for Emergency Assistance to Nuclear Plants).

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

- comprehensive emergency drills (CED) conducted at one NPP based on a realistic accident scenario with the involvement of forces and capabilities as necessary to eliminate the accident consequences;
- regular emergency drills at NPPs with the participation of the OPAS team, the TSCs and the Novovoronezh Emergency Technical Centre.

CEDs 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.

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, the CC, and the 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;
- training in operational interaction and information exchange between the NPP, CC and TSC using different communication facilities.

The Crisis Centre of Rosenergoatom is the OPAS team assembly, information receipt and operation point. The operations by Rosatom's SCC, CC of Rosenergoatom and TSC are coordinated and interlinked.

16.5. Emergency technical centres

In pursuance of the Russian Federation Government Ordinance No. 246 of 25 March 1993 "On the Establishment of Technical Emergency Centres for the Elimination of Emergencies at Nuclear Facilities in the Russian Federation", several Emergency Technical Centres (ETC) were set up in Russia, including in St. Petersburg, Moscow, Novovoronezh (Voronezh Region), and Seversk (Tomsk Region). In 2006, following Rosatom's order, the ETCs in Moscow, Novovoronezh and Seversk were integrated with the St. Petersburg ETC. The Novovoronezh ETC is the nuclear industry's emergency technical centre for assisting NPPs in emergencies.

16.6. Governmental regulatory activities related to emergency preparedness of nuclear plants

In its activities to supervise of emergency preparedness, the Federal Environmental, Industrial and Nuclear Supervision Service (Rostechnadzor) is guided by the laws, regulations and other documents listed in Section 16.1 of this Report, as well as by the "Regulation on Investigating and Accounting Operational Events at Nuclear Plants" (NP-004-08), which defines the categories of operational events that should be recorded and reported to the Regulatory Body, the procedures for notifying on and further informing on the event, and the event investigation procedure.

The major tasks of Rostechnadzor in relation to the emergency preparedness are to organize and carry out the state supervision of the development and implementation of accident prevention activities at the facilities under its supervision, to monitor the preparedness of sites and organizations for minimizing the consequences of accidents, and to take part in establishing the criteria and in developing the rules and regulations for ensuring the emergency preparedness of NPPs.

Rostechnadzor fulfils these tasks as follows:

Licensing activities

In accordance with the "Provision on the Licensing" and the relevant procedures, the material that demonstrate the nuclear and radiation safety of the NPP operation should include accident elimination procedures, beyond design basis accident management guides, and action plans for the personnel protection in the event of an accident at the NPP. This supporting documentation should also contain information on the plant personnel training and qualifications, including the personnel preparedness for actions during design-basis and beyond design basis accidents.

This material is assessed during NPP safety reviews. The result of such assessment is an expert review statement that contains conclusions as to the soundness and sufficiency of the technical and organizational decisions made to ensure the preparedness of the NPP and the Operating Organization for elimination of accidents and their consequences.

The expert review statement may contain proposals on the license conditions relating to improving the emergency preparedness of the nuclear plant and/or the Operating Organization to be taken into account by the Regulatory Body when formulating the license conditions.

Inspections

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 on-site emergency preparedness inspections:

- the state of the documentation defining the NPP personnel actions during accidents (accident management procedures, beyond design basis accident management guides, personnel protection action plan);
- the organization of personnel training to develop and maintain their skills in controlling the NPP unit during accident;
- 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 response services and facilities;
- 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.

Activities in case of nuclear plant operational events

As specified in the "Regulation on Investigating and Accounting Operational Events at Nuclear Plants" (NP-004-08), 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 "Emergency Preparedness" or "Emergency Situation" 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 power 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;

- 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 Analysis Centre (IAC). An order was issued in the light of the post-Fukushima measures to improve the efficiency of Rostechnadzor operation as the nuclear safety regulatory body. The efficiency of Rostechnadzor's operations in conditions of a nuclear plant accident was analyzed in detail. Basing on the analysis outcomes, efficiency enhancement measures were outlined, which included the IAC modernization. A related Rostechnadzor's order has been issued, and the action plans have been developed and approved. Revised versions of the Provision on the IAC and it Operating Regulations have been prepared. The premises have been repaired, and new equipment for the IAC has been purchased and installed.

The centre may operate in two modes: a daily routine mode and an emergency response mode. In the emergency response mode, the centre's functions are to:

- collect and process the Operating Organization's information on the current status of nuclear and radiation safety at the respective NPP;
- notify Rostechnadzor's officials and heads of divisions at Rostechnadzor's Headquarters about the situation development at the NPP;
- support online communication between Rostechnadzor's central staff, Rosatom's SCC, CC of Rosenergoatom, its regional departments, NPPs under supervision, and all organizations concerned, as well as provide information and technical support to the emergency analysis task forces;
- analyze the emergency at the NPP, predict its possible progression, and develop respective recommendations to Rostechnadzor senior officials;
- assess the Operating Organization's actions in bringing the affected NPP into a safe condition, including recovery of the critical safety functions, mitigation of the accident consequences, and timely implementation of the personnel protection plan.

The membership of the IAC task forces involved in the activities during radiation-hazardous emergencies at NPPs has been updated by the Chairman of Rostechnadzor. Regular exercises and drills are conducted to keep the IAC and its task forces ready for action.

Following the Fukushima-Daiichi accident and the implementation by Rosenergoatom of top-priority measures derived from the additional analysis of the Russian NPP protection against extreme external impacts,

Rostechnadzor took part in full-scope exercises to master interactions of different emergency response organizations in conditions that simulate extreme impacts on a multi-unit NPP. Such exercises were held at the site of Kursk NPP and attended by observers from 11 countries. Representatives of the French regulator (ASN) took part in the work of Rostechnadzor's IAC during these exercises.

These exercises demonstrated the capability of Rosenergoatom to ensure the safety of NPPs during such impacts by both engineering and organizational measures.

Thus, proper attention is given to the issues of emergency preparedness in Russia. An industry-level system for the prevention and management of emergencies at NPPs has been established within State Atomic Energy Corporation "Rosatom". A major role in the emergency management activities is played by the Situation and Crisis Centre of Rosatom and the Crisis Centre of Rosenergoatom. An Information and Analysis Centre is operated within Rostechnadzor.

Emergency exercises, as well as regional and plant-level drills are conducted on a regular basis to keep the NPP personnel prepared for actions in emergencies.

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 rules and regulations, as well as by other documents listed and described in the earlier National Reports of the Russian Federation on the fulfillment of the commitments arising from the Convention on Nuclear Safety.

The current requirements to the sites of NPPs under design are given below.

The natural and human-caused conditions in the NPP siting region are investigated in keeping with the following rules and regulations:

- "Siting of Nuclear Power Plants. Basic Safety Criteria and Requirements" (NP-032-01);
- "Design Standards of Seismic Nuclear Power Plants" (NP-031-01);
- "Accounting of Natural and Man-Induced External Impacts on Nuclear Facilities" (NP-064-05).

In accordance with federal standards and rules NP-032-01, the site is considered to be suitable for the NPP deployment if it is possible to ensure safe operation of the NPP given the natural and man-induced processes, phenomena and factors, and safety of the public is ensured and the environment is protected against radiation impacts during normal operation and design basis accidents, while these impacts are limited during beyond design basis accidents. It has been found out that the following should be taken into account in justifying the NPP site suitability:

– impacts of natural and man-caused processes, phenomena and factors on the NPP safety;

– NPP radiation impacts 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.);

– required civil defense engineering activities;

– the size of the controlled area around the site, emergency action planning zone and mandatory evacuation planning zones.

In accordance with Article 31 of Federal Law No. 170-FZ "On the Use of Atomic Energy", special areas are established around the NPP sites for the local public protection: a controlled area and a surveillance zone. Radiation monitoring should be carried out in the controlled area and surveillance zone. The size and boundaries of the controlled area are defined as specified in the regulations and rules on the use of atomic energy and are subject to approval by the state sanitary and epidemiological supervision authorities and approved by the local administration of municipalities or city districts. Within the NPP controlled area it is

prohibited to build any residential or public buildings, children's institutions, as well as medical and health institutions and public catering facilities other than relating to the NPP operation, as well as any industrial, auxiliary and other structures and facilities other than included in the approved project of the controlled area. The state sanitary and epidemiologic supervision authorities may impose restrictions on business activities in the surveillance zone in accordance with the legislation of the Russian Federation.

Paragraph 3.3 of the federal standards and rules NP-032-01 states that the boundaries of the controlled area, the emergency action planning zone and the mandatory evacuation planning zone should be justified in the design with the regard for the fulfillment of the conditions described below. The boundary of the NPP controlled area should be established in accordance with the NPP sanitary regulations and rules.

The federal standards and rules NP-064-05 state that the following should be ensured for each newly designed NPP at low values of the external impact intensity (hazard degree III is the lowest one) adopted in the design basis:

- the seismic stability at accelerations on the free ground surface level of not less than 0.1 g (of the magnitude of the acceleration of gravity);
- stability to shock wave impacts with the wave pressure of not less than 10 kPa, and the compression phase time of up to 1 s;
- the resistance of buildings and structures important for safety to external fires of less than 90 minutes of a standard fire;
- the stability of protective structures of localizing systems to local impact loads to aircraft crash and other missiles that is equal in the contact area to the impact load not less than that of a light aircraft crash (5 tons of weight);
- spatial physical separation of safety systems and their trains.

When justifying the NPP protection against external impacts which intensity is of hazard degree I or II in accordance with NP-064-05, the waiver to take measures for preventing damage from external impacts should be justified by the fact that:

- inadmissible failures of and damages to systems and components important for safety are excluded;
- the frequency values of design basis accidents and severity of their consequences calculated as the result of probabilistic safety analyses of the plant with respect to external impacts do not change greatly as compared to the results of probabilistic safety analyses of the plant with respect to internal initiating events leading to design basis accidents, and these values acceptable;
- the frequency of beyond design basis accidents caused by external natural or man-induced impacts is rather small (less than 10^{-6} 1/year) or

the frequency of the maximum emergency release (discharge) into the environment during beyond design basis accidents caused by external natural or man-induced external impacts is less than 10^{-7} 1/year.

The 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" (EIA).

Additional improvements for the protection against external impacts and the means to mitigate the consequences of beyond design basis accidents during the NPP design and construction

In accordance with Rostechnadzor's decision to analyze the safety of the NPPs under design or construction during extreme external impacts given the lessons of the Fukushima-Daiichi accidents, the following was performed:

- assessments of the stability of buildings and structures important for safety during an earthquake equal to 1.4 SSE for the specific site;
- analyses of the protection against extreme floods (> level with probability a 0.01 % of exceedance);
- checks for stability to hurricanes and tornadoes (the wind speed > 56 m/s), and shock wave (wave pressure > 30 kPa).

The said checks and analyses have demonstrated the stability of the NPP power units under design or construction without extra improvements.

As the result of the safety analyses conducted, extra engineered features were developed for the management of beyond design basis accidents to be implemented at the existing NPPs, those under design and construction:

- an alternative (mobile) air-cooled diesel generator (MDGU);
- a mobile pumping unit (MPU) for external water supply;
- emergency and post-emergency sampling systems;
- systems for emergency and post-emergency monitoring of safety parameters and parameters providing unbiased information on the state of the NPP unit;
- extra measures to prevent exceeding the maximum containment pressure.

The above shows that when new nuclear units are designed in the Russian Federation, serious attention is paid to studies of the candidate sites suitability in terms of safety assurance with

regard to the natural and man-induced processes, phenomena and factors.

Article 18. Design and Construction

The underlying principles adopted in the design and construction of NPPs, as contained in federal standards and rules, are described in detail in the earlier National Reports of the Russian Federation.

18.1. Regulatory framework for design and construction of nuclear plants

The prospects of nuclear power development as part of Russia's electric power industry and deployment of new NPPs in the country are governed by the following programmatic documents:

- General Scheme of the Deployment of Electric Power Installations until 2020 (endorsed by Directive of the Government of the Russian Federation No. 215-r of 22 February 2008);
- Long-Term Program of State Atomic Energy Corporation "Rosatom" Activities (2009-2015) endorsed by Ordinance of the Government of the Russian Federation No. 705 of 20 September 2008;
- Energy Strategy of Russia for the Period up to the Year 2030 (endorsed by Directive of the Government of the Russian Federation No. 1715-r of 13 November 2009;
- General Scheme of the Deployment of Electric Power Installations until 2030 (approved at a session of the Government of the Russian Federation on 3 June 2010);
- Federal Target Program "Nuclear Power Technologies of the New Generation in 2010-2015 and until 2020" (endorsed by Ordinance of the Government of the Russian Federation No. 50 of 3 February 2010).

18.2. Principal features and characteristics of new NPP designs

New NPPs are designed fully in accordance with requirements of the federal standards and rules in the field of the use of atomic energy, as well as with consideration of the requirements and criteria of the IAEA, the ICRP, the IEC and EUR.

The AES-2006 design currently under implementation has the following advantages as compared to earlier WWER designs:

- thermal power has been increased up to 3,200 MW and the unit (gross) efficiency enhanced up to 36.2 %;
- economic efficiency has been increased;
- passive and active safety systems have been optimized;
- equipment in use has been unified;
- material consumption has been decreased;

– the construction time has been shortened.

The AES-2006 design implements a strategic approach involving the maximum use of tested, proven systems, equipment and engineering solutions that have not lost any of their topicality, given the future many-year operation of the unit, while simultaneously integrating technological achievements and evolutionary improvements that have taken place in other current WWER designs and stem from the experience of operating the existing units.

The AES-2006 design presents the estimated extent of evaluation for the employed engineering and circuitry solutions based on the experience in design, operation as well as computational and experimental feasibility studies. Stability of the AES-2006 design to external impacts is shown schematically in Figure 18.1.

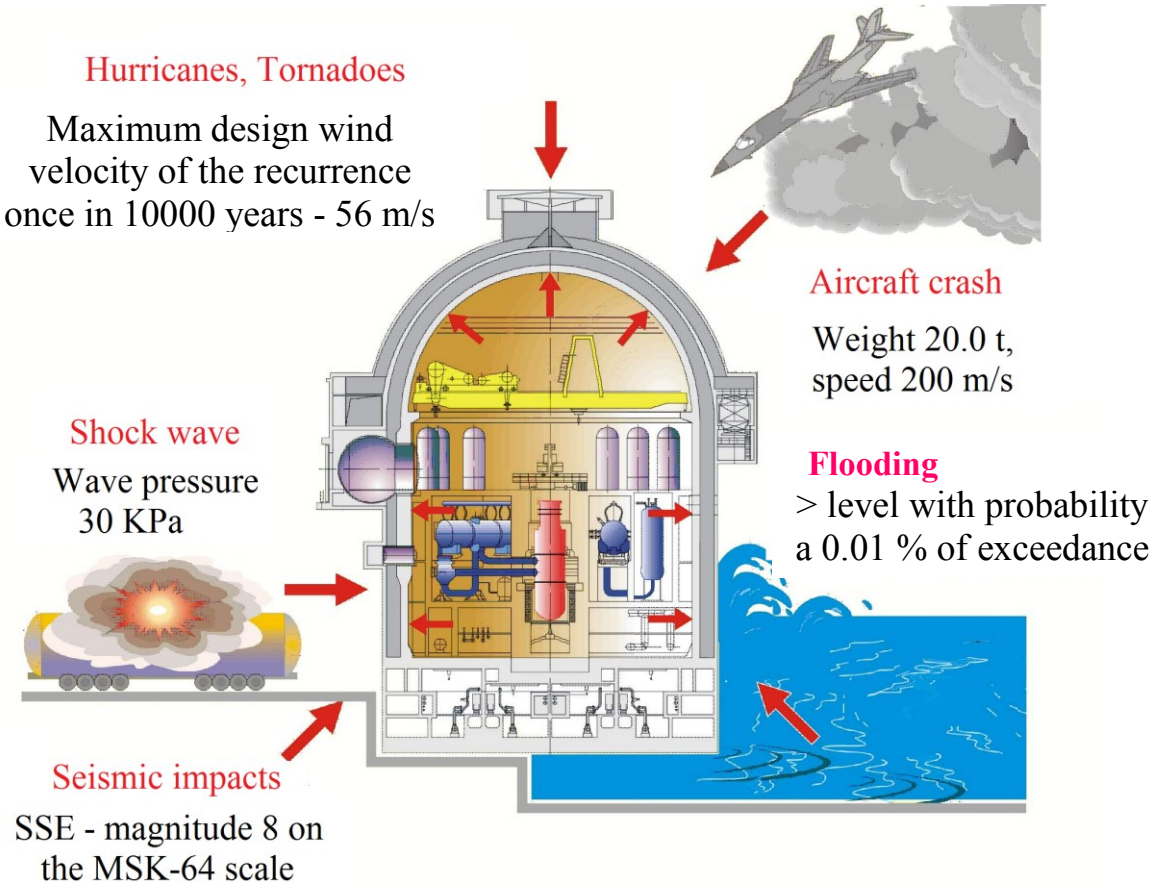


Figure 18.1. Stability of the AES-2006 design to external impacts

The major tasks of the power unit improvement were defined in the course of AES-2006 development, including:

– increase in the reliability of fuel rods, fuel assemblies and the core as a whole;
– increase in the CPS drives efficiency;

- increase in the reliability of the reactor pressure vessel given a longer service life;
- increase in the reliability of physical barriers, including MCP, to prevent release of radioactive products beyond the design boundaries;
- increase in the reliability of safety systems;
- increase in the reliability of the spent fuel pool as a physical barrier in terms of radioactive product spread;
- introduction of additional systems and devices that prevent and limit consequences of severe accidents.

The design implements a number of engineering solutions that make it possible to ensure the NPP safety and avoid excessive release of radioactive fluids into the environment during external and internal natural and man-induced impacts. The design safety concept is based on the use of safety systems employing different operation principles (active and passive), with all safety functions supported by independent operations of active and passive systems.

The development of the WWER-TOI project has been completed (typical optimized and informatized design of a two-unit NPP). This is an upgraded and improved AES-2006 design with a higher performance and a shorter construction time. The technical and economic characteristics of the WWER-TOI design are given in Table 18.1.

Table 18.1. Technical and economic characteristics of the WWER-TOI project

Characteristic	Achieved value
Unit/reactor facility service life, year	60/60
Unit power, MW: - electric (gross) - thermal	 1,255 3,300
Net efficiency for yearly average conditions, %	38
Availability factor (with 18-month fuel cycle), %	93
Possible power change range (load-follow mode), %	100-50-100
Design basis earthquake, MSK-64 magnitude	7
Safe shutdown earthquake, MSK-64 magnitude: - basic version - option (as required by Customer)	 8 9 (up to 0.41 g)
Aircraft crash, t: - design basis initiating event - beyond design basis initiating event	 20 400
Unit independent cooldown time (beyond design basis accident with loss of all AC power sources), h	72
Mandatory public evacuation planning zone, km	not more than 0.8
Area beyond which no public protection measures are required during severe accidents, km	3
Amount of SRW formed during unit operation, m^3	not more than 44.5

Auxiliary power consumption, %	6.47
Specific number of production personnel, person/MW	0.37
Specific area of land occupied in the master plan (for two units w/o regard to circulating water and power release systems), m^2/MW	200
Time of construction from first concrete to first criticality (for serial unit), months	40
Turbine plant	Low-speed
Reactor facility - reduction in CPS control rod number - introduction of new water-lubricated RCPs - introduction of a new vessel steel - primary circuit hydrogen-potassium water chemistry	 Reduced from 121 to 94 done done done
Safety systems	Implemented version includes an optimized combination of active and passive SS channels

An evolution of fast neutron reactors in Russia is the development of a unit with a sodium-cooled fast neutron reactor of 1,200 MW power capacity, which operates within the closed nuclear fuel cycle.

The NPP construction to the AES-2006 design is at the implementation stage at Leningrad NPP-2, Novovoronezh NPP-2 and Baltic NPP.

The construction of two pilot power units is expected to complete in 2014 at Novovoronezh NPP-2 (Unit 1) and in 2015 at Leningrad NPP-2 (Unit 1).

In 2012, "Reports on Safety Analyses for Extreme Impacts" were prepared for the NPPs under construction (Beloyarsk-4, Novovoronezh NPP-2, Leningrad NPP-2, Rostov-3, 4), and the "Program for Improving the Safety of Novovoronezh NPP-2 During Extreme External Impacts" was developed.

It is planned that the following NPP units will be commissioned in the next 10 years in addition to those indicated above:

- Novovoronezh NPP-2, Unit 2 (AES-2006);
- Leningrad NPP-2, Unit 2 (AES-2006);
- Leningrad NPP-2, Unit 3 (AES-2006);
- Leningrad NPP-2, Unit 4 (AES-2006);
- Rostov NPP, Unit 3 (WWER-1000);
- Rostov NPP, Unit 4 (WWER-1000);
- Beloyarsk-4 (BN-800);
- Baltic NPP, Unit 1 (AES-2006);
- Baltic NPP, Unit 2 (AES-2006);
- Nizhniy Novgorod NPP, Unit 1 (WWER-TOI);
- Kursk NPP-2, Unit 1 (WWER-TOI);

– FNHPP (KLT-40S).

18.3. Current situation and prospects of construction of floating nuclear co-generation plants

At the present time, Rosenergoatom is implementing an innovative small power project, i.e. the construction of the first floating nuclear co-generation plant (FNPP) based on the KLT-40S ship reactor for Pevek, the Chukotka Autonomous District. The advantage of FNPP is its mobility: the units deployed on a non-propelled flat-top barge can be delivered to any point of the World Ocean. According to estimates, the construction and operation of the FNPP is more efficient than the construction and operation of onshore power stations for remote coastal areas where it is unprofitable to install transmission lines and deliver fossil fuels.

18.4. Licensing associated with design and construction of nuclear plants

To obtain a NPP construction license, the Operating Organization is required to submit to Rostechnadzor a license application with a set of documents that justify safety of the plant.

As required by the "Administrative Regulation on Implementation of the State Function of Licensing Activities in the Field of Nuclear Energy by the Federal Environmental, Industrial and Nuclear Supervision Service", the set of the nuclear and radiation safety supporting documents should include:

- a preliminary safety analysis report on the nuclear plant;
- a overall quality assurance program – POKAS(O);
- a PSA Level 1;
- where required, upon the request from Rostechnadzor, design documents (including designs of the reactor installation, APCS and systems important for safety, and a description of the physical protection), as well as tests and R&D reports referred to in the preliminary safety analysis report.

The information provided in the nuclear plant Preliminary Safety Analysis Report (PSAR) is based on the materials of the NPP design, and on detailed designs of the reactor installation and systems important for safety. This information should be sufficient to ensure adequate understanding of the NPP design, the safety concepts on which this design is based, the quality assurance program, and major principles of operation planned by the Operating Organization.

Quality assurance programs are developed as required by the documents "Requirements to the Quality Assurance Program for Nuclear Facilities", NP-090-11.

Based on the information contained in the submitted NPP safety justification package, Rostechnadzor assesses these for sufficiency and compliance with regulatory document requirements, specifically to the requirements of federal standards and rules.

In 2010-2012 Rostechnadzor reviewed applications for the sitting and construction of new NPP units. The review of the applicant's safety justification documentation covered a broad range of issues associated with each safety aspect (safety concept, NPP site suitability, design approaches to systems, components and structures important for safety, control and protection system, power supply systems, radiation protection, safety systems, deterministic and probabilistic safety analyses; operation, commissioning, decommissioning). A decision whether to grant the license or refuse the license is made by duly authorized officials of Rostechnadzor based on the results of verifying the credibility of the information contained in the documents submitted as part of the license application demonstrating that the nuclear and radiation safety of the facility is ensured, on the results of inspections, and is properly documented.

As evident from the above, a regulatory framework has been developed and is in use in the Russian Federation to deal with the design and construction of NPPs, which is consistent with the current international safety standards and requirements.

Nuclear plants are designed and constructed only under licenses (permits) granted by Rostechnadzor.

Article 19. Operation of Nuclear Plants

19.1. Justification of safety and licenses for operation of newly built NPP units

The process of licensing the operation of NPPs, as specified in the "Provision for Licensing the Activities in the Field of the Use of Atomic Energy" has seen no changes since the Fifth Meeting of the Contracting Parties.

A decision to grant the license for operation of a unit is made by Rostechnadzor upon the review of the documents demonstrating the safety of operations.

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 Implementation of the State Function of Licensing Activities in the Field of Nuclear Energy by the Federal Environmental, Industrial and Nuclear Supervision Service".

Reports and records on the NPP first criticality, power startup and pilot commercial operation results are submitted to Rostechnadzor when the unit is commissioned (each record is submitted after the corresponding work stage is completed and before the subsequent stage is started). Besides, after the tests are completed, all measurements and deviations are taken into account in the course of updating the final safety analysis report and operating documentation.

The unit first criticality and power startup follow a Rostechnadzor's inspection of the unit factual availability for startup.

In 2010-2011, in accordance with this procedure, preparations for commissioning were conducted at Kalinin-4, at which the first criticality and power startup programs were started on 15 November 2011. Kalinin-4 was put into commercial operation on 25 September 2012.

19.2. Current system for updating safe operation limits and conditions

The Safe Operation Procedure following the requirements as per the "Basic Safety Rules for Nuclear Plants" (OPB-88/97) is the main document to govern the operation of a nuclear unit. It specifies the safe operation limits and conditions, which are justified at the design stage and are updated with regard to the results of start-up and adjustment, first criticality and first power activities. Besides, the Safe Operation Procedure 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.

The procedure of amending the design and operating documentation, including changes to the safe operation limits and conditions of the plant, is set forth in the "Administrative Regulation on Implementation of the State Function of Licensing Activities in the Field of Nuclear Energy by the Federal Environmental, Industrial and Nuclear Supervision Service". Respective amendments are duly made to the design and operating documentation; SAR and the Operating Procedure are also updated.

A permit for making an amendment to the license conditions as requested for by the applicant is given by Rostechnadzor upon the review of supporting documents.

The safe operation limits and conditions may be revised and updated subject to the results of safety analyses (including probabilistic safety analysis or in-depth safety assessment).

19.3. Current system for scheduling maintenance and repairs, inspections and tests at 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 components.

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 1.1.1.01.0678-2007). 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 plant 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 Procedure.

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.

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.

For the purpose of ensuring the availability of equipment in the period between repairs, the strategy of repair depending on the technical condition has been developed in recent years. This approach is used for repair of electricity-operated valves, rotating mechanisms, turbine cylinders and other components as specified in RD EO 1.1.2.01.0769-2008 "Organization of the Nuclear Plant Equipment Repair Based on the Technical Condition. Basic Provisions".

A major decrease in the standard time of the unit repair, as established by RD EO 1.1.2.12.0085-2008 "Maintenance and Repair of the Nuclear Plant Systems and Equipment. Standard Duration of the Nuclear Plant Unit Repair", is contributed to by the introduction at NPPs of "Rosatom Production System" (RD EO 1.1.2.01.0865-2012 "Development of the Rosatom Production Systems during the NPP Repair and Management of Warehoused Production Stock. Provision").

A large package of repair documents has been developed (repair specifications, M&R programs/regulations, process documentation sets), which provides the information support to contractors during the NPP repair planning, preparation and performance.

Work has been reorganized for the repair quality control (RD EO 1.1.2.22.0426-2009 "Maintenance and Repair of the Nuclear Plant Systems and Equipment. Maintenance and Repair Quality Control for the Nuclear Plant Units and Their Post-repair Commissioning. Standard Program").

The duly approved specification for inspections and tests regulates the inspection and testing activities for systems important for safety.

The system for the NPP inspection by the supervisory body and the Operating Organization is based on annual schedules of planned

inspections. The results of the inspections and tests conducted by the Operating Organization are made out as respective reports that contain the detected drawbacks and comments, as well as the measures to eliminate these.

19.4. Procedure for accounting of operational events with safety implications

At the present time, the work to analyze and account of the events significant in terms of safety is regulated by the following documents:
- "Regulation on Investigating and Accounting Operational Events at Nuclear Plants" (NP-004-08);
- "Regulation on the Transfer of NPP Operational Information from the Nuclear Plant to Rosenergoatom and Organizations Concerned" (RD EO 1.1.2.01.0331-2010);
- "Regulation on the Organization of Investigations of Events Important for Safety and Reliability at Nuclear Plants of Rosenergoatom" (RD EO 1.1.2.01.0163-2010);
- "Methodological Guidelines for the Analysis of the Causes of Safety-Reliability-Related Events, Fires, Injuries, Damages to NPP Buildings and Structures at Nuclear Plants" (RD EO 1.1.2.09.0095-2010);
- internal NPP documents that govern the procedures for the investigation and accounting of operational events at NPPs.

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 in the IAEA/NEA International Reporting System for Operating Experience (IRS) as well as in WANO's Operating Experience Program.

The document NP-004-08, which is part of the relevant federal standards and rules, establishes:

- the categories of the NPP operational occurrences to be reported to the Regulatory Body;
- the procedure for accounting of and reporting on occurrences;
- the procedure for investigation of occurrences.

Operational events are divided into the following categories:

- "accidents" (classified by the extent of on-site and off-site radiation impacts);
- "incidents" (classified by the degree to which the defense in depth is impaired and by the onsite 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 and consequences of an operational event are reported by the NPP management to the Operating Organization and the Regulatory Body 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 full report on the investigation and the proposed corrective measures aimed at preventing similar occurrences in future. Each event is rated according to the International Nuclear Event Scale (INES) using the INES User's Manual (IAEA-INES-2001).

The document 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 power units and contingencies[1] at nuclear plants.

"Regulation on the Organization of Investigations of Events Important for Safety and Reliability at Nuclear Plants of Rosenergoatom" (RD EO 1.1.2.01.0163-2010) 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. This regulation 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.

"Methodological Guidelines for the Analysis of the Causes of Safety-Reliability-Related Events, Fires, Injuries, Damages to NPP 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" was 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.

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

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 control 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 operational events are investigated and analyzed:

- operational events at NPPs including those subject to investigation in accordance with NP-004-08;
- fires (ignitions);
- occupational injuries;
- damage to buildings, structures, their parts and structural elements;
- damage to engineered features of hazardous industrial facilities;
- overexposure of personnel;
- major 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 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 immediate root causes for and the factors contributing to such events and indicate the corrective actions taken to avoid their recurrence.

The surveyed results of investigations into operational events 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 (incidents) coming from other NPPs, VNIIAES (including reports in the IRS), and 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 in 2012 shows that out of 50 events that took place, 12 do not fall under INES criteria, i.e. are "out of scale" events, 36 operational events are events of Level "0". Of their total number, only two events proved to be safety-related, i.e. rated by INES as Level "1". It should be noted that 13 out of the total number of the events took place at the Kalinin-4, which was in the process of pilot commercial operation.

The distribution of NPP operational events by INES Levels for 2010–2012 is given in Appendix 9, and the dynamics of the NPP operational events in 2010-2012 under the INES classified is given in Appendix 10.

19.5. Actions of personnel during accidents and emergencies

In case of accidents or pre-accident conditions at NPP units, the operating personnel should follow the requirements of emergency response documents, such as procedures on eliminating pre-accident conditions and design basis accidents, guidelines for the management of beyond design basis accidents, and personnel protection plans.

Should symptoms of an accident or pre-accident conditions be discovered at an NPP, the NPP shift supervisor should immediately report it to the NPP executive officers (Director or Chief Engineer), who would in turn inform the organizations and officials concerned.

The procedure for coping with pre-accident conditions and design basis accidents prescribes the actions to be taken by the operating personnel in order to restore normal operation of the nuclear power unit. This procedure addresses the initiating events and emergencies for systems and components, as well as deviations from the specified parameters, which lead or may lead to design basis accidents. For each initiating event, out of credible ones, consideration is also given to the conditions of its occurrence and possible ways of progression leading to the most severe consequences (a conservative approach).

The progression of initiating events into design basis accidents and of the latter into beyond design basis accidents is prevented by operation of safety systems. Next-generation nuclear plants are designed to have new safety systems based on the passive action, which makes the fulfillment of the required safety functions more reliable.

The main regulatory requirement, which must be complied with for operation of the plant to be permitted, is the availability of procedures for the management of beyond design basis accidents, which describe the measures to be taken to cope with such accidents and mitigate their consequences.

Special attention is given to protecting the leak-tight enclosure of the reactor installation against failure during beyond design basis accidents, and to keeping it available. The main approach to the protection of the leak-tight enclosure was to equip such systems at Russian NPPs with passive autocatalytic recombiners, which provide hydrogen oxidation (recombination) beyond the ignition limits so to prevent the impact from a fire or explosion on the unit's leak-tight compartments under the conditions of a progressing severe beyond design basis accident.

Following the requirements of the "Basic Rules for Nuclear Plant Safety" (OPB-88/97), which demand that personnel should be guided in their actions by the symptoms of the events and conditions that occur at the reactor facility as well as by the prediction of the conditions during the accident progression, the Operating Organization has developed the Symptom-Based Emergency Procedure (SBEP) for all nuclear units with WWER and RBMK reactors. These instructions provide the emergency procedures fully in line with the concept of the personnel actions for the accident management based on the condition of the reactor installation and the physical safety barriers. Using predictions, the SBEP Procedure specifies and directs the actions of operating personnel aimed at terminating the emergency and bringing the unit back into a controllable state, which stops the chain fission reaction, cooling the nuclear fuel in the reactor, and confining radioactive materials within the specified boundaries. In doing so, normal operation systems may be used.

19.6. Engineering 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 external 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.

The system of Rosatom includes 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. Such organizations providing essential and effective support to NPPs plants 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 "St. Petersburg Research, Design and Development Institute "Atomenergoproekt" (SPbAEP);
- JSC "Nizhniy Novgorod Engineering Company "Atomenergoproekt" (NIAEP);
- State Scientific Centre of the Russian Federation "A.I. Leipunsky Institute of Physics and Power Engineering" (IPPE);
- JSC "East-European Leading Research and Design Institute of Power Technologies" (VNIPIET);
- "Research and Design Institute of Installation Technology" (NIKIMT-Atomstroy);
- JSC "Atomtechenergo" (ATE);
- 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 Centre "Kurchatov Institute" (NRC KI).

19.7. Programs for collection and analysis of information on operation of nuclear plants. 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 NS-R-2 "Safety of Nuclear Plants: 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 OIS OE system 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 "Basic Principles of Organizing Rosenergoatom’s Industry-level Information and Analysis System on the Experience of Operating Nuclear Plants" (RD EO 0152-2005). 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;

- 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 Principles" RD EO 0152-2005 is a package of methodological documents developed by VNIIAES, 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, namely "Methodological Guidance on the Collection, Processing and Use of Information on the Operation of Nuclear Plants" (RD EO 0194-00).

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" establishes 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;
- the criteria for assessing and selecting information on the operating experience for in-depth analysis;
- development of and control for the implementation of corrective actions;
- analysis of OE, documentation, use and dissemination of its the analysis results;
- 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 in 2009 the standard "Administrative Instruction for the Analysis and Use of OE Information" (AI 1.3.2.06.014.0017-2008).

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 Centre, 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;
– good practice.

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

Information on the equipment malfunctions and failures received from NPPs is also used in accomplishing the following tasks:

- accumulation of statistical data for 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 the NPP operational occurrences;
- optimization of design-basis algorithms as compared to those of real emergencies;
- analysis of safety system operation modes;
- 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);
- technical statements on the results of feedback on using Russian and foreign OE information documents by nuclear plants and other nuclear enterprises.

VNIIAES' main information and analytical materials on the operating experience of Russian and foreign NPPs are distributed to over 30 addressees within different divisions of the Operating Organization, NPPs and other supporting organizations within the industry, as well as ROSATOM and Rostechnadzor.

For the purpose of ensuring the effective exchange of the results of using the OE information by the SAI OE participants, the system of feedback on the operating experience information documents was extended in 2010 with the list of information documents having been introduced by the "Regulation 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) 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.

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.

19.8. Management of radioactive waste and spent nuclear fuel on NPP sites and measures taken to reduce their volumes

Radioactive waste is managed at NPPs in accordance with Federal Law No. 190-FZ "On the management of Radioactive Waste...".

To reduce the amount of radioactive waste generated, Rosenergoatom sets twice a year the NPP radioactive waste generation standards. To ensure that the specified radwaste generation standards 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 reduce the amount of the waste accumulated and

generated, as specified in the Federal Target Program "Nuclear and Radiation Safety in 2008 and until 2015" and the "Work Program for Management of Radioactive Waste at Nuclear Plants of Rosenergoatom in 2011-2015", the nuclear plants have been equipped with facilities for processing and conditioning of radioactive waste.

The Russian Federation's national policy in the field of radioactive waste management suggests purposeful activities for prevention of radiological impacts on humans and the environment at all waste management stages (generation, collection, transportation, treatment, storage, and final disposal).

At NPPs of Rosenergoatom, the control of radioactive waste processing and intermediate storage is governed by the administrative instruction "Management of Radioactive Waste at NPPs", which is part and parcel of the Quality Assurance Program and is directed at achieving the acceptable level of radwaste safe management.

Spent nuclear fuel (SNF) is managed at Russian NPPs in accordance with the Federal Target Program "Nuclear and Radiation Safety in 2008 and until Year 2015" and Rosatom's Concept of the Spent Nuclear Fuel Management endorsed by Order No. 721 of 29 December 2008.

The major direction in spent nuclear fuel management 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.

Rosenergoatom annually analyzes the state of the NPP SNF management system 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 were recorded in 2011-2012 at NPP units.

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;
- SNF of NPPs with WWER-1000 is transferred to the centralized storage facility at Mining and Chemical Combine 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. To enable the removal of RBMK-1000 SNF, systems have been

created at NPPs for the container storage of SNF and shipment of SNF from the Kursk, Leningrad and Smolensk NPP sites; removal of SNF from Leningrad NPP to the centralized storage facility at MCC was started in 2012;

- SNF of AMB reactors at shutdown Units 1 and 2 of the Beloyarsk NPP had been withdrawn from the reactors and are stored in the at-reactor cooling pools at the units or have been partially removed to the wet storage facility at Production Association (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 PA "Mayak" for the purpose of preparing Beloyarsk NPP units for decommissioning.

Thus, the existing Russian system for regulating the operation of nuclear facilities 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 such facilities.

This is assisted by the continuous scientific and technical support given to the Operating Organization and to the nuclear plants 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.

Major Findings and Conclusion

Major Findings

1. The signing of the Convention on Nuclear safety by the Russian Federation and implementation of its requirements facilitates solving of a number of topical issues related to safety ensuring of operation of nuclear installations.
2. In the Russian Federation a modern legislative and regulatory basis has been developed, which governs issues associated with the ensuring and regulation of safety of nuclear installations. Their evolutionary changes are aimed at enhancement of existing standards and rules for nuclear power development.
3. In the Russian Federation there is an independent Regulatory Authority in place – the Federal Environmental, Industrial and Nuclear Supervision Service (Rostechnadzor). It is subordinate and reports on its activities directly to the Government of the Russian Federation. The Regulatory Authority is provided with human, financial and technical resources, which allow it to execute functions it is entrusted, while retaining independence.
4. The safety priority for nuclear installations is stipulated by the laws and implemented in practice. In accordance with the norms of national and international law, the Operating Organization is fully responsible for the safety of nuclear installations, and has all necessary financial, human and other resources for this purpose.
5. Requirements for quality assurance programs of NPPs are formulated and stipulated by the regulatory documentation.
6. Inspections and assessments of safety of all nuclear units are carried out in a regular manner over the entire life cycle of nuclear power plants. Results of these safety assessments and justifications are taken into consideration by Rostechnadzor when granting licenses for further operation of nuclear installations.
7. Over the recent years the nuclear power units' operating experience has demonstrated sustainable trends of reduction of radioactive substance releases and discharges from NPPs to the environment and reduction of doses to the personnel that confirms effectiveness of safety improvement measures of nuclear units taken by the Operating Organization.
8. Necessary measures of emergency preparedness of nuclear power plants and measures to ensure safety of the personnel, public and environment in the NPP host regions have been implemented on the national level.

9. Inspections carried out by Rostechnadzor and missions conducted by the international organizations have confirmed positive trends in operations and strive of the personnel for improvement of the safety level of NPPs.
10. The Regulatory Authority and the Operating Organization interact with openness, striving for enhancing transparency of their activities.
11. An additional assessment of the degree of protection of the Russian NPPs against extreme external impacts that was carried out after the accident at Fukushima Daiichi plant, confirmed on the whole the stability of the Russian plants in regard of such impacts. The measures taken by the Operating Organizations to improve the degree of protection of NPPs against impacts in excess of the design bases are adequate and implemented as scheduled under supervision of the Regulatory Authority.

Conclusion

The article-by-article review of implementation of the Convention on Nuclear Safety demonstrates that the Russian Federation fulfills all its obligations resulting from the Convention on Nuclear Safety.

Director General of
the State Atomic Energy
Corporation ROSATOM

S.V. Kiriyenko

Acting Chairman of
the Federal Environmental,
Industrial and nuclear Supervision
Service

A.V. Ferapontov

APPENDICES

Appendix 1
List of the Russian NPPs

NPP Units in operation

NPP, unit number	Reactor type	Rated power, MW	Unit operation license No.
Balakovo-1	WWER	1000	GN-03-101-2351
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
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-03-101-2350
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-03-101-2503
Kola-4	WWER	440	GN-03-101-2282
Kursk-1	RBMK	1000	GN-03-101-2315
Kursk-2	RBMK	1000	GN-03-101-2316
Kursk-3	RBMK	1000	GN-03-101-2292
Kursk-4	RBMK	1000	GN-03-101-2293
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-03-101-2427
Rostov-1	WWER	1000	GN-03-101-2232
Rostov-2	WWER	1000	GN-03-101-2362
Smolensk-1	RBMK	1000	GN-03-101-2693
Smolensk-2	RBMK	1000	GN-03-101-2322
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
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	1160	GN-02-101-2548	construction
Baltic, unit 2	WWER	1160	GN-01-101-2289	deployment
Beloyarsk, unit 4	BN	800	GN-02-101-2339	construction
Kursk, unit 5	RBMK	1000	GN-02-101-2317	construction
Leningrad NPP-2, unit 1	WWER	1160	GN-02-101-2277	construction
Leningrad NPP-2, unit 2	WWER	1160	GN-02-101-2276	construction
Leningrad NPP-2, unit 3	WWER	1160	GN-01-101-2344	deployment
Leningrad NPP-2, unit No. 4	WWER	1160	GN-01-101-2345	deployment
Nizhny Novgorod, unit 1	WWER	1160	GN-01-101-2479	deployment
Nizhny Novgorod, unit 2	WWER	1160	GN-01-101-2480	deployment
Novovoronezh NPP-2, unit 1	WWER	1160	GN-02-101-2306	construction
Novovoronezh NPP-2, unit 2	WWER	1160	GN-02-101-2305	construction
Rostov, unit 3	WWER	1000	GN-02-101-2366	construction
Rostov, unit 4	WWER	1000	GN-02-101-2365	construction

NPP, unit number	Reactor type	Rated power, MW(e)	License No.	Type of license
Seversk, unit 1	WWER	1160	GN-01-101-2258	deployment
Seversk, unit 2	WWER	1160	GN-01-101-2259	deployment
Tver, unit 1	WWER	1160	GN-01-101-2498	deployment
Tver, unit 2	WWER	1160	GN-01-101-2499	deployment
Central, unit 1	WWER	1160	GN-01-101-2404	deployment
Central, unit 2	WWER	1160	GN-01-101-2405	deployment

Appendix 2
Major performance indicators of Russian NPPs in 2010-2012

NPPs with WWER-440 reactors

Indicator	NPP	Kola				Novovoronezh		All WWER-440s
	Unit	1	2	3	4	3	4	
1. Operating time factor, %	2010	90.32	86.97	68.59	83.69	88.42	88.21	-
	2011	89.84	88.50	73.12	77.66	88.35	82.92	-
	2012	79.93	88.51	76.29	84.92	73.72	87.74	-
2. Capacity factor, %	2010	69.50	70.86	55.21	81.38	74.17	86.86	72.86
	2011	69.36	70.02	63.69	70.78	88.21	80.92	73.64
	2012	61.94	61.58	61.98	71.83	73.82	87.09	69.52
3. Availability factor, %	2010	85.87	90.75	71.47	85.60	75.60	88.66	83.01
	2011	83.70	83.79	71.68	80.20	89.07	83.11	81.85
	2012	82.24	82.01	78.26	84.88	74.08	89.81	81.88
4. Number of scrams per 7,000 hours of operation	2010	0.00	0.00	2.29	0.00	0.00	0.00	0.38
	2011	0.00	0.00	2.16	0.00	0.00	0.96	0.52
	2012	0.99	0.00	0.00	0.00	0.00	0.90	0.31

NPPs with WWER-1000 reactors

Indicator	NPP	Balakovo				Kalinin			Novo-voro-nezh	Rostov		All WWER-1000s
	Unit	1	2	3	4	1	2	3	5	1	2	
1. Operating time factor, %	2010	80.70	100.00	88.01	81.83	81.91	86.70	82.74	73.11	89.36	-	-
	2011	86.46	85.98	98.49	86.99	88.22	87.63	84.79	27.65	88.32	90.70	-
	2012	73.13	89.13	89.42	97.99	77.79	84.97	92.10	84.89	86.68	88.58	-
2. Capacity factor, %	2010	81.67	103.31	91.25	85.82	83.77	88.94	82.96	67.23	89.14	-	86.01
	2011	89.37	87.38	102.30	91.06	89.81	90.61	85.27	25.33	92.00	88.43	84.15
	2012	75.27	91.83	92.05	101.36	79.38	86.06	93.24	84.23	90.15	88.77	89.53

Indicator	NPP	Balakovo				Kalinin			Novo-voro-nezh	Rostov		All WWER-1000s
	Unit	1	2	3	4	1	2	3	5	1	2	
3. Availability factor, %	2010	82.68	104.62	92.00	85.99	85.54	90.95	83.66	69.36	93.00	-	87.53
	2011	89.70	87.84	102.75	91.18	90.77	90.83	85.75	25.33	92.96	91.36	84.85
	2012	76.16	93.11	92.99	102.47	79.69	87.79	93.89	84.36	91.06	90.28	89.53
4. Number of scrams per 7,000 hours of operation	2010	0.00	0.00	0.00	0.96	1.92	0.91	0.00	1.09	0.00	-	0.54
	2011	0.00	0.00	0.00	0.91	0.00	0.00	0.00	8.21	0.00	0.00	0.91
	2012	0.00	0.90	0.00	0.81	0.00	0.00	0.00	0.93	0.00	0.00	0.17

NPPs with RBMK-1000 reactors

Indicator	NPP	Kursk				Leningrad				Smolensk			All RBMK-1000s
	Unit	1	2	3	4	1	2	3	4	1	2	3	
1. Operating time factor, %	2010	68.39	92.19	72.51	92.57	78.90	83.93	94.30	66.19	61.92	87.06	93.98	-
	2011	94.25	74.65	93.94	65.41	60.15	95.47	86.17	82.83	67.35	94.92	75.11	-
	2012	72.77	88.82	78.55	92.71	34.44	72.98	92.39	93.97	76.75	88.42	71.48	-
2. Capacity factor, %	2010	69.15	91.21	74.30	92.73	78.49	79.56	91.24	65.25	60.29	81.81	95.68	79.97
	2011	93.59	77.61	93.02	67.27	58.80	95.38	84.53	82.19	66.95	90.00	77.34	80.61
	2012	73.07	90.18	76.20	91.23	27.39	65.63	91.46	93.44	77.37	83.37	72.39	76.52
3. Availability factor, %	2010	71.88	91.72	74.54	93.32	79.68	80.90	94.36	65.75	62.47	83.28	97.24	81.38
	2011	93.75	79.62	93.58	67.47	59.58	96.31	85.40	82.84	67.26	90.69	77.46	81.27
	2012	73.64	91.14	77.82	92.19	27.52	66.29	93.45	94.51	77.98	86.93	73.80	77.75
4. Number of scrams per 7,000 hours of operation	2010	2.25	0.00	0.00	1.72	0.99	0.00	0.00	2.38	0.00	0.00	0.00	0.67
	2011	0.00	0.00	0.85	1.20	0.00	1.67	0.00	0.00	2.32	0.00	0.00	0.55
	2012	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.03	0.89	0.00	0.27

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, %	2010	74.67	16.91	87.07	68.89	83.01	-
	2011	81.53	72.64	56.82	55.78	67.86	-
	2012	82.54	74.66	62.17	82.57	67.01	-
2. Capacity factor, %	2010	74.82	10.30	59.33	42.50	49.26	40.35
	2011	80.87	46.58	29.70	28.32	41.08	36.42
	2012	80.77	48.44	35.43	43.73	31.57	39.79
3. Availability factor, %	2010	74.87	16.91	87.52	69.03	83.02	64.12
	2011	80.87	86.81	83.64	87.39	76.21	83.51
	2012	80.77	85.80	71.43	86.08	86.06	82.34
4. Number of scrams per 7,000 hours of operation	2010	0.00	0.00	1.81	0.00	0.00	0.45
	2011	0.00	1.08	0.00	0.00	0.00	0.27
	2012	0.00	0.00	0.00	0.00	0.00	0.00

Appendix 3
Measures taken in the light of lessons of the Fukushima-Daiichi accident

NPPs with RBMK, BN and EGP reactors

1) Mobile emergency response equipment has been supplied to all NPPs:

- mobile pumping sets (MPS) of different types;
- motor-driven pumps of different types;
- mobile 0.2 MW diesel generator units (MDGU);
- mobile 2 MW diesel generator plants (MDGP).

2) NPP safety was additionally assessed and analyzed for extreme internal impacts given the results of an additional analysis into the extent of the Russian NPP protection against extreme external impacts and an expert examination by SEC NRS for pressure-tube and fast neutron reactors.

3) Emergency drill plans have been complemented with a scenario of a beyond design basis accident that affects the whole of the plant with simultaneous engagement of all available units of mobile emergency response equipment (diesel generators, diesel-driven pumps, motor-driven pumps).

4) "Methodological Guidance for the Development of Management Guides for Beyond Design Basis Accidents at NPPs with RBMK-100 Reactors Including Severe Accidents" has been developed.

5) A final document has been developed that contains requirements and recommendations for developing the Management Guide for Beyond Design Basis Accidents at RBMK NPPs Including Severe Accidents.

6) Activities have been organized for introducing seismic protection systems (SSP) at NPPs with pressure-tube reactors.

7) Activities have been organized for RBMK-1000 reactors to determine the need for hydrogen explosion safety systems to be installed in rooms with potential hydrogen release.

8) As part of the activities to equip units with emergency instrumentation and control (EI&C) designed for operation in BDBA conditions, work is currently under way to identify the effective values of external influencing factors and determine the time for which they have effects, which are required to specify the EI&C specifications.

NPPs with WWER-440 and WWER-1000 reactors

1) Mobile emergency response equipment has been supplied to all NPPs:

- mobile 2.0 MW diesel generators (6 kV, 0.4 kV, 220 V DC);

- mobile 0.2 MW diesel generators (0.4 kV);
- mobile high-pressure pumping sets of different capacity and thrust;
- motor pumps of different capacity and thrust.

2) The development of design and budget documentation has been completed for the additional design concepts for the purpose of:

- improving the reliability of off-site NPP power supply;
- energizing DC and AC consumers from MDGUs;
- supplying water to consumers from MPSs;
- supplying water to consumers from motor pumps;
- removing heat to the ultimate heat sink;
- ensuring hydrogen explosion safety within the containment (Balakovo NPP Units 1, 3 and 4; Rostov NPP Unit 1; Kalinin NPP Unit 2; Kola NPP Units 1 and 2; Novovoronezh NPP Units 3 and 4);
- the primary circuit emergency gas removal system (Novovoronezh NPP Units 3 and 4);
- improving the reliability of localizing systems (Unit 5 of Novovoronezh NPP);
- increasing the extent of the MCR and BCR protection;
- pumping water from "minus" elevations of the reactor compartment, the turbine department, standby diesel generator stations and on-shore pumping stations by motor pumps;
- other additional design concepts depending on general and specialized specifications.

3) The procurement and delivery of equipment to NPPs have been started in accordance with order specifications for design and budget documentation with respect to additional design concepts.

4) Work is under way to create a single radio communication system of the TETRA standard at NPPs.

5) The NPP safety has been additionally assessed and analyzed for extreme external impacts with respect to the following:

- the expediency of external cooling for the WWER-1000 and WWER-440 reactor vessels in beyond design basis accidents with the loss of the reactor cooling (the need for the external cooling for WWER-1000 has been confirmed, and work is continued for WWER-440);
- consequences of accidents at hydraulic works of hydropower plants;
- progression of beyond design basis accident and the radiological effects thereof to determine the initial data for designing the system for emergency release from the WWER NPP leak-tight rooms;
- scenarios of beyond design basis accidents for different states of the WWER NPP reactor facilities, including with regard for the planned

upgrades based on additional design concepts to support the specifications.

6) Initial specifications have been developed for the emergency sampling system and equipment.

7) Draft unified specifications have been developed for assessing the seismic stability of the NPP structures and components during earthquakes of the intensity 1.4 SSE.

8) Emergency drill plans have been complemented with the scenario of a beyond design basis accident affecting the whole of the plant with simultaneous engagement of all available units of mobile emergency response equipment.

9) Accident management instructions and guides were updated following the implementation of the planned activities and additional design concepts.

10) A severe accident management guide (SAMG) has been developed and put into operation at the Balakovo NPP Unit 4 with WWER-1000 reactors. SAMGs are developed based on standard SAMGs and working SAMGs are introduced at all NPP units.

Appendix 4
Major safety and reliability activities undertaken by Rosenergoatom as part of upgrading some of the Russian NPP units in 2011-2012

Balakovo NPP

Unit	Activity
Nos. 1, 3, 4	A telescopic rod with a shortened central section mounted on refueling machines
Nos. 2, 3	Advanced PCL and APC equipment installed (EP set)
Nos. 1, 2	Voltage transformers of the ZNOL type replaced
No. 1	A device introduced for reducing stresses in the welded joint between the coolant header and the SG shell by air cooling method
No. 1	Blades for stages 4 and 5 of the RND-3 low-pressure rotor of the K-1000-60/1500-2 turbines replaced for blades of a novel design
Nos. 1, 2, 3, 4	EPSS EUPS of generation II introduced
Nos. 1, 2, 3, 4	A system for the hydrogen concentration monitoring in conditions of beyond-design-basis accidents and a system for the hydrogen removal in conditions of beyond-design-basis accident in the containment introduced
Nos. 1, 2	The automated mechanical quantity monitoring system (AMQMS) upgraded with the function of protection with regard for the vibration state implemented
No. 4	Control valves installed in the emergency and scheduled cooldown system
No. 1	A primary circuit component and piping leakage control system introduced
No. 1	Displacers mounted to the SG primary circuit header covers
No. 1	Complete generating unit of the KAG-24-30/30000UZ replaced
No. 1	Tube systems of the K-1000-60/1500-2 turbine condensers upgraded
No. 1	Tube systems of the TFP condensers upgraded
No. 1	Tube systems of HPHs 1, 2, 3 and 4 upgraded
No. 1	Spent nuclear fuel compacted storage racks introduced with replacement of the existing ones (TG21B01,02 compartments)
No. 1	CPS drives replaced
No. 1	CICS equipment replaced

No. 1	KUAS-5600 automatic station switchgear and the diesel generator excitation at 1SDGS-1,2,3 replaced
No. 1	EPSS 6kV power cables replaced
BOP	220/500kV outdoor switchgear air circuit breakers replaced for gas-insulated circuit breakers

Beloyarsk NPP

Unit	Activity
No. 3	The special ventilation system (PS) upgraded using a battery cyclone
No. 3	An additional emergency cooldown system using an air heat exchanger (ECS AHE) introduced

Bilibino NPP

Unit	Activity
Nos. 1-4	BV-4 NF cooling pool commissioned
Nos. 1-2	Service water pumps replaced
Nos. 1-4	Standby regulators and shutoff valves replaced
No. 4	Construction and installation work performed to replace the air-to-air heat exchanger for a plate heat exchanger
Nos. 1-4	Phased replacement of 110 kV oil circuit breakers for advanced gas-insulated circuit breakers under way

Kalinin NPP

Unit	Activity
No. 1	In-core monitoring system (ICMS) replaced – НУ
No. 1	NFMI-3 neutron flux monitoring instrumentation replaced for upgraded NFMI-16
No. 3	LCP vanes replaced
Nos. 1, 2	Steam generator louver separators replaced
No. 3	Emergency system pump pipe damping system replaced
No. 3	LPH-2 upgraded
No. 2	Benches in SS-1 replaced
No. 2	Sensors and instruments replaced in SS-1
Nos. 1, 2, 3	PGV-1000 steam generator packing assemblies upgraded
No. 2	SS-1,2 DCB replaced
No. 1	Primary feedwater pumps of the 1TK system replaced
No. 1	RHEs, valves and SG blowdown system safety valves replaced
Nos. 1, 2	LPHs upgraded

No. 1	NFMI ionization chamber movement mechanisms upgraded
No. 1	Instrument sensors replaced in SS-2 safety systems (YA, YD, TQ,TH, TJ, TK)
No. 1	Benches, sensors and instruments replaced in SS-3 safety (YA, YD, TQ,TH, TJ, TK)
No. 1	Piping vibration and mechanical quantity monitoring system replaced and TG-1 protection based on vibration condition introduced
No. 1	NAR-B boron solution neutron analyzers replaced for NAR-12M
No. 1	AFAS and AFES replaced
Nos. 1, 2	Containment cylinder SPN-1000 strands upgraded
No. 1	SPP-100 stage 1 HD piping replaced
No. 1	LPC-2 upgraded for the repair period of up to 6 years
Nos. 1, 2	RB RPS ACS normal operation system automatic regulation system upgraded
Nos. 1, 2	MP and TU upgraded for the actuators in TH and RB ACS (1,2HD; 1,2HJ; 1,2LA,W,V,X; 1,2EW,V,X)
No. 1	T-1 unit transformer monitoring system upgraded
No. 2	SS-2,3 DC upgraded
No. 2	TG-2 generator exciter damping system upgraded
No. 2	TVV-1000-4UZ TG rotor upgraded
BOP	SEU-20 electrolysis unit upgraded

Kola NPP

Unit	Activity
Nos. 1-4	Vibration monitoring, diagnosis and protection systems for turbine generators 1-8 introduced
Nos. 1-4	Air circuit breakers, disconnecting switches and voltage transformers of ODS-330 kV replaced
Nos. 3, 4	Control systems for turbine generators 5-8 upgraded
Nos. 1, 2	Additional interlocks for the steam generator level introduced
No. 3	Pressurizer pilot safety devices replaced
No. 4	Hydrogen explosion safety system introduced
Nos. 1-4	Diesel generator excitation systems and protections upgraded
Nos. 3, 4	Primary circuit components and pipelines braced

Kursk NPP

Unit	Activity
Nos.1-4	CPS servo drives and rods replaced
No. 1	Anticorrosive coating applied to the HPC-21 inner surface
No. 1	Full-scale ACLDS system introduced
No. 1	TG-1 rotor upgraded – TG-1 LPC blades and membranes mounted
No. 2	MCP TGV replaced
No. 2	TG-3 rotor upgrading completed
No. 2	Construction of the FSS-2 full-scope simulator completed
No. 3	TG-5,6 separator portion upgraded (installation of internal inlet devices)
No. 3	Upgraded stator mounted at TG-5
No. 3	TG-5 MSR steam superheater portion upgrading completed
No. 3	Fixed bearing vibration and temperature monitoring and recording system introduced on the CPS main circulation pumps and cooling circuit pumps
No. 3	SCS heat exchangers replaced for plate-type heat exchangers
Nos. 3, 4	CPS pumps replaced
No. 3	ERCS system upgraded
No. 4	Production building AFA system upgraded
No. 4	6kV circuit breakers replaced for gas-insulated circuit breakers
No. 4	Dn800 gate valve electric drives replaced on the MFCC pipelines

Leningrad NPP

Unit	Activity
No. 1	Dn800 gate valves replaced on the MFCC pipelines
Nos. 1-4	CPS servo drives and rods replaced
Nos. 3, 4	6kV circuit breakers of the VEM and VMPE types replaced for gas-insulated LF1 and LF2 circuit breakers for consumers of 6 kV 5(6)RA(RB) and 5(6)RNA(RNB) sections with reconstruction of R&ADs and control circuits
No. 4	G-7 generator stator replaced
No. 4	Refueling machine electrical equipment and control system upgraded
Nos. 1-4	SNF disassembly and storage complex commissioned

Rostov NPP

Unit	Activity
No. 1	Steam and feedwater pipeline break limiters introduced
No. 1	Pressurizer tube electric heaters replaced
No. 1	PGV-1000M steam generator packing assemblies upgraded
No. 1	LPH-3,4 upgraded through replacement of tube systems
No. 1	Glands upgraded by SCPG installation
No. 1	Heat exchangers of the 1200TNG-4M type (1ST31W01, 1ST32W01) replaced for 1200TNG-6M heat exchangers
No. 1	Fixed valve electric drive diagnosis system introduced
No. 1	R&AD devices and SDGS excitation system replaced
No. 1	Corrective measures of the report on malfunctions of Rostov NPP Unit 1 (No. 1ROS-P06-03-12-11) for modifying the UEFS blocks (BGRT-A, BKIN-A, BR)
No. 1	System for remote monitoring of the emergency and scheduled cooldown system pipeline displacement introduced
No. 1	R&AD for 6 kV connections of the normal operation systems of Unit 1 replaced for microprocessor devices of the SEPAM 1000 types + series 80 24
No. 1	IOR-24-800 post insulators of UKhL2 replaced for OSK 8-24-4 of UKhL2
No. 2	Steam and feedwater pipeline break limiters introduced
No. 2	Pressurizer tube electric heaters replaced
No. 2	Glands upgraded by SCPG installation
No. 2	Electronic circuit breaker (ECB) introduced
No. 2	Automated system for monitoring the fluid leakage from the containment introduced
BOP	Safety valve test bench upgraded by the safety complex assembly
BOP	Circuit breakers for ODS-500 kV (VNV-500 type) and ODS-220 kV (VVD-220 type) replaced for gas-insulated circuit breakers on a phased basis
BOP	Cable ducts on process racks replaced on a phased basis
BOP	ODS-220 kV current transformers replaced
BOP	Plant DCB (0EE01) upgraded by replacement for an advanced one
BOP	Plant EUPS replaced
BOP	ARMS MK-11 weather station upgraded
BOP	Clean area purification works upgraded and adjusted to bring the quality of purified wastewater to approved

	standards
BOP	Air separation units upgraded by AzhKzh-0,06 units
BOP	OKS upgraded by ESP132 air screw compressors

Smolensk NPP

Unit	Activity
No. 1	14 MCP pumps fitted with fixed IT vibration monitoring and diagnosis systems
No. 1	ERCS upgraded (system operation algorithms, replacement of fast-acting gate valves from ERCS pressurized tanks, connection of the AHCP and NHCP valve control to the ECRS control circuit)
No. 1	Hydrogen removal system (HRS) renovated. Shutoff valves installed on headers
No. 1	Existing CPS replaced for a new-generation IMCPS system complete with PCSS, ERPPS, IMPCS UPS and PCCS UPS
No. 1	"Skala" CCS replaced in full for an advanced APCS ("Skala-micro") complete with a system for by-channel monitoring of coolant rate
No. 1	Automated system for the coolant leakage detection by three parameters (hydrogen, activity, acoustic noise) introduced
No. 1	Turbine generators equipped with vibration monitoring systems
No. 1	Switchboards of 6/0.4 kV and R&AD devices upgraded using advanced hardware and circuit solutions
No. 1	MCR 1T-3T and 5T-7T panels upgraded
No. 1	Dn800 pipeline welded joints (with austenitic cladding) repaired
No. 1	Generator backup excitation upgraded
No. 2	Refueling machine control system upgraded
No. 2	TG oil supply system upgraded
No. 2	TG-4 generator stator and rotor replaced
No. 3	Emergency reactor cooling system (ERCS) upgraded. The ERCS pressurized tank safety valves of the SPPK-4-160 and SPP-KM-100 types replaced for valves of a new type
BOP	SNF SF upgraded (heat exchangers installed during switchover to compacted storage with c=2.0; installation of the pipelines for the system of emergency hydrogen removal from the SFP; organization of compacted SAA storage in the SNF SF SFP)

Appendix 5
Federal standards and rules endorsed since the Fifth National Report

- NP-087-11 "Requirements to the Nuclear Plant Emergency Power Supply Systems", 2012;
- NP-043-11 "Requirements to the Design and Safe Operation of Hoisting Cranes for Nuclear Facilities", 2012;
- NP-090-11 "Requirements to Safety Assurance Programs for Nuclear Facilities", 2012;
- NP-067-11 "Basic Rules for Accounting and Control of Radioactive Substances and Radioactive Waste Within Organizations", 2012;
- NP-086-12 "Rules for the Arrangement and Operation of Reactivity Control rod drives", 2012.

Appendix 6
List of Administrative Regulations and Safety Guides in the field of the use of atomic energy developed and put into effect by Rostechnadzor in 2010-2012

- "Administrative Regulation for Exercising by the Federal Environmental, Industrial and Nuclear Supervision Service of the State Function of Control and Supervision of the Physical Protection of Nuclear Installations, Radiation Sources, Storage Facilities, Nuclear Material and Radioactive Substances, and of the Systems of the Unified State Control and Accounting of Nuclear Material, Nuclear Substances and Radioactive Waste", 2011;
- "Administrative Regulation on Rendering by the Federal Environmental, Industrial and Nuclear Supervision Service of the State Service of Granting Permits for Execution of Works in the Field of the Use of Atomic Energy to Nuclear Facility Employees", 2011;
- "Administrative Regulation of the Federal Environmental, Industrial and Nuclear Supervision Service on Rendering the State Service "organization of the public liaison, ensuring timely and comprehensive review of oral and written applications of citizens, ruling on thereof, and giving answers to the applicants within the period set by the legislation of the Russian Federation", 2012;
- "Administrative Regulation on the Rendering by the Federal Environmental, Industrial and Nuclear Supervision Service the Services of Establishing Guidelines for Maximum Permissible Releases of Radioactive Substances to the Atmospheric Air and Maximum Permissible Discharges to Water Bodies and of Granting Permits for Releases and Discharges of Radioactive Substances into the Environment", 2013;
- "Procedures for the Submission by the Operating Organization to the Authorized Body for the State Regulation of Nuclear Safety of the Documents That Contain the Results Safety Assessment of the Nuclear Installation or Storage Facility and That Justify Safety of Their Operation, and Requirements to the Composition and Content of These Documents", 2011;
- RB-055-10 "Provision on the Development of Quality Assurance Programs for Manufacturing of Items Supplied to Nuclear Installations", 2010;
- RB-056-10 "Provision on the Physical Inventory-Taking of Nuclear Material", 2010;

- RB-057-10 "Provision on the Design and Manufacturing of Fuel Rods and Fuel Assemblies with Uranium-Plutonium (MOX) Fuel", 2010;
- RB-051-10 "Provision on the Development of Quality Assurance Programs for the Design and Development of Items Supplied to Nuclear Facilities", 2010;
- RB-052-10 "Provision on the Reclassifying Nuclear Material as Radioactive Waste", 2010;
- RB-053-10 "Provision on Improving the Prediction Accuracy for Radiological Characteristics of Radioactive Environment Contamination and Radiation Exposure of Personnel and the Public", 2010;
- RB-061-11 "Provision on the Verification and Expert Evaluation of Neutronics Calculation Software", 2011;
- RB-024-11 "Provision on Basic Recommendations for Developing the Probabilistic Safety Analysis of Level 1 for On-site Initiating Events for All Nuclear Plant Operation Modes", 2011;
- RB-065-11 "Provision on the Procedure for Obtaining Data on the Amount of Nuclear Material and Striking Their Balance and Summarizing the Physical Inventory-Taking in the Material Balance Areas", 2011;
- RB-066-11 "Provision on the Application of Mathematical Statistics Methods for Accounting and Control of Nuclear Materials", 2011.
- RB-068-11 "Provision on Basic Recommendations for Developing the Probabilistic Safety Analysis of Level 2 for Nuclear Plants with RBMK reactors", 2011;
- RB-069-11 "Provision on the Composition and Content of Nuclear Site Physical Protection System Efficiency Reports", 2011;
- RB-070-11 "Provision on the Composition and Content of Nuclear Site Vulnerability Analysis Reports", 2011;
- RB-071-11 "Provision on the Inventory-Taking of Radioactive Waste at Organizations", 2011;
- RB-072-11 "Provision on the Inventory-Taking of Radioactive Substances at Organizations", 2011;
- RB-074-12 "Regulation on Recommendations for Comparing the Calculated and Measured Reactivity in Justifying Nuclear Safety of WWER Reactors", 2012;
- RB-075-12 "Calculated Relations and Techniques for Calculating Hydrodynamic and Thermal Characteristics of Equipment Components of Liquid-Metal-Cooled Power Reactor Installations", 2012;

- RB-076-12 "Basic Recommendations for Developing the Probabilistic Safety Analysis of Level 1 for a Nuclear Plant Unit with Initiating Events Caused by On-site Fires and Floods", 2012;
- RB-081-13 "Structure and Content of the Report on the Results of Comprehensive Engineering and Radiological Examination for Decommissioning of a Nuclear Plant Unit", 2013;
- "Regulation on the Quality Control System of the Federal Environmental, Industrial and Nuclear Supervision Service in the Field of State Regulation of Nuclear Safety", 2012.

Appendix 7
Actual number of personnel of the territorial departments for supervision of nuclear and radiation safety of Rostechnadzor, and the number of supervised entities in 2012

Index	Total	CITD	NEITD	UITD	DITD	VITD	SFEITD
Personnel size, persons	802	149	120	112	125	150	146
Number of supervised enterprises and organizations	4731	1771	674	521	377	658	682

Appendix 8
Financing of Rostechnadzor from the federal budget of the Russian Federation in 2010-2012

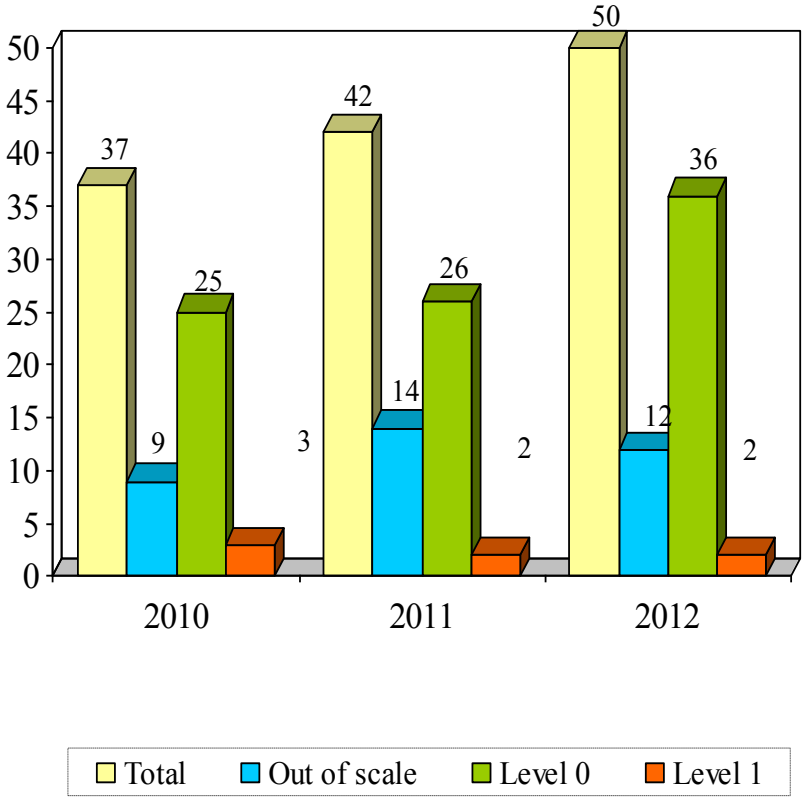
Divisions and subdivisions in the functional classification of federal budget items	Actually financed in 2011, thnd. rubles	Actually financed in 2012, thnd. rubles	Actually financed in 2013, thnd. rubles
Territorial departments	439569.80	409949.00	427945.70
Applied research	115324.50	141277.50	132886.60
including:			
Research and development efforts under governmental contracts	28000.00	24977.30	27746.10
Support to activities of subordinate organizations	43377.70	74780.20	77576.0
Federal Target Program ЭNuclear and Radiation Safety in 2008 and until 2015Э	43946.80	41520.00	87200.0

Appendix 9
Distribution of Russian NPP operational event ratings by INES in 2010–2012

NPP	Number of NPP operational events by INES levels								
	2010			2011			2012		
	Out of scale	0	1	Out of scale	0	1	Out of scale	0	1
Balakovo	1	-	1	2	2	1	2	1	1
Kalinin	-	6	-	1	5(4)**	1	-	16 (13)**	-
Kola	1	2	-	5	4	-	2	1	-
Novovoronezh	-	3	-	2	6	-	2	6	-
Rostov	6 (5)*	5(4)*	-	2	1	-	1	-	-
Kursk	4	3	1	1	4	-	3	3	-
Leningrad	2	7	1	1	3	-	1	3	1
Smolensk	1	-	-	-	2	-	1	5	-
Beloyarsk	-	-	-	-	-	-	-	-	-
Bilibino	-	2	-	1	2	-	-	1	-
Total	15	28	3	15	29	2	12	36	2
	46			46			50		

* Number of operational events at Rostov NPP Unit 2 which was in pilot commercial operation in 2010.
** Number of operational events at Kalinin NPP Unit 4 which was in pilot commercial operation in 2011 and 2012.

Appendix 10
Trends in operational events at Russian NPPs with ratings by INES in 2010–2012



Appendix 11
Requirements to the composition of the set of documents to demonstrate nuclear and radiation safety which is to be submitted to Rostechnadzor together with the license application

Requirements to the composition of the documentation package to demonstrate nuclear and radiation safety when siting a nuclear facility, a radiation source, a nuclear material storage facility, a radioactive waste storage facility (for a nuclear unit):

- feasibility study materials as far as the siting justification is concerned;
- a safety analysis report (containing all required evidence to support the site selection and addressing the safety-related aspects as required by the current regulations required; providing a general description of the nuclear facility and demonstrating its safety to the environment and the public including a preliminary physical protection safety analysis) produced in compliance with effective regulatory documents;
- an overall quality assurance program;
- a quality assurance program for the facility siting.

Requirements for the composition of the documentation package to demonstrate nuclear and radiation safety in construction of a nuclear installation (a nuclear unit):

- a preliminary safety analysis report;
- an overall quality assurance program;
- a quality assurance program for construction;
- design documents (including designs of the reactor facility, safety-related systems and physical protection); R&D and test reports on research and development efforts as well as on the tests referred to in the NPP PSAR[2];
- a probabilistic safety analysis of level 1 for the NPP unit.

Requirements for the composition of the documentation package to demonstrate nuclear and radiation safety during operation of a nuclear facility (an operating nuclear unit):

- final safety analysis report or documents equivalent to it (technical safety case for the nuclear unit and that for its reactor facility, in-depth safety assessment report);
- NPP unit operating procedures;
- PSA of Level 1;
- NPP unit reactor facility certificate;
- NPP unit accident mitigation instructions;

[2] Submitted on request from Rostechnadzor after an application is filed to obtain a license for construction of a nuclear unit.

- NPP unit beyond design basis accident management guides;
- action plan for the personnel protection in the event of an accident at the NPP unit;
- quality assurance program for the NPP unit operation;
- measures to compensate for departures from nuclear regulations and rules;
- action plan to eliminate departures from standards and rules in the field of the use of atomic energy;
- information on recruitment, training and retraining of the NPP unit personnel and granting them permits for working on their own;
- results of the observation of buildings and structures of categories I and II in terms of safety implications covering the entire observation period (subsidence, tilts, etc.);
- instructions on the nuclear safety assurance during storage, transportation and handling of nuclear fuel;
- instructions, programs and schedules for the maintenance, repairs, tests and inspections of systems important for safety[3];
- nuclear material, radioactive material and radioactive waste accounting and control certificates;
- physical protection assurance certificate;
- radioactive waste handling system operating procedures;
- program for the NPP unit preparation for life extension and a certificate of its progress[4];
- NPP comprehensive examination report[5].

[3] Submitted on request from Rostechnadzor after an application is filed to obtain a license for construction of a nuclear unit.

[4] Submitted together with the application filed to obtain a license for continued operation during an additional period.

[5] Submitted on request from Rostechnadzor after an application is filed to obtain a license for construction of a nuclear unit.

Appendix 12
Average annual individual and collective exposure doses for personnel and seconded staff at Russian NPPs in 2010-2012

Table P12.1. Average individual exposure doses for personnel and seconded staff at NPPs in 2010-2012

NPP, units, type of reactor installation	2010		2011		2012	
	Average exposure dose, mSv/year	% of 20 mSv *	Average exposure dose, mSv/year	% of 20 mSv *	Average exposure dose, mSv/year	% of 20 mSv *
NPPs with WWERs						
Balakovo, 1-4, WWER-1000	0.64	3.2	0.52	2.6	0.60	3.0
Kalinin, 1-3, WWER-1000	0.46	2.25	0.49	2.45	0.41	2.05
Kola, 1-4, WWER-440	1.08	5.4	0.84	4.2	1.18	5.9
Novovoronezh, 3,4, WWER-440; 5, WWER-1000	1.05	5.25	1.15	5.75	1.10	5.5
Rostov, 1,2 WWER-1000	0.04	0.2	0.13	0.65	0.11	0.55
Average for WWER NPPs	0.63	3.15	0.67	3.35	0.67	3.35
NPPs with RBMKs						
Kursk, 1-4, RBMK-1000	2.68	13.4	2.37	11.85	2.23	11.15
Leningrad, 1-4, RBMK-1000	1.4	7.0	1.51	7.55	1.24	6.2
Smolensk, 1-3, RBMK-1000	2.04	10.2	1.59	7.95	1.84	9.2
Average for RBMK NPPs	2.03	10.15	1.80	9.0	1.78	8.9
NPPs with BN and EGPs						
Beloyarsk, 3, BN-600	0.64	3.2	0.50	2.5	0.36	1.8
Bilibino, 1-4, EGP-6	3.35	16.75	3.49	17.45	3.70	18.5
Average for BN and EGP NPPs	1.37	6.85	1.34	6.7	1.27	6.35
Average for all NPPs (operating units)	1.39	6.95	1.30	6.5	1.26	6.3

* the average annual effective exposure dose for NPP personnel is 20 mSv.

Table P12.2. Annual collective exposure doses for personnel and seconded staff per NPP in 2010-2012

NPP	person·Sv/unit		
	2010	2011	2012
NPPs with WWER			
Balakovo	0.58	0.48	0.58
Kalinin	0.52	0.60	0.44
Kola	0.66	0.48	0.68
Novovoronezh (three operating units)	1.20	1.54	1.15
Rostov	0.067	0.14	0.12
Weighted average value for WWER NPPs (operating units)	0.65	0.65	0.62
NPPs with RBMKs			
Kursk	4.32	3.83	3.65
Leningrad	2.34	2.39	1.89
Smolensk	3.93	3.41	3.48
Weighted average value for RBMK NPPs	3.49	3.20	2.96
NPPs with BN-600			
Beloyarsk (unit 3)	0.45	0.32	0.25
NPPs with EGP-6s			
Bilibino	0.64	0.69	0.72
Weighted average value for operating NPPs with non-serial units (BN-600 and EGP-6)	0.54	0.50	0.48
Weighted average value for all NPPs (operating units)	1.45	1.38	1.27