Early lessons from Ranger Uranium closure cost overruns

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Abstract

- ERA's announcement on Friday 8 October 2021 that it faces 'material' cost and schedule overruns associated with rehabilitating and closing the Ranger uranium mine, highlights how difficult it is to understand the closure risks that need to be addressed on a mine site, and how important it is to undertake studies designed to improve understanding of these risks, how to address them, how much this will cost and how long the costs will be incurred. Tailings and geochemistry are two of the highest risks associated with both the operation and closure of mine sites.
- In-pit tailings disposal needs to consider the cost of remediating residual risks.
- Closure cost estimates need to be developed using a robust method and costs need to continue to be refined over the life of an operation by conducting trials and progressive rehabilitation to test the assumptions that estimates are based on.
- Depending on the level of uncertainty associated with closure costs, contingencies may need to be included until levels of knowledge improve.

When processing ceased at the Ranger mine on 8 January 2021 it was one of the longest continually operating uranium producers in the world, producing more than 130,000 tonnes of uranium over 40 years of operation. Rehabilitation and closure of the Ranger site was always going to be challenging due to its remote location (260 km southeast of Darwin in Australia's Northern Territory) on Aboriginal land surrounded by the World Heritage listed Kakadu National Park. Successful closure of the site is made more difficult by a legal requirement for final rehabilitation to be completed within a tight timeframe – by January 2026.

On 8 October 2021 Rio Tinto subsidiary Energy Resources Australia Ltd (ERA) announced that 6 months into active closure of the site it faces 'material' cost and schedule overruns for the rehabilitation and closure of the mine. The problems being faced by ERA should serve as a warning to the rest of the mining industry as it has undertaken extensive planning for site closure, and progressive rehabilitation has been occurring since 1994. The Ranger site is one of the most studied mines in Australia with respect to rehabilitation and closure. The Mine Closure Plan is based on 40 years of scientific and technical information drawn from research and monitoring undertaken by ERA and the Supervising Scientist Branch of the Australian Government Department of Agriculture, Water and Environment (Supervising Scientist, 2018). Yet despite all the research and planning that has been undertaken, ERA is still struggling to understand what is required to successfully close the Ranger site, how much it will cost and how much time it will take.

At this early stage it is difficult to know what lessons can be learnt from ERA's struggles to understand the costs to close Ranger. However, it does highlight:

1. How hard it is to understand the closure risks that need to be addressed for a mine site.
2. How important it is to put in the effort to try to understand the closure risks, how to address these risks, how much this will cost and over what period these costs will be incurred.

An article in The Australian from 9–10 October 2021 indicates that at least one of the problems ERA is facing is related to 'dredging and cleaning up water from tailings dumped in old mining pits, with the company looking at whether it could need to install more desalination plants on site to complete the work on time'. ERA's September 2021 Quarter Operations Review reported that the process of floor and wall cleaning activities at the tailings storage facility (TSF) 'has been more complex than planned' and has been pushed back.

Geochemistry (typically the risk of acid and/or metalliferous drainage [AMD]) and tailings are often the highest risks associated with both operating and closing a mine site. If you get either (or both) of these wrong, managing the consequences can result in significant cost over a long period of time. Potential impact to water quality in adjacent receiving waters is particularly important in the case of Ranger as impacts need to be evaluated in the context of Commonwealth environmental requirements (which include the incorporation of the site into Kakadu National Park) and the need to ensure impacts are as low as reasonably possible to protect the people, ecosystem and World Heritage Site and Ramsar wetland values of the surrounding area (Iles, 2019).

The Superfund sites in the United States demonstrate how expensive closure of a mine site can get if the first of these high risks – geochemistry – is not well understood and managed. At the Berkeley Pit in Montana, a treatment facility capable of treating ten million gallons (approximately 38,000 cubic metres) of water per day was constructed in 2019 to treat water from the pit lake that has a pH of approximately 2.5 and elevated levels of copper, arsenic, cadmium and zinc. Similarly, in Australia the Mt Morgan mine in Queensland is predicted to generate AMD for up to 500 years (Gasparon et al., 2007). Active treatment of AMD also creates additional problems through the generation of vast volumes of sludge with high concentrations of metals that must be safely disposed of. Having to install and maintain a treatment facility to deal with AMD for years after mining finishes (or even in perpetuity in the worst-case scenario) will be a significant cost that needs to be understood or preferentially avoided through improved understanding and management of potentially acid forming and other deleterious materials during mining operations.

Another high risk when operating and closing an operation is how to safely and securely contain in perpetuity the large volume of tailings generated by most large-scale mines. The tailings material generated through the separation of the valuable minerals from uneconomic material is often contained in dams which are among the world's largest engineered structures. The risks associated with TSFs during the operation of a mine site are very well known, with recent failures in Brazil having catastrophic consequences and garnering a lot of negative media coverage for their owners.

An in-pit TSF may appear to be a win-win-win by:

- providing a low-cost option for tailings disposal during operations
- addressing the issue of residual voids at closure
- removing the need to construct a dam style TSF that must be designed, constructed, operated and closed in a way that ensures that it is stable for centuries and meets the requirements of the Global Industry Standard on Tailings Management.

However, ERA's problems highlight that in-pit TSFs come with their own risks that need to be understood and addressed. These risks include groundwater contamination, the amount the tailings will settle (sometimes in the tens of metres) and the time required for the tailings to consolidate enough to be safely capped and rehabilitated. The cost of closing in-pit TSFs needs to be considered to avoid underestimating the actual cost to the operation. Sam Paterson (AusIMM Bulletin, 2021) noted some of the ways the risk associated with the operation and closure of in-pit tailings storage facilities can be managed:

- Know the magnitude of the problem:
  - Understand the tailings materials in terms of settling characteristics and consolidation at low pressures
  - Consider the site hydrology to determine drainage path lengths for the consolidation process and any potential receptors of impacted groundwater
  - Review long-term production schedules and model the state of consolidation at the end of deposition and estimate the time for an equilibrium condition to occur
  - Use the model to project future consolidation behaviour, including the rates of settlement and the magnitude of final settlement.
- Review opportunities for operational improvements – good practice such as maintaining a minimum pond volume and maximum beach reduces the amount of water that may require treatment post-closure and the amount of time required before the tailings surface can safely be accessed to place cover material.
- Weigh the risks and benefits and understand the overall cost of any proposed in-pit TSF rather than just the deposition cost.

As for geochemistry, to avoid catastrophic failure or long-term costs associated with having to actively maintain a TSF long after closure, the characteristics of the tailings material must be well understood. This understanding must then be used to develop a method for storing this material safely which considers how the facility can be cost-effectively closed. Like most aspects of closing a mine site, a more effective and generally cheaper solution for closing a TSF will be identified if it is considered as part of the mine's original design, rather than if it is left until it has been operated for years and there are only a few years left in the mine life. Waiting to consider closure at the end of the mine life limits the options available to reduce the risks associated with closing the facility (such as how to manage surface water) and potentially the required materials (such as clean competent rock) may not be available in the volumes needed.

As well as understanding the risks associated with closing a mine site and the best way to address them, it is important to have a robust system to calculate closure costs and to continue to refine cost estimates throughout the life of the mine by conducting trials and progressive rehabilitation to test the assumptions that closure estimates are based on. The importance of having a good understanding of the closure liability associated with a mine site is highlighted by the United States Securities and Exchange Commission (SEC) Rule S-K 1300 which is coming into effect in 2021 after new regulations were released on 31 October 2018. These regulations apply to US registrants with material mining properties, which includes all companies listed on the New York stock exchange (whether a primary listing or not). Although these regulations are focused on the reporting of mineral resources and reserves, companies are also required to report on their closure liability and to disclose any uncertainties regarding their proposed closure methodology and cost estimates. The SRK closure team uses the Standardized Reclamation Cost Estimator (SRCE) model and other tools to develop detailed closure cost estimates for clients. The SRCE model is an established, internationally recognised and auditor accredited costing model which meets International Accounting Standard 37 requirements and uses first principles methods to estimate the quantities, productivities and work hours required for various closure tasks based on site-specific inputs.

The challenges ERA is facing in accurately estimating the cost and schedule to rehabilitate and close the Ranger site highlights how important it is for all companies to understand their closure risks and the assumptions that are being made to derive their closure costs. Closure planning and cost estimation is a relatively new process, and everyone is still learning along the way. Therefore, everybody involved in developing and implementing closure plans needs to actively question how risks are being addressed and whether the assumptions made to develop cost estimates reflect reality. For example, what is the actual distance that you will have to truck the capping material required for a TSF and will there be adequate volumes available when it is required at closure, what volume of impacted water will need to be treated, over what timeframe and what are the costs associated with maintaining water treatment plants for extended periods. Within its 2020 Mine Closure Plan ERA identified that:

- the additional volume of process water that may require treatment is sensitive to many factors (such as above average rainfall, performance of the water treatment plants and the timing of closure of water catchments)
- if water treatment volumes exceed the available treatment capacity it may be necessary to expand the existing capacity (through construction of an additional water treatment plant or other alternate technology).

Although the risk that additional water treatment capacity may be required was identified within the Mine Closure Plan it is noted that ‘this has not been allowed for in the estimate and would come at significant additional cost’ and that ‘any significant delay may further compress the schedule requiring alteration to other closure activities’ (ERA, 2020). In its guidance to the stock market on 8 October 2021, ERA specifically noted that ‘there have been a number of changes between assumptions made during the [2019 feasibility study on which its closure costings were based], and those that have actually or may materialise during execution’. This illustrates the importance of learning from progressive rehabilitation and trials during the life of the mine, updating closure costs based on these learnings and including contingencies based on the level of uncertainty in the cost estimate where required. If rehabilitation and closure is left until the end of mine life, there is no way of testing whether the methodologies the closure costs are based on will be successful, how much they will actually cost to implement and whether contingencies need to be accounted for in the closure cost – as appears to be the case for water treatment at Ranger.

It is also imperative that the sensitivity of closure cost estimates to any assumptions they are based on is understood as in some cases a small change in an assumption may result in a significant change in the cost estimate. In the case of Ranger, the cost for process water treatment may be very sensitive to assumptions made about the closure schedule. A small delay in the schedule that results in a water catchment not being rehabilitated and closed prior to the wet season as planned could significantly increase the volume of water requiring treatment.

Finally, we all have an obligation to continue to share what we have learned (including the hard or expensive lessons) with our colleagues at conferences and workshops as ERA has done with Ranger in the past. It is only by working together that the mining industry can continue to improve its mine closure performance and gain credibility with regulators and the general public.

References:

Energy Resources of Australia Ltd, 2020. Ranger Mine Closure Plan, October 2020.

Gasparon, M, Smedley, A, Jong, T, Costagliola, P and Benevenuti, M, 2007. ‘Acid mine drainage at Mount Morgan, Queensland (Australia): experimental simulation and geochemical modelling of buffering reactions’, in R Cidu & F Frau (eds), *Proceedings of the 2007 International Mine Wast Water Association Symposium*, Mako Edizioni, Cagliari.

Iles, M, 2019. ‘How can frameworks inform water quality objectives for the closure of the Ranger Mine?’, in AB Fourie and M Tibbett (eds) *Mine Closure 2019: Proceedings of the 13th International Conference on Mine Closure*, Australian Centre for Geomechanics, Perth, pp 437–446.

Paterson, S, 2021. ‘In-pit tailings storage facilities – easy win or long-term liability?’, in AusIMM Bulletin.

Supervising Scientist, 2018. Assessment Report: Ranger Mine Closure Plan Rev #: 0.18.0 May 2018. Internal Report 658, September 2018, Supervising Scientist, Darwin.