Remediation at Uranium Mining in the CIS

Description

Uranium exploration took place in Russia after the WWII and vein types mine were discovered in Stavropol. In the fifties uranium exploration was mainly concentrated on regions outside of Russia. In the period 1960 - 1970, exploration took place and led to the discovery of the hydrothermal vein in Streltsov district (eastern Baikal region). Uranium mining with open pit and underground mines took place in 1973. In the seventies, Central Transbaikalian, Yenisejsk, Transuralsk and Vitimsk regions were explored. Nowadays, the Priargunski Complex is the only uranium production site in the ex-Russian federation.

This industry was operated largely without taking into account radiological consequences related to the production process. Nowadays, many installations have been closed definitively and the others mostly continue to operate at reduced capacity. This contract identified the worst locations and situations among the countries having extraction or treatment installations. The major concerns for the population were studied by modelling the exposure scenarios and ascertained by the means of local measurements. The most viable and efficient measures to be taken were proposed.

The project was contracted to the European Fuel Cycle Consortium. This project began with the CRIS number 23347 and came to an end with the CRIS number 25227.

Objectives

The study had the primary objective of identifying the uranium extraction and/or treatment locations and situations in worst condition in the CIS countries. The analysis was limited to the following countries: The Russian Federation, Kazakhstan, Ukraine, Kyrgyzstan and Uzbekistan. Eight large mines were operated in former Soviet Union with a surface of about 240,000 ha (almost 10% of this area is heavily contaminated). The scope of the study dealt also with extraction facilities for special metals (niobium, tantalum or phosphate) where the ore has also a high natural Uranium or Thorium content. Four packages had been defined in the work programme:

1- Identification of the sites and main characteristics (installation, water system, no longer operational or operational systems) that were known or strongly suspected to be harmful. This identification was to be performed in co-operation with local authorities.

2- Western-made off the shelf equipment was to be bought and local authorities were to be trained to measure on air, water and soil the main nuclides of concern (U-238, Th-232, Rn-222, Po-210 and Pb-210). These measurements assessed with prior information were the
sound basis for modelling and calculation of radiological consequences

3- Modelling and computation of radiological consequences was the next sequence. From the above measurement of the actual situation a model is designed and used for long term consequences (over 1000 years) of the contamination. Each remediation action should be assessed by the use of this specific model.

4- Proposal of a ranking of remediation measures (taking into account expenditure, time-frame and radiological benefit).

Project Results

In the whole former Soviet Union different extraction techniques have been used. Radiological risks are mostly from: tailings of low-grade ore, heaps of leached ore, ponds with depleted sludges, depleted ore from in-situ-leaching, the abandoned mines and the contaminated equipment and buildings. The most critical exposure scenarios are normally the pollution of surface or groundwater. The construction of housing on tailings or dried ponds and the use of material from tailings and ponds to build houses are also to be considered.

In order to assess all the selected sites and to provide a ranking in the remediation measures to be taken, the project was divided into 4 different work packages.

Work package 1: Identification of sites

The work concerning the first package has been terminated under this contract.

For Russian Republic, two sites were pointed out: Lermontov and Streltsovsky (Krasnokamensk).

- In Lermontov, uranium mining ceased and decontamination procedures have already taken place. Nevertheless, the ore collecting areas were not decontaminated yet. Mines waters originating from gallery number 9 were released directly to the natural environment. 17 M tons of ore processing residues are spread over 118 ha.
- In Streltsovsky, the main objects able to potentially cause pollution of groundwater in the Shironduky valley are the three tailing ponds.

For Ukraine, 21 sites where mining and milling of uranium ores were determined and five among them were selected for the high level of radioactive commitment on population:

- In-situ leaching site of Devladovo,
- The site of the active Novaya mine
- The tailing storage of KBZh
- The RE-4 and R-5 sites related to the Ingulsky mining group
- Tailing storage D (PChZ site)

For Kazakhstan among the hundred uranium sites five were selected for their distance to the nearest population, the dust granulometry and the climatic conditions: Ulba, Kosachinoye, Botaburum, Kurday and Koshkar-Ata.
Uzbekistan was identified to be the country where the most urgent actions should be taken considering the great radiological impact and influence to the environment. Mainly the tailing depository HMP-1 next to Navoi and the waste rock piles and ore dumps in the Uchkuduk district were incriminated.

Kyrghyzstan offered a tricky situation with uranium mines and ore dumps that returned partially to cultivation and mud flows coupled with earthquakes that led to the contamination of surrounding territory. Three sites were selected Kara-Balta, Mailuu-Suu and Min-Kush.

**Work package 2: Measurements and Equipment procurement**

Due to delay concerning the delivery of the off-the-shelf measuring equipment, the training campaign for local authorities was postponed but finally carried out.

The main nuclides of concern (U-238, Th-232, Rn-222, Po-210 and Pb-210) were measured by the set of the western made robust equipment received. The air, surface water, groundwater, rock, soil and contaminated material samples measured allowed establishing a calculation model. Methodologies for the different measurements were described and assessed. For each country, the work programme for the measures was established and the data achieved were provided.

**Work package 3: Modelling**

Two different sites Kara Balta and Devladovo have undertaken a geological and hydrogeological conceptualisation in order to conduct groundwater and contaminant transport modelling. The TRAFFIC code described the concentration of some contaminants (sulphate, Ra-226, Pb-210, Po-210) versus time. A large uncertainty remains when dealing with this kind of code to assess the remediation scenario against the case scenario. The model developed for Kara Balta during this contract suffered mainly from an insufficient number of samples (additional geochemical data as much as equilibrium distribution coefficient would also be of benefit).

Considering the Devladovo site (carried out by SGN), the code MODFLOW provided the evolution of the contaminant concentrations over 1000 years period but large uncertainties remained considering the unsatisfactory knowledge of hydraulic and transport parameter.

**Work package 4: assessment of Remediation Options and Ranking**

A ranking of mediation was proposed for each selected site. For each situation all the following options have been investigated: do nothing, institutional control, relocation, minimal action or full remediation. All these options were assessed including expenditure, time-frame and radiological benefit.

A ranking of remediation measures was proposed for each selected site taking into account the number of people at risk, the nature and the level of the risk (imminent danger, chronic exposure to ionising radiation, and chronic exposure to toxic compounds) as much as economical and ALARA principles.

**Conclusions and recommendations**
The objectives of the project have been reached. The work package 2 suffered from a delivery delay concerning the measurement devices. Nevertheless the training programme concerning the local authorities took place in 1998.

Among the selected contaminated sites located in the CIS countries, all of them have been assessed and ranked according to a developed methodology given in the final report. Remediation possibilities and most viable solutions were proposed for each site.

It has been pointed out that additional samplings and additional geochemical data could have led to better estimation concerning the geological and hydro geological conceptualisation of the contaminated soils.

On the basis of information received during this study, a list of proposals for follow-up projects was made available: urgent stabilisation of tailings and waste dumps impoundment structures (Mailuu Suu, Min-Kush, Ak-Tjuz, Kadij Say, Ulba), remediation and dewatering of tailings (Lermontov, Zhovty Vody, Ulba, Kara Balta), water management and treatment techniques (Krasnokamensk, Lermontov). A few other projects concerning either modelling or dose calculation methodologies for groups in uranium mining as much as assistance for institutional controls and practical guidelines in uranium mines were also proposed.

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**General Information**

**Title:** Remediation at Uranium Mining in the CIS  
**Programme:** TACIS  
**Amount:** € 567.150,28  
**Budget year:** 1993  
**Countries:** Kazakhstan, Kyrgyzstan, Russia, Ukraine, Uzbekistan  
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**Sector:** WDS - Waste, Decommissioning and Safeguards  
**Duration (months):** 29

**Status:** Closed  
**CRIS number:** 23347  
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**Effective contract date:** 19/09/1995  
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**Closure date:** 19/02/1998
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