

Radiation and Ecological Conditions of the Offshore Waters nearby the Site for SNF and RW Temporary Storage at Andreeva Bay on Kola Peninsula

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1. Introduction

In 1960s, a large technical base of the Northern Fleet was established at Andreeva Bay on Kola Peninsular in Barents Sea. It was involved in support of nuclear submarines, acceptance and storage of radioactive waste (RW) and spent nuclear fuel (SNF). Since 1985, the waste acceptance has been stopped and the technical bases were re-constructed and re-equipped to serve as the sites for temporary storage (STS). In order to get the comprehensive information on the current radiation circumstances in the STS offshore waters for the purpose of its integrated assessment, the radiation ecological monitoring of the offshore waters nearby STS has been conducted.

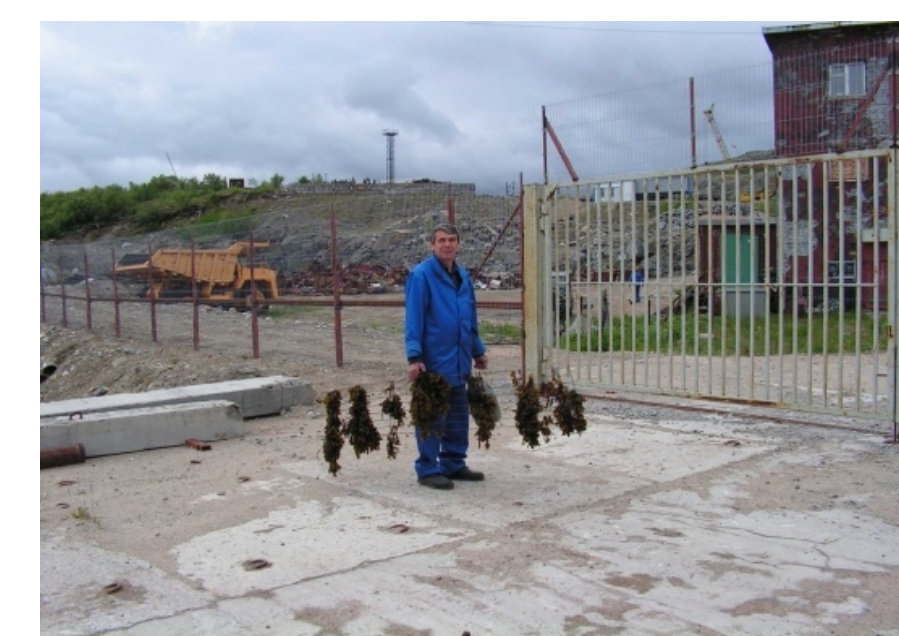
2. Object of study

Information of ¹³⁷Cs, ⁹⁰Sr and ⁶⁰Co concentrations in the seawater, seaweeds, bottom sediments, invertebrates (mussels, Crustacea), and vertebrates (fish fauna) in the local areas of the STS coastal stripe has been obtained.



3. Methods

The radionuclide specific activity in the environmental media was determined by radiochemical and gamma spectrometry methods using the «CANBERRA» semiconductor germanium gamma spectrometer.



4. Results

During the radiation survey, the marine environmental media contamination was found, which is induced both radioactivity arrival from the radioactive material storage sites (via tidal - tidal fluctuations in seawater, melted snow and rainwater), and many-year industrial activity directly in the coastal strip.

The specific activity of man-made radionuclides in the marine environmental media at some parts of the sea offshore waters in HPZ reaches 210 Bq/kg and 3660 Bq/kg in bottom sediments and 690 and 57 Bq/kg in seaweeds, by ⁹⁰Sr and ¹³⁷Cs respectively.

Area	Seawater		Bottom sediments		Seaweeds	
	⁹⁰ Sr	¹³⁷ Cs	⁹⁰ Sr	¹³⁷ Cs	⁹⁰ Sr	¹³⁷ Cs
Health protection zone	0.02-0.26	0.03-0.77	15-210	160-3.6x103	9.4-690	24.5-57

The radionuclide contents in the coastal strip are many times higher than the mean contents of ⁹⁰Sr and ¹³⁷Cs in seawater of Motov Gulf of the Barents Sea of 0.003 Bq/l and 0.002 Bq/l respectively.

In this case, there is a washing away process from the bottom sediments contaminated due to washing out of the coastal strip in the offshore waters. The similar is true for the reasons of local significant concentrations of radionuclides in seaweeds.

Thus, in this case we deal with the coastal contamination of the sea offshore waters.

To confirm this fact, migration mobility levels of ⁹⁰Sr and ¹³⁷Cs were being examined in the environmental chains and strength of their connection with soil and bottom sediments by determining the form of radionuclides in these media.

The most obvious indicators are desorption coefficients – the ratio of the movable radionuclide content to the total radionuclide content.

Name of sample	Migration coefficient ⁹⁰ Sr (K ⁹⁰ Sr)	Migration coefficient ¹³⁷ Cs (K ¹³⁷ Cs)
Soil	0.92	0.04
Soil	0.94	0.17
Bottom sediments	0.82	0.73
Bottom sediments	0.79	0.81

Desorption coefficients of ⁹⁰Sr movable forms are very high (0.92-0.94) for soils, i.e., the practically 90% of total ⁹⁰Sr can penetrate to the plants; migrate along the soil profile and into the sea offshore waters.

Desorption coefficients of ¹³⁷Cs movable forms for soils are much lower (0.04 – 0.17) than for ⁹⁰Sr, because of its higher fixation by soils. Nevertheless, due to its big contents in soils, it represents the significant threat for contamination of the seabed.

Desorption coefficients of movable forms both of ⁹⁰Sr and of ¹³⁷Cs for bottom sediments in Andreeva Bay is very high (0.82 and 0.81 respectively).

However, analysis of ¹³⁷Cs and ⁹⁰Sr contents in the sea fish samples collected the offshore waters close to “SevRAO” facilities did not find any dependence of the radionuclide contents in fish on the area of the catch, because of the fish migration within the coastal shelf. The bottom sediments, seaweeds and molluscs, crustaceans - aquatic animals, which by way of habitat are sedentary and tied to the habitat, are the most significant in term of radiation characteristics of the marine offshore waters.

5. Conclusions

The radiation ecological monitoring of the environmental media demonstrated the significant exceeding of the typical background values of ¹³⁷Cs and ⁹⁰Sr concentrations in seaweeds and bottom sediments in the local areas of the offshore waters nearby the STS. High mobility of the main dose-forming radionuclides, ¹³⁷Cs and ⁹⁰Sr, has been determined in soil and bottom sediments (K_d¹³⁷Cs and ⁹⁰Sr in soils are 0.56 and 0.98 respectively, K_d¹³⁷Cs and ⁹⁰Sr in bottom sediments reaches 0.82).

The findings of the inspection permit to assume the effective migration from the high contaminated parts of the site via the ground water streams. Therefore, radioactive substances enter the offshore sea waters. Having in mind potential further contamination of the STS area, the dynamic survey of the radiation situation is necessary both during the routine operation and at the stage of SNF and RW removal.

The radionuclide accumulation by the invertebrates or by vertebrates is trivial, so, we can conclude that the STS industrial site does not impact on these parts of the ecosystem in Motovsky Gulf. Nevertheless, control of man-made radionuclides in the commercial varieties of fish is required, because it is one of the main parts of the public diet based on the local foods.