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

Fourth Review Meeting
under the Convention
on Nuclear Safety

Moscow 2007

This is the fourth National Report of the Russian Federation on the fulfillment of commitments arising from the Convention on Nuclear Safety. The Report covers nuclear power plant operation period after 2004 and takes into account the recommendations of the third Meeting of Contracting Parties to review the national reports held 11-22 April 2005 in IAEA (Vienna, Austria).

The Report does not address some individual aspects of the fulfillment of Convention's articles that were described in detail in the previous National Reports of the Russian Federation and which have not sustained any changes for the period under review.

This Report places major emphasis on the additional information on the issues and problems that aroused interest in the course of review and discussion of reports at the third Review Meeting of Contracting Parties including those mentioned in IAEA Secretariat's Report "Synopsis of the Relevant IAEA Safety Requirements Reflecting the Issues Addressed by Articles 6 to 19 of the Convention on Nuclear Safety".

Contents

Contents

Contents

List of Abbreviations

BN	Fast Breeder Reactor
EGP	Pressure Tube Boiling Water Graphite Moderated Reactor
ERC	Emergency Response Center of Rosenergoatom Concern
ETC	Emergency Technical Center
IAEA	International Atomic Energy Agency
INES	International Nuclear Event Scale
IRS	Incident Reporting System
KOPUR	Component Lifetime Control, Estimation, Prediction and Management Program
LRW	Liquid Radioactive Waste
LWS	Liquid Waste Storage
MCR	Main Control Room
M & R	Maintenance and Repair
NEA	Nuclear Energy Agency
NPP	Nuclear Power Plant
NSSS	Nuclear Steam Supply System
OPAS	NPP Emergency Assistance Team
OSChS	Industry-level System for Prevention and Mitigation of Emergencies of Rosatom
POKAS	Program of NPP Quality Assurance in Operation
PRIS	Power Reactor Information System
RBMK	Soviet-design Pressure Tube Graphite Moderated Reactor
RF	Russian Federation
Rosatom	Federal Atomic Energy Agency
Rostechnadzor	Federal Environmental, Industrial and Nuclear Supervision Service
RSChS	Unified National System for Prevention and Mitigation of Emergencies
SCC	Situation and Crisis Center of Rosatom
SChSK	System for Prevention and Mitigation of Emergencies on Sites of the Operating Organization
SChSO	Site (NPP) System for Prevention and Mitigation of Emergencies
SEC NRS	Scientific and Engineering Center for Nuclear and Radiation Safety
SFA	Spent Fuel Assembly
SNF	Spent Nuclear Fuel
SRW	Solid Radioactive Waste

TSC	Technical Support Centre
VNIIAES	All-Russian Research Institute for Nuclear Power Plant Operation
WANO	World Association of Nuclear Operators
WWER	Soviet-design Pressurized Water Reactor

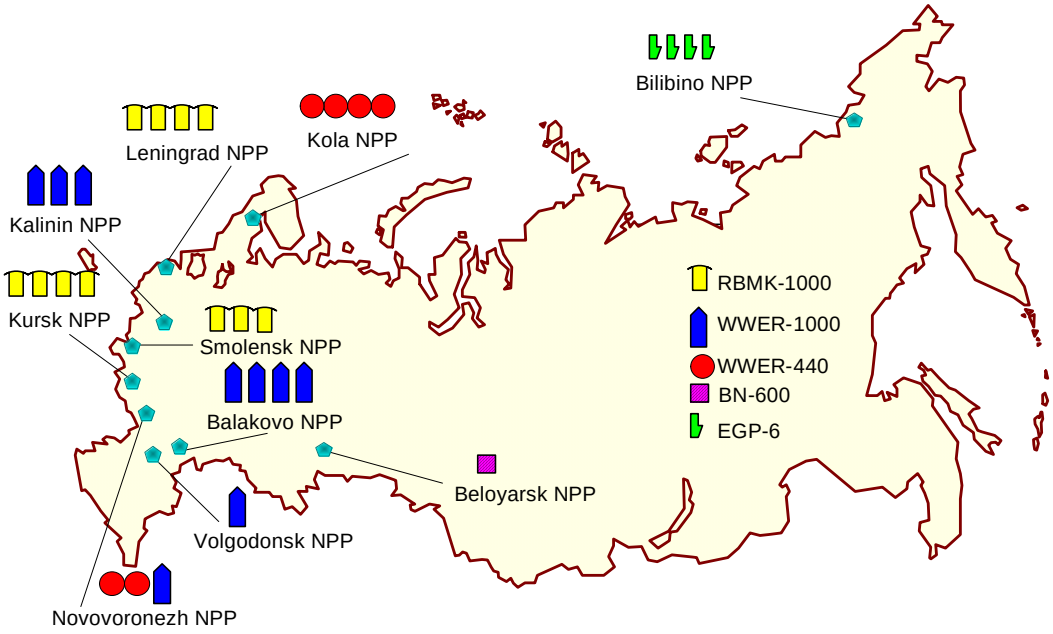
Introduction

As of 01.07.2007, 31 nuclear units at 10 nuclear power plants (NPPs) with a total installed capacity of 23.242 GWe (gross) were in operation in the Russian Federation. The total nuclear electricity generation in 2006 was 154.7 bln kWh or 15.82 % of the overall electricity generated by all Russian power stations.

155.2 bln kWh of electricity has been planned to be generated by all Russian NPPs in 2007.

The location of operating NPPs is shown below.

Location of Russian NPPs



Russian Federation's national policy in the area of nuclear power safety assurance is based on the Federal Acts on the "Use of Atomic Energy", "Radiation Safety of the Public", "Environmental Protection" and others.

These acts are aimed at protecting human life and health, preserving environment while using atomic energy and are intended to promote nuclear science and technology, contribute to the strengthening of international regime of safe atomic energy uses.

In accordance with the Russian Federation Government Ordinance of 28 April 2004 No. 316 the functions to ensure the development and safe operation of nuclear power in Russia were delegated to the Federal Atomic Energy Agency (Rosatom). According to the Russian Federation

Government Ordinance of 3 July 2006 No. 412 the Federal Atomic Energy Agency is a body of state management of atomic energy use at nuclear installations. The Agency performs the functions of pursuing state policy and normative-legal regulation in the field of atomic energy use. The Federal Atomic Energy Agency is directly subordinate to the Government of the Russian Federation.

The Federal Act on the "Use of Atomic Energy" of 21 November 1995 No. 170-FZ specifies that the overall responsibility for the safety of nuclear installations as well as for the safe management of nuclear materials and radioactive substances rests with the Operating Organization.

Today there is only one Operating Organization in Russia - Federal State Unitary Enterprise "Russian State Concern for the Production of Electrical and Thermal Energy at Nuclear Plants" (Rosenergoatom Concern), which incorporates all 10 Russian nuclear power plants.

To execute the federal acts and implement the safety principles stated in the federal codes and standards in the area of atomic energy use, the Operating Organization has adopted the basic activity principles formulated in the "Policy Statement".

The major principles include:

- priority to safety, i.e. assuring nuclear plants safety at all stages of their life cycle is the top priority;
- providing cost-effective and reliable nuclear plant operation and assuring their safety is the major task of the Operating Organization;
- adherence of individuals and organizations involved in all stages of a nuclear plant life cycle to safety culture principles (INSAG-4);
- strict compliance with the Russian Federation legislation, with international conventions, requirements of existing national safety codes and standards in nuclear power and consideration of nuclear plant safety recommendations given by the International Atomic Energy Agency.

Nuclear power development in the Russian Federation is defined by the targeted federal program entitled "Development of Atomic Power Industry Complex of Russia for the Period of 2007-2010 and up to 2015" approved by the Russian Federation Government Ordinance of 6 October 2006 No. 605.

The major objectives of the above Program are: providing accelerated development of the atomic power industry complex to ensure the country's geopolitical interests and energy safety through commissioning new standardized serial nuclear units.

At the first stage of the Program (2007-2010) modification of existing nuclear units is envisaged to extend their lifetime as well as completion of construction of nuclear plants at advanced construction stage. Preparation for the construction of new nuclear plants based on the advanced WWER reactor unit is in progress.

The Program foresees completing the construction of nuclear units at existing sites (Rostov NPP Unit 2, Kalinin NPP Unit 4, Beloyarsk NPP Unit 4) as well as the construction of new nuclear plants (Novovoronezh NPP-2, Leningrad NPP-2, Kursk NPP-2).

The list of Russian NPPs as of 01.07.2007 is given in Appendix 1, which shows NPP units in operation as well as units being prepared for decommissioning.

Further in this Report, in accordance with the requirements of the Convention on Nuclear Safety and taking into account the recommendations stated in the "IAEA Safety Requirements Synopsis" prepared by IAEA Secretariat for the Contracting Parties following recommendations of the Third Review Meeting held in April 2005, a description is given of the article-by-article fulfillment of Russian Federation's commitments arising from the Convention on Nuclear Safety.

Article 6. Existing Nuclear Installations

Major performance indicators of the operating nuclear units in Russia for 2004-2006 are given in Appendix 2.

Safety improvement of the operating NPP units is a continuing process, which includes:

- implementation of the programs (schedules) of step-by-step safety enhancement by means of improvement of unit components and systems;
- improvement of nuclear unit operation practice (organizational and managerial improvements);
- nuclear units safety enhancement in the course of their modification while preparing for lifetime extension beyond the design-specified life.

As mentioned in the third National Report of the Russian Federation, safety assessment of NPP units and implementation of measures aimed at further enhancement of their safety proceed on a continuous basis, namely:

- in the course of obtaining operation licenses and amending the terms of the licenses;
- when changing the regulatory safety requirements in the area of atomic energy use;
- as a result of safety reviews and assessments performed by the Operating Organization;
- as a result of investigating NPP operational events.

6.1. NPP Unit Lifetime Extension

Lifetime extension of operating NPP units on expiration of their design life is one of important tasks at the modern stage of Russia's nuclear power development and one of the most cost-effective investments in NPP safety improvement and preservation of generating capacities.

The efforts to extend operating NPP unit lifetime were launched in response to the "Program of Nuclear Power Development for the Period of 1998-2005 and up to the Year of 2010" approved by the Russian Federation Government Ordinance No. 815 of 21 July 1998 and in line with the "Strategy of Nuclear Power Development in the First Half of the XXI Century" approved by the RF Government on 25 February 2000.

Implementation of a set of measures to extend the lifetime of the first generation units enabled to enhance their safety and also contributed to the improvement of the physical condition of these units and reduction of risks associated with their operation.

NPP unit lifetime extension activities are being performed in accordance with the requirements of the existing Russian legislation and

federal codes and standards in the area of atomic energy use. The documents regulating NPP unit lifetime extension are given in Appendix 3.

According to the regulatory documents adopted in Russia, NPP unit lifetime extension activities include:

- comprehensive examination of a NPP unit;
- evaluation of technical feasibility of extending NPP unit component lifetime;
- unit safety assessment;
- cost-benefit analysis of extending unit lifetime.

The result of the work performed is the decision on the expediency of extending the concerned unit lifetime.

Further work consists in the development of a program of unit preparation for lifetime extension, which incorporates:

- justification of extending the lifetime of non-replaceable components;
- implementation of a comprehensive program of unit upgrading;
- conduct of unit components and systems testing;
- justification of NPP unit safety.

The results of this work are submitted by the Operating Organization to the Russian Regulatory Body for independent review and for obtaining NPP unit operation license for the additional period.

The lifetime extension activities, unit upgrading efforts and expected results of comprehensive unit examinations were described in detail in the third RF National Report.

The work performed for the reported period demonstrated the possibility of NPP unit safe operation beyond the design 30-year lifetime. Regulatory Body's licenses were obtained in the established order for the operation of 11 nuclear units beyond their design life (See Table 6.1).

The duration periods of operation licenses for all NPP units are presented in Appendix 1.

Table 6.1 – NPP Units which Obtained Regulatory Body's Licenses for Operation Beyond the Design Lifetime

Plant name	Unit	Reactor type	Power (gross, MW)	Commis-sioning date (year)	Expiration of design 30-year life (year)
Novovoronezh	**3**	**WWER-440**	**440**	**1971**	**2001**
	4	**WWER-440**	**440**	**1972**	**2002**
Kola	**1**	**WWER-440**	**440**	**1973**	**2003**
	2	**WWER-440**	**440**	**1974**	**2004**
Leningrad	**1**	**RBMK-1000**	**1000**	**1973**	**2003**
	2	**RBMK-1000**	**1000**	**1975**	**2005**
Kursk	**1**	**RBMK-1000**	**1000**	**1976**	**2006**
Bilibino	**1**	**EGP-6**	**12**	**1974**	**2004**
	2	**EGP-6**	**12**	**1974**	**2004**
	3	**EGP-6**	**12**	**1975**	**2005**
	4	**EGP-6**	**12**	**1976**	**2006**

According to the targeted federal program "Development of Atomic Power Industry Complex of Russia for the Period of 2007-2010 and up to 2015" approved by the Russian Federation Government Ordinance of 6 October 2006 No. 605, nuclear unit lifetime extension activities will be continued.

Rosenergoatom Concern is currently taking efforts to prepare for lifetime extension another 13 nuclear units, whose design lifetime expires in the period from 2007 to 2015.

6.2. NPP Unit Upgrading

The Russia's approach to NPP unit upgrading is based on the results of assessing their conformance to the requirements of the existing regulatory documents, probabilistic safety assessments and feedback of NPP operating experience.

For the reported period (2004-2007) system upgrading works were performed at a number of nuclear units, in particular, at RBMK-1000 reactors, namely:

- Kursk NPP Units 1 and 2;
- Smolensk NPP Units 2 and 3;
- Leningrad NPP Units 3 and 4.

Major upgrading actions implemented at the above mentioned units are given in Appendix 4.

In conclusion it should be noted that the provisions of Article 6 of the Convention on Nuclear Safety are fulfilled for all operating NPP units.

The technical and organizational measures that are being implemented allow to maintain the acceptable safety level of the existing Russian nuclear plants.

Article 7. Legislative and Regulatory Framework

Regulation of relations in the area of atomic energy use is performed on the basis of the Russian Federation Constitution as the Basic Law, which has the supreme legal effect and direct action, on the basis of international agreements and conventions (including the Convention on Nuclear Safety, Vienna Convention on Liability for Nuclear Damage, Joint Convention on Safe Management of Spent Fuel and Radioactive Waste, Convention on Early Notification of Nuclear Accidents, Convention on Physical Protection of Nuclear Materials and others which have higher legal effect than the federal acts as follows from item 4 of Article 15 of the Russian Federation Constitution), on the basis of federal acts of the Russian Federation as well as by-laws (subordinate legislation) - regulatory legal acts of the President of the Russian Federation and of the Government of the Russian Federation, federal codes and standards in the area of atomic energy use, regulatory documents of the bodies of state regulation of safety in the area of atomic energy use and regulatory documents of the bodies of management of atomic energy use, federal standards, norms and regulations.

7.1. Federal Acts

The following acts constitute the legal basis for regulation in the area of atomic energy use in the Russian Federation:

- Federal Act of 21 November 1995 No. 170-FZ on the "Use of Atomic Energy";
- Federal Act of 9 January 1996 No. 3-FZ on the "Radiation Safety of the Public".

The following acts, which regulate certain aspects related to atomic energy use, should also be mentioned:

- Federal Act of 10 January 2002 No. 7-FZ on the "Environmental Protection";
- Federal Act of 27 December 2002 No. 184-FZ on the "Technical Regulation";
- Federal Act of 5 February 2007 No. 13-FZ on the "Peculiarities of Managing and Handling the Property and Shares of the Organizations Performing Activities in the Area of Atomic Energy Use and Making Amendments to Certain Legislative Acts of the Russian Federation";
- Penal Code of the Russian Federation of 13 June 1996 No. 63-FZ;
- Russian Federation Code of Administrative Violations of 30 December 2001 No. 195-FZ.

Basic provisions of the federal acts on the "Use of Atomic Energy", on the "Radiation Safety" and on the "Technical Regulation" were described in the previous RF National Reports.

The provisions of the Federal Act on "Environmental Protection" related to nuclear installations (Article 40) in many respects reproduce the provisions of the Federal Act on the "Use of Atomic Energy".

The Penal Code of the Russian Federation (Article 215) sets out responsibility for violations of safety rules in atomic energy facilities that may result or have resulted in human death or environmental contamination.

Russian Federation Code of Administrative Violations (Article 9.6) envisages responsibility for breaking the rules of atomic energy use and nuclear materials and radioactive substances accounting. Besides, the Code sets out the authorities of Regulatory Body's officials to investigate the cases of administrative violations of this kind.

Since the time of submitting the previous RF National Report some amendments were made to the federal acts which, regulate atomic energy use.

The Federal Act of 22 August 2004 No. 122-FZ on "Making Amendments to the Legislative Acts of the Russian Federation and Abolition of Some Legislative Acts of the Russian Federation" introduced some changes and clarifications to the federal acts on the "Use of Atomic Energy", on the "Radiation Safety of the Public", on the "Environmental Protection".

The essence of these changes and amendments concerns the clarification of authorities of the federal legislative and executive bodies as well as the authorities of the entities of the Russian Federation and of local governing bodies in the area of atomic energy use and also in the areas of assuring radiation safety of the public and environmental protection.

The function of ensuring physical protection of nuclear installations was removed from the competence of the federal body of state management of atomic energy use and delegated to the Operating Organization and to the appropriate federal bodies of executive power. Besides, the functions of development and implementation of fire safety measures were delegated to the Operating Organization. Thus, the text of the articles of the Federal Act on the "Use of Atomic Energy" differentiating the spheres of responsibility of governmental authorities and of the Operating Organization was brought in conformance with the text of Article 35 of the above act, which says that the Operating Organization bears full responsibility for the safety of a nuclear installation.

The requirement specifying that the federal bodies of executive power performing state management of atomic energy use or state regulation of safety while using atomic energy shall be specially

empowered for this by the President of the Russian Federation or, on his instruction, - by the Government of the Russian Federation, was excluded. Now, the above bodies are empowered by the appropriate ordinance of the RF Government.

The following authorities were delegated to the bodies of executive power of the Russian Federation in the area of assuring radiation safety: monitoring radiological situation in the country's territory and accounting exposure doses to the public, introducing special modes of living for the population in contaminated zones, establishing the process for defining social guarantees for increased risk of human health effects and damage to property due to radiation impacts. Social guarantees for increased risk and the order of compensations for health damage by radiation effects on individuals involved in radiological activities are set out in the Russian Federation legislation.

The regions of the Russian Federation were excluded from the number of the entities, which perform state management in the area of radiation safety assurance. This sphere of activity was fully delegated to the Russian Federation Government and to the federal bodies of executive power.

The Federal Act of 18 December 2006 No. 232-FZ on "Making Amendments to the Town Planning Code of the Russian Federation and to Certain Legislative Acts of the Russian Federation" introduced changes to the federal act on the "Use of Atomic Energy" to bring it in conformance with the existing town planning legislation of the Russian Federation.

The Federal Act No. 13-FZ on "Peculiarities of Managing and Handling the Property and Shares of the Organizations Performing Activities in the Area of Atomic Energy Use and Making Amendments to Certain Legislative Acts of the Russian Federation" was passed on 5 February 2007. This act:

- gives a new revision of Article 5 of the Federal Act on the "Use of Atomic Energy". It says that the nuclear materials (including radioactive waste containing nuclear materials) and nuclear installations can be both in the federal ownership and in the ownership of legal entities. In this case, the list of nuclear materials, which can be exclusively in the federal ownership and the list of Russian legal entities, which can own nuclear materials (including radioactive waste containing nuclear materials) or nuclear installations are to be approved by the President of the Russian Federation. The owners of nuclear materials and nuclear installations perform monitoring of their safe keeping and appropriate use. These facilities, independent of the type of ownership, are subject to state accounting and control of nuclear materials.

Because of introducing new revision of Article 5, changes also have been made to a number of other articles of the Federal Act No. 170-FZ;

- defines specific features of making structural changes in the atomic power industry complex. It has been set out that the President of the Russian Federation approves the list of enterprises of the atomic power industry complex, which are to be transformed to the open joint-stock companies, whose shares will be incorporated in the authorized capital stock of the company established on decision of the President of the Russian Federation. The President of the Russian Federation also approves the list of enterprises of atomic power industry complex, whose property is to be passed to the indicated major joint-stock company. The originator (founder) of the major joint-stock company is the Russian Federation. The Government of the Russian Federation approves the Charter of the major joint-stock company and supports the implementation of other necessary measures. The Charter of the major joint-stock company must be in accordance with the basic principles of state policy in the area of managing and controlling the property and shares of the companies of atomic power industry complex defined by the Federal Act No. 13-FZ. The issues of succession as regards the function of the Operating Organization and the need for resuming Regulatory Body's (Rostechnadzor) licenses were defined.

The previous RF National Report mentioned that in December 2002 the Federal Act on the "Technical Regulation" No. 184-FZ was passed (currently this act is in force in the revision stated in the Federal Act of 1 May 2007 No. 65-FZ).

In this connection, during the reported period after 2004 and today efforts are in progress to develop technical specifications on nuclear and radiation safety. The overall coordination of efforts to develop technical specifications is performed by the Governmental Commission for Technical Regulation established in accordance with the Russian Federation Government Ordinance of 1 March 2005 No. 97. The Commission works under the chairmanship of the Minister for Industry and Power of the Russian Federation.

The Federal Act of 1 May 2007 No. 65-FZ introduced a number of changes to the act on "Technical Regulation". In particular, a new revision of Article 5 of this act is given. This revision sets out that in relation to products and objects, for which nuclear and radiation safety requirements are established, including requirements to the processes of design (surveys), production, construction, installation, adjustment, operation, storage, transportation, implementation, recycling and burial of these products and objects, the mandatory requirements in addition to the technical specifications are those set out by the federal bodies of state management of atomic energy use and state regulation of safety while using atomic energy.

Thus, the new revision of Article 5 of the Federal Act No. 65-FZ preserves the mandatory nature of the requirements of federal standards and regulations in the area of atomic energy use.

Changes in the Russian legislation that occurred in the period after the submittal of the previous National Report, are of evolutionary nature and are in line with Russia's commitments 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

To expand the provisions of the Federal Act of 21 November 1995 No. 170-FZ on the "Use of Atomic Energy" (as well as of other federal acts related to the issues of atomic energy use), the President of the Russian Federation and the Government of the Russian Federation take legal deeds in the form of President's Decrees and Government's Ordinances.

In the period since the submittal of the third National Report the President of the Russian Federation and the Government of the Russian Federation approved a number of new legal deeds on the issues related to atomic energy use. A number of changes have also been made to the earlier existing regulatory documents of the President and of the Government.

To restructure the atomic power industry complex of the Russian Federation, to preserve and develop its scientific-industrial potential, to strengthen competitive capabilities of the Russian Federation in the world market of products and services associated with atomic energy peaceful use, the President of Russia signed on 27 April 2007 the Decree No. 556 on the "Restructuring of the Atomic Power Industry Complex of the Russian Federation". This Decree accepts the proposal of the Russian Federation Government to establish an Open Joint-Stock Company (OJSC) "Atomic Power Industry Complex" (Moscow) with 100% shares being in the federal ownership.

As the Russian Federation's contribution to the authorized capital stock of OJSC "Atomic Power Industry Complex" they brought in the federally-owned property envisaged by the Federal Act of 5 February 2007 No. 13-FZ including the federally-owned shares of the open joint-stock companies (including OJSCs established through transforming the federal state unitary enterprises). The Decree specifies that the nuclear materials (except those exclusively federally owned) and nuclear installations can be owned by OJSC "Atomic Power Industry Complex" as well as by the OJSCs established through transforming the federal state unitary enterprises mentioned in the Decree starting from the date of state registration of these OJSCs.

The Decree defines the priority areas of activities of the above "Atomic Power Industry Complex", of its daughter and dependent joint-stock companies. These are:

a) design, siting, construction, operation, warranty servicing and routine maintenance, upgrading, repair and decommissioning of nuclear installations, radiation sources and nuclear material and radioactive substance storage facilities;

b) conduct of research in the field of atomic energy use, introduction of new technologies and developments in this field;

c) construction, operation and warranty servicing of NPPs including the facilities located beyond the Russian Federation boundaries;

d) production of electrical and thermal energy at NPPs;

e) prospecting and extracting the minerals containing nuclear materials and radioactive substances;

f) enrichment of uranium and of other nuclear materials;

g) development, production and selling of nuclear reactor fuel assemblies;

h) exports and imports of goods and services associated with the use of atomic energy;

i) training of specialists in the area of atomic energy use.

The basic principles to be followed by OJSC "Atomic Power Industry Complex", by its daughter and dependent joint-stock companies referred to in the President's Decree, are:

a) assuring the priority of stable and safe functioning of the RF atomic power industry complex including the compliance with the requirements of nuclear, radiation, industrial and fire safety, ecological safety and the requirements in the field of environmental protection, physical protection of nuclear installations, of radiation sources, nuclear materials, radwaste, nuclear materials and radioactive substances storage facilities as well as ensuring safe keeping, accounting, control and proper use of mentioned objects and materials;

b) compliance with international commitments and guaranties in the field of atomic energy use.

The Decree also approved the following:

a) the list of nuclear materials that can be exclusively federally owned;

b) the list of Russian legal entities, which can own nuclear materials (except those, which can be exclusively federally owned);

c) the list of Russian legal entities, which can own nuclear installations;

d) the list of federal state unitary enterprises of the atomic power industry complex that are to be transformed to the OJSCs and whose shares

are to be brought in the authorized capital stock of OJSC "Atomic Power Industry Complex";

e) the list of OJSCs of the RF atomic power industry complex that are federally owned and whose shares are to be brought in the authorized capital stock of OJSC "Atomic Power Industry Complex";

f) the list of the federal state educational institutions for additional professional training (proficiency improvement) belonging to the organizations of the RF atomic power industry complex which are to be handed over to OJSC "Atomic Power Industry Complex".

The Russian Federation Government has issued a number of new ordinances, and the following changes have been made to the existing RF Government Ordinances:

- the "Manual on the Development and Approval of the Federal Standards and Regulations in the Area of Atomic Energy Use" approved by the RF Government Ordinance of 1 December 1997 No. 1511, was amended by RF Government Ordinances of 31 May 2005 No. 348, of 5 December 2006 No. 742, of 24 March 2007 No. 179 in connection with the changes in the list of existing federal standards and regulations in the area of atomic energy use;
- a number of earlier approved RF Government Ordinances (in particular, of 14 July 1997 No. 865 on the "Approval of the Manual on the Licensing of Activities in the Area of Atomic Energy Use", of 15 September 1998 No. 1117 on the "State Body Specially Authorized to Sign Agreements on the Transfer of the Federally Owned Nuclear Materials to the Legal Entities") were amended due to the transfer of the functions of state management of atomic energy use from the Russian Federation Ministry of Atomic Energy to the Federal Atomic Energy Agency, and of the functions of the Federal Nuclear and Radiation Safety Authority of Russia to the Federal Environmental, Industrial and Nuclear Supervision Service;
- RF Government Ordinance of 30 July 2004 No. 401 was passed (with changes in the revision of RF Government Ordinances of 21 January 2006 No. 23, of 29 May 2006 No. 335, of 14 December 2006 No. 767) on the "Federal Environmental, Industrial and Nuclear Supervision Service", according to which the above Service was entrusted with the functions of the body of state regulation of safety in the field of atomic energy use, which performs licensing and supervision in the area of atomic energy use. It was defined that the above Federal Service is the Regulatory Body of the Russian Federation under the Convention on Nuclear Safety;
- Russian Federation Government Ordinance of 3 July 2006 No. 412 on the "Federal Bodies of Executive Power, which Perform State Management of Atomic Energy Use and State Regulation of Safety while Using Atomic Energy" was passed. This Ordinance defines that the Federal

Atomic Energy Agency performs state management of atomic energy use in relation to nuclear plants. This Ordinance also defines that the Russian Federation Ministry for Civil Defense, Emergency Management and Liquidation of the Consequences of Natural Calamities, the Federal Environmental, Industrial and Nuclear Supervision Service, the Federal Service for Supervision in the Area of Protection of Consumer Rights and Human Well-being, and the Federal Medical-Biological Agency (FMBA) take part in the state regulation of safety in the use of atomic energy;

- RF Government Ordinance of 1 February 2006 No. 54 was passed, according to which the functions of state supervision in construction, upgrading and overhaul of atomic energy facilities (including nuclear installations, nuclear materials and radioactive substances storage facilities) was entrusted to the Federal Environmental, Industrial and Nuclear Supervision Service;
- RF Government Ordinance of 6 October 2006 No. 605 was passed on the "Federal Targeted Program "Development of the Atomic Power Industry Complex of Russia for the Period of 2007-2010 and up to 2015". This Program was briefly described in the introductory section of this National Report.

7.3. Federal Standards and Regulations in the Area of Atomic Energy Use Approved by the Federal Environmental, Industrial and Nuclear Supervision Service

According to the Federal Act on the "Use of Atomic Energy" and RF Government Ordinance of 1 December 1997 No. 1511, the Federal Environmental, Industrial and Nuclear Supervision Service organizes the development, approves and puts into force the federal standards and regulations that define the requirements in the area of nuclear and radiation safety (except sanitary-hygienic rules) as well as requirements to the state accounting and control of nuclear materials, radioactive substances and radioactive waste. Besides, the federal standards and regulations regulate the procedures for investigating and reporting operational events at nuclear installations and set the order of early notification of different levels of authorities, of governing bodies and of other concerned agencies on the nuclear operational events that occurred.

In the period since the presentation of the third National Report the Federal Environmental, Industrial and Nuclear Supervision Service both independently and with involvement of other federal bodies of executive power and competent organizations has approved a number of new federal standards and regulations and revised some existing federal standards and regulations to assure conformance of the introduced regulatory requirements to the achieved level of science and technology with due

account of domestic and foreign experience in the area of atomic energy use.

The list of new federal standards and regulations as well as the list of federal standards and rules that sustained changes after the submittal of the third Russian Federation's National Report is given in Appendix 5.

7.4. Guidance Documents and Safety Guides Approved by the Federal Environmental, Industrial and Nuclear Supervision Service

To realize its safety regulation functions, according to the RF Government Ordinance of 30 July 2004 No. 401, the Federal Environmental, Industrial and Nuclear Supervision Service issues the regulatory legal deeds in the established area of activity except the issues, whose legal regulation is performed exclusively by the federal constitutional laws, federal acts, regulatory legal deeds of the President of the Russian Federation and of the Russian Federation Government.

One of the types of legal deeds published by the above Federal Service are the guiding documents, which define the requirements to the structure of the documents needed to justify the assurance of nuclear and radiation safety of nuclear installations as well as requirements to the content of these documents, the order of performing verifications of the validity of information contained in the documents submitted to obtain a license as well as to the order of performing the peer review.

The Federal Service's guiding documents also include those, which regulate the order of performing state supervision over nuclear and radiation safety.

Another kind of documents being developed and approved by the Federal Environmental, Industrial and Nuclear Supervision Service are the safety guides, which describe the acceptable for the Regulator techniques and methods of compliance with the requirements of the federal standards and regulations.

The list of guidance documents and safety guides developed and enacted by the Federal Environmental, Industrial and Nuclear Supervision Service in the period after the submittal of the third RF National Report is given in Appendix 6.

Among the safety guides issued during the above period one should mention the "Recommendations on the Content of the In-depth Safety Assessment Report for Operating Nuclear Units (OUOB AS)" RB-001-05. This document was issued to replace the earlier existing RB G-12-42-97 document entitled: "Recommendations for In-depth Safety Assessment of the Operating Nuclear Plants with WWER and RBMK Reactors (OUOB AS)". The abolished RB G-12-42-97 document covered the first generation

NPPs (Novovoronezh NPP Units 3, 4, Kola NPP Units 1, 2, Kursk NPP Units 1, 2 and Leningrad NPP Units 1-4). The new RB-001-05 document's recommendations cover all the operating nuclear units.

The newly issued safety guides (RB-027-04, RB-029-04, RB-030-04) address different safety aspects when extending nuclear unit lifetime.

The RB-032-04 guide contains basic requirements for performing probabilistic safety assessment (PSA) while the RB-028-04 guide describes the risk-informed methodology for ranking deviations from the requirements of regulatory documents in terms of safety impact.

Thus, the Russian Federation has an effective legislative and regulatory framework, which regulates the issues related to nuclear installations' safety regulation and assurance. Its evolutionary changes are aimed at improving the existing standards and further expanding the nuclear power sector.

Article 8. Regulatory Body

8.1. Authorities and Duties of the Regulatory Body

The RF Government Ordinance of 30 July 2004 No. 401 established the Federal Environmental, Industrial and Nuclear Supervision Service as a Regulatory Body in accordance with the Convention on Nuclear Safety. The Ordinance also endorsed the "Manual on Federal Environmental, Industrial and Nuclear Supervision Service", which assigns the following functions to the above Federal Service:

- bring in to the Russian Federation Government draft federal acts, draft legal deeds of the Russian Federation President and Russian Federation Government, and other documents subject to endorsement by the Russian Federation Government;
- acting upon the Russian Federation Constitution, federal constitutional laws, federal acts, the Russian Federation President and the Russian Federation Government deeds, establish on its own the following types of regulatory documents in its area of activity:

- federal standards and regulations in the area of atomic energy use;
- procedure for granting work licences in the field of atomic energy to nuclear facility staff, taking guidance in the list of job positions endorsed by the Russian Federation Government;
- requirements for the structure and contents of documents related to the safety of nuclear installations and/or activities performed in the field of atomic energy and essential for licensing the activities in this field; and review procedure for these documents;
- procedure for organization and implementation of supervision over the state system of nuclear materials accounting and control;
- regulations on other aspects of its area of activity, except for the issues which, according to the Russian Federation Constitution and federal constitutional acts, the Russian Federation President and Russian Federation Government acts, are regulated by federal constitutional acts, federal laws and legal deeds issued by the Russian Federation President and Government;

- oversee and supervise:

- adherence to standards and regulations in the area of atomic energy; fulfilment of nuclear licence terms;
- nuclear, radiation, industrial and fire safety (at nuclear facilities);
- physical protection of nuclear installations, radioactive sources, storage facilities for nuclear and radioactive materials; consolidated state

systems for accounting and control of nuclear and radioactive materials and radioactive waste;

- fulfilment of international commitments of the Russian Federation in the area of safe uses of atomic energy;
- timely return of spent fuel assemblies of nuclear reactors and relevant reprocessing products to supplier country (within the Federal Service authorities);

- license activities in the field of atomic energy, in compliance with the Russian Federation legislation;
- grant work licences to nuclear facility staff;
- check (by performing inspection) adherence of juridical and physical entities to requirements of the Russian Federation legislation, legal acts, rules and regulations in the field of atomic energy;
- approve qualification reference books for managers and experts (employees), which describe requirements for the qualification of personnel seeking licences in the field of atomic energy;
- organize and ensure operation of a system of nuclear facilities oversight in case of emergencies (emergency response);
- being part to a unified national system for prevention and mitigation of emergencies, direct activities of the functional subsystems overseeing facilities presenting a nuclear and radiation hazard;
- take lawful constraining and preventive measures to preclude and/or suppress violation, by legal entities and citizens, of mandatory requirements in the regulated area; take measures to mitigate consequences of such violations.

Making the Federal Service directly subordinate to the Russian Federation Government, and the legislative establishment (Article 25 of the Federal Act No. 170-FZ on the "Use of Atomic Energy") of the Service's authorities allow to guarantee that the Russian Regulatory Body will not be entrusted with responsibilities, which could jeopardise or contradict its safety regulation commitments.

In accordance with the existing norms of law, the decisions and actions of the Federal Service's managers and officials (in particular, taken in the frame of the licensing procedure, administrative law enforcement etc.) can be appealed, also in court. Such a procedure is envisaged in the "Manual for the Licensing of Activities in the Area of Atomic Energy Use" (item 43) approved by the RF Government Ordinance of 14 July 1997 No.

865, in the Russian Federation Code of Administrative Violations and in other regulatory deeds.

General rules for the organization of Federal Service activities are described in the "Manual on the Federal Environmental, Industrial and Nuclear Supervision Service" endorsed by the Chairman of the Federal Service in his order of 24 July 2006 No. 724.

The above Manual, which has been issued in accordance with the Russian Federation Government Ordinance of 19 January 2005 No. 30 "Standard Rules for Interaction of Federal Authorities" regulate the following:

- approval procedure for the organization and staff list of the Federal Service and its regional offices;
- powers of the Chairman and Deputy Chairmen of the Federal Service; rules of dividing powers between Deputy Chairmen;
- powers of heads of Federal Service departments;
- procedure for the Federal Service development of administrative rules for implementing public functions and rendering public services;
- process for planning and setting targets for Federal Service activities;
- process of Federal Service participation in the preparation of documents used to develop a long-term financial plan of the Russian Federation and a draft federal act on a next-year federal budget;
- procedure for Federal Service participation in the planning of the Russian Federation Government meetings; procedure for preparation of the Russian Federation Government meetings;
- order of planning activities of the Federal Service management, of going on business trips and vacations;
- functioning of the Federal Service Management Board ("Collegium"), coordinating and advisory bodies, task groups;
- basic rules for arranging documentation management in the Federal Service;
- procedure for preparation and execution of Federal Service decisions;
- order of implementing Federal Service directives;
- procedure for Federal Service preparation and review of draft acts to be submitted to the Russian Federation Government;
- procedure for planning law drafting activities of the Federal Service; procedure of Federal Service involvement in the law drafting activities of the Russian Federation Government;
- order of interface with judicial bodies;
- order for evaluation of incoming requests;
- procedure for providing access to information about Federal Service activities.

The Federal Environmental, Industrial and Nuclear Supervision Service performs its activities using a quality assurance system that meets the requirements of the "Quality Assurance Manual...".

8.2. Regulatory Body Structure

The functions assigned to the Federal Environmental, Industrial and Nuclear Supervision Service are implemented by the headquarters (central office) and by the regional offices set up by the central office following an established procedure (in particular, by cross-regional offices overseeing nuclear and radiation safety). The organizational chart of the central and regional offices of the Federal Service (showing the number of staff) is given in Figure 8.1.

Figure 8.2 shows central office departments supervising nuclear and radiation safety and cross-regional offices overseeing nuclear and radiation safety (including the on-site inspection offices overseeing nuclear and radiation safety at the plants).

Two technical support organizations are under the Federal Service. These are the federal state institution "Scientific and Engineering Centre for Nuclear and Radiation Safety" (SEC NRS) and federal state unitary enterprise VO "Safety".

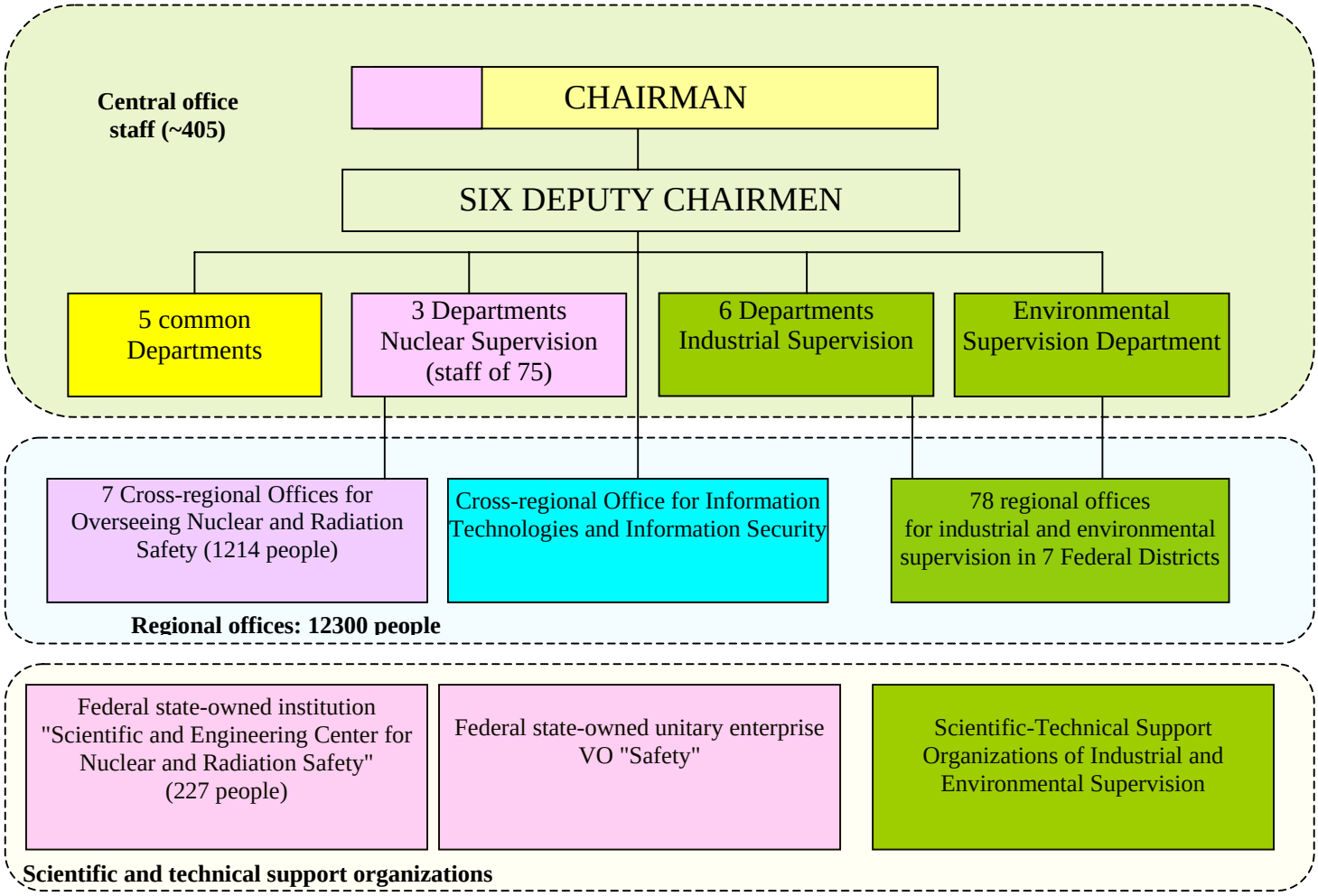


Figure 8.1 - Organizational Chart of the Federal Environmental, Industrial and Nuclear Supervision Service

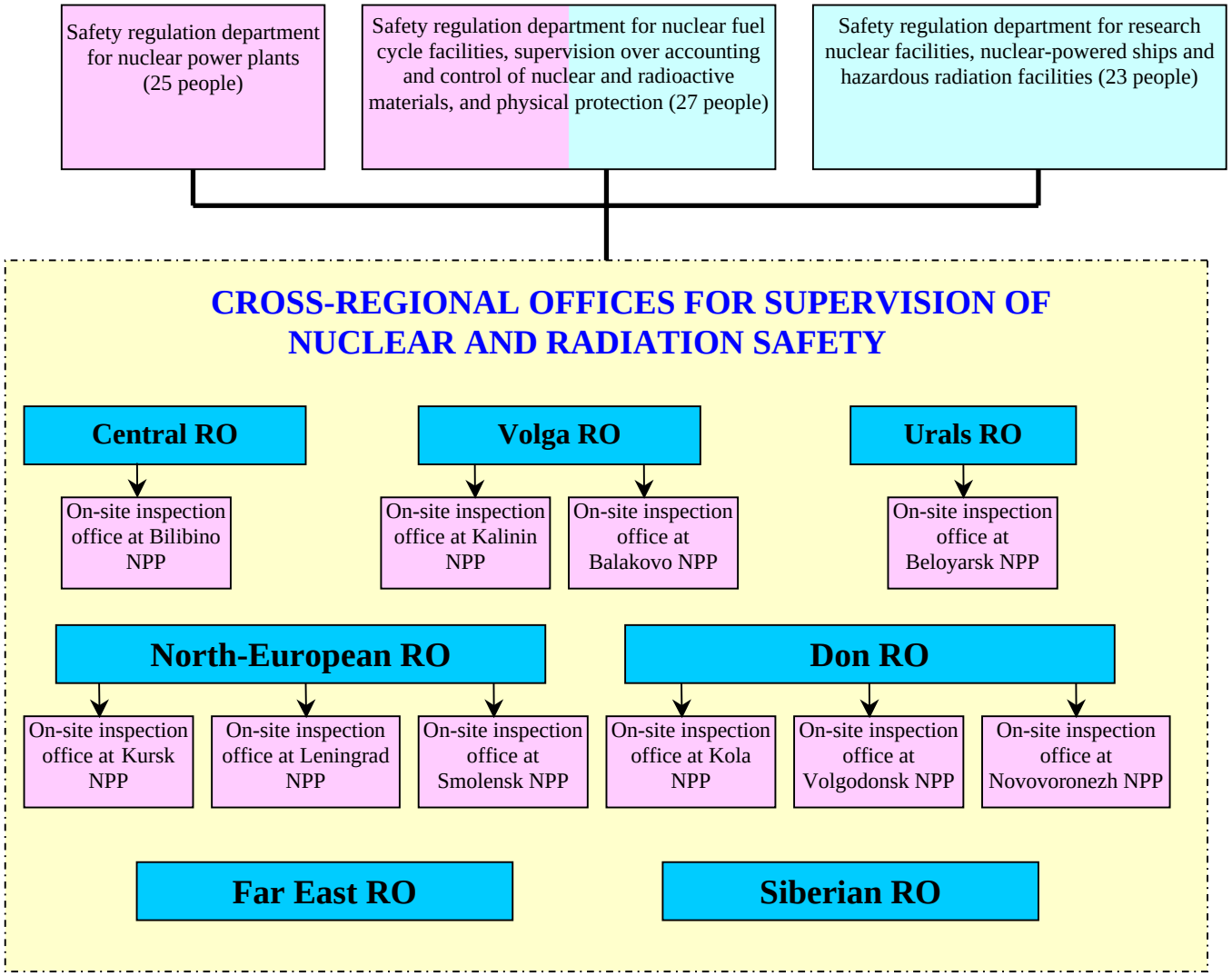


Figure 8.2 - Divisions of the Federal Environmental, Industrial and Nuclear Supervision Service Regulating Nuclear and Radiation Safety

Federal Service's central headquarters, cross-regional offices for supervision over nuclear and radiation safety are staffed with personnel of needed qualifications, requirements to which are set out in the Federal Act of 27 July 2004 No. 79-FZ on the "State Public Service", in the Russian Federation President's Decree of 27 September 2005 No. 1131 and in other regulatory deeds. Retraining of Federal Service's employees is performed on a planned basis in the frame of existing proficiency improvement system, which includes:

- information and software tools ensuring trainees' access to the consolidated information & educational environment;
- additional professional training programs, proficiency improvement courses;
- educational institutions ensuring the needed content and quality of additional professional training of state employees;

- structural divisions of Rostechnadzor, which perform retraining system management.

The data on actual numbers of staff of the Federal Service's cross-regional offices for nuclear and radiation safety supervision in 2006 is given in Appendix 7.

The information about the funding of the Federal Environmental, Industrial and Nuclear Supervision Service from the federal budget of the Russian Federation, as regards nuclear regulation, in 2005-2007 is given in Appendix 8. Trends in the Federal Service funding from the federal budget in 2005-2007 are shown in Figure 8.3.

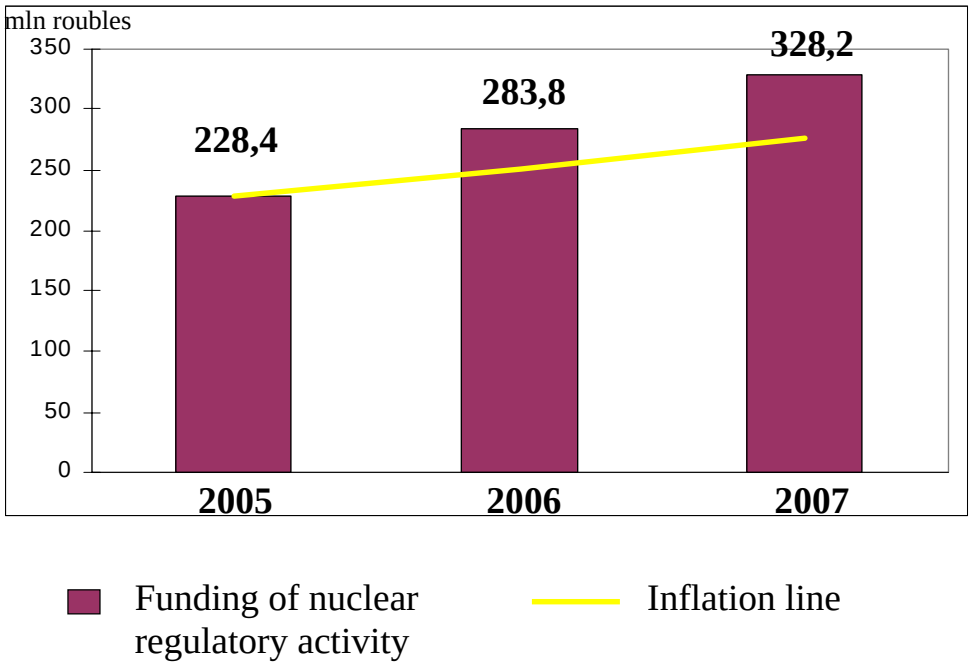


Figure 8.3 - The Federal Budget Funding of the Federal Environmental, Industrial and Nuclear Supervision Service in 2005-2007

8.3. Organization of Technical Review of Safety Documentation for Nuclear Installations

To prepare NPP safety reviews the Federal Environmental, Industrial and Nuclear Supervision Service invites two expert organizations - Scientific and Engineering Centre for Nuclear and Radiation Safety (SEC NRS) and VO "Safety".

In 2006 SEC NRS performed 119 reviews related to nuclear plants.

As of 01.07.2007, the number of SEC NRS employees engaged in the organization and conduct of nuclear unit safety reviews and in the reviews of activities in the course of nuclear unit operation was 64 people (including 9 managers, 48 specialists and 7 technical staff members).

Experts from other organizations also take part in the reviews organized by SEC NRS. They are invited on individual contractual basis (about 250 people).

The scope of funding of SEC NRS-performed safety reviews of nuclear units operation is as follows:

- in 2005: 66.4 mln roubles (0.4 mln roubles coming from the federal budget and 66.0 mln roubles - extra-budgetary funds (contracts);
- in 2006: 74.0 mln roubles (0.3 mln roubles coming from the federal budget and 73.7 mln roubles - extra-budgetary funds (contracts).

Starting from 2007, nuclear unit safety review activities in SEC NRS are being funded from the federal budget (in the amount of ~80 mln roubles annually). This contributes to the strengthening of independence of the Regulatory Body and of its technical support organizations from license holders.

As of 01.07.2007, the actual number of VO "Safety" employees involved in issues related to NPP safety was 37 people.

VO "Safety" invites experts to review the materials on a contractual basis (174 experts were invited in 2005 and 181 in 2006).

The scope of work connected with NPP safety reviews was 28.4 mln roubles in 2005 and 32.5 mln roubles in 2006 coming from extra-budgetary funds (contracts and international activity).

8.4. Technical Support Organizations for the Regulatory Body

The federal state-owned institution "Scientific and Engineering Centre for Nuclear and Radiation Safety" (SEC NRS) and federal state-owned unitary enterprise VO "Safety" provide technical support to the Federal Environmental, Industrial and Nuclear Supervision Service in the area of nuclear and radiation safety.

SEC NRS whose organizational chart is shown in Figure 8.4, provides scientific and technical support to the national nuclear safety regulator in the following areas:

- development of regulatory legal documents in the area of atomic energy (including technical specifications);
- development and revision of technical regulations in the area of atomic energy;
- organization and performance of safety reviews in the area of atomic energy;
- scientific studies to justify nuclear and radiation safety principles and criteria;
- organization of and actual certification of software;
- current activities requested by the central office of the Federal Service.

In 2005-2006 SEC NRS issued 143 scientific and technical reports on various scientific and technical products, such as regulatory documents' revisions, statements of work ("technical assignments") for the development of regulatory documents and reports on research work. In this period SEC NRS prepared 25 new draft federal standards and regulations, two revisions of existing federal standards and regulations, 6 new safety guides subject for endorsement by the Federal Environmental, Industrial and Nuclear Supervision Service as well as two versions of the annually updated list of regulations used by the Federal Environmental, Industrial and Nuclear Supervision Service for safety regulation.

Also, SEC NRS has been reviewing draft documents of the IAEA. In 2005 the Centre reviewed 31 draft IAEA safety standards, made comments and remarks and sent them to the authors. Experts of the Federal Environmental, Industrial and Nuclear Supervision Service including SEC NRS staff, took part in the activities of the IAEA Safety Standards Commission and Radiation Safety Standards Committee.

SEC NRS collaborates with the West-European Nuclear Regulators Association (WENRA) on harmonisation of safety requirements for nuclear plants. By today, SEC NRS has produced reports for the Federal Environmental, Industrial and Nuclear Supervision Service with a detailed description and analysis of a methodology for harmonising safety requirements for nuclear power reactors in WENRA countries; discussion of the findings of a pilot study carried out by the Working group on harmonisation of safety requirements for WENRA reactors; description of a suggested methodology for harmonising safety requirements for Russian nuclear plants developed on the basis of the WENRA methodology; proposals for further work on harmonisation of safety requirements for Russian nuclear plants.

SEC NRS has developed for the Federal Environmental, Industrial and Nuclear Supervision Service and has been maintaining a full-text electronic data base on nuclear regulatory documents currently in force in the Russian Federation.

On request from the Federal Environmental, Industrial and Nuclear Supervision Service, SEC NRS studies operational events at NPPs and annual assessment reports on the operational safety of the plants submitted to the Regulatory Body by the Operating Organization. The Centre maintains an electronic data base on operational events at the plants (ISI-Nadzor), which is used by the Federal Service in its regulatory activity.

SEC NRS has a Software Certification Council, which incorporates several sections. Both SEC NRS staff, prominent scientists from Russian research, Academy of Science and educational institutions, and experts from the front-edge nuclear companies participate in the Council's activities. As of December 2006, there existed valid certificates for 178

software products in various areas (neutronics, thermal hydraulics, strength analysis, radiation safety, PSA, etc.). Of these, 34 computer codes were certified in 2005-2006. According to the federal standards and regulations, certification procedure is mandatory for the software used to perform safety analysis of the plants.

In SEC NRS the quality management system for research efforts, development of regulatory documents, safety justification documents review has been certified within ISO 9001 system.

VO "Safety" assists the Federal Environmental, Industrial and Nuclear Supervision Service in the following areas:

– reviews carried out for the licensing of the upgrades undertaken at Russian NPPs;

– supervision over accounting, control and physical protection of nuclear materials; training of inspectors and development of regulations in this area;

– development of a methodology for licensing enterprises processing weapons-grade plutonium and producing MOX fuel;

– certification of safety-related components supplied to Russian nuclear plants.

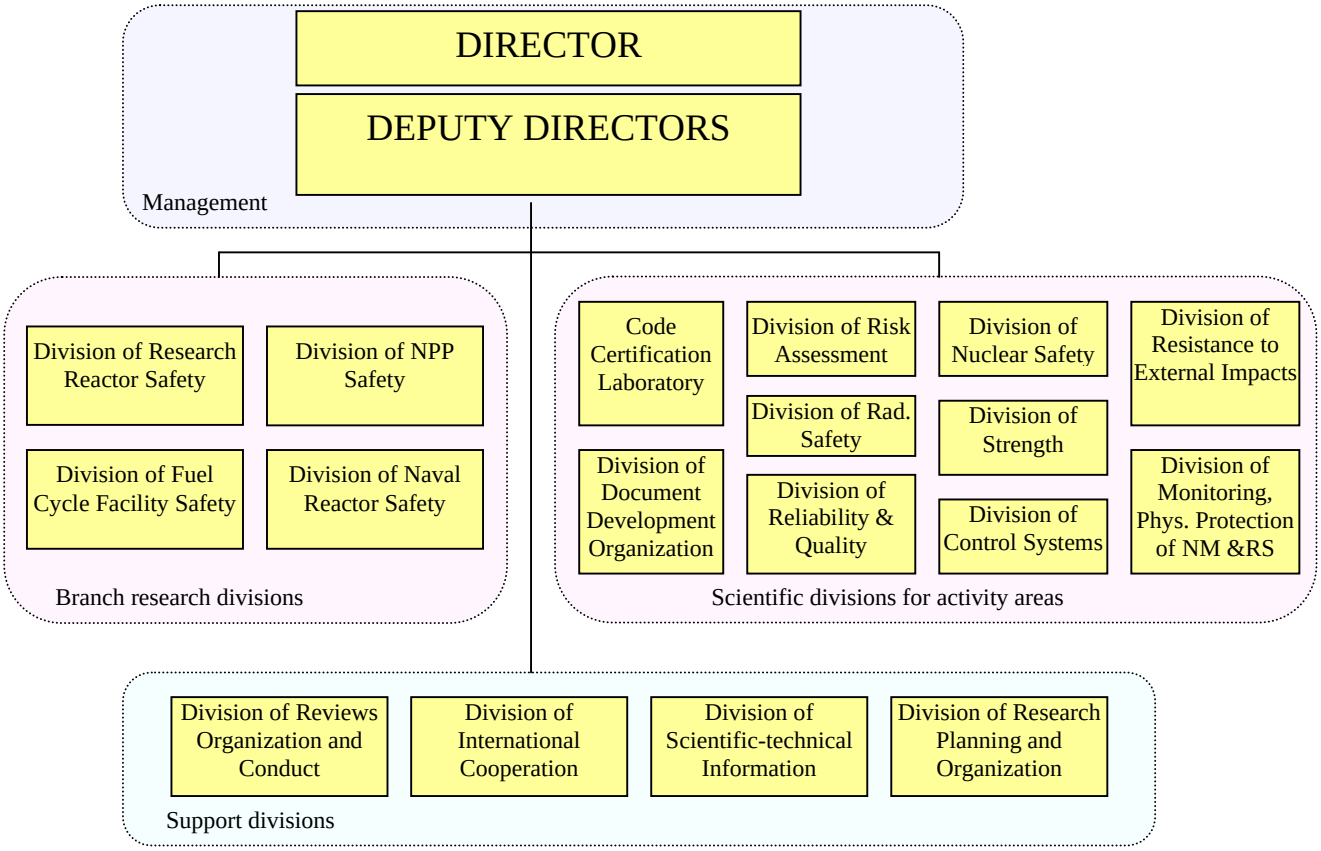


Figure 8.4 - Organizational Chart of the Scientific and Engineering Centre for Nuclear and Radiation Safety

In conclusion, it should be pointed out that the Russian Federation has an independent Regulatory Body – the Federal Environmental, Industrial and Nuclear Supervision Service, which is directly subordinate and reports to the RF Government.

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 the License Holder

In accordance with Article 26 of the Federal Act on the "Use of Atomic Energy", any kind of activity in the area of atomic energy use which is to be licensed by the state safety regulation bodies is allowed only if permission (license) for this activity is available.

The Federal Act on the "Use of Atomic Energy" sets out that the overall responsibility for the safety of a nuclear installation as well as for the proper management of nuclear materials and radioactive substances rests with the Operating Organization, i.e. license holder.

Article 34 of the Federal Act on the "Use of Atomic Energy" defines the role of the Operating Organization. The Operating Organization is established in accordance with the Russian Federation legislation and is acknowledged as the appropriate body, which manages atomic energy use and is suitable for the operation of a nuclear installation, radiation source or storage facility and capable of performing by itself or with involvement of other organizations the following activities: siting, design, construction, operation and decommissioning of nuclear installations as well as management of nuclear materials and radioactive substances. To perform the above kinds of activities the Operating Organization must have permissions (licenses) issued by the appropriate state safety regulation authorities for the conduct of works in the area of atomic energy use. The Operating Organization is provided with authorities, financial, material and other resources sufficient for performing its functions. Interference in the activity of the Operating Organization as regards the operation of nuclear installation, radiation source or storage facility, except cases envisaged by this federal act, by other laws and legal acts of the Russian Federation, is not allowed.

According to Article 37 of the Federal Act on the "Use of Atomic Energy", all the organizations performing research and studies, design, construction and decommissioning of nuclear installations, radiation sources or storage facilities, design and manufacture of components for them, conduct of other works or rendering other services in the area of atomic energy use, must perform the work and give services in such a scope and of such a quality that will meet the nuclear standards and regulations. They are responsible for the quality of work performed and services rendered throughout the design lifetime of a nuclear installation, radiation source, storage facility. On termination of activities of the organizations performing work and giving services in the area of atomic energy for the Operating Organization, the responsibility for all of these activities of these organizations is to be imposed on another organization acknowledged by the appropriate body managing atomic energy use.

All the provisions of legislative acts for defining the responsibility of organizations performing the prescribed kinds of activities in the area of atomic energy use, are accordingly reflected in their Charters.

In accordance with the approved order of the Federal Atomic Energy Agency of 24 April 2006 No. 182, the Charter of the Federal State Unitary Enterprise "Russian State Concern for the Production of Electrical and Thermal Energy at Nuclear Plants (Rosenergoatom Concern)" obliges Rosenergoatom to perform the functions of the nuclear plants Operating Organization in accordance with the Russian Federation legislation and the Charter.

Rosenergoatom Concern bears full responsibility for the safety of Russian NPPs and for the proper management of its nuclear materials and radioactive substances. This responsibility is not removed from the Operating Organization in connection with activities of other enterprises and organizations performing works or giving services to the Operator.

According to the Operating Organization's Charter, all existing nuclear plants are the subsidiaries of the Operator, and NPP managers (directors) are deputy general directors of Rosenergoatom, who perform management of production-technological and financial-economic activity of their subsidiaries (nuclear plants) and are responsible for nuclear plant safety, which is in accordance with the approved Subsidiary Manuals and labor contracts. Plant managers (directors) act within the authorities envisaged by the authority certificates issued by Rosenergoatom Director General.

The issues of license holder's interaction with the Regulatory Body on matters of responsibility for safety are reflected in the "Regulations for the Licensing of Activities in the Area of Atomic Energy Use" (in the revisions of RF Government Ordinances of 3 October 2002 No. 731 and of 1 February 2005 No. 49). This Regulation requires from the Regulator to maintain interaction with the applicant on matters of correcting deficiencies revealed in the course of review of the documents submitted to obtain the license.

While performing the functions and meeting the commitments set out in the Russian Federation legislation and in the Charter, the Operating Organization fulfils the requirements set by the Regulatory Body to implement the authorities given to the Regulator.

The Operating Organization must inform the Regulatory Body of Russia about all cases of violations of safe operation limits and conditions, transmit systematized data on all cases of NPP breach of normal operation as well as submit periodic reports on NPP safety status.

Operator's ability to be responsible for ensuring nuclear installations safety is verified by the Regulatory Body in the frame of the licensing procedure and also when conducting inspections and analyzing the

information presented by the applicant. Regulatory Body performs systematic verification of the fulfillment of the terms of the issued licenses.

Detailed description of the Operating Organization and of its tasks had also been presented in the previous National Reports of the Russian Federation.

Thus, in the Russian Federation the principle of the overall responsibility of the Operating Organization for NPP safety is established by the legislation, defined in the regulatory requirements and is an essential organizational principle of safety assurance.

Article 10. Priority to Safety

10.1. Safety Policy

In accordance with the basic principle of regulation in the area of atomic energy use - safety assurance - set out by the Federal Act on the "Use of Atomic Energy" Rosenergoatom Concern has adopted the "Policy Statement" in 2002. In this Statement the Operating Organization's senior management stresses that nuclear plant safety assurance at all stages of NPP life cycle is the priority task in the Operator's activity. It is further stressed that all individuals and organizations involved in NPP life cycle, at any stage, must be guided in their activities and relations by the safety culture principles.

10.2. Safety Culture and Assessment of its Effectiveness

Safety culture effectiveness is assessed in accordance with IAEA recommendations given in INSAG-4 (Safety Culture), in Report No. 11 of the Safety Series (Development of Safety Culture and Nuclear Safety) and INSAG-15 (Key Practical Issues in Strengthening Safety Culture), and recommendations stated in the Operating Organization's standard "Regulations on Annual Operational Safety Assessment Reports for Nuclear Plants" (ST EO 0143-2005), Section 3.6 Safety Culture Status.

Assessment of the safety culture effectiveness focuses on three areas:

– safety indicators of the plant;

– assessment of the fundamental causes of events or potential errors to learn lessons;

– overall personnel commitment to safety enhancement including the high-level management of this process.

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

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

Safety culture is evaluated against the safety culture indicators identified in the "Manual on the Safety Culture Evaluation Day in Rosenergoatom Concern" put into force by Rosenergoatom Order of 10.12.2004 No. 117.

Safety culture status evaluation helped identify areas for improving safe and reliable operation of the plants, in particular:

- improvement of operating and maintenance procedures;

- improvements in the training of operating and maintenance personnel;
- development of additional procedures and training aids to enhance personnel awareness of safety importance;
- broader use of internal and external NPP operating experience;
- improvement of guidelines addressing the self-assessment of the operational safety;
- introduction of new technologies and materials;
- introduction of symptom-based procedures.

Some plant activities are mentioned below to illustrate this point.

Volgodonsk NPP has been carrying on systematic training in the area of safety culture. Relevant topics have been included in the pre-job training programmes and in the competence maintaining programmes for operating, maintenance and administrative personnel.

Training programmes have been developed for three courses: "Safety Culture", "Team Management", "Psychological Aspects of Educational Interface".

Newly hired people were trained to a special course on safety culture.

Smolensk NPP has put into effect symptom-based emergency operating procedures and operator support procedures, and made health physics improvements which helped reduce the annual collective dose during the overhaul outage at Unit 2 in 2006.

Kola NPP has arranged a remote workstation for a physics engineer, which can be used to perform an on-line check of reactor parameters, search reactor parameters in the file and analyse operating conditions in the reactor by looking through the parameter history in the file of current values.

In 2006 manufacturer acceptance tests were performed on the SIP international cooperation programme to check a new advanced eddy-current testing system for steam generator heat exchanger tubes and an automatic plugging system for defective heat exchanger tubes (Tecnatom).

Rosenergoatom regularly selects the best-performing plants in the area of safety culture.

Safety culture effectiveness is analysed during preparation of an annual summary report on the safety of nuclear units, which discusses in particular the safety culture level and suggests the main areas for improvement.

Thus, the 2005 summary report on the operational safety status at Russian nuclear plants contains the findings of the analysis of key performance indicators (load factor, availability factor, fuel assembly failure rates, unavailability of control and protection systems, annual collective dose). The analysis has revealed an improvement trend in the key

plant performance indicators and a downtrend in the plant downtime caused by the events and failures in plant operation.

The study of the plant- and shop-level events helped identify indicators describing the dominating causes of the events and highlighted the areas of plant personnel activities that should be improved by developing additional safety enhancement measures.

The measures developed at the plants for safety culture enhancement are meant to improve plant performance indicators and eliminate the weaknesses revealed by the analysis of direct and root causes of operational events.

10.3. Role and Importance of the Regulatory Body

The Federal Environmental, Industrial and Nuclear Supervision Service, while performing the functions imposed by the Federal Act on the "Use of Atomic Energy", by other acts and by-laws (described in Section 8 of this Report), pursues state policy in the area of regulating nuclear installations safety as an independent state body.

The Regulatory Body has adopted the Policy Statement entitled: "State Regulation of Nuclear and Radiation Safety in the Territory of the Russian Federation". This Statement says that all activities of the state regulatory body are aimed at attaining major goal, which is: creation of conditions, where the protection of personnel, public and environment against unacceptable radiation impacts is guaranteed, prevention of uncontrolled proliferation and use of nuclear materials is ensured. To achieve this goal Regulatory Body:

- sets out safety criteria, standards and regulations in the area of atomic energy use;
- organizes the development of licensing procedures and the issuing of licenses (permits) for activities in the area of atomic energy use;
- develops and implements NPP inspection programs;
- takes sanctions in case of violations of nuclear and radiation safety requirements;
- supports and conducts independent research into nuclear and radiation safety;
- informs state authorities and the public on the changes in the status of nuclear and radiation safety.

Item 1.2.8 of the "General Guidelines for Assuring Nuclear Plant Safety" (OPB-88/97) approved by the Regulatory Body says that all individuals and organizations involved in NPP siting, construction, operation and decommissioning, in the design and manufacture of NPP components and systems, must acquire a safety culture. All the mentioned

persons must know the nature and extent of their impact on safety. They should be fully aware of the consequences that may result from non-compliance or poor compliance with existing procedures and regulatory documents.

The Regulatory Body of Russia contributes to resolving the tasks of consistent improvement of the safety of nuclear installations up to the world-acknowledged level by taking actions in the frame of existing package of legal documents in the area of atomic energy use and by simultaneous development and implementation of proposals aimed at improvement of the legislative and regulatory framework of the Russian Federation, of licensing and inspection procedures.

Hence, the existing Russian laws and regulatory requirements establish safety priority over all other issues related to nuclear installations as required by the Convention on Nuclear Safety, and this is confirmed by the practice of NPP operation.

Article 11. Financial and Human Resources

11.1. Financial Resources of the Operating Organization

Nuclear, radiation, fire and industrial safety assurance activities for nuclear plants are funded from dedicated funds covered by the prime cost of the services rendered by the Operating Organization, using the rates endorsed by the Federal Energy Commission of Russia (RF Government Ordinance of 7 December 1996 No. 1455 "Inclusion of NPP Safety Expenses in the Prime Cost of Utility Services").

The Operating Organization – Rosenergoatom Concern – accumulates the necessary resources to ensure safe operation of nuclear plants.

It should be mentioned that the Operator's resources have increased substantially in the last three years, which allowed expediting implementation of safety enhancement activities at the operating plants.

Thus, in 2006 the Operator spent:

- 2661 mln roubles for enhancement of nuclear, radiation, environmental, industrial and fire safety of its plants;
- 10335 mln roubles for upgrading and backfitting of the operating plants;
- 1053.105 mln roubles for NPP decommissioning programme;
- 145 mln roubles for personnel training and retraining.

In 2007 the Operating Organization plans to spend:

- 2866.3 mln roubles for enhancement of nuclear, radiation, environmental, industrial and fire safety of the plants;
- 15900 mln roubles for upgrading and backfitting of the operating plants;
- 1268.7 mln roubles for NPP decommissioning programme;
- 170 mln roubles for personnel training and retraining.

11.2. Human Resources of the Operating Organization

In accordance with Article 35 of the Federal Act on the "Use of Atomic Energy", the Operating Organization provides recruitment, training and retraining of nuclear plant personnel.

Personnel recruitment and training in nuclear power is based on regulations, in particular, on the document of the Federal Atomic Energy Agency "Organization of Personnel Management at Nuclear Plants" (attachment to Rosatom Order of 15 February 2006 No. 60).

This document establishes requirements for the following key areas in the management of plant personnel:

- personnel selection and hiring procedure;
- pre-job training;
- retraining to maintain competence (refresher training);

- vocational and advanced (skills improvement) training.

The document is applicable also to the staff of the organizations rendering design, engineering, maintenance, adjustment and testing services for nuclear plants.

As of 01.01.2007 all Russian nuclear plants and support organizations have been completely staffed with skilled personnel necessary for the operation, maintenance and repair of major and auxiliary equipment, implementation of the managerial, economic and other functions.

The average payroll staff of the plants and support organizations is 41514 people.

NPP staff is 40135, of which 36434 people are involved in electricity generation. The number and mix of NPP personnel involved in the generation is compliant with the existing regulatory documents.

As required by relevant regulations, each NPP has on its staff personnel possessing necessary professional skills and admitted for unaided work following an established procedure.

The list of job positions, requirements for personnel skills, procedure for selection, training and admission for unaided work were discussed in detail in the third RF National Report.

Personnel of nuclear plants and maintenance organizations is regularly trained in the plant Training Points and dedicated Training Centres, taking periodic training courses, having individual training and periodic drills using technical aids (simulators, imitators, mock-ups).

In 2006 the Russian nuclear power sector has trained:

- in the Training Centres: 4303 people (operating personnel, maintenance personnel, middle-level managerial staff, instructors);
- in the Training Points: more than 40039 employees.

In addition, 5900 people, including 5438 people from the plants and 462 people from Rosenergoatom headquarters were trained in external educational institutions.

In 2006, 239 plant managers, chief engineers, their deputies and managers of plant divisions were trained on refresher programmes to fulfil the terms of their work licences.

The educational system in the Russian Federation provides training of nuclear power engineers.

11.3. Training, Education and Refresher Training of Personnel

The discussion below covers the issues in a more detailed way than required by Article 11 of the Convention, though they have been

recommended in the "Synopsis of the Relevant IAEA Safety Requirements Reflecting the Issues Addressed by Articles 6 to 19 of the Convention on Nuclear Safety".

- A pre-job training should ensure that an employee possesses the required professional knowledge and skills and should be carried out in accordance with the dedicated pre-job training programmes.

Employees possessing the skills required by the regulations and having no medical and psycho-physiologic contra-indications for taking the particular job are admitted for pre-job training.

If an employee being hired for a job or transferred to another job at a plant has no appropriate professional training or if his/her qualification is below the prescribed level, plant administration may arrange an additional professional training (retraining).

A pre-job training is carried out based on the programmes, which describe:

- skill requirements for trainees (i.e. plant personnel);
- list of guidelines and directives used as a basis to develop the pre-job training programme;
- step-by-step training procedure (including initial examination);
- topical plans for various types of training, which define the scope and contents of each type of training, the training time for each course, section, topic; people responsible for the training;
- list of technical aids used in the training and approved for the training of NPP personnel in accordance with the process set by the Operating Organization;
- order of initial examination;
- time of employee acting as a standby on the job;
- procedure for admission to unaided work;
- evaluation of pre-job training.

- The qualification requirements for personnel, who must obtain a nuclear work licence, are set by the Operating Organization on agreement with the Regulatory Body.

Plant personnel admitted for and/or performing activities associated with the handling of equipment and facilities overseen by supervision and other authorities is trained as prescribed in the relevant standards and regulations.

Plant personnel is trained based on a group or individual pre-job training programme in plant Training Points and/or directly in plant divisions. The training includes:

- theoretical instruction;
- drills using technical aids (if required for the job);
- in-situ probation (if required for the job);
- initial examination;

- standby work on the job;
- obtaining a nuclear work licence in the Regulatory Body;
- admission for unaided work.

• Maintenance of personnel proficiency is a mandatory activity of the Operating Organization and of plant administration, aimed at maintaining the professional knowledge and skills essential for performance of the job functions.

Plant personnel competence is maintained with the help of the plant Training Points, plant divisions and educational institutions.

Annual training to maintain personnel competence takes the following forms:

- off-the-job training in educational institutions providing additional professional training, to refresh knowledge and maintain skills in performing work operations;
- on-the-job training in the plant Training Point and divisions;
- issue-specific, refresher and extra briefings;
- accident management, fire management and emergency response drills;
- simulator training of operating personnel including start-up/shutdown operations, before a planned start-up and shutdown;
- probation, in particular, in relevant organizations; participation in workshops;
- training and periodic qualification of plant personnel involved in the operation of facilities or performing activities overseen by the state supervision and other authorities, as required by the relevant rules approved by these authorities;
- self-study of issues related to the professional activity of an employee.

Plant personnel competence is maintained using the competence maintaining (refresher) programmes. The programmes are developed in compliance with the Operating Organization requirements.

• Topic plans of refresher programmes cover:

- study of sophisticated issues and issues vital for plant safety including process fundamentals, management of design-basis and beyond-design-basis accidents, safety culture principles;
- study of operating experience (including operational feedback and event reports; discussion of industrial accidents, process upsets, etc.);
- study of occupational safety and labour protection issues;
- drills to practice the most important skills (including first aiding, use of protective and fire-fighting means, actions in accidents and emergencies);
- study of modifications in the attended circuits and equipment, and changes to the existing operational documentation.

Refresher programmes cover the following:

- programme goals and duration;
- list of guidelines and directives used as a basis to develop the programme;
- forms of maintaining plant personnel proficiency;
- topic plans defining the scope and contents of each form of maintaining personnel competence; the time to cover each section of the topic plan; list of people responsible for the training;
- list of technical aids duly approved for being used as training tools following the procedure established by the Operating Organization;
- evaluation of the quality of the competence maintaining effort.

The following annual training scope has been prescribed for the refresher programmes:

- Main Control Room personnel: at least 80 hrs including 36 hrs of simulator drills;
- other categories of NPP personnel: no less than 20 hrs.

Examination frequency has been set as follows:

- managers and specialists belonging to operating personnel: once every two years;
- workers belonging to operating personnel: once every two years;
- other categories of plant personnel: once every three years.

Frequency of examining the plant personnel allowed to handle radiation sources, for knowing relevant radiation safety rules and standards:

- managers and specialists belonging to operating personnel, and workers belonging to operating personnel: once a year;
- other plant managers and specialists: once every three years.

- Refresher training programmes developed by plant administration are endorsed by:

- Chief Engineer or plant Deputy Manager/Chief Engineer, for managers and specialists;
- division manager or deputy division manager, for workers.

The Operating Organization has the necessary financial resources to enable training and retraining of NPP personnel. All nuclear plants are staffed with skilled personnel.

Maintenance of NPP personnel skills is carried out using modern technical training tools including full-scope simulators and plant analysers.

Article 12. Human Factor

12.1. Ways to Prevent Human Errors

A continued effort is made to prevent operating personnel errors to ensure safe operation of the plants. The ways and techniques of this work depend on several factors, such as review of the human errors made in the course of professional activities, man-machine interface, and the status of the operational feedback system.

To raise the quality of detection and analysis of the causes of events occurring in NPP operation and develop adequate corrective actions, the Operating Organization developed and put in force on 01.04.2005 "Methodological Guidelines for Analysing the Causes of Operational Events at Nuclear Plants, Fires, Industrial Accidents and Damage to Buildings and Structures" (RD EO 0095-2004). The Guidelines that were developed taking into account ASSET methodology (IAEA-TECDOC-632) and methodology of the Institute of Nuclear Power Operations (INPO), USA (INPO 90-004) recommend to use the following techniques for the analysis:

- adapted ASSET methodology (IAEA);
- Task Analysis (INPO);
- Change Analysis (INPO);
- Barrier Analysis (INPO);
- Event and Causal Factor Chart (INPO);
- Fault Tree Analysis (INPO);
- Psychological Analysis of the Causes of Erroneous Actions of Personnel (developed in Russia).

The methodology developed for investigation and analysis of the causes of nuclear plant events is meant, in particular, to help establish a working atmosphere that requires:

- responsible attitude of personnel towards dealing with the problems that may affect normal operation of the plant and compromise the reliable performance of plant systems and components;
- voluntary reporting of operational weaknesses and errors;
- detection of changes in personnel behaviour that may cause similar abnormal events;
- personnel training in using the cause analysis methodology for investigation of abnormal events, to ensure that the entire sequence is properly described and detected, with identification of the safety significance of the event;
- procedures describing personnel actions and responsibilities in the course of plant operation.

NPP operational events caused by human errors are investigated by a commission, which always includes a psychologist(s).

During event investigation, the psychologist analyses the causes of erroneous actions of personnel from the viewpoint of psychology. This helps identify the causes that led to human error and the factors (organizational, psychological) that had 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 (MCR), Central Control Room, other control rooms and desks at the plant have been investigated from the human factor perspective. The findings were used to make recommendations to improve the MCR mimic panels, enhance lighting, improve ventilation and the general arrangement of the above work places.

Each plant has an operating experience feedback system in place. All significant upsets in the operation of the plant systems and components are investigated by a commission. 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 actions meant in particular to prevent the recurrence of such events.

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

Rosenergoatom has set up and is maintaining an industry-level Information and Analysis System on the Operating Experience of the Nuclear Power Plants, to ensure effective use of NPP operating experience feedback.

The system collects, processes, stores, assesses and disseminates information on NPP operation in Russia and in other countries. The information serves to analyse 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 assistance to operators making critical decisions including lectures, drills and role playing on relevant topics;

- analysis of the operating experience of Russian and other plants using the information received from various sources;
- mandatory sessions with the operating personnel to discuss the abnormal performance of plant systems and components.

Implementation of the above arrangements helps ensure and maintain the required knowledge and skills of operations personnel.

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

The work on prevention, detection and correction of human errors is carried out on the basis of relevant administrative, managerial and organizational decisions. The effort is meant to organize and implement personnel training and competence maintaining activities; update and develop, considering operational feedback, the missing operational documentation describing professional activities of personnel providing operation and maintenance of systems and components.

Of particular importance are emergency preparedness exercises with the participation of personnel of the main plant shops and with involvement of psychologists. The purpose of the exercises is to give personnel a chance to practice self-control techniques, have the experience of working in a team and learn how to avoid erroneous actions.

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

The Federal Environmental, Industrial and Nuclear Supervision Service pays great attention to supervising the effort to account for the impact of qualification, organizational and ergonomic causes of personnel errors on NPP safety assurance.

In accordance with Article 23 of the Federal Act 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 permissions (licences) of the Federal Environmental, Industrial and Nuclear Supervision Service.

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

One of the mandatory conditions for getting a licence 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.

"The Regulations on Issuing Licenses of the Russian Nuclear and Radiation Safety Regulatory Authority for Conduct of Work in the Area of Atomic Energy Use by Nuclear Plant Employees" (RD-04-29-99) has been in force since 2001. According to this document, personnel licensing procedure consists of the following steps:

- the Operating Organization applies to the Federal Environmental, Industrial and Nuclear Supervision Service to give a licence to a candidate licensee;
- the Federal Service reviews the application documentation;
- an ad-hoc commission checks (examines) the candidate knowledge and skills;
- the Federal Service makes a decision to grant or not to grant the licence;
- the licence is given.

Introduction of personnel licensing system enabled a proper quality control of NPP personnel knowledge.

Supervision over personnel proficiency is regulated by the "Guidelines for Arranging Supervision over the Provision of Competence of Operating Personnel of the Nuclear Plants and the Staff Overseeing Nuclear and Radiation Safety of the Nuclear Plants" (RD-04-28-97).

The Guidelines establish the rules and requirements for arranging supervision over the provision of appropriate competence of the plant management, the staff overseeing the nuclear and radiation safety of the plants, personnel managing the production process at the plant, and the staff involved in the physical protection, accounting and control of nuclear and radioactive materials in the course of plant operation.

The regulatory activity incorporates the review of the outcome of the safety activities of plant personnel. The key information sources for this effort are event investigation reports and annual operational safety assessment reports of the plants. The Regulatory Body is maintaining a data base on plant events.

The findings of the above reviews are presented in the annual reports containing human error statistics, information about the managerial weaknesses; description of poor safety culture examples; analysis of the direct and root causes of errors and weaknesses; overview of the corrective actions developed to prevent human error recurrence; trends in human error indicators; proposals for improving competence of the managerial, operations and maintenance personnel.

Regulatory activity includes on-site inspections to check the process of providing plant personnel proficiency (including checks of personnel training in the plant Training Points, Training Centres, and on simulators),

and checks on the fulfilment of the terms of the licences given to plant personnel.

The results of the effort made by the Federal Environmental, Industrial and Nuclear Supervision Service to address human factor in the regulatory activities, have been reported at the meetings of various IAEA working groups in the framework of international exchange of experience.

Analysis of indicators of plant personnel performance in recent years shows that the number of the cases pointing to deficiencies in personnel training tends to decrease. For example, in 2005-2006 NPP personnel made annually, on average, 7-9 errors mentioned in the event investigation reports while in 2000 the number of such errors was 19.

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

Quality assurance (QA) is of prime importance in Russia in all stages of nuclear installation development, construction and operation.

The QA requirements for nuclear plants were reflected in major regulatory documents in force in Russia.

The national QA policy, QA programmes for the operating plants, plants under construction and support organizations were described in detail in the second RF National Report.

The QA management system operates in compliance with the QA administration structure described in the "QA Programme for Plant Operation" – POKAS(E).

POKAS(E) consists of a set of documents describing a combination of organizational, engineering and other QA actions aimed at the implementation of safety principles established in relevant regulations and at achievement of required operation quality indicators.

Planning and actual evaluation of achievements is undertaken at all levels of the QA management system.

POKAS(E) programmes were revised in 2004-2006 at all NPPs considering the new nuclear regulations.

Rosenergoatom has performed internal and external audits at each plant to evaluate POKAS(E) effectiveness, in order to support the functioning of the "QA Programme for NPP Operation" and assess its efficiency. Corrective actions were developed based on the audit findings; they have become a part of the operational practice and are under continued control of the Operating Organization.

To further develop the QA systems at the plants, Rosenergoatom developed in 2002 in accordance with the current requirements for such systems an "Action Plan for Obtaining Certificates of Compliance with GOST RISO 9000-2001 and GOST RISO 14001-98 Requirements".

The Plan prescribes the following organizational actions for all Rosenergoatom plants and enterprises:

- develop work plans for preparation for certification and certification of the QA management and environmental surveillance systems;
- organize activities to standardise the work processes as prescribed by the current in-house standards;
- develop a QA and certification training programme for personnel of Rosenergoatom nuclear plants, enterprises and central office;
- improve organization of Rosenergoatom central office and subsidiaries to improve the QA management system;
- arrange regular workshops to exchange experience on the QA management and certification of relevant systems.

Balakovo NPP was the first Russian nuclear plant to get in 2005 a certificate of QA management system compliance with GOST RISO 9001-2001 and nuclear regulations.

Balakovo plant experience in the preparation for certification is being extended to other plants.

All-Russian Research Institute for Nuclear Power Plant Operation (VNIIAES) received in 2005 a certificate of compliance with ISO 9001:2000 standard in the area of scientific and technical products, engineering and consultant services.

The Federal Environmental, Industrial and Nuclear Supervision Service pays utmost attention to quality assurance in all stages of NPP design, construction and operation. The Russian Federation has in force "Requirements for the Quality Assurance Programme of Nuclear Plants" (NP-011-99), which regulate plant activities covered by quality assurance; types of the QA programmes; requirements for the development and updating of the QA programmes. Safety authority looks at the plant QA programme when making a decision to grant (or not grant) a license for NPP operation and for other activities in the area of atomic energy. To revise the programme, a licensee shall submit an application to the Federal Environmental, Industrial and Nuclear Supervision Service asking to change the terms of the existing licence. The Federal Environmental, Industrial and Nuclear Supervision Service performs audits and inspections to confirm that the plant is operated with adherence to the QA programme.

Hence, Russia attaches prime importance to the assurance of high quality in all stages of nuclear installation design, construction and operation.

Article 14. Assessment and Review of Safety

It has become a practice in Russia to perform systematic safety assessments and reviews in the process of plant life, as stipulated in the Convention on Nuclear Safety.

Safety assessments and reviews are performed by:

- the Operating Organization, with involvement of research, design and architect-engineering organizations – NSSS and reactor installation designers, and other independent organizations;
- the Regulatory Body, with involvement of independent scientific-technical support organizations and high-skilled experts.

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

14.1. Safety Assessment by the Regulatory Body during Licensing

According to the current law, the Operating Organization shall obtain licences for siting, construction, operation and decommissioning of a nuclear plant.

To obtain a licence for a certain kind of activity, the Operating Organization (applicant) submits documents demonstrating nuclear and radiation safety of the plant. The list of the safety documentation has been defined in RD-04-03-2006 "Requirements to the Structure and Content of the Documents which Justify Nuclear and Radiation Safety of a Nuclear Installation, Radiation Source, Nuclear Materials Storage Facility, Radioactive Waste Storage and/or Declared Activity (for Nuclear Plants)". Documentation submitted by an applicant is checked for completeness and then thoroughly reviewed. Based on the findings of the review, the Federal Environmental, Industrial and Nuclear Supervision Service makes a decision to grant or not grant the licence. The licence is granted to the plant Operator only if the conclusions of the plant safety review are positive. The Federal Service defines the licence terms and conditions which become an integral part of the licence.

The Federal Environmental, Industrial and Nuclear Supervision Service is currently exploring the possibility of introducing the risk-informed approach in the regulatory practice. In 2004 the Federal Service issued a safety guide "Review of Plant Non-compliances with Existing Regulations" (RB-028-04), which describes a risk-based methodology for

non-compliance ranking in terms of safety implication. SEC NRS issued in 2006 the draft methodological document "General Principles of Using Probabilistic Safety Analysis to Make Regulatory Decisions with Regard to the Operating Nuclear Plants" (DNP-4-44-2006/1100).

14.1.1. Safety Assessment while Performing Licensing at the Stage of Nuclear Plant Construction

According to Article 28 of the Federal Act No. 170-FZ on the "Use of Atomic Energy", the decisions to construct nuclear facilities are made by the Russian Federation Government. These decisions are made in compliance with the land management legislation, urban development legislation, environmental protection legislation, and taking into account conclusions of public inquiries.

As demanded by the RF Government Ordinance of 5 March 2007 No. 145, the design documentation and findings of the engineering surveys for nuclear installations shall be reviewed by a state-owned institution belonging to the Federal Agency for Construction, Housing Maintenance and Utilities, by certified experts, and with the participation of other state-owned and non-governmental organizations and experts.

In accordance with Article 26 of the Federal Act No. 170-FZ on the "Use of Atomic Energy", to obtain a plant construction licence the Operating Organization shall submit to the Federal Environmental, Industrial and Nuclear Supervision Service a Preliminary Safety Analysis Report for the plant; and, if necessary, (on Federal Service's request) also other documentation.

Hence, the major assessment of the design solutions and measures ensuring the safety of the plant to be constructed is made at the construction licensing stage.

14.1.2. Safety Assessment in the framework of Operation Licensing

All operating Russian nuclear plants have operating licences issued by the Federal Environmental, Industrial and Nuclear Supervision Service. The operating licences are granted only after assessment of the plant safety based on the study and review of the submitted safety documentation, and after the inspections to check provisions for the safe operation of the plant.

The inspections carried out in the course of licence documentation review pursue the following goals:

- assess safety assurance directly at the site;
- verify the validity of information submitted;
- evaluate (by the Regulatory Body) the applicant's capabilities and

conditions for conducting the intended activity.

Similar procedure exists if a license holder applies for revision of the licence terms and conditions (the licensee shall make similar application to the Regulatory Body, in particular, before making modifications in the safety-related systems and in the operational documentation, for instance, in the Technical Specification for the Safe Operation of the Plant, and in some other cases).

The Federal Environmental, Industrial and Nuclear Supervision Service has started issuing licences for up to 10 years.

An effort is nearing completion to introduce the practice of periodic safety reviews at Russian NPPs. The relevant regulatory framework is under development. The review frequency is expected to be at least once every 10 years.

Information about the existing operating licences is given in Appendix 1.

14.2. NPP Operational Audits and Inspections

Pursuant to the requirements of Article 35 of the Federal Act on the "Use of Atomic Energy", the Operating Organization provides continued monitoring of the safe operation of nuclear plants.

The audits and inspections implemented by the Operating Organization are aimed at early detection and prevention of weaknesses in nuclear plant operation.

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

The Operating Organization conducts general and specific audits of the safe operation of nuclear plants; checks NPP preparedness for the fall-winter loads, and also checks adherence to the terms and conditions of the licences granted by the Regulatory Body of Russia.

The Operating Organization also looks after and inspects plant equipment, by performing technical examination of the piping and components, implementing in-service inspection programmes for metallic components and pipelines. Inspection findings serve to assess equipment condition and predict its safe operation life.

Every year, a special commission checks nuclear safety assurance at each operating plant.

The information about the findings of the audits and inspections performed by the Operating Organization is documented in the form of reports and duly submitted to the Regulatory Body of Russia.

Safe operation of Russian NPPs has been reviewed by experts from international organizations. For example, WANO performed in 2004-2006 the Peer Reviews at Kola, Beloyarsk, Bilibino, Kalinin and Novovoronezh

NPPs. The follow-up Peer Reviews to check the results and progress in the implementation of the recommendations made by the main Peer Review mission took place at Kursk and Balakovo NPPs.

In 2005 IAEA had an OSART mission (operational safety review team) at the Volgodonsk NPP. The mission reviewed the operational practice with a view to achieving a common goal – safe operation of the plant.

The conclusions made by the OSART mission rely on the benchmarking of the plant operation against the recommendations of the IAEA safety standards and the best international practice.

As stated in the mission conclusion, Volgodonsk NPP has been demonstrating "high commitment to improvement on a long-term basis". The improvement effort made at the time of plant commissioning and in the first years of its operation clearly suggests future benefits of this attitude.

The OSART team has commended a number of areas, saying, in particular, that:

- the plant has developed and is implementing an efficient well-structured approach towards achieving sustained good house-keeping in all plant areas and working places, which encourages safety-conscious attitude of plant personnel;
- a large-scale exercise was undertaken in 2004 to train emergency response organizations in responding to the plant damage in case of a sabotage;
- Rosenergoatom has weekly videoconferences to achieve early reporting and dissemination of the operational feedback to the high-level managers of all Russian plants;
- the rapid transmission system of process information is linked to other networks, which ensures wide use of this information while reducing MCR operator burden related to dealing with information requests;
- an efficient integrated shift hand-over procedure was developed and is in place;
- the plant management provided good working conditions, which encourages the high safety culture of operations personnel.

The mission has made suggestions for enhancing the operational safety of Volgodonsk NPP.

A final meeting of a follow-up OSART mission took place at Volgodonsk NPP in April 2007. The meeting was attended by the management and by the staff of the plant, Rosenergoatom and Rostechnadzor.

The follow-up OSART mission reviewed implementation and effectiveness of the corrective actions taken to fulfil the recommendations and suggestions made by the international experts in 2005.

The follow-up review has shown that the plant was making a consistent effort in all areas of improvement, was using up-to-date approaches, implementing effective production solutions, including those worthy of being extended to other Russian and world nuclear power plants.

It was pointed out that nearly all recommendations and suggestions mentioned in the Summary Report of the OSART mission of 2005 had been fulfilled. Furthermore, actions are under way to implement two outstanding long-term suggestions and one recommendation.

Volgodonsk NPP was the first to host an OSART mission in modern Russia. Balakovo plant will be the next in 2008.

14.3. Assessment of In-Service Ageing of Equipment

As required by the "General Guidelines for Assuring Nuclear Plant Safety" (OPB-88/97), the Operating Organization develops programmes for checking availability of systems and components, evaluating their ageing processes and replacing equipment with expired lifetime. There exists a KOPUR Programme (surveillance, assessment, prediction, life management of components) for assessment and management of component life.

The Programme covers collection, accumulation and analysis of the operational data on component defects, damage and failures, which is essential for assessment and prediction of ageing parameters. It is used to judge whether equipment performance meets the requirements of the regulatory and design documentation.

The KOPUR Programme envisages:

- monitoring of lifetime characteristics: to periodically assess whether the current life characteristics of components meet the requirements established in the regulatory and design documentation;
- assessment of lifetime characteristics: to quantify the parameters;
- prediction: to assess the residual life of components and equipment;
- management of lifetime characteristics: to ensure the design life characteristics and design time of equipment operation and/or its possible use beyond the design life.

14.4. Operational Safety Assessment of Nuclear Power Plants

Since 1991 all operating Russian NPPs have been carrying out annual operational safety assessments for each unit.

Such assessments are conducted in accordance with the "Regulations on Annual Operational Safety Assessment Reports for Nuclear Plants" (ST EO 0143-2005) and under control of the Operating Organization. The findings and conclusions are documented in a special report.

The safety assessments of the plants are performed to:

- check actual condition of safety and safety-related systems and components;
- examine condition of physical safety barriers and accident localisation systems;
- assess radiation levels at the site and in the environment;
- check implementation of system/component upgrading programmes and assess the impact of these activities on plant safety;
- check the level of nuclear, radiation, industrial and fire safety at the plant;
- review and assess operational events and human errors that occurred at the plant;
- identify actions to further improve safety and reliability of plant operation.

Annual NPP safety assessment reports approved by the Operating Organization are submitted to the Regulatory Body of Russia to review and to take into account in the supervisory activities.

Summarising the annual safety assessment reports of the plants, the All-Russian Research Institute for NPP Operation (VNIIAES) issues a consolidated annual report on the operational safety, which analyses and assesses safety of all NPPs. The report is sent to the Operating Organization, nuclear power plants and Regulator.

Based on the findings of the review of NPP operational events and the annual assessment reports on the operational safety of the plants, SEC NRS also issues an annual report, which discusses the trends in the key performance indicators, the state of the most significant safety issues, and makes proposals for using the operating experience feedback in regulatory activities. The report is sent to the cross-regional offices of the Regulatory Body and to the Operating Organization.

The safety assessments of the plants, performed in 2004-2006, have shown that the safety of all plants is maintained at an acceptable level and measures are in place to further improve plant safety and reliability. During

this period, there was an ongoing trend towards improvement of operational safety indicators, such as reduction of operational events at the plants and of the number of scrams on demand; of an overall number of equipment failures and safety system failures; of human errors and cases of poor safety culture. The radiation levels at the operating plants are acceptable. 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.

14.5. In-depth Safety Assessment of Nuclear Plant Units

In-depth safety assessment work continued in 2004-2006 in compliance with the "Recommendations on the Content of the In-depth Safety Assessment Report for Operating Nuclear Units (OUOB AS)" (RB-001-05).

Table 14.1 contains the findings of the Probabilistic Safety Analysis Level 1 performed for the operating plants.

Table 14.1 – Findings of the Probabilistic Safety Analyses (PSA Level 1) for Operating Plants as of 01.07.2007

Plant (unit)	Reactor type	Integral risk of severe core damage, 1/reactor-year
Balakovo-1	**WWER**	**3.62·E-5**
Balakovo-2	**WWER**	**8.29·E-5**
Balakovo-3	**WWER**	**8.3·E-5**
Balakovo-4	**WWER**	**8.27·E-5**
Bilibino-1	**EGP-6**	**3.092·E-7**
Bilibino-2	**EGP-6**	**3.092·E-7**
Bilibino-3	**EGP-6**	**3.092·E-7**
Bilibino-4	**EGP-6**	**3.092·E-7**
Kalinin-1	**WWER**	**2.43·E-4***
Kalinin-2	**WWER**	**1.242·E-4***
Kalinin-3	**WWER**	**5.53·E-5**
Kola-1	**WWER**	**3.09·E-5**
Kola-2	**WWER**	**2.52·E-5**
Kola-3	**WWER**	**7.96·E-5**
Kola-4	**WWER**	**1.28·E-4***
Kursk-1	**RBMK**	**9.85·E-6**
Kursk-2	**RBMK**	**7.47·E-6**
Kursk-3	**RBMK**	**8.53·E-6**
Kursk-4	**RBMK**	**PSA-1 planned for 2009**
Leningrad-1	**RBMK**	**1.12·E-5**
Leningrad-2	**RBMK**	**3.34·E-5**
Leningrad-3	**RBMK**	**2.0·E-4***
Leningrad-4	**RBMK**	**PSA-1 planned for 2008**
Novovoronezh-3	**WWER**	**3.0·E-5**
Novovoronezh-4	**WWER**	**5.1·E-5**
Novovoronezh-5	**WWER**	**7.8·E-4***
Smolensk-1	**RBMK**	**1.84·E-4***
Smolensk-2	**RBMK**	**1.77·E-4***
Smolensk-3	**RBMK**	**3.83·E-5**
Volgodonsk-1	**WWER**	**7.14·E-5**

Note: * Risk value to be updated taking into account implementation of additional safety improvement measures.

Severe core damage frequency values given in Table 14.1 for the majority of the Russian nuclear plants are in accordance with the target value for operating NPPs stated in INSAG-12 ($<10^{-4}$ per reactor-year for severe core damage frequency). Efforts are in progress to update the obtained values.

The upgrading, safety enhancement and the in-depth safety assessments performed at nuclear plants helped obtain licences for plant operation beyond the design life.

14.6. Regulatory Safety Inspections at Nuclear Plants

To check plant adherence to safety regulations and assess Operator activities with regard to safety enhancement, elimination of non-compliances with safety regulations and fulfilment of licence terms and conditions, the Federal Environmental, Industrial and Nuclear Supervision Service conducts supervision activities consisting of inspections to evaluate the nuclear and radiation safety of the plants at all stages of their life.

There are three types of inspections conducted at Russian plants: comprehensive, targeted and operational.

Comprehensive inspection of a plant covers all (or nearly all) safety issues regulated by the Federal Environmental, Industrial and Nuclear Supervision Service. Usually, this inspection is carried out by a commission including Rostechnadzor inspectors and experts from the central and regional offices. Representatives of other state nuclear safety authorities and independent experts may participate in the inspections.

Targeted inspection consists in a detailed check of one or several safety aspects. The inspection may be performed by a central office or regional office commission, or by Rostechnadzor inspector alone.

Operational inspection includes a detailed check of adherence to safety requirements by individual workers, plant divisions and the plant on the whole, with a view to taking immediate measures to remedy the possible weaknesses. Such inspection is organized and performed by an inspector (or a team of inspectors) from a regional office of the Federal Environmental, Industrial and Nuclear Supervision Service.

In 2005-2006, the commissions set up by the central office of Rostechnadzor, performed comprehensive nuclear and radiation safety inspections at Kursk NPP, Volgodonsk NPP, Kalinin NPP, Smolensk NPP and Leningrad NPP. In addition, the commissions set up by Rostechnadzor central office performed a targeted inspection to check adherence to radiation safety requirements in the process of radwaste handling at Kola NPP; a targeted inspection on the implementation of life extension activities at Bilibino-3, a targeted inspection on adherence to the radiation

safety requirements at Kalinin NPP and a targeted inspection on the upgrades at Leningrad-2.

The central office of Rostechnadzor has planned to perform in 2007 comprehensive inspections at Kola and Bilibino NPPs, and a targeted inspections at Beloyarsk and Bilibino NPPs to check the fulfilment of the licence terms.

The regional offices of Rostechnadzor have performed regular inspections at the plants in accordance with their work plans.

In total, 6026 inspections were carried out in 2005-2006 at the operating plants, enterprises and organizations working in the field of atomic energy including 5 comprehensive inspections, 2452 targeted inspections and 3569 operational inspections.

The inspections performed in 2005-2006 enabled a due check of the safety levels of the plants and a timely response to the weaknesses and violations revealed.

Also, the Federal Environmental, Industrial and Nuclear Supervision Service performs the following with regard to the nuclear and radiation safety evaluation:

- reviews annual reports of the Operating Organization on NPP operational safety status;
- continuously studies NPP operational events;
- assesses annual review reports on the nuclear safety of the plants.

It is evident from the above that the safety assessments and systematic comprehensive and targeted inspections are meant to prevent events and further enhance NPP safety, which is in line with the requirements of the Convention on Nuclear Safety.

Article 15. Radiological Protection

15.1. Radiological Protection Legislation, Standards and Regulations

The following laws and regulatory documents regulate radiological protection of NPP personnel, the public and the environment in the Russian Federation:

- Federal Act on the "Use of Atomic Energy";
- Federal Act on the "Radiation Safety of the Public";
- Federal Act on the "Environmental Protection";
- Radiation Safety Standards (NRB-99);
- Main Health Rules for Radiation Safety Assurance (OSPORB-99);
- General Guidelines for Assuring Nuclear Plant Safety (OPB-88/97);
- Health Rules for Design and Operation of Nuclear Plants (SP AS-03);
- Radiation Safety Rules for NPP Operation (PRB AS-99);
- other rules and standards in the area of atomic energy use.

The Federal Act on the "Use of Atomic Energy" establishes a legal framework and regulation principles for relations arising during the use of atomic energy and is aimed at safeguarding the life and health of humans and protecting the environment.

The Federal Act on the "Radiation Safety of the Public" establishes legal framework for the radiation protection of the public and personnel with the purpose of health protection. The act sets out the main notions, standards, regulation principles in the area of radiation protection; identifies measures essential for the provision of radiation safety, powers of the Russian Federation authorities and authorities of the RF entities in the area of radiation protection. This act and NRB-99 standards were written taking into account the recommendations of the International Commission on Radiological Protection.

OPB-88/97 is the major regulatory document, which sets out principles and basic criteria of safety assurance, formulates main requirements to technical and organizational measures aimed at safety attaining including safety issues resulting from NPP specific character, i.e. being the source of radiological impact on personnel, public and environment.

NRB-99 document specifies requirements and standards for the impact of ionising radiation. In particular, the document regulates the following:

- personnel and public exposure due to the man-made sources of ionising radiation in normal operation;
- personnel and public exposure in case of a radiation accident;
- exposure of personnel of industrial enterprises and the public, caused by the natural sources of ionising radiation;
- medical exposure of the public.

OSPORB-99 specifies requirements for protection of humans against radiation in all conditions of exposure due to ionising sources covered by NRB-99.

Rules SP AS-03 identify and specify implementation of health (sanitary and hygienic) requirements to ensure the radiation safety of personnel, the public and the environment in the process of design, construction and operation of nuclear plants.

Considering the existing engineered safety level of the plants in normal operation (when the radiation doses to the public due to the actual plant releases and discharges are below 10 μSv/year in each radiation hazard), the radiation risk for the public resulting from NPP operation is certainly acceptable ($<10^{-6}$ per year). Therefore, the release and discharge limits specified in SP AS-03 are calculated based on the public exposure of 10 μSv/year.

15.2. Radiological Impact on NPP Personnel

The annual operational safety assessments at Russian NPPs have shown that the radiological situation at all plants meets the requirements of regulatory documents and the requirements of Article 15 of the Convention on Nuclear Safety.

The Federal Atomic Energy Agency and Rosenergoatom have a systematic policy of consistent dose reduction. Targets (reference level) of 40, 30 and 20 mSv/year were introduced in 1991, 1993 and 1997, respectively, with regard to the individual doses to plant personnel. The Radiation Safety Standards (NRB-99) establishes the following dose limits for plant personnel: on average, 20 mSv over any 5 consecutive years but not more than 50 mSv in one year.

Reduction of personnel exposures at Russian nuclear plants is achieved owing to a combination of technical and administrative improvements in radiation protection, safety culture, work management. As a result of this effort, personnel exposure has kept going down with each year.

The data on actual personnel exposure at Russian NPPs with different reactors in 2004-2006 is given in Tables 15.1–15.2.

Table 15.1 – Average Individual Doses to Plant and External Personnel in 2004-2006

Plant, reactor type	2004		2005		2006	
	Average dose, mSv/year	% of 20 mSv	Average dose, mSv/year	% of 20 mSv	Average dose, mSv/year	% of 20 mSv
WWER plants						
Balakovo 1-4, WWER-1000	**0.67**	**3.3**	**0.67**	**3.3**	**0.60**	**3.0**
Volgodonsk 1, WWER-1000	**0.08**	**0.40**	**0.077**	**0.38**	**0.078**	**0.39**
Kalinin 1-3, WWER-1000	**0.42**	**2.1**	**0.54**	**2.7**	**0.46**	**2.3**
Kola 1-4, WWER-440	**1.63**	**8.2**	**1.15**	**5.8**	**1.09**	**5.5**
Novovoronezh 3,4, WWER-440; Novovoronezh 5, WWER-1000	**1.95**	**9.8**	**2.40**	**12.0**	**1.34**	**6.7**
Weight average for WWER plants	**0.95**	**4.8**	**1.00**	**5.0**	**0.74**	**3.7**
RBMK plants						
Kursk 1-4, RBMK-1000	**2.96**	**14.8**	**2.70**	**13.5**	**3.3**	**16.5**
Smolensk 1-3, RBMK-1000	**3.54**	**17.7**	**2.46**	**12.3**	**2.91**	**14.6**
Leningrad 1-4, RBMK-1000	**2.20**	**11.0**	**2.02**	**10.1**	**1.82**	**9.1**
Weight average for RBMK plants	**2.89**	**14.5**	**2.4**	**12.0**	**2.68**	**13.4**
One-of-the-kind plants						
Beloyarsk 3, BN-600	**0.49**	**2.5**	**0.42**	**2.1**	**0.46**	**2.3**
Bilibino 1-4, EGP-6	**4.49**	**22.5**	**3.69**	**18.5**	**3.60**	**18.0**
Weight average for operating one-of-the-kind plants	**1.95**	**9.8**	**1.68**	**8.3**	**1.67**	**8.4**
Weight average for all operating plants	**2.00**	**10.0**	**1.75**	**8.8**	**1.80**	**9.0**

Table 15.2 – Annual Collective Doses to Plant and External Personnel (S) per Nuclear Unit

Plant	S, man·Sv/unit		
	2004	2005	2006
WWER plants			
Balakovo	**0.61**	**0.60**	**0.52**
Volgodonsk	**0.14**	**0.13**	**0.13**
Kalinin	**0.88**	**0.78**	**0.60**
Kola	**0.94**	**0.66**	**0.65**
Novovoronezh (three operating units)	**1.98**	**2.49**	**1.26**
Weight average for all operating WWER plants	**1.00**	**1.00**	**0.69**
RBMK plants			
Kursk	**4.55**	**3.88**	**4.70**
Smolensk	**5.70**	**3.80**	**5.00**
Leningrad	**2.82**	**2.48**	**2.47**
Weight average for all operating RBMK plants	**4.23**	**3.35**	**4.00**
One-of-the-kind plants			
Beloyarsk (Unit 3)	**0.54**	**0.47**	**0.52**
Bilibino	**0.71**	**0.63**	**0.65**
Weight average for all operating one-of-the-kind plants	**0.68**	**0.60**	**0.62**
Weight average for all operating plants	**2.13**	**1.77**	**1.84**

It can be seen in Tables 15.1–15.2 that the dose limits set for personnel of Russian NPPs have not been exceeded.

15.3. Monitoring of Environmental Contamination

All Russian NPPs are equipped with the systems for entrapment of gaseous and airborne radionuclides in plant releases. Owing to the improved fuel fabrication techniques, improvement of the production process at the plants, and introduction of advanced gas and aerosol cleaning

techniques in the last 15 years, releases into the atmosphere have decreased dramatically (by an order of magnitude).

Tables 15.3 and 15.4 show the absolute and relative (as percent of the release limit) daily and annual average of gas and aerosol releases at Russian NPPs in 2006.

The releases given in the Tables produce negligible (practically below the detection limit) doses of public exposure in the vicinity of NPP sites – less than 0.01 mSv/year, which is less than 1 % of the annual external dose caused by natural (background) radiation.

Similar to the previous years, in 2006 the gaseous and airborne releases at the plants stayed well below the prescribed limits. The noble gas releases at the pressure tube plants did not exceed 18 % of the limit. At WWER plants the noble gas releases were less than 7 % of the limit. Iodine releases range from 0.1 to 11.0 % of the limit.

Radionuclide releases in the atmosphere at Russian WWER plants do not exceed the releases from PWR plants operated in other countries.

Table 15.3 – Daily Average Gaseous and Airborne Releases at Russian NPPs in 2006

Plant	**NRG**		**^{131}I**	
	GBq	**% of the target***	**MBq**	**% of the target***
Balakovo	**0.4**	**0.02**	**0.26**	**0.5**
Volgodonsk	**0.7**	**0.03**	**0.10**	**0.2**
Kalinin	**59.0**	**3.1**	**2.50**	**5.1**
Kola	**2.0**	**0.1**	**0.05**	**0.1**
Novovoronezh	**124.0**	**6.5**	**5.21**	**10.6**
Kursk	**921.0**	**9.1**	**7.08**	**2.8**
Smolensk	**299.0**	**3.0**	**1.61**	**0.6**
Leningrad	**1800.0**	**17.7**	**2.44**	**0.96**
Beloyarsk	**33.4**	**1.8**	**No releases**	**-**
Bilibino	**972.0**	**17.7**	**Below the detection limit**	**-**

Note: * Target - reference level.

Table 15.4 – Annual Average Gaseous and Airborne Releases at Russian NPPs in 2006

Plant	NRG		^{131}I		^{134}Cs		^{137}Cs		^{60}Co	
	TBq/yr	% of the limit	MBq/yr	% of the limit	MBq/yr	% of the limit	MBq/yr	% of the limit	MBq/yr	% of the limit
Balakovo	**0.15**	**0.02**	**94.8**	**0.5**	**1.81**	**0.2**	**4.4**	**0.2**	**3.5**	**0.05**
Volgodonsk	**0.24**	**0.03**	**37.4**	**0.2**	**0.2**	**0.02**	**0.44**	**0.02**	**2.6**	**0.03**
Kalinin	**21.7**	**3.1**	**913.1**	**5.1**	**0.40**	**0.04**	**2.17**	**0.1**	**4.08**	**0.05**
Kola	**0.75**	**0.1**	**18.8**	**0.1**	*	-	**8.2**	**0.4**	**80.5**	**1.1**
Novovoronezh	**45.0**	**6.5**	**1900.0**	**10.6**	**38.0**	**4.2**	**71.0**	**3.6**	**290.0**	**3.9**
Kursk	**336.3**	**9.1**	**2585.4**	**2.8**	**9.59**	**0.7**	**62.8**	**1.6**	**178.9**	**7.2**
Smolensk	**109.1**	**3.0**	**588.6**	**0.6**	*	-	**11.7**	**0.3**	**133.9**	**5.4**
Leningrad	**656.5**	**17.7**	**889.1**	**0.96**	**37.2**	**2.7**	**170.0**	**4.2**	**196.0**	**7.8**
Beloyarsk	**12.2**	**1.8**	-	-	*	-	**57.0**	**2.9**	**0.21**	**0.003**
Bilibino	**354.9**	**17.7**	*	-	*	-	*	-	*	-

Note: * The release is below the minimum detection activity of radionuclides.

Systematic activity measurements made in the area of 30 km around the plant and in the monitoring stations located up to 50 km away from the site to determine activity concentration in air, water, soil, vegetation, foodstuffs and agricultural products, suggest that nuclear plant operation has an insignificant impact on the environment.

Hence, the above data confirm that Russian NPPs provide adequate protection of the public and the environment against radiation impact.

15.4. Supervision of Radiological Protection of Nuclear Plant Personnel, the Public and the Environment

Supervision over the radiation protection of NPP personnel, the public and the environment in the areas of NPP sites is carried out by the Department of Sanitary and Epidemiological Supervision of the Federal Medical and Biological Agency under the RF Ministry of Health and Social Development, and by the regional offices of the Department.

The Federal Environmental, Industrial and Nuclear Supervision Service supervises, on behalf of the state, adherence to the regulatory requirements in the area of radiation safety, and compliance with the terms of the plant operation licences.

Radiation safety divisions at the plants monitor the status of radiation protection of personnel the activity releases in the environment. The findings of the monitoring are presented to the regulatory authorities and to the Operating Organization in the form of monthly, quarterly and annual reports.

The Federal Environmental, Industrial and Nuclear Supervision Service and health authorities perform comprehensive and targeted inspections to evaluate the safety of individual plants. The findings of these inspections serve to make relevant recommendations and instructions.

It follows from the above that the Russian Federation has assured the radiation protection of NPP personnel, the public and the environment in the course of nuclear installation operation.

Personnel exposures stay at low level and do not exceed the prescribed limits. Radiological impact of NPPs on the public and the environment (in normal operation) due to the gas aerosol releases and effluent discharge creates additional radiation risk, which is certainly acceptable (less than 10^{-6} per year).

Article 16. Emergency Preparedness

16.1. Regulation of Issues of Emergency Preparedness on NPP Site and Beyond

The issues of personnel and public protection in case of accidents at nuclear plants are regulated in Russia by a number of regulatory requirements. These regulatory requirements have been developed with regard to the Russian and international experience and take into account the recommendations found in the following IAEA Safety Guides:

- "Preparedness of Public Authorities for Emergencies at Nuclear Power Plants. A Safety Guide", No. 50-SG-G6, Vienna, 1982;
- "Preparedness of the Operating Organization (Licensee) for Emergencies at Nuclear Power Plants", No. 50-SG-06, Vienna, 1982.

The Russian Federation is a party to the international agreements relating to the issues of emergency preparedness including the cases of accidents with transboundary consequences:

- "Convention on Environmental Impact Assessment in a Transboundary 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 NPP sites and beyond, include:

- Federal Act No. 170-FZ on the "Use of Atomic Energy";
- Federal Act No. 68-FZ on the "Protection of the Population and Territories against Natural and Man-Induced Emergencies";
- Federal Act No. 3-FZ on the "Radiation Safety of the Public";
- "Regulations for the Unified National System for Prevention and Mitigation of Emergencies" (approved by RF Government Ordinance of 30 December 2003 No. 794, in the revision of the Government Ordinance of 27 May 2005 No. 335);
- "General Guidelines for Assuring Nuclear Plant Safety" (OPB-88/97);
- "Procedure for Announcement of Emergencies, Early Information Transmittal, and Organization of Urgent Assistance to Nuclear Plants in the Event of Radiation Hazards" (NP-005-98);
- "Standard Content of an Action Plan for Personnel Protection in Case of a Nuclear Plant Accident" with Amendment of 30 August 2002 No. 1 (NP-015-2000).

As mentioned in the previous RF National Reports, the above regulatory documents are aimed at preventing the occurrence and progression of emergencies and at minimising the ensuing damage.

These documents define the norms for protecting the Russian and foreign citizens as well as the environment against natural and man-induced emergencies; the organization principles, the required resources, and the interaction in mitigating possible emergencies at nuclear plants; the tasks and functions of the interdepartmental Team for Emergency Assistance to Nuclear Plants (OPAS).

16.2. Implementation of Emergency Preparedness Measures, Emergency Preparedness Plans of Nuclear Plants

In accordance with the current laws and regulations, a Unified National System for Prevention and Mitigation of Emergencies (RSChS) was instituted in the Russian Federation, the activities of which are being managed by the RF Ministry for Civil Defence, Emergency Management, and Response to Natural Disasters (EMERCOM of Russia).

The System covers all the territories (regions) of Russia. In keeping with the Federal Act on the "Protection of the Population and Territories against Natural and Man-Induced Emergencies", the RF Government issued Ordinance No. 304 of 21 May 2007, which approved a classification of natural and man-induced emergencies. This classification is presented schematically in Table 16.1.

Table 16.1 – Classification of Natural and Man-induced Emergencies

Type of emergency	Number of people affected	Material damage (thousand roubles)	Location of emergency
Local	**up to10**	**up to 100**	**Facility**
Municipal	**up to 50**	**100-5000**	**Settlement or in-city territory of a federal-level city**
Inter-municipal	**up to 50**	**100-5000**	**Two or more settlements or in-city territories of a federal-level city**
Regional	**51-500**	**5000-500000**	**Does not exceed the territory of one RF entity**
Inter-regional	**51-500**	**5000-500000**	**Does not exceed the territory of two RF entities**
Federal	**above 500**	**above 500000**	**As decided by the RF Government**

The classification of emergencies serves as a basis for early preparation of appropriate means and resources at various administrative levels to mitigate emergencies and to remedy the damage caused.

EMERCOM of Russia provides interfaces and coordinates the activities of all ministries, agencies and organizations involved in the post-accident remedial actions also outside the exclusion zones of the affected nuclear plants. EMERCOM of Russia organizes training and employment of emergency response and rescue teams for early localisation of emergencies and limitation of the damage caused by them.

An industry-level system for preventing and mitigating emergencies (OSChS) at nuclear plants and other facilities of the nuclear power industry is operating in the framework of the Federal Atomic Energy Agency.

The emergency prevention and mitigation system existing in Russia is shown schematically in Figure 16.1.

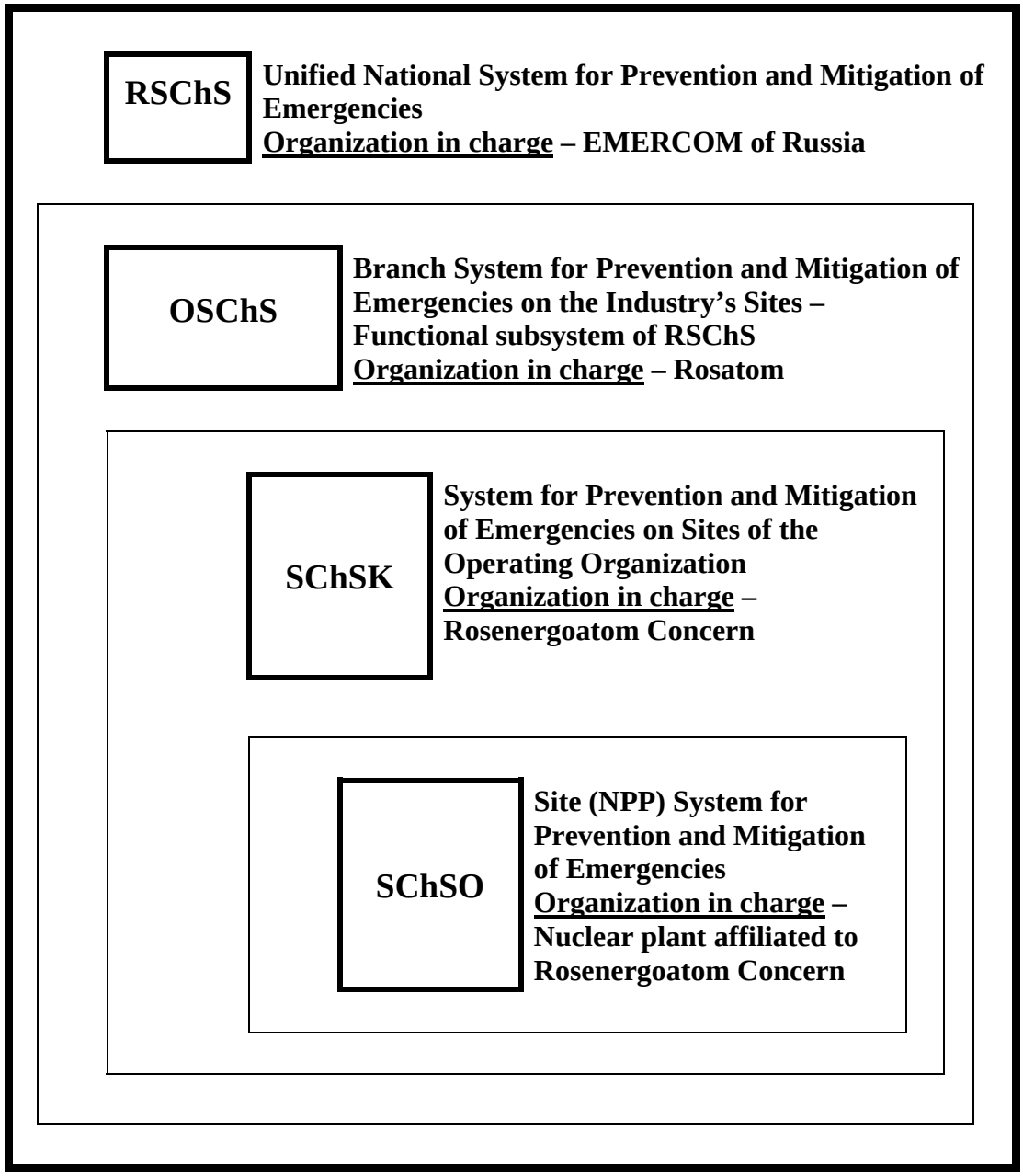


Figure 16.1 - Emergency Prevention and Mitigation System

In accordance with the Regulations for the OSChS system, all the operating nuclear plants provided mature and manageable site systems for prevention of emergencies and appropriate response actions. Seeking to ensure constant preparedness of the resources for response to possible radiation hazards, all nuclear plants developed and obtained approvals for "Action Plans for Personnel Protection in Case of an Accident at the Nuclear Plant" following the requirements of the "General Guidelines for Assuring Nuclear Plant Safety" (OPB-88/97) and the "Standard Content of Action Plans for Personnel Protection in Case of a Nuclear Plant Accident"

(NP-015-2000). These plans define the accident notification procedure, the criteria for decision-making and personnel actions in emergencies, personnel protection measures as well as the procedure for NPP interaction with the territorial divisions of EMERCOM of Russia, other external organizations and local authorities.

The organizational, technical and other measures of assistance to the population of the areas in the vicinity of NPP sites are identified in the "Plans for Public Protection in Case of a Radiation Accident at the Nuclear Plant".

Such plans were developed and approved by executive authorities of the corresponding territories in the Russian Federation. The plans specify the ways of coordinating the activities of the site-based and territorial divisions of EMERCOM of Russia and of arranging their interaction with other ministries and agencies involved in the work for protecting the population against the consequences of accidents.

The Operating Organization and each nuclear plant have both the main and backup means of communication with the Federal Atomic Energy Agency and other higher-level organizations, with the federal safety authorities, territorial civil defence and emergency management bodies of EMERCOM of Russia as well as with the appropriate executive authorities and local administrations.

The communication and warning systems available at nuclear plants allow promptly alerting all the organizations concerned to the danger of an accident at the plant and exchanging the essential information.

The Operating Organization is responsible for arrangement and performance of the work aimed at preventing and mitigating emergencies of both radiological and non-radiological nature.

The key elements in the system of emergency support to NPPs are the Emergency Response Centre (ERC) of Rosenergoatom Concern, the Situation and Crisis Centre (SCC) of Rosatom, the Information and Analysis Centre (IAC) of Rostechnadzor, and the Technical Support Centres (TSC) set up by the organizations acting as Chief Designers, Scientific Supervisors and General Architect Engineers for the NPPs as well as by the leading Russian institutes providing scientific and technical support to the plants. There are 14 Technical Support Centres operating at present. Arrangement of communication between the organizations involved in the emergency response system is shown in Figure 16.2.

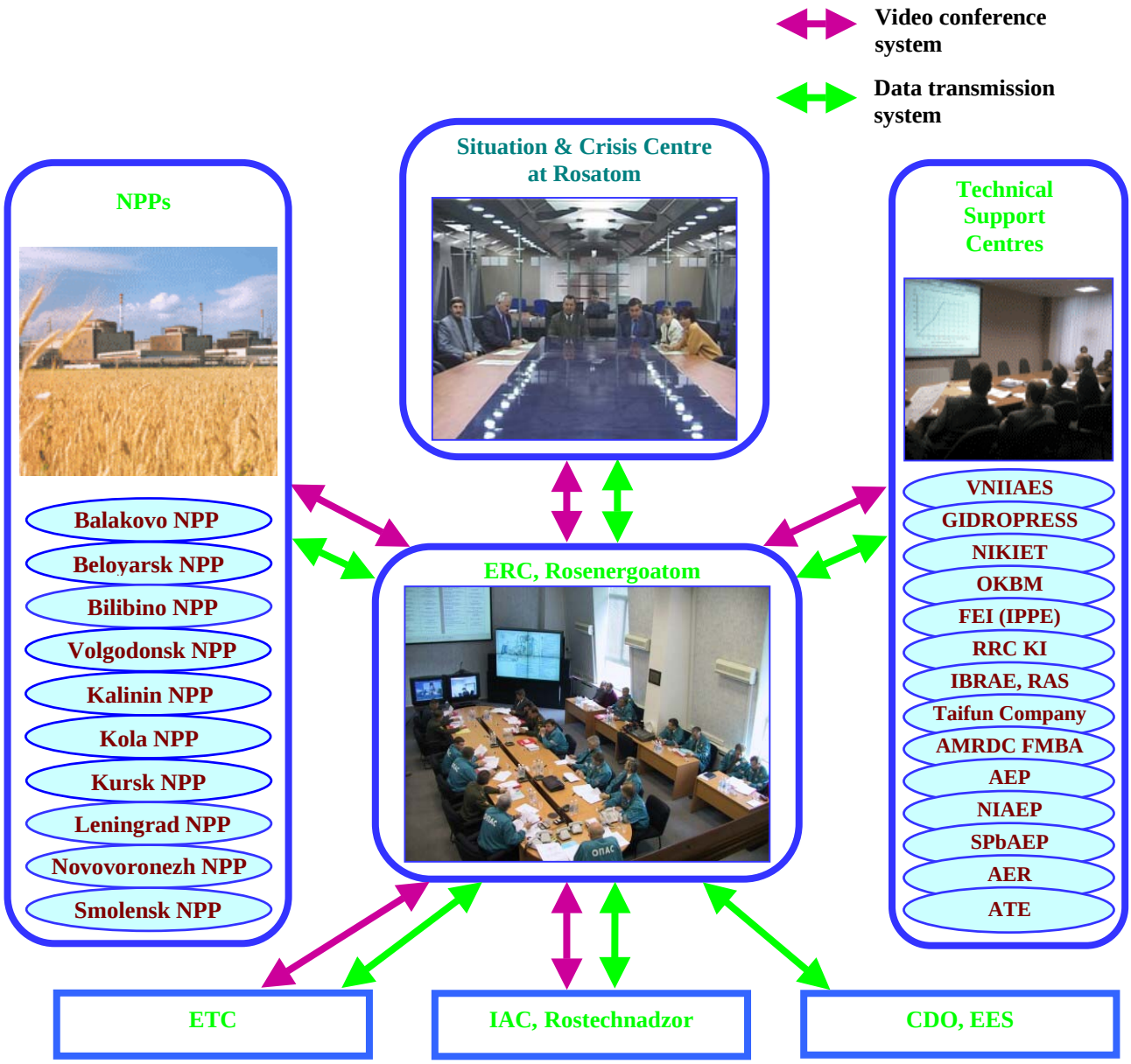


Figure 16.2 - On-line Communication of the Organizations Involved in the Emergency Response System

The role of these emergency response and technical support centres in improving emergency preparedness of NPPs is defined in the "Regulations for Announcement of Emergencies, Early Information Transmittal and Organization of Urgent Assistance to Nuclear Plants in the Event of Radiation Hazards" (NP-005-98) and in the "Procedure for Informing the SCC about the Current Status of Nuclear Facilities and Abnormal Occurrences". This role lies in:

- ensuring the availability of the emergency prevention and mitigation system;

- collecting objective information on the current state of NPP units in technological and radiation terms;
- continuously monitoring the process parameters and radiation characteristics at NPPs;
- checking the preparedness of NPPs and the availability of communication systems for continuous information exchange;
- analysing the situation based on the information acquired;
- promptly predicting the conditions on NPP sites and in the surveillance areas;
- giving timely warnings of emergencies;
- providing engineering support to an affected NPP; interacting with the Technical Support Centres;
- informing the stakeholders about the situation at NPPs via operating communication channels;
- alerting the Team for emergency assistance to nuclear plants (OPAS);
- arranging interaction with the affected NPP, with the ministries and agencies concerned and communicating with the mass media and general public;
- monitoring the progress of the measures taken.

The above Centres operate around the clock, and their activities are coordinated.

At the site level, the Manager (Director) of a nuclear plant is responsible for the actions taken to prevent and eliminate emergencies within the plant’s exclusion zone and for implementing the "Action Plan for Personnel Protection in Case of an Accident at the Nuclear Plant".

The processes of taking measures to ensure emergency preparedness of Russian nuclear plants and of bringing into effect the "Action Plan for Personnel Protection…" are defined in the "Procedure for Announcement of Emergencies, Early Information Transmittal and Organization of Urgent Assistance to Nuclear Plants in the Event of Radiation Hazards" (NP-005-98).

The latter regulatory document establishes the criteria for announcing the states of "Emergency Preparedness" and "Emergency Situation".

16.3. Measures to Inform the Public on Emergency Preparedness

The function of informing the general public is performed at Rosenergoatom Concern by the Information and Public Relations Centre. In the event of an emergency at a NPP the Centre undertakes the following activities:

- collection of information about accident initiation and progression at the NPP, about the measures taken to localise the accident and to minimise its consequences;
- preparation of press releases approved by the OPAS team leaders; prompt provision of the information to mass media;
- organization of press conferences for the OPAS team leaders;
- monitoring of the electronic and publishing mass media for coverage of the situation at the NPP;
- arrangements made to present information about the accident, its localisation and the remedial actions on the Web-site of the Operating Organization (Operator);
- interaction with information divisions of the nuclear plants.

All nuclear plants have information divisions, whose tasks are similar to those listed above.

16.4. Training and On-Site Emergency Drills

Training of nuclear plant personnel for actions in emergencies includes studies at the TSC, emergency drills, command post and special tactical exercises, field training.

Training of the Operator’s staff, personnel of nuclear plants and employees of supporting organizations in civil defence, in prevention and mitigation of emergencies follows the requirements of RF Government Ordinance of 4 September 2003 No. 547, on "Public Training in Defence against Natural and Man-Induced Emergencies" and the "Manual for Arranging Public Training in Civil Defence" (in the revision of RF Government Ordinance of 15 August 2006 No. 501).

The order of training the Operator’s staff, personnel of nuclear plants and members of their families and employees of supporting organizations for actions in emergencies is set out in the "Guidelines on Preparing and Implementing Measures for Civil Defence, Prevention and Mitigation of Emergencies at Nuclear Plants" (RD EO 0074-97).

Specialists on the staff of administration bodies and those working in the system for prevention and mitigation of emergencies, nuclear plant personnel, and employees of supporting organizations are trained under specially developed programmes at institutions of continuing professional education, at civil defence and emergency management training centres of the RF entities as well as at municipal civil defence courses.

Training of special agency-level units assigned to nuclear plants is arranged in accordance with the "Manual on Special Agency-level Unit at Nuclear Plants" (RD EO 0341-02).

The Operator, nuclear plants and supporting organizations plan and carry out annual exercises and drills:

- to check the preparedness of governing bodies, means and resources for actions in emergencies;
- to practice actions in emergencies and during accidents at NPPs;
- to practice emergency interaction inside shifts, as well as their interfacing with fire brigades, medical staff, emergency response and rescue teams and services;
- to train personnel in issuing warnings, in preventing adverse progression of accidents and in minimising their consequences;
- to test the abilities to apply first aid, to use the means of individual protection, fire-extinguishing equipment, etc.;
- to practice arrangements for evacuation of people;
- to check the preparedness of personnel for prompt and proper actions on their own.

The Operating Organization pursues the following activities:

- methodological and training sessions for the officials and the civil defence and emergency management employees of the headquarters and nuclear plants – at least once a year;
- comprehensive emergency exercises for the OPAS Team, nuclear plants, Emergency Technical Centres (ETC), as well as for the federal stakeholders aimed at working through all the aspects of joint and individual actions in response to radiation accidents and in protecting personnel and population, with possible involvement of civil defence resources – once a year;
- tactical antiterrorist exercises to practice interaction of the OPAS Team, Emergency Response Centre, Rosenergoatom divisions and TSC with task units of law enforcement agencies and medical services – once a year.

Nuclear plant activities include:

- methodological and training sessions for the managerial staff, officials and specialists in civil defence and emergency management – at least once a year;
- command post exercises (CPE) aimed at improving the interaction between officials of the authorities concerned, which involve a package of tasks for arranging the activities of accident mitigation teams during both initiation of an accident and minimisation of its consequences – once a year;
- accident management and fire-fighting drills of the personnel as well as drills for actions in emergencies – according to annual time schedules developed by the NPP.

Such a time schedule provides for each member of the operating personnel to take part:

- in accident management drills – at least once in every three months, and in plant-scale drills – at least once a year;
- in accident management, plus fire-fighting, drills – at least once in every six months.

Besides, the OPAS, ERC and TSC teams take part in CPE or plant-scale accident management drills to practice concerted efforts at least once in two years in accordance with the time schedule developed annually by the Operating Organization.

During the exercises and drills, use is made of simulator facilities, including full-scope simulators of NPP units.

16.5. Emergency Technical Centres

Pursuant to RF Government Ordinance of 25 March 1993 No. 246, on "Establishment of Emergency Technical Centres for Mitigation of Emergencies at Nuclear Facilities of the Russian Federation", several Emergency Technical Centres (ETC) were set up in Russia including those in St. Petersburg, Moscow, Novovoronezh (Voronezh region), and Seversk (Tomsk region). In 2006, following Rosatom directive, the Centres in Moscow, Novovoronezh and Seversk were affiliated to the St. Petersburg ETC. The Novovoronezh ETC is the emergency technical centre of the nuclear industry designated for rendering assistance to nuclear plants in emergencies.

16.6. Governmental Regulatory Activities in Assuring Emergency Preparedness of Nuclear Plants

In its activities to supervise the emergency preparedness management, the Federal Environmental, Industrial and Nuclear Supervision Service is guided by the laws, regulations and other documents listed in Section 16.1 of this Report as well as by the "Regulations for Investigating and Accounting Operational Events at Nuclear Plants" (NP-004-97), which defines the categories of operational events to be accounted for (see Appendix 9), the order of notification, subsequent reporting of the event, and the order of its investigation.

The main responsibilities of the Federal Environmental, Industrial and Nuclear Supervision Service in regard to emergency preparedness are to supervise the development and implementation of accident prevention measures at the facilities, to monitor the preparedness of enterprises and organizations for minimising their consequences as well as to take part in defining the criteria and in developing standards and regulations for assuring emergency preparedness of NPPs.

The way Rostechnadzor fulfils these responsibilities is described below.

Licensing

In accordance with the Licensing Regulations and relevant Procedures, the documents to demonstrate the assured nuclear and radiation safety during operation of nuclear power plants should include accident mitigation instructions, guidelines on beyond-design-basis accident management, and action plans for personnel protection in case of accidents at nuclear plants. These justification documents should also contain information about the training and qualifications of plant personnel including their preparedness for actions during design-basis and beyond-design-basis accidents.

The above documents are assessed during NPP safety reviews. As a result of such assessment, a review report is produced with conclusions as to the soundness and sufficiency of the technical and organizational decisions taken to ensure the preparedness of the NPP and the Operator for mitigation of accidents and minimisation of their consequences.

The review report may contain proposals concerning the terms of the license validity in regard to improvements in emergency preparedness of the nuclear plant and/or Operating Organization, which will be taken into consideration by the Regulatory Body in defining the license validity terms.

Inspection

One of the objectives pursued by the Russian Regulatory Body in its inspection activities is to check on the preparedness of nuclear plants for mitigation of accidents and minimisation of their consequences.

Such NPP inspections include checking and assessing:

- the state of documents that specify personnel actions during accidents (accident mitigation instructions, guidelines on beyond-design-basis accident management, action plan for personnel protection);
- the organization of personnel training to develop and maintain their skills of plant control during accidents;
- the availability of the emergency warning system including the condition of communication channels;
- the condition of sheltered stations for control of accident management operations, their equipment, and availability of appropriate documents;
- the arrangements for plant personnel protection in case of a radiation accident as regards the preparedness of the appropriate emergency response services and facilities;
- the plans and programmes for emergency drills and exercises at the plant including interaction with the local and federal authorities to

ensure preparedness for public protection.

If required, inspections will also cover other, site-specific aspects of emergency preparedness.

Actions in case of NPP operational events

Following the "Regulations for Investigating and Accounting Operational Events at Nuclear Plants" (NP-004-97) in regard to events with the symptoms and consequences of a radiation accident, the Federal Environmental, Industrial and Nuclear Supervision Service will set up a commission to investigate the event, unless the President or the Government of the Russian Federation take a decision on forming a governmental commission.

In the event of the state "Emergency Preparedness" or "Emergency Situation" announced at a nuclear plant, a representative of the Regulatory Body will take part in the work of the Team for emergency assistance to nuclear plants (OPAS). The main responsibilities of the Regulator's representative in the OPAS Team are:

- to make sure that complete and timely measures are taken to restore the affected power unit to a safe condition including recovery of the critical safety functions, to remedy the accident consequences, and to carry out personnel protection plan within appropriate time;
- to check on the validity and promptness of the published or transmitted information about the nature and consequences of the accident;
- to notify periodically the Regulatory Body officials of the current status of nuclear and radiation safety at the plant and of the remedial measures taken.

The Regulatory Body has its own Information and Analysis Centre (IAC), which, in accordance with the relevant Manual (RD-02-16-2004), has two modes of operation, – routine and emergency response activities. In the latter case, the functions of the Centre include:

– collection and processing of the information on the current status of nuclear and radiation safety at the nuclear plant in question, coming from the Operating Organization;

– notification of Rostechnadzor officials and division heads of its headquarters of the developments in the situation at the plant;

– provision of on-line communication between Rostechnadzor headquarters, Rosatom's SCC, ERC of Rosenergoatom and its regional branches, NPPs under supervision, and all the stakeholders; provision of information and technical support to working teams in their analysis of the emergency;

– assessment of the emergency at the NPP, prediction of its possible progression, and development of appropriate recommendations to the management of the Regulatory Body;

– review of the Operator's actions in restoring safety at the affected NPP including recovery of the critical safety functions, minimisation of accident consequences, and timely implementation of personnel protection plan.

By his order of 26.01.2007, the Chairman of the Federal Environmental, Industrial and Nuclear Supervision Service renewed the membership of the IAC teams involved in the activities during radiation emergencies at nuclear plants. Regular exercises and drills are performed to keep the IAC and its working teams in readiness for action. The drill to deal with a "Simulated Accident Involving a Break in a Surge Line of the Pressuriser and Accompanied by Radioactive Release to the Environment at Balakovo Unit 4" was carried out in October 2006 and earned high marks from the foreign observers present at the drill.

The Federal Environmental, Industrial and Nuclear Supervision Service, acting as an independent body, will notify, if required, the central and local public authorities of the Russian Federation about the event at the NPP and the actions taken or in progress, and will arrange cooperation with the mass media.

Thus, proper attention is being paid to the issues of emergency preparedness in Russia. The Federal Atomic Energy Agency set up an industry-level system for prevention and mitigation of emergencies at nuclear plants. An important role in the emergency management activities belongs to the Situation and Crisis Centre of the Federal Atomic Energy Agency and to the Emergency Response Centre of the Rosenergoatom Concern. Information and Analysis Centre is functioning within the Federal Environmental, Industrial and Nuclear Supervision Service.

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

Article 17. NPP Siting

Selection of a nuclear plant site and its acceptance in terms of plant construction and safe operation are subject to regulation by federal laws, federal standards and regulations, guidelines of the Russian Regulatory Body, building codes and standards as well as by other documents, which were identified and described in the previous National Reports of the Russian Federation on the Fulfilment of Commitments Resulting from the Convention on Nuclear Safety.

Current requirements for sites of the new nuclear plant designs under development are presented below.

17.1. Requirements for NPP Sites

The natural and man-made conditions in the region of potential NPP location are investigated in keeping with the following regulatory documents:

- NP-032-01 "Siting of Nuclear Power Plants. Basic Safety Criteria and Requirements" (effective since 30.04.2002);
- NP-031-01 "Seismic Design Rules for Nuclear Plants" (effective since 01.01.2002);
- NP-064-05 "Account for External Natural and Man-made Impacts on Nuclear Power Facilities" (effective since 01.05.2006).

The stage of feasibility studies for NPP construction involves surveys and investigation of the processes, phenomena and factors likely to affect plant safety, which include:

- comprehensive seismic risk zoning;
- micro-seismic zoning;
- geological and hydro-geological explorations;
- study and calculation of radionuclide transport by surface and ground water;
- hydrometeorological and aerological surveillance and calculations;
- study of man-induced processes and phenomena; predictions and assessments.

The candidate site is studied from the viewpoint of the possibility of ensuring the safety of the plant with regard to the natural and man-induced processes, phenomena and factors as well as the safety of the population and protection of the environment against radiation impacts during normal operation and in case of design-basis accidents.

The siting investigations should produce information on the limiting factors of such location and should identify the territories where plant siting

is unacceptable (according to NP-032-01 criteria). Such sites will be excluded from further consideration.

Nuclear plants may be sited in regions of adverse natural and man-induced processes, phenomena and factors on condition that technical and organizational measures are taken to assure plant safety.

Site-peculiar hazard levels of the phenomena and factors of natural and man-induced origin are identified (NP-064-05 divide these phenomena and factors into three levels of hazard in terms of the consequences of environmental impacts), based on which they define the criteria of NPP safety and resistance to external impacts followed by the development of engineering measures for NPP site protection.

17.2. Account for Safety-Related Natural and Man-Induced Factors

Major criteria and requirements to NPP safe siting set out for new plants by the Russian regulatory documents can be summarised as follows:

- it is not allowed to place NPPs on sites located directly on the active geological breaks; on the sites with seismicity characterised by the magnitude of the safe shutdown earthquake (SSE) above 9 by MSK-64 scale; in the territories, where NPP siting is forbidden by the environmental protection legislation;
- unfavourable for NPP siting are the territories of active volcanoes or active mud volcanism; the territories susceptible to tsunami, catastrophic floods or inundations; the territories that may be flooded due to dam breaks; the areas of mudflow impacts; the regions with seismicity above 7 by MSK-64 scale; the territories, where recent earth crust movements were identified; zones of tectonic anomalies; regions with karst (thermokarst) evolutions; areas with active landslide and other soil slip processes; floodland terraces of rivers and banks of reservoirs with high velocities of shear line movement and abrasion bench kerb; slopes of 15° and above; the sites, where ground water is near the surface; areas with structurally and dynamically unstable soils, permafrost earth as well as soils with low deformation module; the territories, which contain facilities (including ammunition depots), whose explosions and fires may result in toxic substance releases and other impacts exceeding the design-basis ones.

It is allowed to site NPPs in unfavourable regions and in the areas with dangerous processes, phenomena and factors of natural and man-made origin provided the technical and organizational measures to assure safety have been completed.

Engineering surveys and research into the processes, phenomena and factors of natural origin capable of affecting NPP safety shall be performed in the plant locations and on-site.

The following tectonic activity characteristics in NPP location are to be identified:

- schematics of break and rupture locations, of the areas with earthquake potential showing the orientation and boundaries of these areas;
- potentially hazardous breaks;
- amplitudes, velocities and gradients of the latest and current earth crust movements, parameters of potential movements;
- characteristic of active zone breaks (geometry, amplitudes and directions of displacements in the breaks, time of last activation).

The following is to be identified within NPP site:

- characteristics of initial earth oscillations at safe shutdown earthquake;
- potential for landslides on the slopes taking account of soil conditions and seismic oscillations with intensities up to SSE as well as taking account of underground water impacts, tectonic anomalies, current geo-dynamic processes;
- potential for and NPP safety impact of karst (thermokarst), suffosion and karst-suffosion processes;
- existence of specific soils (biogenic, subsident, shrinking, swelling, salted, permafrost, eluvial, man-made soils), their power and physical-chemical properties (deformation modules, strength characteristics etc.) and assessment of their impacts on the non-uniform subsidence of NPP structures, reactor building heel at earthquakes with magnitudes up to SSE inclusive;
- areas with water-saturated loose soils liable to liquefaction at seismic impacts with a magnitude of up to SSE inclusive;
- NPP safety impacts of ground water level rise, and site underflooding during underground water spread, filtration from irrigated lands, water leakages, atmospheric precipitations, thaw;
- intensity of tornado, maximum values of velocity of wall rotation and speed of tornado linear motion, pressure difference between periphery and centre of tornado funnel.

For NPP site they determine maximum water level and duration of potential flooding due to precipitations, intensive thawing, high reservoir level, river bed blockage by avalanche and landslide. Besides, for coastal sites they assess the characteristics of potential maximum inundation due to tsunami or a combination of rising tide and wind-induced wave onset, the probability of tsunami (seiche) and the maximum wave height with account for seismo-tectonic conditions, coast configuration, landslides into reservoir.

In the site location and on-site they perform examinations to identify sources of potential man-made hazards. Analysis and assessments of NPP safety impacts from the sources of man-made hazards are performed taking into account the remoteness of these sources from the plant. It is allowed to

disregard the sources of man-made hazards with probabilities less than 10^{-6} per year. The sources of man-made hazards are the facilities with a potential for accidents causing explosions and fires, discharges of high-explosive, flammable, toxic and corrosive substances. They analyze NPP safety impacts of all stationary and mobile sources of explosions including facilities for the production, reprocessing, storage and transportation of chemicals and explosives located at the distance of up to 5 km, ammunition depots - at the distance of 10 km from NPP site boundary. Also determined are the parameters of the impacts of most dangerous explosions, and NPP safety is demonstrated taking into account the shock wave and secondary consequences of a potential explosion in the form of ground shakes, projectiles and local conditions for gaseous plume migration.

Factors to be analyzed are NPP safety impacts from all potential fixed and mobile sources of emergency discharges of active chemicals at the distance of up to 5 km from site boundary including industrial facilities, which process, utilize, store and transport toxic and corrosive substances. They determine the parameters of impacts on NPPs and their probabilities during events caused by explosions and fires, discharges of explosive, flammable, toxic and corrosive substances at industrial facilities, land and water transport facilities; caused by aircraft (airplanes and helicopters) crashes; floods involving front breaks of reservoirs located on rivers upstream of NPP site; accidents at water transport facilities and in coastal port zones resulting in explosions and fires, hazardous chemical releases if the plant is situated at the sea shore; by electromagnetic fields; external fires (burning of forests, peat, flammable liquids); mining of minerals, excavations (tunnels, mines, open pits); oscillations of water level in NPP water supply source.

The above shows that when new nuclear units are designed in the Russian Federation, the candidate sites are studied for acceptability in terms of safety assurance with regard to the natural and man-induced processes, phenomena and factors.

Article 18. Design and Construction

The basic principles of NPP design and construction found in the federal standards and regulations, and the results of their elaboration were described in detail in the previous National Reports of the Russian Federation.

18.1. Regulatory Framework for Design and Construction of Nuclear Plants

The basic principles of NPP design and construction in Russia laid down in the federal standards and regulations were discussed in the previous National Reports of the Russian Federation on the Fulfilment of Commitments Resulting from the Convention on Nuclear Safety.

The assessment made by the IAEA in the document "Comparison of the Russian Nuclear Power Plant Safety Concept Contained in OPB-88 and the Next Lower Level Norms/Rules with the NUSS Requirements", IAEA, VVER-RD-69, 1994, confirmed that the Russian basic safety principles, standards and regulations are essentially similar to the international standards developed within the IAEA NUSS Programme.

The basic principles to be followed during NPP design and operation are stated in the following codes and standards:

- "General Guidelines for Assuring Nuclear Plant Safety" (OPB-88/97);
- "Standards for Designing Seismically-resistant Nuclear Plants" (NP-031-01);
- "Siting of Nuclear Plants. Basic Criteria and Requirements to Safety Assurance" (NP-032-01);
- "Accounting for External Impacts of Natural and Man-induced Origin on Atomic Energy Facilities" (NP-064-05);
- "Fire Safety Rules in the Russian Federation" (PPB-01-03);
- "Health Rules for Nuclear Plant Design and Operation" (SP AS-03);
- and others.

18.2. Improvements in the Designs of New NPPs

Development of new nuclear plants with 1000-1200 MWe WWER reactors, which are planned to be constructed after 2012, draws on the positive domestic and international experience.

The safety of NPPs is achieved through implementation of the defence-in-depth principle.

New NPP designs implement the following approaches:

- conformity to the requirements of current standards and regulations in the area of atomic energy, provision of margins to ensure the compliance with the established safety criteria;
- conformity to the globally accepted approach to safety systems of pressurised water reactors;
- combination of active and passive principles of safety system functioning with extensive use of passive systems;
- use of NPP inherent safety features;
- high level of automation for the control of active safety systems to preclude personnel intervention at initial stages of accidents;
- design of safety systems with regard to the conditions and impacts of design-basis accidents, and to the conditions of beyond-design-basis accidents.

The main principles of ensuring reliable operation of safety systems followed in the design of new nuclear units include:

- redundancy;
- design of components and systems in accordance with the safe failure principle;
- physical separation of trains and systems, elimination of dependence on support systems;
- protection against internal impacts (fires, floods, water-steam jets, projectiles, pipe whipping, adverse changes in plant room environmental conditions);
- ensuring protection against site-typical impacts of natural origin (earthquakes, tornadoes, hurricanes, high and low water levels, high and low temperatures etc.) and of man-made origin (accidents at air/water/land transport facilities, accidents in long-distance pipelines, external fires, dam breaks etc);
- assuring higher level of reliability for safety functions with greater number of demands for operation;
- continuous and/or periodic monitoring of availability; self-diagnostics;
- conservative approach in case of accidents progressing within the design-basis limits and a realistic approach to beyond-design-basis accidents (extended design).

The design solutions are aimed at implementation of inherent safety features specific to facilities with pressurised water reactors.

The inherent safety of a reactor installation is its capability to prevent development of initiating events and accidents, to restrict their consequences without personnel involvement, energy consumption and outside aid for a long time. This time period should be used by personnel to assess the situation and take corrective actions.

The level of inherent safety is determined by the following criteria: duration of the permissible "non-intervention period" in various situations; the degree to which the values of the key safety parameters are inherently restricted, slow progression of abnormal processes.

The inherent safety features of a reactor should provide restriction of energy release, of reactor pressure and temperature, and of heat-up rate; they should limit the extent of integrity loss by the primary circuit, the leakage rate and the degree of fuel damage.

18.3. Licensing for NPP Design and Construction

Decisions to construct a nuclear installation are taken by the Government of the Russian Federation.

The design solutions and the measures taken to ensure the safety of the nuclear plant to be built are mainly reviewed during licensing of NPP construction.

To obtain a license for building a nuclear unit, the Operating Organization must submit to the Regulatory Body an application for a license complete with a package of documents to prove the capability of the applicant to carry out NPP construction on its own or by enlisting the services of other organizations.

In keeping with the "Requirements to the Structure and Content of the Documents which Justify Nuclear and Radiation Safety of a Nuclear Installation, Radiation Source, Nuclear Materials Storage Facility, Radioactive Waste Storage and/or Declared Activity (for Nuclear Plants)" (RD-04-03-2006), the package of documents produced to demonstrate nuclear and radiation safety assurance and submitted to obtain a building license, should contain:

- Preliminary Safety Analysis Report (PSAR) for the nuclear plant;
- a general Quality Assurance Programme – POKAS(O);
- specific Quality Assurance Programmes for various activities;
- design documents (including those for reactor, automated process control system, safety-related systems, and description of the physical protection system), reports on tests and development efforts referred to in the PSAR;
- PSA Level 1.

The Quality Assurance Programmes are developed in compliance with the requirements of the Regulatory Body, which are laid down in the document entitled "Requirements for the Quality Assurance Programme of Nuclear Plants" (NP-011-99).

The information presented in the Preliminary Safety Analysis Report of the Nuclear Plant (PSAR) is based on the documents pertaining to the NPP design and the engineering design of the reactor facility and safety-

related systems. This information should be full enough to give an adequate insight into NPP design and its safety concept, into the Quality Assurance Programme and the basic operation principles adopted by the Operating Organization.

On the strength of the information found in the PSAR, the Regulator assesses the adequacy of the safety case for construction, commissioning, operation and decommissioning of a NPP on a particular site so as to avoid overexposure of personnel and population (as against the permissible dose levels) and to prevent violation of the regulatory limits for releases of radioactive substances and their concentration in the environment during normal operation and design-basis accidents, as well as to make sure that such impacts may be limited in case of beyond-design-basis accidents.

The safety concept presented in the PSAR must meet the requirements of the current regulatory documents.

The Preliminary Safety Analysis Report should cover, among other things, the nuclear unit decommissioning issues. The main safety principles and requirements as applied to decommissioning are found in the regulatory document "Rules of Safety Assurance during Decommissioning of a Nuclear Unit" (NP-012-99).

The decision on granting a license or rejecting a license application are made by persons authorised accordingly by the Regulatory Body on the basis of the results produced by verification of the information presented in the application documents, by review of the documents to demonstrate the assured nuclear and radiation safety of the installation in question as well as by inspections. The decision is documented as officially required.

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 new nuclear plants, which is consistent with the international safety standards and requirements.

Nuclear plants may only be designed and constructed subject to the availability of licenses (permits) granted by the Regulatory Body of Russia.

Article 19. Operation

19.1. Safety Case and Licenses for Operation of Newly Built Nuclear Power Units

The procedure for licensing the operation of nuclear power units laid down in the "Manual for Licensing the Activities in the Area of Atomic Energy Use" has not changed since the third Meeting of the Contracting Parties.

Following this procedure, Unit 3 of Kalinin NPP was commissioned in 2005, which was the last one among the new power units put into operation in Russia. All major activities in the plant commissioning were carried out under a construction license.

The decision on granting the license for the power unit operation was made by the Regulatory Body of Russia upon review of the documents to support the application of the Operating Organization.

The documents required to demonstrate the assured nuclear and radiation safety of the newly built power unit to be commissioned, are identified in the "Requirements to the Structure and Content of the Documents..." (RD-04-03-2006). To obtain an operation license, the Operating Organization submitted the operational and other documents covering the issues of safety in operation of the power unit, which included the Power Unit Commissioning Programme, the First Criticality Programme with an experimental procedure, and the First Power Programme.

In the course of power unit commissioning, reports were submitted to the Regulatory Body to present the results of the first-criticality and first-power activities as well as of the pilot operation of the power unit (with each report submitted on completion of the corresponding work stage before starting the next one). Besides, with the tests completed, all the variations and deviations were taken into account in the final updating of the safety case and the operational documentation.

The power unit was brought to first criticality and then to first power after the Regulatory Body had inspected the plant to make sure that it was actually ready for the start-up.

19.2. Current System for Updating Safe Operation Limits and Conditions

The "Technical Specification of NPP Safe Operation" is a key document to guide the operation of every power unit. It specifies the limits and conditions of safe operation justified at the design stage and updated in accordance with the results of the pre-commissioning, first-

criticality and first-power activities. Besides, the Technical Specification defines the rules and main methods for safe operation of the plant as well as the general order of operations related to plant safety.

The procedure for updating the design and operational documents including changes in the safe operation limits and conditions, is set forth in the Regulator's Guidelines "Main Principles of Preparing, Considering and Taking the Decisions on Updating the Design, Technological and Operational Documentation with Implications for Nuclear and Radiation Safety" (RD-03-19-94). Such updating may result in the revision of safe operation limits and conditions. Any modification that may lead to a change or updating of safe operation limits and conditions and operational limits, is only made upon comprehensive review of its safety case presented in the corresponding documents, scientific and technical reports, calculations and other documentation. The corresponding changes are made in the design and operational documents as required by the pertinent procedure, and the Technical Specification is updated, which means that the licensing conditions for operation will be also changed.

The Regulatory Body will grant permission to change the terms of the license as requested by the applicant after the supporting documents are reviewed.

Safe operation limits and conditions may be demonstrated as suggested by the results of safety analyses (including probabilistic safety assessment) or in-depth safety assessment.

19.3. Current System of Regulating Maintenance and Repairs, Inspections and Tests of Nuclear Installations

The Russian nuclear power sector has a unified system of in-service maintenance and repairs (M&R), which is meant for NPPs of different types and takes into account the design specifics of reactors and major equipment.

The full list of documents, which must be available at a nuclear power unit during its operation including the documents dealing with maintenance, repairs, inspections and tests, is established by the "Basic Rules for Operation of Nuclear Plants" (RD EO 0348-02).

Based on the current M&R documents, the administration of each NPP develops a specific maintenance and repair programme, which is implemented according to M&R schedules worked out and approved for all types of plant equipment and systems. The operations are carried out in accordance with the M&R Procedure for safety-related systems available at every power unit and follow the time schedule approved by NPP administration.

Maintenance of the equipment and systems is performed mainly by plant personnel and includes surveillance of variations in the parameters of operating equipment for their early correction, preventive actions, and the specified tests of equipment, instruments and systems.

All the repairs are carried out by the plant's M&R personnel and by contractors licensed by the Regulatory Body.

Preventive maintenance is performed regardless of the actual condition of the equipment by the beginning of the work, at the intervals and to the extent specified in M&R procedures.

The frequency and scope of planned maintenance of the plant's equipment and systems are dictated by the need for keeping the equipment and systems in a robust state to meet the conditions of safe operation and the operational limits established in the NPP design. The necessity for unplanned maintenance and repair of equipment and systems is determined by inspection of their condition.

The established examination and testing procedure specifies such operations for safety-related systems.

Systematic inspection of nuclear plants by the Regulatory Body and the Operating Organization follows the annual schedules of planned inspections. Article 14 of this Report gives a detailed account of the plant inspection issues.

The results of inspections and examinations carried out by the Operating Organization are recorded in the statements, where the deficiencies revealed are identified, critical comments are presented, and the corrective measures are suggested.

19.4. Procedure for Accounting Safety-Significant Operational Events at NPPs

Current activities in the accounting of and analysing operational events at nuclear plants including safety-significant ones are regulated by the following documents:

- "Regulations for Investigating and Accounting Operational Events at Nuclear Plants" (NP-004-97);
- "Procedure for Early Reporting to Rosenergoatom Concern, Rosatom, Rostechnadzor and JSC "SO-CDU EES" (Central Dispatching Office of the United Grids of Russia) on Current Operation of Nuclear Plants" (RD EO 0331-2004);
- "Regulations for Organization of Investigations of Operational Events at Nuclear Plants by Rosenergoatom Concern" (RD EO 0163-2005);

- "Methodological Guidelines for Analysing the Causes of Operational Events at Nuclear Plants, Fires, Industrial Accidents and Damage to Buildings and Structures" (RD EO 0095-2004);
- NPP documents specifying the procedure for investigating and accounting operational events.

It should be noted that the regulatory framework for these activities was developed in full regard to the IAEA recommendations set forth in Safety Guide No. 93, "System of Reporting Unusual Events at Nuclear Power Plants" and taking into account the Russian experience of involvement in the international Incident Reporting System (IRS), IAEA/NEA as well as in the WANO's programme "Operating Experience" ("Exchange of NPP Operating Experience").

The Regulations NP-004-97, which is part of the federal standards and regulations, establishes:

- the categories of operational events to be investigated;
- the order of accounting the events and the order of corresponding notification;
- the order of investigating the operational events.

Operational events fall into the categories of:

- "accidents", according to the degree of on-site and off-site radiation impacts;
- "incidents", according to the degree of defence-in-depth degradation and on-site radiation impact.

Operational events are those resulting in deviations from normal operation, from the established limits and/or conditions of safe operation.

All events at the plant with the symptoms and consequences of an operational event are reported by the plant management to the Operating Organization and to the Regulatory Body as an early event report within one hour of its occurrence or detection and then in the extended form of a preliminary event report within 24 hours of its occurrence or detection.

Within the next 15 days, a commission will carry out an investigation, whereupon the nuclear plant will send a full report to the Regulatory Body and the Operating Organization giving an account of the investigation performed and proposing corrective actions to prevent similar events in future. Each operational event is rated according to the International Nuclear Events Scale (INES) following the INES User's Manual (IAEA-INES-2001).

The RD EO 0331-2004 Procedure (the Operator's guideline) was produced to bring the requirements of corporate documents in compliance with the industry-level and federal documents that specify the procedure for prompt notification of the appropriate authorities and organizations

about the current state of power units and the abnormal conditions[1] at nuclear plants of the Rosenergoatom Concern.

"Regulations for Organization of Investigations into Operational Events at Nuclear Plants by Rosenergoatom Concern" RD EO 0163-2005 (effective since 01.12.2005) set forth the requirements for organizing and conducting investigation of various operational events at NPPs by Rosenergoatom Concern. Besides, this document defines the categories of operational events at NPPs that are not reportable to the Regulatory Body. The Regulations seeks to ensure a systems approach at Rosenergoatom Concern to investigation of operational events and early detection of deviations from normal operation that can potentially have severe consequences.

"Methodological Guidelines for Analysing the Causes of Operational Events at Nuclear Plants, Fires, Industrial Accidents and Damage to Buildings and Structures" RD EO 0095-2004 (effective since 01.04.2005) define the procedures for identifying the direct and root causes and the contributing factors of NPP abnormal events, whose consequences are classified as: operational event at the plant, fire, industrial accident, damage to buildings and structures etc., with the aim of working out appropriate corrective actions to prevent their recurrence.

These Methodological Guidelines were developed with regard to the IAEA ASSET Methodology (IAEA-TECDOC-632) and the methodology of the US Institute of Nuclear Power Operations (INPO 90-004), which had proved their efficiency in many countries with operating nuclear plants.

Application of the Methodological Guidelines presupposes that, besides the covered methods for analysing the causes of abnormal events at NPPs, special methods should be employed to analyse, wherever required, the direct causes of system component failures (e.g., metal inspection methods, water chemistry monitoring methods, radiochemical methods for determining the dose received, methods for estimating the strength of structural components, etc.).

Methodological Guidelines RD EO 0095-2004 are used during investigation and analysis of the following types of events at nuclear plants:

- operational events including those to be investigated in accordance with NP-004-97;
- fires (ignitions);
- industrial accidents;
- damage to buildings and structures, to their parts and structural components;
- damage to engineered features of dangerous facilities;

[1] Abnormal conditions imply a breach of normal production conditions, of radiation, fire and chemical safety conditions, of normal social conditions at the nuclear plant.

- overexposure of personnel;
- undue environmental contamination.

Methodological Guidelines are also used in investigating and analysing the causes of events connected with deficiencies in the organization of various activities, e.g., violations of work schedules and processes, failures to supply materials and spare parts, violations of technological or financial discipline.

Reports on investigation of operational events are kept at the NPP till the time of its decommissioning. The Operating Organization has a computerised database for recording and analysing operational events at NPPs maintained by VNIIAES.

The Operator arranges for the issue of quarterly and annual reports to cover all operational events at NPPs including those of safety significance, in which the direct and root causes as well as the contributory factors are identified and the corrective actions taken to preclude the recurrence of similar events are described.

The managerial, operation and maintenance personnel of NPP divisions, whose activities are safety-related, will get acquainted with such overviews of the reported investigation results. Besides, Russian nuclear power plants will study and analyse all the reports and reports on investigation of operational events (incidents) coming from other NPPs, from VNIIAES (including inputs from the IAEA/NEA IRS), and from WANO. Analysis of the significance of safety issues addressed in these reports as applied to specific plant conditions is performed. From these accounts, information is selected, which may be of interest for training the operating and maintenance personnel of a particular NPP. Such information is analysed by instructors of training points and centres and will be subsequently used as instructional material in training and retraining plant personnel.

The reports and reviews on analysis of operational events at Russian and foreign NPPs contain recommendations to the managerial, operating and maintenance personnel concerning the ways of preventing similar events. The above documents are disseminated among all NPPs, appropriate divisions of the Operator’s and Regulator’s headquarters, and the organizations providing scientific and technical support to NPPs.

Analysis of the operational events at Russian nuclear power plants, that occurred in 2006, shows that out of the 42 events, 18 do not fall under INES criteria, i.e. they are "out of scale", and 24 events are rated as Level "0". Among the total number of NPP operational events there were no safety-related events, i.e. the events rated by INES at Level "1" and above.

Distribution of NPP operational events rated by INES in 2004-2006 is presented in Appendix 10, while their trends over the same period are shown in Appendix 11.

The presented data show that the number of operational events at Russian NPPs decreases every year, while their "severity" according to the INES criteria is fairly low.

19.5. Personnel Actions during Accidents and Emergencies

In case of occurrence of accidents or emergencies at nuclear plants, the operating personnel are guided by the requirements of appropriate emergency action documents. These are procedures for eliminating emergency situations and design-basis accidents, guides for beyond-design-basis accident management, action plans for personnel protection.

If any symptoms of an occurring emergency or an accident are detected at a nuclear plant, the plant shift supervisor will immediately report it to the plant management (Director or Chief Engineer) and will notify the appropriate organizations and officials of the event, following the List given in Appendix 12.

The procedure for eliminating emergencies and design-basis accidents defines the actions to be taken by operating personnel in order to restore the nuclear unit to a normal condition. This document addresses the initiating events and emergencies in systems and components as well as deviations from the specified parameters that will or may lead to design-basis accidents. For each initiating event, among all those credible, consideration is also given to the conditions of its occurrence and to the ways of accident progression that will have the most severe consequences (a conservative approach).

Progression of initiating events into design-basis accidents, and of the latter into beyond-design-basis accidents is prevented by safety systems. Designs of NPPs of the next generation are being developed to incorporate new safety systems designed for passive operation, whereby performance of the intended safety functions will be made more reliable.

A major regulatory requirement and a prerequisite for permission to operate a nuclear power plant, is the availability of a beyond-design-basis accident management procedure, which should describe the measures to be taken for managing beyond-design-basis accidents and for mitigating their consequences.

Special attention is paid to protecting reactor hermetic enclosure confinement against failure during a beyond-design-basis accident and to maintaining its operability. The main idea in the work on protecting the confinement during beyond-design-basis accidents was to fit up such systems at Russian NPPs with passive autocatalytic hydrogen recombiners, which provide hydrogen oxidation (recombination) beyond the ignition limits, and thereby prevent fire or explosion impacts on the leak-tight

compartments of the power units under the conditions of a severe beyond-design-basis accident.

Pursuant to the "General Guidelines for Assuring Nuclear Plant Safety" (OPB-88/97), which require that personnel should be guided in their actions by the symptoms of the events in progress and the reactor facility state as well as by prediction of the conditions to emerge in the course of accident progression, the Operating Organization developed symptom-based emergency operating procedures (SB EOP) for all power units with WWER and RBMK reactors. These new emergency procedures are fully consistent with the concept of personnel actions in accident management taken with regard to the condition of the reactor facility and the physical barriers. Based on prediction, these procedures specify the actions of operating personnel, guiding them to terminate the abnormal event and to bring the power unit back to a controllable state, when the chain fission reaction may be suppressed, the nuclear fuel in the reactor cooled down, and the radioactive substances confined within proper boundaries. In doing so, the use of normal operation systems is also allowed.

19.6. Provision of Engineering and Scientific Support to NPPs

The Russian Operating Organization provides the required engineering and scientific support to nuclear plants throughout their life cycle using both its own resources and external services.

The types and forms of engineering support vary at different stages of plant construction, commissioning and operation depending on the problems to be dealt with by the Operator and a particular nuclear plant.

For certain work to be done, the Operating Organization and the nuclear power plants will normally award contracts to enlist the services of specialised research, design, maintenance, set-up and other organizations, as well as of nuclear equipment manufacturers.

The Federal Atomic Energy Agency embraces in its framework major research, design and architect-engineering institutes, maintenance, set-up, construction, installation and other companies and organizations, which have extensive work experience in the nuclear power industry and are licensed by the Regulatory Body for corresponding kinds of activities. Such organizations providing essential and efficient support to NPPs include:

- Design Bureau (OKB) "Gidropress";
- Research and Development Institute of Power Engineering (NIKIET);
- Design Bureau for Mechanical Engineering (OKBM), Nizhni Novgorod;

- Design Institute "Atomenergoproekt" (AEP), Moscow;
- "Atomenergoproekt" Institute (SPbAEP), St. Petersburg;
- "Atomenergoproekt" Institute (NIAEP), Nizhni Novgorod;
- National Research Centre "Institute of Physics and Power Engineering" (FEI);
- All-Russian Research and Design Institute of Energy Technology (VNIPIET);
- Research and Design Institute of Installation Technology (NIKIMT);
- "Atomtekhenergo" Company (ATE).

Continuous scientific and technical support in dealing with NPP operation issues is provided to the Operating Organization by the All-Russian Research Institute for Nuclear Power Plant Operation (VNIIAES).

Besides, the Operating Organization and the nuclear plants receive scientific support in regard to a wide range of safety problems from the Russian Research Centre "Kurchatov Institute" (RRC KI).

19.7. Programmes for Collection and Analysis of Information on Operating Experience of NPPs. 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 NPP safety assurance laid down by the IAEA in INSAG-12 "General Principles of Nuclear Plant Safety", in Safety Report No. 110 "Safety of Nuclear Installations", Safety Guides NS-R-2 "Safety of Nuclear Power Plants: Operation" and NS-G-2.11 "System for the Feedback of Experience from Events in Nuclear Installations", Rosenergoatom Concern, as the Operator, organizes and coordinates the activities to provide proper functioning of the industry-level System for Analysis and Use of Nuclear Plant Operating Experience (SAI OE), with VNIIAES rendering scientific and technical support in this effort. Basic arrangement of the analysis and feedback of operating experience, as practiced in the nuclear industry, is schematically shown in Figure 19.1.

Organization and functioning of the industry-level system rely on the following components: documentation management system of Rosenergoatom Concern; the system of human resources management; the industry-level Information and Analysis System for NPP Operating Experience (OIS OE); the financing system; and the management and supervision system.

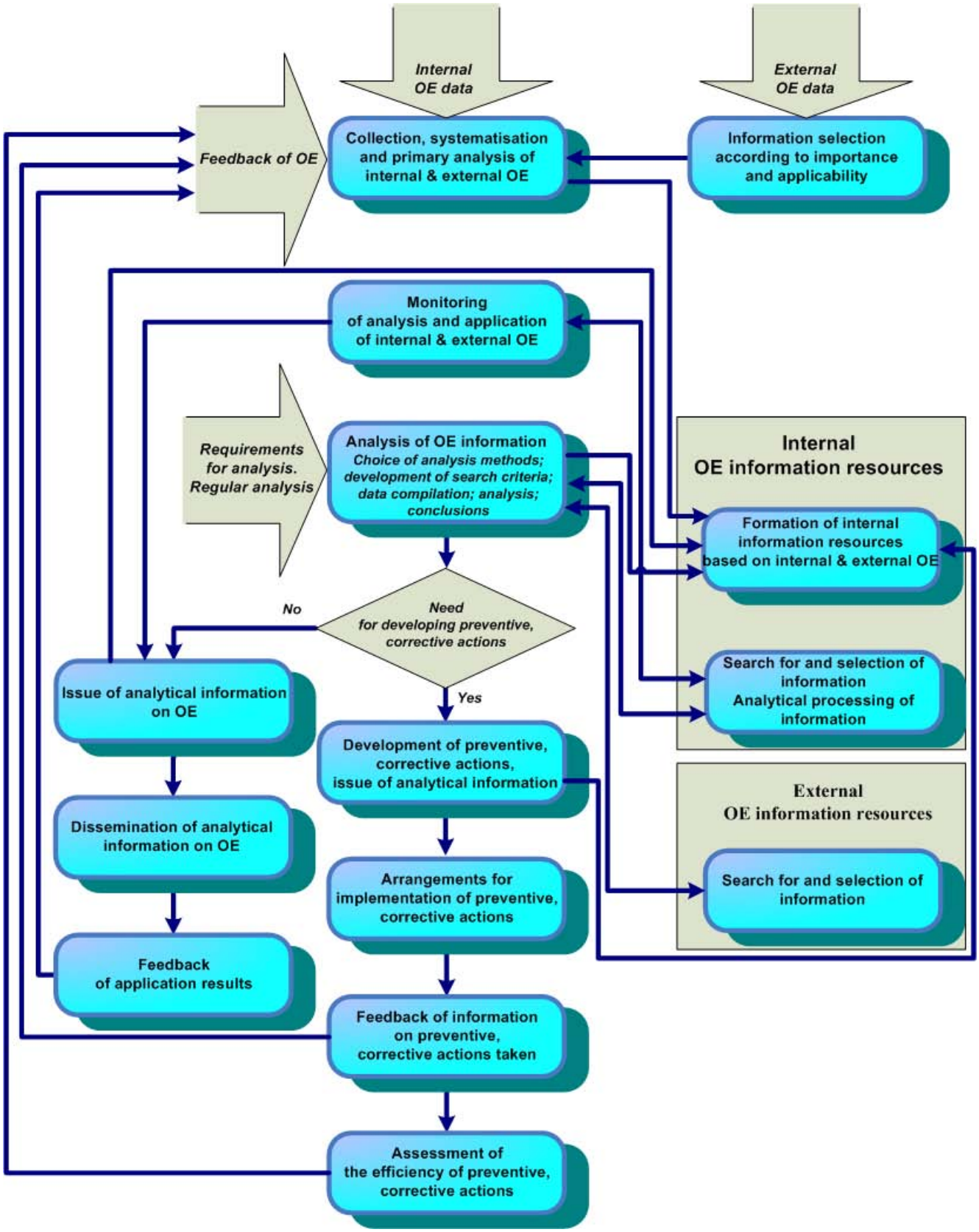


Figure 19.1 - Basic Schematic of the Analysis and Feedback of Operating Experience (OE)

Organization of efficient data collection, storage, processing, analysis, exchange and dissemination as well provision of the proper feedback of operating experience, are based on the systems approach. The key feature in implementing the systems approach is the information system deployed at the industry and plant levels, which operates in an integrated information space and uses shared data exchange media. The industry-level Information and Analysis System for NPP Operating Experience of Rosenergoatom Concern (OIS OE) is intended for collection, accumulation, storage, exchange and analysis of various structured information on the operating experience of nuclear plants as part of the Corporate Information System of Rosenergoatom Concern, e.g. information about all operational events including likely precursors of serious incidents and accidents.

OIS OE operation largely depends on the development and implementation of procedures for interaction of its participants and for data handling within it. A revised guide of the Operator entitled "Basic Principles of Organizing the Industry-level Information and Analysis System for Nuclear Plant Operating Experience of Rosenergoatom Concern" (RD EO 0152-2005), was brought into effect in 2005. The purpose of this document is to provide for efficient exchange and use of information on operating experience of nuclear plants by the nuclear industry organizations, i.e. – nuclear plants in operation and under construction, enterprises and organizations of Rosenergoatom, research and design institutes of the Federal Atomic Energy Agency – to assure safe, reliable and economically efficient operation of nuclear plants.

The document contains requirements for the organization of the OIS OE System and for its functioning procedures covering:

- composition and configuration of the System to fit the specific subject areas of its data domain;
- arrangement of topical information processes and resources of the System at the industry and plant levels;
- arrangement of topical information processes and resources of the System at the inter-industry and international levels;
- assignment of responsibilities for supervision, coordination and performance of work, for methodological support and maintenance of the System operation.

An important addition to the "Basic Principles" (RD EO 0152-2005) was made by VNIIAES, which developed a package of methodological documents to determine the order of preparing (scope, formats, etc.), transferring and using various OE information by nuclear plants and different companies (organizations) within the framework of OIS OE System, namely: "Methodological Guidelines for Collection, Processing

and Feedback of Information on the Operating Experience of Nuclear Plants" (RD EO 0194-00).

Using the information coming from nuclear plants, VNIIAES maintains industry-level databases for the specific subject areas of the OIS OE System.

With the aim of defining the principal requirements for accumulation, analysis, application and dissemination of the OE information in the industry throughout the life cycle of NPPs to minimise the adverse impacts on the plants and to enhance the quality of their operation, Rosenergoatom developed in 2006 the Operator's standard "Analysis and Use of Operating Experience of Nuclear Plants. Basic Principles" (STO 1.1.1.01.002.0646-2007). This document sets out the main principles of organizing and functioning of the system for analysis and use of operating experience (SAI OE) of domestic and foreign NPPs at the existing and emerging nuclear plants as well as in the divisions of Rosenergoatom Concern. The Basic Principles refer to:

- organization of the OE analysis and feedback system at the plant and industry levels;
- main sources of OE data;
- criteria for assessing and selecting OE data for in-depth analysis;
- development of corrective actions and supervision of their implementation;
- OE analysis, documentation, application, and dissemination of its results;
- quality control in accumulation, analysis and application of OE data.

Work is under way at Rosenergoatom to develop and introduce Administrative instructions on analysis and use of operating experience of nuclear plants with the aim of elaborating the main provisions of the above standard both at the industry and at the plant levels (i.e. at all the information management levels of the OE analysis and use system).

The Operating Organization developed and has been actually using since 2005 a special programme for training and retraining of specialists in the divisions of the Rosenergoatom Concern, nuclear plants and supporting organizations, who deal with investigation and analysis of event causes as well as with the feedback of OE at the plant and industry levels.

To provide for Russia's participation in the international information systems of the IAEA (IRS, PRIS, INES) and being a member of the WANO Moscow Centre, VNIIAES receives and circulates through the nuclear industry the following information on foreign experience:

- events at NPPs;

- NPP performance indicators;
- operating experience of NPPs;
- experience with peer reviews;
- good practices.

Application of Russian and foreign operating experience allows preventing nuclear plant operational events and enhancing plant safety.

Information on operational events and equipment failures received from NPPs is also used for the following purposes:

- to obtain statistics for probabilistic safety assessments of NPPs;
- to estimate major equipment reliability indicators;
- to reveal the trends in and to make comparative assessments of the operational activities;
- to identify recurrent events and to find out the reasons for such recurrence;
- to compare the progression of real abnormal processes with the design-basis algorithms;
- to analyse the performance of safety systems;
- to develop recommendations for prevention of operational events.

Based on analysis of operational events and other information received from nuclear plants, industry enterprises, international and foreign organizations, VNIIAES issues various analytical documents on domestic and foreign operating experience containing both generalised data and accounts of individual events and facts, which may be of interest to the industry specialists. The issued documents include, for example:

- Annual summary reports on assessment of the operational safety of Russian nuclear power units;

- Quarterly and annual reports on analysis of the main performance indicators of Russian NPPs;

- Quarterly and annual reports on analysis of operational events at Russian NPPs, which describe such events, their causes and safety implications, assess the personnel actions and identify the corrective actions planned to prevent the recurrence of similar events;

- Event rating forms of INES ratings of events;

- Annual reports on the flaws, damage and failures of equipment at Russian NPPs with recommendations for equipment improvement;

- Summary lists of technical solutions taken at Russian NPPs;

- Reports on operational events at Russian NPPs;

- Reports on incidents at foreign NPPs (from IAEA/NEA IRS);

- Issue-specific reports on analysis of: reactor scrams, safety system failures, etc.;

- Overviews of serious incidents at domestic and foreign NPPs;

- Quarterly information letters about the feedback from nuclear plants and other enterprises of the industry to VNIIAES reports on domestic and foreign operational occurrences.

The major information-analytical materials of VNIIAES concerning the operating experience of domestic and foreign NPPs are sent out to more than 25 addressees in various divisions of the Operating Organization, nuclear plants, supporting enterprises (organizations) of the nuclear industry as well as in Rosatom and Rostechnadzor divisions.

To expedite the distribution and subsequent use of such information in local computer networks of NPPs, the analytical reviews are e-mailed in electronic form to all NPPs and are also placed in the system of internal Web servers of OIS OE maintained by VNIIAES, which is accessible to hundreds of representatives of all NPPs appointed by Chief Engineers as well as of other affiliated entities and divisions of the Operating Organization.

19.8. On-Site Management of Radioactive Waste and Spent Nuclear Fuel and Measures Taken to Reduce Their Quantities

19.8.1. Radioactive Waste of NPPs and Waste Reduction Measures

The main objectives of radioactive waste (RW) management at NPPs are:

- to reduce as much as practicable the RW quantities that have to undergo processing;
- to develop and introduce a new generation of efficient and cost-effective facilities for solidification of liquid radioactive waste;
- to develop a technology for RW storage and disposal.

The main purpose of developing methods for liquid radioactive waste (LRW) treatment is to reduce the total volume of such waste and, at the same time, to minimise the possibility of radionuclides escaping to the environment. Attainment of these purposes can be largely facilitated by solidification of liquid waste and by placement of the solid products in storage facilities where their long-term monitoring may be provided.

The processes and equipment for treatment of solid radioactive waste are designed to reduce the waste mass and volume and to enhance the reliability of radioactive material confinement.

The industry's strategy for management of radioactive waste from Russian NPPs provides for the following stages in these activities:

- LRW collection and sorting by the level of activity, salt content, and presence of surfactants. Solid radioactive waste (SRW) is also classified by the activity level and, besides, is divided into combustible, non-combustible, metal, and other categories depending on the decisions taken for its subsequent treatment or storage;
- RW concentration (volume reduction). The concentration methods practised by NPPs are evaporation for LRW and compaction and incineration for SRW;
- temporary disposal of concentrated waste in on-site storage facilities. The reason for such storage may lie in the absence of facilities for final waste treatment or in the need for reducing the waste activity, which is achieved owing to decay of short-lived radionuclides;
- waste conditioning, with liquid and solid waste converted to a form suitable for storage, shipment off the NPP site, and for disposal in centralised repositories;
- storage of conditioned RW on NPP site is viewed as a temporary measure dictated by the need to reduce waste activity. To this end, use is made of special engineered structures (storage facilities) built on NPP sites;
- transportation and final removal of waste from the sphere of human activities by its disposal in special repositories.

As of today, nuclear plants have completed the first three stages of the above concept and some of them have already entered the fourth stage.

All the RW management activities are covered in the industry-level "Programme for Handling Radwaste at NPPs of Rosenergoatom Concern", which was updated in 2003 with regard to the recent regulatory documents.

Based on this industry-level Programme, an individual work programme and a site-specific RW management process were developed for each NPP. In deciding on a particular process, consideration was given to the storage conditions, availability of appropriate facilities as well as to the operating conditions of the plant.

Besides, each NPP has worked out measures to reduce RW generation, which are updated on an annual basis.

Administrative instructions on RW management as part of the quality assurance system have been developed and put into effect at all NPPs.

All the above documents were developed with regard to and in compliance with the current safety regulations.

All nuclear plants operating in Russia have standard RW treatment and processing facilities, which allow reducing the activity and volumes of radioactive waste.

High-evaporation facilities are in operation at Balakovo, Volgodonsk and Novovoronezh NPPs; equipment for packing salt fusion cake in metal-and-concrete casks is nearing commissioning at Volgodonsk NPP.

LRW solidification facilities are planned to be put into operation at Kola, Kursk, Leningrad and Novovoronezh plants in 2007-2009.

Bituminisation facilities are in use at Kalinin and Leningrad NPPs.

The ion-selective sorption process for LRW treatment has been introduced at Beloyarsk NPP and is about to be brought in at other plants.

In 2006 Kola NPP put into operation a pilot complex for liquid radwaste treatment.

The Waste Processing Centre (WPC) at Balakovo NPP comprises sorting, incineration, compaction and cementation facilities. Besides, it is planned to bring into service facilities for high-percentage decontamination of spent ion-exchange resins at Kalinin NPP.

Compaction facilities operate at Balakovo, Beloyarsk, Kola, Kursk, Smolensk and Novovoronezh NPPs.

Incineration facilities are available at Balakovo, Beloyarsk, Kola, Kursk, Smolensk and Leningrad NPPs.

The Operator keeps the RW storage conditions at NPPs under systematic control.

19.8.2. On-Site Storage of Spent Fuel

Storage of spent nuclear fuel (SNF) at NPPs is currently carried out in two ways depending on back end of the nuclear fuel cycle:

- the SNF of WWER-440 and BN-600 plants undergoes interim storage in at-reactor spent fuel pools followed by shipment off the site to a reprocessing facility;
- the SNF of WWER-1000, RBMK-1000, EGP-6 and AMB reactors is not reprocessed and is kept in special on-site storage facilities or in the central storage facility of the Krasnoyarsk Mining and Chemical Complex (MCC).

On NPP sites SNF is placed in spent fuel pools (SFP) adjacent to the reactors as well as in cooling ponds of separate-standing storage facilities. Leaky spent fuel assemblies, in their individual flasks, are also kept in the SNF pools.

After 3 to 5 years of cooling in spent fuel pools, spent fuel of WWER-440 reactors is taken to the RT-1 facility at "Mayak" Complex for reprocessing at a rate dictated by SNF accumulation.

Spent fuel assemblies (SFA) have been completely removed from the sites of Novovoronezh Units 1 and 2.

SFAs of WWER-1000 reactors are shipped to the central storage facility of the Krasnoyarsk MCC after a cooling period of no less than 3 years.

The RBMK-1000 plants normally practice interim spent fuel storage in at-reactor pools, where each SFA – placed in a separate flask filled with

water – is kept for at least 3 years, whereupon the assemblies are transferred to the on-site SNF storage facility for temporary disposal.

The Concept of Spent Nuclear Fuel Management adopted by the RF Ministry for Atomic Energy and officially approved in 2003, envisages arrangement of long-term SNF storage on NPP sites with the use of double-purpose metal-and-concrete casks.

To this end, containerised SNF storage complexes are being set up at RBMK-1000 plants. The planned time of their commissioning is the year of 2008 for Kursk and Leningrad NPPs and 2009 for Smolensk NPP.

The SNF handling technology at the Bilibino NPP is limited to storage in at-reactor spent fuel pools.

The Work Programme for safe handling of spent nuclear fuel at Bilibino NPP and for preparation of its power units for decommissioning includes a package of measures to assure long and safe SNF storage in the site facilities in case it proves impossible to remove it from the site. The main SNF management option lies, as before, in long-term "dry" on-site storage – in the existing facilities and in the additional spent fuel pool (SFP-4). The latter is planned to be commissioned in 2008.

To provide for decommissioning of the AMB reactors at Beloyarsk (Units 1 and 2 were shut down in 1981 and 1989, respectively), spent fuel assemblies were partly removed from the plant territory, with the remaining SFAs enclosed in special dry cans and kept in the plant’s cooling pools. Safe handling of SNF from the AMB reactors is provided following the Programme for assuring safe storage of spent nuclear fuel of AMB reactors and its removal from Beloyarsk site approved by Rosenergoatom Concern in 2004.

Detailed information concerning safe management of spent nuclear fuel and radioactive waste in the Russian Federation was presented in 2006 in the National Report of the Russian Federation to the Second Review Meeting under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

Thus, the current Russian system for regulating the operation of nuclear installations including maintenance and repair, inspection and tests, investigating and accounting of operational events at nuclear plants as well as radioactive waste and spent nuclear fuel management is capable of assuring safe operation of NPPs.

Attainment of this goal is facilitated by the continuous scientific and technical support rendered to the Operating Organization and to the nuclear plants by a number of research,

design and architect-engineering institutes as well as through the use of the industry-level operating experience utilisation system and by the use of foreign NPP operating experience.

Major Conclusions

1. Signing of the Convention on Nuclear Safety by the Russian Federation and practical implementation of its requirements have contributed to more effective resolution of a whole number of issues related to safety assurance in the operation of nuclear installations.
2. An effective legislative and regulatory framework exists in the Russian Federation to regulate nuclear installation safety. Evolutionary changes in this framework are aimed at improving the existing standards and further expansion of the nuclear power sector.
3. An independent Regulatory Body exists in the Russian Federation - the Federal Environmental, Industrial and Nuclear Supervision Service, which is subordinate and reports directly to the Russian Federation Government. The Regulatory Body is provided with human, financial and technical resources allowing the performance of its intended functions while preserving independence.
4. The priority of safety issues in regard to nuclear installations has been affirmed by legislation and is a matter of normal practice. The Operating Organization, in accordance with the national and international legal norms, bears full responsibility for the safety of nuclear installations, and to this end it has the needed financial, human and other resources.
5. The requirements to the quality assurance programmes of nuclear plants have been formulated and defined in the regulatory documents.
6. The safety levels of all nuclear plants are systematically reviewed and assessed throughout plant life cycle. The assessment results and the safety cases presented, are taken into consideration by the Regulatory Body of Russia when licenses are granted for further operation of nuclear installations.
7. Analysis of the operating experience of nuclear power units over the recent years shows steady trends towards a reduction in the number of operational events at Russian nuclear plants and decrease of radioactive releases and discharges into the environment as well as of personnel exposure. This testifies to the efficiency of measures taken by the Operating Organization to improve the operational safety of nuclear power units.

8. Proper steps have been taken at the governmental level to provide the emergency preparedness of nuclear plants and to ensure the safety of personnel, population and the environment in the location of NPPs.
9. The inspections made by the Russian Regulatory Body and by international missions confirmed the positive trends in the operational activities as well as personnel commitment to further improve nuclear plant safety level.

Conclusion

It follows from the article-by-article review of the progress with the fulfillment of the Convention on Nuclear Safety that the Russian Federation complies with all her commitments resulting from the Convention on Nuclear Safety.

Head
Federal Atomic
Energy Agency

S.V. Kirienko

Chairman
Federal Environmental
Industrial and Nuclear
Supervision Service

K.B. Pulikovsky

APPENDICES

Appendix 1

List of Russian Federation NPPs

Nuclear Units in Operation

NPP name, Unit No	Reactor type	Power, MWe		Unit operation license issued by the Russian Regulatory Body	
		net	gross	License No	License expiry date
Balakovo-1	WWER	950	1000	GN-03-101-0991	25.12.2007*
Balakovo-2	WWER	950	1000	GN-03-101-1406	31.03.2010
Balakovo-3	WWER	950	1000	GN-03-101-1245	15.03.2009
Balakovo-4	WWER	950	1000	GN-03-101-1445	30.06.2010
Beloyarsk-3	BN	560	600	GN-03-101-1078	08.04.2010
Bilibino-1	EGP-6	11	12	GN-03-101-1339	12.01.2009
Bilibino-2	EGP-6	11	12	GN-03-101-1373	25.12.2009
Bilibino-3	EGP-6	11	12	GN-03-101-1451	30.12.2010
Bilibino-4	EGP-6	11	12	GN-03-101-1616	28.12.2016
Kalinin-1	WWER	950	1000	GN-03-101-1132	01.07.2008
Kalinin-2	WWER	950	1000	GN-03-101-1333	30.09.2009
Kalinin-3	WWER	950	1000	GN-03-101-1335	30.09.2009
Kola-1	WWER	411	440	GN-03-101-1130	06.07.2008
Kola-2	WWER	411	440	GN-03-101-1314	30.07.2009
Kola-3	WWER	411	440	GN-03-101-1081	03.04.2011
Kola-4	WWER	411	440	GN-03-101-1230	07.10.2009
Kursk-1	RBMK	925	1000	GN-03-101-1614	19.12.2016
Kursk-2	RBMK	925	1000	GN-03-101-1248	28.01.2009
Kursk-3	RBMK	925	1000	GN-03-101-1180	15.11.2008
Kursk-4	RBMK	925	1000	GN-03-101-1181	30.11.2008
Leningrad-1	RBMK	925	1000	GN-03-101-1615	21.12.2016
Leningrad-2	RBMK	925	1000	GN-03.101-1455	12.07.2008
Leningrad-3	RBMK	925	1000	GN-03-101-1527	07.12.2009
Leningrad-4	RBMK	925	1000	GN-03-101-1515	26.12.2010
Novovoronezh-3	WWER	385	417	GN-03-101-1626	29.12.2016
Novovoronezh-4	WWER	385	417	GN-03-101-1215	31.12.2008
Novovoronezh-5	WWER	950	1000	GN-03-101-1217	31.12.2008
Rostov-1	WWER	950	1000	GN-03-101-1368	01.01.2010
Smolensk-1	RBMK	925	1000	GN-03-101-1200	30.12.2008
Smolensk-2	RBMK	925	1000	GN-03-101-1227	30.01.2009
Smolensk-3	RBMK	925	1000	GN-03-101-1649	14.12.2019

Note: * Materials for license extension are under review by the Regulatory Body.

Appendix 1 continued

Units in the Stage of Decommissioning

NPP name, Unit No	Reactor type	Power, MWe		Operating organization	Start of construction	Date of commissioning	Date of removal from service
		net	gross				
Beloyarsk-1	AMB	102	108	REA	01-Jun-58	26-Apr-64	01-Jan-83
Beloyarsk-2	AMB	146	160	REA	01-Jan-62	01-Dec-69	01-Jan-90
Novovoronezh-1	WWER	197	210	REA	01-Jul-57	31-Dec-64	16-Feb-88
Novovoronezh-2	WWER	336	365	REA	01-Jul-64	14-Apr-70	29-Aug-90

Note: REA - "Rosenergoatom Concern".

Appendix 2

Major Performance Indicators of Russian NPPs in 2004-2006

WWER-440 Plants

Indicator	NPP	Kola				Novovoronezh		All WWER-440 Plants
	Unit	1	2	3	4	3	4	
1. Operation time factor OTF, %	2004	81.71	63.91	87.53	89.52	82.91	87.48	82.18
	2005	78.78	84.24	87.58	89.95	82.57	82.51	84.27
	2006	87.45	86.73	84.89	82.39	86.99	87.17	85.94
2. Load factor LF, %	2004	68.21	49.91	77.64	66.37	69.71	80.73	68.65
	2005	60.60	79.97	57.63	62.09	74.08	73.01	67.79
	2006	65.97	73.60	63.99	71.27	80.02	76.91	71.84
3. Availability factor AF, %	2004	83.64	73.82	88.38	86.78	71.23	83.73	81.33
	2005	90.56	85.62	88.49	90.21	75.66	75.20	84.45
	2006	89.95	87.35	89.98	84.12	82.42	81.72	85.99
4. Number of automatic scrams per 7000 hours of operation	2004	0	0	0	0	0	0	0
	2005	0	0	0	0	0	0	0
	2006	0	0.92	0.94	0.97	0	0	0.46

Note: Russian NPPs major performance indicators for 1990-2003 are given in the previous National Reports on the fulfillment of the Convention on Nuclear Safety.

Appendix 2 continued

WWER-1000 Plants

Indicator	NPP	Balakovo				Volgodonsk	Kalinin			Novovoronezh	All WWER-1000 Plants
	Unit	1	2	3	4	1	1	2	3	5	
1. Operation time factor OTF, %	2004	78.56	85.54	86.60	85.85	88.43	81.73	87.37	-	45.89	80.00
	2005	87.19	87.77	80.59	87.89	87.08	82.41	73.93	-	32.66	77.44
	2006	85.81	88.01	95.37	82.54	84.31	81.18	84.47	76.39	88.61	85.19
2. Load factor LF, %	2004	79.17	83.77	86.16	83.81	88.96	82.93	88.31	-	43.38	79.56
	2005	87.33	83.31	74.72	83.01	86.84	81.97	73.51	-	30.68	75.17
	2006	86.98	86.47	92.39	81.34	86.53	80.85	84.75	75.73	87.04	84.68
3. Availability factor AF, %	2004	79.39	86.42	87.41	86.67	89.17	83.79	88.74	-	43.86	80.68
	2005	87.67	86.42	80.12	88.49	87.86	83.08	75.02	-	31.45	77.68
	2006	87.23	89.26	96.31	83.92	86.91	81.95	86.29	76.03	88.08	86.22
4. Number of automatic scrams per 7000 hours of operation	2004	0	0.93	0	0.93	0	0	0	-	1.74	0.37
	2005	0	0	0	0	0	0	1.08	-	0	0.13
	2006	0	0	0	0	0	1.97	0	0	0	0.21

Appendix 2 continued

RBMK-1000 Plants

Indicator	NPP	Kursk				Leningrad				Smolensk			All RBMK-1000 Plants
	Unit	1	2	3	4	1	2	3	4	1	2	3	
1. Operation time factor OTF, %	2004	83.82	49.17	87.22	68.94	19.52	89.25	95.92	93.84	29.50	94.63	88.40	72.75
	2005	87.34	88.84	63.90	89.70	94.24	52.02	61.61	89.47	96.04	42.62	93.51	78.12
	2006	80.93	83.56	83.94	45.12	87.33	20.09	94.45	70.74	68.73	94.82	64.28	72.18
2. Load factor LF, %	2004	81.44	45.57	85.23	66.99	16.75	83.03	86.48	90.14	28.66	91.43	87.40	69.37
	2005	77.09	85.01	61.74	87.29	88.73	46.81	55.94	84.34	90.79	37.73	90.63	73.28
	2006	72.35	80.98	82.84	44.83	84.52	18.22	91.74	70.10	67.38	93.68	61.65	69.84
3. Availability factor AF, %	2004	83.34	45.66	87.21	68.31	18.21	86.55	90.88	92.84	29.25	94.23	88.39	71.35
	2005	83.08	87.85	63.91	89.57	93.68	50.28	61.93	89.91	94.82	41.73	93.33	77.28
	2006	78.59	83.55	84.27	45.37	85.90	18.87	94.65	70.90	70.27	94.80	62.01	71.74
4. Number of automatic scrams per 7000 hours of operation	2004	0	4.86	0	0	4.08	0.89	0	1.71	0	0	0	0.7
	2005	0	0	0	0	0	0	0	0	0.83	0	0	0.09
	2006	0.99	0.96	0	0	0.92	11.9	0	0	1.16	0	0	0.7

Appendix 2 continued

BN-600 and EGP-6 Plants

Indicator	NPP	Beloyarsk	Bilibino				EGP-6 plants
	Unit	3	1	2	3	4	
1. Operation time factor OTF, %	2004	81.92	84.63	66.89	81.58	83.14	79.06
	2005	79.65	78.81	83.92	70.25	83.47	79.11
	2006	79.92	81.76	82.74	74.68	75.98	78.79
2. Load factor LF, %	2004	80.04	44.48	25.04	39.63	34.10	35.81
	2005	77.75	35.55	35.25	27.57	33.25	32.91
	2006	78.58	33.31	29.51	33.94	33.41	32.54
3. Availability factor AF, %	2004	80.83	84.88	70.15	85.48	83.13	80.91
	2005	78.77	78.89	84.23	69.71	83.57	79.10
	2006	79.23	83.53	83.47	75.64	75.76	79.60
4. Number of automatic scrams per 7000 hours of operation	2004	0	0	0	0	0.96	0.2
	2005	0	0	0.95	0	0	0.2
	2006	0	0	0	0	0	0

Appendix 3

Codes and Standards which Regulate NPP Unit Lifetime Extension

The following documents regulate NPP unit lifetime extension:

- Federal Act on the "Use of Atomic Energy".

Article 9 empowers RF Government to take decisions in the area of atomic energy use relating to design, construction, operation, decommissioning of the federally owned nuclear installations.

- Federal Codes and Standards in the Area of Atomic Energy Use:

– " General Guidelines for Assuring Nuclear Plant Safety" (OPB-88/97), NP-001-97 or PNAE G-1-011-97;
– "Rules for Design and Safe Operation of Nuclear Installations Equipment and Piping", (PNAE G-7-008-89) allow for the possibility to extend component and NPP unit lifetime as a whole;
– State Standard "NPPs and their Equipment Reliability" (GOST 26291-84) defines the specified NPP lifetime as NPP calendar operation time specified in the design, on expiration of which NPP further operation might be continued once the decision was taken based on investigations of NPP safety and economic efficiency.

To expand the existing regulatory and methodological framework relating to NPP unit lifetime extension in Russia the following documents defining technical requirements to the conduct of activities associated with NPP unit preparation for lifetime extension and criteria for successful activities completion were developed and put into force:

– Federal Standards and Regulations "Main Requirements to NPP Unit Lifetime Extension" (NP-017-2000);
– Guiding Document of the Regulatory Body "Requirements to the Structure and Content of the Documents that Justify Safety in the Period of NPP Unit Extended Operation" (RD-04-02-2006).

The Operating Organization - Rosenergoatom Concern - developed and put into effect in the established order the following guiding and methodological documents as a follow-up development of federal codes and standards:

– "Typical Program of NPP Unit Comprehensive Examination for Lifetime Extension" (RD EO 0283-01);
– "Regulations on the Management of Service Life Characteristics of NPP Unit Elements" (RD EO 0281-01);
– "Program of Ensuring the Quality of the First Generation NPP Unit Lifetime Extension Activities" (RD EO 0291-01);

- "Basic Guidelines for Extending the Lifetime of NPP Units of the Second Generation" (RD EO 0327-01);
- Methodologies for Justifying Equipment Residual Lifetime.

Appendix 4

Measures for NPP Safety Improvement and Upgrading

1. Major Safety Improvement Measures Implemented at Kursk NPP Units 1 and 2 in 2004-2006

No	Unit number	Description of measureт
1.	1	Replacement of pumps in Reactor Protection System channels' cooling circuit
2.	1	Replacement of excitation system for DGs 1-4
3.	1	Replacement of voltage transformers
4.	1	Replacement of components of turbine generator 1 (TG-1) system of vibration diagnostics and axial displacement monitoring
5.	1	Replacement of instrumentation, of "Skala-micro" information & monitoring system and RPS
6.	1	Upgrading of condensate purification control system for TGs-1, 2
7.	1	Upgrading of steam drum level maintaining system
8.	2	Modification of Emergency Core Cooling System
9.	2	Modification of excitation systems and of relay protection & controls for TGs-3, 4
10.	2	Introduction of Integrated Control, Protection & Monitoring System
11.	2	Introduction of the upgraded "Skala-micro" information & monitoring system
12.	2	Upgrading of Emergency Power Supply System
13.	2	Installation of the full-scope Automated System of Coolant Leak Detection

Table 1 continued

No	Unit number	Description of measure
14.	2	Installation of emergency protection system for distributing group header
15.	2	Modification of unit essential power supply system
16.	2	TG-4 upgrading (modifications to 4 low pressure cylinders, to the flow path section of the high pressure cylinder)

2. Major Safety Improvement Measures Implemented at Leningrad NPP Units 3 and 4 in 2004-2006

No	Description of measure
1.	Upgrading of Essential Service Water System to improve its fail safe capability during external impacts
2.	ECCS improvement based on multi-train principle to ensure system efficiency with account for single failure principle
3.	Introduction of additional algorithms to provide ECCS automatic activation in case of event occurrence
4.	Introduction of a signal to automatically close the valves in the water supply line of the small-size feed pump in both reactor sides simultaneously
5.	Providing automatic trip of the motor-driven feed pump at deaerator level decrease to the setpoint which monitors the needed water inventory to keep the small-size feed pump in operation
6.	Installation of flow limiting inserts in the pressure lines of the small-size feed pumps instead of the control valves
7.	Installation of redundant valves in the pressure lines of the small-size feed pumps

3. Major Upgrading Measures Implemented at Smolensk NPP Units 2 and 3 in 2004-2006

No	Unit number	Description of measure
1.	2 and 3	Replacement of fuel channels with expired service life
2.	2	ECCS upgrading
3.	2 and 3	Upgrading of the primary circuit overpressure protection system
4.	2	Modification of reactor technological protections
5.	2	Replacement of ECCS batteries with expired service life with seismically resistant ones
6.	3	Introduction of improved algorithm for load sequencing in 6 kV essential bus
7.	3	Ventilation system upgrading. Installation of additional passive fire protection ducts

Appendix 5

List of Federal Codes and Standards Regulating Nuclear Plant Safety Put into Force by the Federal Environmental, Industrial and Nuclear Supervision Service in the Period since the Submittal of the Third RF National Report

1. Newly Issued Federal Codes and Standards

- "Consideration of External Impacts of Natural and Man-induced Origin on Atomic Energy Utilization Facilities" (NP-064-05);
- "Safety Rules for the Transportation of Radioactive Materials" (NP-053-04);
- "Safety in Radioactive Waste Management. General Guidelines" (NP-058-04);
- "Safety Rules for the Storage and Transportation of Nuclear Fuel in Nuclear Power Facilities" (NP-061-05);
- "Basic Rules for Nuclear Materials Accounting and Control" (NP-030-05);
- "Basic Rules for Accounting and Control of Radioactive Substances and Radioactive Waste in Organizations" (NP-067-05);
- "Requirements to Safety-related Controlling Systems in Nuclear Plants" (NP-026-04);
- "Rules for Design and Operation of Nuclear Plants' Safety-related Ventilation Systems" (NP-036-05);
- "Rules for Design and Safe Operation of Components and Elements of Water Cooled Reactor Installations of Floating Nuclear Plants" (NP-062-05);
- "Valves for Nuclear Plant Piping. General Technical Requirements" (NP-068-05);
- "Rules for Conformance Assessments of Components, Materials and Semi-finished Products Supplied to Atomic Energy Utilization Facilities" (NP-071-06);
- "Safety Rules for the Management of Nuclear Plant Radioactive Waste" (NP-002-04);
- "Requirements to the Content of the Safety Analysis Report for the Fast Breeder Reactor Plants" (NP-018-05).

2. Amended Federal Codes and Standards

- "Requirements to the Content of the Safety Analysis Report for WWER Plants" (NP-006-98).

Appendix 6

List of Guidance Documents and Safety Guides Developed and Put into Force by the Federal Environmental, Industrial and Nuclear Supervision Service in the Period Since the Submittal of the Third RF National Report

Guidance Documents

- "Requirements to the Structure and Content of the Documents which Justify Safety for Extended Operation Period of a Nuclear Plant Unit" (RD-04-02-2006);
- "Requirements to the Structure and Content of the Documents which Justify Nuclear and Radiation Safety of a Nuclear Installation, Radiation Source, Nuclear Materials Storage Facility, Radioactive Waste Storage and/or Declared Activity (for Nuclear Plants)" (RD-04-03-2006);
- "Regulations on the Department for the Regulation of Safety of Nuclear Fuel Cycle Facilities, Supervision over Accounting and Control of Nuclear Materials and Radioactive Substances and Physical Protection" (RD-01-07-2006);
- "Regulations on the Process of Development of Guidance Documents of the Federal Environmental, Industrial and Nuclear Supervision Service" (RD-03-12-2005);
- "Methodological Guidance for the Process of Preparing Drafts of Annual Plans of Developing Guidance Documents of the Federal Environmental, Industrial and Nuclear Supervision Service" (RD-03-13-2005).

Safety Guides

- "Methodological Recommendations for the Conduct of Physical Inventory of Nuclear Materials at Nuclear Installations and in Nuclear Materials Storage Facilities" (RB-026-04);
- "Structure and Content of Report on the Results of Comprehensive Examination of a Nuclear Unit for the Purpose of Its Lifetime Extension" (RB-027-04);
- "Analysis of Non-conformance of a Nuclear Plant Unit to the Requirements of Existing Regulatory Documents" (RB-028-04);
- "Structure and Substantiation of Materials for the Justification of Residual Lifetime of Nuclear Unit Elements for the Purpose of Its Lifetime Extension" (RB-029-04);

- "Analysis of Operating Experience when Extending Nuclear Unit Lifetime" (RB-030-04);
- "Recommendations on the Content of the In-depth Safety Assessment Report for Operating Nuclear Units (OUOB AS)" (RB-001-05);
- "Structure and Content of the Safety Analysis Report for Nuclear Unit Decommissioning" (RB-031-04);
- "Basic Recommendations for Performing Nuclear Plant Probabilistic Safety Assessment" (RB-032-04).

Appendix 7

Data on the Actual Numbers of the Russian Regulatory Body Regional Office Staff Members and on the Number of Supervised Enterprises in 2006

Indicators	Total	CR	NER	UR	FER	SR	VR	DR
Number of regional office staff members	1158	226	171	153	64	168	211	165
Number of supervised enterprises and organizations	3526	1053	497	526	148	414	521	367

Legend:

CR – Central Region Nuclear and Radiation Safety Inspection

NER – North-European Region Nuclear and Radiation Safety Inspection

UR – Urals Region Nuclear and Radiation Safety Inspection

FER – Far East Region Nuclear and Radiation Safety Inspection

SR – Siberian Region Nuclear and Radiation Safety Inspection

VR – Volga Region Nuclear and Radiation Safety Inspection

DR – Don Region Nuclear and Radiation Safety Inspection

Appendix 8

Russian Regulatory Body Financing from the Resources of the Russian Federation Federal Budget in 2005–2007

Name of sections and subsections of the functional classification of the federal budget expenses	**Actually funded in 2005, thousand rubles**	**Actually funded in 2006, thousand rubles**	**Set out for 2007, thousand rubles**
TOTAL EXPENSES ***For:***	228419.1	283769.8	328212.6
Regional offices	201097.5	246547.0	286907.4
Total for applied research in the area of national economy ***including:***	27321.6	37222.8	41305.2
Performing R&D under state contracts	569.0	569.0	569.0
Maintaining activity of subordinate institutions	21005.6	30423.8	36736.2
Federal targeted program "Nuclear and Radiation Safety in Russia" for 2005-2006	5747.0	6230.0	-
Federal targeted program "Reducing Risks and Mitigating Consequences of Situations of Natural and Man-induced Origin in RF" up to 2010	-	-	4000.0

Appendix 9

Categories and Symptoms of NPP Operational Events

Category	Event symptoms and consequences
Accidents	
A01	Release of radioactive substances into environment during beyond design basis accident resulting in potential acute radiation effects on NPP personnel members (employees) and members of the public, health effects, radioactive contamination of a large territory. Trans-boundary transfer of radioactive substances is possible. Prolonged impact on the environment.
A02	Release of radioactive substances into environment resulting in the achieving or exceeding, beyond NPP exclusion zone boundary, of the "B" level of criteria for taking urgent decisions at the initial phase of the accident: predicted exposure dose during the first 10 days of 500 mGy for whole body or 5000 mGy for thyroid, lungs and skin.
A03	Release of radioactive substances into environment resulting in the exceeding, beyond NPP exclusion zone, of the "A" level of criteria for taking urgent decisions at the initial phase of the accident: predicted exposure dose during the first 10 days of 30 mGy for whole body or 500 mGy for thyroid, lungs and skin. Notes: 1. The accidents of A01, A02, A03 categories are characterised by the exceeding of the maximum design-basis limit for fuel rod damage. 2. Levels "A" and "B" of the criteria for taking urgent decisions at the initial phase of the accident are in accordance with NRB-99 radiation safety standards.
A04	Release of radioactive substances into environment resulting in the exceeding, within the exclusion zone, of the basic limit of exposure to members of the public of 5 mSv/year. Single external and/or internal exposure of personnel members to a dose, which exceeds the potentially detrimental exposure (200 mSv). Fuel rod damage exceeding safe operation limits for the number and extent of fuel rod defects while the maximum design basis limit has not been exceeded.

Appendix 9 continued

Category	Event symptoms and consequences
Incidents	
P01	Release of radioactive substances into the habitable room (rooms), on-site or into environment that occurred due to system (component) failures, operating procedure deficiencies, personnel errors resulting in: • contamination of habitable room (rooms) with beta nuclides of 10000 particles/(min·cm^2) and/or with alpha nuclides of 200 particles/(min·cm^2); • contamination of the exclusion zone leading to a dose which does not exceed 5 mSv/year. Single external and/or internal exposure of personnel members to a dose exceeding the basic dose limit but is not above the potentially detrimental exposure (200 mSv).
P02	Breach of safe operation limits (except the radiation limits).
P03	Breach of safe operation conditions.
P04	Unavailability of one or several safety system trains detected during the routine test or NPP unit in-service examination.
P05	Safety system actuation associated with the need to perform safety function during NPP unit operation and involving additional, as compared to design basis, failures of safety system components in excess of single failure and/or due to personnel errors.
P06	Safety system actuation associated with the need to perform safety function during NPP unit operation and not involving additional, as compared to design basis, failures of safety system components in excess of single failure and/or due to personnel errors.
P07	Actuation of a safety system or safety system train not associated with performing safety function including that part of fire extinguishing system, which provides the conditions for safety system functioning.

Appendix 9 continued

Category	Event symptoms and consequences
Incidents	
P08	Reactor installation shutdown or unit disconnection from the grid without scram actuation during NPP unit operation caused by system (component) failures and/or personnel errors or external impact.
P09	NPP unit power reduction by 25 % and more of the power level immediately preceding this reduction caused by system (component) failure and/or personnel errors or external impact (excluding events stated in item 2.2 of the "Regulations for Investigating and Accounting Operational Events at Nuclear Plants" (NP-004-97 or PNAE G-12-005-97).
P10	Drop and/or damage to fuel assembly, fuel rod during new or spent nuclear fuel handling operations caused by the failure of systems, components (including NPP lifting equipment used during nuclear fuel handling) and/or personnel errors.
P11	Damage or defects of NPP components of Safety Categories 1 and 2 that occurred or were detected during NPP unit operation but did not lead to an initiating event.

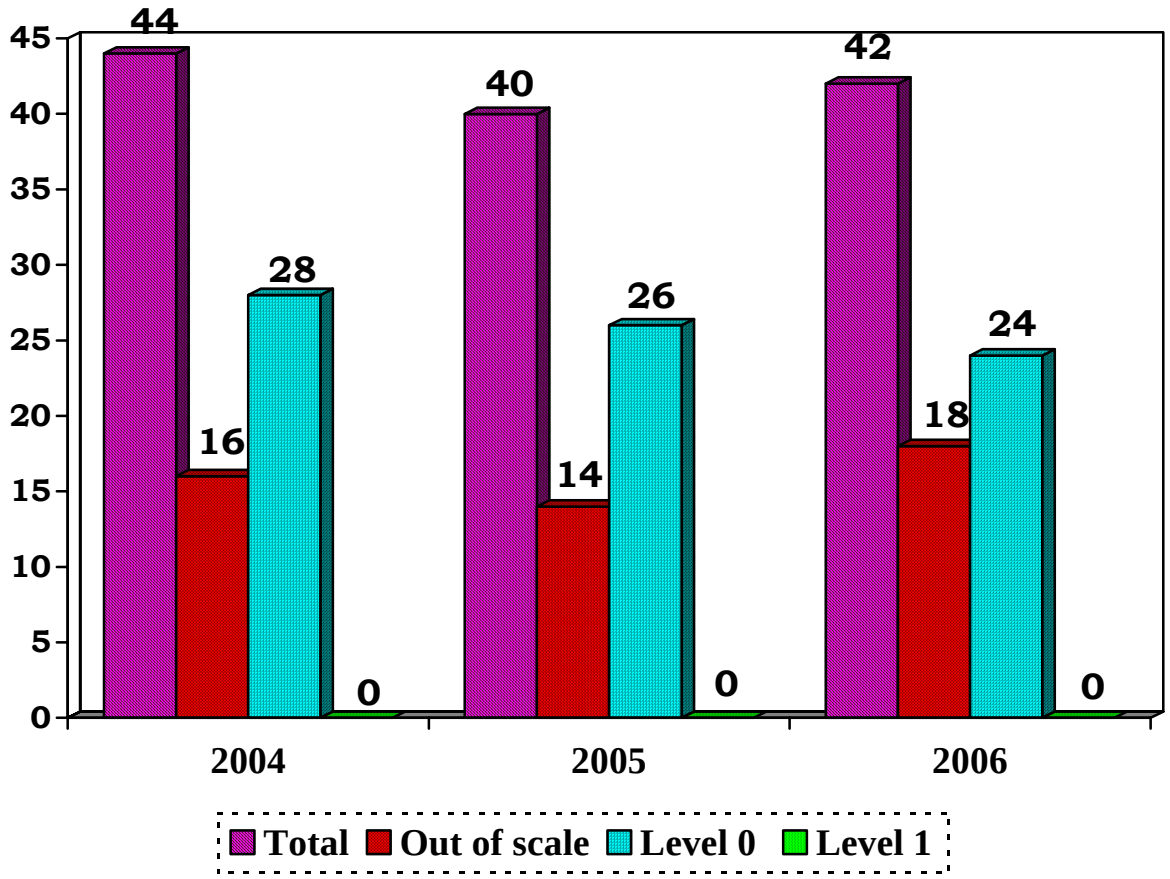
Appendix 10

Distribution of Russian NPP Operational Event Ratings by INES for 2004–2006

Plant name	Number of NPP operational events (INES level)					
	Out	0	Out	0	Out	0
	2004		2005		2006	
Kola	3	0	1	0	1	3
Novovoronezh	1	5	2	6	1	4
Balakovo	0	4	0	0	3	0
Kalinin	0	2	5	13	5	5
Volgodonsk	1	1	1	0	1	0
Kursk	4	7	3	2	0	6
Leningrad	4	7	2	1	4	3
Smolensk	1	0	0	3	2	3
Beloyarsk	2	0	0	0	1	0
Bilibino	0	2	0	1	0	0
Total	16	28	14	26	18	24
	44		40		42	

Appendix 11

Trends in Russian NPP Operational Events Rated by INES for 2004–2006



Appendix 12

List of NPP Safe Operation Regime Violations to be Immediately Reported by NPP Administration

Name of violation of NPP safe operation regime	Organizations and persons to be notified at all kinds of violations of NPP safe operation regime
Declaring the state of "Emergency Preparedness"	Rosenergoatom's dispatcher on-duty. Territorial bodies for civil defense and emergency management of a city and region (autonomous district). Head of resident NPP Inspection Office. Environmental Protection Committee of the district. Engineer on-duty of the respective Rostechnadzor district (in case of damage to NPP component(s) registered in the bodies of Rostechnadzor). Heads of administration of a city and region (autonomous district). Dispatcher of corresponding department of the RAO Power System "United Power System of Russia" (in cases envisaged by the existing Manual on the Relations between NPP and Power System). NPP Health Center. NPP fire protection service security division and regional fire protection office. Military unit of the RF Ministry of Interior in charge of NPP physical protection (military unit duty officer, commander of the guard). Russian Ministry of Interior and Federal Security Service units responsible for a NPP. Territorial division of the Russian local hydrometeorological service responsible for a NPP. Organizations of other ministries and agencies in the territory of NPP and exclusion zone. Local administration in the 5-km zone around a NPP. Emergency Management Commission of Rosatom (to be notified by NPP management).
Declaring the state of "Emergency Situation"	
Fire with a potential for radiological accident	
Natural disasters (earthquakes, tornadoes, floods etc.) that may cause a radiological accident	
Attempts by criminals to commit criminal actions that may result in a radiological accident	