

RADIOACTIVE WASTE MANAGEMENT AND DECOMMISSIONING **IN THE RUSSIAN FEDERATION**

[2014]

1. NATIONAL REGULATORY FRAMEWORK FOR MANAGEMENT OF RADIOACTIVE WASTE AND DECOMMISSIONING

1.1 National framework

1.1.1 Overview of national policy

Management of radioactive wastes (RW), spent nuclear fuel and decommissioning of nuclear and radiation hazardous facilities in Russia is arranged in accordance with the Federal Law “On the use of atomic energy” dated 21.11.1995 № 170-FZ, Federal Law «On radioactive waste management and introduction of amendments in certain legal acts of the Russian Federation” dated 11.07. 2011 № 190-FZ, as well as some other federal laws and normative legal acts, given further on in Section 2 of the present document.

Policy of Spent nuclear fuel management

General strategy of further development of nuclear industry in Russia is based on implementation of closed nuclear fuel cycle at NPPs with fast neutron reactors.

With consideration of the mentioned above Russian national policy of SNF management is based on the provisions that spent fuel is not a kind of radioactive waste and is subject to reprocessing for its further returning in nuclear fuel cycle of regenerated nuclear materials for fresh fuel production.

Spent nuclear fuel management in Russia is performed in accordance with the Federal Law “On the use of atomic energy”, “State Corporation Rosatom concepts on spent nuclear fuel management” and “Programme for the development of the infrastructure for spent nuclear fuel management for the period 2011 – 2020 and further till 2030”, as well as laws and normative legal acts given in Section 2 of the present document.

At present in Russia at radio-chemical plant PT-1 (RT-1) of the Manufacturing group “Mayak” (Tchelyabinsk region, the Urals) spent nuclear fuel of VVER-440, Fast Neutron reactors BN-600, nuclear navy and research reactors is being recycled, which ensures limited closure of nuclear fuel cycle (in Uranium for NPPs with RBMK reactors).

It is supposed that till 2030 in Russia at Mining and chemical combine there will be built a new radiochemical plant on spent nuclear fuel recycling with the productivity and technical characteristics capable to ensure transition to closed nuclear cycle of the nuclear industry on the whole (for both, uranium and plutonium).

Construction of radiochemical plant PT-2 will be preceded by a full-scope development of innovative technologies of SNF and RW recycling in Experimental and demonstration center, which is a research facility and pilot plant for SNF recycling with the productivity up to 100 tons uranium per year. Such

Experimental and demonstration center is under construction at mining and chemical combine with its first stage being planned to be started in 2017.

RW treatment policy

National policy of RW treatment is defined by the Federal law “On radioactive wastes treatment” and normative-legal documents given further on in Section 2.

According to the Federal law the Russian Federation builds a Common state system of radioactive wastes treatment with the main purpose to arrange and ensure technologically up-to-date, environmentally safe and economically efficient radioactive wastes treatment.

Common state system of RW treatment will represent a logical system of objects that will perform their activities in the area of RW treatment, infrastructure facilities on RW treatment as well as requirements on RW treatment including its mandatory disposal.

According to the Federal Law on RW treatment the main principles of the Common state system of RW treatment will be the following:

- priority of human life and health protection of the present and future generations, environment protection from the impact of radioactive wastes;
- prohibition of import to the Russian Federation and export from the Russian Federation of radioactive wastes with the purpose of their storage, recycling and repository except for certain cases envisaged by the present law;
- responsibility of RW producing organizations for safety in RW management until its transfer to the national operator responsible for disposal;
- financial support of activities on radioactive waste management, including its disposal on the expenses of organizations which produce RW as a result of their activity;
- ensuring interdependence of RW generation stage and stages of RW management;
- accessibility for citizens and public associations to information related to the management of radioactive waste

The law establishes a classification of radioactive waste, the requirements for disposal of radioactive waste, the requirements to the treatment of radioactive waste and the accumulation facilities, as well as financial support of the basis on radioactive waste management, including RW of so-called “nuclear legacy”. Adoption of the law consolidated the shift from controlled storage of radioactive waste to the practice of its conditioning and disposal, providing reliable isolation of RW for the entire period of its potential danger.

The implementation of the Federal Law is followed by the development of legal framework and organisational basis of the system on RW management, as well as by the establishment of the facilities of the required infrastructure, including the systems for disposal of conditioned RW, which is currently missing.

To ensure development of the system of RW management in Russia considering the implementation of the Federal Law on RW management there have been introduced some important changes in the

organisational structure of the State corporation “Rosatom” division, responsible for the final stage of the life-cycle with allotment of state functions and business-activity.

Decommissioning policy

State Corporation "Rosatom" considers one of the priorities of its activity creation of conditions enabling timely, corresponding to modern international standards, cost-effective decommissioning of nuclear and radiation hazardous facilities, maximally excluding the shift of the problem onto future generations.

Activity on decommissioning is performed in accordance with the Federal Law ‘On the use of atomic energy’, federal rules and regulations set forth below in Section 2, and the Concept of the decommissioning of nuclear installations, radiation sources and storages of the State Corporation "Rosatom" (approved in 2008, currently being updated with the adoption of the Federal law “On RW management” and other changes).

Currently, the companies of the State Corporation "Rosatom" are performing the most urgent measures on decommissioning of nuclear and radiation hazardous facilities, prescribed by the federal program "Nuclear and Radiation Safety in 2008 and for the period until 2015." Integrated solution of decommissioning is considered to be implemented within the framework of the planned continuation of works on the program for the period 2016-2025.

Plans to perform the required work on decommissioning should be closely linked with the plans to create storage facilities and final isolation, with the creation of the appropriate infrastructure of RW treatment (conditioning, transportation) and the development of the legal framework (new category of RW accounting RW – “Special RW” and supposed features of financing decommissioning and “nuclear legacy” radioactive waste management).

At present a comprehensive system for decommissioning of the State corporation “Rosatom” facilities is in the stage of development and formation.

1.1.2 Involved organisations

Overview of relevant institutions

Main organisations and resources in the area of spent nuclear fuel, radioactive waste treatment and decommissioning are concentrated in the State corporation “Rosatom”, which according to the federal legislation performs state control of the entire activity in the use of atomic energy, including ensuring of nuclear, radiation and environmental safety.

To perform these functions in the State corporation “Rosatom” there was established the Direction on the state policy in spent nuclear fuel, RW treatment and decommissioning, which incorporates the following structural divisions:

- Project office “Establishment of common state system on radioactive waste treatment”;
- Project office on spent nuclear fuel management;
- Directorate on decommissioning of Nuclear and radioactive hazardous facilities.

To discuss the problems and developments of the required recommendations in the State corporation “Rosatom” there was established a Scientific and Technical Council, which includes sections in the subject area of spent nuclear fuel, RW treatment and decommissioning.

The State corporation Rosatom consists of the head companies consolidating the enterprises of one production purpose (for example, JSC Rosenergoatom - operation of nuclear power plants), JSC TVEL - a production cycle from uranium mining to production of fuel elements) therefore there is the second level of management - the Departments of the head companies coordinating activities on management of spent nuclear fuel, RW treatment and decommissioning, carried out at the enterprises of the head company.

“The involved organizations” shall also include:

- specialized organizations in the field of radioactive waste treatment (Federal State Unitary Enterprise "Federal Center for Nuclear and Radiation Safety", Federal State Unitary Enterprise "National operator on RW treatment", Federal State Unitary Enterprise "RosRAO", Federal State Unitary Enterprise "Radon") and decommissioning (JSC "ODTs UGR", JSC "ODITs VVER");
- operating organizations which are engaged in the activity on spent nuclear fuel management, RW treatment and decommissioning according to federal or other programs;
- research institutes and State corporation "Rosatom" centers;
- The institute of nuclear power safety (IBRAE of the Russian Academy of Sciences) which is not a part of the State corporation "Rosatom" , but on a permanent basis participates in the preparation of federal programs and other fundamental documents connected also in the activities on the spent nuclear fuel management, RW treatment and decommissioning.

Various aspects of the activities in SNF, RW treatment and decommissioning are handled by the organizations of Rostekhnadzor (Research and technical centre of Rostekhnadzor, VO "Safety") and other federal agencies, as well as research institutes of the Russian Academy of Sciences and Research Centre "Kurchatov Institute".

1.2 National organisations responsible for technical regulation National regulatory organizations

Authorities of safety state regulation are defined by the Federal Law “On the use of atomic energy”. Competence, structure and human resources of public safety regulation defined by the relevant regulations of the Government of the Russian Federation.

Budgetary financing activities of public safety regulation are approved by the State Duma and the Federation Council of Russia in the framework of the budget for the planned year.

Currently the bodies on state regulation of safe use of nuclear energy, including activities on SNF, RW treatment and decommissioning are as follows:

Federal Service for Environmental , Technological and Nuclear Supervision (Rostekhnadzor)
Rostekhnadzor is a federal executive authority performing the following functions:

- state regulation of safety in the use of nuclear energy in accordance with the Federal Law on the use of atomic energy;

- functions of the regulatory body of the Russian Federation in accordance with the Convention on Nuclear Safety and the Joint Convention on Safety of spent fuel and radioactive waste,
- functions of the competent authority of the Russian Federation in accordance with the Amendment to the Convention on Physical Protection of Nuclear Materials.

Within these functions fulfilment Rostekhnadzor:

- independently adopts federal regulations in the field of nuclear energy;
- controls and supervises nuclear, radiation, industrial and fire safety at nuclear facilities; ensures physical protection of nuclear facilities (NF), irradiation sources (IS), storages, nuclear materials (NM) and radioactive substances (RS), monitors systems for state accounting and control of nuclear materials, radioactive substances; radioactive wastes; fulfilment of the international obligations of the Russian Federation in the field of the safe use of nuclear energy;
- is responsible for licensing activities in the field of nuclear energy;
- issues permits: to carry out work in the field of nuclear energy, emissions and discharges of radioactive substances into the environment.

State corporation for atomic energy “Rosatom” (State corporation “Rosatom”)

The State Corporation "Rosatom" ensures state regulation of the safe use of nuclear energy for its member companies on the basis of amendments in the art. 23 of the Federal Law on the Use of Atomic Energy, introduced in 2007 after the adoption of the Federal Law "On the State Atomic Energy Corporation" Rosatom".

The Federal Service for Supervision of Consumer Rights Protection and Human Welfare (Rospotrebnadzor)

Rospotrebnadzor is a federal executive authority responsible for State Sanitary and Epidemiological Supervision of sanitary legislation of the Russian Federation.

Federal Medical-Biological Agency (FMBA of Russia)

FMBA of Russia conducts state regulation of radiation safety in the use of nuclear energy, including radiation monitoring of working conditions of the employees at the serviced nuclear facilities and condition of the Radiation Safety of the public.

Ministry of the Russian Federation for Civil Defence, Emergencies and Elimination of Consequences of Natural Disasters)

Russian Emergency Ministry performs state supervision in the field of population and territories protection from emergency situations of environmental and technological nature.

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

Ministry performs the functions of state policy implementation and legal regulations in the field of study, use, reproduction and conservation of natural resources, including the regulation of radiation control and monitoring.

The Federal Service for Supervision of Natural Resources (Rosprirodnadzor)

Rosprirodnadzor performs the functions of control and supervision in the field of environmental protection (state environmental control) and state environmental expertise, including materials substantiating licenses for activities in the field of SNF and RW treatment and decommissioning.

1.3 National operating organisations

National implementing organizations

According to the Federal Law on Atomic Energy and the Federal Law on radioactive waste management safety of radioactive waste management until its transfer to the national operator for RW treatment is under responsibility of the operating organizations, which have these RW as a result of their activity.

Operating organizations whose activities are connected with the generation of radioactive wastes are nuclear power plants, nuclear fuel cycle enterprises, research institutes and centres, facilities of the nuclear navy fleet.

The main specialized agencies on transportation, storage and processing of RW are FSUE "RosRAO" and FSUE "Radon".

There are specialized non-governmental organizations with ownership, providing individual services in SNF management, radioactive wastes treatment and decommissioning (JSC "Ecomet", LLC "Quant", JSC "RAOPROEKT", JSC "Khimmed", etc.)

According to the Federal Law on RW treatment by government order of the Russian Federation № 384-r dated March 20, 2012 there was established a specialized organization responsible for disposal of radioactive wastes - National operator for RW treatment (FGUP "NO RAO") with the following areas of activity:

- ensuring the safe management of radioactive waste accepted for disposal;
- provision of operation of RW disposal facilities;
- acting as the design and construction customer of the radioactive wastes disposal points;
- forecasting the required infrastructure for treatment of radioactive wastes and disposal of radioactive waste volumes;
- keeping the state register of RW and state cadastre of RW storage points.

For the improvement of technology and gaining experience of decommissioning of similar facilities in Russia Experimental and demonstration centres were created. Currently there are in use Experimental and demonstration centres to Experimental the technology for nuclear power units with VVER reactors (VVER ODITS) at Novovoronezh NPP and Experimental and demonstration centre on decommissioning uranium-graphite reactors (ODC UGR) at Siberian chemical combine.

2. NORMATIVE AND LEGAL FRAMEWORK

2.1 Basic legislation and main regulations

Primary legislation

Activities in the area of SNF management, radioactive waste treatment and decommissioning are regulated by a set of legal documents, including federal laws, decrees of the President of the Russian Federation and the Government of Russian Federation, federal regulations and other relevant departments

The fundamental legal documents:

- Federal Law "On the Use of Atomic Energy" dated 21.11.1995 № 170-FZ.
- Federal Law "On Radioactive Waste and Amendments in a separate legislative acts of the Russian Federation" of 11.11.2011 № 190-FZ.
- Federal Law "On ratification of the Joint Convention on the Safety of Spent Nuclear Fuel management and the Safety of Radioactive Waste treatment" of 04.11.2005, № 139-FZ.
- Federal Law "On Environmental Safety" of 10.01.2002 № 7-FZ.
- Federal Law "On Subsoil" of 21.02.1992 № 2395-1.
- Federal Law "On Radiation Safety of the population" of 09.01.1996, № 3-FZ.
- Federal Law "On Sanitary and Epidemiological Welfare of the population" of 30.03.1999 № 52-FZ.
- Federal Law "Water Code of the Russian Federation" of 19.06.2007 № 74-FZ.
- Federal Law of "The State Atomic Energy Corporation" Rosatom "of 01.12.2007, № 317-FZ.

2.2 Principal regulations (rules)

General regulations

- Norms of radiation safety НРБ-99/2009
- Main sanitary rules of radiation safety assurance ОСПОРБ-99/2010
- Sanitary rules of radioactive wastes treatment СПОО-2002

2.3 Rules/regulations related to specific activities

Specific Regulations

According to the federal law on radioactive waste treatment into the system of RW classification there has been introduced a new concept - "Special RW". This category refers to radioactive wastes, for which the risks associated with radiation exposure, other risks, as well as costs associated with the recovery of RW from the storage facility, subsequent treatment, including disposal prevail over the risks and costs

associated with the disposal of such radioactive wastes in their location . In particular, special RW may refer to sediments in LRW ponds generated as a result of protection programs at radiochemical plants.

Rules specifying the attribution of RW to the category of "special" and specific features of such RW treatment are currently under development.

2.4 Normative documents

Regulatory Documents

2.4.1 Radioactive wastes management

Radioactive waste management

- Safety precautions for management of radioactive waste at nuclear power plants NP-002-04
- Collecting, processing, storage and conditioning of liquid radioactive waste. Safety requirements of NP-019-2000.
- Collecting, processing, storage and conditioning of solid radioactive waste. Safety requirements of NP-020-2000.
- Treatment of gaseous radioactive waste. Safety requirements of NP-021-2000.
- Safety regulations for temporary storage of radioactive wastes that are formed during mining, processing and use of minerals NP-052-04.
- Disposal of radioactive wastes. Principles, criteria and essential safety requirements NP-055-04.
- Safety during management of radioactive wastes. General provisions NP-058-04.
- Near Surface Disposal of Radioactive Waste. Safety requirements NP-069-06.
- Immobilization of transuranic radioactive waste. Safety requirements NP-076-06.
- Reprocessing of spent nuclear fuel. Safety requirements. NP-013-99
- The basic rules of accounting and control of radioactive substances and radioactive wastes in the organization NP-067-05
- Safety assessment of near-surface radioactive wastes RB-011-2000.
- Ensuring safety of radioactive waste management in the process of mining, processing and utilizing minerals RB-014-2000.
- Ensuring safety of radioactive waste management generated as a result of mining, processing and utilization of minerals RB-014-2000.
- Recommendations for establishing acceptance criteria for conditioned radioactive waste storage and disposal RB-023-02.
- Structure and content of Safety Analysis Report for solid radioactive waste storage RB-050-09.

- Regulation on the structure and content of Safety Analysis Report for subsurface disposal of radioactive wastes RB-058-10.
- Requirements for the quality assurance program on radioactive wastes RB-003-98.
- About the Criteria of liquid, solid and gaseous waste attribution to radioactive wastes, criteria of radioactive waste attribution to specific radioactive wastes and criteria for classification of removable radioactive wastes. The Russian Federation Government Decree of October 19, 2012 № 1069

2.4.2 Decommissioning *Decommissioning*

- Safety rules for the decommissioning of nuclear power plant unit NP-012-99
- Safety rules for the decommissioning of research nuclear facilities NP-028-01.
- Safety rules for the decommissioning of nuclear power plants for ships RT-037-02.
- Safety rules for the decommissioning of nuclear fuel cycle installations NP-057-04.
- The concept of the decommissioning of nuclear installations, radiation sources and storages of the State Corporation "Rosatom". Approved on 30.01.2008, is currently being updated with consideration of the Federal Law on radioactive wastes treatment and changes introduced after its approval.
- Federal target program "Nuclear and Radiation Safety for 2008 and for the period till 2015" (FTP NRS 2008-2015). Approved by the Decree of the Government of the Russian Federation of 13.07.2007 № 444.

2.5 Licensing *Licensing procedures*

- Federal Law "On Environmental Impact Assessment" of 23.11.1995 № 174-FZ.
- Federal Law "On licensing of certain types of activities" of 08.08.2001 № 128-FZ
- Instruction in the Review statement and documents submitted to obtain a license to operate in the field of nuclear energy by the central office of the Federal Service for Environmental, Technological and Nuclear Supervision RD-03-08-2004.

2.6 Information and Participation of the Public

Federal Law "On the use of Atomic Energy" guarantees the rights of public organizations (associations) and citizens to be informed and participate in policy-making in the field of nuclear energy (Article 13-14).

Licenses for activities related to SNF, RW management and decommissioning are issued only after approval of safety of the declared activities at public hearing.

3. WASTE MANAGEMENT STRATEGY AND CURRENT PRACTICE

3.1 Waste classification and quantities

Waste classification

Russian RW classification is based on the provisions of the Federal Law of 11.11.2011 № 190 -FZ " On Radioactive Waste and Amendments to Certain Legislative Acts of the Russian Federation" and Decree of the Government of the Russian Federation of 19.10.2012 , № 1069 "On criteria of solid, liquid and gaseous waste attribution to radioactive waste , the criteria of radioactive wastes attribution to special radioactive wastes and to disposed radioactive wastes, and classification criteria for disposal of radioactive wastes".

Classification system takes into account both characteristics of radioactive wastes, and aspects of their subsequent disposal. Suggestions have been made for further development of the Russian classification system in the direction of RW synchronization with similar foreign documents and IAEA recommendations.

Solid, liquid and gaseous wastes containing radionuclides, except for waste generated during the implementation of activities not connected with the use of nuclear energy for mining and processing of minerals and organic materials with a high content of natural radionuclides belong to RW class if the sum of ratios specific (for solid and liquid waste) or volume (for gaseous waste) activities of radionuclides in the waste to their limit values shown in the above-mentioned Decree of the Government of the Russian Federation of 19.10.2012, №1069, exceeds 1.

In case of impossibility to determine the amount of relations between specific activities of radionuclides in the waste to the above limits of solid waste containing radionuclides, except for the wastes generated during the implementation of activities not related to the use of nuclear energy - mining and processing of minerals and an organic materials with a high content of natural radionuclides belong to RW class if specific activity of the radionuclides in the waste exceeds:

- 1 Bq/g – for alpha-nuclides;
- 100 Bq/g – for beta nuclides.

In case it is impossible to determine the amount of relations between specific activities of radionuclides in the wastes specified in the annex to the present document their limit liquid waste containing radionuclides , except for waste generated during activities not related to the use of nuclear energy – such as mining and processing of minerals and organic materials with a high content of natural radionuclides belong to radioactive wastes in case specific activity of radionuclides in the waste is more than:

- 0,05 Bq/g – for alpha-nuclides;
- 0,5 Bq/g – for beta nuclides.

Solid and liquid wastes generated during the implementation of activities not related to the use of nuclear energy such as mining and processing of minerals and organic materials with high content of natural radionuclides are attributed to RW based on calculation using formulas that take into account specific activity of radium-226, thorium-232 and potassium-40.

According to the federal law on radioactive waste management radioactive waste can be classified in the category of "Disposed RW" and "Special RAO" with regard to the subsequent management.

Disposed radioactive wastes

To the class of removable RW there belong RW for which the risks associated with radiation exposure, other risks, as well as costs associated with the recovery of RW from RW storage facility, followed by proper treatment, including disposal, do not exceed the risks and costs associated with disposal of radioactive waste in their location.

Disposed RW can be classified by the following features:

- depending on the half-life of the radionuclides contained in RW : long-life radioactive waste and short-life radioactive waste.
- depending on the specific activity : high-level radioactive waste (HLW) , intermediate-level radioactive waste (ILW) , low-level radioactive waste (LLW) , very low-level radioactive waste (VLLW).
- depending on the state of aggregation: liquid radioactive waste (LRW) , solid radioactive waste (SRW) , gaseous radioactive waste (GRW).
- depending on the content of nuclear materials: RW containing nuclear materials, radioactive waste not containing nuclear material.
- spent sealed sources of ionizing radiation (SIR);
- RW generated during extraction and processing of minerals and organic materials with an increased content of natural radionuclides.

Classification of solid RW by specific activity

Category of RW	Specific activity of RW, Bq/g			
	Tritium	Beta-nuclides	Alpha-nuclides (including transuranium)	Transuranium elements
VLLW	$< 10^7$	$< 10^3$	$< 10^2$	$< 10^1$
LLW	$10^7 - 10^8$	$10^3 - 10^4$	$10^2 - 10^3$	$10^1 - 10^2$
Middle LRW	$10^8 - 10^{11}$	$10^4 - 10^7$	$10^3 - 10^6$	$10^2 - 10^5$
HLW	$> 10^{11}$	$> 10^7$	$> 10^6$	$> 10^5$

Classification of liquid RW by specific activity

Category of RW	Specific activity of RW, Bq/g			

	Tritium		Tritium	
LLW	$<10^4$	$<10^3$	$<10^2$	$<10^1$
Middle LRW	10^4-10^{11}	10^3-10^7	10^2-10^6	10^1-10^5
HLW	$>10^8$	$>10^7$	$>10^6$	$>10^5$

Classification system considers both characteristics of RW as well as aspects of its further disposal.

Classification of disposed RW in relation to the methods of its further disposal

Class	Type of RW	Method of disposal
Class 1	Solid or liquid solidified HLW with high heat containing radionuclides with the following specific activities: Tritium -> 10^{11} Bq / g By beta-emitters (except for tritium) -> 10^7 Bq / g Alpha emitters (excluding TRU) $> 10^6$ Bq / g For transuranic nuclides -> 10^5 Bq / g	Disposal in points of deep disposal of preconditioned radioactive wastes to reduce its heat release.
Class 2	Solid or liquid solidified HLW and spent sealed sources of ionizing radiation containing radionuclides with the following specific activities : Tritium -> 10^{11} Bq / g By beta- emitters (except for tritium) -> 10^7 Bq / g Alpha emitters (excluding TRU) $> 10^6$ Bq / g For transuranic nuclides -> 10^5 Bq / g Solid long-life ILW containing radionuclides with half-lives of more than 30 years and a specific activity : from 10^8 to 10^{11} Bq / g - for tritium radioactive waste; from 10^4 to 10^7 Bq / g - for RW containing beta- emitting radionuclides (except for tritium); from 10^3 to 10^6 Bq / g - for radioactive waste containing alpha - emitting radionuclides (except transuranic); from 10^2 to 10^5 Bq / g - for RW containing transuranic radionuclides	Disposal in points of deep disposal of non-preconditioned radioactive waste without in order to reduce its heat exposure.

Class 3	<p>Solid ILW containing radionuclides with a specific activity: from 10^8 to 10^{11} Bq / g - for tritium radioactive waste; from 10^4 to 10^7 Bq / g - for RW containing beta-emitting radionuclides (except for tritium); from 10^3 to 10^6 Bq / g - for radioactive waste containing alpha-emitting radionuclides (except for transuranic); from 10^2 to 10^5 Bq / g - for RW containing transuranic radionuclides; Solid long-lived LLW containing radionuclides with half-lives of more than 30 years and a specific activity: from 10^7 to 10^8 Bq / g - for tritium radioactive waste; from 10^3 to 10^4 Bq / g - for RW containing beta-emitting radionuclides (except for tritium); from 10^2 to 10^3 Bq / g - for radioactive waste containing alpha-emitting radionuclides (except for transuranic); from 10^1 to 10^2 Bq / g - for RW containing transuranic radionuclides.</p>	Disposal in points of subsurface disposal of non-preconditioned radioactive waste to be placed at the depth of 100 meters.
Class 4	<p>Solid long-life LLW containing radionuclides with specific activity : from 10^7 to 10^8 Bq / g - for tritium radioactive waste; from 10^3 to 10^4 Bq / g - for RW containing beta -emitting radionuclides (except for tritium) ; from 10^2 to 10^3 Bq / g - for radioactive waste containing alpha - emitting radionuclides (except transuranic) ; from 10^1 to 10^2 Bq / g - for RW containing transuranic radionuclides. Very low-level solid radioactive waste containing radionuclides specific activity : to 10^7 Bq / g - for tritium radioactive waste; to 10^3 Bq / g - for RW containing beta -emitting radionuclides (except for tritium) ; to 10^2 Bq / g - for RW containing alpha-emitting radionuclides (except for transuranic) ; to 10^1 Bq / g - for RW containing transuranic radionuclides.</p>	Near surface disposal at the same level with ground surface
Class 5	<p>Liquid ILW containing radionuclides with specific activity: from 10^4 to 10^8 Bq / g - for tritium radioactive waste; from 10^3 to 10^8 Bq / g - for RW containing beta -emitting radionuclides (except tritium) ; from 10^2 to 10^6 Bq / g - for radioactive waste containing alpha - emitting radionuclides (except transuranic) ; from 10^1 to 10^5 Bq / g - for RW containing transuranic radionuclides. Liquid LLW containing radionuclides specific active- Stew : to 10^4 Bq / g - for tritium radioactive waste; to 10^3 Bq / g - for RW containing beta -emitting radionuclides (except tritium) ; to 10^2 Bq / g - for RW containing alpha-emitting radionuclides (except transuranic) ; to 10^1 Bq / g - for RW containing transuranic radionuclides.</p>	Disposal in points of deep disposal of liquid radioactive waste, constructed and operated as for the day of validation of the Federal Law on Radioactive wastes treatment.

Class 6	RW generated during mining and processing of uranium ores, as well as during the implementation of activities not related to the use of atomic energy while mining and processing minerals and organic materials with a high content of natural radionuclides.	Disposal in points of subsurface disposal of non-preconditioned radioactive waste
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Specific radioactive wastes

The category of "Special RW" include RW, for which the risks associated with radiation exposure, other risks, as well as costs associated with the recovery of RW from RW storage facility, followed by proper treatment, including disposal, prevail over the risks and costs associated with the disposal of radioactive wastes in their location.

The Federal law on radioactive waste management characterizes the "Special RW" as follows:

"Special RW include RW formed as a result of the state armament program and state defence order, the use of nuclear weapons for peaceful purposes or as a result of nuclear and (or) radiation accident at a nuclear facility, LRW placed in surface reservoirs – storages with total capacity of more than 25,000 cubic meters, commissioned before validation of the Federal Law on treatment of radioactive wastes and sediments, as well as sediments in such storage ponds that meet the following criteria:

- calculated in accordance with the federal rules and regulations, as well as sanitary rules in the field of radiation safety collective effective dose for the entire period of the potential hazard of radioactive waste and the risk of potential exposure associated with the removal of radioactive waste exceeds the collective effective dose for the entire period of the potential hazards and the risk of potential exposure associated with the disposal of radioactive waste in their location;
- costs associated with the disposal of radioactive wastes (including the costs of their extraction, processing, conditioning, transportation to the point of disposal and disposal) exceed the total amount of possible harm to the environment in case of disposal of radioactive waste in their location and the cost of disposal of radioactive waste in place their location (including the cost of transition point of storage of radioactive waste at the point of disposal of non-preconditioned radioactive waste, its operation and closure, as well as costs of safety assurance during the period of the potential hazard coming from RW);
- point of storage of radioactive waste and sanitary protection zone located outside the boundaries of settlements, protected areas, coastal protection lines and water protection zones of water bodies, and other security protection zones established in accordance with the legislation of the Russian Federation”.

Waste quantities

As for 01.01.2011 in different types of storages in 43 regions of the Russian Federation there have been stored the following quantities of Radioactive wastes:

Liquid radioactive wastes (LRW)

LRW are located in 83 companies (330 storages on the whole) and 3 points of deep disposal of radioactive wastes in geological formations.

The total volume of liquid radioactive wastes makes - 486 million m³ (4,27 • 10¹⁹ Bq). The main part of the accumulated LRW – are LLW (97.1%), which activity makes 8,43 • 10¹⁵ Bq (approximately 0.02% of the total activity of LRW).

High-level liquid radioactive wastes make less than 0.5% of the total volume of liquid radioactive wastes, but their activity with makes about 42% of the total activity of LRW. All high-level liquid radioactive wastes are isolated from the environment.

Solid radioactive wastes (SRW)

SRW are located at 136 facilities and in 1466 points of RW temporary storages.

The total volume of SRW makes - 87 mln. tons (3,59•10¹⁹ Bq). The main part of the accumulated SRW (69 mln. tons) belongs to low level RW, 97% of them is at the enterprises on mining and processing of uranium ores.

High-level SRW contains 98% of the total activity of SRW. The bulk of accumulated HLW - is vitrified LRW cladding, contaminated equipment, spent reactor internals located at radiochemical plants ("Mayak", Mining and chemical combine, Siberian chemical combine and SCC). All HLW are located in specialized buildings or structures and are isolated from the environment.

Generation of RW in 2012:

- LRW – 2,05 mln. m³.
- SRW – 1,4 mln. tons.

The above data on the quantities of waste will be further clarified by the results of 2012 secondary registration of RW and their locations in accordance with the Federal Law on the treatment of radioactive waste and the Russian Government Resolution "On the conduct of initial registration of RW" of 25.07.2012 № 767.

3.2 Strategy in the field of radioactive wastes management

Waste Management Strategy

3.2.1 Nuclear fuel cycle wastes ***Nuclear Fuel Waste***

Currently in Russia there are implemented all stages of the nuclear fuel cycle - from mining and enrichment of uranium ore to reprocessing of SNF with extraction of uranium used repeatedly.

Strategy for further development of the Russian nuclear industry is aimed at the closure of the nuclear fuel cycle both for uranium and plutonium based on nuclear power plants with fast neutron reactors.

In view of the above, Russia's national policy in the field of SNF management is based on the notion that SNF is not RW, is recyclable and is subject to return to the nuclear fuel cycle of the recovered nuclear materials.

As a result of reprocessing of SNF for nuclear weapon materials at Manufacturing group "Mayak", Siberian chemical combine and Mining chemical combine there were formed significant amounts of liquid

high-level wastes (HLW) stored in special containers with the provision of the necessary safety measures (RW of "nuclear legacy").

At the moment due to the halt in activity of radiochemical plants of defensive purpose liquid HLW are generated only at MG "Mayak", where since 1979 there is operated radiochemical plant RT-1 for reprocessing SNF from VVER-440, BN-600, research reactors, as well as naval reactors and atomic icebreaker fleet. Recovered highly enriched uranium is then used in the manufacture of fresh fuel for nuclear power plants with RBMK reactors.

All liquid HLW generated at RT-1 plant "Mayak" and part of the accumulated liquid HLW of "nuclear legacy" are solidified by a vitrification method at installation with ceramic melter with the capacity up to 500 l/h for initial LRW.

For nearly 25 years of existence, the vitrification plant "Mayak" solidified about 30 thousand cubic meters of liquid HLW and embodied in aluminophosphate glass more than 600 million curies of activity. Vitrified RW are placed in special canisters and stored at "Mayak" until creation of geological disposal facilities.

In 2015 there will start operation of a new vitrification installation EP-500/5 instead of the expired EP-500/4. The technology is Experimentaled on the use of the induction melter "cold crucible" that will vitrify accumulated HLW with complex composition.

3.2.2 Low and Intermediate-Level Radioactive Waste

For a long time nuclear fuel cycle technology was mainly used for defence purposes to obtain weapons-grade uranium and plutonium at three reprocessing plants in USSR - "Mayak", MCC and SCC. The main requirement for waste management system at that time was their isolation, which used a simplified design engineering structures (SRW) and specially equipped storage reservoirs (LRW). Currently, these systems do not meet modern requirements, thus works are conducted on transition to modern technologies of RW treatment, as well as well as transfer of the accumulated wastes to safe condition (RW of "nuclear legacy").

After detailed geological studies at SCC and GCC technology has been applied for underground disposal of liquid radioactive waste of low and intermediate level by injection into isolated aquifers located at a depth of 180-500 m in the rocks. Underground landfills for the disposal of liquid radioactive waste are equipped with observation wells for continuous monitoring of the radiation. Within only 40 years of landfills operation there were isolated about 58 million cubic meters of LRW. It is expected to continue underground disposal of liquid radioactive waste for some more time to create complexes of radioactive waste management based on modern technologies.

System of low and intermediate level LRW treatment at MG "Mayak" is based on isolating them in special open type storage ponds, located at the site of the combine. In 2015, there will be started operation of cementation centre for intermediate-level liquid radioactive waste, which will allow to decommission, and then conserve the most potentially dangerous radiation reservoir storage Karachai (B-9), the total activity in which according to estimates is above 100 million Curie.

Currently RW of low and intermediate radioactive level from nuclear power plants are processed and are stored at NPP sites.

Design solutions for RW treatment at NPPs recently constructed ensure RW conditioning, containerization and temporary storage in engineering constructions on the territory of NPP to transfer for disposal to the national operator on RW management.

At nuclear power plants built before the 70th of the last century, conditioning of SRW and solidification of LRW concentrates was supposed to be done during the plant decommissioning. For this reason, a number of nuclear power plants accumulated radioactive waste requiring processing to reduce the amount and transfer into the form which is safe for storage. In this regard, the work was carried out to extract the accumulated SRW followed by their selection and processing by the methods of compaction and combustion; activities are done on supplying the plants with the full set of equipment required for conditioning of RW.

Accumulated residues from evaporation of the source LRW NPP are assumed to be recycled by technology based on selective sorption of radionuclides with a final product of this procedure being the containers with radioactive cement compound directed to waste facilities, and non-radioactive saline melt. First time the technology has been experimented and implemented at Kola NPP. The advantage of this technology is a significant decrease in the volume of conditioned radioactive wastes sent for disposal.

RW of low and medium activity levels generated as a result of the use of radioactive substances and nuclear materials in science, medicine and industry are directed to specialized institutions - FSUE "RosRAO" and FSUE "Radon" for conditioning and storage before transfer for disposal of the national operator on RW management.

LRW with low level of activity from the Research Institute of Atomic Reactors (RIAR) are injected into aquifers to a depth of 1130-1550 m similar to the method of the underground injection used at SCC and GCC. According to the data as for 2012 there have been buried 6.6 cubic meters of LRW.

One of the most important technical challenges in the coming years is supply of the enterprises with a complete set of equipment for RW conditioning, which also includes several nuclear power plants with SRW and LRW treatment facilities being under construction.

The unsolved problem for today is creation of regional storage facilities and disposal of radioactive wastes due to which RW storages are still arranged at industrial sites of NPPs. The absence of such facilities also prevents large-scale activities on decommissioning.

3.3 Waste management issues at national level

The national activities in the field of radioactive waste management are associated with the implementation of the provisions of the Federal Law on radioactive waste management and the implementation of the federal target program "Nuclear and Radiation Safety in 2008 and for the the period until 2015."

This includes the following main areas:

- Improving the system of RW register and control (formation of state cadastre of storage points and points of final isolation of RW, as well as state register of RW with consideration of their initial registration in 2012 and places of their location).
- Completion of the formation of the Common RW management system, including the necessary legal and regulatory framework of its operation.

- Carrying out first priority works to establish points of the final isolation of low and intermediate level RW (RWDS in Leningrad region, commissioning of RWDS plant at UEHK etc.).
- Carrying out first priority works to establish underground laboratory for development of the technology of geological disposal of HLW and long-life radioactive wastes in the Krasnoyarsk Territory.
- Carrying out first priority works to address the problem of accumulated radioactive wastes of "nuclear legacy" at MG "Mayak", SCC and GCC and other companies involved in defence programs.
- Preparation of design decisions on the final state of all operating tailing pits at the facilities of uranium mining and enrichment.
- Completion of the formation of the mechanism and regulatory framework of funding for treatment of radioactive wastes and decommissioning, taking into account provisions of the Federal law on radioactive waste management, concerning the classification of radioactive wastes and the responsibility of enterprises and government for RW treatment, including disposal.

3.4 Research and Development

3.4.1 Research infrastructure

The State Corporation "Rosatom" has an extensive system of research institutes and centers, created in Soviet times for the creation and development of the nuclear industry and energy.

These institutes and centers are part of different departments of the State Corporation "Rosatom" to fit the profile of their activities.

Most nuclear institutions to some extent are concerned with SNF management of radioactive waste treatment and decommissioning, in particular VNIINM, Radium Institute, Atomic Reactors, FEI VNIIAES, SverdNIKhimmash, VNIPIPT etc.

To the scientific and research infrastructure of the State corporation "Rosatom" there belong also laboratories of large industrial enterprises, in particular, radiochemical combines which conduct researches to find solutions of their own issues which also include RW management.

Researches in the area of SNF, RW management and decommissioning are done with participation of:

- research institutes of the Russian Academy of Sciences, in particular Institute of non-hazardous Nuclear Power Development (Nuclear Safety), Institute of Physical Chemistry and Electrochemistry (IPC EC), Institute of Geology, petrography and mineralogy (IGPM), Institute of Geochemistry (GEOKHI), etc.
- Scientific Research Center "Kurchatov Institute".

- Private commercial companies specializing in narrow areas.

Identification of areas of work, evaluation, examination of proposals and other issues are discussed at the meetings of the Scientific and Technical Councils of State corporation "Rosatom" and the institutes of the Russian Academy of Sciences (RAS).

3.4.2 *Contents of R&D plans*

Basic research and development in the field of SNF and RW management, decommissioning are performed under federal programs of parent companies, members of the State Corporation "Rosatom" (e.g. a program on radioactive waste of "Rosenergoatom" covers all issues of RW NPP).

Ongoing Russian research and development activities are mainly related to the following tasks:

- Implementation of projects "Breakthrough" (Proryv) and "Establishment of Experimental and demonstration center for innovative reprocessing of SNF" at MCC.
- Resolving the problems of accumulated RW of "nuclear legacy", primarily in relation to MG "Mayak" (introduction of systems to immobilize liquid ILW and HLW, the elimination of open ponds of LRW, etc.)
- Safety justification of the points for disposal of radioactive wastes, including geological disposal facilities.
- Creation of unified equipment for conditioning and transportation of radioactive waste.
- Development and improvement of technologies for work on decommissioning and remediation of radioactively contaminated territories.
- Modelling of processes and technological cycles related to management of spent nuclear fuel and radioactive waste.

The content of work programmes depends on specific conditions.

The content and format of construction programs for decommissioning must conform to regulations set given in Section 2.

3.5 Financing of Radioactive Waste Management

3.5.1 *Framework and responsibilities*

Financial sources for the activity, connected with SNF and RW are:

- targeted federal funds for federal programs and subsidies for radioactive waste management ;
- resources of the State Corporation "Rosatom" on the implementation of innovative projects;
- regional budgets ;
- companies' and parent companies' own funds;

- special funds established under applicable law;
- funds accumulated in a special reserve fund of the State Corporation "Rosatom" for the disposal of radioactive wastes ;
- funds gained within the international scientific and technical cooperation;
- other resources, which do not contradict the legislation of the Russian Federation.

According to the federal law on radioactive waste management, established the requirements for mandatory disposal of all types of radioactive waste, the operator should transfer financial means to The specialized reserve fund of the State Corporation "Rosatom" for disposal of the generated radioactive waste.

Later, on a statutory basis the following provisions of funding sources for decommissioning of nuclear and radiation hazardous facilities should be consolidated:

- For facilities that have RW accumulated from activities prior to the validation of the federal law on radioactive waste management, decommissioning financing of these facilities should be funded from the federal budget, regional budgets and local budgets, with possible involvement of extra-budgetary funds and international cooperation;
- for facilities (operated and designed) without accumulated problems at the time of validation of the Federal Law, decommissioning of these facilities should be funded from special funds established by the operating organisations under the current legislation.

3.5.2 *Status of financing schemes*

Funding of SNF and RW management mainly is carried out within the federal programs, approved by the Government of the Russian Federation and specialized reserve funds of the State Corporation "Rosatom".

Selection of performers of sections of the federal programs is carried out on a competitive basis. Means of specialized reserve funds are allocated by a directive of Director General of State Corporation "Rosatom" after appropriate consideration of the application of an enterprise by the Departments of "State Corporation".

4. *DECOMMISSIONING STRATEGY AND CURRENT PRACTICE*

4.1 *Decommissioning strategy*

The National Strategy of the State Corporation "Rosatom" in the field of decommissioning is based on the absolute necessity of a timely, environmentally sound and cost-effective decommissioning of the relevant nuclear and radiation hazardous facilities and excluding the shift of this problem solution onto future generations.

The main tasks of the State Corporation "Rosatom" in the area of decommissioning in the nearest future are:

- nuclear and radiation hazardous facilities transition to the state completely excluding their potential nuclear danger, due to the removal of spent nuclear fuel and nuclear materials;
- create basic elements of interrelated branch systems of decommissioning, SNF management and the Unified State System for RW management,
- development and improvement of the regulatory framework on decommissioning based on domestic and foreign experience and the recommendations of international organizations, regulating planning and preparation for decommissioning at all stages of the life cycle of the facility and directly on the decommissioning stage,
- effective utilization of scientific and technological achievements of modern technology and practical experience on decommissioning;
- development and implementation of effective organizational schemes for practical implementation of works on decommissioning, SNF and RW management, including creation of conditions for the development in this field of all kinds of services, including engineering;
- organizing and coordinating the work on determination of science-based criteria and indicators to show achievement of the objectives on decommissioning, with social and economic viability;
- creation of conditions for the use and development of infrastructure at operating and shutdown facilities, including NPP units to ensure conduct of works on decommissioning;
- international cooperation in the field of decommissioning on the basis of intergovernmental agreements and contracts.

Ongoing and planned activities on decommissioning of nuclear hazardous facilities should consider the following aspects:

- enactment of the Federal Law on radioactive waste containing the new requirements and concepts, including obligatory disposal of radioactive waste,
- introduction of the category of specific waste that can be stored and buried at their locations , as well as the introduction of the category of VLLW
- need to synchronize the work plans on decommissioning with the plans of RW management infrastructure development (providing transport , warehousing and final isolation points) to eliminate the intermediate storage of large amounts of radioactive waste produced during decommissioning .
- need to optimize the volume of RW at the stage of decommissioning planning.
- experience gained in organizing and conducting work on decommissioning in the process of implementing the Federal target programme on nuclear and radiation safety 2008-2015
- development of international relations on the decommissioning and SNF, RW management, etc.

Currently, the following basic options for decommissioning are accepted :

1) Dismantling - is a decommissioning option, providing decontamination facility, radioactive waste management and hazardous waste, including disposal and transition of the facility and location to the condition that ensures their complete or partial withdrawal from the control of state safety authorities. This type of decommissioning may be implemented in the following ways:

- immediate elimination of nuclear hazardous facilities (immediate dismantling) or
- delayed elimination of nuclear hazardous facilities (nuclear hazardous facilities parts) after conservation under supervision (deferred dismantling).

2) Safe storage (disposal) at site – an option of decommissioning, providing consecutive transition of facility to the point for Special RW storage, and then – to Special RW conservation point. This transition is performed by localization of the radioactively contaminated and activated components of the facility with the creation of required physical barriers preventing an unauthorized access to the area of localization and ensuring radiation safety of the personnel, the public and the environment throughout the period of RW potential hazard.

Since all radioactive wastes can result from the decommissioning works shall be sent to the national operator on RW management, the activities of processing, conditioning, transportation and interim storage of radioactive waste after decommissioning must be ensured within the activity operating organizations.

VLLW generated during decommissioning can be stored (disposing) at the industrial site sanitary protection zone or outside of the sanitary protection zone, as well as on a dedicated site for the disposal of industrial waste. To support this it is necessary to introduce modern technologies and certification, allowing for efficient and accurate analysis of the characteristics of radioactive waste and VLLW, and the release of waste from the radiation monitoring

4.2 Status of decommissioning projects

4.2.1. Nuclear Power Reactor Sites

JSC "Concern" Rosenergoatom ", which includes all Russian NPPs) has composed a perspective program on shutdown and decommissioning of NPPs. The primary power units, subject to decommissioning in elimination mode, are Novovoronezh NPP power units 1-2 and Beloyarsk NPP units 1-2 shutdown and conserved a few years ago.

Currently preparation is going for practical work. Works on Beloyarskaya NPP are complicated by necessity of removing residues of the spent fuel from spent fuel storage pools, some of which is damaged.

For practicing technologies of decommissioning of NPP with VVER reactors at Novovoronezh there is established Experimental demonstration engineering center on decommissioning "(ODITS)", which has the status of a branch of JSC "Concern" Rosenergoatom ".

4.2.2 Other Sites

According to the forecast beside those power units mentioned above NPP there are 10 uranium-graphite industrial reactors of defence purposes, located at industrial sites "Mayak" , MCC and SCC which are subject to decommissioning.

Priority practical work on the decommissioning of one of such industrial reactor is currently held under option "disposal onsite" at SCC. To practice the technology for decommissioning of PUGR reactors and similar reactors at SCC there was created and is operated the Experimental Demonstration Center on decommissioning uranium-graphite reactors (ODC "OAG").

There are 14 more research reactors which are subject to decommissioning, as well as a significant number of units and ships of naval icebreaker nuclear fleet.

There are conducted priority works associated with shutdown, conservation and decommissioning of open ponds of LRW at "Mayak" , MCC and SCC .

Particularly acute problem for "Mayak" is the volume of storage ponds (particularly reservoirs of Techinsky cascade) and high content of radionuclides in some of them (pond B-9 "Karachai" pond-17) . Works on environmental issues are "Mayak" extensively ongoing.

There are done preparatory works on justification of environmentally sound conservation of tailing storages at the enterprises of mining and uranium enrichment.

4.3 Decommissioning issues at national level

Currently, the State Corporation "Rosatom" has shutdown, but not decommissioned more than 120 nuclear and radiation hazardous facilities, and in the future the number of such facilities will increase.

All companies developed the concept of local decommissioning of their own facilities, preparatory works are done within the available funding.

The most urgent works on decommissioning are underway within the federal target program "Nuclear and Radiation Safety in 2008 and within the period up to 2015."

General action plans for decommissioning over the next 15-20 years are defined in general, but the details on the extent and terms will be clear after the approval of the Russian Federal Program " Nuclear and Radiation Safety in 2016 - 2020 and in 2025 year " by the Government, where will be provided a list of large-scale activities on decommissioning. The concept of this program is currently being coordinated by the interested federal bodies of executive power.

The scale and pace of activities on decommissioning must be synchronized with the terms and volume of constructed points of the final isolation.

Planned works and activities on decommissioning:

For the period until 2015

To complete:

- implementation of measures on decommissioning provided by the federal target programme for the years 2008-2015 and policy documents of the State Corporation "Rosatom";

- development a Program of decommissioning for the medium and long term perspective, taking into account the "Program for the Development of the Nuclear Energy Complex of Russia for 2007-2010 and until 2015", approved by the Government of the Russian Federation dated 06.10.2006 № 605.

For the period 2016-2020:

To implement:

- transition of the shutdown nuclear and radiation hazardous facilities in nuclear safe condition (removal of spent nuclear fuel and nuclear materials);
- removal, processing or provision of a reliable long-term isolation of the process media accumulated at the plants which are to be decommissioned ;
- maintaining the integrity and effectiveness of protective barriers of nuclear and radiation hazardous facilities transferred to the final shutdown mode;
- development of concepts on decommissioning of the final shutdown is planned for the period up to 2030 ;
- development of documentation for obtaining licenses on decommissioning of the facilities which have been shutdown;
- adjustment and development of the legal framework regulating activities on decommissioning, SNF and radioactive waste handing in the conditions of the development of atomic energy complex and the new legal, property and financial relations ;
- develop criteria for full or partial withdrawal of nuclear and radiation hazardous facilities from the control safety regulatory bodies;
- separation of responsibilities for financial security works within the process of decommissioning between government and business entities ;
- synchronization of the works planned in the State Corporation "Rosatom" on decommissioning with activities on SNF and radioactive waste management;
- creation of industrial information system on decommissioning.

For the period after 2020 (strategic perspective):

To complete the formation of:

- modern regulatory framework for the planning and management of decommissioning;
- robust mechanisms for sustainable financial provision for the process of decommissioning which would be effective in a market economy;
- the required logistics and industrial infrastructure, including creation of the required federal / regional storage facilities, and disposal facilities for radioactive waste generated during decommissioning.

4.4 *Research and Development*

Research and development work to ensure decommissioning addresses the following objectives:

- adopting existing domestic technology to the specifics of work at certain facilities;
- development of the innovative technologies that promote technological leadership in this area;
- targeted acquisition and adaptation of foreign technologies to increase the efficiency of works on decommissioning ;
- development of calculation (including the use of mathematical models) and experimental research methods required to support safety and economical effectiveness of technical solutions on decommissioning.

4.5 *Financing of decommissioning*

4.5.1 *Framework and responsibilities*

Sources of decommissioning funding are:

- targeted federal funds for federal programs and subsidies on radioactive waste management;
- means of the State Corporation "Rosatom" on the implementation of innovative projects;
- the regional budget;
- own funds of the organizations and their parent companies;
- special funds established under applicable law;
- funds accumulated in the special reserve funds of the State Corporation "Rosatom" for decommissioning and disposal of radioactive waste ;
- funds received within the international scientific and technical cooperation and assistance programmes;
- other means, which do not contradict the legislation of the Russian Federation.

Major works on SNF, RW management and decommissioning are currently funded from the federal target program "Nuclear and Radiation Safety in 2008 and for the period up to 2015 ." The total budget for the program is 145 billion rubles , including 75 billion rubles - to solve the problem of "nuclear legacy".

According to the federal law on radioactive waste management , which establishes requirement of mandatory disposal of all types of radioactive waste, the operator should transfer specialized funds to the reserve fund of the State Corporation "Rosatom" for the disposal of generated radioactive waste. When preparing the draft of nuclear and radiation hazardous facilities decommissioning, disposal cost should be included in the overall costs of decommissioning.

Later, on a statutory basis there should be consolidated the following provisions about the sources of funding for decommissioning of Nuclear and radiation hazardous facilities:

- For the facilities that have accumulated RW as a result of their activity prior to the enactment of the federal law on radioactive waste management , funding of decommissioning of these facilities should be effected from the federal budget, budgets of the Russian Federation, local budgets , with possible involvement of extrabudgetary funds and international cooperation;
- facilities (both – operated and under construction) without accumulated problems at the time of the Federal law enactment - funding of decommissioning of these facilities should be effected from special funds established by the operating companies under the current legislation.

Responsibility for the decommissioning of the "nuclear legacy" is borne by the state, but the mechanism for the Assignment of the "nuclear legacy" has not been worked out yet.

Responsibility for decommissioning of the facilities which do not belong to the category of "nuclear legacy" is borne by the operating organizations.

4.5.2. Status of financial guaranties

Financial guarantees for decommissioning works are provided by the general law of the Russian Federation.

ACRONYMS AND ABBREVIATIONS

MCC - Mining and Chemical Combine (Krasnoyarsk region, Siberia)

State Corporation "Rosatom" - State Atomic Energy Corporation "Rosatom"

USS RWM - Unified state system of RW management

Russian Ministry of Natural Resources- Ministry of Natural Resources and Ecology of the Russian Federation

Russian Ministry of Emergency Situations - Ministry of the Russian Federation for Civil Defence , Emergencies and Elimination of Consequences of Natural Disasters

NIIAR - Atomic Reactors Scientific Research Institute (Ulyanovsk region)

NO RAO - national operator for RW management

ODITS Branch of JSC "Concern" Rosenergoatom " - " Pilot - demonstration Engineering Center for decommissioning of nuclear power plants with VVER units"

UDC "OAG " - Experimental Demonstration Center for decommissioning of uranium-graphite reactors

VLLW - Very low level waste

SNF - Spent Nuclear Fuel

MG "Mayak" – manufacturing group "Mayak" (Chelyabinsk region, the Urals)

RW - Radioactive waste

RAC - Russian Academy of Sciences

RS - Radioactive substances

Rostehnadzor - Federal Service for Ecological, Technological and Nuclear Supervision of the Russian Federation

Rospotrebnadzor - Federal Service for Supervision of Consumer Rights Protection and Human Welfare

Rosprirodnadzor - Federal Service for Supervision of Natural Resources

SCC - Siberian Chemical Combine (Tomsk region)

FMBA - Russian Federal Medical - Biological Agency

FTP NRS 2008-2015 - Federal target program "Nuclear and Radiation Safety in 2008 and for the period up to 2015"