

# **RADIOACTIVE WASTE MANAGEMENT PROGRAMMES IN OECD/NEA MEMBER COUNTRIES**

## **RUSSIAN FEDERATION**

**[2014]**

### **NATIONAL NUCLEAR ENERGY CONTEXT**

Nuclear energy use for civilian purposes was started in the USSR in 1954 after commissioning of the world's first NPP in Obninsk, Kaluga region. Currently, the Russian nuclear industry covers the complete nuclear fuel cycle: from uranium ore mining to power generation, including partial fuel-cycle closure for uranium.

In 2013 there were 33 power units operated at 10 NPPs of Russia with total electric power of 23.6 MW, including 17 pressurized water reactors (11 VVER-1000 and 6 VVER-440 reactors), 15 channel-type boiling water reactors (11 RBMK-1000 and 4 EGP-6 reactors), 1 fast-breeder BN-600 reactor. At different construction stages are 10 power units, including the fast-breeder BN-800 reactor at Beloyarsk NPP.

The nuclear generation share in total matrix of energy supply in Russia makes about 17%. The nuclear power share in the European part of Russia is considerably higher; in particular it comes up to 40% in the north-west of the European region. According to “Energy strategy of Russia for the period until 2030”, the outrunning growth of the nuclear-energy share is anticipated in the total amount of electric power generation.

National policy of Russia on nuclear power safety is defined in the document “State policy principles on nuclear and radiation safety in the Russian Federation until 2025” approved by the presidential Decree No.539 dated March 01, 2012. The purpose of the state policy is to successively reduce man-caused impact on the population and environment to the acceptable level when using the nuclear power.

The activities on management of radioactive waste (RW) and spent nuclear fuel (SNF) and on decommissioning of nuclear- and radiation-hazardous facilities (NRHF) is performed in Russia in compliance with the Federal Law No.170-FZ “On Use of Nuclear Energy“ dated November 21, 1995, the Federal Law No.190-FZ "On Management of Radioactive Waste and Amendment of Some Acts of Law of the Russian Federation" dated July 11, 2011, and other federal laws and regulatory legal acts.

The integral elements of the planned large-scale development of the nuclear industry are: decommissioning of the power units, which life-time period has run out (first of all these are two power units of Novovoronezh NPP and two units of Beloyarsk NPP); construction of a new plant for SNF reprocessing, and creation of the system of RW storage facilities (SF) and RW disposal facilities.

## **SOURCES, TYPES AND QUANTITIES OF WASTE**

Main sources of RW in Russia:

- Mining and milling of radioactive ore;
- Sublimation and separation productions;
- Nuclear fuel manufacturing;
- Operation of NPPs, nuclear research facilities, nuclear fuel cycle enterprises, ships with nuclear power installations and their servicing depots;
- SNF reprocessing;
- Use of nuclear materials (NM), radioactive substances (RS) and sources of ionizing radiation (SIR) in the industry, medical institutions, scientific and research institutes, etc.;
- Decommissioning of nuclear power facilities and remediation of radiologically contaminated areas.

As of January 01, 2011, the following quantities of RW were stored in different types of storage facilities in 43 regions of the Russian Federation.

### **Liquid radioactive waste (LRW)**

LRW are allocated at 83 enterprises (330 storage facilities in all) and in 3 facilities meant for underground disposal of LRW in geological formations.

The total volume of accumulated LRW is 486 mln. m<sup>3</sup> ( $4.27 \cdot 10^{19}$  Bq). The major part of LRW is low-level RW (97.1%) with the activity making  $8.43 \cdot 10^{15}$  Bq (about 0.02% of total LRW activity).

High-level LRW makes less than 0.5 % of the total LRW volume, but its activity makes about 42% of LRW total activity. All high-level LRW is isolated from the environment.

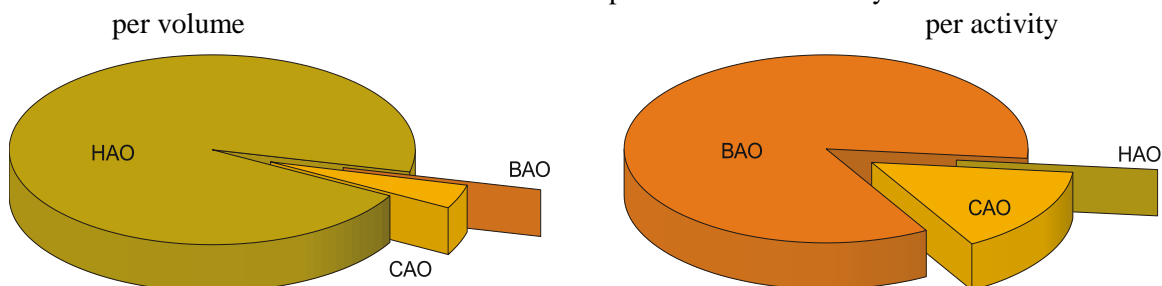
### **Solid radioactive waste (SRW)**

SRW is allocated at 136 enterprises in 1466 RW temporary storage facilities.

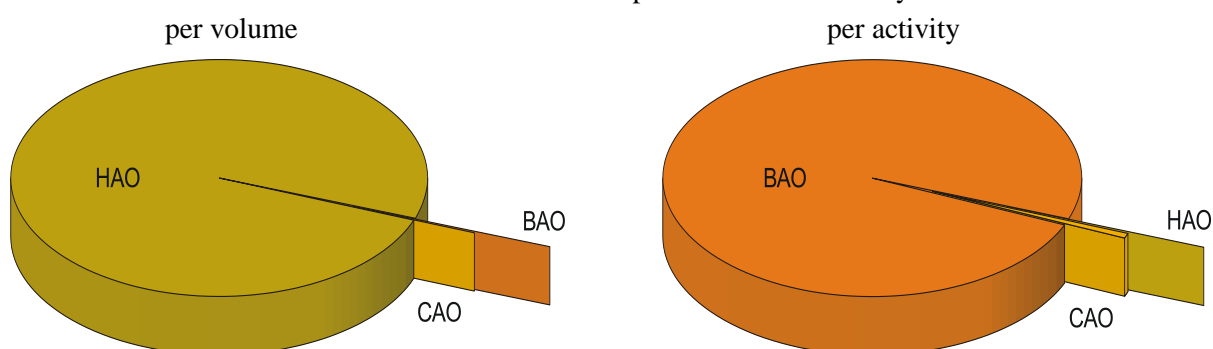
The total volume of accumulated SRW is 87 mln. t ( $3.59 \cdot 10^{19}$  Bq). The major part of SRW (69 mln. t.) is low-level RW, with 97% of this waste located at the uranium-ore mining and milling enterprises.

High-level SRW contains 98% of SRW total activity. The major amount of the accumulated high-level waste includes vitrified LRW, fuel element claddings, contaminated equipment, spent radioactive sources, which are located at the radiochemical plants of the Production Association "Mayak", the Mining Chemical Combine (GKhK), and the Siberian Chemical Combine (SKhK). All HLW is located in the specialized buildings and structures, and isolated from the environment.

Share of accumulated LRW per volume and activity:



Share of accumulated SRW per volume and activity:



**Generation of RW in 2012:**

- LRW – 2.05 mln. m3.
- SRW – 1.4 mln. t, where 97 wt % waste is LLW from the mine industry, with the total activity of  $3.3 \cdot 10^{14}$  Bq or 0.003% activity of all accumulated SRW.

The above data on RW quantities will be updated based on the results obtained by the reregistration of RW and their locations. This reregistration was implemented in 2012 in compliance with the Federal Law on waste management and according to the RF Government Resolution No.767 dated July 25, 2012 “On Initial registration of RW”.

The initial registration will result in:

- Identifying the amounts of RW accumulated prior to the entry into force of the Federal law on RW management;
- Specifying the conditions for RW disposal;
- Defining the quantities of RW to be removed and special RW to be left in the place of its generation;
- Classifying the RW storage facilities by type;
- Defining legal entities having ownership of RW and its storage facilities.

As a result of the initial registration, the collected actual information on RW scope and characteristics will allow development of long-term optimal action plan for RW management, including defining necessary costs for separate enterprises and for the industry as a whole.

## **RADIOACTIVE WASTE AND SPENT NUCLEAR FUEL MANAGEMENT POLICIES AND PROGRAMMES**

### **Nuclear spent fuel and radioactive waste management policies**

National policy on SNF management is based upon the statement that SNF is not RW and is subject to reprocessing in order to return it to the nuclear fuel cycle of regenerated nuclear materials (NM) for manufacturing of fresh nuclear fuel.

SNF management is performed in Russia in compliance with the Federal law on nuclear power use and “The concept of spent nuclear fuel management of State Corporation “Rosatom”, which was approved by the Order № 721 dated December 29, 2008.

National policy in the area of RW management is stipulated by the Federal law on RW management and by a number of other federal regulatory documents.

The unified state RW management system (USRWMS) is being established in compliance with the Federal law of Russian Federation, with the the primary purpose to organize and insure the technologically up-to-date, environmentally safe and economically efficient RW management.

The Unified state system for RW management will represent a logical pool of entities working in the field of RW management, RW management infrastructure facilities, as well as requirements for RW management, including mandatory RW disposal.

As per the Federal law on RW management, the main principles of USRWMS will include:

- Priority for protection of life and health of the present and future generations of population, and protection of environment from negative impact of radioactive wastes;
- Prohibition for RW import to the Russian Federation and RW export from the Russian Federation for the purpose of RW storage, treatment and disposal, excluding limited number of cases foreseen by this law;
- Responsibility of the RW generating organizations to ensure safety of RW management until RW is transferred to a national RW management operator who is responsible for RW disposal;
- Financial provision of RW management activities including RW disposal at the expense of organizations, which operation results in RW generation;
- Provision of interdependence of RW generation stage and RW management stages;
- Accessibility of RW management information for civilians and public associations.

The law establishes RW classification, RW disposal requirements, requirements for accumulated RW management and storage facilities, as well as financial fundamentals for safe management of RW, including the so-called “nuclear legacy” RW. The Law confirmed the transfer from the monitored RW storage practices to the RW conditioning and disposal practices, ensuring reliable isolation of RW for the whole period of its potential hazard.

The Federal law implementation involves development of regulatory and organizational fundamentals for RW management system, and build-up of necessary infrastructure facilities, including a conditioned RW disposal system, which is currently not established.

The present status of RW management activities is characterized by the following factors:

- Considerable quantities of accumulated RW at industrial sites of many enterprises; this RW is subject to treatment, conditioning, intermediate storage and transfer for disposal;
- Large amounts of RW and very low level waste (VLLW), which is expected during decommissioning of NRHF and is subject to treatment, conditioning, intermediate storage and transfer for disposal;
- Lack of an approved chart of the Russian Federation regional planning activities for RW disposal;
- Initial stage of implementation of the Federal law (on RW management) provisions referred to responsibilities and financing sources for management of the following RW groups: accumulated RW, RW generated during decommissioning of the “nuclear legacy” NRHF, and RW generated during decommissioning of NRHF, which are not referred to “nuclear legacy”.
- Lack of practice and proven mechanism to classify certain NRHF RW as “special” RW.

### **Programmes and projects**

Programmes and projects on SNF and RW management are focusing on development of RF nuclear industry on the basis of up-to-date technologies for closed nuclear fuel cycle implementation, including creation of a highly efficient and economically viable system for RW management (including RW disposal activities), as well as solving the “nuclear legacy” problems.

Main practical arrangements to ensure nuclear and radiation safety of nuclear power and industry, SNF and RW management and decommissioning activities are implemented within the framework of the Federal target programme “Nuclear and Radiation Safety in 2008 and for the period up to 2015”. This programme is prepared to be extended for the period of 2016-2025.

Before 2030 it is planned to construct a new radiochemical plant for SNF reprocessing at the Mining Chemical Combine (GKhK). The capacity and technical characteristics of this plant will allow insuring transfer to a closed nuclear fuel cycle of the nuclear industry (both for uranium and plutonium).

Prior to the construction of new radiochemical plant (RT-2), the Experimental Demonstration Center (EDC) of GKhK will perform large-scale optimization of the advanced technologies for reprocessing of the existing SNF and treatment of RW generated as a result of this SNF reprocessing. One of the fundamental requirements imposed on new SNF-reprocessing technologies is the reduction of generated RW (first of all – liquid high-level waste).

EDC will comprise two main facilities:

- The enlarged complex of research “hot cells”, in which various processes and process equipment will be optimized using existing SNF (with a capacity of up to 3-5 ton of heavy metal per year) and RW, including the process of immobilization of high-level waste prior to its subsequent disposal in the geological repository;
- The pilot-production plant for optimization of innovation technologies to reprocess SNF from VVER-1000 reactors with a capacity exceeding 100 t of heavy metal per year. Currently, the ini-

tial stage of the project is being implemented - construction of facilities and manufacturing of equipment.

The first stage of EDC (the complex of research “hot cells”) is scheduled for commissioning in 2016.

The project implementation will allow transfer to the higher level of NPP process cycle with thermal neutrons at VVER-1000 reactors, including reprocessing of SNF and conditioning of generated RW.

The target of another large-scale project (“Breakthrough” Project) is to create a nuclear-power complex based on closing the nuclear fuel cycle for uranium and plutonium by constructing the NPPs with fast breeder reactors.

The “Breakthrough” project consolidates R&D to develop high-power fast-breeder reactors, closed nuclear fuel cycle technologies as well as new types of fuel and materials, and focuses on brand new nuclear-power engineering in terms of nuclear and radiation safety and maximal utilization of power potential of uranium raw materials.

Project “Breakthrough” includes many innovations, including those using new type of nuclear fuel (nitride fuel) and new nitride SNF reprocessing technology based on combination of pyrochemical and water extraction techniques, as well as new layout, design and engineering solutions. As regards the RW management, the “Breakthrough” project envisages to resolve problems of “everlasting” radiation hazard of long-lived RW repositories by burning some of radionuclides in fast-breeder reactors.

There are some other projects and programmes, apart from the above-mentioned ones, which are implemented in Russia in the field of management of existing and accumulated RW. In particular, the most urgent environmental problems of Production Association “Mayak” are being consistently resolved: immobilization of accumulated high-level liquid waste, conditioning of generated RW, liquidation and conservation of surface water bodies with low- and intermediate-level liquid waste (Karachai Lake, B-17 water body), activities to ensure safety of radiologically contaminated water bodies of the Techa River reservoir cascade.

Active search for and justification of sites for regional RW repositories is under way, and the task is being performed to provide all NPPs and enterprises of “RosRAO” company with all equipment and facilities required for RW conditioning and storage.

Work is in progress to justify construction (in the Nizhnekansky rock mass of Krasnoyarsk region) of an underground laboratory for optimization of the technology for ultimate disposal of high-level RW.

## **Radioactive waste of nuclear fuel cycle**

Nowadays all stages of nuclear fuel cycle are implemented in Russia – from mining and enrichment of uranium ore to SNF reprocessing, including recovery of uranium to be reused.

Strategy for further development of the Russian nuclear industry is focused on nuclear fuel cycle closing both for uranium and plutonium, using NPPs with fast-breeder reactors.

Taking into consideration the above-mentioned, the Russian national policy on SNF management is based on the statement that SNF is not RW and is subject to reprocessing in order to return it to the nuclear fuel cycle of regenerated nuclear materials.

As a result of SNF reprocessing for production of weapons-grade nuclear materials, the considerable high-level LRW (the “nuclear legacy” RW) quantities were generated at PA “Mayak”, the Siberian chemical combine, and the Mining chemical combine, and are stored in special tanks with the required safety measures insured.

Currently, due to shutdown of radiochemical plants operated for defense purposes, the liquid high-level RW is generated only at PA “Mayak”, where the radiochemical plant RT-1 has been operated since 1979 to reprocess SNF from NPP VVER-440 and BN-600 reactors, the research reactors as well as the nuclear Navy and icebreaker reactors. The extracted highly enriched uranium is used for fabrication of fresh fuel for NPP RBMK reactors.

All high-level liquid RW generated at RT-1 plant of PA “Mayak” and a part of accumulated high-level liquid “nuclear legacy” RW is solidified by the vitrification technique using the ceramic melter with a capacity of up to 500 litres/hour of initial LRW. All in all, about 30 thousand cubic metres of high-level LRW were solidified over nearly 25 years of vitrification-shop operation at PA “Mayak”, and more than 600 mln. Curie was vitrified into aluminophosphate glass. The vitrified RW is placed into special tanks and stored at PA “Mayak” until the RW final repositories are constructed in geological formations.

New vitrification facility EP-500/5 will be commissioned in 2015 instead of EP-500/4, which operating period has run out. The technology is being optimized using the induction “cold crucible” melter, which will allow vitrifying the accumulated high-level RW of complex chemical composition.

## **Low and intermediate level radioactive waste**

### ***RW of nuclear fuel cycle enterprises***

For a long period of time the nuclear fuel cycle technologies were used for defense purposes to produce weapons-grade uranium and plutonium in the USSR at the radiochemical combines – PA “Mayak”, the Mining Chemical Combine (GKhK) and the Siberian Chemical Combine (SKhK). The RW isolation was the basic requirement for the RW management systems at that time. The engineering structures (for SRW) and the specially equipped water bodies (for LRW) were used for that purpose. Nowadays these systems do not meet the up-to-date requirements, and therefore the activities are underway to convert to state-of-the-art RW-conditioning technologies and to transfer the accumulated “nuclear legacy” RW to a safe form.

Following the detailed geological research at GKhK and SKhK, a new technology has been implemented for underground disposal of low- and intermediate-level LRW through injection of RW into the isolated underground layers located 180-500 m deep in the massive rock. The LRW disposal landfills are equipped with the system of observation wells for continuous radiation monitoring. Over 40 years of operation, about 58 mln. cubic metres of LRW were isolated. It is expected to continue the LRW underground disposal for some time until RW management complexes are provided based on state-of-the-art technologies.

The low- and intermediate-level LRW management system of PA “Mayak” is based on RW isolation in the special open-water basins located at the site of this enterprise. In 2015 the intermediate-level LRW cementation complex will be commissioned to allow decommissioning and subsequent conservation of the most radiation hazardous water body “Karachai” (B-9). It is estimated that it contains over 100 mln Ci.

## ***RW at NPPs***

Currently, the NPP's low- and intermediate-level RW is treated and stored at NPP sites.

At NPPs that were built recently, the design RW-management solutions ensure RW conditioning, containerization and temporary storage in the engineering structures at NPP site until RW is transferred for disposal by the national RW operator.

At NPPs built before 1970s, conditioning of SRW and solidification of LRW concentrates was supposed to be conducted during NPP decommissioning. For this reason, RW accumulated at some NPPs require treatment to reduce its volume and transfer to a safe form for storage. In this connection, work is being performed to retrieve accumulated SRW with subsequent sorting and treatment by the compaction and burning techniques. The active measures are conducted to finally equip NPPs with the complete set of the RW conditioning equipment.

Accumulated vat residues resulting from evaporation of initial NPP LRW are expected to be treated using the technology based on selective sorption of radionuclides. As a result, the final products are containers with a radioactive cement compound, which are transferred to RW storage facilities, and a non-radioactive molten salt. For the first time, this technology was tested and implemented at Kola NPP. The advantage of the technology is the considerably reduced volume of conditioned RW that is transferred for disposal.

## ***Other RW***

Low- and intermediate-level RW, which is generated when using radioactive substances and nuclear materials for scientific, medical and industrial purposes, is transferred to specialized organizations – FSUE “RosRAO” and FSUE “Radon” for conditioning and storage until this RW is transferred for disposal to the national RW-management operator.

Low-level LRW of the Research Institute for Nuclear Reactors (NIIAR) is injected into the underground layers 1130-1550 m deep as per the technology similar to that used at SkhK and GKhK. All in all, 6.6 cubic metres of LRW was disposed in 2012 according to the available data.

## **Radioactive waste storage and disposal facilities**

There are three underground facilities operated in Russia for disposal of low- and intermediate-level LRW generated during operation of the following enterprises: the Mining Chemical Combine (GKhK), Krasnoyarsk region; the Siberian Chemical Combine (SKhK), Tomsk region; and the Research Institute for Nuclear Reactors (NIIAR), Ulyanovsk region. The major part (89%) of all accumulated intermediate-level LRW of the industry is isolated from the environment in these disposal facilities in deep geological formations.

According to Federal law on RW management, new enterprise was established in Russia in 2012 – the National operator for RW management (NO RAO), which is responsible for RW disposal, including construction and operation of facilities for final disposal of RW.

Currently, the activities are conducted under the leadership or with the involvement of NO RAO to select potentially suitable sites and to justify the proposed design solutions (the population and public organizations are informed of these activities), to create the infrastructure for RW disposal, and to develop respective projects and programmes. Based on the data on accumulated RW (including “nuclear legacy”



RW) and forecast for expected RW generation, the assessment is being carried out of the required RW disposal facilities to be provided.

According to the NO RAO's investment programme intitled "Construction of first disposal facilities", it is scheduled to create a system of RW disposal facilities of all classes until 2025, including construction of an underground laboratory as the first stage of a geological repository.

It should be noted of the problems arising in the process of selecting sites for RW disposal facilities. These problems are related to achieving public consensus on the issue. The considerable time-consuming and other efforts are needed to resolve these problems.

### **"Nuclear legacy" liabilities and historic waste**

Earlier activities performed within the defense programmes led to generation of considerable amounts of "nuclear legacy" RW. The major part of it is low-level LRW located in the open-water bodies of PA "Mayak", GKKh and SKhK.

The activities on decommissioning and conservation (in some cases - liquidation) of these water bodies are considered of great importance and performed on a continuous basis. Primary tasks are conservation of Karachai water body containing intermediate-level LRW, and ensuring safety of the Techa River reservoir cascade of PA "Mayak".

Basic activities in the field of "nuclear legacy" RW management are funded through the budget of Federal target programme "Nuclear and Radiation Safety in 2008 and for the period up to 2015". Over 50% of the programme's funds (75 bln Rub) are allocated to resolve the "nuclear legacy" problem.

### **Waste of ore mining and processing enterprises**

Waste contaminated by natural radionuclides is isolated in tailing dumps of mining enterprises. Preliminary activities are being performed to transfer tailing dumps to final state with minimal environmental impact.

### **Decommissioning policies and projects**

Currently, more than 120 NRHFs are shutdown but not decommissioned at enterprises of State Corporation "Rosatom", and in the future the number of these facilities will be increased.

The national decommissioning strategy of State Corporation "Rosatom" is based on ultimate need of timely, environmentally safe and cost effective decommissioning of nuclear- and radiation-hazardous facilities and focused on measures not to leave this problem for future generations.

Basic tasks of State Corporation "Rosatom" in the field of decommissioning for the nearest future are as follows:

- Convert the shut-down NRHFs to a state that ultimately excludes potential nuclear hazard by removing nuclear materials (NM) and SNF;
- Establish basic elements of interconnected industrial systems for decommissioning, SNF management and the Unified state system for RW management;
- Develop and improve the decommissioning rules and regulations based on national and foreign experience, recommendations of international organizations. These rules and regulations should

cover activities for decommissioning planning and preparation at all stages of nuclear cycle and directly at the decommissioning stage;

- Use effectively the up-to-date solutions and technologies and practical experience in the decommissioning field;
- Develop and implement effective organizational patterns for successful implementation in practice of activities for decommissioning and management SNF and RW. These patterns should ensure that necessary conditions are in place for development of all types of services in this field, including engineering services;
- Organize and coordinate activities to identify scientifically justified criteria and indicators for achieving the decommissioning purposes, taking into consideration social and economic acceptability;
- Establish conditions for using and developing infrastructure facilities at the operating and shut-down facilities (including NPP units) to ensure successful decommissioning activities;
- Develop international cooperation in the field of decommissioning based on intergovernmental agreements and contracts.

The activities scheduled and performed on NRHF decommissioning shall take into consideration the following aspects:

- Putting in force of the Federal law on RW management, which contains new requirements, including mandatory RW-disposal requirement;
- Introduction of the category of “special RW” that can be stored and disposed in situ, and a category of “very low-level radwaste” (VLLW);
- Need to align decommissioning plans with infrastructure development plans on RW management (provision for transportation, RW storage and final-disposal facilities) to prevent intermediate storage of large amounts of RW generated at decommissioning stage;
- Need to optimize amounts of generated RW when planning decommissioning activities;
- Experience gained when organizing and conducting decommissioning activities during implementation of Federal target programme “Nuclear and Radiation Safety in 2008 and for the period up to 2015”;
- Development of international relations in the issues related to decommissioning and management of SNF and RW, etc.

The most urgent decommissioning activities are conducted now within the framework of the Federal target programme “Nuclear and Radiation Safety in 2008 and for the period up to 2015”.

All enterprises have developed local concepts for decommissioning of their own facilities, and the preparatory work is done using available funding.

General plans for decommissioning activities for the following 15-20 years have been defined on the whole, but the work scope and time will be finally determined when the RF Government approves the Federal target programme “Nuclear and Radiation Safety in 2016-2020 and for the period up to 2025”, which provides for large-scale activities in the decommissioning field. The concept of this programme has been submitted for approval by the concerned Federal executive authorities.

The work scope and schedule of decommissioning activities shall be aligned with the scope and schedule of construction of RW final disposal facilities.

The scheduled decommissioning activities are as follows:

Until 2015

Complete:

- Implementation of decommissioning activities foreseen by the Federal target programme “Nuclear and Radiation Safety in 2008 and for the period up to 2015” and by the guiding documents of State Corporation “Rosatom”;
- Development of the mid-term and long-term decommissioning programmes taking into consideration “Development of a nuclear power industrial complex of Russia for 2007-2010 and on prospect till 2015”, approved by RF Government Resolution No. 605 dated October 6, 2006.

For the period of 2016-2020:

Ensure:

- Conversion of the shutdown NRHFs into nuclear radiation safe state (removal of nuclear materials and SNF);
- Removal, treatment or reliable long-term isolation of the process media accumulated at the enterprises that are subject to decommissioning;
- Integrity and efficiency of protective barriers of ultimately shutdown NRHFs;
- Development of a decommissioning concept for the facilities to be ultimately shut down before 2030;
- Development of documentation to obtain licenses for decommissioning of shutdown facilities;
- Updating and development of regulatory documents, which govern decommissioning activities and management of SNF and RW within the context of development of nuclear power industrial complex and new legal, property and financial relations;
- Development of criteria for entire or partial removal of NRHF from being supervised by the safety regulatory authorities;
- Division of responsibilities of the state and economic entities for funding of decommissioning activities;
- Alignment of the scheduled (by State corporation “Rosatom”) decommissioning activities with the SNF and RW management activities;
- Establishment of the nuclear-industry information system on decommissioning activities.

After 2020 (strategic perspect):

Finalize:

- Up-to-date legal and regulatory framework for decommissioning planning and regulation;
- Reliable mechanisms for sustainable funding of decommissioning, which are effective in the market economy conditions;

- Required material and technical resources, and industrial infrastructure including necessary federal/regional storage and disposal facilities for RW accumulated during decommissioning activities.

### **NPP sites**

JSC “Rosenergoatom Concern” has drawn up a long-range programme for shutdown and decommissioning of the Russian NPP units, which all are parts of this organization.

First units subject to decommissioning (in the form of liquidation) are units No.1 and 2 of Novovoronezh NPP and units No.1 and 2 of Beloyarsk NPP, which were shut down and conserved several years ago.

Currently, the preparation is being done for practical steps. The activities at Beloyarsk NPP are difficult to perform because it is necessary to remove the partially damaged remnants of SNF from the cooling ponds.

The Experimental Demonstration Engineering Center (EDEC) has been established (as a subsidiary of JSC “Rosenergoatom Concern”) at Novovoronezh NPP for optimization of technologies for decommissioning of NPP with VVER reactors.

### **Other sites**

According to prediction, 10 industrial defense uranium-graphite reactors located at PA “Mayak”, GKKhK and SKhK are subject to decommissioning.

The first-priority practical activities for decommissioning of one of the industrial uranium-graphite reactors are performed at SKhK (“on-site disposal” option). The Experimental Demonstration Center (EDC “UGR”) has been established at SKhK for optimization of technologies for decommissioning of uranium-graphite reactors and similar reactors.

Also subject to decommissioning are 14 research nuclear reactors and a significant number of power units of Navy and nuclear icebreakers.

The first-priority activities are performed for shutdown, conservation and decommissioning of open-water bodies for LRW storage at PA “Mayak”, GKKhK and SKhK.

This problem is very acute for PA “Mayak” taking account of the volume of water bodies (in particular, water bodies of Techa cascade) and high content of radionuclides in some of them (B-9 “Karachai” and B-17 water bodies). The environmental problems are being solved at PA “Mayak” on continuous and large-scale basis.

Preparatory activities are performed to justify solutions to ensure environmentally safe conservation of tailing dumps at the uranium-ore mining and processing enterprises.

## **Research and development**

The research and development activities performed currently in Russia are mostly related to accomplishment of the following tasks:

SNF and RW management:

- Implementation of projects “Breakthrough” and “Establishment of Experimental Demonstration Center for innovation reprocessing of SNF” at GKhK.
- Solving problems related to management of accumulated “nuclear legacy” RW (particularly, at PA “Mayak”) (implementation of new vitrification facilities for high-level LRW, cementation facility for intermediate-level LRW, liquidation of open-water bodies for LRW, etc.)
- Safety justification for RW disposal facilities, including those in geological formations.
- Creation of unified equipment for RW conditioning and transportation.
- Modeling of processes and technological cycles related to SNF and RW management.

Decommissioning:

- Adaptation of available domestic technologies for work specifics at particular facilities;
- Development of innovation technologies contributing to technological leadership in this area;
- Procurement and adaptation of foreign technologies allowing to increase decommissioning efficiency;
- Development of computation (including mathematical models) and experimental research methods required for safety and economical efficiency justification of decommissioning activities.

## **TRANSPORT**

SNF and RW transportation within the territory of the Russian Federation is performed in compliance with the established federal norms and rules in the field of nuclear energy; special transportation rules; rules for transportation of dangerous goods, as well as with regard to the existing international safety standards for radioactive materials transportation, including:

- Federal law “On Use of Nuclear Energy”;
- Federal law "On radioactive waste management and introduction of changes in certain legislative acts of the Russian Federation“;
- Safety rules for transportation of radioactive materials NP-053-04;
- Basic rules for accounting and control of radioactive substances and radioactive waste in an organization NP-067-05;
- Rules for physical protection of radioactive substances and radiation sources during transportation NP-073-06;
- Basic sanitary rules for ensuring radiation safety (OSPORB-99/2010);
- Radiation safety standards (NRB-99/2009), etc.

SNF and RW transportation within the territory of the Russian Federation is performed by rail and road using certified transportation packaging sets and containers as defined in Rostekhnadzor license for management of nuclear materials and radioactive substances during their transportation.

Import of SNF to the territory of the Russian Federation for intermediate technological storage and (or) reprocessing is implemented in compliance with the Russian Federation legislation and international agreements with RF in case of positive conclusion of State Environmental Expertise. Foreign trade contract for import of foreign SNF shall include provisions for subsequent RW export to the RW- supplying country, unless otherwise provided for by RF international contracts.

According to the Federal law “On environment protection” (Art. 48 and Art. 51) and the Federal law “On radioactive waste management” (Art. 31), import of RW to the Russian Federation from foreign countries is prohibited for the purpose of technological storage, treatment, neutralization or disposal.

All SNF accumulated during operation of NPP and other nuclear facilities is subject to transportation to centralized SNF storage facilities located at PA “Mayak” and at GKKhK, or to Radiochemical plant PT-1 (at PA “Mayak”) for reprocessing.

Currently, RW transportation is relatively moderate in Russia due to lack of centralized storage and disposal facilities for RW accumulated at NPPs and nuclear-industry enterprises (this RW is currently stored in the territory of enterprises). Only RW from research, medical and some other organizations is subject to transportation for which the system of centralized storage facilities “Radon” was established some time ago. This system is now reorganized into the specialized enterprises “RosRAO” and FSUE “Radon”.

The objective for the nearest future is to optimize existing packages (containers) and manufacture them in quantities sufficient for transportation and disposal of conditioned RW in the disposal facilities.

## **COMPETENT AUTHORITIES**

### **Federal policy development**

The Federal policy in the field of decommissioning and management of SNF and RW is developed and implemented by State Corporation “Rosatom”, which is the state authority having functions of the state customer within the framework of the federal programmes. If required, the other agencies and their subordinate organizations are also involved in the Federal policy development.

To perform the established functions, the Directorate for state policy on decommissioning and management of SNF and RW has been established in the Division for Final Life Cycle Stage (FLCS) of State Corporation “Rosatom”. This Directorate consists of the following departments:

- The Project office “Establishment of unified state RW management system”;
- Project office “Establishment of the nuclear-industry SNF management system”;
- Department on NRHF decommissioning.

Division for Life Cycle Final Stage (LCFS) of State Corporation “Rosatom” includes the Federal Center on Nuclear and Radiation Safety that performs functions of a managing company in the field of RW management.

### **Regulation and licensing**

Powers of the safety regulatory authorities are defined by the Federal law on use of nuclear energy. Competence, structure and human resources of the safety regulatory authorities are defined by appropriate resolutions of the Russian Federation government. The budgetary funding of the activities performed by

the safety regulatory authorities is approved by the State Duma and the Federation Council within the budget for the scheduled year.

Currently, the following authorities are referred to state nuclear-safety oversight authorities, which regulate activities in the nuclear-energy field, including management of SNF and RW and decommissioning activities:

***Federal Service for Environmental, Technological and Nuclear Supervision (Rostekhnadzor)***

Rostekhnadzor is a federal executive authority, which performs the following functions:

- State safety supervision in the area of nuclear power use in compliance with Federal law on the use of nuclear energy;
- Functions of a RF regulatory body in compliance with the Nuclear Safety Convention and Joint Convention on safe SNF and RW management,
- Functions of RF competent authority in compliance with Amendment to the Convention on nuclear material physical protection.

Within the above functions Rostekhnadzor:

- Independently approves federal regulatory documents in the field of nuclear power use;
- Performs monitoring and supervision of nuclear, radiation, technical and fire safety at nuclear power facilities; physical protection of nuclear facilities (NF), radiation sources (RS), disposal facilities (DS), nuclear materials (NM) and radioactive substances (RS), systems of state accounting and control of NM, RS, RW; commitment of the Russian Federation to international obligations in the field of ensuring safety in the field of nuclear power use;
- Performs licensing of activities in the field of nuclear power use;
- Gives permissions for activities in the area of nuclear power use, radiation substances (RS) emissions and discharges to the environment.

***State Atomic Energy Corporation “Rosatom” (State Corporation “Rosatom”)***

State Corporation “Rosatom” performs state safety regulation of nuclear power use in its subordinate enterprises in accordance with the amendment in Art. 23 of the Federal law on the use of nuclear energy, which was introduced in 2007 after adoption of the Federal law “On the State Atomic Energy Corporation “Rosatom”.

***Federal Service for Supervision in the Sphere of the Protection of Consumer Rights and Human Welfare (Rospotrebnadzor)***

Rospotrebnadzor is a federal executive authority, which performs state sanitary and epidemiological supervision over observance of the Russian Federation sanitary legislation.

***Federal Medical and Biological Agency (FMBA of Russia)***

FMBA of Russia performs government regulation of radiation safety on nuclear power use, including radiation monitoring at nuclear power facilities and environmental monitoring.

***Ministry of the Russian Federation for Civil Defence, Emergency Situations and the Rectification of the Consequences of Natural Disasters (RF Ministry of Emergency Situations)***

Ministry of Emergency Situations of Russia performs state supervision in the area of protection of the population and areas against natural and man-made emergencies.

***Ministry of Natural Resources and Ecology of the Russian Federation (RF Ministry of Natural Resources and Ecology)***

RF Ministry of Natural Resources and Ecology formulates state policy and ensures regulatory control on study, use, reproduction and protection of natural resources, including radiation monitoring and control.

***Federal Service for Supervision in the Sphere of Natural Resources Use (Rosprirodnadzor)***

Rosprirodnadzor ensures control and supervision in the area of environment protection (state environmental monitoring) and state environmental expertise, including documents justifying granting of licenses for management of SNF and RW, and decommissioning activities.

**Implementing agencies**

The following organizations can be referred to implementing agencies:

- Specialized organizations for RW management - FSUE “National Operator on RW management”, FSUE “RosRAO”, FSUE “Radon”) and for decommissioning (JSC “EDC “UGR”, JSC “EDEC VVER”);
- Operating organizations involved in management of SNF and RW and decommissioning activities as participants of federal and other programmes;
- Operating organizations, activities of which result in generation of RW, as well as organizations having accumulated RW.

**Key organizations that play an important role in nuclear fuel cycle**

The managing company in the area of RW management is the Federal Center on Nuclear and Radiation Safety, which is a part of the Division for Life Cycle Final Stage (LCFS) of State Corporation “Rosatom”.

State corporation “Rosatom” consists of parent companies consolidating enterprises of the same industrial function (for example, JSC “Rosenergoatom Concern” – operation of NPPs, JSC “TVEL” – industrial cycle from mining to fuel element manufacturing). Parent companies have own administrative bodies – departments, which coordinate activities of enterprises of a parent company, including SNF and RW management and decommissioning activities.

The following can also be referred to the organizations playing important role in nuclear fuel cycle activities:

- Federal safety regulatory bodies at the stage when new system of federal norms and regulation is being established;
- Research and development institutes and centres of State Corporation “Rosatom”;



- The Nuclear Safety Institute (IBRAE) of the Russian Academy of Sciences, which is permanently involved in preparation of federal programmes and other fundamental documents, including those related to management of SNF and RW and decommissioning activities;
- The National Research Centre “Kurchatov Institute”.

The organizations of Rostechnadzor (the Research Technical Center of Rostechnadzor, FSUE VO “Safety”) and other federal agencies as well as the research and development institutes of the Russian Academy of Sciences are involved in different aspects of management of SNF and RW and decommissioning activities.

## FINANCING

The sources of funding of management of SNF and RW and decommissioning activities are as follows:

- Targeted federal budgetary funds allocated for federal programmes and grants in the field of RW management;
- Funds of State Corporation “Rosatom” for implementation of innovation projects;
- Regional budgetary funds;
- Own funds of enterprises and parent companies;
- special funds created in accordance with legislation in force;
- Money accumulated in special reserve funds of State Corporation “Rosatom” for decommissioning and RW disposal;
- Money received in the course of international scientific and technical cooperation;
- Other funds, which are used in accordance with the Russian Federation legislation.

Basic activities in the field of management of SNF and RW and decommissioning are currently funded from the budget of the Federal target programme “Nuclear and Radiation Safety in 2008 and for the period up to 2015”. The total budget of the programme makes 145 bln Rub., including 75 bln Rub. allocated for resolving the “nuclear legacy” problem.

According to the Federal law on RW management, which requires mandatory disposal of all types of RW, the operators should transfer money to the special reserve fund of State Corporation “Rosatom” for disposal of accumulated RW. While developing the project for NRHF decommissioning, cost for disposal of accumulated RW should be included into total cost of decommissioning activities.

Later on the following provisions on funding of NRHF decommissioning activities should be enshrined in the law:

- for facilities where RW had been accumulated before adoption of the Federal law on RW management: decommissioning of these facilities should be funded from the federal budget, budgets of the Russian Federation entities, and local budgets. Extrabudgetary funds and money from international cooperation can also be used;
- for facilities (both operated and being designed), which did not have accumulated RW before the effective date of the Federal law: decommissioning of these facilities should be funded from special accumulation funds established by operators in accordance with legislation in force.

## **PUBLIC INFORMATION**

### **Government**

The Federal law on the use of nuclear energy ensures rights of public organizations (associations) and citizens to information and involvement in formation of policy in the field of use of nuclear energy (Articles 13-14).

Licenses for SNF and RW management and decommissioning activities are granted only if this is agreed by population, public organizations and municipal authorities for safety justification of the declared activities at public hearings.

The major scope of information on various aspects of SNF and RW management and decommissioning activities is presented by State Corporation "Rosatom" and Rostekhnadzor.

State Corporation "Rosatom" regularly publishes and/or places on its Web site the information and news about the industry on the whole and about certain enterprises individually. It also organizes issue of books and other informational material on issues related to management of SNF and RW and decommissioning activities; arranges preparation of RF national reports on fulfilment of obligations under Joint Convention on safety of management of SNF and RW.

Rostekhnadzor regularly publishes and/or places on its Web site the reports containing information on monitoring, supervisory, licensing and authorization activities; analyses of safety and emergency vulnerability reduction measures of supervised facilities, including analysis of negative man-made impact on the environment, and results of expert reviews. The reports should be placed on Rostekhnadzor's Web site and published at quarterly scientific magazine "Nuclear and radiation safety" (published since 1998), and available for the public at large.

### **Industry**

All enterprises of State Corporation "Rosatom" should regularly publish information (including information on management of SNF and RW and decommissioning activities) on their Web sites or in printed publications.

### **Basic Web sites:**

***State Atomic Energy Corporation "Rosatom" (State Corporation "Rosatom")***

<http://www.rosatom.ru>

***Federal Service for Environmental, Technological and Nuclear Supervision (Rostekhnadzor)***

<http://www.gosnadzor.ru>

***Federal Service for Supervision in the Sphere of the Protection of Consumer Rights and Human Welfare (Rospotrebnadzor)***

<http://www.rospotrebnadzor.ru>

***Federal Medical and Biological Agency (FMBA of Russia)***

<http://www.fmbaros.ru>

***Ministry of the Russian Federation for Civil Defence, Emergency Situations and the Rectification of the Consequences of Natural Disasters (RF Ministry of Emergency Situations)***

<http://www.mchs.gov.ru>

***Ministry of Natural Resources and Ecology of the Russian Federation (RF Ministry of Natural Resources and Ecology)***

<http://www.mnr.gov.ru>

***Federal Service for Supervision in the Sphere of Natural Resources Use (Rosprirodnadzor)***

<http://www.rpn.gov.ru>

**Federal State-Funded Institution “Scientific and Engineering Centre on Nuclear and Radiation safety” (SEC NRS)**

<http://www.secncrs.ru>

**Federal State Unitary Enterprise VO “Safety” (FSUE VO “Safety”)**

<http://vosafety.ru>

**Nuclear Safety Institute of the Russian Academy of Sciences (IBRAE)**

<http://www.ibrae.ac.ru>

**JSC “Federal Centre for Nuclear & Radiation Safety “ (JSC FCNRS)**

<http://www.fcncrs.ru>

**Federal State Unitary Enterprise United Ecological, Scientific and Research Centre of Decontamination of Radioactive Waste and Environmental Protection (FSUE “Radon”)**

<http://www.radon.ru>

**Internet portal “Russian Nuclear Community”**

<http://www.Atomic-energy.ru>