

Radioactive Waste Management in Central Asia-12034

Tamara Zhunussova*, Malgorzata Sneve*, Astrid Liland*
Norwegian Radiation Protection Authority*

ABSTRACT

After the collapse of the Soviet Union the newly independent states in Central Asia (CA) whose regulatory bodies were set up recently are facing problems with the proper management of radioactive waste and so called “nuclear legacy” inherited from the past activities.

During the former Soviet Union (SU) period, various aspects of nuclear energy use took place in CA republics of Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. Activities range from peaceful use of energy to nuclear testing for example at the former Semipalatinsk Nuclear Test Site (SNTS) in Kazakhstan, and uranium mining and milling industries in all four countries. Large amounts of radioactive waste (RW) have been accumulated in Central Asia and are waiting for its safe disposal.

In 2008 the Norwegian Radiation Protection Authority (NRPA), with the support of the Norwegian Ministry of Foreign Affairs, has developed bilateral projects that aim to assist the regulatory bodies in Kazakhstan, Kyrgyzstan Tajikistan, and Uzbekistan (from 2010) to identify and draft relevant regulatory requirements to ensure the protection of the personnel, population and environment during the planning and execution of remedial actions for past practices and radioactive waste management in the CA countries. The participating regulatory authorities included: Kazakhstan Atomic Energy Agency, Kyrgyzstan State Agency on Environmental Protection and Forestry, Nuclear Safety Agency of Tajikistan, and State Inspectorate on Safety in Industry and Mining of Uzbekistan.

The scope of the projects is to ensure that activities related to radioactive waste management in both planned and existing exposure situations in CA will be carried out in accordance with the international guidance and recommendations, taking into account the relevant regulatory practice from other countries in this area.

In order to understand the problems in the field of radioactive waste management we have analysed the existing regulations through the so called “Threat assessment” in each CA country which revealed additional problems in the existing regulatory documents beyond those described at the start of our ongoing bilateral projects in Kazakhstan, Kirgizstan Tajikistan and Uzbekistan.

INTRODUCTION

Central Asia is bordering the Russian Federation to the north, China to the east, the Caspian Sea to the west covering the territory of about 3.5 million km², with a population of more than 55 million people.

During the Soviet period, the uranium mining operations in CA served as one of the main uranium producers for the SU military complex. The regulatory standards for exposure and emissions control to all Soviet Republics were administered by the

Ministry of Medium Machine Building and were the same across the USSR (United States of Socialistic Republics). After the collapse of the SU in 1991, the former Soviet Republics became independent and inherited the legacy in the form of wastes coming mainly from uranium ore processing and tailings. This management was based on the old Soviet regulatory documents that are mostly inconsistent with the international standards and guidance and need substantial improvements.

Many radioactive waste storage facilities in CA, especially in the Kyrgyz Republic and Tajikistan, are located in regions of seismic activity, in landslide- and mudflow-prone areas and areas subject to flooding and high ground water levels, and near the banks of the rivers that form the base of the large water basin of the CA region. Many tailings are situated near towns, other populated areas and state borders, and there is a concern for possible long-term hazard to health and the environment [1]. The legacy problems left behind by uranium mining and milling in CA countries are not very different one from another except for Kazakhstan where in addition nuclear weapon testing took place during 1949-1990 and left large territories with contaminated soil and underground water. Kazakhstan also had the fast neutron reactor BN-350 in the past and its decommissioning poses a special case for radioactive waste management. The challenge concerning radiation safety in connection with the accumulation of natural radionuclides in the environment due to the mining of hydrocarbon raw material is also very important for Kazakhstan. Huge territories are contaminated and continue to be contaminated in the process of oil field activity. According to the radio-ecological studies, the regions of oil and gas fields in Western Kazakhstan are in a critical ecological situation due to technogenic radiation. For instance, in 1992–1997, the radio ecological studies at the sites of oil production in Mangistau's and Atyrau's oblasts revealed 50 oil fields of 3,370 km² with 275 sites of radioactive contamination. It has been determined that in the process of oil production, the contamination of the environment with the natural radionuclides uranium, radium and thorium, in concentrations exceeding the background radiation tens or hundreds of times, is associated with the strata waters extracted from the depths together with oil [1].

METHOD

Analyses were performed of the existing regulatory documents in Kazakhstan, Kirgizstan Tajikistan and Uzbekistan and comparison with IAEA recommendations and safety standards in the field of radioactive waste management taking into account NRPA's experience in the development of the regulatory documents in the Russian Federation.

RESULTS AND DISCUSSION

Based on the analysis of the existing situations in the field of RW management in CA the most important constraints to the development and implementation of efficient regulatory control, monitoring systems, and the planning and implementation of remediation plans, can be summarized as follows: inadequate regulatory and legislative framework for the safe management of radioactive waste; limited availability of national funding; inadequate legislative and regulatory framework for the operation, closure and environmental remediation of mines; inadequate knowledge of the inventory of the

legacy components and the risks associated with them; cross-border regional problems related to the former uranium facilities in CA countries. In regard to the legal and regulatory framework, it should be noted that there are no proper national policy and strategy for radioactive waste management in CA countries which have been developed and approved by their Governments. Existing regulatory documents do not address the issues regarding safety assessments and safety cases or the implementation of long-term institutional control and monitoring of the abandoned dumps with RW or its future disposal sites, neither during operation nor after their closure. There is also a need to develop safety criteria (reference levels) and determine measures to be taken for existing exposure situations (past practices). In addition, there is a lack of safety requirements for different types of disposal facilities in accordance with the different categories of radioactive waste. Safety criteria and clearance levels are also not established. There is no proper criteria for clearance or release of the territory from regulatory control, and no sufficient reliable data for assessment of the “realistic” risks presented by the legacy sites; very varied public and social attitudes toward the legacy sites; shortage of state-of-the-art equipment and machines. The problem on regulations of the remediation of contaminated territories is connected with the fact that no accurate quantitative criteria defining reference levels to begin the rehabilitation of a territory have been established. So, for example, in cases when the individual annual dose that can be received on a territory is less than 10mSv, there is no basis for intervention, while if an individual annual dose is more than 100 mSv, intervention is always justified. The IAEA recommends in the WS-R-3, paragraph 3.2, an existing annual effective dose limit of 10 mSv from all sources, including natural background radiation [2]. This will normally be assessed as the mean dose for an appropriately defined critical group. Remedial measures would often be justified below the generic reference level, and national authorities may define a lower reference level for identifying areas that might need remediation. The interim edition of the International Basic Safety Standards, paragraphs 5.7–5.9, establishes that the government and the regulatory body or other relevant authority shall ensure that the strategy established for the control of existing exposure situations is commensurate with the risks associated with the existing exposure situation and that remedial or protective actions yield sufficient benefit to outweigh the detriments associated with taking them, including detriments in the form of radiation risks. The implementation of remediation does not imply the elimination of all radioactivity or all traces of radioactive material. The optimization process may lead to an extensive remediation but not necessarily to the restoration of pre-existing conditions. The regulatory body or other relevant authority and other parties responsible for remedial or protective actions shall ensure that the form, scale and duration of such actions are optimized. While this optimization process is aimed at providing optimized protection of all exposed individuals, priority shall be given to those groups of individuals whose residual dose exceeds the reference level and all reasonable steps shall be taken to avoid doses remaining above the reference levels. Reference levels shall typically be expressed as an annual effective dose to the representative person in the range 1–20 mSv or other equivalent quantity, the actual value depending on the feasibility of controlling the situation and past experience in managing similar situations. The regulatory body or other relevant authority shall periodically review the reference levels to ensure that they remain appropriate in the light of prevailing circumstances [3].

According to the existing regulations in CA it is not quite clear how to convert the radioactive wastes that have already accumulated, that are currently being generated, and those that will be produced in the future they have various chemical and physical states as well as radionuclide composition in a condition suitable for their disposal. On the basis of which criteria should RW disposal sites be excluded from the institutional control? What is the scope of the long-term institutional control and monitoring for the future disposal sites, both during their operation and after their closure? These questions could only be answered by performing a safety assessment, but the requirements for performing such an assessment and its use for affecting remedial and post closure solutions is still not present in the regulatory framework in CA countries. Except for in some obvious cases, such as Mailuu Suu and similar sites, sufficiently reliable data for assessment of the “realistic” risks presented by the legacy sites presently does not exist. A reliable database is paramount for the justification and prioritization of the remediation, especially in the case of some less obvious sites. The preparation of effective and efficient remedial plans requires additional data to that which is available for most of the legacy sites today. In addition to the tools needed for data collection, evaluation and interpretation, which will be dealt with in the section on monitoring, there is a lack of state-of-the-art machinery used in mining and remediation. There is little suitable computer software, no GIS or plotters available for preparing remediation plans, no laser scanning surveying instruments to support remediation work, and no proper drilling rigs and sampling devices for investigation of the sites. A particular problem is going to be the lack of machines (e.g. bulldozers and scrapers) capable of working on steep slopes, e.g. for construction of covers. No large size (100+ ton) haulage trucks are available for relocating waste rock or tailings. The available machinery is old and small in size (often dating back to the 1980s), which does not allow for efficient implementation according to international standards. Unless large-scale investments in machinery can be made, the remediation plans must consider the slower working pace and the international funding agencies must be made aware, and take account, of this.

Beyond facilitating the use of internationally relevant and acceptable considerations, the sharing of experience, knowledge, information and good practice between countries will help the newly independent CA countries deal with the legacy left from uranium mining and milling. The overall aim of a further stage of co-operation is also to facilitate co-operation among the participating project partners and help them in developing sound environmental and social legislation and regulations, thus clearing the way for the sustainable development of the uranium mining regions in the future.

The cross-border issues of monitoring and remediation of the former uranium facilities in the region are rather sensitive because the most of the former uranium facilities are located near the borders of the adjacent states. The water pathways are the main factor of the cross-border aspects of the problem. The Syr-Daria River is the main artery of potential contaminant transfer, as the watershed spreads from Kyrgyzstan and flows through the Fergana Valley, where a significant number of uranium residue and tailings piles are situated. Consequently, the integrated monitoring of water contamination with radionuclides and chemical elements is an issue of international significance due to the possible impact of the former uranium facilities. However there is a lack of the experienced personnel for remedial works in CA, also with the government administration that provides the funding, the regulators checking and approving the

permit requests, and the operators implementing the remedial works. The personnel responsible for raising international funds and co-operating with the funding agencies, steering the national remediation program, organizing the projects and controlling the implementation, would need training on the job, supported by experienced international experts.

To date the regulatory authorities in the CA countries and the NRPA have jointly developed or are developing of the following regulatory documents: "Proposal for new radioactive waste (RW) classification in Kazakhstan", "Proposal to establish the new major criteria for RW disposal in Kazakhstan", "Draft Regulatory Document -Rules for Radioactive Waste Disposal in the Republic of Kazakhstan", "New regulatory guidance document on the topic of radiation and environmental protection when handling RW in Kirgizstan", "New regulatory guidance document on management of radioactive sources in Kirgizstan", "Establishment of the technical requirements for a systematic radiation monitoring scheme around the RW tailings dumps in Kirgizstan", "Development of regulatory criteria in the field of radiation safety of personnel, population and environment for RW management in relation to the uranium industry, in accordance with international recommendations in Kirgizstan", "Law on Radioactive Management in Tajikistan", "Rules on RW management in Tajikistan", Proposal of a New Regulatory Guidance on Radioactive waste classification in Uzbekistan, A "New Regulatory Document -Requirements for RW storage and disposal in Uzbekistan", "A New Regulatory Document -Requirements for monitoring of the RW storage facilities in Uzbekistan"

CHALLENGES

From the perspective of the current knowledge of the state of affairs, it appears necessary to first obtain a consistent and reliable assessment of the legacy sites and components, which should include:

- The characterization of the inventory of both radioactive and non-radioactive contaminants.
- The effluent and influent streams from the disposal sites and the emissions to the air.
- Information on the geotechnical stability of the sites, erosion, stability of the current containment barriers, if any, and the design details of the containment barriers.
- A safety assessment and an environmental impact assessment.
- To develop the understanding of a site, an appropriate monitoring and surveillance plan must be set up, including specifications of where to sample, how to sample, and how many samples must be taken, etc. The use of the recently acquired instruments and equipment should be incorporated into these plans.
- The decisions regarding in-situ stabilization or relocation of residues such as

tailings should be based on the results obtained on the basis of the new data.

As for filling all of the gaps in the regulatory and legislative framework in the Central Asian countries, the following safety requirements or actions need to be developed and implemented:

- To elaborate the draft national policy and strategy for radioactive waste management to be approved and implemented by the Government.
- Review, update and elaborate the needed legal and regulatory framework for the safe management of existing exposure situations and radioactive waste. This includes the regulatory basis for the licensing of future disposal facilities, including the elaboration of safety assessments, safety cases and environmental impact assessments.
- Review, update and elaborate the needed legal and regulatory framework (including authorization, inspection and enforcement) for the safe management of radioactive waste and radioactive waste management facilities, including those linked with the production of NORM waste.
- Clearly define how the responsible organizations will realize the national policy for radioactive waste management with use of the available technical measures and financial resources.
- To define how and when the identified objectives and tasks will be achieved.
- To define what level of competence is necessary in order to achieve these tasks, and how it will be provided.
- To develop the management pathways for each type of radioactive waste, through all stages of the RW life cycle (from the moment of generation to disposal), as part of the national strategy for radioactive waste;
- To strengthen trust of the public concerning radioactive waste management and remedial action.
- The establishment of mechanisms for providing resources and funding for the safe decommissioning, remedial actions and long-term RW management.
- The availability of sufficient and qualified human resources to perform the rehabilitation activities and safe management of radioactive wastes, including resources for training and R&D, where needed.
- Implementation of monitoring of the radioactive waste storage facilities and disposal sites both during their operation and after their closure (including institutional control where needed).
- To perform the safety assessment and radiological impact assessment for the contaminated territories and to take the needed measures to diminish the risks in accordance with the results of this assessment.
- To carry out long-term monitoring and control over the abandoned objects of the uranium industry, and to take the necessary security measures to prevent unauthorized access on the contaminated territories.
- To carry out long-term monitoring and control over nuclear test sites and to take security measures where it is necessary to prevent unauthorized access on the contaminated territories.

- To carry out long-term monitoring and regulatory control over the sites of gas and oil production that have contaminated soils and storage places for the contaminated pipes and the equipment, and also to take the security measures where necessary to prevent unauthorized access on the contaminated areas.
- To implement an effective authorization and inspection process for new mining and milling industries, as well as for other industries (e.g. gas and oil) that produce radioactive materials with NORM, in order to avoid creating exposure situations similar to those existing today.
- To develop safety requirements for the design and implementation of radiation monitoring of the territories contaminated with natural and artificial radionuclides.
- Development and implementation of projects concerning final disposal or secondary processing radioactive materials.
- Development and implementation of the needed projects concerning restoration.
- To establish the quantitative criteria defining the “reference levels” and to consider that the rehabilitation of the sites will be strongly dependent on the established safety criteria (reference levels) and the existing exposure situation.
- To develop criteria and hygienic specifications on the rehabilitation of territories contaminated by radionuclides. This could provide socially comprehensible guarantees of radiation safety for the population being on the territories with radioactive contamination.
- To develop regulatory documents for maintaining the radiation safety of the personnel and the population during the subsequent use of the territory, buildings and constructions after rehabilitation. Guidance should be developed for the derived levels of residual contamination of territory with radioactive substances for several most probable options of their use after rehabilitation, for example, territories of unlimited use; territories of limited use for the industrial needs with using radioactive materials; territories of limited use for industrial needs without using radioactive materials.
- To develop derived reference levels for the radiation parameters that can be directly measured when implementing radiation control.
- To develop classification of radioactive waste in accordance with the recently approved IAEA international recommendations in this regards.
- To develop and approve safety requirements (regulations) for the design, siting, construction, operation, closure and establishment of institutional control needed for disposal facilities in accordance with the approved national policy and strategy on radioactive waste management.
- To authorize projects concerning secondary processing of the uranium tailings impoundments with the purpose to extract uranium.

In case of secondary processing of the uranium tailings impoundments and extraction of uranium or other minerals from mine waters, it is necessary to implement and enforce an authorization process that will require the potential investors to be responsible for the implementation of the projects concerning restoration at every tailings impoundment involved. This process should include:

- Performance of a safety assessment and Radiological Impact Assessment;
- Rehabilitation and secondary processing of the uranium tailings impoundments.
- Final disposal and rehabilitation of the off-balance ores and extraction of uranium from mine waters.
- Final disposal and rehabilitation or secondary processing of the uranium tailings impoundments.
- Final disposal and rehabilitation or dislocation of secondary processing of the uranium tailings impoundments.
- Organization of permanent radiation monitoring at existing tailings impoundments.

The present project will try to prioritize these regulatory documents, which should be developed to eliminate existing gaps in the regulatory basis, based on an assessment of what possible future influence the absence of these documents might have on the population.

It is also clear that in order to remove the threats associated with the presence of radioactive wastes, both that which has already been accumulated as a result of previous activity and that which is currently being generated in significant amounts and which could be produced in the future, it is necessary to develop at least the following documents:

- A national policy and strategy for radioactive waste management;
- A new classification of radioactive waste, including identification of the corresponding categories;
- Safety requirements on the design, siting, construction, operation, closure and establishment of institutional control needed for disposal facilities in accordance with the approved national policy and strategy on radioactive waste management;
- Safety requirements for the management of radioactive waste.

It is clear that in order to remove the threats associated with the presence of extensive territories contaminated by radionuclides, their rehabilitation is required and, accordingly, it is necessary to develop a legal and regulatory framework defining:

- Responsibilities of the Government, the licensees (operators) and other interested parties in existing exposure situations;
- Justification and optimization of protective actions in existing exposure situations, including safety-related criteria such as “reference levels” and derived quantities to be directly measured;
- Institutions or organizations to be responsible for the remedial actions in areas with residual radioactive materials;
- Criteria and hygienic specifications on the rehabilitation of contaminated territories with radioactive materials; and
- Regulatory framework preventing the occurrence of similar situations in the future.

Taking into account further:

The level of the threats associated with the presence of extensive territories that have already been contaminated with radionuclides could be considerably reduced and remain at acceptable level within a reasonable period of time if the following actions would be taken:

- Establishing a strong and effective legal and regulatory framework, including the proper enforcement actions to guarantee the safe management of remedial actions and radioactive waste management and at the same time providing the assurance that similar situations will not repeated.
- Carrying out the safety assessment and radiological impact assessment for the contaminated territories and, in accordance with the results of these assessments, to take the needed measures to diminish the risks.
- Carrying out institutional control, including the long-term monitoring and control over the abandoned objects of the uranium industry where it is necessary to prevent unjustified exposure of the public.
- Carrying out institutional control, including the long-term monitoring and control over nuclear test sites (in Kazakhstan) where it is necessary to prevent unjustified exposure of the public.
- Carrying out monitoring and regulatory control over the places of gas and oil production that have contaminated soils and storage places for the contaminated pipes and the equipment, and also taking the proper security measures where it is necessary to prevent unauthorized access to the contaminated areas.

The elaboration and implementation of a national policy and strategy for radioactive waste management is of high priority considering:

- The level of the threats connected with the presence of radioactive wastes increases continuously, due to their increased volume in view of the incessant operation of uranium mining, oil and gas production and other industries
- The increased amount of radioactive waste that will be produced in the future if existing plans to build new nuclear power plants (e.g. in Kazakhstan) are realized, and keeping in mind the operation of nuclear installations that already exist
- There are no defined end points for the management of the radioactive wastes that already exist, nor those which could be produced in the future

The factor strengthening this conclusion is that the CA states have signed and recently ratified the “Joint Convention on the Safe Management of Spent Nuclear Fuel and the Safe Management of Radioactive Waste” [4]. This means that the radioactive waste management in the republics without a developed national policy and strategy can be considered by the international community as non-fulfillment of the international obligations that the republics have adopted.

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