Ensuring Safety of Bauxite Dams through Digitalization

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Abstract

The instrumentation set up around dams is a vital part of the surveillance and governance of tailings storage facilities (TSF) to monitor the geotechnical performance. The data collected in the field helps the geotechnical team, consultants, and governmental agencies take care of TSF during construction, operation, and closure. The conventional monitoring procedure often relies on collecting instrumentation data manually at a particular frequency, limited to adverse weather conditions, accessibility, reading errors, and human effects. Digitalization makes it possible to improve the information collection stage, increasing the frequency and adapting to individual local conditions regarding solar incidence, rain absorption, and others. The custom built reports and graphs have significantly improved the critical analyses of geotechnical engineering teams. However, technology and automation do not replace the field and operational activities. Instead, they complement a geotechnical engineer's important role and ensure safety for operating personnel, community, and the environment. This paper describes the monitoring system installed in the tailings storage facilities and the procedures and controls adopted while migrating from conventional inspections and data collection to a modern control center. It highlights the barriers to implementing the Hydro Paragominas' tailings storage facilities system.

Keywords: Bauxite dams, Geotechnical digitalization, Instrumentation.

1. Introduction

Hydro currently owns and controls one of the primary mining operations in Brasil, the Paragominas bauxite mine. The bauxite mine is located in Paragominas, Pará, Northern Brasil. The installed production capacity is approximately 16 Mtpy of run-of-mine, producing about 11.5 Mtpy of bauxite and generating approximately 4.5 Mtpy of tailings. The mine started operations in 2006, six years after Hydro acquired the operations.

For the disposal of tailings and water recovery, Hydro Paragominas operated two different tailings systems – the Valley and the Plateau Systems. While the Valley System's design aimed for the final and permanent disposal of desiccated bauxite tailings, the Plateau System comprises four temporary drying areas. In contrast, the tailings are permanently deposited in the mined-out stripes through the patented backfilling methodology. Figure 1 shows the two tailings systems in Paragominas.

The Valley System, in operation from the very beginning of the mine operations, consists of three dams: the B5 dam, located upstream of the valley, is intended for water drainage storage; the B1

dam has the purpose of receiving bauxite tailings, and the B6 dam, located further downstream, is a sediment containment facility and is also essential for the plant water balance. As the Valley System approached the end of its useful life, the Plateau System started to operate.

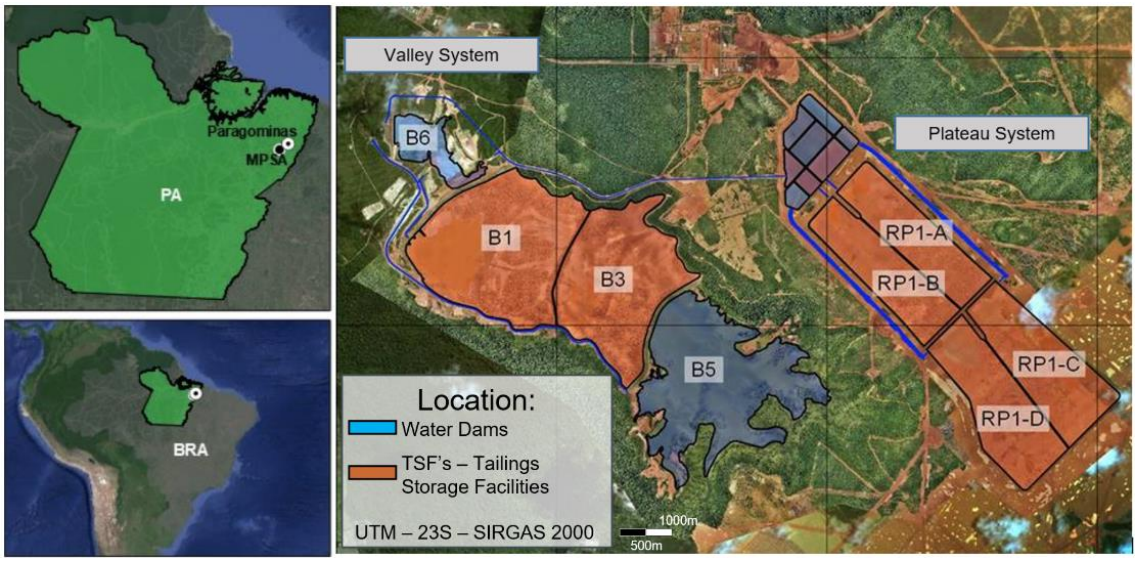

Figure 1. Valley and Plateau tailings systems in Hydro Paragominas.

Tailings storage facilities are amongst mining companies' most critical structures of production and environmental matters. The safety of the tailings dam directly influences the mining operation, environmental protection, and the safety of the community's life and property [1], as evidenced after the last incidents involving tailings dams.

In this context, the mining operation and tailings management in the Amazon biome require a total commitment to safety, social and environmental standards, and best practices. Since adequate monitoring is an essential part of tailings management, as described in the recently published Global Industry Standards on Tailings Management, advances in the related technologies have supported the operation, maintenance, and surveillance of the TSF.

Amongst the well-known challenges of geotechnical monitoring, the current demand for automation imposed by federal agencies in Brasil has required more effort for the sector to provide suitable solutions. The sector's main challenges are data transferring, communication, power supply, reliability, and redundancy.

Authors [2] pointed out that the governance of data generated in the field and detailed monitoring must undergo constant evaluation, analyzing its performance and verifying if current conditions are satisfactory. It also mentions that a proper design will serve as the first step in providing adequate monitoring and that it should provide the conditions for evaluating the efficiency of the installed instrumentation and when it will be necessary to adjust it.

2. The Monitoring System

Both tailings systems, object of study of this work, are located in the northeast of Pará, at the Paragominas bauxite mine complex. The importance of instrumentation in dams is similar to regular industrial plant, measuring the performance, create key performance indicators (KPI's), develop control management, triggered action response plans (TARP's), while it creates value regarding environment, social and governance.

6. Conclusions

The trend towards digitization of mining dams, motivated by the automation of geotechnical instruments and constant recordings of Closed-Circuit Television (CCTV), generates a significant volume of data compared to the old monitoring conditions, primarily manual and on site. This approach provides much larger data bank and enable the possibilities for statistical analysis, better visualization and improved management of assets. In addition, they require a more significant number of people and a multidisciplinary team from planning to implementing the entire IT/AT (automation technology) structuring, culminating in the proper analysis of the images and geotechnical monitoring information.

Field evaluations and manual readings of the instruments remain good practices and are of paramount importance for identifying the dam's performance on site and carry out calibration for to allow analysis of the data coming from automated instruments.

By conducting analysis, Hydro Paragominas could use digitalization in the industrial area, which is considered crucial for the environmental, social, and governance business. The main driver for this innovation path has been to deliver increased productivity, reduce risks and improve technical team analytic capacity.

7. References

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