UDC: 621.039

IMPLEMENTATION OF OBLIGATIONS OF RUSSIA UNDER THE JOINT CONVENTION ON THE SAFETY OF SPENT FUEL MANAGEMENT AND ON THE SAFETY OF RADIOACTIVE WASTE MANAGEMENT

Kryukov O. V.[1], Khaperkaya A. V.[1], Dorofeev A. N.[1], Ferapontov A. V.[2], Kudryavtsev E. G.[2], Linge I. I.[3], Utkin S. S.[3], Dorogov V. I.[3], Sharafutdinov R. B.[4], Ponizov A. V.[4], Vasilishin A. L.[4]

[1]State Corporation "Rosatom", Moscow, Russian Federation

[2]Rostekhnadzor, Moscow, Russian Federation

[3]Nuclear Safety Institute of RAS, Moscow, Russian Federation

[4]FBU Scientific Engineering Centre of Nuclear and Radiation Safety, Moscow, Russian Federation

Article received on February 18, 2019

The article summarizes the activities on the development of National reports of the Russian Federation on the implementation of obligations arising from the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management presented at the review meetings of the Contracting Parties in the period from 2006 to 2018.

Keywords: *Joint Convention, safety, radioactive waste, spent nuclear fuel, meeting of Contracting Parties, national report, good practice.*

World nuclear power currently choosing the strand for its further development relies significantly on pending safe and cost-effective decision regarding the nuclear fuel cycle option (open or closed) and the components associated with its final stage — nuclear decommissioning, management of spent nuclear fuel (SNF) and radioactive waste (RW). Efforts in these areas are carried out both to demonstrate the safety and obtain relevant permits on the establishment of open (SNF disposal — Finland, Sweden) and closed nuclear fuel cycle (CNFC) infrastructure facilities. The latter one suggests continued SNF reprocessing with nuclear material mono-recycling, development of technologies and transition to industrial-scale multi-recycling of nuclear materials allowing them to be used in currently operated reactors and reactor units of new generation (Russia, France, India, Japan, China). RW disposal infrastructure has been expanding [1—3]. Development of underground research laboratories (facilities) designed to perform computational and experimental research demonstrating the safety of high-level waste disposal in deep geological formations is ongoing. Upgraded are the existing and developed are some new decommissioning technologies for nuclear and radiation hazardous facilities (hereinafter, NRHF) [4, 5].

Important scientific, research, design and practical activities have been implemented recently covering the key areas (segments) of the NFC final

stage enabling noticeable advances achieved by organizations run by SC Rosatom [6—11]. Below are overviewed the key activities that have been already completed or are being implemented according to the existing schedule.

Achievements in the first area associated with the "establishment of SNF management system" involved:

- Construction of "dry" SNF storage facility complex for SNF from RBMK-1000 and WWER-1000 at FSUE MCC with a design capacity of over 30,000 tons of SNF;
- Construction of Pilot-Demonstration Center's (PDC) start up unit for SNF reprocessing based on innovative technologies;
- Construction of SNF cutting complexes at NPPs with RBMK-1000 units;
- Establishment of transport infrastructure and start of SNF shipments from the sites of power and research reactors to centralized storage and reprocessing facilities.

Achievements in the second segment dealing with the "Establishment of a Unified State System for RW management" involved:

- Completion of projects on the backfilling of open surface water reservoirs for LRW storage B-2 at JSC SCC, № 354 at FSUE MCC, V-9 at FSUE PA Mayak;
- Preliminary inventorying campaign implemented in 2013—2014 that embraced the entire territory of the Russian Federation to identify RW inventory and the setup at RW sites (in keeping with the Government Resolution of the Russian Federation of July 25, 2012 № 767 On the Preliminary Inventorying of Radioactive Waste);
- Developing a set of federal regulations in the field of RW disposal safety;
- Commissioning of RW near-surface disposal facility's (NSDF) first section in Novouralsk region.

Advances in the third section associated with "Nuclear Decommissioning" are seen as follows:

- Followed up activities on decommissioning of 160 facilities, including 40 research complexes and NPPs;
- Construction of two pilot-demonstration centers designed for uranium-graphite reactor and WWER reactor unit decommissioning;
- 35 nuclear decommissioning projects implemented in 2014—2017 including decommissioning of production uranium-graphite reactor (PUGR) EI-2 at JSC SCC site and building B at JSC VNIINM site within the Moscow city area.

Strategic issues associated with nuclear power development have been regularly discussed on the pages of Radioactive Waste Journal with some recently viewed bias towards the topics addressing the challenges of the final NFC stage [12—15]. Present article is yet another case in point evidencing this.

For more then two decades most part of issues associated with the safety of final NFC stage have been widely discussed on a regular basis, once in three years, at one of most important global arenas provided by the Joint Convention on the Safety of Spent Nuclear Fuel Management and the Safety of Radioactive Waste Management (Joint Convention) [16]. Joint Convention defines the requirements on the safety of SNF management [16, Chapter 2] and the safety of RW management [16, Chapter 3] being globally accepted and approved. Under the Joint Convention, Contracting Parties are supposed to take voluntary obligations concerning the measures ensuring the compliance with the requirements on the safe management of SNF and RW; coverage of ongoing and planned activities in the areas being considered under provisions of the Joint Convention by means of National Reports and their regular discussion at meetings of the Contracting Parties [17]. The Joint Convention summarizes only some basic fundamental provisions providing no further details. However, Contracting Parties consider both the obligations undertaken under relevant national programs and the discussion of their fulfillment at the meetings of the Contracting Parties with great deliberation.

The Joint Convention was ratified by the Russian Federation in 2005, thus, Russia has been taking part in relevant discussions since the second Review Meetings held in 2006. Lookback evaluation of efforts aimed at ensuring the safety in 2006—2018 presented in five national reports of the Russian Federation [18] enabled to reveal the pattern of their development and to provide some forecasts on the trends in the fulfillment of the obligations arising from the Joint Convention. Due to the historical background associated with the development of nuclear power and its dynamics, in the recent decades, great attention has been paid in Russia to addressing so called "nuclear legacy" challenges [19], [20]. These circumstances that had been reflected in the national reports affected the way in which the proposed analysis of further activities on the fulfillment of obligations taken under the Joint Convention had to be carried out.

On the one hand, by the time of Joint Convention ratification by the Russian Federation, some challenges have been accumulated, on the other – Federal Targeted Program Nuclear and Radiation Safety in 2008—2015 (FTP NRS) was under development with its funding from the state budget being already approved.

By the time the FTP NRS was launched, the issues to be addressed for a number of nuclear facilities both in terms of SNF and RW management were

Table 1. Obligations of the Russian Federation and their fulfillment denoted at the Review Meetings of the Contracting Parties in the field of SNF management in 2006–2018 and relevant plans up to 2030

Review Meeting, year	Obligations of the Russian Federation and their fulfillment denoted at the Review Meetings of the Contracting Parties
2006	Construction of a dry SNF storage facility at MCC site was started
2008	Approval of the Federal Targeted Program Nuclear and Radiation Safety in 2008–2015. Construction of a dry SNF storage facility at MCC site
2012	Commissioning and operation of a centralized dry storage facility for SNF. Upgrading and reconstructing the wet SNF storage facility. Design development for a Pilot-Demonstration center for SNF reprocessing
2015	Completed construction of dry SNF storage facility for RBMK-1000 SNF and WWER-1000 SNF at FSUE MCC. Construction of SFA cutting complexes for RBMK-1000 SNF at Leningrad and Kursk NPPs. The project on upgrading WWER-1000 SNF wet storage facility at FSUE MCC was completed. Construction license for Pilot-Demonstration Center for SNF reprocessing at FSUE MCC was issued. Development and implementation of joint activities on enhancing the safety of wet SNF storage facility and dry SNF storage facility at FSUE MCC with due account of lessons learned from the Fukushima Daichi accident
2018	Regular shipments of accumulated SNF for centralized storage and reprocessing. In 2014–2016, dry storage facility at FSUE MCC accepted over 13,000 of RBMK-1000 SFAs from Leningrad and Kursk NPPs. Construction of the first start up unit of the pilot demonstration center for SNF reprocessing was completed. Development of an advanced reprocessing technology for main types of accumulated SNF
2030 (forecast)	SNF reprocessing rate exceeds the one of its generation. All federally owned RBMK-1000 SNF is held in safe long-term dry storage facilities. Developed are some innovative technologies for SNF reprocessing excluding RW releases into the environment and resulting in minimum SRW generation

considered as quite complicated with some of them even considered critical.

The main problem considered in the field of SNF management, was almost completely exhausted free capacity of at-reactor SNF storage facilities for RBMK-1000 SNF at Leningrad NPP, Kursk and Smolensk NPP. RBMK-1000 SNF accounted for most part of the total accumulated inventory of all SNF types at all enterprises of the Russian Federation amounting to 18,500 tons.

The situation has started to change following the adoption of the FTP NRS with relevant activities being launched. First of all, significant progress was made in the construction of infrastructure facilities designed for SNF management. Key activities of the program were consistent with the obligations of the Russian Federation taken under the Joint Convention. Table 1 overviews the dynamics of the obligations fulfillment by the Russian Federation denoted at the Review Meetings of the Contracting Parties.

It's already by the end of FTP NRS implementation [21, 22] that this challenge has been partially addressed mostly by the activities on the development of SNF transport and storage infrastructure. Constructed was a new dry storage facility for RBMK-1000 SNF and upgraded was a wet SNF storage facility at MCC site. SFA cutting complexes were commissioned at NPPs with relevant transportation facilities being in place.

Table 2 presents the dynamics showing the decrease in SNF accumulation at Leningrad and Kursk NPPs with RBMK-1000 units. At Smolensk NPP, relevant activities on the development of infrastructure facilities enabling SNF transportation from the NPP site are scheduled for completion in 2019.

Table 2. Dynamics showing the decrease in SNF accumulation at Leningrad and Kursk NPPs with RBMK-1000 units

Operating organization and its branches	SNF amount, tons			
	01.01. 2008	01.01. 2011	01.01. 2014	01.01. 2017
Kursk NPP	4,612	5,023.9	4,733.883	4,387.834
Leningrad NPP	4,485.2	4,906.6	4,776.363	4,332.007
TOTAL	9,097.2	9,930.5	9,510.246	8,719.841

Despite demonstrating a steady decrease in RBMK-1000 SNF amount at NPP sites, visualization of at-reactor storage facility filling dynamics [23] (figure 1) provides a clear idea on the scale of the existing problem. Decrease in the stored amount of this fuel occurs not that fast, nevertheless, the program providing for the practical steps on addressing the challenge of at-reactor storage facilities filling with RBMK-1000 SNF above the design capacity level have been launched. If the rate of SNF

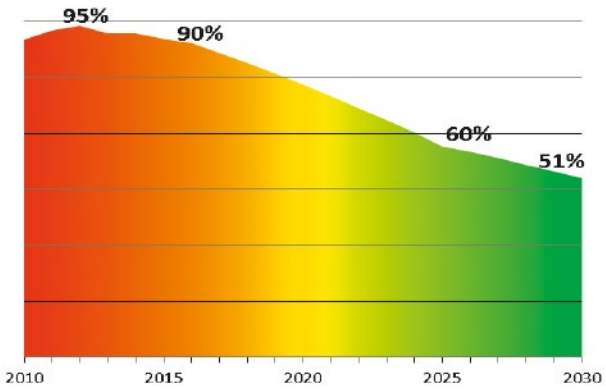

Figure 1. Filled capacity of at-reactor storage facilities at RBMK-1000 NPPs

shipment achieved to date persists, all the amount of RBMK-1000 SNF currently accumulated at reactor sites will be delivered to long-term dry storage facilities by 2030.

By the time FTP NRS was started to be developed, the key unresolved issues in the field of RW management were as follows: continued accumulation of RW, availability of open surface storage reservoirs containing large amounts of liquid radioactive waste (LRW), and what is more important — no available regulations stating the responsibility of RW generators for further disposal of the waste.

Further radical changes in the field of RW management started to occur with the adoption of the Federal law of July 11, 2011 № 190-FZ On Radioactive Waste Management and Some Amendments Introduced to Particular Legal Acts of the Russian Federation (190-FZ) laying down legal framework for the development of a Unified State System for RW Management in the Russian Federation (USS RW). The law provided for a transition to the practice of mandatory disposal of both accumulated and newly generated RW. This has directly influenced the development of RW management activities, including those associated with the fulfillment of obligations taken under the Joint Convention (table 3).

Table 3. Obligations of the Russian Federation and their fulfillment denoted at the Review Meetings of the Contracting Parties in the field of RW management in 2006—2018 and relevant plans up to 2030

Review Meeting, year	Obligations of the Russian Federation and their fulfillment denoted at the Review Meetings of the Contracting Parties
2006	Development of draft Federal law On Radioactive Waste Management Launching the Unified State Data Base on Sealed Radionuclide Sources
2009	Start of Federal Targeted Program Nuclear and Radiation Safety in 2008—2015 implementation Development of draft Federal law On Radioactive Waste Management Operation of the State System for Accounting and Control of Radioactive Materials and RW
2012	Adoption of the Federal Law of July 11, 2011 № 190-FZ On Radioactive Waste Management and Some Amendments Introduced to Particular Legal Acts of the Russian Federation (190-FZ) laying down legal framework for the development of a Unified State System for RW management in the Russian Federation (USS RW) providing for a transition to the practice of mandatory disposal of both accumulated and newly generated RW. Establishment of a National Operator for RW management responsible for RW disposal and other activities in the field of RW management
2015	Design development for an underground research laboratory (deep disposal of RW) Introducing amendments to RW classification system based on disposal routes Activities performed to achieve environmentally safe configuration of open surface LRW storage reservoir facilities (term referred to in Russian literature sources as conservation): • JSC SCC — backfilling of open surface LRW storage reservoir B-2 was completed, efforts on conservation of reservoir storage facility B-1 are still ongoing; • FSUE MCC — backfilling of open surface LRW storage reservoir № 345 was completed; pre-conservation efforts still ongoing at LRW reservoir storage facilities № 354a, №365, № 366; • FSUE PA Mayak — in 2015 backfilling of reservoir V-9 (lake Karachay) is planned for completion
2018	Implementation of activities scheduled under the Federal Targeted Program Nuclear and Radiation Safety in 2016 —2020 and until 2030 was started Conservation of open surface LRW storage reservoirs is ongoing. Implementation of IAEA peer review recommendations on LRW deep well injection practice. Development of underground research laboratory under HLW disposal project Development of RW classification system based on waste disposal routes Disposal of RW from JSC UECC (LLW and ILW) in the first section of near-surface disposal facility for RW in Novouralsk region. Processing and evaluation of preliminary registration campaign results addressing RW and RW sites; lists of RW disposal facilities, RW long-term storage facilities, facilities for non-retrievable RW emplacement developed and approved by the Government of the Russian Federation with their further registration in the System for state accounting and control of radioactive material and RW
2030 (forecast)	Development of RW disposal facilities. Development of regional complexes for RW processing Amount of RW disposal exceeds the amount of RW generation Activities preceding the termination of operations at LRW deep well injection facilities

Table 4 presents the quantitative characteristics for the dynamics of RW accumulation reflected in RW inventory lists submitted under the national reports of the Russian Federation.

Table 4. Dynamics of RW accumulation

		2007	2010	2013	2016
SRW	Amount, mln tons	82	87	90.4	Amount (SRW+LRW): 556.36 mln m^3 Activity: $1.14 \cdot 10^{20}$ Bq
SRW	Activity, Bq	$1.68 \cdot 10^{19}$	$3.59 \cdot 10^{19}$	$4.7 \cdot 10^{19}$	
LRW	Amount, mln m^3	476	487	489.6	
LRW	Activity, Bq	$4.37 \cdot 10^{19}$	$4.27 \cdot 10^{19}$	$4.2 \cdot 10^{19}$	

Most part of currently accumulated SRW by volume accounts for enterprises engaged in uranium mining and milling activities; as for LRW — for FSUE PA Mayak site.

Major spur was due to the decommissioning of most challenging NRHFs out of over 2,000 nuclear and radiation hazardous facilities. Table 5 summarizes the key results associated with the implementation of relevant obligations in nuclear decommissioning taken by the Russian Federation under the Joint Convention.

In the considered period (five national reports of the Russian Federation presented at Review Meetings of the Contracting Parties), legal framework was significantly improved. Dynamics reflecting the development of the regulations are shown in table 6.

Table 5. Obligations of the Russian Federation and their fulfillment denoted at the Review Meetings of the Contracting Parties in nuclear decommissioning in 2006–2018 and relevant plans up to 2030

Review Meeting, year	Obligations of the Russian Federation and their fulfillment denoted at the Review Meetings of the Contracting Parties
2006	Development of nuclear decommissioning plans 4 NPP units and 9 research reactors (hereinafter, RR) are at different decommissioning stages
2009	Pre-decommissioning and decommissioning efforts are implemented at 4 NPP units, 11 RRs, and 1 NFC facility (KhMZ)
2012	Pre-decommissioning and decommissioning efforts are implemented at 4 NPP units, 11 RRs, 13 production uranium-graphite reactors (hereinafter, PUGR) and over 30 other NFC facilities Completed are the following key activities on nuclear decommissioning – dismantled was the equipment of structure 8 and site 115a at SCC, decommissioned were VVRL-02 and 03 facilities at FSUE NIIP site, decommissioned was a facility for metal uranium reprocessing at JSC KhMZ
2015	Completed were the following activities: • 12 nuclear and radiation hazardous facilities were decommissioned, including critical test stands at IPPE (RF-GS) and JSC VNIIKhT (PKS SO-2M), RR RBT-10/1 (RIIAR), experimental installations at IPhVE, radiochemical compartment at VNIIKhT, facilities for tetra- and hexafluoride production at KChKhK (FSUE RosRAO); • Ongoing efforts on ensuring safe decommissioning of PUGR at FSUE PA Mayak, JSC SCC and JSC MCC.
2018	Decommissioning efforts are implemented at 160 facilities, including 40 research complexes and NPPs; 2 pilot demonstration centers for decommissioning were established: • For uranium-graphite reactors; • For NPPs with WWER reactor units; In 2014 – 2017, 35 nuclear and radiation hazardous facilities were decommissioned, including: • PUGR EI-2 at JSC SCC site; • Building B at JSC VNIINM site; • Research reactor facility AST-1 (JSC RIIAR); • Nuclear power unit of KM-1 stand (FSUE NITI).
2030 (forecast)	Plans call for the decommissioning of over 150 nuclear and radiation hazardous facilities

Table 6. Obligations of the Russian Federation and their fulfillment denoted at the Review Meetings of the Contracting Parties in the development of legal and regulatory framework in 2006–2018 and relevant plans up to 2030

Review Meeting, year	Obligations of the Russian Federation and their fulfillment denoted at the Review Meetings of the Contracting Parties
2006	Enactment of the Federal Law of the Russian Federation of November 4, 2005 (№139-FZ) On the Ratification of the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management Development of the Federal law On Radioactive Waste Management
2009	Alterations in the system of state management in the field of atomic energy use: Establishment of JSC Nuclear Power Industry Complex (Decree of the President of the Russian Federation of April 27, 2007 № 556 On Reorganization of the Nuclear Power Industry Complex of the Russian Federation. 100% of JSC Nuclear Power Industry Complex shares will be under federal ownership. Establishment of the State Atomic Energy Corporation Rosatom (hereinafter, Rosatom) (Federal law of December 1, 2007 № 317-FZ On the State Atomic Energy Corporation Rosatom): the Corporation united JSC Nuclear Power Industry Complex, organizations belonging to nuclear power complex, nuclear and radiation safety organizations, as well as those involved in fundamental research in atomic energy uses, educational and scientific institutions. By the Decree of the President of the Russian Federation of May 12, 2008 No.724 "On the System and Structure of Federal Executive Authorities", the Federal Service for Ecological, Technological and Nuclear Supervision was transferred to the jurisdiction of the Ministry of Natural Resources and Environment of the Russian Federation. Developed and submitted for review to state authorities was the draft Federal law on Radioactive Waste Management

Continue of table 6

2012	Managerial restructuring in nuclear regulation: Rostechnodzor was transferred from the jurisdiction of the Ministry of Natural Resources of Russia and is now directly subordinated to the Government of the Russian Federation Federal Law of July 11, 2011 No.190-FZ "On Radioactive Waste Management and Some Amendments Introduced to Particular Legal Acts of the Russian Federation" was adopted. Federal Law of November 30, 2011 No.347-FZ "On Amendments to Certain Legislative Acts of the Russian Federation Regulating Safety of Atomic Energy Uses" was adopted. Amendments were introduced to the Law On Atomic Energy Use. Development of Government Resolutions: • The procedure and the schedule for the development of Unified State System for RW Management; • National Operator for RW Management was identified; • Formal procedure for state regulation of RW disposal tariffs, establishing fundamental pricing principles; • The procedure and the schedule for implementing the Preliminary RW Inventorying Campaign; • Formal procedure for the return of sealed radionuclide sources (hereinafter, SRS) to the territory of the Russian Federation, formal procedure for SRS return to the supplier-state, formal procedure for RW handover for disposal; • Criteria used to categorize solid, liquid and gaseous waste as RW, criteria for RW categorization as non-retrievable and retrievable RW, criteria for retrievable RW classification. Establishment and operation of USS RW; National Operator for RW Management was identified.
2015	Developed were: • RW acceptance criteria for disposal (NP-093-14) • Safe decommissioning of nuclear power facilities. General provisions (NP-091-14) Reviewed and upgraded were the following regulations: • Safe management of RW. General provisions (NP-058-14) • RW disposal. Principles, criteria and main safety requirements (NP-055-14). • Near-surface disposal of RW. Safety requirements (NP-069-14). • Rules for the safe management of RW at NPPs (NP-002-14). • Basic Sanitary Rules for Radiation Safety (OSPORB-99/2010). • Sanitary rules for RW management (SPORO-2002)
2018	Amendments introduced to the Federal Law "On Atomic Energy Use". Federal Targeted Program Nuclear and Radiation Safety in 2016–2030 was approved (Resolution of the Government of the Russian Federation of November 19, 2015 No. 1248). Based on the Preliminary RW inventorying campaign Order of the Government of the Russian Federation of February 17, 2016 № 238-r was developed to identify: • The owners of RW and RW storage facilities; • RW amounts, characteristics, sites, conditions at RW sites, RW categories (non-retrievable, retrievable) specified for each RW storage facility. Developed were: • RW acceptance criteria for disposal (NP-093-14), including those on SRSs accounting for SSR-5 provisions; • Rules for safe transportation of radioactive material (NP-053-16) accounting for SSR-6 provisions. Developed were Federal norms and rules on the content and structure of safety analysis reports (GSR Part 5, SSR-5): • RW storage facilities (NP-099-17); • Disposal facilities for solid RW (NP-100-17). Developed were the requirements on the safety of facilities holding non-retrievable RW and storage facilities for non-retrievable RW (NP-103-17). Developed were Federal norms and rules on the safe predisposal management of RW (GSR Part 5): • Liquid RW (NP-019-15); • Solid RW (NP-020-15); • Gaseous RW (NP-021-15); • RW generated by NPPs (NP-002-15). Developed were Federal norms and rules On the Safe Decommissioning of Nuclear Facilities. General provisions (NP-091-14) considering GSR Part 6 provisions. Developed and reviewed were the Federal norms and rues specifying safety requirements during the decommissioning of: • NPP units (NP-012-16); • Production uranium-graphite reactors (NP-007-17); • Research reactor facilities (NP-028-16); • NFC facilities (NP-057-17); • RW storage facilities (NP-097-16).
2030 (forecast)	Development of a draft program for nuclear and radiation safety assurance till 2050. Fully-fledged operating Unified state system in place providing for all the needs

Some fundamental changes in the ownership status of SNF, RW and nuclear facilities occurred since the Russian Federation had ratified in the Joint Convention.

Owners of some nuclear facilities, facilities handling SNF and RW, being under state ownership in 2006 were transferred into JSCs, accordingly, these organizations also assumed obligations for their safe maintenance, including the implementation of activities provided for under the final life cycle stage. Thus, in the National Report of 2006 the obligations considering RW management were restricted to the requirements on the safe storage of RW. In 2015, the obligations were divided according to RW ownership: for RW generated prior to 190-FZ enactment in 2011 being under State ownership, RW generated later with relevant responsibilities assumed by RW generating organizations. Changes in the ownership status also implies changes in the financing. From now on, predisposal management of RW and RW disposal costs should be covered by relevant operating organizations.

Thus, lookback study of the obligations assumed by the Russian Federation under the Joint Convention and of relevant results achieved, allows to conclude that a significant progress both regarding the scale and the rate of implemented activities in SNF and RW management and nuclear decommissioning has been attained. This positive dynamic is primarily due to activities addressing the challenges in the following areas:

- SNF management — decrease in the SNF amounts stored at NPP sites with RBMK-1000 reactor units, commissioning of SNF management complex (involving centralized dry and wet storage facilities, SNF reprocessing using innovative technological platform, fabrication of MOX fuel);
- RW management — establishment of a waste disposal system covering different RW classes, RW accumulation was stopped, open surface LRW storage reservoirs were backfilled;
- Nuclear decommissioning — significant increase in the rate of nuclear decommissioning (RR, PUGR, reactor facilities).

Despite some important progress in ensuring the safety of nuclear legacy facilities, some big challenges remain to be addressed to ensure safe RW and SNF management with yet some new tasks to be resolved as well.

Below are listed those considered as the most complicated to address:

In RW management:

1. Implementation of Computational and Experimental research program to demonstrate and assess the long-term safety of deep disposal facilities for liquid radioactive waste approved by the State Corporation Rosatom and Rostechnadzor in 2015, and evaluation of its results. A set of necessary activities needs to be implemented to ensure the long-term safety of the facilities, to develop the supporting infrastructure, as well as those preceding the termination of deep well LRW injection into geological reservoir beds, closure of LRW deep disposal facilities.

2. Preparatory efforts implemented to stop LRW discharges including the discharges into industrial water reservoir storage facilities. Attaining environmentally safe configuration of open surface LRW storage water reservoirs and their elimination.

3. Deployment of construction activities to establish a system of near-surface RW disposal facilities with RW disposal rate exceeding the one of its generation.

4. Construction of URL in the Nizhnekansk rock mass, conducting experimental and calculational research, decision making on the construction of a deep disposal facility for RW;

5. Safety case development and decision making on the facilities holding non-retrievable RW.

In SNF management:

6. Continued practice suggesting SNF removal from NPP sites via its shipment for centralized storage and reprocessing;

7. Deployment of main activities addressing some challenging types of accumulated SNF, reprocessing of damaged and unconditioned SNF at FSUE PA Mayak site;

8. Launching the program for industrial scale WWER-1000 SNF reprocessing at MCC site;

In nuclear decommissioning:

9. Decommissioning and dismantlement of over 150 nuclear and radiation hazardous facilities;

10. Decommissioning of 7 PUGRs.

Positive dynamics associated with activities on SNF, RW management and nuclear decommissioning, including those carried out under Federal Targeted Programs allow to predict successful implementation of the scheduled plans (tables 1, 3 , 5, 6) on fulfilling the obligations of the Joint Convention in the future.

Let's dwell on some issues considered as uncommon for the Joint Convention, but nonetheless being on the table at the Review Meetings of the Contracting Parties.

Obligations of the Contracting Parties under the Joint Convention were initially taken on a free will basis. However, at recent meetings held under the Convention on Nuclear Safety and the Joint Convention, along with relevant procedures for taking voluntary commitments, attempts were made to introduce some procedures enabling to select

competitive elements from some obligations based on the accepted definitions of "Good practice" and "Areas of success".

The choice of the examples corresponding to the obligations consistent with "areas of success" definition made according to the proposed mechanism is similar to the traditional one: it rather elaborates on already existing approaches of the Joint Convention which in their essence account for the best or some of the best results chosen based on Contracting Party's opinion out of all those proposed in the national report discussing the fulfilment of the obligations. Most part of such examples in the fields of SNF, RW management, safety regulation and public engagement have been identified easily by the Contracting Parties at the sixth Review Meeting.

As for the "good practice", in the definition approved by the Joint Convention in May 2014 at the second extraordinary meeting, the term "important contribution" was applied: "Good practice is a new or reviewed practice, policy or program introducing some important contribution in ensuring the safe management of radioactive waste and spent nuclear fuel…". A number of Contracting Parties understands the definition in such a way that the word combination "important contribution" predetermine the best of all "good practices" presented by the Contracting Parties, which introduced an element of competitiveness. Attempts to use the definition of "good practice" at the Fifth Review Meeting proved to be unsuccessful. These attempts also proved to be ineffective at the Sixth Review Meeting even though the application of "good practice" definition became even stricter. Following all the discussions held, only 6 examples of "good practice" have been identified:

1. Significant progress in the development of a final disposal facility for spent nuclear fuel: construction license was issued, construction was started. All interested parties were engaged in the siting process. Decision was made after the consent of local municipality had been obtained.

2. Completed development of a holistic differentiated approach to the management of all types of waste which in addition to the overall work on the program implementation prompted the recent project on the establishment of a purpose-designed disposal facility for VLLW.

3. Competent approach on introducing a hierarchical system for waste management which greatly contributed to the implementation of the national program, especially with regard to LLW management. This resulted in a significant reduction of LLW amounts requiring disposal in purpose-designed facilities, and, consequently, facility's operating lifetime extension for a hundred of years.

4. Construction of a centralized storage facility ensuring treatment and long-term storage of disused sealed radioactive sources.

5. Openness and transparency — public engagement in the national process of regulatory overview by means of acquiring relevant information on a yearly basis independent on the licensing process.

6. Establishment of a consulting forum at each licensed facility involving representatives of the regulatory authority, regulating expert organization, local community and experts recommended by local population and local authorities.

Ineffectiveness of the approach used to select "good practice" case studies requires its improvement. During the 2018 review meeting, the possibility of introducing some amendments to the rules for country group formation was discussed so that countries with similar programs could be considered under one group enabling more qualified discussion of national reports and the identification of "good practices". This matter was proposed to be discussed at a separate extraordinary meeting of the Contracting Parties. [24] discusses a modification of the process so that many of the obligations undertaken by the Contracting Parties could be divided into groups based on particular features. Thanks to this approach the review of their fulfillment at review meetings could be performed considering more narrow dedicated segments and with more uniform obligations. Such an approach allowing to compare facilities being similar in their size and purpose may contribute to more effective selection of "good practice" examples. Other approaches ensuring consistent application of definitions introduced by the Joint Convention should be discussed as well.

References

1. Overview of international practices of SNF and RW disposal / Tsebakovskaya N. S., Utkin S. S., Kapyrin I. V. et al. Edited by Linge I. I., Polyakov Yu. D. — M.: Komtelkhprint, 2015. 208 p. (In Russian).

2. Tsebakovskaya N. S., Utkin S. S., Linge I. I., Pron I. A. International SNF and RW disposal projects. Part I. State-of-art in deep geological disposal projects in European countries: Preprint of IBRAE, no. IBRAE-2017-03. Moscow: IBRAE RAN, 2017. 35 p. (In Russian).

3. Tsebakovskaya N. S., Utkin S. S., Konovalov V. Yu. International SNF and RW disposal projects. Part II. State-of-art in deep geological disposal projects in the USA, Canada and Asian region: Preprint of

IBRAE no. IBRAE-2017-04. Moscow: IBRAE RAN, 2017. 41 p. (In Russian).

4. Best International Practices in Nuclear Decommissioning and Remediation of Contaminated Sites. V. 1 / Tsebakovskaya N. S., Utkin S. S., Ivanov A. Yu, et al. / Edited by Linge I. I. and Abramov A. A. M.: IBRAE RAN, 2017, 366 p. (In Russian).

5. Best International Practices in Nuclear Decommissioning and Remediation of Contaminated Sites. V. 2 / Tsebakovskaya N. S., Utkin S. S., Ivanov A. Yu, et al. / Edited by Linge I. I. and Abramov A. A. M.: IBRAE RAN, 2017, 187 p. (In Russian).

6. Dorofeev A. N., Bolshov L. A., Linge I. I., Utkin S. S., Savelyeva E. A. Strategic Master-Plan for R&D demonstrating the safety of construction, operation and closure of a deep geological disposal facility for radioactive waste. *Radioactive Waste*. 2017, no. 1, pp. 33—42. (In Russian).

7. Strategic Master-Plan addressing the the problems of the Techa Cascade of water reservoirs at FSUE "PA "Mayak" / IBRAE RAN et al. — Approved by the Director General of the State Corporation "Rosatom" on 12.02.2016. (In Russian).

8. Utkin S. S. Strategy of bringing the Techa Cascade of water reservoirs at FSUE "PA "Mayak" into a radiologically safe state. *Izvestiya Rossiyskoy Akademii nauk. Energy,* 2016, no. 5, pp. 132—139. (In Russian).

9. Abramov A. A., Dorofeev A. N. Current state and prospects for the development of RW management system in the Russian Federation. *Radioactive Waste,* 2017, no. 1, pp. 11—22. (In Russian).

10. Evolution of long-term safety case for LRW-GR / Dorofeev A. N., Sharafutdinov R. B., Utkin S. S., Savelyeva E. A., Ponizov A. V., Kudryavtsev E. G., Pron I. A., Konovalov V. Yu. *Radioactive Waste.* 2017, no. 1, pp. 55—64. (In Russian).

11. Dorogov V. I., Ponizov. A. V., Khaperskaya A. V. On preparation of the Fifth National report of the Russian Federation On implementation of obligations arising from the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management. *Radioactive Waste*. 2017, no. 1, pp. 100—107. (In Russian).

12. Velikhov E. P., Ponomarev-Stepnoy N. N., Volkov V. G. et al. Remediation of radioactively contaminated facilities and territories of RSC "Kurchatov Institute". *Atomnaya energiya,* 2007, v. 102, Iss. 5, pp. 300—306. (In Russian).

13. Establishment of the national system for radioactive waste management: lessons learnt, advances and expectations / Bolshov L. A., Linge I. I., Kovalchuk V. D., Utkin S. S., Elfimova T. L., Poyakov Yu. D. *Atomnaya energiya,* 2011, v. 111, no. 3, pp. 126—131. (In Russian).

14. Volkov V. G., Zvrkov Yu. A., Ivanov O. P. et al. Methods for high-level waste management in decommissioning of MR and RFT research reactors. *Atomnaya energiya,* 2013, v. 115, iss. 5, pp. 271—275. (In Russian).

15. Linge I. I., Utkin S. S., Khamaza A. A., Sharafutdinov R. B. Experience of application of international requirements to long-term safety cases for radioactive waste disposal facilities: problems and lessons learnt. *Atomnaya energiya,* 2016, iss. 120, pp. 201—208. (In Russian).

16. International Atomic Energy Agency, Joint Convention on Radioactive Waste on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management. INFCIRC/546, IAEA, Vienna, 2001.

17. International Atomic Energy Agency, Joint Convention on Radioactive Waste on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management. Rules of Procedure and Financial Rules. INFCIRC/602/Rev. 5, 30 December 2014.

18. International Atomic Energy Agency Web. National Reports. https: // jc.iaea.org/NRList.asp.

19. Nuclear legacy challenges and ways to address them / Edited by Evstratov E. V., Agapov A. M., Laverov N. P., Bolshov L.A., Linge I. I. — M.: 2012. — V.1. — 356 p. (In Russian).

20. Nuclear legacy challenges and ways to address them. Development of radioactive waste management system in Russia / Edited by Bolshov L. A., Laverov N. P., Linge I. I. — M.: 2013. — V.2. — 392 p. (In Russian).

21. Nuclear legacy challenges and ways to address them. Decommissioning / Edited by Bolshov L. A., Laverov N. P., Linge I. I. — M.: 2015. — V.3. — 316 p. (In Russian).

22. Elimination of nuclear legacy: 2008—2015 / Edited by Abramov A. A., Kryukov O. V., Linge I. I. — 2015., — 182 p.

23. Kryukov O. V. Director for State Policy in the field of SNF and RW management and decommissioning of State Corporation "Rosatom". Actions of the State Corporation "Rosatom" in the framework of the 5th National Report of the Russian Federation. IAEA, Vienna, 24 May 2018. (In Russian).

24. Khaperskaya A. V., Dorofeev A. N., Utkin S. S., Dorogov V. I., Samoylov A. A., Mamchits E. G., Ponizov A. V., Vasilishin A. L. On some aspects of identifying "good practices" in the framework of the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management. *Radioactive Waste,* 2018, no. 4 (5), pp. 83— 89. (In Russian).

Information about authors

Kryukov Oleg Vasiljevich, Director of state policy in the field of SNF, RW and decommissioning of hazardous facilities, State Corporation Rosatom (24, Bolshaya Ordynka St., Moscow, 119017), e-mail: OVKryukov@rosatom.ru.

Haperskaya Anzhelika Viktorovna, PhD, Senior Manager of the Project Office on the Development of Spent Nuclear Fuel Management System, State Corporation Rosatom (24, Bolshaya Ordynka St., Moscow, 119017), e-mail: AVKhaperskaya@rosatom.ru.

Dorofeev Aleksandr Nikolaevich, PhD, Head of the Project Office on the Development of a Unified Radioactive Waste Management System, State Corporation Rosatom (24, Bolshaya Ordynka St., Moscow, 119017), e-mail: ANDorofeev@rosatom.ru

Ferapontov Aleksey Victorovich, PhD, Deputy Director, Federal Service for Ecological, Technological and Nuclear Supervision (34, Taganskaya St., Moscow, 109147), e-mail: rostehnadzor@gosnadzor.ru

Kudryavtsev Evgeniy Georgievich, PhD, Head of Department, Federal Service for Ecological, Technological and Nuclear Supervision (34, Taganskaya St., Moscow, 109147), e-mail: egkudryavtsev@gosnadzor.ru

Linge Igor Innokentevich, Doctor of Technical Sciences, Deputy Director, Nuclear Safety Institute (52, Bolshaya Tulskaya St., Moscow, 115191), e-mail: linge@ibrae.ac.ru

Utkin Sergey Sergeevich, Doctor of Technical Sciences, Head of Department, Nuclear Safety Institute of RAS (52, Bolshaya Tulskaya St., Moscow, 115191), e-mail: uss@ibrae.ac.ru.

Dorogov Viktor Ilyich, PhD, Head of Office, Nuclear Safety Institute (52, Bolshaya Tulskaya St., Moscow, 115191), e-mail: vid@ibrae.ac.ru.

Sharafutdinov Rashet Borisovich, PhD, Deputy Director of Federal State-Funded Institution Scientific and Engineering Center for Nuclear and Radiation Safety (2/8, Malaya Krasnoselskaya St., Moscow, 107140), e-mail: charafoutdinov@secnrs.ru

Ponizov Anton Vladimirovich, Head of Office, Federal State-Funded Institution Scientific and Engineering Center for Nuclear and Radiation Safety, (2/8, Malaya Krasnoselskaya St., Moscow, 107140), e-mail: ponizov@secnrs.ru.

Vasilishin Aleksandr Leonidovich, Head of Office, Federal State-Funded Institution Scientific and Engineering Center for Nuclear and Radiation Safety (2/8, Malaya Krasnoselskaya St., Moscow, 107140), e-mail: vasilishin@secnrs.ru.

Bibliographic description

Kryukov O. V., Khaperkaya A. V., Dorofeev A. N., Ferapontov A. V., Kudryavtsev E. G., Linge I. I., Utkin S. S., Dorogov V. I., Sharafutdinov R. B., Ponizov A. V., Vasilishin A. L. Implementation of Obligations of Russia under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. *Radioactive Waste,* 2019, no. 1 (6), pp. 25—36 (in Russian).