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Radio-ecological characterization and radiological assessment in support of regulatory supervision of legacy sites in northwest Russia

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ABSTRACT

The Norwegian Radiation Protection Authority has been implementing a regulatory cooperation program in the Russian Federation for over 10 years, as part of the Norwegian government's Plan of Action for enhancing nuclear and radiation safety in northwest Russia. The overall long-term objective has been the enhancement of safety culture and includes a special focus on regulatory supervision of nuclear legacy sites. The initial project outputs included appropriate regulatory threat assessments, to determine the hazardous situations and activities which are most in need of enhanced regulatory supervision. In turn, this has led to the development of new and updated norms and standards, and related regulatory procedures, necessary to address the often abnormal conditions at legacy sites.

This paper presents the experience gained within the above program with regard to radio-ecological characterization of Sites of Temporary Storage for spent nuclear fuel and radioactive waste at Andreeva Bay and Gremikha in the Kola Peninsula in northwest Russia. Such characterization is necessary to support assessments of the current radiological situation and to support prospective assessments of its evolution. Both types of assessments contribute to regulatory supervision of the sites. Accordingly, they include assessments to support development of regulatory standards and guidance concerning: control of radiation exposures to workers during remediation operations; emergency preparedness and response; planned radionuclide releases to the environment; development of site restoration plans, and waste treatment and disposal. Examples of characterization work are presented which relate to terrestrial and marine environments at Andreeva Bay. The use of this data in assessments is illustrated by means of the visualization and assessment tool (DATAMAP) developed as part of the regulatory cooperation program, specifically to help control radiation exposure in operations and to support regulatory analysis of management options. For assessments of the current radiological situation, the types of data needed include information about the distribution of radionuclides in environmental media. For prognostic assessments, additional data are needed about the landscape features, on-shore and off-shore hydrology, geochemical properties of soils and sediments, and possible continuing source terms from continuing operations and on-site disposal. It is anticipated that shared international experience in legacy site characterization can be useful in the next steps. Although the output has been designed to support regulatory evaluation of these particular sites in northwest Russia, the methods and techniques are considered useful examples for application elsewhere, as well as providing relevant input to the International Atomic Energy Agency's international Working Forum for the Regulatory Supervision of Legacy Sites.

1. Introduction

The rapid development of commercial and military uses of radioactive material from the 1950's through to the 1980's led to the development of many nuclear facilities worldwide. In many countries, these facilities were built and operated before the regulatory infrastructure was in place to ensure that they were effectively decommissioned and returned to beneficial use at the end of their operating life. The legacy from this under-regulated build up was the creation of partially remediated or abandoned nuclear facilities, or areas where spills or accidents have occurred that are contaminated with long-lived radioactive and toxic residues that pose substantial and continuing environmental and health

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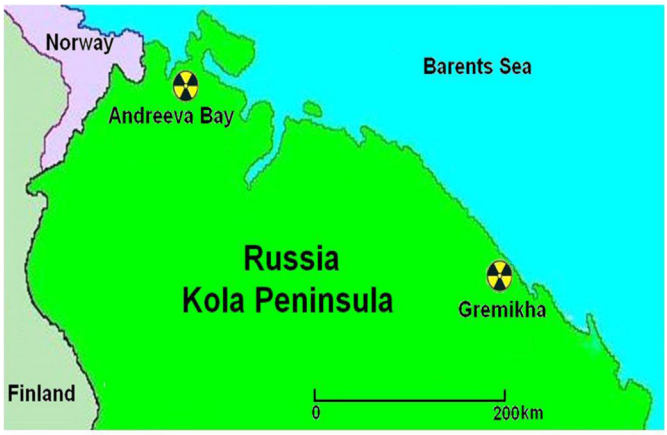

Fig. 1. Location of STS Andreeva Bay and STS Gremikha.

concerns. Many factors, including a lack of resources, lack of trained staff and lack of a national policy and/or regulatory framework for their management, have contributed to sustaining this legacy such that it largely still exists today in many countries.

Included among the significant nuclear technology legacy sites are the Sites for Temporary Storage (STS) at Andreeva Bay and Gremikha in the Kola Peninsula in the Russian Federation (RF); see Fig. 1 for locations. Previously designated as shore technical bases within the Russian military navy, they are now operated by SevRAO as part of ROSATOM. Their significance in legacy terms has arisen because of the large amounts of spent nuclear fuel (SNF) and radioactive waste (RW) which have been stored there, and, noting the passage of time since its original deposition, the degraded state of the SNF, the failure of containment barriers and the overall poor condition of facilities, see Figs. 2 and 3 for illustrations. However, the RF has already had in place for several years an important program of site rehabilitation. Progress has been described from a regulatory perspective in Shandala et al. (2008a), alongside data on the radioactive source term and other relevant information about the sites.

In a parallel development, the Norwegian Radiation Protection Authority (NRPA) has been implementing a bi-lateral regulatory cooperation program with corresponding regulatory authorities in the RF for over 10 years. This forms part of the Norwegian government's Plan of Action for enhancing nuclear and radiation safety in northwest Russia (NMFA and NRPA, 2009). The overall long-term objective of the regulatory cooperation program has been the enhancement of safety culture and it includes a special focus on the regulatory supervision of legacy sites.[1] Reflecting this history of bi-lateral cooperation and other on-going work, the role of regulators in safety culture development was recently highlighted in IAEA (2013).

The STSs at Andreeva Bay and Gremikha are important legacy sites considered within the NRPA regulatory cooperation program. NRPA's main partner in cooperation projects on the STSs is the Federal Medical-Biological Agency of Russia (FMBA), which is the lead regulatory authority in the RF responsible for supervision of the rehabilitation of the STSs. The work described in this paper was carried out largely by staff of the Federal Medical-Biological Center (FMBC) under the supervision of the FMBA.

[1] For the purposes of discussion in this paper, a legacy site is taken to be a facility or area that has not completed remediation and is radioactively contaminated at a level which is of concern to regulatory authorities. The same interpretation is used within the International Atomic Energy Agency's (IAEA) International Working Forum for Regulatory Supervision of Legacy Sites (RSLS).

Fig. 2. General view of the STS Andreeva Bay prior to major remediation activities.

The output from projects set up within the regulatory cooperation program has included initial regulatory threat assessments, to determine the hazardous situations and activities which are most in need of enhanced regulatory supervision. In turn, this has led to the development of new and updated norms and standards, and related regulatory procedures, necessary to address the often abnormal conditions at nuclear legacy sites. In relation to STS Andreeva and STS Gremikha, the initial threat assessment was reported in Ilyin et al. (2005), and the first major program of regulatory development carried out in response was reported in Shandala et al. (2008a). In addition, regulatory developments in radiological protection of workers, medical radiological aspects of emergency preparedness and response, and radiological criteria for remediation of sites were reported in Shandala et al. (2008b), Simakov et al. (2008) and Savkin et al. (2008) respectively. Sneve et al. (2008) provides an overview of those regulatory developments and further progress through 2008 and 2009 is provided in Roudak et al. (2011).

Since that work was reported, substantial further regulatory developments have taken place in relation to the STS. This paper presents in Section 2 the results of further investigations at STS Andreeva made by FMBC to characterize the site in terms of

Fig. 3. 2003 view of old SNF storage building (background) and containers with SNF (foreground).