



Radio-ecological regulations for remediation of the sites for temporary storage of the spent nuclear fuel and radioactive waste

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1. Introduction

Two technical bases of the Northern Fleet were created in the Russian Northwest in the 1960s at Andreeva Bay in the Kola Peninsula and Gremikha village on the coast of the Barents Sea. They maintained nuclear submarines, performing receipt and storage of radioactive waste (RW) and spent nuclear fuel (SNF). No further waste was received after 1985 and the technical bases have since been re-categorized as sites of temporary storage (STS).

Remediation of sites and facilities of the STS of SNF and RW in Andreeva bay and Gremikha village on the Kola Peninsula is one of regulatory functions of the Federal medical-biological agency (FMBA of Russia). The work has involved the Russian Federation Burnasyan Federal Medical Biophysical Centre, which is technical support organization of the FMBA of Russia. In this work took part the Norwegian Radiation Protection Authority (NRPA) in frame of the Norwegian government's Plan of Action to improve radiation and nuclear safety in northwest Russia.

2. Material and Methods

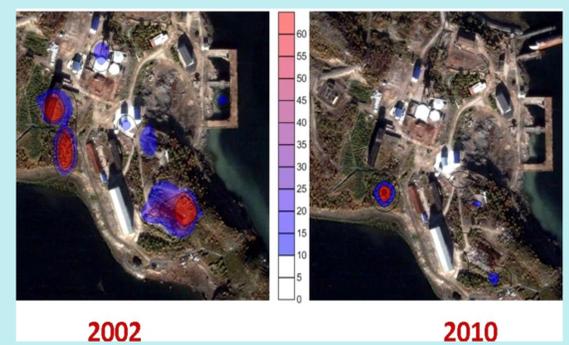
Over 2005-2012, more than 300 samples of environmental media, local foods and drinking water were collected in Andreeva Bay and Gremikha village expeditions; moreover, personal dose monitoring was implemented. Gamma-spectrometry and radiochemical methods were applied in sample measurements.



3. Radiation situation on-site the STS in Andreeva Bay

The accomplished examinations showed that gamma dose rates within the STS territory varied over a wide range: in controlled access area - from 0.2 to 140 $\mu\text{Sv/h}$; in uncontrolled area - from 0.2 to 12 kBq/kg; in health protection zone - from 0.1 to 0.2 kBq/kg. Within supervised area, gamma dose rates varies from 0.063 to 0.14 $\mu\text{Sv/h}$ with an average value of 0.12 $\mu\text{Sv/h}$, which does not differ from the levels typical for the territories of Northwest Russia and in the Murmansk region.

The highest level radioactive contamination of soil on-site induced by man-made radionuclides is observed in the area of the old technological pier and around some SNF store facilities, where ¹³⁷Cs specific activity reaches 5.7×10^7 Bq/kg, and that of ⁹⁰Sr is 5.7×10^6 Bq/kg. ¹³⁷Cs and ⁹⁰Sr concentrations in soil within HPZ and SA is at the background level typical for "clean" Russian Northern areas and does not exceed 36 Bq/kg and 4 Bq/kg, respectively.



4. Remediation Criteria and Norms

Analysis of the radiation and hygienic situation based on the obtained data permits to conclude that in the course of and after termination of RW and SNF removal from the STS area will require implementation of the large-scale and large-term program on remediation of the site. Taking into account the up-to-date approaches to the radiation safety assurance, when developing the remediation regulation, we focused on justification of the residual dose limits for workers and for the public.

In case of conservation and renovation remediation options, the remediation criteria comply with the current RF laws and regulations. For the liquidation option, the regulations developed taking into account the up-to-date international recommendations have been proposed. Having in mind the current situation and the planned activities, the renovation (conversion) option seems to be the most likely for both STSs.

Decommissioning option	Category	Dose constraint			Dose limit according to (NRB-99)
		Due to residual contamination	Due to the new activity with radiation source use	Total	
Conservation	Workers	2	-	2	20
	Population (SA area)	0.1	-	0.1	1
Conversion ("brown lawn")	A personnel category	3	7	10	20
	B personnel category	1	1	2	5
	Population (SA area)	0.1	0.15	0.25	1
Liquidation ("greenfield")	Population (STS area)	1	-	1	There are no regulation in NRB - 99/2009
	Population (the rest area)	0.1	-	0.1	

5. Conclusions

Environmental radiation monitoring demonstrated significant excess (in comparison with typical background values) of ¹³⁷Cs and ⁹⁰Sr contents at local parts of the coastal strip of the STS health protection zone in seawater, seaweeds, bottom sediments, vegetation and soil.

Results of radionuclide sorption examination in soil and ground water permit to assume the presence of effective migration from contaminated areas via groundwater, causing radioactive inflow into offshore marine waters. Having in mind a possibility of further contamination of the STS area, dynamic surveillance is needed of the radiation situation both at routine activity, and at SNF and RW removal.

The described work carried out under joint FMBA and NRPA Project, devoted to regulation of the public radiation and nuclear safety during STSs operations, current output has included the following documents:

- Initial Threat Assessment for the situation at STS sites.
- Guidance "Criteria and norms on remediation of STS sites and facilities contaminated with man-made radionuclides".
- Guidance "Hygienic requirements for personnel and public radiation safety guaranteeing at the stage of designing the work with SNF and RW at STSs"



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