Statens strålevern
Norwegian Radiation Protection Authority

StrålevernRapport 2016:7

Regulatory support in radiation safety and radioactive waste management in Central Asia

Results of project completed in 2013–2015

Reference:
Siegien-Iwaniuk K, Sneve K M, Zhunussova T, Tazhibayeva I, Kim A, Romanenko O, Tolongutov B, Solomatina A, Mirsaidov I, Kuldjanov B, Radjuk R I, Schandala N K, Titov A V. Regulatory support in radiation safety and radioactive waste management in Central Asia. Results of project completed in 2015.
StrålevernRapport 2016:7. Østerås: Statens strålevern, 2016.

Key words:
Regulation of legacy In Central Asia, remediation, nuclear legacy, uranium legacy, radioactive waste, uranium mining and the milling, contaminated land, public protection, protection of environment, regulatory compliance

Abstract:
This report describes work carried out between 2013 and 2015 within NRPA cooperation and support to Central Asian authorities in enhancement of regulatory base in the area of radiation safety of nuclear and uranium legacy sites.

Referanse:
Siegien-Iwaniuk K, Sneve K M, Zhunussova T, Tazhibayeva I, Kim A, Romanenko O, Tolongutov B, Solomatina A, Mirsaidov I, Kuldjanov B, Radjuk R I, Schandala N K, Titov A V. Regulatory support in radiation safety and radioactive waste management in Central Asia. Results of project completed in 2015.
StrålevernRapport 2016:7. Østerås: Norwegian Radiation Protection Authority, 2016.
Language: Norwgian.

Emneord:
Regulering av historisk avfall i sentral Asia, opprydding, historisk avfall fra atom og uran produksjon, radioaktivt avfall, uran gruvedrift og utvinningsavfall, miljøforurensning, strålevern og beskyttelse av miljøet, anvendelse av regulering.

Resymé:
Rapporten beskriver arbeid som ble utført fra 2013 til 2015 innenfor Stråleverns samarbeidsprosjekter med myndighetene i Sentral Asia med fokus på støtte regelverksutvikling på område strålingssikkerhet og historisk radioaktivt og uran avfallshåndtering.

Head of project: Malgorzata K. Sneve
Approved:

Per Strand, director, Department of Department for Emergency Preparedness and Environmental Radioactivity.

68 pages.
Published 2016-06-22
Cover design: 07 Media.
Printed by 07 Media.
Printed number: 30 (06-16)
Cover photo: Katarzyna Siegien-Iwaniuk, NRPA/NRSA/IRSN

Norwegian Radiation Protection Authority, P.O. Box 55, N-1332 Østerås, Norway.
Telephone +47 67 16 25 00, fax + 47 67 14 74 07.
E-mail: nrpa@nrpa.no
www.nrpa.no
ISSN 1891-5205 (online)
ISSN 0804-4910 (print)

StrålevernRapport 2015:7

Regulatory support in radiation safety and radioactive waste management in Central Asia

Results of project completed in 2013–2015

Statens strålevern

Norwegian Radiation Protection Authority

Østerås, 2016

Program Coordinators:

M K Sneve, NRPA
P Strand, NRPA
A Kim, KAEC MINT RK
I Tazhibayeva, NTSC
B Tolongutov, ChEL KR
U Mirsaidov, NRSA
H T Halilov, SI «Sanoatgeokontehnazorat»
V. Romanov, FMBA
N K Shandala, SRC FMBC

List of Contributors:

Kazakhstan:

M Tulegenov, KAEC MINT RK
O Romanenko, NTSC
Z Akhmetova, CSEC MH RK
N Gorr, MEEP RK
V Tsyngaev, NNC

Kyrgyzstan

A Solomatina, ChEL KR
A Usubalieva, ChEL
N Rashepkina, ChEL KR
N Kubanichbek, SAEP&F KR
A Khalmurzaev, SAEP&F KR
R Beishenkulova, DSES MH KR
M Savosin, KKRK KR
A Anarkul, RW Agency ME KR
A Seytkazieva, RW Agency ME KR
D Sacyev, GETI

Tajikistan

I Mirsaidov, NRSA
B Barotov, NRSA
J Solomonov, NRSA

Uzbekistan

S Yakubbekov , SI Sanoatkontekhnazorat
S Alimova, SI Sanoatkontekhnazorat
D A Zaredinov, Ministry of Public Health of RUz
O P Ten, Ministry of Public Health of RUz
U S Salikhbaev, INP AS RUz
R I Radyuk, INP AS RUz
B K Kuldjanov, INP AS RUz
A Abdujabarov, INP AS RUz
V P Kupchenko, NPC «Geology of uranium and rare earth metals»of the Republic of Uzbekistan
A K Rakhimbaev, INP AS RUz
V D Rakhimov, INP AS RUz

Russian Federation

A V Titov, SRC FMBC
S M Kiselev, SRC FMBC
M P Semenova, SRC FMBC
V A Seregin, SRC FMBC
D V Isaev, SRC FMBC

NRPA

T Zhunussova
K Siegien- Iwaniuk

Contents

Executive Summary

The former USSR participated in a major share of the world uranium mining and processing industry. The sites were located primarily on the territories of today's Central Asian republics. After the collapse of the Soviet Union, the extraction and processing of the majority of uranium ore sites in Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan were closed fully or partially but without proper regulatory control, remediation or institutional control where needed.

The safe closure of the uranium sites and decommissioning of facilities usually should be followed by remediation. However, for various reasons, not all companies in the Central Asian countries completed full and safe remediation of the uranium mining and producing facilities. Moreover, because of the lack of proper supervision and maintenance, the protective coatings from tailings, waste dumps, drainage systems and treatment plants were destroyed. This resulted in environment radiation situation on-site and off-site changed for worse.

The Norwegian Radiation Protection Authority has been involved in a regulatory cooperation program since 2008. The projects that have been financed by the Norwegian Ministry of Foreign Affairs have been oriented toward the improvement of the regulatory framework in Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan by assisting in the review or development of proper regulations in these areas concerning radiation protection, radioactive waste management and remediation. Additionally, the Russian Federation and Ukraine later joined the cooperation on the uranium legacy.

The Norwegian activities involve attempts to harmonize the regulatory approaches by considering well recognised international safety principles and standards during the development process of the regulatory documents. An effective and efficient regulatory basis for remediation and radioactive waste management is a must for a proper and safe remediation process.

The cooperation has been constructed to be flexible enough to address a broad range of activities. On one side includes discussions with interested parties and sharing of information in working groups during the preparation of draft documents. On another side promotes and supports the neighbourly cooperation via discussions in wider international forums that include all project beneficiaries and Western experts during projects review meetings in addition to participation in other international forums and initiatives.

Norway provides expertize, international experience and good practice that takes into account IAEA recommendations and guidance. However, each country takes responsibility for the final approval process of the developed documents. This can result in changes to the final reviewed by NRPA expertize version of the documents when the legislation process is involved.

As part of this collaboration, national regulatory threat assessment reports were developed during the first stage of cooperation in 2008. These documents presented the situation in the region and revealed the main threats that resulted from inconsistent or outdated legal and regulatory frameworks. For the next step and according to the results of the threat assessment reports, key issues were taken into consideration and legal and regulatory documents were developed in the fields of radiation protection, radioactive waste management and remediation. The second stage of the project continues the upgrading of the regulatory framework in a consistent manner with the threat assessment report findings.

During the second phase of the project between 2012 and 2015, 13 documents were developed, part of which have already been approved and introduced into the legal and regulatory framework.

List of Abbreviations and Acronyms

BSS	Basic Safety Standards
ChEL KR	Chuj Ecological Laboratory of Kyrgyz Republic
CSEC MH RK	Committee of Sanitary Epidemiological Control of Ministry of Health of the Republic of Kazakhstan
DSES MH KR	The department of Sanitary - Epidemiological Supervision under Ministry of Health of Kyrgyz Republic
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
KAEC	Kazakhstan Atomic Energy Agency
KR	Republic of Kazakhstan
NNC	National Nuclear Center of RK
NORM	naturally occurring radioactive materials
NRPA	Norwegian Radiation Protection Authority
NRSA	Nuclear and Radiation Safety Agency of Tajikistan
OLA	Office of Legal Affairs
RT	Republic of Tajikistan
RW	radioactive waste
RWM	radioactive waste management
SAEP	State Agency of Environment Protection and the Forestry of the Kyrgyz Republic
SanPiN	Sanitary code and rules
SE	State Enterprise
SI	State Inspectorate
SISIM	State Inspectorate on Supervision of Geological Study of Depths, Safety in Industry, Mining and Public Sector under the Cabinet of Ministers of the Republic of Uzbekistan
SRC FMBC	Federal Medical Biological Center
TSOs	Technical Support Organizations
USSR	Union of Soviet Socialist Republics

1 Introduction

The Central Asian countries that were part of the former Soviet Union were involved in uranium mining and the milling industry from 1944 until the breakup of the USSR in 1991. After 1961, many mines were closed. The safe closure of the uranium sites and decommissioning of facilities should be followed with remediation. However, for various reasons, not all companies completed full and safe closure, decommissioning and remediation of the uranium mining and processing facilities and sites. There were significant remediation activities only in a few cases (situated in populated areas or in direct proximity to them). There were no remediation works on waste dumps in any of the Central Asian countries. Moreover, because of the lack of proper regulatory control, supervision and maintenance, the protective coatings of tailings and waste dumps, drainage systems and treatment plants were destroyed (Fig. 1). This resulted in potential consequences for the health of the people and the environment. This also resulted in radiation situation on-sites and off-sites that changed for the worse. Throughout this time, the pattern of abandonment was similar in all of the Central Asian countries.

Fig. 1 Examples of uranium legacy sites in Central Asia (Chatkalo-Kurama region in Uzbekistan (left up), a foothill of a remediated rock pile at «Vostochny» mine in Kazkhstan (right up), the «Yellow hill» in Tajikistan (left down), and Mailuu- Suu in Kyrgyzstan (right down))

After 1991, in newly independent Central Asian countries, part of the conventional operating uranium mines was closed, and many uranium legacy sites were left without appropriate monitoring, maintenance and regulatory control. However, since the 1990s, the situation has differed from state to state. Tajikistan and Kyrgyzstan have no current uranium mining operations, unlike Uzbekistan and Kazakhstan. Currently, Kazakhstan is the third largest uranium producer in the world.

Another Cold War legacy includes the radioactive waste generated in areas where nuclear tests (i.e., 500 air and subsurface explosions) were performed for military and peaceful purposes, as is the case in

Semipalatinsk, Kazakhstan. The radioactive debris and fallout that were generated by the nuclear fission-contaminated soil and water were spread into the air during the nuclear explosion.

Today, in Russia and the Central Asia, the area of lands affected by the uranium industrial activities is 80 km2, in particular: 51.7 – in Kazakhstan, 16.0 – in Russia, 6.5 – in Kyrgyzstan, 3.0 – in Tajikistan and 2.8 km2 – in Uzbekistan (1).

There is a pressing need to remediate all these legacy sites to produce safe conditions to avoid present and future unacceptable radiation exposure for people and the environment. The situation is aggravated by the fact that many tailings and radioactive waste storage facilities are located in regions of seismic activity, in landslide and mudflow-prone sectors, in zones subject to flooding and high ground water levels and near the banks of rivers that form the base of the large water basin in Central Asia. Therefore, since gaining independence, the situation has prompted the newly independent countries to seek assistance in remediating the many tailing piles, waste rock stockpiles and abandoned production facilities.

However, before remediation can occur, countries must have the necessary legal and regulatory framework to initiate, perform, and control remedial actions at the operating and legacy sites with an acceptable risk for the people and the environment.

The Norwegian Radiation Protection Authority has been involved in this regulatory cooperation program since 2008. The activities were financed by the Norwegian Ministry of Foreign Affairs. The cooperation significantly included assisting the relevant regulatory bodies in performing their responsibilities concerning the remediation of legacy uranium mining and processing facilities. The key outcome, besides the improvement of the regulatory base, is the strengthening of the capacity of regulatory authorities in all four countries and improvements in the professional skills and knowledge of the regulators [2].

Sister regulatory authorities that NRPA closely cooperated with included:

- the Kazakhstan Atomic Energy Committee (KAEC),
- the State Agency on Environment Protection and Forestry under the Government of the Kyrgyz Republic (SAEP),
- the Nuclear and Radiation Safety Agency of Tajikistan (NRSA, TA), and
- the State Inspectorate on Supervision of Geological Study of Depths, Safety in Industry, Mining and Public Sector under the Cabinet of Ministers of the Republic of Uzbekistan (SISIM).

The projects were aimed at identifying and drafting relevant regulatory requirements needed to ensure the protection of personnel, the population and environments during planning and implementation of radioactive waste management in Central Asia.

On the management side, the NRPA activity was designed to allow participants to share expertise and experiences to implement their regulatory functions. Norway supported the regulatory cooperation, which, among other tasks, encourages the establishment of working groups for dialogue between internal organizations. These groups were integrated with representatives of the operator, research organizations and regulators. The main goal of the working groups was to develop a platform for exchanging views and approaches. A primary objective was to consult with each other prior to new regulations coming into effect. Thus, the NRPA actively encouraged the participation of Technical Support Organizations (TSOs) during the development and review work. TSOs were appointed to develop draft regulatory documents, to review licensing applications and to suggest possible changes in the future regulatory process.

The exchange of people and information is the basis for trust and confidence by providing more informed and coordinated regulations, which may eventually lead to an agreement on what constitutes the best regulatory practice.

One of the advantages of the Norwegian project is the flexibility and consideration of an individual approach to each beneficiary. Additionally, NRPA promotes the exchange of information between neighbour countries with similar backgrounds and legacy problems. All of the project participants have different experiences, background and financial resources to regulate and remediate the legacy regions.

To improve the cooperation and make it more efficient, twice a year there are organized technical meetings, where all counterparts can exchange their experiences and discuss the obtained results.

The Russian Federation has many legacy sites and facilities on its territory, in addition there is knowledge and information from the time of the former USSR that may help in the characterization and remediation of some of the identified sites in Central Asia countries. This was one of the reasons why they joined the project in 2014. By involving Russia and Russian experts, there was an attempt to unify the approach to the remediation by developing the common guide «Radiation Safety Regulation during Remediation of Sites and Facilities of the Former Uranium Mines» that could be used in Russia and in other countries after the adaptation process. This process involved experts from all of the beneficiary countries in addition to experts from western countries.

Ukraine has similar legacy problems as other participating, in this project. Ukraine has similar legacy problems as in the Central Asia countries; it needs to manage sites left after 1991. Ukraine needs assistance and a perspective view for developing new regulations, updating existing regulations and adapting to the latest international standards, recommendations and best practice. This is why Ukraine joint the cooperation project in 2015.

The last meeting was held in Bishkek, Kyrgyzstan on 26-28 January 2016 and it had the objective to review the results and summarize the entire project under NRPA cooperation with regulatory authorities in Central Asia. During the 3-day meeting, there was organized a conference that included the participation of all involved parties and organizations in the Kyrgyz Republic to discuss the actual situation in the radiation safety field in the country and make proposals to improve the regulatory infrastructure. Additional issues concerned the main results of the work and activities during the last 6 months. The regulatory cooperation possibilities for 2016-2018 were also discussed in addition to possibilities for international cooperation (ENSTII - training, educational projects; IAEA - new regulatory network of CGNSS, EC and EBRD).

Documents that were developed under the Central Asian project from 2012-2015 are presented in Fig. 2 (additionally, see Chapter 8):

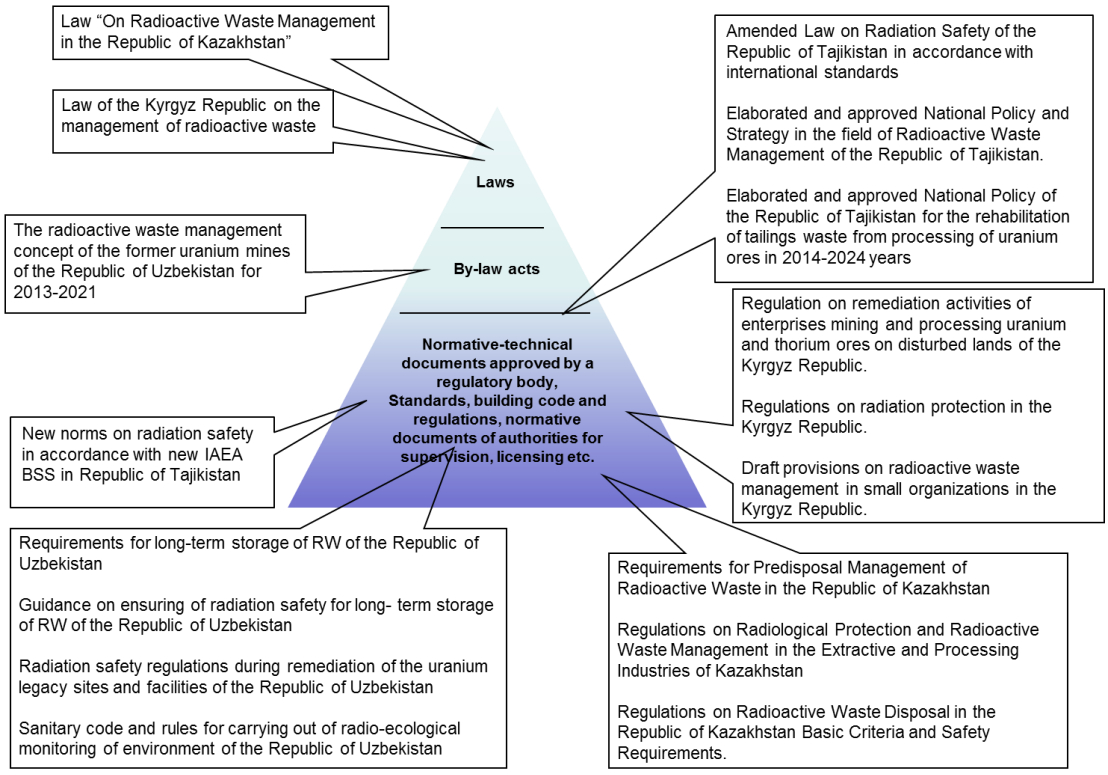

Fig. 2. Documents developed under NRPA projects.

1.1 References for section 1

1. *Regulatory supervision of the uranium mine and milling legacy sites in Russian Federation. V. Romanov, N. Shandala. Proceedings of International Workshop «Uranium Legacy of the Soviet Union in the Central Asia: Problems and Decisions». Dushanbe, 20-22 November 2012.*
2. *Zhunussova T., Sneve M., Romanenko O., Solomatina A., Mirsaidov I. Threat Assessment Report Regulatory Aspects of the Remediation and Rehabilitation of Nuclear Legacy In Kazakhstan, Kyrgyzstan and Tajikistan. StrålevernRapport 2011:5. Østerås: Statens strålevern, 2011.*

2 Kazakhstan

From the former USSR, Kazakhstan inherited an infrastructure for radioactive waste management in which a minimization of expenses for processing and disposal of waste were prevalent, and an underestimation of the scope of challenges that were connected with its management included safety aspects and leaving a solution to the problem primarily for future generations.

In the Republic of Kazakhstan (RK), radioactive waste (RW) that contains naturally occurring radioactive materials (NORMS) are wastes from uranium mining and production industries, including geological exploration of uranium deposits, mining and processing of mineral resources that contain radioactive elements, oil and gas production, metallurgical industries in the form of dumps, tailings, contaminated soils, pipes, and equipment. Additionally, there is liquid and solid radioactive waste that was generated from the BN-350 during decommissioning in Aktau and from accumulated RAW from existing research reactors in Alatau and Kurchatov and from disused sealed radioactive sources. RW from the use of radioisotopes in various industries, medicine, agriculture and from nuclear applications in were also generated. Radioactive waste and contaminated equipment are also present in the territories as a result of nuclear tests that were performed in Kazakhstan (approximately 500 air and subsurface explosions were executed in Kazakhstan for military and peaceful purposes) (Fig. 3).

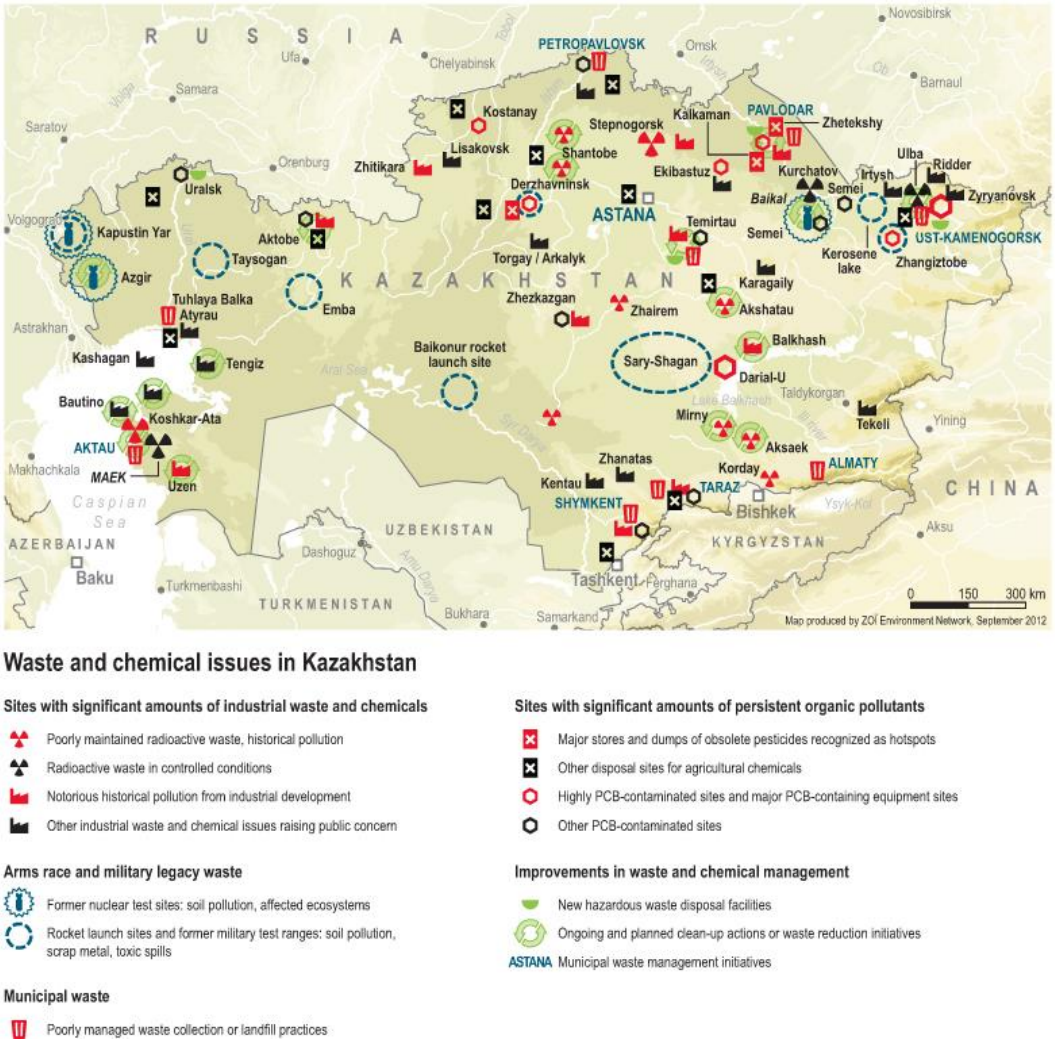

Fig. 3. Locations of RW from various origins in the territory of Kazakhstan

Currently, in Kazakhstan, a large amount of radioactive waste is accumulated and there is a tendency towards increasing the volume that requires ensuring its safe management, including its disposal. The most important aspects of the problem include:

- imperfection of the existing radioactive waste management system,
- incompleteness of the organizational process of the radioactive waste management, and
- a lack of effective financial mechanisms to meet internationally acknowledged principles for the safe management of radioactive waste.

These problems are a source of:

- unwarrantable risks of hazardous impact of ionizing radiation to the public and the environment that are associated with the radioactive waste that is already accumulated in Kazakhstan,
- potential increase of radiation risks in the future and the probable rise in social-psychological tension in society that is connected with the intentions to develop the nuclear power industry in Kazakhstan, and
- the risks of stably developing a society, which are associated with potential obstacles to speed-up industrial development in Kazakhstan, and addressing the economic burden of radioactive waste management for future generations.

The radioactive waste management system that exists in Kazakhstan currently does not include the disposal of radioactive waste of all types and categories. The national operator that should be responsible for the implementation of the national policy and strategy on radioactive waste management has still not been appointed.

Radioactive waste is an issue for consideration in any activity that involves the use of nuclear energy or radiation sources, and its safe management is necessary to reduce risks to facility personnel, to the general public and to reduce the environmental impact. Radioactive waste in Kazakhstan has not been placed in licensed sites for long-term storage and final disposal. One of the main reasons for this situation has been the lack of an adequate and relevant regulatory framework for RW management in Kazakhstan, and it is necessary to establish an adequate state-wide regulatory system to deal with this problem.

Taking into account the scope of the existing challenges mentioned above, the solution is likely to be carried out via elaboration, approval by the government, and implementation of the state policy in the sphere of radioactive waste management, which should be supported by the development and introduction of a medium-term strategy for radioactive waste management.

Currently, the regulation of radioactive waste management in the Republic of Kazakhstan is implemented in accordance with the Laws of the Republic of Kazakhstan:

- «On the Use of Atomic Energy» № 94 as of April 14, 1997,
- «On the Radiation Safety of the Public» № 219-1 as of April 23, 1998,
- «The Environmental Code of the Republic of Kazakhstan» № 212-III as of January 09, 2007,

in addition to other legal acts in the field of nuclear energy and departmental technological safety regulations and instructions.

The threat assessment analysis accomplished in the previous stage of cooperation showed the weaknesses in the regulatory and legal framework of Kazakhstan. The main recommendation was to begin developing a national policy and strategy for radioactive waste management, which requires approvable by the Kazakhstan government.

Moreover, in 1997, the Republic of Kazakhstan signed the «Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management» and later ratified it in February of 2010. Thus, Kazakhstan has committed to take several steps to bring its activities and legal framework in accordance with international safety recommendations in the field of spent nuclear fuel and radioactive waste management.

The first national report under the Joint Convention that was developed in May of 2012 revealed that:

- it is necessary to develop, approve and issue a RK law «On RW management in RK»,
- a national operator for radioactive waste management should be established,
- it is necessary to develop and implement in the near future a general national strategy for RW management based on domestic and world experience and in accordance with IAEA recommendations, and
- it is important to conduct works on harmonization of current frameworks and to develop a new legal and regulatory framework that regulates radioactive waste generation and management in accordance with the selected strategy.

The findings of the Regulatory Threat Assessment Report and the Joint Convention Report showed that the existing regulatory framework in Kazakhstan does not fully meet international requirements and recommendations, which indicate a need for further development of a regulatory framework for radioactive waste management. Based on this understanding, in December 2012, a project was implemented under the Norwegian-Kazakh cooperation that had the overall objective to develop and establish a national radioactive waste management policy and a relevant strategy within the Republic of Kazakhstan. Moreover, to ensure the protection of personnel, population and the environment during the planning and conducting of safe RW management in Kazakhstan, the regulatory framework needs further development in accordance with international experience and IAEA recommendations. Under the project, there were two legislative and regulatory requirements that were drafted:

- «Law on the radioactive waste management in the Republic of Kazakhstan», and
- «Regulations on the predisposal management of the radioactive waste in the Republic of Kazakhstan».

The developed documents should be put into force in the near future in accordance with the established procedures in Kazakhstan.

The project has included the participation of the following internal and external organizations during the development of the documents:

- Ministry of Ecology and Environmental Protection of RK (MEEP RK),
- Committee of Sanitary Epidemiological Control of Ministry of Health of RK (CSEC MH RK),
- National Nuclear Center of RK (NNC),
- Norwegian Radiation Protection Authority (NRPA),
- Federal Medical Biological Center of Russia (FMBC), and
- Kazakhstan Atomic Energy Committee (KAEC MINT RK).

2.1 Draft law «On Radioactive Waste Management in the Republic of Kazakhstan»

The draft law, «On Radioactive Waste Management in the Republic of Kazakhstan», clearly defines the key aspects of the policy for the Republic of Kazakhstan on radioactive waste management. This law establishes a legal framework and regulates relations for the safe management of radioactive waste from the moment of its generation to its final disposal.

The document was drafted in three stages. First, an analytical review was performed on the RW management legislation in other countries and the IAEA recommendations, and the current situation concerning the RW management in Kazakhstan was analysed.

The second stage was to define the technical specifications that are required to develop a document to ensure the compliance of the developed draft law with international conventions that have been established via the development of similar documents. The document includes detailed requirements and content of the law.

During the last stage, the law, «On Radioactive Waste Management in the Republic of Kazakhstan», was drafted. The NRPA reviewed the document using experts from Western Europe and the FMBC (Russian Federation). A discussion of the comments was performed in the working group with representatives of involved ministries and regulatory bodies from Kazakhstan. The formulated comments and suggestions were incorporated into the document. The final version of the draft law, «On Radioactive Waste Management in the Republic of Kazakhstan», was issued after additional discussion with experts and representatives from the involved ministries and regulatory bodies, including the NRPA.

The draft law, «On Radioactive Waste Management in the Republic of Kazakhstan», allocates responsibilities and guarantees engagement with the main interested parties that are involved in the radioactive waste management. The document defines the national policy with regard to import of nuclear waste that is generated outside of its territory and covers potential export of radioactive waste. It also contains a general provision on the procedure to perform regulating control over radioactive waste management and clearly indicates the distribution of responsibilities. The law also defines the disposal approach and identifies the national operator as the organization responsible for the development of future actions regarding the disposal of radioactive waste.

The draft law establishes that the national operator will be responsible for the development of the national strategy for radioactive waste management and for the frequency of its review and approval by the government. Additionally, the national operator will be responsible for the implementation of this strategy, including the implementation of remediation work in contaminated territories from past practices and the disposal of waste generated from this remediation.

This document defines the funding mechanisms to ensure the safety and sustainable development of radioactive waste management. Additionally, the document takes into account the scale of both the resources available in Kazakhstan (human, financial, technical) and the required resources to implement the national policy for RW management.

The developed draft law also includes requirements for:

- notification,
- licensing of radioactive waste management activities,
- suspension, modification, renewal, and revocation of licenses,
- implementation of inspections,
- application of sanctions,
- appealing of regulatory decisions,
- emergency preparedness during radioactive waste management,
- classification of radioactive waste,
- procedures for storage and disposal of radioactive waste,
- implementation of radiation control during radioactive waste management,
- transportation of radioactive waste,
- management of disused sealed radioactive sources,
- liquid and gaseous radioactive waste management,
- design of a specialized enterprise on radioactive waste management,
- site selection, including investigations and procedures for the allocation and construction of a specialized enterprise for radioactive waste management,
- development and expertise of a construction design of a specialized enterprise for radioactive waste management,

- development of a safety assessment and safety case for radioactive waste management facilities of the specialized enterprises,
- commissioning and operation of specialized enterprises for radioactive waste management,
- environmental monitoring,
- rights of organizations to obtain benefits and compensations,
- social guarantees for citizens living and working in the area of the facility location and personnel working with RW, and
- the purpose and legal basis for international cooperation on radioactive waste management.

2.2 Draft regulatory document «Requirements for Predisposal Management of Radioactive Waste in the Republic of Kazakhstan»

The draft «Requirements for Predisposal Management of Radioactive Waste in the Republic of Kazakhstan» was developed in accordance with the draft law «On the RAW management in the Republic of Kazakhstan» and defines the key issues and safety requirements to be considered for the predisposal management of radioactive waste prior to its disposal in Kazakhstan.

The development was organized in three steps. First, the analytical review of the RW predisposal management experience and regulations in other countries were compared to current regulations in Kazakhstan, in addition to IAEA recommendations for radioactive waste predisposal management. Specialists from CAESC ME RK, MEEP RK, CSEC MH RK, NTSC and NNC were familiarized with the current system RW management in European countries (Norway, UK, Germany, France, etc.) and in the Russian Federation. The differences between the western requirements and the Kazakhstan regulatory and methodological requirements that are related to RW predisposal management were identified. The criteria and the amount of the necessary information necessary for acquiring consistent regulatory and methodological requirements for RW predisposal management in Kazakhstan and in other countries were specified.

First, based on the analysis, technical specifications were developed, and then the draft regulatory document, «Requirements for predisposal management of radioactive waste in the Republic of Kazakhstan» was developed. In developing the document for the IAEA recommendations, international experience and the current situation in the Republic of Kazakhstan were both considered.

These regulations are mandatory for all legal entities and individuals engaged in the generation, collection, reprocessing, conditioning and storage of RAW in Kazakhstan. They are applicable to the management of radioactive waste of all types prior to its disposal, and they cover all stages of the management of the waste from generation to disposal, including reprocessing (preliminary reprocessing, reprocessing and conditioning) and storage but excluding spent nuclear fuel.

The requirements of the regulations apply to waste that was generated from commissioning, operation, shutdown and decommissioning of nuclear facilities, the use of radionuclides in medicine, industry, agriculture, scientific research and education, the processing of materials containing naturally-occurring radionuclides and remediation of contaminated territories.

Structurally, the regulations are composed of six sections. Section 1 contains the general provisions on RAW management prior to its disposal. Human health and the environmental protections are discussed in section 2 of the regulations. Section 3 discusses the obligations required for RAW management prior to its disposal. Approaches for RAW management prior to its disposal and elements of the management are established in Section 4. Section 5 establishes requirements for the safe design and operation of facilities and for their safe operation involving radioactive waste management prior to its disposal. Section 6 provides final provisions for enactment of the regulations.

During the preparation of the document, IAEA recommendations were taken into account regarding the radioactive waste management requirements up to the moment of its disposal and relevant requirements

that have been developed in Russia, in the USA, and in other countries (Norway, UK, Germany, France, etc.).

The regulatory framework supporting the development of the «Requirements for Predisposal Management of Radioactive Waste in the Republic of Kazakhstan» is based on:

- the law «On the Use of Atomic Energy» (1), which describes some aspects for consideration in national policy on radioactive waste management in the Republic of Kazakhstan (cl. 13), namely:
    - All radioactive waste generated on the Republic of Kazakhstan territory shall be disposed of in such a way as to ensure the radiation protection of the public and the environment for the entire period of time during which it can pose a potential threat.
    - The disposal of radioactive waste shall be provided for by design and technical documentation as a mandatory stage for any type of activity related to radioactive waste management.
    - The procedure to arrange the collection and management of radioactive waste and the authorities and organizations engaged in this activity shall be determined by the government in accordance with the legislation of the Republic of Kazakhstan.
    - Environmental requirements established by the Environmental Code of the Republic of Kazakhstan shall be complied with when using radioactive materials and waste.
- the Environmental Code of the Republic of Kazakhstan, which prohibits disposal of radioactive waste and materials on the surface and in the depths without taking measures to prevent the release of radioactive substances into the environment, regulates transboundary movement of radioactive waste and materials, and regulates the supervision and control during RAW management for radiation safety (Section 39),
- the Hygienic Standards, «Sanitary and epidemiological requirements for the radiation safety», adopted by the Resolution of the Government of the Republic of Kazakhstan №201 as of 03.02.2012,
- the draft of the currently developed law on the radioactive waste management in the Republic of Kazakhstan, and
- other legal documents, as necessary.

2.3 Conclusions

In the present project, the development of relevant legislation and regulatory requirements applies to the following specific fields of assistance:

- radiation safety strengthening in Kazakhstan,
- improvement of the regulatory framework and the regulator's capabilities for the effective and efficient regulation and control of the radioactive waste management, , and
- transfer of know-how to the regulator and the technical support organization from western experience regarding its own work, as appropriate. The knowledge gained in the course of implementation of this project will improve Kazakhstan's practices regarding safe radioactive waste management.

In the course of the project, some issues appeared resulting in some delays that were caused by the following main reasons.

- There was a reorganization of the Kazakhstan Atomic Energy Agency of the Ministry of Industry and New Technologies into the Committee for Atomic and Energy Supervision and Control of the Ministry of Energy of the Republic of Kazakhstan.

- The functions of the Committee of State Sanitary and Epidemiological Surveillance of the Ministry of Health of RK were transferred to the Agency of the Republic of Kazakhstan on Protection of Consumers.
- The two reasons that are listed above resulted in an intensive rotation of personnel in these organizations, including the experts who worked in the working group under the project. For the involved Kazakhstani parties, this created problems in their participation in discussions of the developed regulatory documents.

A large amount of radioactive waste from various sources has been accumulated and continues to be generated in Kazakhstan. A solution to the existing problems is possible via systematic implementation of the state policy on radioactive waste management and the corresponding strategy. Kazakhstan does not yet have an accepted formal strategy for radioactive waste management.

Recently, the national authorities of Kazakhstan have developed an understanding of the need to adopt the law, «On the Radioactive Waste Management in the Republic of Kazakhstan», and it is clear that initiation of this action will be supported in Kazakhstan. However, it can only be formally submitted for review and approval together with a package of appropriate and complementary regulatory documents.

Under cooperation with NRPA, drafts of the following documents were developed that regulate radioactive waste management in the Republic of Kazakhstan:

- draft law «On the radioactive waste management in RK»,
- concept for the strategy of RW management in the RK and proposal on introduction of a new classification of RW in the RK,
- regulations for RW management in the RK prior to their disposal (RW predisposal management),
- regulations for RW management in the mining industry of Kazakhstan, and
- regulations for RW disposal in the RK.

These documents cover the main regulatory issues of radioactive waste management. However, the major issues still requiring further analysis and study include:

- criteria and requirements for environmental remediation of contaminated territories,
- a procedure for interaction between authorized regulatory national authorities of the Republic of Kazakhstan regarding RW management (the draft law provides only general provisions), and
- establishment of an effective mechanism for funding radioactive waste management, decommissioning and remediation in the Republic of Kazakhstan (the Draft Law provides only the most general provisions).

To address the abovementioned issues in the next phase of the NRPA cooperation, the following tasks are planned:

- development of a regulatory document, «Criteria for environmental remediation of territories and facilities of uranium ores mining and processing enterprises», in accordance with the guidelines of the «Regulation of radiation safety in remediation of the territories and facilities of uranium legacy», as developed by SRC FMBC,
- development of a Memorandum of Understanding regarding the interaction between the authorized regulatory national bodies in RW management in Kazakhstan, and
- an analysis of existing financial mechanisms to fund radioactive waste management, decommissioning and remediation in the Republic of Kazakhstan and its comparison with similar funding mechanisms that are currently in place in developed western countries. Based on this analysis, there will be recommendations provided for the introduction of an effective mechanism for funding radioactive waste management in the Republic of Kazakhstan in accordance with the provisions of the draft law, «On the radioactive waste management in the Republic of Kazakhstan».

Within accomplishing these issues the next step will be the initiation of the procedure for getting review and concurrences for the draft law, «On the radioactive waste management in the Republic of Kazakhstan», that will include a package of appropriate supporting regulatory documents and recommendations.

2.4 References for section 2

1. *Law of the Republic of Kazakhstan on the use of atomic energy (No. 442-IV ZRK dated 12 January 2016).*
2. *IAEA Expert Mission Report. Assessment of the Current Post-Remediation Status of Uranium Legacy Sites in Kazakhstan (Astana, Kokchetau, Aktau). 28 September 2014 – 3 October 2014.*
3. *Law of the Republic of Kazakhstan on ratification of the Convention on Nuclear Safety (No. 245-IV ZRK dated February 3, 2010) .*
4. *Law of the Republic of Kazakhstan on ratification of the Joint Convention on Safety of Spent Fuel Management and Safety of Radioactive Waste Management (No. 246-IV ZRK dated February 3, 2010) .*
5. *Rules for organization of collection and disposal of radioactive waste in the Republic of Kazakhstan (RK ME Order No.209 as of March 18, 2015).*
6. *IAEA. End-of-Mission Report. Assessment of the status of former uranium production sites in Southern Kazakhstan (Almaty, Korday, Aksuek, Mirnyi, Astana). 19 - 23 October 2015.*
7. *Governmental, Legal and Regulatory Framework for Safety. General Safety Requirements. IAEA. No GSR Part 1. IAEA. 2010.*
8. *The International Basic Safety Standards for Protection against Ionizing Radiation and the Safety of Radiation Sources. IAEA Safety Series No. 115 . IAEA. 1996.*
9. *I.L. Tazhibayeva, O.G. Romanenko, A.Kh. Klepikov, A.P. Blynskiy, A.A. Kim. Conception for radioactive waste management in the Republic of Kazakhstan.*

3 Kyrgyzstan

The Kyrgyz Republic is a mountainous country in which more than 80% of territory is located 1500 m above sea level. The country's territory is subject to natural cataclysms, such as landslips, earthquakes, flooding and mudflows. Kyrgyzstan is characterized by very difficult and extreme natural conditions and a high vulnerability of the mountain ecosystem.

In the past, the territory of the Kyrgyz Republic was one of the main raw mineral bases of natural uranium and rare-earth elements for the former USSR. In places where material extraction and ore processing in the Kyrgyz Republic occurred, there is a trans-boundary risk because of the potential (inadvertent) removal of material that contains radioactive waste. The most critical situation involves the potential risk of trans-boundary displacement of some tailings from Majluu-Suu to the Fergana valley. It has become a major concern for countries in the Central Asian region.

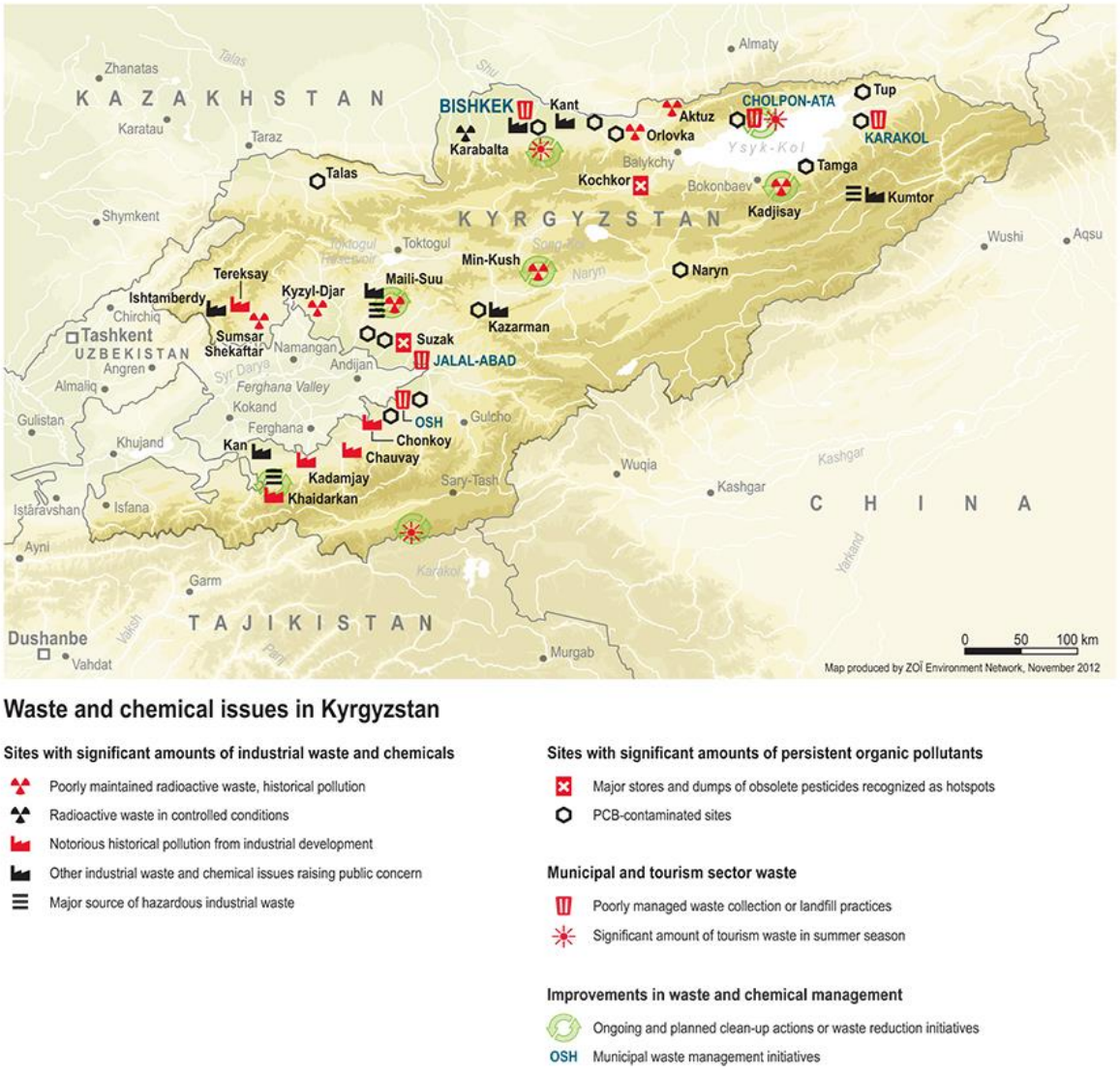

Fig. 4. Locations of RW from various origins in the territory of Kyrgyzstan

Today, according to the government of the Kyrgyz Republic, on its territory, there are 75 storage sites of radioactive wastes from the former mining industry, and the total amount of this solid waste exceeds 145 million m^3, and the occupied space is 650 hectares (6,5 km^2).

The most dangerous regions include 33 radioactive waste tailings with 48.31 million m^3 of radioactive wastes. These include 29 uranium tailings with a total volume of radioactive waste in excess of 41 million m^3. The dumps, and especially the tailings, did not comply with safety standards before, when the mines and mills were active, and they continuo not to comply with.

The tailings were closed from 1966 to 1973. After the collapse of the USSR, most of the uranium tailings remained without technical and regulatory supervision or control for a long time. The technical condition of the tailings at the time of the takeover by the Ministry of Emergency Situations of the Kyrgyz Republic required remediation. From 1993 to 1999, emergency remediation actions and ongoing maintenance work was conducted sporadically.

A large quantity of radioactive waste was placed on the surface of the earth in remaining dumps and tailings that were inherited from the long-term activity of uranium enterprises. Thus, remediation work was not performed in time, and most of the tailings have been exposed to natural hazards. Thus, there is a need to remember that their design did not take into account the long-term effects, potential landslides, floods and mudflows. The situation is aggravated by the fact that the majority of tailings from waste in the country are in areas of high seismic and landslide activity, in mudflow and high water areas, and on sites with close bedding of subsoil waters. The surfaces of the tailings are subject to natural and anthropogenic influences, and this is why the safety conditions are becoming worse.

Additionally, in the Kyrgyz Republic, there are many disused radioactive sources that were used in various industries, such as in medicine, etc. that cannot be returned to the suppliers and need to be considered radioactive waste and managed according.

Fig. 5. Picture of the Tuyuk-Suu tailings

The legal framework shall regulate radiation protection to reduce the potential impact on human health and reduce radiation exposure as a result of the mismanagement of radioactive waste, including disused sealed sources. Additionally, the regulatory framework should facilitate the development, production and use of radiation sources, and it should take into account safety, conditions of reasonableness, social fairness and feasibility.

The Kyrgyz Republic takes the responsibility for adopting legislative, regulatory and administrative measures for ensuring radiation safety. However, because of the lack of national experience, the control and enforcement of the legal and regulatory framework on radioactive waste management has not been sufficiently implemented in the country. Currently, the Kyrgyz Republic has no financial or technical resources for the appropriate maintenance, control and remediation of legacy sites or for the development of a system for the timely mitigation of the radiation risks.

The project, «Support to the development of the regulatory body for radiation and nuclear safety in the Kyrgyz Republic», for the period of 2013 to 2015 was a logical extension of the project that had a similar title and ended in 2012. During implementation of the project from 2009 to 2012, considerable progress was made in identifying and understanding the regulatory threats due to exposure to radioactive waste and radioactive materials in the Kyrgyz Republic. There was also an understanding of the need to establish a national policy on radioactive waste management and to expand appropriate strategies.

The objective of the 2013-2015 activities is to support the development of a legislative and regulatory framework for radiation protection and safe management of radioactive waste with particular emphasis on the historical heritage of uranium mining and processing sites. The high relevance for the development of new regulations was confirmed by the fact that the country has implemented a number of technical assistance projects that are aimed at conducting remediation activities in the areas of the former uranium industry. Implementation of the newly developed documents will create conditions for stability and a continuity of technical assistance in the preparation and implementation of engineering measures in the framework of international projects, and it will ensure good performance for the supervising regulatory objectives.

Under the project, four normative documents were prepared that contain the basic requirements for radioactive waste safety and responsibility, in addition to issues regarding remediation and the protection of occupationally exposed personnel, the public and the environment. The new guidelines are designed so that they complement the existing normative framework of the Kyrgyz Republic and in compliance with the IAEA safety standards. The new regulations will apply to radioactive waste management with emphasis on storage, mining and processing of uranium ore, handling of disused sealed radioactive sources and contaminated areas

3.1 Draft law of the Kyrgyz Republic: «On Radioactive Waste Management»

The main premises for drafting the new law, «On Radioactive Waste Management», concern the need to establish a national policy on radioactive waste management and improve the regulatory framework and infrastructure for radiation safety. The document will become a part of the national policy for radiation safety, and it will be the basis for the development of national programs (strategies) on radioactive waste management.

The main arguments for the development of a new law on radioactive waste management include:

- the development and improvement of radiation safety for occupationally exposed workers, the public and the environment,
- the development of a safety culture in radioactive waste management,
- the registration of radioactive waste,
- the development and improvement of the regulatory infrastructure,
- the development and improvement of a centralized national system for radioactive waste management, and
- the organization and development of special reserve funds for the management and disposal of radioactive waste and remediation of legacy sites that are owned by the Republic.

The new law includes:

- issues related to the safe management of all types of radioactive waste, excluding spent nuclear fuel management, and
- issues regarding the classification of radioactive waste according to international recommendations, the general requirements for the establishment of regulatory bodies and the liability of the operators, the funding mechanism, the protection of personnel, the protection of the Kyrgyz Republic population, etc.

The document gives clear and understandable definitions of radioactive waste management and the actions necessary to regulate it.

The law establishes the responsibilities of the government, the regulator and the operator, and it provides the regulatory framework as a whole for radioactive waste management. The law determines the liability of the operator, the responsibility of organizations that perform activities that generate waste and

establishes ownership and funding for the safe management of radioactive waste. It outlines the basic criteria (organizational and legal) for safe managing of radioactive waste (RW reception, transport, processing, conditioning and storage).

The new law also identifies the organization responsible for the development of the national strategy in accordance with the Act (the policy) and the governmental organization to which the national strategy will be presented for approval. The new law will also establish the frequency for reviewing and updating this national strategy.

Typically, countries with a limited amount and type of radioactive waste usually choose one organization for the centralized management of radioactive waste including disused sealed sources. In Kyrgyzstan, there are now two national operators that cover only partially the storage facilities and some types of RW. Currently, if with not covered storage facilities or with non-covered type of RW, appear any problems, case will fall under the responsibility of interdepartmental commissions. Thus, the government and public authorities must provide a mechanism for monitoring and supervision that would cover all types of waste and all waste storage facilities. Additionally, the document establishes the liability of:

- the government,
- the regulatory body,
- the authorized state bodies, and
- the operator (licensee).

The law on radioactive waste management will effectively cover the requirements of the Constitution of the Kyrgyz Republic and the governmental programs that are responsible for implementing the strategy in accordance with radiation safety policies and the Kyrgyz legislation on public radiation safety.

The drafted document concurs with the new government policy regarding environmental protection and safety that is included in the national document, «National Strategy for Sustainable Development of the Kyrgyz Republic for the period 2013-2017 years.»

In the next step, interested parties in the country will be invited to review the effectiveness of the new provisions on:

- development of governmental funds,
- classification of the waste according to international standards,
- development of reports that contain safety case and safety assessment, which include periodic reviews of the safety assessment,
- development of regulations that support the new law,
- appointment of the main operator of radioactive waste streams, and
- improvements in the regulatory system of radioactive waste management (reporting, certification storage of information).

3.2 New regulatory guidance document on remediation

The main arguments for the development of a new regulatory document on remediation activities include:

- developing and improving the radiation safety for workers, the public and the environment,
- developing basic principles for safe and secure remediation, accounting and minimization of radioactive waste,
- developing requirements for establishing cost estimates and developing of special reserve funds for the decommissioning and remediation of legacy uranium mining and processing facilities,

- the document will be the basis for instruction on local programs and strategies, feasibility studies, safety assessments, projects for construction, etc. for sites and facilities that are subject to remediation, and
- implementing the ratified Joint Convention requirements for the safe management of radioactive waste and the improvement of the international image.

The new standard document is designed for use by regulatory bodies, organizations responsible for design and operation, organizations that provide construction and engineering work, land owners or organizations that own land that is likely to be remediated. The new document provides requirements for the remediation of disturbed lands and territories due to the uranium industry and due to industries in which natural occurring radioactive materials and their decay product wastes are formed.

The remediation of legacy and contaminated sites is part of the safe management of radioactive waste. The developed guidelines provide basic safety provisions for remediation of territories and equipment from mining and processing of radioactive ores. The guidelines take into account the protection of workers, the public, the environment, and the issue of transboundary movement of radioactive waste.

The document also regulates the closing of facilities that are used for mining and processing of uranium and thorium ores and the disposal of the radioactive waste that is produced by these enterprises, regardless of the legal form of activity, and it regulates the implementation of measures to reduce the formation of new radioactive waste from the remediation of disturbed areas.

The document provides clear and understandable definitions for radioactive waste management and remediation activities for the uranium tailings and other stored radioactive waste and for the surrounding contaminated land. This regulation also provides the basic requirements for processes and activities related to the planning and implementation of remediation of contaminated land. It determines the duties of the organization, assigns responsibilities for radioactive waste management (the operator), for planning, for design and for implementation of remediation works, and it establishes the requirements for optimization of decision-making and financing for the remediation and safe management of radioactive waste. Additionally, it establishes the basic measures (organizational and legal) for remediation, including the development of a conceptual plan and implementation of the developed tools for the project.

3.3 Development of the main provisions concerning radiation protection during occupational exposure

The main arguments for the development of a new regulatory document on remediation activities include the development and improvement of radiation safety for occupationally exposed workers, the development of a safety culture, the development of plans to optimize radiation protection and improved staff training in the workplace.

The purpose of this task was to prepare a regulatory document that contains the basic provisions and requirements for occupational radiation protection in terms of practices and conditions during normal operations and during emergency situations. The main purpose of this document is the protection of personnel from planned and unplanned exposure. Additionally, the guidelines will be a basis for local programs and strategies, feasibility studies, safety assessments, projects for construction, etc. for radioactive facilities or sites where the handling of ionizing radiation sources occurs.

The provided requirements are an essential component for the support of radiation safety in organizations and enterprises that have possible occupational exposure. The document regulates issues for the safe performance of administrative and technical activities regarding radiation protection during planned exposure situations and in emergency exposure situations. The new regulatory document will fill in the gaps that currently exist in the legal and regulatory framework. Gaps arose after 1993 when the country ceased to apply almost all of the guidelines of the former Soviet Union. The review and development of regulations was complicated by the fact that all regulations for radiation and nuclear safety went into a secret mode, making it difficult or impossible to access for the government bodies of Kyrgyzstan during the period of its formation.

Over the past 20 years, in the radiation field, protection has been developed and a small amount of regulations have been in use. The most effective of these were the Radiation Safety Standards (NRB99), but the legal force of these ended in 2009. Beginning in 2009, for almost 5 years in the country, there have been no regulations in this area. The first document, the «Updated Radiation Safety Standards, Basic Sanitary Rules of Radiation Safety», and other complementary standards should appear in 2016.

The new regulatory document provides clear and understandable definitions of radiation protection and radiation doses, and it provides actions for the development of activities to reduce and optimize the radiation dose on occupationally exposed workers.

The document lists the duties of the organization where there are in use radiation sources, it establishes requirements for optimizing decisions when choosing and financing radiation protection, and it establishes the basic measures (organizational and legal) for radiation protection. The new regulatory document concurs with the state and direction of government policy on the safety of workers that was provided in the Labour Code of the Kyrgyz Republic.

Interested parties in the country are invited to consider the following safety requirements:

- responsibility of the operator and employees,
- optimization of radiation protection,
- requirements for radiation protection plans,
- investigation levels and recording levels,
- information and training of workers,
- health surveillance,
- methods and means of protection, and
- establishment and use of dose constraints during different practices.

3.4 Basic regulations for radioactive wastes management generated in small organizations.

The purpose of this activity was to prepare a regulatory document that contains the basic provisions on the requirements and recommendations for safe radioactive waste management in small organizations that use radioactive materials.

These requirements were established because organizations may generate waste with a radionuclide composition that has a wide spectrum of different consistencies and aggregate properties, and the activity of this waste can vary over a wide range. However, the resulting volume of the radioactive waste and the intensity of RW usually is not significant, unless from disused radioactive sealed sources.

The main arguments for the development of this regulatory document for the management of radioactive waste that results from the use of radioactive materials in medicine, agriculture, research and education include:

- conditions for exemption or clearance from regulatory control,
- development of a safety culture,
- development of plans for the optimization of radiation protection, and
- safety improvements during the management of radioactive waste.

In the country, there is a number of laboratories and companies that use radioisotope instruments, calibration sources and conduct investigations using radioisotopes, which are radioactive materials. The development and improvement of radiation safety for managing small but dangerous amounts of radioactive waste is important.

Among the users of radioactive materials and radioisotope devices in the Kyrgyz Republic, there are medical organizations, research laboratories, logging organizations and industrial organizations, such as:

- Nuclear Medical Center, Cancer Center (Bishkek),
- Central Scientific Research Laboratory of «KGRK» (Kara-Balta),
- Mountain Department of CJSC, the «Kumtor Gold Company» (Issyk-Kul region),
- the radiological and laboratory DPZi GSEN at the Ministry of Health for the Kyrgyz Republic (Bishkek),
- the physical laboratory of the National Academy of Sciences of the Kyrgyz Republic (Bishkek),
- LLC «Sigma» (Kara-Balta),
- LLC «Chui Ecological Laboratory» (Kara-Balta),
- «Alex Stewart Ltd» (Kara-Balta), and others.

Currently, for the safe management of radioactive waste in these and similar organizations, the regulatory framework in the Kyrgyz Republic contains gaps. For new organizations, recently, training has been organized on radiation safety and safety culture. It is expected that part of the new regulatory regulations (NRB-2009, OSPRB 2009) that contain requirements for the control of exposure and dose limits and some of the requirements for radioactive materials will be issued only during 2015.

The new document will include issues for the management of radioactive waste, temporary storage, optimization of personnel protection given the volume, composition and activity determination of the hazard category of the radioactive waste and clearance from regulatory control when possible.

3.5 Conclusions

The documents developed under the Norwegian project allow more effective implementation of the radiation and waste safety requirements in the Kyrgyz Constitution and the government policy and strategy that is accordance with the policies and laws on radiation safety for the population, workers and environment. All documents were developed in accordance with the latest international recommendations.

Participation in the Norwegian project has influenced in the solution of the legacy situation in the country by improving the national legal and regulatory framework and enhancing the level of expertise of the specialists involved in the process of document development. All of the regulations that were developed during the projects in cooperation with the NRPA are new documents in Kyrgyzstan, and they do not repeat the requirements from other currently in place regulatory documents. The main gain is that these regulations will allow the development of a national policy and strategy in the near future for the safe management of radioactive waste and for the protection of personnel, the population and the environment.

The following documents were developed during the 2013-2015 period:

- law of the Kyrgyz Republic on the management of radioactive waste,
- regulation on remediation activities of uranium and thorium mining and processing facilities and sites of the Kyrgyz Republic,
- regulations on radiation protection in the Kyrgyz Republic, and
- safety provisions on radioactive waste management in small organizations.

Currently, in coordination with government bodies (ministries and agencies), documents are being prepared for passing expertise to the Kyrgyz Republic, which include regulatory impact analysis within working groups and legal and stylistic revisions.

Thus far, the Ministry of Justice posted the two documents adopted by the government in the field of radioactive substances and sources of ionizing radiation that were developed in collaboration with the NRPA during the 2009-2012 project:

- Guide for environmental monitoring around the storage of radioactive waste, and
- Guide for the management of radioactive waste.

Future cooperation should be focused on the uranium and thorium tailings, particularly on the management of lands after remediation, optimization of radiation safety during remediation and evaluation of the effectiveness of tailing remediation and waste dumps by establishing institutional controls including monitoring. One very important point for future consideration is the creation of an effective regulatory scheme for radioactive waste management and the problem of financing and other resources.

For the next period of cooperation, it is proposed to develop:

- a regulatory guidance document on the management of radioactive sources,
- requirements for decommissioning of radiation and nuclear facilities including waste management facilities,
- requirements and procedures for radiological monitoring plans and institutional control after closure of disposal facilities for radioactive waste produced by mining and processing facilities that contain uranium and thorium ores and materials, and
- regulations for the clearance of radioactive material from regulatory control and the safety requirements during the release.

3.6 References for section 3

1. *Law of the Republic of Kyrgyzstan General technical regulations «On Radiation Safety»*
2. *Law of the Republic of Kyrgyzstan «On the tailings and waste dumps» from 26.07.2001 №57.*
3. *Law of the Republic of «On radiation safety of the population of the Kyrgyz Republic», 17.06. 1999 №58. (amended on 28.03.2014 г)*
4. *Law of the Republic of Kyrgyzstan «On Environmental Protection» from 16.06.1999 №53 (amended in2012)*
5. *Law of the Republic of Kyrgyzstan «On Ecological Expertise» (amended 2012), № 102 from 13.05.1999*
6. *Law of the Republic of Kyrgyzstan «On Air Protection» (amended 2012 г.), № 109 from 13.05.1999*
7. *Law of the Republic of Kyrgyzstan «On the transfer (transformation) of land plots», № 145 from 30.05.2013*
8. *Law of the Republic of Kyrgyzstan «On normative legal acts of the Kyrgyz Republic» № 241 from 20.07.2009*
9. *Law of the Republic of Kyrgyzstan «On Subsoil» (amended 2013)*
10. *Law of the Republic of Kyrgyzstan «On the licensing system in the Kyrgyz Republic» (amended 2013)*
11. *Law of the Republic of Kyrgyzstan «On health care of the KR population» (amended 2012)*
12. *Normative acts of the Republic of Kyrgyzstan*
13. *NORM 17.5.3.04-83 «Earth. General requirements for land recultivation»*
14. *Radiation Safety Standards (NRB-2009) (introduced in 2015)*
15. *Basic sanitary rules of radiation safety (OSPORB-2010) (introduced in 2015)*
16. *Sanitary rules of liquidation and conversion of enterprises (SPLKP-91)*
17. *Sanitary norms of designing enterprises of the nuclear industry and installations. Part 5. Requirements of the design of the ore processing facilities (SNP-77) (introduced in 2015)*

4 Tajikistan

In Tajikistan, several uranium ore deposits and mining and processing facilities were operated in the past. The country's own ores and imported raw materials were processed primarily at the former Leninabad Geochemical Combine facility (currently SE «Vostokredmet») and at hydro-metallurgical plants that were located in the vicinity of the uranium ore extraction sites in Adrasman , Taboshar or Isphara.

Fig. 6. Locations of RW from various origins in the territory of Tajikistan

Based on the SE «Vostokredmet» estimations, the total amount of residual radioactive materials that are contained in the tailings and waste rock piles in Tajikistan is approximately 55 million tons (with a total estimated activity of 240-285 x 10^{12} Bq), and the total volume of waste rock piles and tailings in the vicinity of the former hydrometallurgical plants and chemical-leaching sites is more than 170 million tons.

The waste rock piles and tailings at Taboshar, Adrasman and Degmay (which are near the outskirts of Chkalovsk) are not well contained and/or protected. The surface of the tailings usually has no protective cover and has been eroded or damaged by burrowing animals. Significant amounts of contaminants are subject to dusting and wind blow. The current situation requires intervention and remediation activities. The covers over the tailings and waste rock piles are often washed away by water, mudslides and wind.

This situation creates a source of highly contaminated drainage water that is migrating into surface and ground water bodies that are used by the local population.

The following sites require more urgent remediation actions:

- Open tailings «Pure-ore Factory»,
- Digmay,
- Adrasman,
- shafts and the right bank balance ores of Khujand.

Fig. 7. Tailings in Adrasman in Tajikistan

Before remediation can occur, Tajikistan must face its normative-regulatory base limitations. For radioactive waste that was produced during former uranium production, existing regulations are not complete and require improvement and adherence with the latest IAEA Safety Standards.

The regulatory threat assessment report that was developed in 2008 showed that the level of threats for territories in Tajikistan that are already extensively contaminated with radionuclides can be reduced and maintained at acceptable levels if the following are met:

- an established strong and effective legal and regulatory framework, including proper enforcement actions to guarantee both the safe management of remedial actions and radioactive waste management, while providing an assurance that similar situations will not be repeated,
- a safety assessment and a radiological impact assessment for contaminated territories and, in accordance with the results of these assessments, taking the needed measures to diminish the risks, and
- conducting an institutional control, including the long-term monitoring and control over abandoned and remediated objects of the uranium industry to prevent unjustified exposure of the public.

To remove or decrease threats that are associated with the management of radioactive wastes, for both previously accumulated waste and waste that is currently being generated in significant amounts or will be produced in the future, it was necessary to enhance the regulatory framework with the development of:

- a national policy and strategy for radioactive waste management,
- a new classification of radioactive waste, including identification of corresponding categories,
- safety requirements for the design, placement, construction, operation, closure and establishment of institutional controls that are needed for disposal facilities in accordance with the approved national policy and strategy on radioactive waste management,
- safety requirements for the predisposal management of radioactive waste, and

- safety requirements for existing exposure situations and a clearance policy and clearance levels that are to be applied.

To improve this situation, the Parliament of the Republic of Tajikistan has adopted laws for radiation

safety, for the use of nuclear energy and for licensing certain types of activities. In the next phase, several regulations will be adopted, including a regulation on the state regulatory authority.

The Nuclear and Radiation Safety Agency of the Academy of Sciences of the Republic of Tajikistan (NRSA) was organized in 2003 in accordance with the law «On Radiation Safety». The NRSA is a state regulatory authority for the radiation safety of occupationally exposed personnel, the public and the environment. The NRSA started preparation of regulatory and legal documents for radiation safety right after it was founded. The documents were prepared with the participation of IAEA experts and some were based on existing Russian documents. However, during the process of implementation, Tajikistan was faced with application difficulties. Furthermore, a regulatory framework still does not exist for many types of activities.

The aim of the Norwegian project was to enhance the regulatory infrastructure in Tajikistan via the development of legislative, regulatory, methodological and other regulatory documents to ensure the radiation safety of occupationally exposed personnel, the public and the environment when work in different areas is planned. Activities of the project included:

- introducing amendments to the law on radiation safety in accordance with international standards,
- development and approval of new norms on radiation safety in accordance with the newly adopted law on radiation safety and the recently approved IAEA Basic Safety Standards (GSR Part 3), and
- elaboration and approval of a national policy and strategy for the remediation of the uranium legacy sites.

4.1 Amendments to the Law on radiation safety in accordance with international recommendations.

An analysis of the current regulations that are inforce on radiation safety was conducted in Tajikistan. A common agreement was that the law on radiation safety, despite its preparation with IAEA experts in 2002 and its approval in 2003, requires revision and amendments to be in compliance with the currently published IAEA safety standard series on radiation protection.

To identify the gaps and to have technical expertise for the review and development of the legal and regulatory framework with Norway's bilateral cooperation, Tajikistan participated in schools for drafting regulations that were organized by the IAEA. With IAEA experts' assistance, revisions of the drafts of the law and regulatory requirements on radiation and waste safety were performed by taking into account the national specifics.

The participation of Tajikistan experts in the «Schools for Drafting Regulations» was as follows:

- 2-27 May 2011 (legal and regulatory framework on RWM).
- 12 November – 7 December 2012 (law and norms on radiation safety in accordance with IAEA newly issued GSR Part 3).
- 25-29 November 2013 (Meeting on MS Progress and Feedback on IAEA Schools of drafting regulations).
- 3-14 November 2014 (National Program on implementation of National Strategy for remediation of legacy sites for 2014-2024).

The legal and regulatory framework on radiation safety was developed primarily in accordance with recently published IAEA GSR Part 3 by taking into account the national specifics. Upon comparing the

(based on IAEA GSR Part 3) latest drafts of the law and regulations with the current legislation in the country, it was discovered that the regulations contradict the existing Law 42 that was developed in 2003.

The NRSA's director decided to fully revise Law 42 to make it fully comply with the IAEA safety recommendations in addition to taking the national specifics into account. Law 42 was fully revised and officially submitted to the IAEA Office of Legal Affairs (OLA) for their review, comments and proposals. On 31 October 2014, comments and proposals were received from the OLA. Most of the OLA comments were incorporated into the law, and its official negotiation began with relevant ministries and authorities that led to further submission to the Parliament for approval.

4.2 Elaboration and approval of a new standards on radiation safety in accordance with new adopted law on radiation safety and new IAEA BSS.

Standards on radiation safety were developed in cooperation with IAEA experts during the IAEA school for drafting regulations from 12 November to 7 December 2012 in accordance with the newly issued IAEA GSR Part 3. The approval of these standards is pending. Once the new Law 42 is promulgated, the NRSA will be authorized, in accordance with Article 6 of this law, to approve the already developed standards on radiation safety in bilateral cooperation with Norway.

4.3 Elaboration and approval of the national policy and strategy in the field of uranium legacy sites remediation.

A national strategy was developed in accordance with the latest IAEA safety standards and technical documents on the remediation process for areas affected by past activities and accidents. Currently this national strategy was approved by the President of Tajikistan via a Governmental Decree. Approval of the national strategy for the remediation of the uranium legacy sites lead to the assigning of a national body that is responsible for this task. By Governmental Decree, the Ministry of Industry and New Technologies was tasked with performing all physical remediation jobs at all sites.

The national strategy approval also leads to the approval of several other documents related to this topic, particularly:

- By the Governmental Decree of the RT from 08.01.2014, № 505 was approved the «National Strategy of the Republic of Tajikistan on remediation of tailings UPLS for 2014 - 2024.»
- Its main objectives include the creation and effective functioning of an integrated system for radioactive waste management of legacy uranium. This includes minimum radiation exposure of the population and the environment by ensuring radiation safety during radioactive waste management, special measures for the radiation protection of the population, the remediation of contaminated sites and tailings of radioactive waste and physical protection of radiation hazardous facilities,
- RT Governmental Decree №507 dated 1 August 2014 on State Cadastre of RW storage facilities.
- RT Governmental Decree №524 dated 2 August 2014 on State Authorized Body for legacy sites remediation (responsible for all stages of remediation process).
- RT Governmental Decree №362 dated 30 May 2015 on Order of radioactive waste movement through state border to foreign countries and within the Republic of Tajikistan.
- Registration Card for storages of RW temporary storage. Amendment to RT Governmental Decree №507 dated 1 August 2014

4.4 Conclusions

After the collapse of the Soviet Union, there was an urgent need for the development of the legal and regulatory frameworks for radioactive waste management because the previous Soviet Union regulations did not take into account the problems that the country currently faces and did not comply with

international standards on RWM. For this purpose, the bilateral project with the NRPA contributed to improving the legal and regulatory framework. However, there is an urgent need to develop other documents, such as a national program for the implementation of the national strategy for the period from 2016 until 2024, and other regulatory requirements because the actual work related to a feasibility study and environmental impact assessment began at different legacy sites (different international projects) without appropriate legislation in place. Thus, there is an urgent need to develop these documents to supervise the current activities in accordance with developed legislation that will be in place.

The infrastructure of the regulatory body should be adequate enough to supervise all of the activities performed by different organizations in the country. Currently, the regulatory body faces problems that require urgent solutions. These areas include the follow.

Training of regulatory authority staff

Because the regulatory body and its Technical Support Organization (TSO) is tasked with the review, assessment and licensing of the remediation activities of the legacy sites, there is an urgent need to organize the proper qualification of the regulatory staff which can include fellowships for at least 4 staff of the regulatory body and two staff of the TSO. These fellowships should be focused on reviewing the licensing process, which includes familiarization with the set of documents that are provided by operators as required and must be given to the regulator for the licensing process. Based on this familiarization, necessary amendments will be introduced for the regulation of Tajikistan on licensing the activity related to remediation of legacy sites. Currently, necessary provisions are available in the legislation that require the operator to get a license before performing any kind of activity related to the remediation. However, the regulator does not develop the set of documents that are required for the operator for submission of required documentation and information. It is not enough just to know what set of documents should be submitted by the operator, it is also necessary for the regulator to familiarize themselves with the entire process and visit a site that has already been remediated. TSO staff need training from technical perspectives, which includes but is not limited to performing monitoring of sites before, during and after remediation, spectrometry measurements, measurement and interpretation of the results of monitoring programmes from legacy sites and other technical aspects related to these activities.

Equipment, tools, accessories and accreditation of the laboratory in accordance with ISO standards

Currently, regulators and the TSO has an infrastructure in place to perform measurements of different samples from legacy sites to make interpretations. However, the laboratory is not fully equipped to make it fully operational. Thus, there is an urgent need to procure small tools and accessories that will allow the regulator and TSO to perform analysis in accordance with international standards and to validate the data submitted by operators during their activity.

Upgrading the infrastructure of the NRSA branch office in the northern part of Tajikistan

Because all of legacy sites of Tajikistan are located in the northern part of Tajikistan, there is an urgent need to upgrade the infrastructure of the NRSA branch office in the north. First, this implies purchasing or constructing a new building for the NRSA branch office because currently the branch office is renting two rooms for their activities. There is no space for the laboratory, and the current space is not sufficient to perform their regulatory functions adequately. Among the other support for the NRSA branch office, there is an urgent need to equip the laboratory, train the staff on the subjects mentioned above, provide vehicles for inspection activities and provide other urgent components that are necessary to adequately perform the regulatory functions.

5 Uzbekistan

For more than 40 years, the Republic of Uzbekistan was one of the material bases of the uranium industry in the former USSR. Large uranium deposits were discovered in the area of Syr-Darya and Amu-Darya rivers.

During the mining process, the ore was extracted, sorted and delivered for further processing to the Navoi Ore Metallurgical Combine (Navoi, Uzbekistan) and to the Leninabad Ore Chemical Combine (at present – SE «Vostokredmet» in the town of Khujand, Tajikistan). A large portion of the waste generated during extraction and processing was stored at the mine sites, in particular, on the slopes of the river valley from the Yangiabad settlement to the Angren city. A similar pattern was observed at other mining areas. Some uranium-containing ore waste from underground mining was disposed of at underground mines.

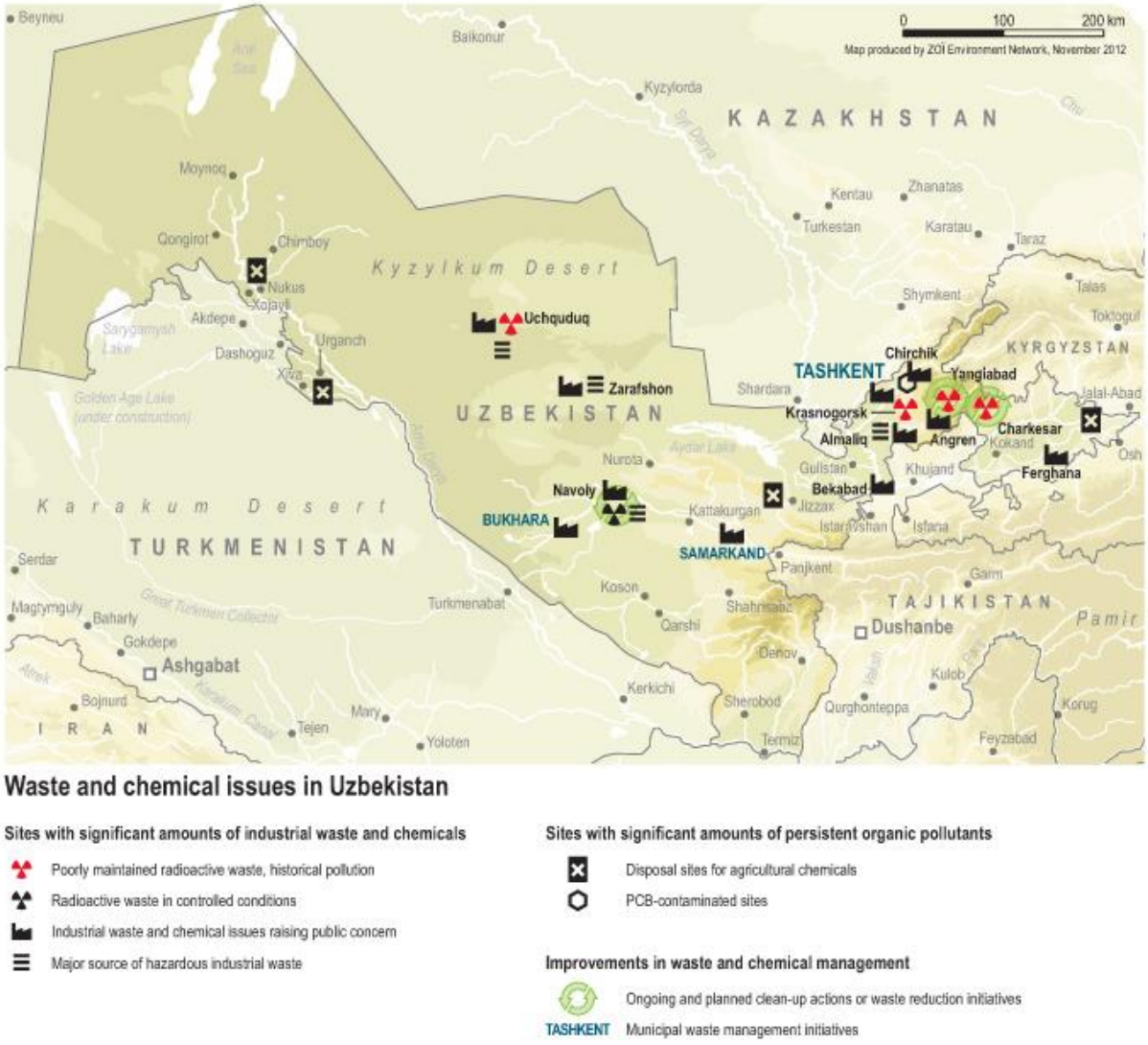

Fig. 8. Locations of RW from various origins in the territory of Uzbekistan

Most uranium mines and processing plants were shut down before 1995. The decommissioning and closing of uranium mines and facilities were performed without any significant engineering measures or

regulatory oversight and sufficient financing. Moreover, some facilities were simply abandoned. Today, these unprotected sites can potentially affect the human health and the environment.

Safety assessment, monitoring and, if necessary, remediation of territories that inherited the environmental pollution problem should be provided via the appropriate legislation and regulations on radiation safety, environmental and health protection.

Natural events, such as earthquakes (which became an everyday occurrence in these regions), landslips, avalanches and storm rain can do serious harm to unstable tailing dumps and lead to the discharge of potential dangerous waste NORMs into the environment.

Regular uranium ore extraction and processing activities led to the formation in the region of a large quantity of RW, which is placed in mountain and tailing dumps. The greatest threat is represented by tailing dumps from operating and closed, without any institutional and regulatory controls, mining enterprises due to weak protection from natural disasters and proximity to the Central Asian waterways, cities and national frontiers. It is necessary to note that, in Central Asia, uranium «tails» are concentrated in the densely populated Fergana valley, in particular, in the Sogdijsky area of Tajikistan, in the Dzhalalabad region of the Republic of Kyrgyzstan, and also in Tashkent and Navoij regions of the Republic of Uzbekistan. These tailing dumps conceal a potentially threat to people and the environment. There is a real danger of pollution of underground waters and territories (during natural cataclysms) as well as of the rivers of the Central Asian water pool. The risk is very high, and the consequences of possible failures can be significant both for a large number of people and for the environment.

In Central Asia, the problem of uranium tailing dumps (incorporating long-living radioactive and toxic elements) is extremely serious. If an urgent and effective solution is not provided, the problem can become the reason for emergency situations on a regional scale with a transboundary character. To liquidate the consequences of such events, considerable means and dozens of years can be required, because the RW contains radionuclides with a long half-life (up to some thousand years). Currently, the Republic of Uzbekistan does not have sufficient financial and technical resources to ensure remediation of polluted territories with long-lived radioactive and toxic elements and long term safe disposal of RW. The decommissioning and closing of uranium mines (Charkesar, Yangiabad and Krasnogorsk) were conducted under insignificant technical measures or regulatory oversightand without sufficient financing. Some objects were simply thrown away. The absence of qualified experts and experience in the given field was a common problem after the acquisition of independence.

Fig. 9 Typical picture of the Charkesar-1 uranium mine

The major factors that define the state strategy in the field of radiation safety and radioactive waste management in the Republic of Uzbekistan are as follows: first, the presence of radioactive waste, including waste from uranium mining and processing industry and other sources andsecond, the necessity to remediate Uzbekistan territories contaminated by past practices performed without safe and proven technologies for processing these materials.

Fig. 10. Former ore concentrating plant in Yangiabad

Between 1992 and 2002, a number of laws (i.e., «The law on state sanitary inspection», «About radiation safety» and «About waste») were issued in the Republic of Uzbekistan. In 2009, Uzbekistan ratified the Joint Convention on the safety of spent fuel and radioactive waste.

In 2010, the Cabinet of Ministers approved the organizational and technical measures for the preparation and implementation of remediation projects for radioactive tailings. The existing legal and regulatory frameworks in the Republic of Uzbekistan in the field of uranium industry and produced in this industry radioactive waste required revision and development in accordance with international standards and in accordance with national priorities. There was a clear need to develop regulations and work procedures for radioactive uranium waste.

In August 2010, a contract was signed between NPRA and the state regulating authority of Uzbekistan (SI «Sanoatgeokontehnazorat») in the framework of the project «Support for the development of standards and regulations for the management of radioactive waste and its long-term monitoring». In 2012, the project was renewed. The main goal was to support the development of the regulatory basis and to strengthen the capacity of the Regulatory Authority on radiation protection of occupationally exposed personnel, public and the environment at planning and performing work related to RW management at tailing dumps, areas with increased content of radioactive elements and off-balance ores.

The work under this cooperation was performed by the Institute of Nuclear Physics of the Academy of Sciences of the Republic of Uzbekistan with a support of experts from NRPA, Ministry of Public Health of the Republic of Uzbekistan, SI «Sanoatgeokontehnazorat» and the Scientific-Production Centre «Geology of Uranium and Rare-Earth Metals» of the Republic of Uzbekistan. Three main documents were developed:

- Governmental document on «National Strategy for the management of radioactive waste produced in the former uranium mines of the Republic of Uzbekistan for 2013-2021».
- Sanitary codes and rules for carrying out environmental radiological monitoring in the territories of tailing dumps of uranium production.
- Regulatory documents on long-term storage of radioactive waste. Related to this three documents have been developed:
    - Requirements on long-term storage of radioactive waste.
    - Guideline on ensuring of radiation safety at long-term storage of RW.

- Rules on radiation safety during remediation of territories and facilities from uranium legacy sites.

5.1 Development of Governmental document «The radioactive waste management strategy of the former uranium mines of the Republic of Uzbekistan for 2013–2021»

The RW management strategy is based on the Constitution of the Republic of Uzbekistan, decisions of its Government and on the safety requirements for managing radioactive waste that were developed within the frame of the previous NRPA project . Additionally, this strategy corresponds to the requirements of the Joint Convention on safe management of Spent Nuclear Fuel and Safe Management of RW, which was ratified by the Republic of Uzbekistan.

The main objectives of the Strategy are to solve problems in the field of RW management of former uranium mining and processing facilities and to establish a legal framework for the management of a newly formed and previously accumulated radioactive waste as well as for the safety of the public living at the areas of tailing dump locations.

The primary objectives of the Strategy for solving problems related to safe management of the previously and newly formed RW from uranium industry are:

- creation of mechanisms for safe management of the RW, including the establishment of modern standard-legal framework for regulating management of RW,
- development of technologies and acquisition of means for the maintenance, detection, gathering, processing, temporary storage, remediation of legacy sites, management and transportation of RW,
- creation of safe facilities for reliable isolation of RW to minimize their influence on the environment during long-term storage,
- development and realization of target programs aimed at reduction of RW formation in the uranium industry and remediation of polluted territories,
- improvement of the national emergency response system for major radiation accidents,
- formation of the information field for reporting radiation problems and ecological situations in the interests of sustainable development of the State and its society, and
- expansion of international cooperation in the field of RW management.

To achieve the defined goals of the National Strategy it is necessary to act in the following directions:

- improvement of the existing legal and regulatory framework on radiation safety, particularly for existing exposure situations, as well as for the state monitoring system and the management of RW of former and existing uranium industry,
- provision of financial resources needed for remediation of radioactive objects and for safe management of radioactive waste of former uranium industry to an ecologically and radiologically safe state,
- creation of a real coordination system of departmental activities for emergency response to radioactive objects,
- optimisation of a licensing system for the realization of RW management activities and independent review of activities connected with such waste,
- improvement of control and statistical reporting systems of RW,
- establishment of an effective institutional control including long-term monitoring where it is needed, and
- expansion of the international cooperation in the field of radiation and ecological safety.

In the developed document, the implementation mechanism of the Strategy provisions is presented for the short- and long-term, regional and branch programs. All programs are directed to solve problems in the field of management of RW of former and operating uranium mines in the Republic.

In addition, attention is given to the development of program-target methods of RW management of former uranium mines with a special attention to medium-term planning. Furthermore, special attention is provided to the development and acceptance of strategy and program documents that define long-term prospects in the field of management of RW from former uranium mines in the Republic. The Strategy realization will be conducted in three stages.

5.2 Carrying out control monitoring of the radio-ecological state of tailing dumps of uranium industry

The proper application of regulatory documents needs to be proven in real life. The radio-ecological monitoring on the territories of legacy uranium mining and processing sites and facilities is performed by a number of organisations of the Republic. However, there is no uniform execution approach. Within the cooperation with NRPA, elaboration of the Sanitary Codes and Rules for conducting radio-ecological monitoring of the environment was planned and performed. The practical use of the document, which was developed with the support of the Norwegian Radiation Protection Authority, will strengthen the authority of the regulatory body in the Republic. Charkesar was chosen as a pilot object for monitoring. It was chosen because remediation actions are implemented on part of the object by the government. Therefore, the requirements, established in the Sanitary Codes, should be practically implemented.

Radio-ecological monitoring was performed at the uranium deposit of Charkesar. It is located at the foothills of the Kuraminsky ridge, in the Pap district of the Namangan region of Uzbekistan, northwest of the densely populated Fergana valley. The deposit was produced by two mines: Charkesar-1 and Charkesar-2. The Charkesar-2 mine is located at the suburb of the settlement with the same name in the valley of a small mountain river. The Charkesar-1 mine is located 5 - 6 km to the west in a waterless desolate mountain valley. The total activity of radionuclides, which are in the industrial areas of the Charkesar deposit, is estimated to be 3×10^{13} Bk. The total amount of radioactive dumps is 482.5 thousand m^3, located on the area of 206.2 thousand m^2.

The work on qualitative and quantitative estimation of the state of the surrounding environment was performed. It included 1) collecting soils, off-balance uranium ores from dumps and mines, and vegetation, 2) radiation inspection of inhabited premises and administrative structures at the Charkesar settlement, and 3) laboratory analysis of the selected samples. Based on the received data, the characterization of both mines was accomplished.

Fig. 10. Outflow of the mine water in Charkesar 1

The content of radionuclides and toxic metals in self-streaming mine waters was assessed. Radionuclides and heavy metals arrive with mine waters and accumulate in the soil of the sanitary zone of the mine. It is reasonable to expect that the process will be also apparent in adjoining areas. Therefore, pollution of the

soils, which are located in immediate proximity to the Charkesar settlement, is formed. At its limits, the mine water is filtered in a friable water-permeable adjournment. This can lead to pollution of the underground fresh water, which is located lower on a relief and forms a deposit of fresh underground water, which is used as a water supply for the population. Rock debris and off-balance ores without appropriate supervision collapse and pollute the environment. The distribution of radioactive pollution towards the relief fall is fixed. It is shown that:

- water with a high concentration of radionuclides is used to water livestock. In addition, constant outflow of mine waters can lead to pollution of soils and underground water with radionuclides, and
- raised discharge of radon from the surface of dumps at the Charkesar-2 mine leads to the exposure of population living at the Charkesar settlement.

Based on: the collected historical information, received monitoring data, criteria for remediation actions and other sources of information, the territories will be defined as sites where remediation actions are needed. The critical pathways of exposure should be defined, and the estimation of doses to the personnel and the population have to be conducted. The results of the monitoring should be used to perform and verify the safety assessment.

5.3 Development of the sanitary codes and rules for performance of radio-ecological monitoring of environment on the territories of tailing dumps of uranium production.

The existing legal and regulatory framework in the Republic of Uzbekistan corresponds to the basic provisions of the international documents. However, it is necessary to complement this framework, especially in the field of management of RW from the uranium industry by taking into account the national priorities.

The development of a regulation which establishes safety requirements for disposal of radioactive waste in Uzbekistan as well as the requirements needed for the development and implementation of the institutional control including monitoring of these facilities is of significant importance for the Republic. In Uzbekistan, there are sanitary rules for liquidation, preservation and reshaping of enterprises of mining and processing of uranium ores that need to be completed by taking into account the received data from the threat and safety assessmentsof former uranium mines.

The Sanitary rules and codes (further - SanPin) establish requirements for the organization and implementation of the state radio-ecological monitoring (further - REM) on the objects where the radioactive waste from uranium industry is located.

REM of the environment is directed towards characterizing the situation and assisting in the decision making process to solve the problem of radiation impact on the environment. Additionally, REM forms an information basis for developing the state strategy for ensuring radiation safety of the population and the environment.

The scale of REM should achieve control and be sufficient for the decision making process. SanPiN is designated for ensuring radiation safety and preservation of the environment

The environment control criteria and the necessary characteristics of water, atmospheric air, soil, ground and vegetation are defined.

5.4 Requirements for long-term disposal of radioactive waste

This document establishes the safety requirements fr the design, construction, operation and closure of near-surface disposal of radioactive waste in tailing dumps from uranium mining and processing and establishes requirements to ensure safety of the long-term disposal of RW.

The document establishes the general requirements. The safety of disposal facilities should be provided during their operation, closure and post closure period. The document establishes that solid or conditioned RW is subject to long-term storage or disposal.

The acceptance criteria of RW disposal are based on the results of the safety assessment of the system, the characteristics of the site, and both facility features and RW packages are taken into account. For the organizations that produce waste, the establishment of characteristics of RW packing, its collection and maintenance will be key for assuring the quality of RW management before its disposal.

The basic requirements and recommendations for accepting radioactive waste for disposal are as follows:

- requirements for basic characteristics of the RW form,
- requirements for RW containers,
- requirements for RW packaging,
- recommendations for admissible radionuclides and for the content of radionuclides in near-surface disposal facilities,
- recommendations for the sphere of applicability of RW characteristics, which are used for establishing acceptance criteria of the conditioned RW for its disposal,
- requirements for the site for placing the RW disposal facility, and
- requirements and recommendations for safety assessment of the RW disposal facility.

The set of requirements and recommendations serves as a guideline for developing methods for: RW conditioning, operation of installations for processing and conditioning of RW, designing, operating and closing the RW disposal facility, establishing waste acceptance criteria for the disposal of RW in disposal facilities.

5.5 Guideline on ensuring of radiation safety at long-term storage or disposal of RW

The state owns facilities for long-term RW storage, facilities for holding special RW, disposal facilities for special RW and other facilities for RW storage. The state does not own RW storage facilities on the premises of RW producers.

The owners of RW and of the facilities for RW storage are obligated to provide safe RW management, safe operation, decommissioning or closing of facilities for RW storage or disposal. The purposes of ensuring safety of managing RW are:

- to ensure reliable protection of the workers (personnel), the public and the environment from radiation exposure due to RW,
- to ensure reliable isolation of LRW and SRW from the environment, protection of present and future generations and biological resources from radiation exposure without imposing an excessive burden on future generations, and
- to prevent, during RW management, emission (release) of radioactive substances into the environment in quantities that exceed limits, which were established in the authorized standard legal acts and/or in the authorization.

When managing RW, the following principles should be observed:

- ensure comprehensive level of safety for workers (personnel) and public from radiation exposure to RW according to the principles of justification, limitation and optimization (a principle of health protection),
- ensure comprehensive level of safety for the environment from harmful radiation exposure to RW (a principle of environmental protection),
- account for the interrelation between different stages of RW formation and its management (a principle of interdependence of stages of RW formation and its management);

- predicted levels of irradiation of future generations due to RW disposal should not exceed permissible levels of population irradiation that are established by the currently enforced standard documents (a principle of protection of future generations);
- unreasonable burden for ensuring RW management safety should not be imposed on future generations (a principle of not placing burden on future generations);
- formation and accumulation of RW should be limited to a minimum achievable level (a principle of control over the formation and accumulation of RW), and
- prevention of accidents with radiation consequences and attenuation of possible consequences in case of their occurrence.

The safety assessment includes analysis of the design, operation, shutdown, decommissioning or closure of radioactive waste storage/disposal facilities to ensure the protection of the workers and the public, as well as the environmental protection under normal conditions and during emergencies.

Safety assessment should be periodically reviewed and, if necessary, safety should be reassessed when changes occur in safety requirements or in operational conditions, installations or procedures.

The typical operational activities associated with radioactive waste storage are the routine operations of receipt, processing, placement, storage and retrieval of waste packages and their preparation for disposal. The supporting activities include radiation protection, monitoring and surveillance, testing and examination of waste packages, inspection of components of the storage facility, maintenance and repair, labelling of waste packages and record keeping.

Storage facilities should operate in accordance with written procedures. These procedures should ensure the compliance with operational limits and conditions that are approved for the storage facility and authorized by the regulatory body.

Modification of the storage conditions should be subject to specific plans and procedures and should be accompanied by appropriate authorizations from the regulatory body. The impact of any modifications on the safety of the stored waste should be considered in the reviewed safety assessment in each case.

Storage and disposal facilities should operate in accordance with a set of operational limits, conditions and controls that are derived from the safety assessment of the facility to identify safe operational boundaries. Operational limits and conditions define specifications that relate to waste packages, safety systems and procedures, radiological criteria and requirements for the qualification and preparedness of personnel. Operational limits and conditions for storage facilities should be developed by the operator and should be subject to approval by the regulatory body. Operational limits and conditions should be revised, as necessary, based on the experience from commissioning, operating and modifying the facility and based on changes in safety standards.

The risks posed by the waste and its storage conditions should be taken into consideration for determining the operational limits and conditions. The operational limits and conditions will be specific to each storage facility. The operator may wish to set administrative margins below the specified limits as an operational target to remain within the operational limits and conditions.

The problems of radiation protection, maintenance service, checks and inspection, safeguarding and management of access, emergency preparedness and readiness and developing documentation on safety of the objects of long-term storage of RW are considered.

5.6 Rules on radiation safety during remediation of territories and facilities from uranium legacy sites

The rules, which are based on the recommendations of ICRP and IAEA safety standards, establish uniform approaches for ensuring radiation safety of the personnel, the public and the environment when conducting work on remediation of territories and objects that are contaminated because of the activities of uranium ore mining and processing enterprises.

The duties of the operator and of the regulatory body are established in the given document. These duties relate to the elaboration and review of the remediation plan and its performance even after the realization of all remediation actions. The principles of safety assessment of reliability and optimization are stated. The content of the remediation plan is described as well as for institutional control and requirements for ensuring radiation safety during the remediation actions.

According to the basic international standards on radiation safety, the surveillance and control areas are established on the territory of the facility or site to be remediated.

The control zone is a limiting zone, where it is required or can be required to have special protection and safety measures to control exposure or prevent dissemination of radioactive pollution under normal operating conditions and to prevent or restrict the level of potential exposure.

The surveillance area is a zone, where working conditions are under supervision. However, usually, special measures of protection and safety are not required. A zone of control may be within controlled area, but it is not obligatory.

In the control zone, it is necessary to create a number of zones, inside which concrete special measures of protection should be introduced. The borders of these zones are defined depending on the expected radiation doses of the personnel during the remediation work. The criteria of remediation, which depend on the reference levels, are established by the regulatory body and are considered in this document.

The following potential uses are possible for uranium mining and processing sites after performing remediation actions:

- change the designated purpose of basic structures, buildings, engineering systems and equipment of the facility to bring them to radiation-safe conditions for conducting other industrial activities (e.g., mining and processing of mineral and organic raw materials), and
- liquidate installations to further use the territories and objects for:
    - limited and controlled agricultural activities, livestock farming and fish-breeding,
    - constant residing of the population,
    - temporary stay of the population (a park or a rest zone), and
    - unlimited use of the platforms for agricultural activity, livestock farming and fish-breeding.

Radiation monitoring should be conducted throughout the remediation process and, when needed, as part of the institutional control.

The requirements for monitoring different environmental objects (potable water, surface water, underground water, atmospheric air, air aerosols, radon, soil and foodstuff) are described. The requirements for releasing territories and installations from regulatory control after conducting remediation actions are established.

5.7 Conclusions

The strategy was developed for radioactive waste management of former uranium mines in the Republic of Uzbekistan for 2013-2021. The importance of this document is defined by the need to solve radiation safety problems and the need to implement remediation actions in polluted contaminated territories of the republic of Uzbekistan. The strategy for remediation of legacy uranium mines and processing facilities encompasses problems such as improvement of the legal and regulatory framework, systems of the state control and financing mechanisms. In addition, the systems for review, optimisation, and authorization are defined. The mechanism of the strategy realization in three stages was developed. The strategy is in the cabinet of ministers of the RU for approval.

The monitoring of radiological conditions of the most dangerous territories of legacy uranium mines and processing in the Charkesar settlement was performed. During this work, qualitative and quantitative evaluation of conditions in the surrounding environment was conducted. This includes selection of soils,

off-balance uranium ores from dumps, mine waters, and vegetation as well as radiation inspection of inhabited premises and administrative structures in the Charkesar settlement. Additionally, laboratory analysis of the selected samples was performed. Based on the obtained results, both mines were characterized.

Radio-ecological monitoring of territories of the heritage of the uranium manufacturing industry is conducted by a number of organisations of the republic. However, there is no coherent approach for its implementation. Therefore, sanitary codes and rules on how to plan and perform radio-ecological monitoring of the environment was developed. The sanitary code is already approved by the main health officer of the Republic of Uzbekistan.

The presence of significant amount of RW from uranium production requires safe management. Safe management is impossible without a proper legislative and regulatory base. To ensure radiation safety of the contaminated territories, it is necessary to evaluate the risks due to deficiencies in legal and regulatory framework of RW from uranium production. During the performance of Task 4 of this project, three documents were developed, which took into account the international standards and recommendations:

- Requirements on long-term storage of RW,
- Guide on ensuring of radiation safety at long-term storage of RW, and
- Rules on radiation safety during remediation of territories and facilities of legacy uranium mining and processing facilities.

All three documents were submitted to SI «Sanoatgeokontehnazorat» for approval.

In general, during the cooperation between NPRA and the state regulating authority of Uzbekistan SI «Sanoatgeokontehnazorat» in 2010-2015, the following documents were developed:

- Threat regulatory assessment report ;
- Guidance on the classification of radioactive waste in Uzbekistan;
- Requirements for the management and disposal of radioactive waste in Uzbekistan;
- Requirements for monitoring radioactive waste disposal facilities;
- Radioactive waste Concept of the former uranium mines of the Republic of Uzbekistan for the period 2013-2021 years;
- Sanitary codes and rules of the radiological environmental monitoring at the uranium industry tailings;
- The requirements for long-term storage RW;
- Guidelines for radiation safety during long-term storage;
- Rules on radiation safety during remediation areas and settings uranium legacy.

Almost all of the abovementioned documents were developed after the threat assessment report (2011), where regulation gaps were identified. Five years later, the regulatory threat assessment report requires an update. Below in the table that summarizes the updated information.

Table 1. Summarized data on identifying regulation gaps in Uzbekistan.

Document	Availability in the regulatory base of the Republic of Uzbekistan	Risk due to underdevelopment of a document
The law on radioactive waste	Absent	Improper distribution of duties and responsibilities, which results in incorrect interactions between the authorities, regulatory bodies and operators
Regulatory requirements for elaborating the safety case and safety assessment for any activity or facility that deals with the radioactive waste management	Absent	Improper placement, design, construction, operation, shutdown, decommissioning, closure and remediation
Regulatory requirements for the final disposal of radioactive waste	Absent	Radiation threats both to present and future generations
On the institutional control of shutting down closed mining and disposal facilities	There are internal regulations for controlling stopped facilities at closed plants	Risks to the public due to high exposure doses and threats to the environment
Regulations for safe closure and decommissioning of facilities	Absent	Improper planning of actions and irregular allocation of resources. Overexposure danger to workers and the public
Regulation for managing spent nuclear fuel	Absent	Potential risks to the personnel and the environment
Methodology for estimating the influence of tailing dumps from uranium production on the population health	Absent	Incorrect risk assessment and decision making
Regulations for managing other RW (e.g., medical and industrial)	Partially developed	Improper management of such waste
Regulations for managing NORM radiation sources	Absent	Potential risks to the population and to the environment

6 Russian Federation

More than fifty years of the industrial development of nuclear power, nuclear weapons and a nuclear fleet contributed to the development of the the mining and processing of uranium ores and uranium industry. In the former USSR, the main uranium mining and processing facilities were located in the middle Asian republics (today, they are the Central Asian countries). By the late 1990s, the majority of these facilities were closed. To summarize previous chapters, for various reasons, not all companies in the Central Asian countries completed remediation. There was a lack of proper supervision and maintenance, protective coatings for tailings and waste dumps, and poor conditions of drainage systems and treatment plants. A safe remediation process should have been followed for the closure and decommissioning of the uranium sites and facilities. This resulted in worsening radiation situations on and off the sites.

One of the conditions for successful remediation is adequate regulatory supervision that is performed due to an update in the legal and regulatory framework.

All of the republics of the former USSR regulated in some way the following areas:

- design of facilities,
- arrangement and operation of underground and heap leaching of uranium,
- operation of uranium mines, and
- closure, conservation and function changes of facilities for radioactive ore mining and processing.

Some of these regulations are still inforce today. Nevertheless, the majority do not comply with the latest radiation safety requirements (postulated in the relevant ICRP and IAEA documents) and require for revision.

Currently, the Central Asian countries and Russia are involved in the development of regulatory documents on the management of sites and facilities that are contaminated following the activities of former uranium mines.

To be accordance with regulations concerning the post-USSR uranium legacy in Russia and Central Asia, there was a need to have one coordinated approach to ensure radiation safety during the remediation of territories and facilities, including the post-remediation period. This became the primary objective for the joint NRPA and FMBC projects with active participation from Central Asian national regulators.

The departments include:

- Institute of Nuclear Physics of the Uzbekistan Academy of Sciences of Uzbekistan
- Department of Information and International Relations of the Nuclear and Radiation Safety Agency of Tajikistan,
- Chui Ecological Laboratory from Kyrgyzstan
- Department State Scientific and Technical Centre for Nuclear and Radiation Safety of Ukraine.

The project activities began with an assessment of the radio-ecological conditions of the uranium legacy sites and facilities in Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. During the next step, regulatory documents were developed under NRPA cooperation between 2008 and 2014 and were reviewed by Russian experts. Then, the following guide was developed: «Radiation Safety Regulation during Remediation of the Former Uranium Mines». The document includes approaches for assurance of radiation safety of workers and the public during various stages of remediation, the conducting of radiation control and monitoring, the generation of remediation criteria, radiation protection optimization, etc. The guide intends to be used during development of national normative and methodical regulatory documents of Russia and the Central Asian countries, taking into account the national legislation and radiation safety regulations and standards.

6.1 Findings of the radio-ecological assessment at the uranium legacy sites in the Central Asian countries

The results of the survey were used during the development of the guide for the radiation safety regulations during remediation of the uranium legacy sites. The collected data showed the level of existing information and knowledge on areas of the uranium legacy, including nearby settlements gamma dose rates and concentrations of the natural radionuclides in the soil and surface water to assess the environmental impact of the contaminated sites. In total, 119 publications were reviewed and additional studies were conducted for Orlovka village (Kyrgyzstan). In particular, the following were studied:

- gamma dose rate,
- specific activities of the natural radionuclides in soil, including distributions by site area and depth,
- activity concentrations of the natural radionuclides in the vegetation,
- activity concentrations of the natural radionuclides in the water (mine water, drainage water, and water from surface water bodies),
- radon activity concentration in the air,
- radon exhalation from the soil surface, and
- activity concentrations of the natural radionuclides in the air.

Tables 2-5 include basic information about the analysed legacy sites in the Central Asian countries.

Table 2 Main uranium legacy sites in Kyrgyzstan [3,4]

No.	Waste storage site	Number of facilities	
		Tailing impoundments, slurries	Waste rock dumps
I Zapadnyi (Western) Mining and Chemical Combine			
1.	Town of Mayluu-Suu	23	13
2.	Shekaftar settlement	-	8
II Kara-Balta Ore Mining Combine			
3.	Min-Kush settlement	4	4
4.	Kadji-Say settlement	1	1
III Kyrgyz Mining and Metallurgical Combine			
5.	Ak-Tyuz settlement	4	3
6.	Orlovka settlement (Bourdu)	1	4

Table 3 Information on the tailing impoundment legacy sites in Tajikistan [5]

Name of tailing impoundments	Location
Tailing impoundment	Digmay cavity, 1.5 km - Gozien
Tailing impoundment	Town of Gafurov, 0.5 km
Tailing impoundment, Maps 1-9	2 km from the town of Chkalovsk
Tailing impoundment (I-II phases)	Town of Taboshar,2 km
Tailing impoundment (III phase)	Town of Taboshar, 0.5 km
Tailing impoundment (IV phase)	Town of Taboshar, 1.0 km
Tailing impoundment Shop No. 3	Town of Taboshar, 3.0 km

Name of tailing impoundments	Location
Storage facility of the poor ore mill (POM)	Town of Taboshar, 4.0 km
Tailing impoundment 2	1 km from the settlement of Adrasman
Mine-3	2 km from the town of Khujanda

Table 4 Basic facts about the RW tailings of active and former uranium ore mining and processing facilities in Uzbekistan [6]

Facility	Type of waste
Town of Navoi	Uranium industry waste. MP-1
Town of Uchkuduk and its suburbs	Off-balance ores
Sectors in mines in the suburbs of Uchkuduk, Zafarabad and Nurabad	Contaminated soil from processing solution spillages
Suburbs of Angren and the villages of Charkesar and Krasnogorsk	Waste dumps of off-balance ores, contaminated equipment, buildings and constructions

Table 5 Closed sites of the uranium industry in Kazakhstan [7]

City/Name	Object	Number of objects
Tomaskoye	mines	1
Aktau/Melovoye	mines	2
Zaozerniy/Zaozernoye Mine No.8	mines	1
Tastukolskoje/Rudnik No.9	mines	1
Aksu/Manubaiskoje	mines	1
Shatskoe	mines	1
Kokshetau/Ishimskoje	mines	1
Kokshetau/Balkashinskoje	mines	1
Shokpak/Shokpak,Kamyshovoje	mines	2
Saumalkol/Grachevskoje/Rudnik No.12	mines	1
Muzbel/Kurdai	mines	1
Aktau/ Koshkar-Ata	mill tailings	1
Tselinny/Stepnogorsk	mill tailings	1
Botaburum/Vostochniy	mines	2
Botaburum/Vostochniy	waste rock	2
Kusylsay/Zapadniy	mines	7
Shalgiya/Djideli	mines	1
Shalgiya/Kostobe	mines	1
Balkashinskoe	mines	1

In addition to the sites listed in Table 5, there are areas in Kazakhstan that were contaminated during geological surveys. There are also contaminated areas around boreholes at the uranium mining sites where they used the in-situ leaching method.

Due to the small amount of data available on the radiation situation in the tailings area near the village of Orlovka (Kyrgyzstan), additional studies were conducted in 2013. The interest in this area was due to its location next to two tailings. One of the areas was under remedial activities, whereas the other was not.

The studies of these tailings areas and the village of Orlovka included:

- gamma dose rate (automobile and foot gamma survey) measurements,

- natural radionuclide activity concentration measurements (K-40, Ra-226 and Th-232) in the soil using a portable gamma spectrometer,
- sampling of soil and plants followed by measurements of the radionuclide activities using a stationery gamma spectrometer, and
- measurements of the radon activity concentration outdoors and in the dwellings (short-term measurement).

Table 6 and Figure 11-12 provide the measured gamma dose rates.

Table 6 – Gamma dose rate around the tailings

Measurement location	**Dose rate, µSv/h**		
	Minimum	*maximum*	*average*
Orlovka	0.099	0.134	0.11
Tailings site	0.13	7.5	0.97

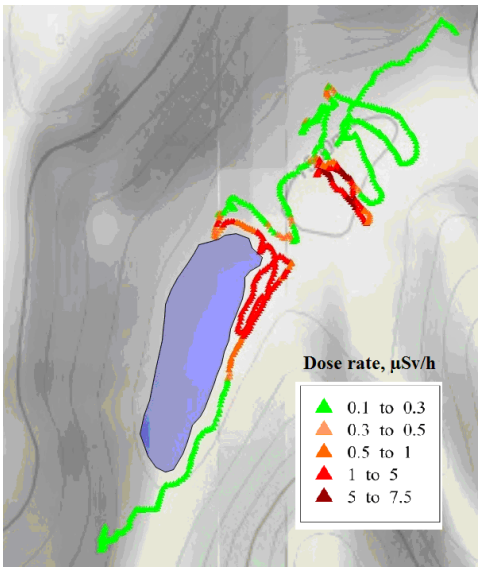

Fig. 11. Dose rates for the tailing site

Fig. 12. Dose rates within the Orlovka area

The lower (non-remediated) part of the tailings (sediment pond) is filled with water. In the dried area, the highest dose rates reached 5 μSv/h.

The upper (remediated) part of the tailings is covered with clean ground. Generally, the gamma dose rate does not exceed 0.3 μSv/h. However, there are areas where the protective covering has been disrupted, and in these regions, the dose rate reaches 7.5 μSv/h.

The radon EEC at the tailings site is <0,14 Bq/m^3 in the lower part and 320 ± 50 Bq/m^3 in the upper part.

A survey in Orlovka showed the following.

- On the majority of the settlement territory, the dose rate does not exceed 0.12 μSv/h.
- The dose rate in dwellings of the settlement varies over from 0.14 to 0.18 μSv/h.
- The radon EEC in dwellings varies from 40 to 320 Bq/m^3.

6.1.1 Tailings

For remediated tailings that are covered with a neutral soil layer that is 0.3 - 2.5 m in thickness, the gamma dose rate is 0.2 - 0.6 μSv/h. The radon exhalation from the surface of the tailings does not exceed 1 Bq/(m^2·s). The radon activity concentration at some tailing sites in areas with reliable coverage varies over a wide range from 22 to 100 Bq/m^3.

However, there are local areas at many tailing sites where the protective coating has been disrupted either by wildlife populations, during excavation, due to flushing of the protective layer, etc. In these areas, the dose rate reaches 15-22 μSv/h. Additionally, increased dose rates were registered in tailing areas where the protective coating has been disrupted, and in addition to the tailing materials, there is contaminated equipment (e.g., at the tailing site in the Kaji-Say village, the dose rate in the area reaches 3.4 μSv/h, whereas the dose rate at the remaining part of the tailings is 0.3-0.6 μS/h). In areas with disrupted coatings, the radon exhalation is 3-9 Bq/(m^2·s).

At non-remediated tailing sites, (without a neutral soil protective coating), the dose rate varies over a wide range.

- Within tailing area numbers 2-4 in Ak-Tyuz, it ranges from 0.4 to14 μSv/h.
- At the Digmay tailing site, it ranges from 0.12 to 22 μSy/h (with the highest values in the central part).
- In the shoaled part of the Koshkar-Ata tailings, it ranges from 0.8 to 1.5 μSv/h, and it reaches almost 15 μSv/h.
- In the shoaled part of the Buurdinskoe tailings , it ranges from 0.13 to 5 μSv/h.
- On the exposed surface of the tailings of the Stepnogorsk mountain-chemical combine, it ranges from 2.5 to 6.0 μSv/h, whereas in local areas, it reaches 23 μSv/h.

Prior to the backfill of tailings near the village of Adrasman, the gamma dose was 4.0-15 μSv/h. The study analysis showed that the concentration of natural radionuclides varies widely in the tailings area, and it depends upon the depth of the rock in the tailings. At the Min-Kush tailings site, the Ra-226 concentration in the surface layer varies from 100 to 10,100 Bq/kg. In the surface layer of the tailings, in the Kaji-Say village, the Ra-226 concentration reaches 4,990 Bq/kg, whereas in the deeper layers, it reaches 31,000 Bq/kg. At other tailing sites, the highest Ra-226 concentrations are within the range of 11,000 to 27,500 Bq/kg, whereas those of U-238 are 590 to 100,000 Bq/kg. The release rate of Rn-222 on the surface of the tailings that do not have a protective coating is from 3.8 to 65 Bq / (m^2·s).

The radon activity concentration at the exposed tailings, according to different references, varies over a wide range up to 6,500 Bq/m^3 in areas where the coating is absent or in some locations in

the direct vicinity of the tailings. The high Rn-222 exhalation from the tailings and the high Rn-222 concentrations in the air have been registered at the Digmay tailings site. Due to the climatic conditions in this region, the surface of the tailings are always dry, and deep cracks have resulted from drying that are formed on the surface and that promote the entry of radon into the air from the deep soil layers.

Generally, data on radon concentrations at the tailing sites are scarce. Mainly short-term measurements have been conducted in the summer. These data do not provide reliable information on the annual radon activity concentration.

The activity of natural radionuclides in the air at the tailings site is 10^{-4}-10^{-5} Bq/m^3. This is significantly lower than the activity concentrations that are permissible for the public and workers. However, similar to Rn-222, data on radionuclide concentrations in the air are scarce and provide no idea of the potential range of variation.

6.1.2 Waste rock and off-balance ore dumps

In Central Asia, there are both remediated and open (exposed) dumps of waste rocks and off-balance sheet ores. The gamma dose rate on the surface of the dumps varies from the natural background level to several *μSv/h*.

The highest levels are registered at dump number 4 near Mailuu-Suu (11.3 *μSv/h*) and at dump number 5 near Shekaftar (11 *μSv/h*). At the dumps around Min-Kush settlement, the gamma dose rate reaches 5 *μSv/h*, and at the poor ore factory and at the dump of the off-balance ores in Taboshar, the rate is up to 4 *μSv/h*. Within the ore yard in the Yangiabad settlement, the dose rate reaches 7.5 *μSv/h*. The gamma dose rate in some parts of the dump site near the Krasnogorsk settlement exceeds 6-15 *μSv/h*.

Before remediation, the gamma dose rate at the industrial sites and dumps of the Kurday deposit reached 15 μSv/h. In the early 2000s, the dumps were covered with a clay layer that was 1 m thickness. The gamma dose rate decreased up to 0.15-0.35 μSv/h. However, subsequently, the protective coating were partially destroyed and, according to ref. [8], the gamma dose rate at the onsite dumps varies over the range of 0.88-1.23 μGy/h.

During 2004-2005, dump numbers 1 and 2 near the Charkesar settlement were covered with a neutral material. The gamma dose rate on the surface of the dumps was 0.3-0.4 μSv/h. However, in 2007, in some onsite areas, the gamma dose rate exceeded 1.7 μSv/h, and the radon exhalation from the surface of the waste rock was from 2 to 20 Bq/(m^{2}·s).

The dumps near the Khujand settlement are covered with a neutral soil that is 0.5 m thick, and the dose rate does not exceed 0.8 μSv/h. The researchers obtained different results when measuring radon concentrations in the air at the site of the dumps. Thus, according to ref. [58], the radon activity concentration at the site of the Poor Ore Factory (POF) in Taboshar is 17 Bq/m^3, and according to ref. [10], it exceeds 2,000 Bq/m^3. The average specific activity of Ra-226 in Maylu-Suu varies from 300 to 1,700 Bq/kg. In local regions, the Ra-226 specific activity reaches 7,000 Bq/kg.

Some higher values have registered at other Central Asian dumps. Thus, the Ra-226 specific activity in the Shekaftar dumps varies over the range of 71 to 11,400 Bq/kg, and in the Taboshar POF, it varies over the range of 1,130 to 7,000 Bq/kg.

6.1.3 Open pits

In area, where uranium mining was conducted via the open pit method, they remained being filled with water. In the area of the pits, the gamma dose rate is greater than 0.5 μSv/h. In some areas, dose rates from 1.9 to 4.0 μSv/h have been registered (e.g., Taboshar pit number 3). The concentration of natural radionuclides in the soil varies over a wide range, and they reach 4,080 Bq/kg for U-238 and 6,600 Bq/kg for Ra-226 in some areas. The Rn-222 activity concentration varies typically from 20 to 90 Bq/m^3, and it reaches 460 Bq/m^3 in some areas.

The activity concentration of the natural radionuclides in air is 10^{-4} -10^{-5} Bq/m^3. This is significantly lower than the activity concentrations permissible for the public and workers. However, similar to Rn-222, data on the radionuclide concentrations in the air are scarce and provide no information on the potential variation range.

The uranium concentration in the pit water is 20-70 Bq/L, whereas that of Ra-226 is 0.2-0.54 Bq/L. The U-238 concentration in muscles of fish originated from the pit does not exceed 1.5 mg/kg of raw mass. The Po-210 concentration in fish originated from the pit varies over the range 130-1280 Bq/kg and is significantly higher in comparison with other surface water reservoirs.

6.1.4 Flowing boreholes

The increased gamma dose rates around flowing boreholes have registered in local areas in a diameter of 300-500 m. Generally, the highest values are registered in the nearest vicinity to the boreholes and can exceed 20 µSv/h.

The specific activity of Ra-226 in the surface soil layer reaches 12,700 Bq/kg. Therefore, 30-40 cm soil layer is contaminated due to migration.

Manmade contamination of the soil also occurs in the areas of spontaneous release of mine water. Concentrations of Ra-226 and U-238 in the mine water can reach 700 and 18,000 Bq/m^3, respectively. The gamma dose rate due to the soil contamination can reach 7 µSv/h, whereas the Ra-226 concentration in soil is 60,000 Bq/kg. The specific activity of Ra-226 in the soil near Charkesar reaches 62,800 Bq/kg where mine water flows.

6.1.5 Radiation situation in the settlements

Generally, the outdoor and indoor gamma dose rates in the settlements that are located around the nuclear legacy sites and facilities does not differ from those of background regions. However, there are local areas with increased levels due to the use of materials from dumps and tailings.

High indoor radon levels are due to settlement distributions in radon hazardous areas, and radon protective measures are not taken during the house-building stage.

The impact of the former uranium mining and milling facilities on the public (except for the unauthorized presence of public onsite dumps and tailings) occurs via three main pathways:

- the intake of water from springs flowing through the tailings and dumps,
- the intake of vegetables grown in gardens located in the contaminated areas, and
- the intake of milk and meat of domestic animals that graze on former uranium sites.

6.2 Approaches to establishing reference levels in the countries

One of the main tasks of the regulatory bodies is to establish reference levels for the site end-state after the remediation completion.

Remediation does not always mean full removal of contamination. Remediation do not may imply that the condition that prevailed before the contamination can be achieved again; this is not normally the case and may not be necessary.

However, whenever contamination of a site takes place, the affected community (and eventually other interested parties) will wish to see the contaminated land fully ‘cleaned up’. In other words, members of the public will generally push for the return of the environment to the prevailing conditions before the contamination took place.

The above situation may be seen as legitimate; however, the costs with environmental cleanup will generally increase significantly with the extent of remediation provided to a particular site. The plan must be demonstrated that beyond a certain point of remediation, no clear benefits, from the radiological point of view, will be obtained with further reduction of the residual contamination,

and that the resources to be applied in the pursue of a 'cleaner' environment could serve better social purposes. Therefore, it is absolutely necessary that good communication between all involved parties is established. Lessons learned with a number of projects highlight the requirement for the implementation of appropriate communication and stakeholder involvement strategies.

However, it is necessary to recognize that social, political and economic situations will be quite different in different countries, and therefore no common solution or approach can be easily made available. Finding the appropriate approach to deal with a specific situation constitutes one of the most important challenges for regulators and implementers.

For the existing exposure situations, 1-20 mSv/year reference levels area recommended [11].

The second issue to be mentioned when establishing the reference levels is an option of the site use in future. Sites can be located in the direct vicinity of the settlement (such as in Uzbekistan or Tajikistan). In this case, various options of their use are possible: from the recreation zone to the settlement.

Other sites are located far from settlements and in mountains. It is obvious that there are limited use options of such sites in near future.

The future use of sites will be determined by local authorities taking into account public opinion, and in some cases – the decision is made at the Governmental level (e.g. to build an industrial facility).

Common (unified) remediation criteria for the site may be established regardless its future use. However, different options of the site use assume the presence of different representative persons; and significant pathways of exposure, duration of staying on-site etc. for these persons can differ. Total doses to the representative person (dose generated during the staying on-site plus dose, generated over the rest time) can be rather different in comparison with doses to the other population. For example, let us address the following situation. A unified criterion has been established for both uses, the site use for permanent residence and for use as an industrial enterprise. In the first case, the representative person is a person who stays at the village for the most part of the time - usually a retired or children. This representative person can receive dose equal to the criterion during the whole year. In the second case, the representative person is a member of the personnel of the facility, who receives dose equal to the criterion only during the working hours and extra dose during time spent in the village where he/she lives. If, in addition, this person lives at the area of the former remediated uranium site, his total dose will be close to the double one being received by the representative person permanently residing in this settlement.

Therefore, criteria are advisable to be established in a site-by-site approach taking into account the future use of the site.

The following end-states of using the uranium legacy sites after the remediation completion may be considered:

- the change of target functions of the main constructions, buildings, engineering systems and equipment of the facility (object), bringing them into the radiation-safe condition for conducting practical activities such as for mining and processing of mineral and organic materials;
- closure of the enterprise and continued use of the sites and facilities for the purpose of:
- agricultural activity and animal husbandry, fish farming;
- permanent residence of the population;
- temporary staying of the population (park, recreation/rest area etc.).

Reference levels can be established in values of additional exposure induced by residual contamination on-site, or in values of gross exposure induced by residual contamination and natural background.

In the first case, natural background value shall be known, which was on-site before the uranium facility operation. If such kinds of data are available, these data shall be amended taking into account technical characteristics of the devices being used at that time. Natural background around the sites can vary over the wide range, especially in mountains. On-site contamination is induced by natural radionuclides. Identification of their contribution on the background of the same radionuclides is possible, but involves additional research (e.g., studies of activity ratios of natural radionuclides). Furthermore, the use of differential techniques increases uncertainty of the final result.

6.3 Development of regulatory guidance for Radiation Safety Regulations during the Remediation of Sites and Facilities from the Former Uranium Mines

As mentioned above, a guide was developed to bring uranium legacy regulations in compliance in Russia and in Central Asian countries. This was aimed to generate agreed upon approaches for radiation safety assurance during the remediation of sites and facilities. The guide reflects the requirements to be considered in the national regulatory documents on:

- a remediation plan,
- criteria for the site end-states,
- radiation monitoring on-site and off-site at various stages of remediation,
- safety assessment,
- environmental impact assessment,
- criteria for personnel selection, and
- decontamination of equipment, buildings and vehicles.

The annexes to the guide include reference material, which can be useful when developing regulatory documents, including requirements for personal protection equipment, examples of interested parties engagement, optimization methods and criteria of the site end-states used by various countries during remediation of uranium sites. The document is intended as a reference for the regulatory bodies of Russia and Central Asian countries during the development of national normative and methodical regulatory documents at different stages of remedial operations and upon the review of documents that supporting applications for authorization for remediation of the uranium legacy sites.

The document includes:

- requirements for justification of protective actions and optimization of protection and safety,
- requirements for establishing and implementing remediation programmes (plans), post-remediation control measures if appropriate, and the placement of an appropriate strategy for radioactive waste management,
- requirements for the protection of workers and the public in existing exposure situations,
- criteria and regulations for remediation of the uranium mining and processing sites and facilities,
- health care requirements for radiation protection of workers and the public at the stage of design, organization and performance of remedial operations,

- safety and hygienic requirements for the management of waste resulting from remedial operations,
- arrangement of radiation monitoring of the environmental media during remediation,
- requirements for individual dose monitoring of workers during remedial operations,
- methodical recommendations on operational radiation and medical criteria to initiate urgent protective measures in the case of a radiological accident,
- requirements for the establishment of infrastructure support to continue 'self-help protective actions' in the affected areas via providing information, advice and monitoring.

6.4 Conclusion

The primary objective that was achieved during this project was to develop a proposal for the coordination of the uranium legacy regulations in Russia with those in the Central Asian countries. These regulations aim to generate agreement in approaches to radiation safety assurance during the remediation of sites and facilities that are contaminated due to uranium mining activities.

The project consisted of two main activities. First, a study and analysis was performed of the available results of the radio-ecological monitoring at the uranium legacy sites in the Central Asian countries. Were also performed radiation research in Orlovka and FMBC experts reviewed the documents developed under the NRPA Central Asian program. Second, the activities were indirectly based on the outcomes of the study and analysis to draft the guide, «Radiation Safety Regulation during Remediation of Sites and Facilities of the Former Uranium Mines», to generate coordinated approaches for developing national regulatory documents. The document is based on key fundamental IAEA documents on radiation safety, and it takes into account the special features of the contaminated sites due to the uranium mining activities.

The guide has been submitted to the Central Asian countries for coordination and to FMBA for approval.

6.5 References for section 6

1. *General Conclusions IAEA Safety Glossary. Terminology used in nuclear safety and radiation protection - 2007. International Atomic Energy. Vienna (2007).*
2. *Regulatory supervision of the uranium mine and milling legacy sites in Russian Federation. V. Romanov, N. Shandala. Proceedings of International Workshop «Uranium Legacy of the Soviet Union in the Central Asia: Problems and Decisions». Dushanbe, 20-22 November 2012.*
3. *Uranium tailings in Central Asia: national challenges, regional consequences, global solution. Information material for the Bishkek regional conference, 21-24 April 2009.*
4. *Zhunussova T., Sneve M., Romanenko O., Solomatina A., Mirsaidov I. Threat Assessment Report Regulatory Aspects of the Remediation and Rehabilitation of Nuclear Legacy In Kazakhstan, Kyrgyzstan and Tajikistan. StrålevernRapport 2011:5. Østerås: Statens strålevern, 2011.*
5. *Mirsaidov U.M. Enhancing regulatory control, safety assessment and training of the regulatory staff in the Tajik Republic. International Working Forum on Regulatory Supervision of Former Sites (RSFS). 17 – 21 October 2011 Vienna Austria.*
6. *National Report on the Environmental Conditions and Use of Natural Resources uin the Uzbek Republic – 2008 (Retrospective analysis over 1988-2007). State Committee of the Uzbek Republic on the Nature Protection. Tashkent – 2008.*
7. *Shishkov I.A., Kayukov P.G. Radio-ecological problems of the Kazakh Republic connected with survey and development of uranium deposits. «Bulletin of NAN RK. Geology and Engineering Science series» 5 (401). 2013, p. 69-76.*

8. *Salbu, B., Stegnar, P. Legacy of Uranium Mining Activities in Central Asia – Contaminatin, Impact and Risks. Summary Report of Results Obtained within the NATO RESCA Project and the Joint Project between Norway, Kazakhstan, Kyrgyzstan and Tajikistan 2011.*

9. *Yunussov M.M. Radiation hazardous facilities in the Northern Tajikistan. International conference of scientists and experts for the purpose of scientific and technical assessment of the radioactive waste tailings specific problems near Min-Kush under the auspices of the OSCE Centre in Bishkek - Bishkek, 2007 – p. 32 – 36.*

10. *Stegnar P., Shishkov I., Burkitbayev M., Tolongutov B., Yunussov M. Assessment of the radiological impact of gamma and radon dose rates at former U mining sites in Central Asia. Journal of Environmental Radioactivity 123 (2013) 3-13, pp. 3-13.*

11. *IAEA Safety Standards Series, «Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards», General Safety Requirements Part 3, No GSR Part 3, Vienna (2014).*

12. *SanPiN 2.6.1.2523-09 Radiation Safety Standards (NRB-99/2009) of 02.07.2009. Registered by Ministry of Justice of the Russian Federation on 14 August 2009, registration number 14534.*

13. *IAEA Safety Standards Series, «Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards», General Safety Requirements Part 3, No GSR Part 3, Vienna (2014).*

7 Conclusions

The key desirable result to achieve is a strengthened capacity of regulatory authorities in all participating countries and improved professional skills and knowledge of the regulators. The measure of success will be the quality, formal acceptance and application as soon as possible of the described in this report regulatory documents. Overall, it is anticipated that the work will lead to the enhanced safety culture and environmental protection awareness among operators, regulators and other interested parties. This, in turn, can support the wider implementation of national strategies for safe radioactive waste management and environmental protection and sustainable development.

The existing situation in Central Asian countries with a legacy uranium mining and processing industry arises due to several factors. These factors include the USSR legacy, week governmental attention and funding, lack of qualified manpower at the operating and regulating authorities to deal with safe, sustainable and controlled remediation of uranium legacy sites, which passed to the newly established republics in 1991.

Additionally, there was a lack of proper legal and regulatory framework and infrastructure to deal with this problem. Similar to other spheres, coordinated activities and joint attempts are needed to solve common problems of the entire region. The multiplicity of unsolved tasks, which may threaten the public and the environment in medium and long term, can in the future lead to serious consequences for all republics in the region.

Norway, under the Norwegian Action Plan and through NRPA, attempted to help coordinate activities and communication of specialists from all countries that have legacy uranium mining and processing facilities on their territories. Norwegian cooperation has a broad range of activities. It includes discussions and sharing of information internally in working groups during the preparation of draft documents. Additionally, the cooperation promotes and supports neighbourly cooperation through discussions in wider international groups, which consist of all project beneficiaries and Western experts, during project review meetings and participation in international forums and initiatives.

The cooperation with Central Asian countries began with regulatory threat assessment reports, which provided complete overview of the regulatory issues regarding radioactive waste management and uranium legacy situation in the Central Asia. Next step was to introduce recommendations for enhancing the legal and regulatory framework and inclusion of cooperation between the countries and interested parties.

The first priority of NRPA was to develop within the project framework the Law or National Policy on Radioactive Waste Management. The drafted documents accounted for the current needs and local specifics, and their content differed from country to country. Table 7 reflects the main elements addressed by the Law or National Policy on Radioactive Waste Management in each country in accordance with IAEA recommendations.

It is clear that, in the case of Kazakhstan and Kirgizstan, all areas are accounted for by the drafted or already approved national documents. The Kazakh document is very detailed. In Tajikistan and Kyrgyzstan, the documents are much more generic in comparison with the Kazakh draft. However, both documents provide responsibilities to the regulatory body for regulating radioactive waste. Additionally, the Tajik document regulates the activities of individuals and entities associated with radioactive waste management and establishes the principles for the protection of people and the environment from harmful effects of radioactive waste and management of radioactive waste produced by mining and processing activities.

For Uzbekistan, it is important to mention that despite the comments and suggestions provided by NRPA to develop a law for radioactive waste management, the regulator decided to draft a policy

with a limited scope called «Policy for the management of uranium mining and milling radioactive waste and legacy sites», which does not consider radioactive waste management in general. In this case, a recommendation was made to be careful to avoid contradictions when the general policy and strategy on radioactive waste management is developed, because it is required by the Joint Convention on Safety of Spent Fuel management and Safety of Radioactive Waste Management.

Table 7. Issues that were considered by different countries, which participated in the Joint Project, in their Law or Policy and Strategy on radioactive Waste Management.

COUNTRY	**Kazakhstan**	**Kirgizstan**	**Tajikistan**	**Uzbekistan**
ALLOCATION OF RESPONSIBILITIES	Chapters 6, 11, 12, 13, 17, 18, 19, 20, 24, 44, 45, 52, 54, 57	Chapters 6, 7, 8 (1,2,3,4), 10, 12	Chapters 6, 7, 8, 10, 11	
PROVISION OF RESOURCES	Chapter 7	Chapter 22	Chapter 5	Chapter 6
SAFETY AND SECURITY OBJECTIVES AND REQUIREMENTS	Chapters 4, 5, 8, 9	Chapters 11, 14, 15, 24, 25, 26, 27, 28, 29, 30	Chapters 4, 16, 17, 19, 21, 22, 23	Chapter 3
WASTE MINIMIZATION	Chapter 10	Chapter 14	Chapter 4	Chapter 6
EXPORT/IMPORT OF RADIOACTIVE WASTE	Chapters 41, 42, 43	Chapter 13		
NATIONAL OPERATOR	Chapters 14, 15, 16	Chapter 9	Chapter 11	
INVENTORY AND LEGACY SITES	Chapters 29, 30, 31, 37, 40	Chapters 18, 19, 23	Chapters 13, 14, 15	Chapter 5
PUBLIC INFORMATION AND PARTICIPATION	Chapters 53, 55	Chapters 6, 21		Chapter 8
FINAL DISPOSAL	Chapters 10, 34	Chapters 16, 17	Chapters 16, 19, 20, 24, 25	

7.1 Benefits of regulatory cooperation.

To evaluate and to observe the tangible results of the regulatory cooperation and support of regulatory bodies, it is necessary to assess the situation over a wider period of time due to the legislation process, approval and implementation of the developed regulations and, finally, the financial resources and commitment and possibilities of each country. At this point, it is important to mention the political and economic aspects. The level of safety that a regulator demands should be a function of the governmental commitment, political conditions and income levels of a society. Increased levels of protection are expensive, and governments need to balance these costs with the benefits in terms of safety for the workers, the public and the environment.

Although there is limited quantified information on direct influences that the results of this regulatory cooperation had on the public and the environment, the general benefits are clearly identifiable.

The regulatory alignment and ongoing cooperation ultimately improve the following aspects for the countries, their citizens and regulators:

- regulatory framework,
- level of safety in the countries through regulations according to the latest international recommendations,
- safety culture,
- regulatory efficiency and effectiveness (regulatory cooperation between NRPA and the Central Asian countries is about helping regulators become more efficient and effective in achieving their goals of ensuring health, safety, and environmental protection),
- neighbour cooperation (working in a smaller environment with the involvement of international organizations and consultants improves engagement in the Central Asian region and can save time and money by sharing work and experience when addressing common regulatory challenges in the area of radiation protection and safety), and
- ability of the Central Asian state regulators to protect their citizens from radiation and influence of the legacy sites.

7.2 Future activities

On 26-28 of January 2016, during the annual meeting that was held in Bishkek, NRPA regardless informed cooperates about necessity to limit the budget for projects related to nuclear and uranium legacy in Central Asia. Instead were discussed possibilities of activities in other fields. All representatives gave their understanding for the situation and committed themselves to continue work on regulatory enhancement; all countries presented their planes for the continuation of work in the next 2 years:

Kazakhstan

The development and implementation of the law «On radioactive waste management in the Republic of Kazakhstan» includes:

- development of the implementation strategy of the draft law «On radioactive waste management in the Republic of Kazakhstan,» and
- update of supporting regulatory documents for the draft law «On radioactive waste management in the Republic of Kazakhstan.»

Kyrgyzstan

1. review and amendment of the Law «On Radiation Safety in the Republic of Kyrgyzstan» in accordance with latest international recommendations and standards,

2. development of safety requirements for the institutional control (including monitoring and surveillance) after the closure of uranium mining and processing facilities, and
3. development of safety requirements for the long term management of disused sealed radioactive sources.

Tajikistan

1. elaboration of the national strategy for remediation tailing waste from processing of uranium ores in 2014-2024,
2. elaboration of safety requirements in radiotherapy, and
3. elaboration of safety requirements in nuclear medicine.

Uzbekistan

Introduction of amendments and addendums for the law of the Republic of Uzbekistan «About waste» dated 05.04.2002 No 362-11, which provides safety requirements for the remediation of areas contaminated with radioactive waste.

Russian Federation

Preparation of the proposal for amendments to the law «On Radiation Safety and radiation safety standards of the Russian Federation», which in part is related to the existing exposure situation.

8 Summary of documents developed under the NRPA cooperation (2013 – 2015)

Kazakhstan

No	Title of the document	Category (law, decree, regulation, standards)	Scope of the document
1.	Law On Radioactive Waste Management in the Republic of Kazakhstan	Law	The law defines the legal basis and regulates relations in the field of safe management of radioactive waste from the moment of its generation and to the moment of its final disposal.
2.	Requirements for Predisposal Management of Radioactive Waste in the Republic of Kazakhstan	Regulation	The regulation provides requirements for the safe management of radioactive waste of all types prior to its disposal and encompasses all stages of waste management from generation to disposal, including processing (pre-treatment, treatment and conditioning) and storage. The regulation does not apply to the management of spent nuclear fuel.
3.	Regulations on Radiological Protection and Radioactive Waste Management in the Extractive and Processing Industries of Kazakhstan	Regulation	The regulations cover the regulatory and organizational aspects of control of the personnel and public exposure in the extractive and processing industries as well as the aspects of management of radioactive waste, which is produced by the abovementioned industries. The regulations describe the radiation protection system that is to be applied to the technological processes in the extractive and processing industries and to their waste. Additionally, the regulations define the roles and responsibilities of different interested parties.
4.	Regulations on Radioactive Waste Disposal in the RK, Basic Criteria and Safety Requirements	Regulation	The regulations establish principles, criteria and basic safety requirements for the near-surface disposal of radioactive waste and for the disposal of radioactive waste in deep geological formations. The regulations aim to exclude unacceptable risk of harm to the public health and the environment at present and in the future. The regulations are applicable for disposal facilities (of solid and solidified radioactive waste) that are under design, construction, operation or closure.

Kirgizstan

No	Title of the document	Category (law, decree, regulation, standards)	Scope of the document
1	Draft Law of the Kyrgyz Republic «On Radioactive Waste Management»	Law	The law establishes the responsibilities of the government, regulators and operators, and sets a legal framework for radioactive waste management. The law defines basic criteria (organizational and legal) for safe managing of radioactive waste (RW reception, transport, processing, conditioning and storage).
2	New regulatory guidance document on remediation	Regulation	Requirements for the remediation of disturbed lands and territories due to uranium industry and other industries that produces waste with naturally occurring radioactive materials and their decay products
3	Main provisions concerning radiation protection in occupational exposure	Regulation	The regulation contains basic provisions and requirements related to occupational radiation protection in terms of practices and conditions during normal operation and during emergencies. The document sets duties of organizations with radiation sources and establishes basic measures (organizational and legal) for radiation protection.
4	Basic regulations for managing radioactive waste generated by small organizations	Regulation	The document includes issues on managing radioactive waste, temporary storage, and optimization of personnel protection, given the volume, composition and activity of the radioactive waste hazard category and clearance from the regulatory control.

Tajikistan

No	Title of the document	Category (law, decree, regulation, standards)	Scope of the document
1	Amendments to the Law on radiation safety	Law	This Law regulates the relations of physical and legal persons arising from activities involving ionizing radiation sources. This Law establishes the legal basis for radiation safety activities to protect the life, health and property of person and the environment from the harmful effect of ionizing radiation.
2	Elaboration and approval of a new standards on radiation safety in accordance with new adopted law on radiation safety and new IAEA BSS	Regulation	These standards define the basic requirements for protecting the people from exposure to ionizing radiation, the safety of radiation sources and to protect the environment. This regulation aimed to prevent unauthorized access to or destruction, loss, theft or unauthorized transfer of radioactive sources so as to reduce the likelihood of accidental harmful exposure to such sources.

No	Title of the document	Category (law, decree, regulation, standards)	Scope of the document
3	Elaboration and approval of the national policy and strategy in the field of uranium legacy sites remediation.	Decree	The aim of the National Strategy is the creation and effective functioning in Tajikistan of a holistic system of radioactive waste accumulated in previous periods, allowing to achieve the minimization of radiation exposure of the population and the environment by ensuring the safety of radioactive waste management, special measures for radiation protection of the population, remediation of contaminated sites and tailings of radioactive waste and physical protection of radiation hazardous objects. To create an organizational and legal framework and infrastructure that makes it possible to conduct remediation plans with a rational use of financial, technical and human resources taking into account international best practices. A national strategy was developed in accordance with the latest IAEA safety standards and technical documents on the remediation process for areas affected by past activities and accidents

Uzbekistan

No	Title of the document	Category (law, decree, regulation, standards)	Scope of the document
1	The Strategy on radioactive management of the former uranium mines of Republic Uzbekistan for 2013-2021	By-law act	The main objective of the strategy is to establish main principles and action plan to solve problems of managing RW from former uranium mines, to establish a legal regime for managing the newly formed and previously accumulated radioactive waste, and to ensure the safety of population that lives in the areas of tailing dumps.
2	Sanitary codes and rules of carrying out of radio-ecological monitoring of environment on areas of tailing dumps	Regulative-technical documents approved by the state regulatory body	Sanitary rules and codes were developed in the light of implementation of the Laws of the Republic of Uzbekistan «About the Radiation Safety», «On Wastes» «On Protection of the Nature» and assigned for enterprises engaged with radioactive wastes of uranium industry, radiation hygiene physician of radiological laboratory of SSESC, organizations of interested Ministries and agencies, which realize the radiation monitoring of environment. It establishes requirements for organizing and performing state radiation-ecological monitoring (REM) of the objects, where radioactive waste from uranium mining and processing activities is placed.
3	Requirements on long-term storage of	Regulative documents of governmental	The present document is applied to long-term storage of radioactive waste and establishes the requirements for ensuring of safety at

No	Title of the document	Category (law, decree, regulation, standards)	Scope of the document
	the RW	regulation and supervising authorities	long-term storage of the RW.
4	Guide on ensuring of radiation safety at long-term storage of RW	Regulative documents of governmental regulation and supervising authorities	This guide is to ensure radiation safety during long-term storage of radioactive waste (hereinafter the Guidelines) sets out the principles, criteria and basic recommendations for long-term storage of radioactive waste. This manual applies to the long-term radioactive waste storage facilities, tailings waste from uranium production. (
5	Rules on radiation safety of territories and facilities of uranium legacy during remediation actions	Regulative-technical documents approved by the State regulatory body	Establishes uniform approaches to ensure radiation safety of the personnel, the public and the environment when conducting remediation work on the territories and objects that were contaminated due to the activity of uranium ore mining and processing enterprises.

Russia

No	Title of the document	Category (law, decree, regulation, standards)	Scope of the document
1	Radiation Safety Regulation during the Remediation of Sites and Facilities of Former Uranium Mines	Guidance	Brings in compliance the uranium legacy regulations in Russia and in the Central Asian countries, which are aimed at generating agreed upon approaches to ensure radiation safety during remediation of sites and facilities.

Statens strålevern
Norwegian Radiation Protection Authority

2016

StrålevernRapport 2016:1
Årsrapport

StrålevernRapport 2016:2
Scales for Post-closure Assessment Scenarios (SPACE)

StrålevernRapport 2016:3
Nettbasert tilsyn med industriell radiografi

StrålevernRapport 2016:4
Regulatory Cooperation Program between Norwegian Radiation Protection Authority and Russian Federation

StrålevernRapport 2016:5
Regulatory Supervision of Legacy Sites: from Recognition to Resolution

StrålevernRapport 2016:6
Kartlegging av radon på Svalbard og Jan Mayen

StrålevernRapport 2016:7
Regulatory support in radiation safety and radioactive waste management in Central Asia

ISSN 1891-5191 (online)
ISSN 0804-4910 (print)