

Assessment of Regulatory Support Program Based on the 10 Years Joint Cooperation between Norway and Russian Federation – 15635

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ABSTRACT

The Norwegian Radiation Protection Authority (NRPA) has been implementing a regulatory support 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 with special focus on nuclear legacy problems in Northwest Russia. During this time there has been cooperation in more than 24 different projects. Significant component of the Plan of Action is to provide support its sister authorities in the Russian Federation, over the years a considerable degree of confidence and mutual trust has been built up among all the relevant organizations, allowing for real progress to be made in meeting protection objectives.

The main goal of the regulatory projects is to develop regulatory requirements to ensure protection of personnel, population and environment, during remediation uranium and nuclear legacy sites. Many of the legacy issues originated from the military program. It is therefore vital that the military authority has agreed to be a part of the cooperation program, i.e. Directorate of State Supervision over Nuclear and Radiation Safety of the Ministry of Defense of the Russian Federation

INTRODUCTION

The Russian Federation has a substantial and effective regulatory basis for controlling radiation and nuclear safety and security hazards, including those associated with legacy sites and facilities. However, regulatory supervision of legacies presents important challenges linked to the complexity of legacy situations, the abnormal status of facilities at legacy sites and conditions of wastes, the evolution of the national radioactive waste management strategy, and the transfer of sites and facilities from military to civilian supervision.

The program outputs have included appropriate regulatory threat assessments, to determine the hazardous activities which are most in need of enhanced regulatory supervision; development of the norms, standards and regulatory procedures, necessary to address the often abnormal conditions at nuclear legacy sites. Subsequently they have been prepared and confirmed as official regulatory documents of the Russian Federation. Above that, the program provided the regulatory authorities with tools which are needed to carry out their responsibilities, meaning updated Federal Norms and Regulations and regulatory guidance which account for international requirements and recommendations, as well as other relevant national good practice and development of effective and efficient regulatory procedures for licensing and compliance monitoring. They also include assessments to support development of regulatory standards and guidance concerning emergency preparedness and response, planned radionuclide releases to the environment, development of site restoration plans, and waste treatment and disposal. NRPA's overall long-term objective is the enhancement of safety culture and includes a special focus on the regulatory supervision of legacy sites.

The two key regulatory authorities for civil protection in Russian Federation are the Federal Environmental, Industrial and Nuclear Supervision Service of Russia (Rostechnadzor) and the Federal Medical-Biological Agency (FMBA). Rostechnadzor focuses on nuclear and radiation safety and the

FMBA focuses on radiological protection. Both are supported by technical support organizations. Accumulated scientific potential experts from Russian agencies and NRPA, experience gained during this program in radiation safety, as well as the study materials available enable to solve many difficult tasks in radiation safety and are considered useful in the overall regulatory supervision of legacy sites, and is particularly important since the most hazardous activities concerning recovery and removal of spent fuel, some of which is in a poor condition, are still due to take place. It is our view that the sharing of assessment experience in these areas within an international context is extremely valuable.

GENERAL SCOPE OF PROJECTS COMPLETED

FMBA is an executive authority responsible for regulation of radiation safety of workers at the industrial enterprises of the Federal Atomic Energy Agency (Rosatom) and of the public living in the territories within the sphere of their impact. The important issue of the FMBA regulatory functions deal with remediation of the sites of temporary storage of the spent nuclear fuel (SNF) and radioactive wastes (RW) in Andreeva bay and Gremikha village on the Kola Peninsula.

The key objective of cooperation was to enhance the radiation protection and safety in the Northwest Russia, at the Kola Peninsula - Andreeva Bay, where the largest worldwide facility to store radioactive waste and spent nuclear fuel is located. In the foreseeable future, a large-scale removal of spent nuclear fuel from this temporary storage facility is scheduled and bringing its site to radiation safe conditions. It is well known that the regulatory problems aimed at radiation safety and protection cannot be solved without detailed radiation survey and researches, the measurement and evaluation of doses to workers and the public and the most important – without development of practical activities and guidance documents.

Cooperation with SRC-FMBC

Threat Assessment

One of first projects, in order to develop opinion on the most important issues requiring supervision and enhanced regulation within cooperation, was The Threat Assessment Report [1]. The initial threats of radiological risks in the scope of the regulatory responsibility of FMBA of Russia were assessed. As the outcome of the project the following threats have been identified:

- Poor condition of infrastructure for SNF and RW storage, complicating their subsequent decommissioning;
- Insufficient available methodological framework for radiation safety regulation under irregular conditions of SNF and RW management during remediation;
- Lack of sufficient information on the radiation-hygienic conditions around the facility and, hence, the uncertainty in the assessment of dose to the public;
- Insufficient organization of interaction between operator-regulator and ambulance agencies in case of emergencies during remedial operations.

This project has been performed in close contact with the radiation safety service of The Northern Federal Enterprise for Radioactive Waste Management (SevRAO) facility in the course of actions aimed at normalization of the radiation situation on-site and industrial buildings before the beginning of the second stage of the STS remediation including SNF and RW management.

On this basis, the special Russian-Norwegian work program has been developed in the field of regulatory supervision in the Northwest Russia. Under this program, over the period 2005-2013, scientific and applied studies have been carried out at the SevRAO premises in the following areas:

- Radiation safety at the facility and work conditions of the personnel;
- Radiation protection of the public;
- Environmental monitoring;

- Medical response in extreme and emergency situations.

Since 2005, a large volume of remedial work has been completed. This work had significant impact on the nature of radiological risks; therefore, re-evaluation of threats previously considered became necessary in addition to prioritization of the remaining important issues, which require the supervision and regulation development at the current stage of the site remediation. Analysis of changes over the period 2005-2013 has been performed. Additionally one more area of work was newly included- safety culture, because takes into account the impact of anthropogenic factor that plays a significant role when carrying out the planned (scheduled) SNF and RW management.

Radiation Protection of Workers

Considering the importance of training / maintenance of the required level of occupationally important psycho-physiological merits (memory, attention, perception, anticipation, the spectrum of cognitive functions and others) from the position of the regulator and the operator it should be emphasized that this is the task of the operator (the company), but serves as a future basis for launching necessary actions of the regulator (FMBA of Russia and other supervision bodies) to minimize the harm associated with deficiencies of the operator to ensure the reliability of the human factor. And the worldwide practice shows that such deficiencies are the basis for the vast majority of radiological incidents. Therefore, the development of regulatory documents should follow the assessment of the extent of the compliance of occupational important psycho-physiological merits of the worker with the requirements of the activity (it is impossible to regulate the uncontrolled characteristics) and, if necessary, training/maintenance of psycho-physiological characteristics and stress resistance of the worker. This is especially important in case of complicated radiation situation.

Analysis of national and international regulatory documents on radiation safety and protection of workers and the public during remedial operations at contaminated areas, found its reflection in the guidance “Radiation Protection of workers and the public during remediation of nuclear legacy sites” developed under one of the joint project, which includes the requirements for the main aspects of the personnel and public protection during remediation of radioactively contaminated areas, it covers:

- radioactively contaminated sites of industrial facilities in the course of their decommissioning;
- areas contaminated due to radiological accidents;
- areas contaminated due to nuclear weapon tests.

The guidance is intended for institutions of FMBA engaged in the federal state health epidemiological supervision, and institutions, engaged in planning and execution of works on remediation of radioactively contaminated areas.

Under DOSEMAP project (2009-2010) “Arrangement of the database on radiation situation and the database on individual occupational doses at SevRAO facility” the hardware methodical complex for dose prediction to workers has been developed and introduced in practice of Regional Management-120 under FMBA of Russia and SevRAO. Project outcomes allow to visualize results of long-term observation of the radiation situation parameters, predict individual doses to workers when planning SNF and RW management using ALARA principle, carry out, as appropriate, retrospective restoration of individual doses to workers, promptly make a selection of workers to carry out specific radiation hazardous operations and operations to mitigate consequences of potential accidents taking into account accumulated and predicted doses. DOSEMAP-2 was continuation of DOSEMAP project with primary objective to develop tool to regulate the personnel radiation protection optimization during the second stage of remediation of the SevRAO Facility in Andreev Bay and Facility in Gremikha taking into account the special features of its accomplishment under real SevRAO conditions and relevant international recommendations and guidance. During DOSEMAP-3, the software complex was being

tested in Regional Management 120 and at the Andreeva Bay SevRAO facility; as a consequence - the user's Manual of the software complex was being finalized, certification of the software for analysis of the radiation situation was being conducted.

Radiation Protection of the Public and Environment

Over the period 2005 – 2007, have been developed:

- Assessment of the radio-ecological situation;
- Criteria and regulations for the sites of temporary storage (STS) remediation for three potential options of the environmental remediation (conservation, conversion and liquidation), and the guidance for application of these criteria and regulations;
- Guidelines for radiation control and monitoring at different stages of the STS operation;
- Additional radio-ecological criteria for contaminated marine environment and database on radionuclide concentrations in the marine environmental media.

All mentioned work has been completed within the Russian legislation and taking into account the available international experience.

Until 2008, big amount of data has been accumulated on the radio-ecological situation, doses to the public, radionuclide migration etc. In order to track changing situation, predict supervise and regulate its further development under conditions of the on-going remediation of the STS, in 2008-2009 within the DATAMAP project, a computer map of radio-ecological data has been created. Further, this map has been transformed into a geo-information system. Developed system is required to store and retrospectively use all factual data on control and monitoring, and also for automated information support of regulation and in the radiation safety specific decision making systems during remediation of "radiation legacy" sites of the former USSR.

Between 2009 and 2012, the detailed gamma survey of the STS and supervised area (SA) sites has been carried out (more than 2000 measurements) and soil samples have been collected in reference points of radiation monitoring. Today, tool is used to support decisions in radiation protection of the environment during remediation of the STS site to:

- analyze available data on the radiation situation and carry out statistical analysis including the contouring of parameter isolines by interpolating a limited set of measured values;
- visualize data of the aquifer contamination in the three-dimensional geometry;
- plot changes in the mean annual activity concentrations of radionuclides and dynamics of activity concentrations of radionuclides over a specified period of time with reference to the topographic base and to compare these values with established criteria;
- predict the contamination of: soil by the depths, ground water, vegetation, mushrooms and wild berries.

The main task of project ENVIRONMENT was to assess the impact of manmade radioactive contamination on the environment at the STS site and surrounding area and to justify the sufficiency of the previous criteria for the site remediation for the purpose of the environmental radiation safety. Within the project an algorithm for dose calculation has been selected; analysis of the sufficiency of available information for dose calculation to reference animals and plants has been carried out. The dynamics of radiation exposure to the environment at the STS site has been assessed. As a supplement to the Dosemap-3 system, have been developed a software including an algorithm for dose calculation for representative animals and plants. Prediction of radiation exposure to the reference organisms under compliance with criteria for the STS area remediation has been made. Also, the sufficiency of the previous remediation criteria for the environmental protection has been assessed.

Radioactive Waste Management at Andreeva Bay and Saida Bay

The laboratory of radiation protection of workers, within FMBA-NRPA collaborative projects was involved in addressing the problems of optimization of the regulatory base of the federal state health care supervision of safe radioactive waste management during remediation of the former shore technical bases of the Northern Fleet. As an outcome have been prepared two documents.

Guidance “Hygienic requirements for management of industrial waste at the Federal State Unitary Enterprise “Northern Federal Facility for Radioactive Waste Management” Guidance includes the main criteria of the ascription of industrial waste, containing manmade radionuclides, to the very low level waste (VLLW) category and to the category of industrial waste released from the regulatory control. Within this document, the requirements for the special features of the industrial site at Andreeva Bay SevRAO site have been developed on the basis of analyzed algorithms for management of such kind of waste. The criteria of toxic safety and the procedure of their application have been established for conditions of toxic industrial waste management at the industrial site of the Andreeva Bay SevRAO facility. Scenarios and conditions for release the VLLW landfill from the regulatory control have been developed.

Guidance “Requirements for radiation protection of workers, the public and environment during arrangement of radioactive waste management in the Center of Conditioning and Long-Term Storage of the Federal State Unitary Enterprise “Northern Federal Facility for Radioactive Waste Management” - Guidance specifies the procedure of the RW management during the RW long-term storage taking into account special features of the waste management in the Northwest Russia resulted from operations being carried out within the programs aimed at mitigation of nuclear legacy; regulates the safety requirements at different stages of RW preparation for long-term storage including collection and sorting in accordance with the accepted classification, packaging, transportation, treatment, conditioning and storage. The criteria and requirements for regulation of safe RW management have been developed on the basis of the current health legislation and normative-and-methodical base of the regulatory supervision in Russia, as well as taking into account technological specificities defined by the design of the Center for conditioning and long-term storage of radioactive waste at Saida Bay.

Emergency Preparedness and Response

Over 2005-2009, under the projects “Improvement of medical and radiological aspects of emergency preparedness and response at the SevRAO facilities” and “Development of the operational radiological and medical criteria to initiate an emergency plan and apply early protective actions at the SevRAO facilities”, the emergency training has been performed at the Andreeva Bay STS. Next under the project “Preparation and conducting the emergency training on the radiological protection of the personnel of the Ostrovnoy Branch of SevRAO and the population of Gremikha village”, a large-scale training has been arranged and conducted with participation of more than 100 persons from 17 organizations of various ministries and agencies.

The results of this training showed that the necessary procedures of radiation-hygienic and medical activities for workers and the public at the early stage of a radiological accident can be provided by the MSU-120 (Medical Sanitary Units), RM-120 (Regional Management) and CH&E-120 (Centre of Hygiene and Epidemiology) of FMBA in cooperation with "SevRAO", management of closed territorial formation (CTF) "Ostrovnoy" and the naval hospital of CTF "Ostrovnoy". Moreover, severe climatic conditions of the Arctic, the remoteness, the difficulty of delivery and deployment require training cooperation with medical institutions of the Murmansk region. As result of interview with the Gremikha

villagers, has been recognized need for that type of activities and promote public confidence in the competence of the administration and specialists, their ability to carry out the necessary protective and health measures aimed at ensuring the health of the population in the event of a radiological accident. In addition, during the practical activities devoted to response in case of emergency when transporting radioactive material the emergency response arrangement, regulatory response procedures, remote operation of expert groups, making consolidated assessments of consequences of emergencies were being worked out.

STARTEGY project showed that the current state of technology and practice of RW and SNF management at NWC "SevRAO" makes threat of radiological emergencies for the public and the environment minimal and highly unlikely. Set of analyzed data, including material of emergency drills and training held, show that the potential threats of radiation exposure to workers of the facilities, the environment and the population of the Northwest region of Russia are systematically reduced. Emergency planning and response within the FMBA system is systematically improved, due to substantially contribution of the work and research carried out in the framework of the collaborative Russian-Norwegian projects.

Risk Assessment of the Performance Reliability Violation of Workers Involved in Spent Nuclear fuel and Radioactive Waste Management

Studies completed within projects PRM, PRM2 and PRM3 may be considered as the most important stages of generation of organizational-and-technical system to assure occupational reliability of workers involved in the SNF management. Within PRM and PRM2 has been achieved:

- The prototype pattern of the expert and diagnostic informational system for monitoring risks of the performance reliability violation ("EDIS_STS") to be used during pre-shift and annual medical and psychological (psycho-physiological) examination of the SevRAO workers. Proposals on the safety culture assessment at SevRAO facilities.
- Procedure to receive the safety culture indicators, integral assessment of its level.
- Method and software to assess the safety culture at NWC SevRAO facilities and description of regulatory actions in case of its reduced level.

Analysis of available regulatory documents on the safety culture at radiation and nuclear hazardous facilities under PRM2 project, showed that by today general scientific and methodological basis has been developed to facilitate introduce the conceptual provisions of the safety culture into the practice of its application in order to identify positive and negative features of organization in terms of nuclear and radiation safety of different nuclear facilities and sites.

The PRM3 project is independent area in the set of projects being carried out by SRC-FMBC within cooperation with NRPA. Common objective of these projects is to assure safety of the SNF management operations and to increase the effectiveness of the activities of health authorities and services in case of complicated radiation circumstances. To assure safety, the DOSEMAP and DRIVE project deal with 3D simulation of radiation situation in workshops, where operations are being carried out both under relatively stable radiation background, and under the radiation situation changing during the required operations, while within the PRM3 project such kind of safety is assured on the basis of the human factor through training/maintenance of the required level of occupationally important psycho-physiological characteristics.

Development of Methodological Support of Integrated Regulation of Assessment of Radiation Safety Related to the Decommissioning at the Enterprises of Nuclear Shipbuilding and Ship Repair.

The objective of the "SATO" project was to develop activities to assure radiation safety at the facilities involved in decommissioning and disposal of Ships of Atomic Technological Service (SATS) taking into

account the special features of the facilities and on the basis of the relevant international rules and regulations.

Collaborative Projects of Southern Urals Biophysics Institute (SUBI) and Urals Research Centre for Radiation Medicine (URCRM).

Over 2012-2014, within the NRPA – FMBA cooperation, in the course of studies, radio-ecological simulation of potential purification of lakes within the Techa water cascade has been carried out. The after-death radiometry of long-lived radionuclides in bodies of residents of the Ozersk city and adjacent settlements, located in the supervision area of PA “Mayak”, has helped to clarify effective dose to the public due to the long-term exposure to long-lived radionuclides. The dynamic assessment of plutonium and americium inhalation intake was based on the concentration measurement of these isotopes in atmospheric air. Moreover, intake of cesium-137 and strontium-90 to the residents’ bodies has been assessed on the basis of consumption of the wild bird meat. Reference representatives of ichthyofauna of radioactively contaminated water reservoirs have been identified and effects for fishes being caught in the most contaminated areas of sampling have been established.

In conclusion, the event of the RW accumulation and environmental contamination in some cases is so complicated and unique, that indicates special regulation has to be implemented.

CONCLUSIONS

During last 10 years twenty four regulatory projects with support of NRPA, were conducted by State Research Center- Burnasyan Federal Medical Biophysical Center (SRC - FMBC), as technical support organization under FMBA of Russia. This support included technical issues of regulatory supervision and involving expertise from Norwegian and other national experts and experts from international organizations (IAEA). Projects were intended to support development of regulatory documents to assure radiation protection during spent nuclear fuel and radioactive waste management, in the course of the projects implementation relating to remediation of STSs at Andreeva Bay and Gremikha village (NWC SevRAO – branch of RosRAO facilities).

Documents produced under the program create a system covering big part related to regulation of radiation and environmental protection of the personnel, public and environment at SevRAO facilities. Basis for selection of technologies and assessment of radiological, economic and social factor has been developed. Most of work completed is innovative in this field even for involved organizations.

Additionally projects related to Mayak, managed by SUBI and URCRM, gave significant input and provide scientific basis in establishing standards for regulation of legacy sites in general.

Joint regulatory program between Norway and Russian Federation contributed to international focus on regulatory supervision of legacy sites. Result was creation of International Working Forum for the Regulatory Supervision, where experience in role of regulators in planning legacy management and regulatory supervision of legacy sites can be reviewed.

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