THE REGULATIVE BASE OF RADIOACTIVE WASTE MANAGEMENT IN THE RUSSIAN FEDERATION

OA Kochetkov, IBPh Russia

Abstract

The paper deals with the current challenges in radiation protection regulation during radioactive waste management. The RF nuclear legislation needs improvement and establishment of the state centralized control over RW management taking into account international recommendations and experience.
The role of the international community in solving problems to enhance safety of RW management is emphasized.
The paper demonstrates: regulative provision of radiation protection within the RF Sanitary legislation and ways for implementation of effective and efficient regulatory sanitary and hygienic supervision of radiation protection during RW management, storage and disposal at Rosatom's enterprises, and especially at SevRAO facilities.
The necessity of the special documents aimed at radiation protection regulation during RW management, is justified.

The Legal System of Safe RW Management in Russia

The current RF nuclear legislation system based on a set of the Federal laws on «Nuclear Energy Use» and on «The Public Radiation Protection» is guided by common international provisions and recommendations of interstate bodies on nuclear and radiation protection and safety. Generally, this system successfully solves its key task - safety and protection assurance in nuclear power industry and peaceful use of nuclear energy (Fig.1).

FL on «The Public Radiation Protection» №3-FZ of 09.01.1996.

FL on «Nuclear Energy Use» №170-FZ of 21.11.1995.

FL on «Environmental Preservation» №7-FZ of 10.01.2002.

FL on «The Entrails» №2395-1 of 21.02.1992.

Water Codex of the Russian Federation №74-FZ of 03.06.2006

Land Codex of the Russian Federation №136-FZ of 25.10.2001.

Forestry Codex of the Russian Federation №200-FZ of 04.12.2006.

Fig 1. The legislative regulation of radiation protection

Unfortunately, the RF legal system, including ratified international treaties (The Joint Convention on Safe Management of Spent Fuel and Safe management of Radioactive Waste, adopted by IAEA 05.09.1997) does not contain any legal regulations to make some legal persons or the State responsible for SNF and RW management. Moreover, the Law on «The State Policy in Radioactive Waste Management» has been under discussion for more than 10 years and it is yet to be adopted. Now, a new draft law on "The Radioactive Waste Management" is under discussion and its signing is planned for 2008. This law would establish proper legal regulations of the responsibility for RW management.

Despite the mentioned problems, an efficient system of nuclear and radiation protection regulation has been created and is currently operating in RF (Fig.2).

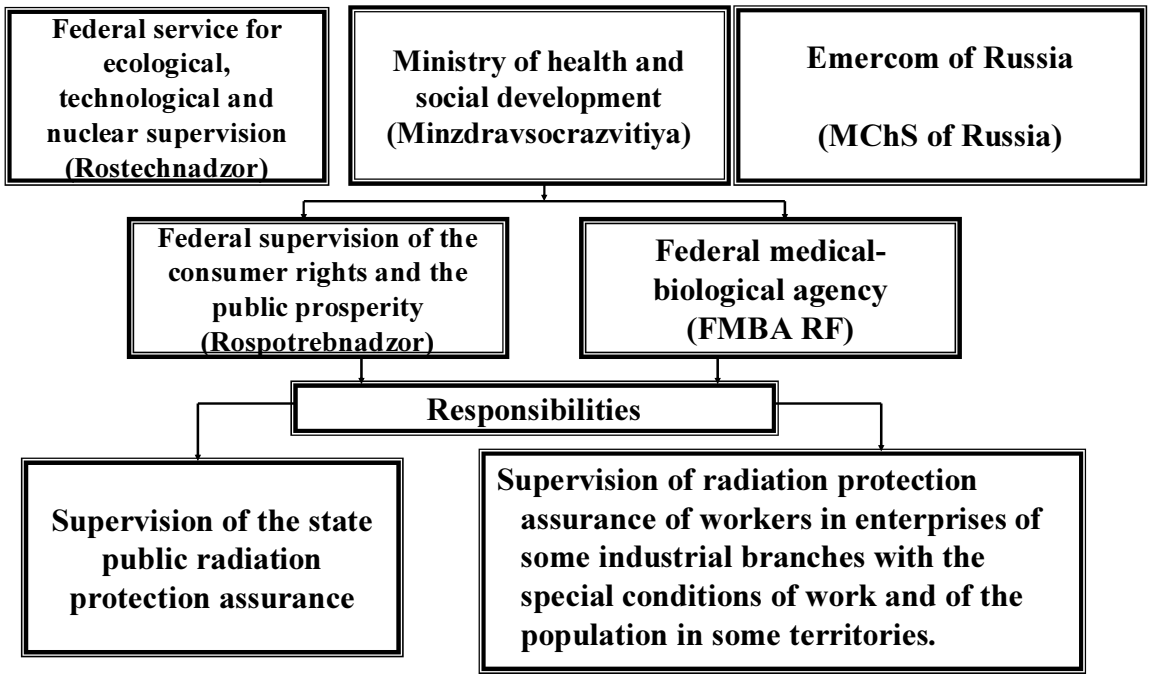

Fig.2. Safety and protection regulatory bodies in nuclear energy use

The Government and radiation protection regulatory bodies have different responsibilities in this system, according to the current regulative basis which includes the subordinate legislation, legal acts, federal regulations and rules, regulations and rules of the sanitary legislation, resolving system of licensing and supervision (a system of nuclear and radiation protection regulation) (Fig.3 and 4).

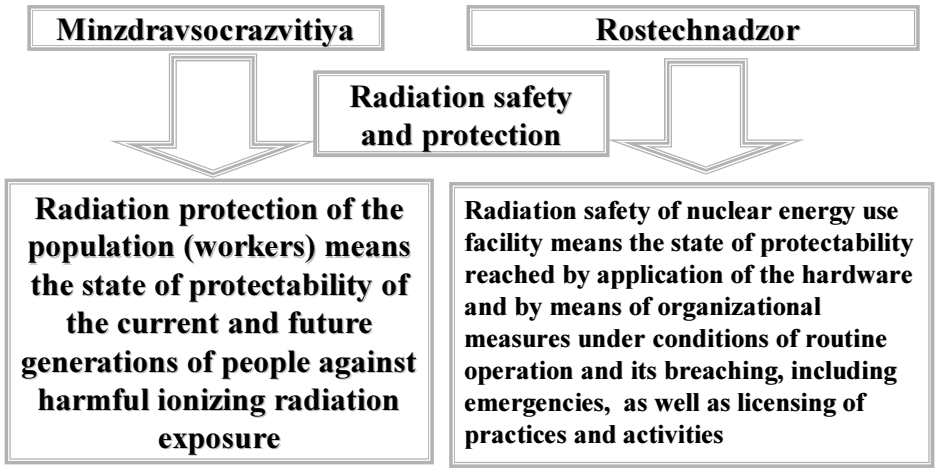

Fig. 3. Distribution of functions between radiation protection and safety regulatory bodies

Special services of sanitary and epidemiological supervision have been in the core of the occupational and public radiation protection regulation since the first years of nuclear power industry development. Here, the state safety and protection regulation of technologies and personnel, as well as regulation of sanitary and epidemiological well being of the population is based on the sciencientific, medical and hygienic requirements presented in the regulative

documents of the sanitary legislation. The concept of the current Russian system of sanitary epidemiological regulation corresponds to the international system of radiation safety and protection regulation (Fig.4).

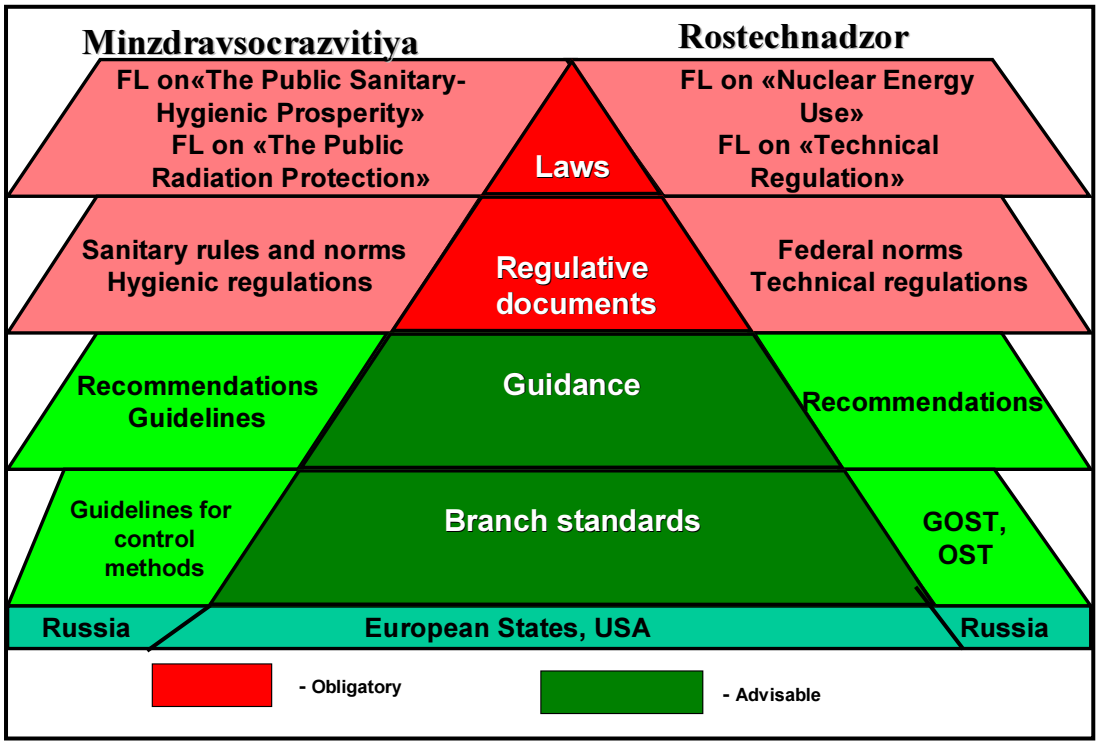

Fig. 4. The structure of radiation safety and protection regulation according to the international standards

The main sanitary legislative laws emphasize the priority of the sanitary regulative requirements with respect to all types of regulative documents concerning the human protection in different spheres of his life.

The state sanitary epidemiological regulation of the occupational radiation protection at Rosatom enterprises is one of the main functions of the Federal Medical-Biological Agency (FMBA RF). As development of the national radiation safety and protection regulative requirements (NRB-99 and OSPORB-99), many sanitary rules and guidelines for control and supervision of the occupational protection at functioning and designed nuclear enterprises have been elaborated. Figure 5 shows the hierarchy structure of the regulative documents within the sanitary legislation.

The RW management problems occupy a fitting place in this system. In addition, the Russian RW management activity is guided by international treaties, in which it is involved.

Now, RW management issues, including RW disposal, become quite relevant both in the documents of the international organizations and in Russia; in particular, they are under consideration of the comprehensive federal target program "Nuclear and radiation protection assurance for 2008 and for the period till 2015".

RW management is an independent field, which is to be controlled and directed centrally at the level of the state system.

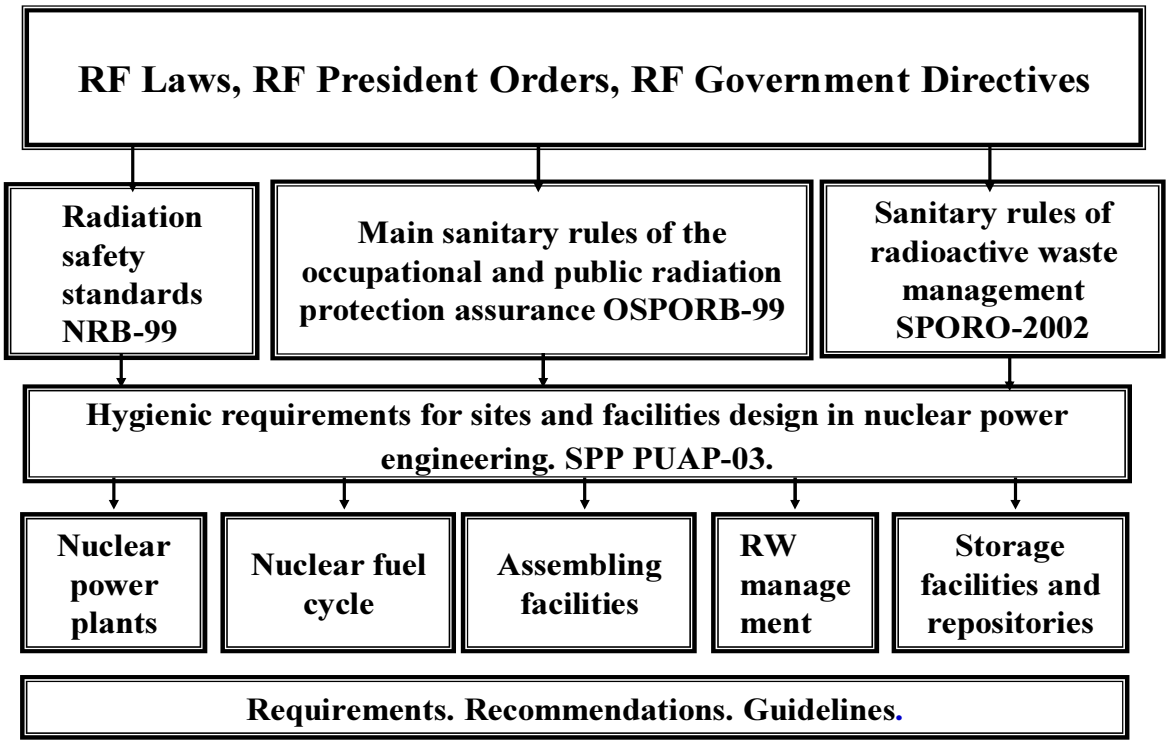

Fig. 5. Regulative provision of the occupational and public radiation protection at Rosatom enterprises within the sanitary legislation

Special Features of RW Classification Requirements in Different States

The waste classification serves as a base for the development of a unified national policy and definition of the strategic tasks in the field of RW management, operation of the regulation and supervision system at all stages of RW management (establishment of safety assessments, dose criteria, regulations and rules). Current legislative and regulative acts dealing with a routine practice of RW management at the industrial facilities.

The Russian RW classification is based on the waste subdivision in terms of specific activity levels for the state regulation purposes. It helps to evaluate potential hazard of the waste generated, to define requirements for waste management of different potential hazard levels and to implement RW account and control (Fig.6).

Management of the RW accumulated by the military industry in the past and generated as a result of reductions of the Navy forces and NPP decommissioning etc. remained beyond the scope of legal regulation. These problems are being solved within international, federal and branch programs.

There are many systems of RW qualitative and quantitative classification in the states of the world community. In the majority of states, the RW classification system is based on IAEA recommendations and structured in terms of the sources of origin (parts of NFC), aggregate state and radioactivity levels. (Fig.7)

In Germany a qualitative classification system was built based on the industrial needs and acceptability of disposal options (2 RW categories have been selected: heat generating and that with low heat generation). The French RW classification is based on different waste management options. Each RW category corresponds to a particular acceptability criterion depending upon their specific activity level and half-life. All RW are conveyed to specialized facilities.

Waste category	Specific activity, kBq/kg		
	Beta-emitting radionuclides	Alpha-emitting radionuclides (except for Transuranium)	Transuranium radionuclides
Low level	less than 10^3	less than 10^2	less than 10^1
Intermediate level	from 10^3 to 10^7	from 10^2 to 10^6	from 10^1 to 10^5
High level	more than 10^7	more than 10^6	more than 10^5

Fig. 6. Classification of liquid and solid radioactive wastes by their specific activity (OSPORB-99)

IAEA Recommendations:

- 4 categories in accordance with the national RW management system (account of specific activity, half-life and heat generation).

Russia:

- 3 categories by specific activity and radionuclide radiation type.

USA:

- 3 categories by radionuclide half-life ($T_{1/2}$) and alpha-emitter contents.

Italy:

- 3 categories by decay time of radionuclides being contained up to the natural levels.

France:

- 3 categories by radionuclide specific activity, ($T_{1/2}$) and alpha-emitter contents.

All national classifications have different bound activity values for the similar waste categories

Fig.7. Different national approaches to RW classification

In Russia, waste characterization depending upon disposal mode have not been introduced into the classification; nevertheless, SPORO-2002 contains the requirements similar to the international ones (Fig.8).

IAEA			IAEA	RUSSIA	Russia (OSPORB-99, SPORO-2002)		
			Type of disposal				
RW	1	HLW with long-lived	Disposal in geological formations	Disposal in underground or in geological formations	HLW T1/2 > 30 years	1	
	2	ILW with long-lived	Underground disposal	Underground disposal	ILW T1/2 > 30 years	2	
				Shallow disposal	ILW T1/2 < 30 years (Short-lived)		
	3	LLW with long-lived	Shallow disposal		LLW	3	RW
	4	Very short-lived $T_{1/2} \leq 100$ days up to exemption levels EW (VSLW)	Storage for decay up to clearance levels, uncontrolled disposal		Short-lived wastes T1/2 < days up to <LLW T1/2 < 1 year up to RW SAMS	4	
	5	Exemption level of VLLW or a bit higher (VLLW)	Shallow disposal with restricted control (landfills)	Disposal as conventional industrial wastes	Contaminated materials of limited use A_{sp}<LLW-0,3 (exemption level) Bq/g	5	Industrial wastes
	6	Exempted waste (EW)	Release from control, uncontrolled disposal in dumps		Contaminated materials of unlimited use A_{sp}.<0,3 Bq/g	6	

Fig. 8. Characteristics of RW-containing wastes depending upon their disposal type

Russian classification requirements for RW generally comply with the IAEA classification adopted in other States. However, the absence of any orientation to the final management stage – reliable RW isolation - should be mentioned, which is the most topical issue now.

The Russian classification system does not contain requirements for the limited content of fissionable materials in RW and VLLW category is absent either. Requirements for RW and SNF long-term storage and disposal are not clearly defined.

At the same time, the contemporary stage of nuclear power development is specified by nuclear power plants decommissioning and remediation of nuclear legacy contaminated sites, i.e., by processes which are accompanied with generation of the vast amount of low level wastes (LLW) and very low level wastes (VLLW). Normative regulation of such processes in Russia is under development.

It must be noted that Russia has the fundamentals of the RW management safety regulation, but there is no up-to-date procedure of long-term safety regulation with respect to the storage facilities that would take in to account the specifics of the national nuclear fuel cycle, especially for nuclear powered fleet installations (Fig.9).

OSPORB-99

Para. 3.12.20. Detailed procedure of radioactive waste management at each stage is under regulation of the special rules.

SPORO-2002

Para. 1.3. For radiation facilities, in cases when sources of RW generation, sites for their collection, interim storage, as well as routes of their transportation, treatment and disposal facilities are located on-site, special sanitary requirements must serve as a guidance accounting special features of RW management under these particular conditions

Fig. 9. The main provisions specifying generation of the RW management regulative base.

The more nuclear installations are subjected to decommissioning, the more appropriate storage facilities, disposal landfills and, hence, safety regulatory requirements are needed. Now, these challenges are being solved in Russia, like in some European States, within special rules for specific RW management technologies.

A Role of the International Community in Improvement of Safe RW Management

The international community recognizes its responsibility for this issue; therefore it takes active measures to organize cooperation between the States and international organizations to improve safety and protection of spent nuclear fuel and radioactive waste management. Safety assessment procedure must be coordinated and unified at the international level to identify some design and operational long-term storage/disposal procedures.

Challenges in management, storage and disposal of radioactive wastes resulted from NS dismantlement are especially acute for the northwest Russia. Now, the majority of RW are stored at the sites of temporary storage (STS) in Andreeva Bay, Saida and Gremikha, as well as at the plants involved in NS dismantlement. These wastes' radioactivity and toxicity are rather different. The main problem is connected with RW the activity level of which is very low. These wastes are generated during NS dismantlement and remediation of sites.

The main FMBA RF regulatory functions deal with NS dismantlement, RW conditioning, storage and disposal, as well as SNF and RW STS remediation at SevRAO facilities in Andreeva Bay, Sajda Bay and Gremikha on the Kola Peninsula.

The selection of RW safe management regulatory strategies in the North-West region is a difficult decision, which needs to consider problems connected with RW special features and diversity, the specific site for storage and disposal, environmental protection, and also with some economic aspects.

Arrangement of the Normative Base for Radiation Protection Regulation in the Northwest Region of Russia

Within the Cooperation Protocol signed between NRPA of the Kingdom of Norway, and Medical-Biological Agency (FMBA RF), Institute of Biophysics implements the projects on development of the regulative documents, aimed at effective and efficient regulatory sanitary hygienic supervision to secure radiation protection assurance during works at the SevRAO facilities. So, during 2006-2007, eight documents have been developed and approved: the Guidelines "Personal dose monitoring of the occupational exposure at SevRAO facility № 1"(MU 2.6.5.06-08), the Guidance "Criteria and Norms for Remediation of Sites and Facilities Contaminated with Man-Made Radionuclides, Pertaining the Federal State Unitary Enterprise «SevRAO» of the Federal Atomic Energy Agency" (R 2.6.1. 25 - 07) etc.

In 2007, FMBA RF approved the Guidance R 2.6.5.04-08 R.ONAO SevRAO-08 «Hygienic Requirements for the Industrial Waste Management at the Federal State Unitary Enterprise (Northern Federal Enterprise for Radioactive Waste Management) ». The guidance presents the regulatory requirements for the industrial waste management containing man-made radionuclides with activity levels which are lower than LLW, and this guidance supplements the main safety requirements postulated in OSPORB-99 and SPORO-2002. The VLLW concept has been officially introduced, and classification requirements have been established for this waste category. The acceptability criteria for VLLW disposal have been developed (Fig.10). The boundary between low and very low level wastes is defined, as in other States, by means of establishment of each radionuclide specific activity upper limits in the particular package. The adequate bounds for several indexes have been established for RW with the known isotope composition (^{90}Sr- 20% and ^{137}Cs – 80%) (Fig.11).

The requirements for the VLLW disposal landfill and criteria for its decommissioning have been developed first (Fig. 12). Waste quantitative characteristics and requirements for acceptance of VLLW being conveyed to disposal, have been established for the specific storage facility.

Waste category	Specific β-activity, kBq/kg	Superficial contamination, β-particles/m·cm^2	Dose rate at 0.1 m from the surface of the package, μSv/h
VLLW	0,3 – 12,0	50,0 – 500,0	0,1 – 1,0
Cleared wastes	≤ 0,3	≤ 50,0	Not more than 0.1 exceeding of the natural radiation background, typical for the particular place

Fig.10.Criteria of SevRAO industrial waste ascription to the VLLW category

Radionuclide specific activity in the package, kBq/kg	Maximum radionuclide specific activity in the package, kBq/kg	Levels of VLLW superficial β-contamination, part/m*cm^2	Equivalent dose rate, μSv/h	Maximum content of long-lived α-active radionuclides, %
0,3 - 30,0	< 100,0	50,0 - 500,0	< 1,0 at 0.1 meter distance from the package	0,1

Fig. 11. Characteristics of RW acceptability being conveyed to VLLW disposal landfill, at the isotope composition ^{90}Sr (20%) and ^{137}Cs (80%)

Full clearance	Clearance level non-exceeding by specific activity	Non-exceeding of the annual effective dose to the critical group of the population ≤ 10 μSv, collective dose ≤ 1 man-Sv	Non-exceeding of the public exposure level at unintended human intrusion ≤ 0,1 mSv/year collective dose ≤ 1 man-Sv /year	Non-exceeding of 0.3 mSv/year public dose constraint after the closure
Limited clearance	Excess clearance level			

Fig.12. Criteria of the VLLW landfill release from the regulatory control

Taking into account significant VLLW volumes, uncertainties in the isotope composition of the legacy wastes, the high potential hazard of the major radionuclides, possible scenarios of the post-closure use of the disposed wastes have been developed in the Guidance:

- exemption from the regulatory control, provided that the specific activity being averaged over the disposal facility will not be higher than 0.3 kBq/kg («Greenfield»).
- limited use of the disposed wastes with the activity level higher than 0.3 kBq/kg, but lower than 12 kBq/kg;
- arrangement of the "brown lawn" within the STS keeping at the same time the landfill conversed there, and the industrial site transfer into the category of "the federal reserve lands".

With the purpose of solving problems in RW treatment and storage, Rosatom and the administration of Murmansk region made a joint decision regarding the construction of the Sajda Centre for conditioning and storage of solid and hardened low and intermediate level RW generated during NS dismantlement in the northwest Russia. This Centre is planned to be designed near Sajda Bay since 2008.

However, there are no regulative solutions of problems connected with the occupational and public radiation protection assurance, environmental preservation during implementation of programs aimed at arrangement of sites for RW long-term storage; centers for low and intermediate level waste conditioning and storage.

According to the Russian requirements of OSPORB-99 and SPORO-2002, development of unified requirements and principles of radiation protection assurance during LLW and ILW management is obligatory for application both by RW owners and the Sajda Centre, with the purpose of effective radiation hygienic supervision of safety and protection assurance in the region.

In 2008, development of the Guidance «Radiation Hygienic Requirements for Organization of Radioactive Waste Management in the SevRAO Centre of Conditioning and Storage in Sajda bay» is planned. The German partners make the construction design of Sajda Centre according to the German safety regulations. The available NPP RW storage facility in Lubmin serves as a base of the design. The design envisages use of the German and Russian equipment and technologies.

The available initial data on arrangement of the RW decommissioning centre in Sajda Bay is the evidence that the developers of the regulatory document must first of all solve the problems specifying the regulatory requirements:

- Coordination of the Russian and German quantitative criteria (specific activity) of RW classification.
- Adaptation of the German technologies to the Russian safety requirements.
- Development of long-term safety regulatory criteria with respect to the RW storage facilities; storage of the reactor compartments from the dismantled NS for the operational and post-operational periods.
- Development of requirements for Sajda Centre operation and organization of the personnel labor, aimed at radiation protection assurance and health keeping of workers and the public as well as environmental preservation.

Not only engineering requirements, but also hygienic ones must assure the occupational, public and environmental protection during RW conditioning and storage in the Sajda Centre; they include:

- Classification requirements for RW being accepted for treatment and storage in the Sajda Centre;
- Requirements for RW collection and package, being removed from the RW owner organizations;
- Requirements for RW transportation beyond the RW owner facility and on-site Sajda Centre;
- Requirements for RW acceptance from RW owners;
- Requirements for allocation and equipment of Sajda Centre;
- Requirements for RW storage in Sajda Centre;
- Requirements for the personnel, protective/preventive measures and personal hygiene;
- Requirements for radiation monitoring .

The regulative document of the Sanitary legislation planned to be developed will become a part of the unified state control system of RW management practice. It will also ensure account and monitoring of radiation situation conditions, occupational and public doses during operation and service of the conditioning and storage centre in Sajda Bay.

The criteria and regulations justified in the document can be adapted for application in other specialized organizations for RW management.

CONCLUSIONS

The common ethic principle of the radioactive waste management says that the State getting benefits of nuclear technologies use, must take the responsibility to solve the problems related to the completion of the Nuclear Fuel Cycle.

Science and engineering are in progress, so new technologies and approaches to radiation facilities operation and arrangement of the special organizations for RW management are emerging, modes and types of waste protection and isolation for long-term periods (above hundreds years) are being improved. Therefore, the available legislative and regulative

documents need changes. Of course, the RF nuclear legislation needs further elaboration. As you know, ICRP has issued a new version of its fundamental recommendations (Publication № 103), which will serve as a base to review some regulative provisions of radiation protection assurance. Undoubtedly, these provisions will be reflected in new documents of the Russian sanitary legislation. In addition, new approaches will be extended and justification for RW management requirements will be reflected in these documents and I believe in assistance and support of our western colleagues in this field.

Our experience shows that when developing new regulatory documents, a detailed analysis of the national efforts in radiation protection assurance is needed. Application of new radiological criteria developed by ICRP must be balanced and take into account the current Russian social and economic realities.

The comprehensive solution of the RW management problem is necessary, including arrangement of the state regulatory system, generation of the regulative and legislative base, development of RW and SNF treatment and transportation technologies, construction of reliable buildings for their long-term storage and disposal.

O A Kochetkov