Management of Low Activity Radioactive Waste (TORTA II) in Caldas Decommissioning Unit, Brazil

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1. Introduction

The Caldas Decommissioning Unit (UDC) belonging to *Indústrias Nucleares do Brasil* (INB) was the first uranium extraction and processing mine in Brazil, which is located in the municipality of Caldas, state of Minas Gerais. Activities took place between 1982 and 1995 and were paralyzed due to ore characteristics associated with market conditions. During this period, more than 100 million tons of material were exploited and approximately 1,500 tons of uranium concentrate were produced. Since then, the UDC has been working in the decommissioning phase.

Among the actions in order to guarantee the protection of workers, the neighboring population and the environment, this work will present the management of Low Activity Radioactive Waste so-called TORTA II.

TORTA II is a material resulting from the chemical treatment of monazite carried out at the São Paulo Unit that was decommissioned in the 90s. It is considered a low activity waste and needs to be stored in accordance with radiological protection standards. Monazite was processed to produce rare earth compounds used in ceramics, composition of electronic materials, superconductors, permanent magnets and special metallic alloys.

Around 13,000 tons of this waste are stored in approximately 20,000 metal drums and 20,000 plastic drums in 4 storage sheds (named C-05, C-06, C-07 and C-09), in addition to 4 semi-buried concrete silos. The average dose rate on the surface of the drums is approximately 600 µS/h and inside the C-05 shed is 900 µS/h. All these structures are located in a controlled area called AA-171 of approximately 120,000 m², all surrounded by wire fence.

2. Improvements made to the physical storage structure

In the period of May and June 2022, INB performed the replacement of the roof tiles and the side closure of one of the storage sheds used for TORTA II (Shed C-07).

This renovation was carried out with no incidents or accidents. All procedures were approved by CNEN before work began. During the activity, inspections were carried out to assess compliance with radiological controls by workers, actions to prevent material dispersion and waste management that were adopted by INB.

For this activity was hired a company to supply materials, equipment and specialized labor. Before starting activities in the shed, everyone involved in the operation underwent training in radiological protection, work safety, operational aspects, emergency plan and first aid. All the tiles in the shed were replaced, totaling an area of approximately 1,300 m² (Figure 1). The new tiles are more resistant, being made of galvanized steel with a variable length according to the dimensions of the building, thus eliminating the need for splices or welding.

Figure 1. Infrastructure improvements in the Shed C-07.

3. Overpacking activities

In January 2022, INB started the remediation of packages containing TORTA II, prioritizing unstable stacks. The remediation target was the overpacking of 1,500 drums with new steel drums and stacking on new pallets. The operation was approved and supervised by CNEN and lasted four months. In this operation, the total weights are being registered in addition to sampling the material for laboratory analysis with the aim of improving the inventory of this material.

Workers in this activity used a variety of Personal Protective Equipment (PPE), including special protective clothing, as well as radiation detectors to control radiation exposure, ensuring that exposure to values within the limits allowed by Brazilian legislation, which is 20 mSv/year. Conservatively, INB adopted a limit of 18 mSv/year for this activity. Considering the radiation safety principle ALARA (As Low As Reasonably Achievable), a sand shield was built inside the shed, which reduces the dose rate by 40 times, reducing the external exposure of workers.

Based on the dose records (Figure 2), the work teams must be reviewed so that the adopted limits are not exceeded. With the progress of the activities, it was possible to observe that the forklift operator receives the highest dose, requiring replacement in a period of approximately 4 months. Another observation is that the shielding of the area has been effective in reducing the doses of workers.

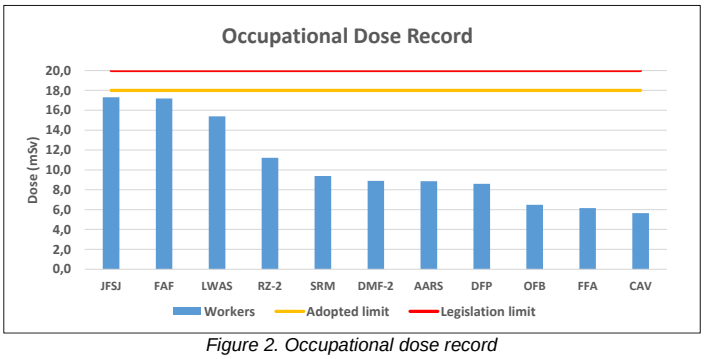

Figure 2. Occupational dose record

Still in 2022, INB returned in September 2022 the remediation of TORTA II packages. This second phase of remediation provided for the overpacking of all remaining drums in Shed C-05, approximately 16,000 drums, with expected deadline in September 2023.

Just as done for the first phase of remediation, INB hired an exclusive bed for the entire duration of the activity in a regional hospital for the decontamination of victims of a possible accident. In January 2023, technical staff from INB and the hospital carried out a simulated accident event (Figure 3), so that the dynamics of care could be trained and the response time could be checked.

Figure 3. Accident care simulation carried out at a regional hospital in Poços de Caldas, Minas Gerais.

Until August 2023, the remediation activity continues and more than 90% of the 19,600 drums were remediated (Figure 4) and is expected to be completed by the deadline of September 2023.

Figure 4. Overpacked drums on new steel pallets in the Shed C-05.

4. Planned actions and future projects

Civil works and engineering services will be performed to continue the improvements. Among these planned actions, the following stand out:

- ✓ Replacement of the semi-buried concrete silo roof with a new one made of steel. At the moment, the contractor is preparing the structural report and detailing the project at the executive level for subsequent approval by CNEN.
- ✓ Construction of a new radiological control point on AA-171. Activities are currently underway to obtain approvals, licenses and authorizations from regulatory bodies.
- ✓ Construction of a new storage shed and refurbishment of an existing shed. At the moment, the definition of the scope of the service is in progress to hire an engineering company to detail the new design and the needs of the renovation.

5. Conclusions

Regarding the final disposal of this low activity waste, INB still does not have a definition. Among the possible solutions, TORTA II can be permanently stored in the unit or even sold to companies interested in reprocessing to obtain elements of interest such as uranium, thorium and rare earths. Despite this, with these management improvement actions, the company's objective of protecting people and the environment is expected to be achieved until the definitive solution is conceived and implemented.