Contaminated Area Management Plan for a Mining and Milling Uranium Facility – Preliminary Results

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1. Introduction

Uranium Concentration Unit (URA) is a facility which belongs to Indústrias Nucleares do Brasil (INB), in which uranium mining and milling activities are carried out to produce ammonium diuranate (ADU) as uranium concentrate.

The URA facilities are basically composed of a disused open pit mine (Cachoeira mine), an open pit mine in progress (Engenho mine), a solid mining waste pile, tailing ponds, a beneficiation plant that include an ore crushing area, a heap leach yard and a chemical milling plant (Figure 1).

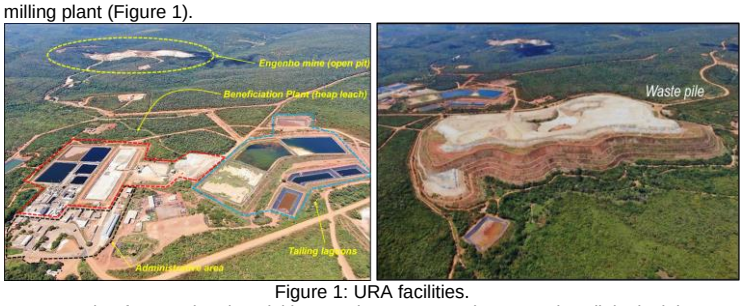

Figure 1: URA facilities.

As a result of operational activities at the URA, environmental radiological impacts generated by unusual events such as infiltration of process liquids into the soil due to failures in the waterproofing system were perceived. To understand the extent of the impact generated and to propose mitigating actions, it was necessary to prepare a management plan for the contaminated area, carried out seeking to comply with the specific resolution of the Brazilian National Council for the Environment (CONAMA) for the management of contaminated areas that establish steps that allow the identification and investigation of an environmental liability, contemplating, at least, the following:

"I. Identification: step in which areas suspected of contamination will be identified based on a preliminary assessment.

II. Diagnosis: step that includes detailed investigation and risk assessment.

III. Intervention: stage of execution of control actions to eliminate the danger or reduce, to tolerable levels, the risks identified in the diagnosis stage."

2. Identification

2.1. Preliminary Area Investigation

Area investigation was made bay evaluation of previous existing studies and reports, such as:

- Groundwater flow modelling, fractured aquifer conceptual model, and environmental hydrogeological study for potential characterization of soil and groundwater contamination in URA area.
- Characterization, radionuclides migration and radiological impact analysis on production platform of URA.
- Investigation and remediation of leaching yard report.
- Annual reports of URA environmental monitoring programs.

Potential sources of contamination were classified according to the activities carried out in each area, being the Cachoeira mine pit, milling area, effluent storage pond, effluent recycling pond and waste disposal area with high potential for subsurface contamination.

A mathematical model of the flow of the fissured aquifer in the URA area was used, scenarios of contaminant release were simulated and the delimitation of the groundwater capture zone of the tubular wells in activity and those that may be exploited through the MODPATH application in MODFLOW software.

Simulation results and monitoring data indicate that chloride and sulfate move out of the tanks area in processing plant (around 200 m away) in 15 years, in a southeast direction, and results for uranium indicated slow displacement and that the largest portion of uranium remains in the unsaturated zone, below the tanks, with very little movement. Regarding the transport in the fissure aquifer, the simulations suggested that there is no movement in the domain.

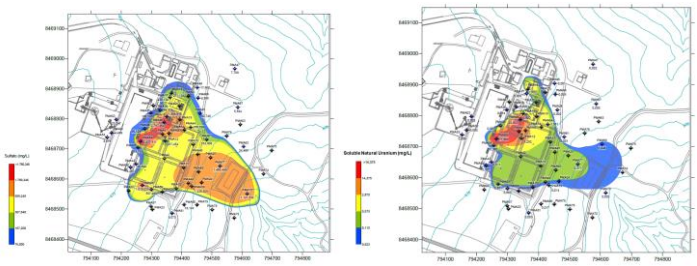

Figure 2: Sulfate and Uranium contaminations on processing plant platform.

In the area of treated effluent containment ponds, concentrations above the standards were observed for all modelled parameters, except dissolved natural uranium (Figure 3).

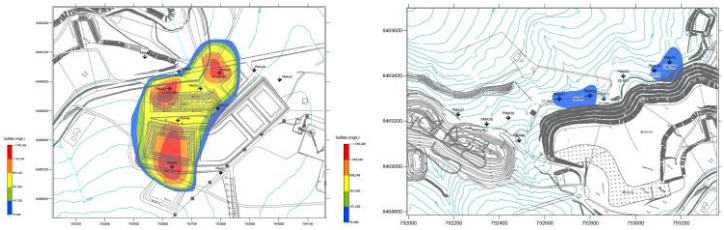

Figure 3: Sulfate contamination on ponds and waste pile area.

Although most of the activities necessary for the preliminary investigation have already been carried out, some complementary investigations to remedy minor weaknesses in the diagnosis are still necessary.

3. Diagnosis

3.1. Confirmatory and detailed investigation

The Confirmatory Investigation Plan must be prepared based on a sampling strategy aimed at the chemical species of interest and directed at all identified potential sources of contamination and must contain: The scanning methods (screening / geophysical) or the justifications for the adoption of the probabilistic distribution of sampling points; The justifications for selecting the chemical species of interest to be determined and the means to be sampled, for defining the position and number of sampling points and for specifying the investigation methods to be employed; Indication of the sources of information consulted. As the net of monitoring wells that can be sampled is not representative to delimit the entire horizontal and vertical extension of contamination, new monitoring wells were proposed (Figure 4).

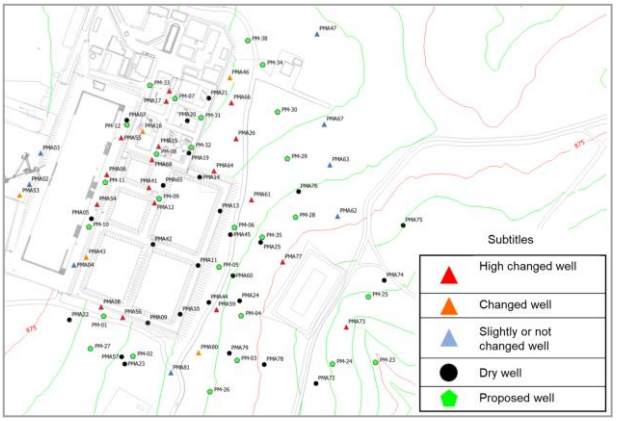

Figure 4: Proposed wells for confirmatory investigation.

4. Intervention

4.1 Emergency containment actions

Pumping and treatment consists of removing contaminated water through extraction wells, so that it can be treated and reused. Although it has recently been replaced or used in combination with other remediation methods, it is still widely used to remediate contaminated groundwater around the world, especially for hydraulic containment of contamination plumes. An area for application of the technique was proposed (Figure 5).

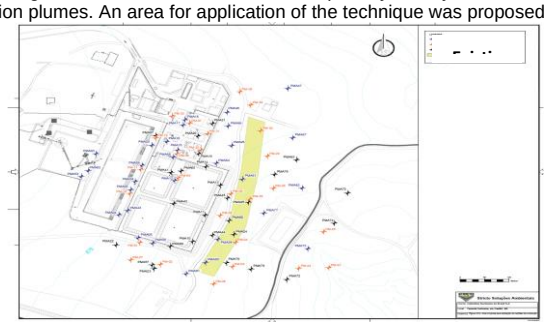

Figure 5: Proposed area for pump and treatment.

The radius of influence of pumping, as well as the number of wells, will be defined after a pilot pumping test. A complementary remediation plan will be drawn up with the definitive impact mitigation measures.

5. Conclusions and Acknowledgements

- The identification and preliminary investigation of the contaminated area was successfully carried out, the detailed diagnosis and emergency containment measures are in progress. The plan was defined in accordance with CONAMA resolution 420/2009. Acknowledgments to INB's environmental coordination team, and the company Stricto for their cooperation in the work.