Joint Russian-Norwegian Collaboration on Radioactive Contamination from Dumped Nuclear Waste in the Kara Sea - 3 Years with Expeditions to the Dumping Sites: Goals and Investigations

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JOINT RUSSIAN-NORWEGIAN COLLABORATION

The joint Russian-Norwegian expert group for the investigation of radioactive contamination in the northern areas was established in 1992 under the joint Russian-Norwegian Commission for Cooperation in the environmental sector. The expert group was formed as a result of allegations claiming that dumping of radioactive waste by the former Soviet Union had taken place in the Barents and Kara Seas. The expert group is headed by the Ministry of Environmental Protection of the Russian Federation and the Norwegian Ministry of Environment.

In 1993 the Governmental Commission of the Russian Federation on sea dumping of radioactive waste (Whitebook No. 3, 1993) confirmed that totally 6 submarine reactors and part of the reactor assembly from the icebreaker Lenin containing spent fuel, and 11 reactors without fuel have been disposed in the Tsivolky Fjord, Stepovogo Fjord and Abrosimov Fjord at the east coast of Novaya Zemlya and in Novaya Zemlya Trough. The total activity (inventory) as estimated by the Russian Commission was 85 PBq for the fuelled reactors and 3.7 PBq for the unloaded reactors at the time of disposal. Furthermore, about 6500 containers, 155 large objects and 17 vessels containing low or intermediate level radioactive waste (~575 TBq) have been dumped in the Kara Sea (White Book No. 3, 1993). According to the International Artic Sea Assessment Project (IASAP) the inventory is probably less than previously assumed due to low burnup.

The objectives of the expert group are: to collect reliable information on handling, storage, discharges and especially dumping of liquid and solid radioactive material in the Northern seas; to perform field investigations in areas where dumping of radioactive materials has been performed; and to assess the present and future consequences for man and the environment of radioactive contamination originating from the dumping of radioactive waste and from other sources. In addition, the expert group has

initiated a joint project on past and potential transport of radionuclides from the Chelyabinsk region to the Kara Sea. Joint field work at Mayak PA, was carried out in June 1994 (Christensen *et al.*, 1995).

EXPEDITIONS 1992-1994

Joint Russian-Norwegian expeditions to the Kara Sea have taken place annually since 1992 (Fig. 1). The 1992 expedition to the open Kara Sea included for the first time scientists from Western countries. During the 1993 expedition underwater investigations of dumped objects in the Tsivolky Fjord and the Stepovogo Fjord was performed in addition to sample collection. This program was also carried out in the Abrosimov Fjord and the Stepovogo Fjord in 1994.

The work program onboard the research vessel "Victor Buinitsky" of Roshydromet Murmansk Area Department included:

- localization and investigation of dumped objects within the Fjords of Novaya Zemlya using high-frequency side scanner sonar, remote operated vehicle (ROV) equipped with a high frequency sonar, video camera, underwater NaI-detector, as well as sediment and waste sampling devices
- sampling of surface and near bottom waters by means of pumping devices. The water was filtered through 1 mm membranes.
- sampling of sediments by Smøgen corer, Petersen grab or Niemistö gravity corer
- sampling of biota (fish, brown algae, etc) by fish nets, traps or three angle bottom dredge
- gamma measurements performed in situ using a NaI-detector or onboard ship using HPGe-detector.

After the expedition, samples were taken to laboratory for analysis of gamma, beta-, and alpha-emitters.

OPEN KARA SEA 1992, 1993

The concentrations of ^{137}Cs, ^{90}Sr and $^{239,240}Pu$ in sea waters were generally low (Table 1). The concentration of ^{137}Cs varied within 120-500 Bq/m^2 and $^{239,240}Pu$ within 2-24 Bq/m^2 in the upper 10 cm sediments in the Kara Sea (Table 2), while significantly higher levels were observed outside the Kara Gate (^{137}Cs: 910 Bq/m^2, $^{239,240}Pu$: 135 Bq/m^2).

Table 1. Concentration of ^{137}Cs and ^{90}Sr in sea water (Bq/m^3) from dumping sites at Novaya Zemlya and the open Kara Sea.

Horizon	Tsivolky Fjord		Stepovogo Fjord		Novaya Zemlya Trough		Kara Sea	
Surface	4-6	4-6	3-7	4-7	4-7	2-3	3-8	3-11
Near bottom	6-14	3-4	6-31	4-26	7-14	2-3	8-20	4-6

Based on the spatial distribution of the concentrations of ^{137}Cs, ^{90}Sr and Pu-isotopes in waters and sediments the following sources could be identified: global fallout from atmospheric nuclear weapons testing, and probably local influences from underwater detonations SW of Novaya Zemlya (e.g. Pu-isotopes); transport by the Ob and Yenisey rivers draining large catchment areas affected by global fallout and areas contaminated with radionuclides from releases from nuclear facilities (e.g. ^{90}Sr), and marine transport of radionuclides in discharges from the Sellafield nuclear reprocessing plant (e.g. Cs-isotopes) and from fallout from the Chernobyl accident (e.g. ^{134}Cs).

The concentration levels obtained at the Novaya Zemlya Trough in 1993 were within the ranges observed in the Kara Sea in 1992. Thus, no additional contribution from discharged or dumped radioactive waste could be identified in the open Kara Sea.

Table 2. Concentration of ^{137}Cs and ^{60}Co (Bq/kg d.w.) in the surface sediments (0-2 cm) at dumping sites at Novaya Zemlya and the open Kara Sea.

Tsivolky Fjord 1993		Stepovogo Fjord 1993		Novaya Zemlya Trough 1993		Kara Sea 1992	
^{137}Cs	^{60}Co	^{137}Cs	^{60}Co	^{137}Cs	^{60}Co	^{137}Cs	^{60}Co
4-30	< 1-4	8-300	< 1-20	7-30	< 1	2-53	< 1

TSIVOLKY FJORD 1993

Inspections with sonar and underwater camera, gamma measurements with underwater detector, and sampling of waters and sediments took place close to dumped objects including a large cargo vessel (JRNC, 1994). The levels of ^{137}Cs and ^{90}Sr in water were similar to that of the open Kara Sea (Tab. 1 and 2). However, the presence of ^{60}Co (up to 20 Bq/kg) in upper sediment layers at the dumping sites reflected leakages from dumped radioactive waste.

STEPOVOGO FJORD 1993-1994

Inspections with sonar and underwater camera revealed the presence of a sunken submarine (1993, 1994) as well as metal containers (1994). Based on results from the 1993 expedition, the levels of ^{137}Cs and ^{90}Sr in surface water were similar to that of the open Kara Sea, while enhanced levels were observed in bottom waters close to the sunken submarine (Table 1). The presence of ^{60}Co (Table 2) as well as traces of ^{152}Eu and ^{154}Eu in sediments close to the submarine reflected leakages from dumped radioactive waste (JRNC, 1994).

The analytical results from the 1994 expedition are given by Salbu *et* al (1995).

ABROSIMOV FJORD 1994

During the 1994 expedition 3 reactor compartments, 3 vessels and a large number of containers were located by using sonars and ROV with an underwater camera. In situ gamma measurements with underwater NaI detector and measurements of sediments with Ge-detectors onboard ship indicated enhanced levels of ^{137}Cs and ^{60}Co close to dumped objects.

The analytical results are given by Salbu *et* al. (1995).

CONCLUSIONS

The enhanced levels of ^{137}Cs and ^{90}Sr, and the presence of ^{60}Co in sediments from Stepovogo Fjord as well as traces of ^{60}Co in samples from Tsivolky Fjord, show that leakage from dumped radioactive waste has taken place. The contamination was localized to nearby dumped objects.

The concentrations of radionuclides in waters and sediments in the open Kara Sea are presently very low and significantly lower than in other marine areas, e. g. the Irish Sea, the Baltic Sea, and the North Sea. The results imply that the impact of radioactive contamination from dumped radioactive waste on the Kara Sea environment is at present very low.

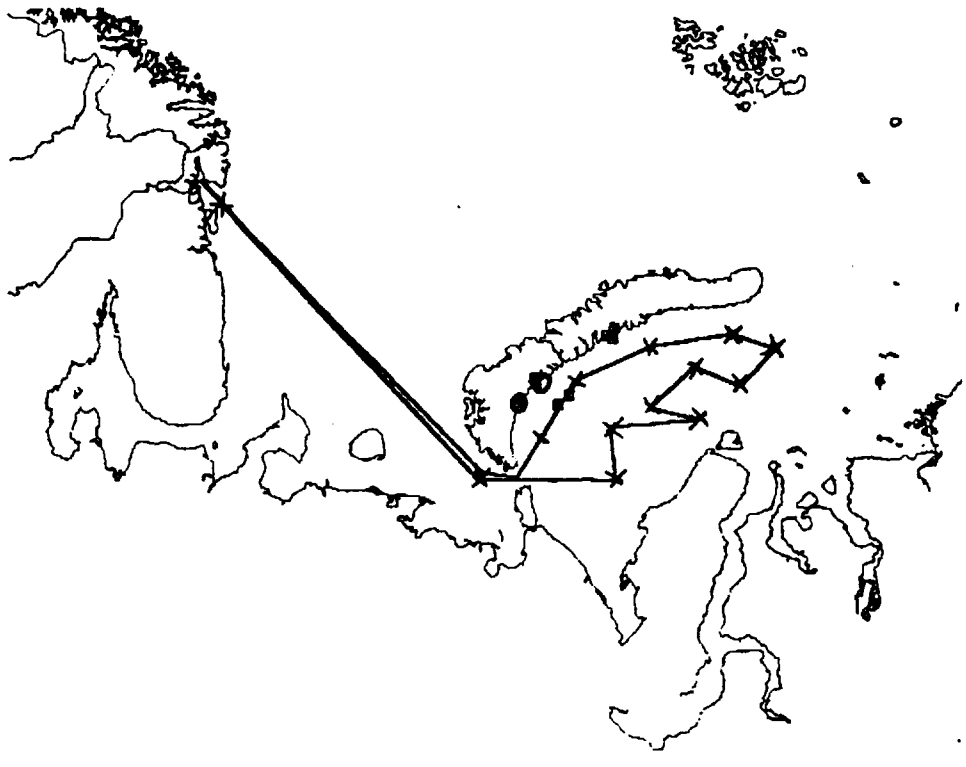

Figure 1. Route of the Joint Russian-Norwegian Expeditions to the Kara Sea in August 1992 (x), August-September 1993 (□) and August-September 1994 (0)

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