

Challenges in the Nuclear Legacy Regulation

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Abstract. The nuclear legacy covers such military and industrial facilities, which do not comply with the up-to-date requirements for nuclear and radiation safety, and sites contaminated following the past nuclear activities and uranium mining. In terms of the environmental safety, the most significant are consequences of the defense activity and large-scale radiological accidents: legacy contaminations in the Urals – Techa River and Kyshtym (past activity of the PA “Mayak”), sites for spent nuclear fuel (SNF) and radioactive waste (RW) temporary storage originated from the dismantled nuclear submarines in the Russian Northwest and Far East. The nuclear legacy includes numerous territories in Russia and ex-Soviet republics affected by the uranium mining and milling facilities. The main current problem is the lack of comprehensive regulatory and legal framework in the existing legislation on the nuclear legacy management to implement principles aimed at prevention of harmful impact of such legacy sites on the environment and human health, reduction of the burden to the next generations. Russia plays an active role in the nuclear legacy regulation, which consists mainly of limiting generation of new nuclear legacy specific problems or, in other words, elimination of new nuclear legacy appearance. The basis for the nuclear legacy regulation is its regulatory and legal support including the radioactive waste classification, requirements for limiting contents of the fissile materials in wastes, long-term storage and final isolation of waste. The FMBA’s position on this issue has actively been represented at the IAEA International Forum on the regulatory supervision of the nuclear legacy sites, where Russia is a leader of the working group “Enhancement of the regulatory infrastructure”.

Key Words: Nuclear legacy, radioactive waste, spent nuclear fuel, existing exposure situation

1. Introduction

The beginning of XXI century marks the documented milestone of the necessity recognition to regulate the nuclear legacy all over the world and in Russia, in particular. The first national statement on “Fulfillment of Engagements Resulted from “Joint convention on safe management of spent nuclear fuel (SNF) and radioactive waste (RW)” made by Russia in 2006 says: «...The nuclear legacy mitigation is complex and comprehensive challenge and it cannot be solved fully within the nearest years because of economic and scientific problems». The conception of the Federal Target Programme “Nuclear and radiation safety for 2008-2015” mentions «the nuclear legacy presence and recognizes both the necessity to solve problems connected with past activity, including military ones, by stages at the governmental level and inadmissibility to postpone their solving any more». “Draft law on “Radioactive Waste Management” introduced in government, 2009, approved in 2011 and operating today in Russian Federation. Chapter «Long-term stages and objectives» from law on “Radioactive Waste Management” states the particular time steps: 2015 – to stop accumulation of challenges in nuclear and radiation safety and protection; 2025 – to solve challenges in nuclear legacy.

2. The nuclear legacy definition

The nuclear legacy covers such military and industrial facilities, which do not comply with the up-to-date requirements for nuclear and radiation safety, and sites contaminated following the past nuclear activities and uranium mining. In terms of the environmental safety, the most significant are consequences of the defense activity and large-scale radiological accidents: legacy contaminations in the Urals – Techa River and

Kyshtym (past activity of the PA “Mayak”), sites for SNF and RW temporary storage originated from the dismantled nuclear submarines in the Russian Northwest and Far East. The nuclear legacy includes numerous territories in Russia and ex-Soviet republics (abandoned tailing dumps etc.) affected by the uranium mining and milling facilities. Initial remediation operations at nuclear legacy facilities were performed: 1) without proper consideration of ecological requirements at the site and adjacent area when its life cycle is terminated; 2) in accordance with regulatory requirements that do not correspond to up-to-date needs for nuclear and radiation hazardous facility management.

3. Actual problems in the nuclear legacy regulation

3.1. Legislative structure

Principles of legislative regulation are postulated in laws and directives of the Government of the Russian Federation. National system of radiological protection and radiation safety assurance in the Russian Federation is based on three principal documents: Radiation safety standards (2009), Main rules for radiation safety and protection (2010) and Rules for Radioactive Waste Management (2002) [1, 2, 3]. Figure 1 shows hierarchical frame of regulative and methodical documents on an example of radiological protection regulation of the personnel and population as applicable for the facilities of the State Atomic Energy Corporation “Rosatom”.

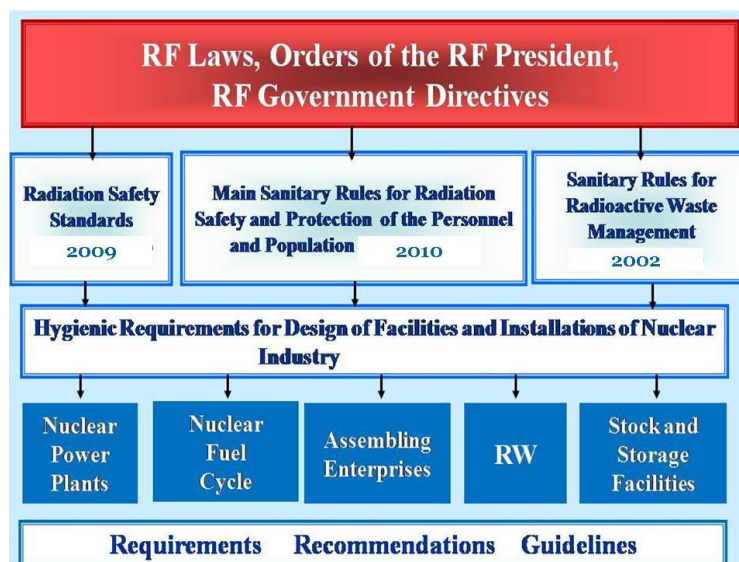


Fig. 1. Normative and methodic support of radiological protection of the personnel and population of the “Rosatom” facilities

The legislative and regulative background established over the recent decade supports safe operation of nuclear facilities. However, its practical application revealed some problems as well. In the regulatory documents, there are difficult questions to be solved connected with nuclear legacy, in particular those of remediation of sites contaminated due to past nuclear and uranium activity. Generally, the main current problem of the nuclear legacy regulation is the lack of comprehensive regulatory and legal framework in the existing legislation on the nuclear legacy management to implement principles aimed at prevention of harmful impact of such legacy sites on the environment and human health, reduction of the burden to the next generations.

3.2. Proposals on Enhancement of the regulatory infrastructure

In order to fill the current lack of provisions to solve nuclear legacy problem, the actual normative and methodical documents should be supplemented with provisions of new ICRP radiological protection

system laid down in fundamental ICRP Publication 103, as well as new International Basic Safety Standards developed by IAEA [4, 5]. Thus, the urgent tasks are: first, to introduce the existing exposure situation into the national standards in harmony with the ICRP system; second, to develop criteria for site remediation and return, by stages, to uncontrolled uses; third, to consider possibilities and methods of optimization for the remediation strategies under development. New ICRP and IAEA documents provide flexible approaches to solve these tasks [6].

FMBA of Russia plays an active role in the nuclear legacy regulation, which consists mainly of limiting generation of new nuclear legacy specific problems or, in other words, elimination of new nuclear legacy appearance. The basis for the nuclear legacy regulation is its regulatory and legal support including the radioactive waste classification, requirements for limiting contents of the fissile materials in wastes, long-term storage and final isolation of waste [7, 8]. IAEA approves such approach and many states follow this approach. In addition, in 2011 Russia introduced a new Law on "Radioactive Waste Management", so new legislative acts will be necessary, to facilitate regulation of the nuclear legacy issues.

4. The Russian experience in nuclear legacy regulation

4.1. Nuclear legacy originated from P/A "Mayak" activities

In Russia, there are problems connected with past military activity of some facilities. For example, the accident at "Mayak" plant in 1957 and other radiation accidents caused severe consequences for workers and for the environment. So, at the latter 1940s RW resulted from production of the weapon plutonium were being released Techa River. Total discharged volume was about 3 millions Ci. This caused high radioactive contamination of the river system and radiation exposure to the population of the coastal settlements. Their doses were from 4 to 5 Sv. Over the first two years after the discharges, 940 cases of the chronic radiation disease have been registered among those residents [9].

The radiation situation around the Techa River Reservoirs is under control and monitoring now. So, it does not induce any radiation exposure to workers and population. The critical group of the population of Muslyumovo village is an exception. ^{90}Sr specific activity in milk became 10-15 times lower over the period from 1958 up to now. At the same time, since 2003, the stable tendency of ^{90}Sr increasing in milk is being registered due to increasing concentration of this radionuclide in the river water. Cows pasture at the flood-lands and drink the river water, so concentration of ^{90}Sr in samples of their milk is higher than the permissible limit. In this light, living in the settlements at the Techa coastal area, especially at the Muslyumovo vicinity is potentially hazardous. FMBA of Russia sent its conclusions and recommendations to the State Atomic Energy Corporation "Rosatom". Our conclusions gave occasion to make decision jointly with administration of Chelyabinsk region on re-settlement of these residents to the safer place.

Thus, in some cases the situation with RW accumulation and environmental contamination was so complicated and unique that the special regulation is to be implemented. In case of nuclear legacy in the Southern Urals area, the law on "The Status and Safe Use of Sites and Facilities of the PA "Mayak" should be developed.

In addition to independent assessment of the radiation situation connected with the nuclear legacy, FMBA of Russia carry out long-term special epidemiological studies. Health examination of the contingent "Mayak" personnel register revealed later effects in a form of increasing deaths due to malignant neoplasms and leukemia of workers engaged over 1948-1958. These years, workers were over-exposed significantly, when training the new technology. After 1958, indexes of the cancer mortality became already twice lower in comparison with the national data [10].

4.2. Nuclear legacy in the Northwest Russia

Many radiation hazardous facilities are located today in the Northwest Russia, but the main risks are resulted from the former Naval technical bases. These bases supported operation of nuclear submarines, performing reception and storage of radioactive waste and spent nuclear fuel. They are located on Kola Peninsula close to the Russian-Norwegian boundary. FMBA of Russia was entrusted with responsibilities and obligations for supervision of these facilities. We implement these responsibilities in close cooperation with our colleagues from Norwegian Radiation Protection Authority.

Our interaction developed by the following stages:

- Signing the agreement between the Norwegian Radiation Protection Authority and FMBA of Russia;
- Collaborative work has been organized within projects relating to activities in the Northwest Russia, under financial support of the Norwegian party;
- Joint visits to the legacy sites in USA, UK and some other states have been undertaken;
- We hold periodic workshops, meetings and conferences.

When carrying out the regulatory supervision of the nuclear legacy sites in the Northwest Russia within our cooperation, we solve the following problems:

- Assessment of radiological threats for the purpose of identification of the priority regulatory issues;
- Detailed analysis of the radiation situation on-sites, areas and in the vicinity of the sites for temporary storage. Radiation control and monitoring of the environmental conditions;
- Assurance of the radiation protection of workers and the population. Development of the computer maps and geo-information systems;
- Emergency response and training;
- Safety culture related to the risk monitoring of the performance reliability;
- Review of the projects connected with the STS remediation including the SNF and RW management.

Execution of the mentioned natural, practical and theoretical works terminates with the development of some regulatory documents aimed at assurance of radiation protection and safety of workers, population and environment, as well as development of the documents for regulation of the SNF and RW management on the STS site. It should be noted that in practice of the Russian regulatory bodies, the documental basis of the protection system is insufficient; therefore, development of the new regulatory documents was very important, especially those on the STS remediation criteria taking into account the ICRP requirements. Moreover, some radiation hazardous operations being planned at the STS have not ever been performed in Russia (for example, removal of the spent fuel assemblies from the emergency storage facility or transportation of the damaged spent fuel assemblies).

Thus, on the base of the received results of monitoring and assessment of the current risks, 8 site specific regulatory documents have been developed for the bodies and institutions under the FMBA of Russia involved in the measures for control of the facility. Those documents include the requirements for: radiation protection of workers and population; personal dose monitoring; the RW management including the low level radioactive waste; implementation of the environmental monitoring; radiation monitoring nearby the SevRAO facility; and remediation of the sites [11, 12, 13].

Having in mind that execution of radiation hazardous operations assumes some risks for workers and for the population because of potential emergencies, the special attention is paid to the emergency preparedness of the territorial divisions of the FMBA of Russia. Emergency trainings and exercises were performed in 2006 in Andreeva Bay and in 2009 in Gremikha village.

5. IAEA International Forum on the regulatory supervision of the nuclear legacy sites

The FMBA’s position on issue of the nuclear legacy regulation has actively been represented at the IAEA International Forum on the regulatory supervision of the nuclear legacy sites (hereinafter referred to as Forum). The Forum considers three types of legacy:

- Development and application of nuclear technologies at different radiation hazardous facilities including the accident consequences affected the facilities in charge;
- Uranium mining and ore milling;
- Emergency legacy facilities far from the site of the accident.

As for Russia, these are: sites for SNF and RW temporary storage; areas and facilities affected by radioactive contamination resulted from P/A “Mayak” activity; available tailing dumps and other objects of the uranium mining infrastructure.

The general goal of the Forum is promotion and support of effective and efficient regulatory supervision during legacy site management in compliance with IAEA Fundamental principles, Safety Standards and taking positive international experience into account. Initiated by the Norwegian Radiation Protection Authority, in 2010, the first technical meeting of the Forum was held. Terms of Reference for activities in next 3 years was discussed and approved at this meeting. In 2011, at the second technical meeting the Forum Working Plan has been approved.

Figure 2 shows the organizational structure of the Forum. The coordination group includes the chairman, coordinators of working groups and IAEA scientific secretary. This group coordinates activity of three working groups:

- No 1: Enhancing the regulatory infrastructure (under FMBA of Russia leadership), which will learn the regulatory experience in regulatory supervision of the legacy for the purpose of future development of recommendations on enhancing regulatory infrastructure;
- No 2: Safety assessment methods and environmental impact assessment (under leadership of the US Nuclear Regulation Commission). This group focuses on application of different methods for safety assessment required to assure legacy site management;
- No 3: Professional Development for Regulators (under leadership of the Australian regulatory body), its work focuses on the professional development and training of regulatory staff for supervision of legacy sites.



Fig. 2. Organization Structure of the Forum

The Russian experts participated in all technical meetings of the Forum and headed Working group 1 «Enhancing the regulatory infrastructure». The main activities of working group 1 are learning and generalization of the experience of regulators, when planning and implementing the process of regulatory supervision of legacy sites, and development of recommendations to enhance the regulatory infrastructure.

The Working group will collect, collate and analyze materials on the historical experience in remediation of legacy sites and issue recommendations on enhancement of such practice as applicable for the regulatory supervision of legacy sites. In its work, Working group 1 is going to solve four tasks:

- 1) Development of a questionnaire to assess the status of the national regulation of nuclear legacy:
 - Legislative basis (convention, national strategy, laws);
 - Infrastructure of the state regulatory bodies;
 - Normative and methodical basis (regulations, methodical documents);
- 2) Development of the summary on the status of the national strategy on the nuclear legacy regulation taking into account the questionnaire-specific information collected;
- 3) Summary on the nuclear legacy sites;
- 4) Analysis of national working programs on nuclear legacy regulation.

Working group 1 prepared draft version of the Questionnaire, taking into account the relevant IAEA documents. Questionnaire consisting of thirty three questions and covering the following areas (modules):

- Legislative and governmental responsibilities;
- Responsibilities and functions of the regulatory body;
- Organization of the regulatory body;
- Authorization by the regulatory body;
- Review and assessment;
- Inspection and enforcement;
- Development of regulations and guides;
- Specification of nuclear legacy sites in your country.

Implementation of the Plan submitted by Working group 1 gives us reason to expect that within the Forum the following work will be carried out:

- Exchange of experience in the legacy management;
- Exchange of information on success, failures and problems;
- Specification of national frameworks of the legacy regulation;
- Provision of feedback on problems inherent to the national circumstances etc.

6. Conclusion

- (1) The nuclear legacy covers such military and industrial facilities, which do not comply with the up-to-date requirements for nuclear and radiation safety, and sites contaminated following the past nuclear activities and uranium mining. In terms of the environmental safety, the most significant are consequences of the defense activity and large-scale radiological accidents: legacy contaminations in the Urals – Techa River and Kyshtym (past activity of the PA “Mayak”), sites for SNF and RW temporary storage originated from the dismantled nuclear submarines in the Russian Northwest and Far East.
- (2) The current Russian normative and legislative regulatory basis assures safe operation of nuclear facilities, but its practical application revealed some nuclear legacy problems, including those connected with environmental remediation and difficulties in the optimization principle application. National system is based on three principal documents: Radiation safety standards, Main rules for radiation safety and protection, Rules for Radioactive Waste Management, needed to be amended taking into account the new ICRP radiological protection

system and new IAEA International basic Safety Standards in order to fill a lack of provisions to solve the nuclear legacy regulation problems.

- (3) In order to solve problems of the nuclear legacy regulation, the following is required:
- to introduce the existing exposure situation into the national standards in harmony with the ICRP system and IAEI standards;
 - to develop criteria for site remediation and return, by stages, to uncontrolled uses;
 - optimization of «the question price», that is it is necessary to develop and to consider possibilities and methods of optimization for the remediation strategies;
 - to introduce some legal limit relating to stop generation of new problems in the field of the nuclear legacy. The waste classification is the basis for the regulatory system operation. Such kind of problems is to be solved by development of additional the by-laws in the light of acceptance of the Federal Law on “Radioactive Waste Management” in 2011;
 - important tasks are the development of new regulatory documentation, improvement of efficient regulatory supervision, independent review and assessment, different stakeholder involvement in addition to other regulatory bodies not only Russian but also foreign ones, because similar problems exist in the states, which having nuclear legacy.
- (4) International Cooperation can play a significant role in regulatory issues of the nuclear legacy and environmental remediation. These issues could be facilitated through active dialog with different states and IAEA member states especially. Therefore, all persons involved in nuclear legacy regulation are invited for exchange of experience and active participation in IAEA Forum on the Regulatory Supervision of Legacy Sites.

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