FEASIBLE SOLUTIONS FOR URANIUM PRODUCTION SITES DEMOLITION

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ABSTRACT
This paper reviews the major solutions for demolition of Uranium production sites in the Republic of Bulgaria, emphasizing on the existing sites in the Buhovo Mining Area. It briefs the characteristics, the current conditions, the proposed project phases, and the feasible solutions for demolition of the sites, and presents an evaluation of the environmental risks associated with each method. In conclusion, it summarizes the findings and highlights the advantages of the blast method of demolition for this type of radioactive sites.

BASIC CHARACTERISTICS OF THE URANIUM MINING AND PRODUCTION IN THE BUHOVO MINING AREA

The Uranium production in Bulgaria began in 1920 in the first Bulgarian Uranium Mine located in the Goten Phacoidal Fault to the north of the town of Buhovo.

The first exploration trenches, small pits, two shafts and one adit were built in 1936-1938, and in 1939 the annual production of the mine was approximately 300 tons of uranium ore.

The Uranium production stopped during the WWII (1941-1944), however the research and production were relaunched after the war, and expanded into the Buhovo Mining Area, which contained 9 separate mines: Goten 1, 2 and 3; Chamilov Kamak, Borche, Chora, etc. The Uranium production of the area was approximately 26 % of the national Uranium production. The Uranium ore mined in the Buhovo Mining Area contained approximately 0,084 % Uranium.

The mining operations were conducted primarily under the surface. Geotechnological block lixiviation by sodium solutions was introduces in the area in 1987. These two mining methods constrain the processing of the Uranium ore.

The first Uranium processing plant in Bulgaria was built in 1947, 1 km north-east of Buhovo. It was a multipurpose plant for processing ore with high or average Uranium content. The plant consisted of 6 integrated technological units which performed the complete processing, dressing, sorbing and extraction of Uranium concentrate in two basic forms: ammonium-uranil-carbonate and 3-uranium-8-oxide, which were sold on the market.

In the early days (1947-1956), the production waste was dumped directly in the Yaneshnitsa River, which floats in close proximity to the plant. Two permanent tailings ponds with a total capacity of 660,000 m$^2$ were build later.

The environmental effects of the Uranium production in the area are: destruction of the landscape, surface pollution from the ore transport facilities, deposition of waste earth and rock material in waste banks, pollution of the ground waters, especially after implementation of the geotechnological lixiviation, however, the most severe environmental damage results from the operation of the processing plan. The waste dumped directly in the Yaneshnitsa River resulted in large waste deposits in the river bed, known as “Yana Spillover”, with a total estimated area of 120 hectares.

The severe environmental disbalance extends to the whole Buhovo Mining Area, which includes: the villages of Kremikovtsi, Yana, Gorni Bogrov, Seslavtsi and the town of Buhovo; and seriously damages forest and agricultural areas. As noted above, the pollution results primarily from the processing operations.

The total impacted area in the region is approximately 160,000 decares, which is inhabited (primarily in the urban parts) approximately 10,200 people.

CURRENT STATE AND PHASES IN THE PROCESS OF ENVIRONMENTAL REHABILITATION.

In 1992, the Decree of the Council of Ministers terminated all Uranium production in the territory of the Republic of Bulgaria and launched the process of environmental rehabilitation of the Buhovo Mining Area.
During this stage, prioritizing and selecting the appropriated demolition method involves manual and machine demolition, the other – blast demolition. The lower environmental impact of this demolition method results from the method for management of the blast of the radioactive material, which is governed by the following principle:

- description of the landscape and all air-drafts and currents.
- determining the distance from the demolished objects to potential objects of impact, and defining the safety (guarded) zone around the blast.
- classification of the types of power and utilities supply to the facility, machines, instruments, types of bearing structures, construction of external and internal walls.
- optimizing the direction of falling of the demolished object.
- defining the number, sequences and stages in the blast demolition on non-electric detonation (NONEL with delay of milliseconds) and electric detonation (in the second demolition phase – secondary blast).
- estimating and defining the parameters of the holes, including specific depth of the charge hole of 140-190 mm, diameter of a dice. Space 35-40 mm; type BB pulverous ammonium-nitrate - cartridge, the optimal quantity for one charge – 0.055-0.065 kg, total number of charges for the building/facility – 680-790 units. blast separated in time by 4-stage intervals of up to 2000 ms.

The different phases of the environmental rehabilitation process take care of different types and levels of radioactive and other physical, chemical or biological pollution, which require different rehabilitation procedures.

The types of pollution can be subdivided into two categories: pollution generated by the mining and the processing operations and pollution generated in the process of demolition of the production facilities and environmental rehabilitation.

The first type of pollution includes waste piles, banks, pits, quarries, damaged areas around the shafts, waste waters. However, the most serious problems are the waste deposits in the river bed of Yaneshnitsa River, which accumulated before the building of the tailings ponds, and the impact of the inappropriate demolition of the tailings ponds. The environmental rehabilitation for this type of pollution involves primarily mechanical and biological procedures.

The second type of pollution includes the mining and processing infrastructure, in this case, the Metallurg Processing Plant. However the demolition of the processing facilities will render new radioactive waste.

We have to take consideration of the environmental risks involved in the different implementation stages of the plant demolition. The environmental risk in general, depends on the following: the method and the concrete solution for the demolition of the plant. There are two feasible solutions, one involves manual and machine demolition, the other – blast demolition; the transportation method of the resulting waste; and the depositing of the waste material.

Some of the problems during the demolition process are the prolonged exposure of the workers to radioactive radiation, contact with radioactive waste and objects, generating mechanical pollution (dust) and its distribution.

The first two problems dominate the manual and machine demolition of the facilities, and require a brief stay of the workers on the project site. Here, the management of the health and environmental risk boils down to limiting the period of time when the workers are on the site, providing appropriate protective equipment and clothing. Any failure to meet the health and environmental requirements results in unreasonably high health and environmental risk. This method of demolition also fails to eliminate the dust pollution completely. The falling pieces of the buildings and the construction waste create a distinct area impacted by dust pollution, but it is smaller that the impacted area when using blast demolition.

Blast demolition was used for most of the facilities (especially for the demolition of facility No 7 - Sushka). The demolition of facility No.7 required minimum number of workers, who made holes in the building and placed the explosives for a minimum time and in highly radioactive environment.

The scope of the dust pollution, determined during monitoring the blast operation indicated that the changes in the amount of dust within 30 m of the blast are very small. The level of the dust increased from 0.63 mg/m³ before the blast to 0.72 mg/m³ after the blast. In addition to that the gamma-radiation remained 75-310 mR/h, the beta-radiation and the specific radioactivity of Radon at 1 m of the surface of the demolished structure did not change. This information indicates that there is only negligible environmental impact from the blast.

All measurements were taken with respect to the measurement of the atmosphere, which enables comparison with results measured by conventional methods.

The lower environmental impact of this demolition method results from the method for management of the blast of the radioactive material, which is governed by the following principle:
Specific data of the environmental and health safety, and classification as preliminary, technological and supplementary actions immediately after the blast process. One of the characteristics of the process is the dismantling of all machines, equipment and pipes, washing with high-pressure water of the bearing structures, walls, etc, meeting or achieving compliance with all labor safety and health provisions and other regulations applicable to the blast process. Immediately after the blast, the dust is liquidated by water curtains and screens.

These basic rules and principles of the blast process in radioactive environment are the fundamental concept of the project implementation for blast demolition of the plant facilities and infrastructure. The project is customized to specialized blast operations, and is in compliance with all applicable legislation, including those concerning the use of nuclear energy, radiation protection, qualifications, etc. At the same time, the project is coordinated with all respective control authorities and parties, who have any interest in the project implementation (institutions).

Based on the observations and analysis of the conditions and restrictions for the implementation of the demolition phase of the project, we can make the following conclusions:

1. There are no significant differences in the extent of the dust pollution resulting from the two different demolition methods (manual and blast).
2. The blast demolition ensures lower exposure of the workers to radiation.
3. In normal atmospheric condition, the environmental impact is negligible.
4. The blast demolition method should be preferred, since it renders waste material of size, which facilitates the load and transport operations.

REFERENCES


Dimitrov, Stoev. Project for the Demolition of the Metallurg Processing Plant in the town of Buhovo.

Recommended for publication by Department of Opencast Mining and Blasting, Faculty of Mining Technology