

**Cross-Cutting issues in Regulatory Supervision of Spent Fuel
Radioactive Waste and Radioactively Contaminated Land in
North-West Russia**

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ABSTRACT

The Norwegian Government is promoting improvements in radiation protection and nuclear safety in North-West Russia. Among priority areas there is the improvement of spent nuclear fuel and radioactive waste management, as well as remediation operations at the Shore Technical Bases operated by Federal Enterprise SevRAO at Andreeva Bay and Gremikha on the Kola Peninsula. The extreme radiological conditions at these sites present novel difficulties for regulatory supervision of operations. The situation at these sites is such that the existing regulations are applicable, and actions to remedy the situation are not permitted under the current regulatory regime. An improved regulatory process, including development of special norms and rules, is required to take account of this unusual situation.

The Norwegian strategy includes not only support to industrial projects, but also support to Russian Federation regulatory bodies, to ensure that work is carried out in compliance with Russian Federation law, taking account of international recommendations and other national good practice as relevant in the RF. Accordingly, the Norwegian Radiation Protection Authority has set up a programme of cooperation with the Federal Medical–Biological Agency (FMBA), which is the primary radiation protection authority in the RF. The work is carried out with technical input from the Russian Institute of Biophysics and with inputs from western technical support organisations. The overall objective of the work is to promote effective and efficient regulatory supervision of SevRAO activities at Andreeva Bay and Gremikha within the scope of responsibilities of FMBA.

This paper describes the results of an initial threat assessment which allows consideration of the cross-cutting issues associated with developing an overall effective site management plan which deals with short- and long-term issues, and protection of workers as well as of the public and the environment, while achieving a timely and effective use of resources in order to solve the problems.

INTRODUCTION

The Norwegian Government, through a Plan of Action implemented by the Norwegian Ministry of Foreign Affairs (MoFA), is promoting improvements in radiation protection and nuclear safety in North-West Russia. Among priority areas is the improvement of spent nuclear fuel (SNF) and radioactive waste (RAW) management, as well as remediation operations, at the Shore Technical Bases (STBs) which are operated by the Russian Federal Enterprise SevRAO at Andreeva Bay and Gremikha on the Kola Peninsula. The STBs were set up originally as part of the infrastructure for the operation of the Russian navy nuclear submarine fleet.



Attention is focussed at these sites due to the very poor storage conditions that exist for the significant inventories of SNF and RAW. The handling of these materials to put them into a safe condition is especially hazardous because of the physical degradation of the fuel the since its emplacement due to the poor storage conditions. Furthermore, significant quantities of radionuclides have already escaped into the ground around the storage facilities. The potential for spreading of this contamination and for further releases creates additional hazards, both locally and on a regional scale.

The extreme radiological conditions at Andreeva Bay and Gremikha, see examples below, present novel difficulties for regulatory supervision of operations. The existing regulations were developed for routine conditions of SNF and RAW management. The situation at these sites is such that the existing regulations are not applicable, partly because of changes in regulatory responsibility and partly because the facilities have not been operated in accordance with previous requirements. Furthermore, actions to remedy the situation are not practical under the current regulatory regime, since the current regime was developed without allowing for the possibility of the current conditions at the sites. An improved regulatory process, including development of special norms and rules, is required to take account of this unusual situation.

MoFA's strategy includes not only support to industrial projects, but also support to Russian Federation regulatory bodies, to ensure that work is carried out in compliance with Russian Federation (RF) law, taking account of international recommendations and other national good practice as relevant in the RF. Accordingly, MoFA, through the Norwegian Radiation Protection Authority, has set up a programme of cooperation with the Federal Medical–Biological Agency (FMBA), which is the primary radiation protection authority in the RF. The work is carried out with technical input from the Russian Institute of Biophysics and with inputs from western technical support organisations.

The overall objective of the work is to promote effective and efficient regulatory supervision of SevRAO activities at Andreeva Bay and Gremikha within the scope of responsibilities of FMBA. Within this scope, the cooperation is being implemented through three specific projects addressing regulatory supervision in the following areas:

1. Radiation exposure of workers;
2. Radiation exposure of the public during operations and in the longer term after remediation work is completed; and
3. Emergency preparedness and response.

An early step in each of the three projects has been to assess, from a regulatory perspective, the radiological threats currently existing and presented by the work which is due to be carried out at the STBs. The purpose was to obtain a view, from the regulatory perspective of FMBA, of the most important issues which require supervision and regulatory development. These assessments have been combined into a single initial threat assessment¹ report [1], which is described further below.

COMBINED INTIAL THREAT ASSESSMENT

It is noted that the basic laws of the RF on use of radioactive materials and radiation protection provide a full basis for normal operations. However, given the special situation of the STBs, this combined intial threat assessment has been prepared in order to identify:

- the main radiological threats to workers and the public which require regulatory attention;
- the main requirements for risk assessment, i.e. those issues which will require most urgent and/or detailed analysis;
- any relevant additional regulatory requirements, and the nature of the safety work instructions to be developed by the operator; and
- key issues in the implementation of the regulatory process.

Radiological Threats

The main radiological threats at Andreeva Bay and Gremikha can be summarised as follows, in approximate order of priority:

1. At both bases, there are storage areas containing highly radioactive materials (spent nuclear fuel, and a range of liquid and solid radioactive wastes) and severely contaminated parts of the territory. Dose rates in parts of the sites exceed 1 mSv/h.
2. The territory and area of water next to the STB Andreeva Bay is contaminated by Sr-90, Cs-137 and Co-60, from local sources of radioactive contamination. Abnormal levels of Cs-137 in the ground are observed in three areas of the Andreeva Bay site, the highest values being up to 10^6 Bq/kg close to Building 5 (a building used in the past for SNF storage). Soil samples taken in Zaozersk, show concentrations of Cs-137 and Sr-90 that were not higher than 50 Bq/kg, much

¹ The term initial threat assessment is used here to avoid confusion with the multiple concepts associated with the term “risk assessment”. This threat assessment is a preliminary, qualitative review of risks and hazards providing outline information to enable additional effort and resources to be focussed on those areas that most require attention.

lower than on industrial site and decreasing with distance from the site. Local concentrations of Cs-137 in soil in Gremikha village reach 2400 Bq/kg.

3. Concentrations of Cs-137 in bottom sediments of the coastal strip next to the STB areas in Andreeva Bay vary from < 20 to 600 Bq/kg depending on distance from the mouth of the brook. Content of Cs-137 in the brook water also varies within the range <20-500 Bq/l near Building 5. Local contamination of seaweeds and periphyton in the area of vessel anchorage is more than a factor of ten higher (>2500-4600 Bq/kg) than in seaweeds from elsewhere in the STB area, whereas contamination of bottom sediments (600 Bq/kg at vessel anchorages) varies only by a factor of about three. Comparable levels are observed in areas at Gremikha.
4. Average annual concentration of Sr-90 and Cs-137 in the atmosphere at Andreeva Bay are ten times lower than acceptable levels activity, but are much higher than background levels in the Murmansk region, site of the nearest major population.
5. Activity concentrations of Cs-137 in the sea water in Andreeva Bay are similar to background levels. Nevertheless trace radioactive contaminations of sea water in the area of berths in Andreeva Bay are noted. Concentrations of Cs-137 in the sea water area of Gremikha STB are approximately twice those in the open sea.
6. Assessment of real public radiation exposure doses on the basis of available data is difficult, because many parameters of radiation-hygienic situation have not been researched. Namely, there are insufficient data on the levels of radionuclides in drinking water and foods (including venison, fish and wild plants).
7. There is little data on the existence of radionuclides in soils and their migration in the environment in Andreeva Bay and Gremikha.

Actions to Reduce the Threats

As indicated above, the Andreeva Bay and Gremikha village (STB) sites comprise a range of radioactive sources, including spent nuclear fuel, liquid and solid radioactive wastes, and areas of environmental contamination. Given the very high dose rates existing, it is important to prioritise and schedule actions to control these sources in order to ensure that the hazards are minimised appropriately. There would be significant advantage in removing spent nuclear fuel as the first priority as outlined below.

The current very high dose rates on-site mean that, under present conditions, any on-site operations carry a significant health risk. The very high dose rates are thought to be largely attributable to the spent nuclear fuel (SNF) and high level radioactive wastes (RAW), e.g. SNF in dry storage areas 2A, 2B and 3A at Andreeva. The present storage conditions for these materials are unstable and liable to deterioration, such that these conditions also constitute a significant and increasing accident risk. Thus, while the removal of SNF would entail a significant increase in occupational doses, and a temporary increase in the probability of an accident occurring while the SNF is removed, it is envisaged that, in the long-term, the removal of SNF would result in a significant reduction in both the on-site dose rates and the risk of serious accidents. This would allow other on-site operations to be conducted more safely and, given appropriate management, within the normal regulatory regime.

A programme of work to remove the SNF from the dry storage cells at Andreeva Bay promptly has been proposed, but would require special regulations for working in abnormal conditions on-site. An alternative programme of work, involving infrastructure improvements on-site so that work can be carried out within existing regulations for normal conditions, has also been formulated, but the infrastructure improvements would require several years' work before removal of the SNF could begin (allowing the possibility of further deterioration). The aim is to find the optimum solution whereby the SNF can be removed as soon as possible, without breaching fundamental safety norms.

It is also clear that more information is required to fully characterise the condition of other wastes and sources of contamination on-site. Once the SNF has been removed the improved dose-rate conditions should make it possible to determine the condition, risks and dose rates implied by the remaining waste streams more effectively. On the basis of this information, priorities for further clean up and waste treatment actions may then be identified. It may then be possible to carry out those activities under regulations for normal conditions.

There is no information to suggest that off-site contamination levels require urgent action. However, there is little information about radiological conditions off-site, and a number of specific data gaps have been identified, related to the levels and movement of radionuclides in the environment. Although this is of lower priority than the removal of SNF, it would be possible to gather off-site information at the same time to inform the development of regulatory criteria for long-term planning for rehabilitation and site de-licensing.

Provisional Regulatory Activities

In order to undertake any programme of work to mitigate the threat posed by SNF on the sites that can be agreed between operator and regulator, assessment of the following factors will be required:

1. The current situation: dose rates, worker and public doses under current conditions; the risk to workers and the public from accidents (before any action); and the likely development of the situation (including changes in the dose rates and accident risks) if no action were taken.
2. The risks of undertaking remediation work: detailed identification of work procedures; doses and accident risks implied by different procedures; and identification of appropriate procedures to reduce the probability and/or impact of potential accidents
3. The future situation: residual doses and risks following different remedial action strategies.

Supporting this work, regulations and procedures for workers on-site need to be developed that can be applied to abnormal situations while remaining within the existing legal norms.

In parallel, activities can be undertaken preparatory to future decision making on the decommissioning and eventual de-licensing of the sites and any necessary cleanup in the surrounding areas. The main preparatory activities would aim to:

1. obtain better information on radiological conditions off-site, and how these are changing due to conditions on-site (this information can also be an input to defining the current situation),
2. develop regulatory criteria and guidance for the cleanup of contaminated areas and de-licensing of the sites,
3. develop regulatory criteria for clearance of wastes as non-radioactive waste, and for long term management of radioactive waste, and
4. develop procedures for evaluating whether proposed activities represent the optimised approach, so that radiological impacts are kept as low as reasonably achievable (ALARA), economic and social factors being taken into account.

The conclusions drawn so far are considered preliminary. Future actions concerning radiological protection supervision will depend on the development and application of broader environmental protection objectives and the corresponding application of environmental impact assessment methods.

REFERENCE

1. L Ilyin, O Kochetkov, A Simakov, N Shandala and M Savkin. “Radiological Risks Associated with SevRAO Facilities Falling Within the Regulatory Supervision Responsibilities of FMBA: Initial Threat Assessment”. Report in printing, to be available from Norwegian Radiation protection Authority, Osteras. (2005)