

## APPENDIX M10

# PIRSA GUIDELINES FOR THE MANAGEMENT OF ACID MINE DRAINAGE AT ANGAS ZINC PROJECT

## ANGAS PROCESSING FACILITY MISCELLANEOUS PURPOSES LICENSE APPLICATION 2019/0826



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**Government of South Australia**

Primary Industries and Resources SA

# **Guidelines for the Management of Acid Mine Drainage**

**at the**

**Proposed Angas Zinc Project,**

**Strathalbyn, South Australia**

## Background

The geochemical assessment data from tests reported on the tailings samples from this project demonstrate that the tailings composition at the ANGAS project is unusual in terms of its high net acid producing potential. Oxidation of the Angas orebody has been demonstrated to be an extremely rapid process and the potential for AMD generation and release of some heavy metals raise the real potential of contamination from this project.

At issue are the potential for contaminant release from surface operations and processing, surface waste storage (waste rock dumps and the TSF), and the underground mine. Provided the surface operations are suitably decommissioned after the mine ceases to operate, the surface drainage issue should cease at that time. On the other hand, contamination resulting from seepage from the underground mine is likely to become an issue primarily after operations cease, as during operations all mine water is likely to be pumped to the surface.

There is potential for contaminant release from the TSF both during operations and into the future and these guidelines have been prepared specifically to cover the TSF, which for this purpose includes the:

- TSF cell and confining embankments.
- Associated wastewater reclaim ponds.
- Tailings delivery system.
- Water return system

These guidelines have been compiled for this specific project by drawing from applicable Australian TSF Guidelines and SA EPA Guidelines prepared to cover the containment of non-mining solid wastes. Applicable Guidelines include:-

“Guidelines on the Safe Design and Operating Standards for Tailings Storage Facilities” (Western Australia 1999);

“Management of Tailings Storage Facilities” (Victoria Nov 2004);

ANCOLD “Guidelines on Tailing Dam Design, Construction and Operations” (October 1999)

“Guidelines on landfill facilities for domestic, commercial and industrial solid waste” (SA EPA, Draft rev C-March 2005) and associated EPA Guidelines, which include: -

- *Guideline for leachate containment and management systems for domestic, commercial and industrial solid waste landfills (EPA, draft rev C-March 2005).*
- *Guideline on the use of geosynthetic materials in base liner systems (EPA, draft rev 2-August 2004).*
- *Guideline for closure and post-closure plans for domestic, commercial and industrial solid waste landfills (EPA, draft rev C-March 2005).*
- *Guideline for capping systems for domestic, commercial and industrial solid waste landfills (EPA, draft rev 3-March 2004).*

These guidelines have been jointly produced by PIRSA and the EPA to address the risks specific to the Angas Zinc Project, and if followed will be accepted as an alternative (in regards to the approval of an EPA licence and the MARP) to a requirement to comply with the EPA 2005 "Guidelines on landfill facilities for domestic, commercial and solid waste".

In view of the high potential for contamination from any discharge from this site and the outcomes – be they real or perceived, in this environmentally important location, the objectives set for the proponents to meet have already been indicated to be:

**There is to be no contaminant released from this site during operations, or into the future.** This is intended to primarily cover surface or underground seepage containing AMD or heavy metal ions or the transport of solid waste products as a result of embankment failure, weathering or dusting.

A preliminary design concept for the project presented by the proponent envisaged a side hill TSF with an embankment on three sides and very little catchment area above the site. The maximum embankment height was expected to be of the order of 15 metres above natural ground level. The rate of waste disposal and total storage of the TSF gives it a landfill class of “Large” according to the EPA guidelines.

As a result of initial discussions with PIRSA, the proponents have already undertaken to thicken the tailings before discharge into the TSF (resulting in less water being delivered into the TSF) and to line the base to limit base seepage. They have also indicated that the facility is to be designed and managed such that there will be no storage of supernatant water or rainfall runoff on the surface of the tailings – again to limit the potential for base seepage.

The design concepts shown to date indicate that the tailings are to be discharged from multiple spigots down slope towards the embankment. The proponents have also indicated that a geomembrane (HDPE liner) is to be placed over the tailings prior to capping and that the facility is then to be rehabilitated to limit the potential for seepage into the stored tailings.

As part of the process outlined in these guidelines, the proponents will be required to undertake a comprehensive risk assessment of all relevant aspects of their proposed design and to detail the measures they will be implementing to monitor, report and remedy any deviation from this objective. To assure the stakeholders that they can meet the set objectives, the proponents will need to demonstrate that their design is practicable and that a safe and stable facility will result from the construction, operation and decommissioning of the TSF.

The risk assessment and the risk based design upon which that assessment is to be based is to be undertaken in accordance with the *Risk Management Guidelines, HB 436:2004 (companion to AS/NZS 4360:2004) incorporating Amendment No. 1 dated Dec 2005.*

The basis for evaluating risks will be: -

- The guidelines listed above
- The contextual notes listed below.

The proponents have indicated that they will be conforming to the ANCOLD guidelines (1999) as a minimum standard in the design criteria for the TSF.

### **Contextualizing Notes**

In order to produce a concise set of guidelines for this project, it was decided to build upon the existing guidelines listed earlier rather than develop a completely stand alone document. Using the numbering in the table of contents in the ANCOLD guidelines as a guide (and the text of that document), the criteria most relevant to this project will include:

#### *Section 4 Tailings Storage Concepts.*

- Currently multipoint spigot, down hill discharge and sub aerial deposition.
- With thickened tailings, the proponent could consider different deposition concepts to produce a surface profile that will direct water away from the embankment during operations and minimise the need for a decant system and then the potential for overtopping and scour of the embankment after closure.

#### *Section 5 Water Management*

- *Item 5.4 Tailings decant water* –high rate and deep cone thickeners in operation in Australia rarely produce a consistent high density tailings product.
  - The proponents will need to detail how their design will cope with supernatant water and provide the details of a system to remove the "decant pond" water from the TSF.
- *Item 5.6 Water Recovery* – a separate water retention pond will be required to receive and store all excess supernatant water and precipitation removed from the TSF (and possibly contaminated surface water run-off from the site).
  - The depth of water that this could hold will produce driving heads that could produce far greater base seepage than will occur within the TSF and will require an adequate lining system.
  - Unless this contaminated water can be pumped for secure storage elsewhere on the site, the reclaim pond area will need to be adequate to ensure that the water can be dissipated by evaporation.
- *Item 5.7 Floods* – to be allowed for as per the ANCOLD guidelines.
- *Item 5.8 Underdrainage and Seepage* – the concept to be adopted for and the design of the base liner system to satisfy the stated objective while producing a dense stable bed of tailings will be a most critical aspect of the design.

#### *Section 6 Design Criteria for Tailings Dams*

- *Item 6.1 Hazard Rating* – as per the ANCOLD guidelines.
- *Item 6.4 Design Flood and Freeboard* – as referenced in Item 5.7.
- *Item 6.6 Foundations* – the embankments are to be engineered earthen structures, designed and constructed to ANCOLD specifications.
- *Item 6.7 Seepage and Pore Pressure* – seepage modeling must demonstrate that the objectives will be met into the future (for at least 200 years).
  - Measures that can be taken to minimize seepage from the TSF (and reclaim pond) are discussed in Item 6.7.5 in the ANCOLD document and under Item 5.8 above.

- *Item 6.8 Filters* – it may be desirable to construct a drainage layer between the liner and tailings to ensure that the “head of water” on the base liner is kept to a minimum (possibly reducing the specification for the liner) and enabling the water reporting to the base of the tailings during consolidation to drain to a sump and be removed from the TSF.
- *Item 6.9 Liners* – the provision of leachate containment and management systems adequate to meet the set objectives is probably the most crucial of all design considerations.
  - In particular this is applicable to the upstream face of the confining TSF embankment and to the base of the TSF and water reclaim pond.
  - In addition to the guidance provided in this section of the ANCOLD document, the “considerations and details” set out in the *Guideline for leachate containment and management systems for domestic, commercial and industrial solid waste landfills (SA EPA, draft rev C-March 2005)* should be incorporated.
  - Useful information on geosynthetic materials used as liners as part of a barrier system is contained in *Guideline on the use of geosynthetic materials in base liner systems (SA EPA, draft rev 2-August 2004)*.
- *Item 6.11 Stability Scenarios* – design as per the ANCOLD guidelines.
- *Item 6.12 Earthquake Analysis* – design as per the ANCOLD guidelines using the earthquake intensity appropriate to this location.
- *Item 6.13 Settlement* – after deposition the tailings will settle due to consolidation.
  - This settlement must be taken into account when establishing the final profile of the TSF after capping, particularly with respect to the final height of the perimeter embankment.

#### *Section 7 Construction Issues*

- The base preparation for the TSF, the perimeter embankments and the water reclaim ponds are to conform to good engineering practice as typified by the ANCOLD guidelines and the “considerations and details” in the *Guideline for leachate containment and management systems for domestic, commercial and industrial solid waste landfills (SA EPA, draft rev C-March 2005)*.

- The construction of the perimeter embankments of the TSF (and reclaim ponds if applicable) are to conform to good engineering practice.

#### *Section 8 Operation and Monitoring*

- Management practices for operation and monitoring are to be established in accordance with Section D (Operation) in the document *“Management of Tailings Storage Facilities” (Victoria Nov 2004)*.
  - Also in accordance with these guidelines, tailings delivery and water return systems (pumps, pipelines etc) need to be bunded to control spillages.
- The proponents are to detail monitoring arrangements for all measurement systems, specify KPI's that action remedial measures and the specific action to be taken to redress real and potential breakdowns in operations and of protective measures.
- The proponents are in particular to identify all instrumentation and inspection techniques to be established and monitoring undertaken to detect any seepage from the site.

#### *Section 9 Decommissioning*

The objectives, principles and minimum requirements for decommissioning, closure and aftercare are outlined in Section 9.1 in the ANCOLD Guidelines. There are several other documents that present these criteria, for Australian conditions and in similar terms. Being written at different times they reflect an emerging terminology, but all reflect on issues relevant to this project and should be consulted in planning for decommissioning. These include: -

- Section 12, Appendix D (Page 25) of the *“Guidelines on the Safe Design and Operating Standards for Tailings Storage Facilities” (Western Australia 1999)*.
- Section E, (Page 23), *“Management of Tailings Storage Facilities” (Victoria Nov 2004)*.
- *Guideline for closure and post-closure plans for domestic, commercial and industrial solid waste landfills (SA EPA, draft rev C-March 2005)*.

*And specifically for capping systems: -*

- *Guideline for capping systems for domestic, commercial and industrial solid waste landfills (SA EPA, draft rev 3-March 2005)*.

The proponents will be required to provide a detailed plan for decommissioning this facility. Specific issues that are to be addressed will include: -

- The proposed profile for the TSF after closure.
- The proposed capping system.
  - The measures proposed for encapsulating the tailings (with a HDPE membrane) to ensure that additional water cannot infiltrate into the contained tailings and promote further seepage.
  - The details of the soil cover, and plans for revegetation of the TSF.
- The stormwater management strategies, covering: -
  - Management of surface water on the site;
  - Management of stormwater on the surface of the TSF;
  - The plans for closure of the reclaim water pond.
- Soil erosion mitigation strategies for the surface of the TSF and the outer face of the confining embankment.
- Techniques to be employed for ongoing monitoring of the facility for base seepage – and action plans for remedying the situation should any contamination be detected.

### **Risk Based Design**

The risk assessment and the risk based design upon which that assessment is to be based is to be undertaken in accordance with the *Risk Management Guidelines, HB 436:2004 (companion to AS/NZS 4360:2004) incorporating Amendment No. 1 dated Dec 2005.*

In order to consider all risks and yet concentrate effort on the high-risk issues, a staged approach is required. The relevant sections in the guidelines are identified below: -

- Stage 1 is a qualitative assessment that identifies all hazards and risks and identifies higher risk items (Section 6.1.3).
- Stage 2 is a semi-quantitative and quantitative assessment as set out in Sections 6.1.4 and 6.1.5.

- In Stage 3, the mitigations that form the basis of the design are assessed in accordance with Section 8 and based upon the risk evaluation process as set out in Section 7.
- Stage 4: The MARP document requires that the proponents specify the monitoring and review procedures that will be used to verify the assumptions, performance and reliability of the design.
- Stage 5: The proponents will then prepare a risk assessment plan in accordance with Section 11.