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Problems of radiation safety at mined out uranium properties in Uzbekistan

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Republic of Uzbekistan was one of the main uranium production areas in former Soviet Union for more than 40 years. About 150 uranium production facilities have been constructed for that time in connection with hydrothermal and sedimentary-metamorphic deposits of the fold basement and stratal-infiltration deposits of the sedimentary cover. 18 of these facilities are located in Tadzhikistan and Kyrgyzstan along the boundary with Uzbekistan.

Exploration and operation activities in the deposits located in the fold basement were in general in form of mining. It was resulted in essential violation of landscape, development of various underground excavations, damps, tailing impoundments, lower grade stockpiles. All these need large volume of radioactive decontamination and restoration activities. 54 sites from 67 (80%) located in the territory of Uzbekistan need radioactive decontamination and restoration now.

Very serious radiation settings have occurred in some of these sites nowadays. Radioactive dumps of Cherkesar-I and Cherkesar-II mined out uranium deposits are out of any control in Fergana valley in Pap region of Namangan province. The radioactive materials are collected in dumps covered with neutral ground. The cover is washed out in some places by rains. Intensity of gamma radiation is 300 to 450 μr/h, radon exhalation is up to 7 Bk/m^2*sec (while the normal level is up to 1 Bk/m^2*sec). Water runs out from mothballed mines and its microelement composition is close to the composition of the technological solution. The water contains a number of very toxic elements (beryllium, manganese, iron, and aluminum). Water concentration of radionuclides is uranium - 23.4 Bk/1 (the normal level is 9.6), radon - 1433 (80), radium - 15.9 (0.94). The same set of the toxicants has been found in bottom sediment of a stream, its total alpha-activity reaches 35 to 81 KBk/kg. The spring water runs to a small valley and then to a village where the water is used for cattle watering and irrigation, that is hazardous for the local people health. Living in stone houses is also hazardous as they have been built of damp material and plastered with sand from Uigursai uranium deposit located in vicinity with the village. 250 living and public buildings have been examined. Gamma-activity level of 60 to 120 μr/h was observed in 50% of them, radon exhalation is 200-500 to 3000 Bk/m^3 (normal level is 100). The village habitants suffer from increasing rate of disease of blood, circulation and respiratory organs, urogenital system and oncologic diseases. Similar situation can be seen in other mined-out uranium facilities of the Republic (Yangiabad, Rezak, Shakaptar and others).

Radiation setting is happier in the cover mined-out facilities because the underground leaching (UL) technique, which is much more environmentally safer, was used there. However, local contamination of surface of the UL sites and, mainly, underground water of ore-bearing horizon occurs and preserves for a long time using this technique. Main reasons of the contamination are: technologic solution spillings, disbalance of pumping-in and pumping-out, solutions remained in leaching areas, running out of these solutions into neighbouring horizons. Sulphuric acid underground leaching has lead to essential deterioration of environmental condition of ore bearing horizon underground water in the site under operation. The underground water was assayed for 27 components. Major of them noticeably exceeds the ultimate permissible concentrations. These are, before all, the solvent components - sulphate-ions and ions of hydrogen, leached elements - uranium, iron, aluminum, manganese, some heavy metals and other toxic elements, products of technological processing -

nitrates and others. The highest contamination rate was observed for sulphates - 20 times and more, aluminum and uranium - hundreds times, iron and beryllium - thousand times.

In spite of the fact that areas of contamination in case of underground leaching are rather small and, as a rule, not exceed 100 m - 150 m radius from the UL site, the contamination is hazardous enough if the underground water is used in economics. As regime observations during 8-10 years have shown, the composition of technological solutions in the UL sites does not change essentially within the contour of lower oxide formation, at the same time, areas of underground water contamination expand to some extent. These date do not allow to hope the underground waters will be self-restored soon.

So, many tens of the mined-out UL sites in the territory of the Republic need to be reclaimed to restore initial quality of water, especially if water of ore-bearing horizons is fresh one.

The underground water reclamation provides restoration of the remaining solutions using to different extent a mechanism of sorption-capacity properties of the ground. The mechanism comprises 3 methods of decreasing underground water contamination within a mined-out block: by pumping out the remaining solutions and replacing them with stratal water ("washing" technique), by displacement of the remaining solutions with compressed air ("displacement" technique), or by intensifying natural demineralization using of increased rates of filtration of contaminated water in local volumes ("drawing" technique).