Department of Natural Resources, Mines and Energy

Guidance Note QGN 29

Surface tailing storage facility management

Mining and Quarrying Safety and Health Act 1999

March 2018

Queensland Government

Reference is made to the following legislation as applicable to a Mine or Quarry in Queensland:

- *Mining and Quarrying Safety and Health Act 1999*
- Mining and Quarrying Safety and Health Regulation 2017

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To ensure you have the latest version, check the DNRME website: https://www.business.qld.gov.au/industry/mining/safety-health/mining-safety-health/legislation-standards-guidelines or contact your local Inspector of Mines.

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This publication has been compiled by the Mines Inspectorate, Department of Natural Resources, Mines and Energy.

Contents

1. Introduction

This guidance note has been issued by the Queensland Mines Inspectorate of the Department of Natural Resources, Mines and Energy (DNRME).

It is designed to assist mine management and workers to be aware of the hazards and resultant risk arising from less than adequate (LTA) tailings storage facility management.

DNRME would like to acknowledge the help provided by Evolution Mining, particularly its Cracow mine staff, in assisting with this guidance note.

2. Background

Mines that carry out wet or chemical processing of their ore can produce significant amounts of slurry-like waste, often stored in large surface tailings (dam) storage facilities (TSF). This waste requires specialised handling and management to achieve safe storage and to minimise damage to the environment.

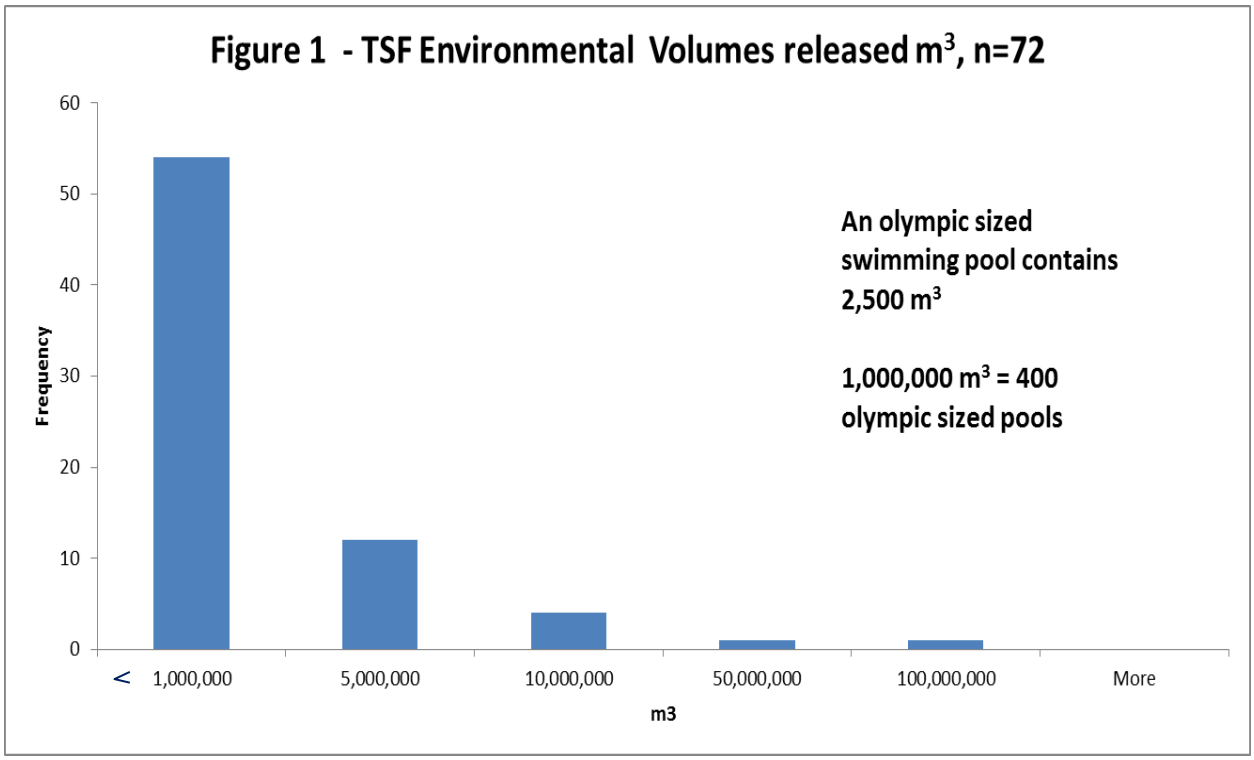
Less than adequate (LTA) management of TSFs, often compounded by poor initial design, uncontrolled expansion or modification of the dam structure or extreme weather events, has led to many tailing dam failures worldwide. In some cases these have caused the immediate deaths of those people working on or living below the TSF.

Some historical TSF failures are detailed in Table 1.

Date	Mine	Mineral	Mechanism of failure	Vol. released	Risk/Consequence
5 Nov 2015	Germano mine, Bento Rodrigues, distrito de Mariana, Região Central, Minas Gerais, Brazil	Iron ore	Failure of two tailings dams holding a combined 62 million m^3 (the Fundão dam failed releasing tailings into the Santarém dam, which subsequently failed)	32 million m^3	Slurry wave flooded town of Bento Rodrigues, destroying 158 homes, killing at least 17 persons and 2 reported missing; slurry pollutes North Gualaxo River, Carmel River and Rio Doce over 663 km, destroying 15 square kilometres of land along the rivers and cutting residents off from potable water supply
30 Jan 2000	Baia Mare, Romania	Gold recovery from old tailings	Tailings dam crest failure after overflow caused from heavy rain and melting snow	100,000 m^3 of cyanide-contaminated liquid	Contamination of the Somes / Szamos stream, tributary of the Tisza River, killing tonnes of fish and poisoning the drinking water of more than 2 million people in Hungary
25 Apr 1998	Los Frailes, Aznalcóllar, Spain	zinc, lead, copper, silver	Dam failure due to foundation failure	4-5 million m^3 of toxic water and slurry	Thousands of hectares of farmland covered with slurry
19 July 1985	Stava, Trento, Italy	Fluorite	Dam failure, caused from insufficient safety margins and inadequate decant pipe construction	200,000 m^3	Tailings flow 4.2 km downstream at 90 km/h; 268 people killed, 62 buildings destroyed
21 Oct 1966	Aberfan, Wales, United Kingdom	Coal	Dam failure (liquefaction) from heavy rain	162,000 m^3	The tailings travelled 600 meters, 144 people were killed

Table 1: Historical TSF failures.

Figure 1 below graphs the magnitude of releases from 72 tailings dam failures.



3. Purpose and scope

The purpose of the guidance note is to provide information to mine management on basic risk based precautions and concepts to ensure the safety of TSFs for mine sites. It does not address tailings disposal or placement into underground mines or waste dumps.

There are a number of factors affecting the complexity and therefore the operating envelope of any TSF, therefore this guidance note must not be relied upon as a single source for safety verification.

4. Legislative requirements under the MQSHA

Any activities associated with TSF are subject to the general risk management principles given in the MQSHA and the Mining and Quarrying Safety and Health Regulations 2017 (MQSHR).

Section 42A of the MQSHA provides specific obligations for those who design and construct TSF to ensure they are safe.

Due to the nature of TSF hazards and their controls, the site management structure should include one person who is appointed to be responsible and accountable for the management of the facility. In addition to this the Site Senior Executive (SSE) must ensure supervisory staff involved in the management of a TSF are competent.

5. Legislative requirements of environmental and heritage protection

Legislation and guidance covering the administration and management of TSF in Queensland is coordinated by the Department of Environmental and Heritage Protection (EHP).

Main guidance to determine inspection type activities is provided in the *Manual for assessing consequence categories and hydraulic performance of structures*, November 2013, Department of Environmental and Heritage Protection', and *Guideline – Environmental Protection Act 1994 - Structures which are dams or levees constructed as part of environmentally relevant activities'*, EM634 Ver. 6'.

The manual sets out how to determine if a TSF will be classified as a regulated structure, based on its design and use, and a correlated consequence (risk) ranking. Under this scheme, TSF only become regulated structures, if the consequence category is significant or high.

The guideline sets out the process used to authorise structures such as a TSF, including regulated structures. Specifically it requires submission of a certified design plan and other documentation by the holder of the authority. Each regulated structure must have a certification given by a suitably qualified and experienced person that confirms the regulated structure is designed, constructed, maintained and operated in accordance with the regulatory requirements.

The guideline specifies that regulated structures must be inspected each calendar year by a suitably qualified and experienced person. At each inspection, the condition and adequacy of all components of the regulated structure must be assessed and a report must be prepared.

This report must contain details of the assessment and include recommended actions to ensure the ongoing integrity of the regulated structure. These reports and other information form part of the ongoing 'license to operate'. Typical contents/headings of an Independent Expert's inspection report can be seen in Appendix 1.

Additional guidance is provided also by the Australian National Committee on Large Dams Incorporated (ANCOLD Inc.).

6. Basic principles

Tailings are generally described as a combination of:

- fine-grained solid waste material remaining after the recoverable minerals have been extracted from crushed and ground mined ore,
- processing chemicals and
- any remaining process water.

Tailings form a slurry that can be placed into a TSF to confine the tailings.

The term TSF refers to the overall storage facility and may include one or more tailings dams, associated pumping, decanting, monitoring and warning systems, storm water diversion and drainage channels etc. This warrants an integrated management approach.

Once a TSF is full, or the mine has ceased to operate, the operation must provide for safe long term storage. Typical long term storage parameters must consider natural weather events such as normal rainfall, or larger weather events such as heavy rainfall and seismic events. It must also consider ongoing maintenance requirements of the structure and programs for water and hazardous effluent or emission treatment.

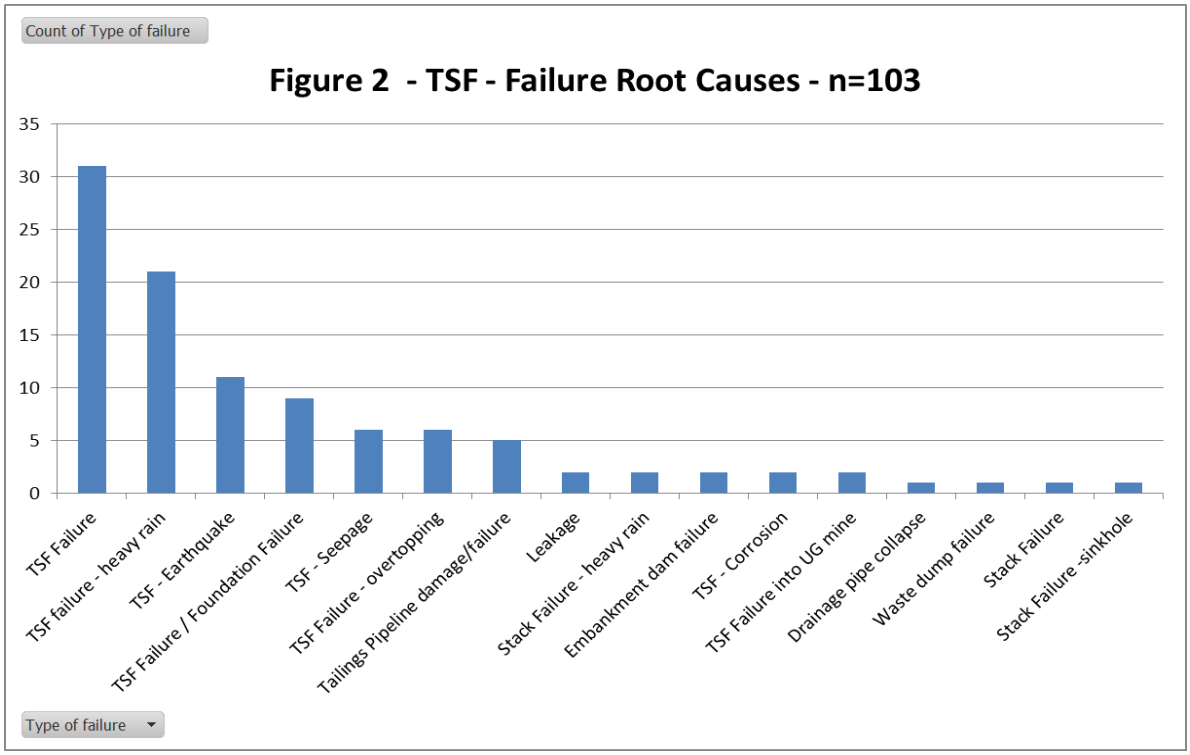
7. Typical hazards, operational and closure risks of a TSF

The main TSF hazard arises from attempting to contain an essentially liquid substance inside a structure normally constructed from natural materials such as earth and rock, or from consolidated tailings themselves and therefore variable and / or inhomogeneous, in a natural setting that can be impacted by severe weather events, or in some instances seismic events.

This gives rise to failure hazards, where contributing factors may include:

- LTA planning including siting of the TSF, design and construction of the dam, modifications, extensions/enlargements, leading to failure during or after operation of the TSF.
- Exceedance of storage capacity from rainfall events resulting in induced erosion or piping of the outer tailings face potentially causing the failure of the TSF.
- Rupture of the tailings slurry delivery pipeline or decant water return pipeline leading to contamination downstream.
- Blockage of the spillway and subsequent overtopping, TSF wall erosion and failure.
- Rupture or partial failure of wall caused by piping action.
- Geotechnical failure, excessive deformation or seismicity-induced failure of the containment wall resulting in TSF failure.
- Overfilling of the tailings storage facility with tailings, leading to overtopping of the containment wall by water.
- Seepage through the containment wall, leading to further gradual degradation and slumping/weakening of the downstream side of the TSF.
- Contaminated seepage into the foundation impacting on the groundwater or vegetation downstream.
- Windblown particulate (dust) or gaseous emissions from the TSF causing contamination of the TSF surrounding area, and causing potential sources of exposures to mine workers.
- Entrapment and drowning of workers when working near dam edges or decant stations through.
- Exposure of birds, wildlife or livestock to potentially contaminated decant water that ponds on the surface of the TSF.
- Potential entrapment of wildlife or livestock on soft tailings.

Figure 2 below provides a frequency analysis of historical TSF failures and their root causes[1].



[1] World Information Service on Energy. Chronology of major tailings dam failures; 2016.

Additional failure modes post-closure may include:

- rainfall-induced erosion of the outer face of the containment walls, which may break through to the actual tailings cell, expose and mobilise tailings downstream
- blockage and failure of the spillway, causing successive failure of the dam wall and tailings loss downstream
- overtopping by rainfall runoff, causing erosion of the containment wall and tailings loss downstream
- failure of the cover system placed over the tailings surface causing excessive dust generation.

8. Inspection regime

The inspection regime must provide for and consider the immediate, ongoing, future safety and integrity of the TSF. It must provide a site specific set of minimum risk-based requirements so that the particular TSF and critical engineering/performance controls can be inspected and verified in a consistent manner.

General documentation that should be maintained for each TSF includes:

- Investigation, design, and construction documentation including Data Book, Design Report and 'as-constructed' details (or Construction Report), operating permits, hydrology, and the sites facility description.
- TSF risk classification and ranking.
- Standing Operating Procedures (SOPs), including underpinning risk assessments.
- Management Structure and local working arrangements, skills and competencies required to capably manage the TSF.
- Detailed TSF Operating and Maintenance Manuals.
- Inspection, Monitoring and Evaluation Reports.
- Dam Safety Review Reports – internal and external (audits).
- Emergency Action Plans (TARPs).

The design and assessment of TSF is critical work. The SSE must ensure it is undertaken by persons with the particular technical competencies required to carry out this work. The persons who carry out this work should have:

- Recognised qualifications through a suitable engineering degree, professional qualification evidenced through appropriate practical industry experience and peer review.
- Practical design and construction experience of all facets of TSF
- Practical experience in TSF inspections
- An appropriate amount of specific experience related to engineering aspects of mining projects, specifically covering geotechnical characteristics and behaviour of extractive wastes.

It must be noted that competence on the grounds of academic ability alone is not sufficient and must include practical experience.

A list of suggested review and inspection frequencies is given in Table 1 [2]

[2] Adapted from *Establishment of guidelines for the inspection of mining waste facilities, inventory and rehabilitation of abandoned facilities and review of the BREF document No. 070307/2010/576108/ETU/C2 Annex 2 Guidelines for the inspection of mining waste facilities, European Commission DG Environment; 2012.*

Table 1 Recommended Review and Inspection Frequency for TSFs			
Assessment type	**Frequency**		**Personnel**
	Operational phase	**After-care phase**	
Visual inspection	Daily, or more frequently as required.	Every six months	Dam operators, after the closure possibly follow-up staff
Pre-wet season inspection	Well before wet season so repairs can be carried out.	Well before wet season so repairs can be carried out.	Dam operators , independent engineer
Annual review	Yearly	Yearly	Engineer, corporate owner, the 'Operator'
Independent audit	Yearly	Every 5 - 10 years	Independent Expert, corporate owner, the 'Operator'
Safety evaluation of existing dams (SEED)	Yearly	15 - 20 years	Independent expert, corporate owner, the 'Operator'
Sampling and instrumentation assessment	6 monthly, 2 months prior to known storm season	Yearly prior to storm season	Dam operators
By exception	As required, e.g. after seismic event	As required, e.g. after seismic event	Independent Expert, corporate owner, the 'Operator'

When determining TSF management and inspection regimes the following may also be considered:

- Current regulatory compliance requirements (legislation, regulations, standards, ACOPs, permits, voluntary commitments, native title, landholder arrangements etc.).
- TSF construction records – methods used and appropriate TSF risk classification (and resultant minimum performance requirements). This is important as the construction type, e.g. upstream, downstream or centreline, has direct implications on the stability and behaviour of a TSF.
- Internal (management) responsibility for the TSF shown in the mines management structure.
- Training and education of mine personnel to ensure safe management of the TSF.
- Review of previous monitoring and inspection reports, and audits, and resultant recommendations and their current state of implementation.
- Review of recent TSF incidents nationally and globally and check for applicability at local TSF.
- Assessment of impacts on areas downstream from the TSF.
- Assessment of ongoing and potential environmental impacts.
- Assessment of water pooling around buttresses and ground water levels.
- Inspection post regional seismic events.
- Wet season preparedness – actual progress/compliance against plan.
- Emergency preparedness for the TSF – including:
    - TARPs - defined action thresholds and documented effective response to early warning signs of potential catastrophic failure e.g. severe weather, flooding, earthquakes, structural failure of walls, dams and / or bunding
    - Effective warning systems for downstream areas where necessary
    - Mock exercises and downstream preparedness
    - Failure of the tailings detoxification circuit
    - Failure of tailings pipe line
    - Risk of structural failure of the dam embankment

    - Risk of overflow from the dam as a result of heavy rain
    - Native fauna or stock on or in the TSF.
    - Post-seismic event integrity check of TSF and instrumentation
- Review of the current waste management plan and all its components with special scrutiny of changes to original design, as constructed plans, waste and water management and potential changes in environmental conditions.
- Assessment of any potential risks related to other activities on site with respect to the TSF e.g. changes to water management, infrastructure etc.
- Assessment of existing human resources available to capably manage the TSF including requirements of training to maintain required levels of qualifications, skill and experience. These human resources must be listed in the site's management structure.
- Assessment of closure readiness against current TSF status and mine plan, and ongoing and future budgetary requirements.
- Assessment of all monitoring equipment.
- Validation of required monitoring regimes.
- Assessment and validation of suitability and function of control equipment associated with the TSF.
- Waste transport systems and placement systems, including maintenance regimes of these systems/infrastructure.
- Power supply and backup systems to all control and monitoring systems/infrastructure.
- Water decanting systems, spillways, drains, channels, weirs, and culverts and their maintenance (e.g. cleaning of drains), plus lifesaving equipment such as life-rings or lifejackets.
- Assessment of suitability of any equipment required to maintain a TSF – earthmoving equipment, mobile cranes, pontoons, pumps, piping, connectors, isolation facilities, communication equipment, PPE.

9. Inspection reports

Documentation of assessments, reviews and inspections must be kept and maintained as part of the information associated with a particular TSF. Inspection reports form the tangible evidence that an inspection has been carried out and provides the basis for ongoing TSF management and maintenance programmes.

Inspections should focus on the following areas:

- Visible damage of the containment structure – dam walls and spillways e.g. cracks
- Water pooling around dam walls and buttresses
- Ground water levels
- Integrity of erosion protection
- Required free-board incl. visible signage to allow remote sighting.
- Leaks or ruptured joints in pipe systems
- Active discharge spigots must not cause erosion in the embankment face
- Development and shape of 'beach'.
- Movements of crests and slopes.
- Availability and clear visibility of depth indicators, including clear vision of the MRL
- Drainage systems and patterns that could create any zone of seepage or damage to the TSF containments structure.
- Evidence of any leakage or seepage – present and past.
- Visible material transport in leakage downstream of TSF.
- Accumulation of debris such as rubbish, trees and other vegetation on dams, dam walls, spillways, drains, near culverts etc. that could block the discharge causing erosion or backup of water.

- Ability to readily and safely access (particularly during storm and high water level events) all areas of the TSF – roads to dam walls, spillways, decants, weirs, channels, monitoring stations, power supply etc.
- Any evidence identifying leakage through and around discharge arrangements.
- Erosion downstream of any outlet.
- Discharge regulation equipment – weirs and gates, water measurement equipment, and accessibility in times of severe weather.
- Emergency discharge arrangements and backup power supplies incl. TARPs

A typical inspection report may include:

- Scope of the inspection and purpose, including any specific reasons for the inspection.
- Type of the inspection - daily, weekly, monthly, yearly, targeted (subject specific), independent engineering review etc. (e.g. during a lift, post seismic event, post identification of wall cracks / damage)
- A complete and accurate list of all documentation viewed prior to the inspection, particularly previous inspection reports and 'outstanding actions'
- Any documentation used to assist in the process of carrying out the inspection (e.g. checklist, audit form etc.)
- A brief description of the inspection, including names, positions and qualifications of all persons involved.
- Comprehensive list of all observations including identified defects. Ideally these are supplemented by interviews with workers/participants, photographs, sketches, monitoring data and resultant actions from the inspection addressing the issues in a systematic manner.
- List of all documentation used / collected, referred to during the inspection.
- Risk based conclusions, recommendations, corrective measures and timelines (due dates) to be taken (incl. allocation of responsibility where possible.)
- Update of outstanding actions and their risk levels.
- Records of any closeout meetings and discussions
- Report Distribution list.

Appendix 2 contains an example inspection report. Appendix 3 contains an example audit template.

10. Management review

As a minimum, mine management must carry out an annual internal review and audit to validate its TSF management systems, particularly that sound risk based controls are in place to ensure the ongoing integrity and safety of the TSF.

The review and audit should be carried out well before the storm season so any identified issues can be rectified. Management review should also cover human resources, including training / education to facilitate sound TSF operations. Competencies for the operation of TSFs may include:

- RIIWBP202D - Distribute tailings
- PMAOPS460 - Monitor and operate tailings management facilities
- RIIWBP203D - Monitor tailings dam environment.

11. Summary

TSFs are a vital part of many mines' operational infrastructure.

A properly designed, operated and maintained TSF, under normal circumstances, will grow slowly and safely as it is filled with tailings.

Poorly designed, operated or maintained TSFs have in the past contributed to a number of high consequence accidents and environmental disasters.

A sound regime of design, construction, operation and maintenance or modification, validated through inspection and auditing activities, as outlined in this guidance note, will help ensure ongoing long term integrity of a TSF.

12. Appendices

Appendix 1: Typical contents/headings of the Independent Expert's inspection report

(Amended from the Department of Environment and Heritage Protection Guideline, under the *Environmental Protection Act 1994*, 'Structures which are dams or levees constructed as part of environmentally relevant activities').

1. Name and situation of mine waste facility
2. Name and address of Competent Person/Inspecting Engineer
3. Qualifications of the Inspecting Engineer
4. Date of appointment as Competent Person/Inspecting Engineer (summary of experience), and name of authority issuing the appointment
5. Date of expiry of statutory appointment
6. Name and address of Operator who appointed the Competent Person/Inspecting Engineer
   - 6.1 Name and address of Enforcement Authorities
   - 6.2 Name and address of Responsible Contacts
   - 6.3 Mine/Quarry Manager
   - 6.4 Mill Superintendent
   - 6.5 Facility Supervisor
7. Date of Inspection:
8. Background:
   - 8.1 The Terms of Reference, i.e. legislation/regulation/compliance/post incident reporting
   - 8.2 Scope of Inspection
   - 8.3 Documentation
9. General description:
   - 9.1 Description of the facility
   - 9.2 Layout plan/topographical photo of the TSF, its surrounds and potentially outlying hazardous topography
   - 9.3 Adjoining mines including underground mines
   - 9.4 Catchment details
   - 9.5 Geology
   - 9.6 Local weather /climate characterisation – past, current and trending
   - 9.7 Details of modifications, remedial works and history, recent reports and investigations
   - 9.8 Embankment details, main confining embankment, decant system, tailings disposal system, emergency spillway, etc.
   - 9.9 Access details including redundant access ways in case on an emergency.
   - 9.10 The risk rating of the TSF, and what equipment or processes the TSF have in the context of the risk ranking.
   - 9.11 Availability of risk-based dam operators' manuals and other procedures.
   - 9.12 Availability of a risk-based TARP, including fit for purpose equipment to maintain the TSF particularly in a severe weather event.
10. Description of inspection and conditions found:
    - 10.1 General
    - 10.2 Confining embankment(s), main embankment, saddle dams, disposal paddocks/lagoons
    - 10.3 Spillway arrangements, decant system, emergency spillway
    - 10.4 Reservoir area
    - 10.5 Return water system
    - 10.6 Tailings deposition
    - 10.7 Old workings
    - 10.8 Inspection and monitoring routines

10.9 Instrumentation, surface/hydrographic survey; piezometers; seepage; freeboard, (MRL)

11. Review of flood and discharge capacity
    - 11.1 Hazard categorisation
    - 11.2 Flood study
    - 11.3 Alterations to overflow sill or to the level of water that may be stored
    - 11.4 Means of lowering the water and of controlling the inflow
12. Seismic risk
13. Climate risk – severe weather history, source of (long term) weather information, and modelling of severe weather events
14. Supervision provided by the Operator
15. Correctness of particulars in the statutory record
16. Findings and recommendations of the Competent Person/Inspecting Engineer
    - 16.1 Conclusions
    - 16.2 Recommendations in the interests of safety and timetable for completion
    - 16.3 Recommendations not in the interests of safety
17. Date of next inspection
18. Dated this _____ day of _____20_____
19. Signature & (printed) Name -Independent Expert
20. Figures/Plans
21. Photographs

Appendix 2: Example Inspection report

Inspection detail to assure day to day performance and function	**Other Observations**
Incidents/Accidents previous 24 hours	% completion to rectify/control
Weather	Ongoing climate data – seasonal awareness
Daily tonnages of waste product deposited	Piezo metric data, waste density
Condition of embankments, roadways and other earthworks for instability, settlement, cracking, deformation, seepage etc.	Seismic data
Condition of tailings feed lines, pumps, sumps, pontoons, conveyors and deposition pipes	Settlement/movement beacons – leaks or rupture
Tailing disposal management – deviations	
Condition of water return pumps, sumps, valves and reticulation system, pipelines	Seepage measurement volume and quality (rain fall gauges, piezometer/groundwater readings). Use of geophysical methods of detecting internal erosion and anomalous seepage.
Condition of spillways, inlet and outlet channels, storm diversion systems	Discharge flow and quality, water borne emission quality
Condition and functioning of all seepages, sumps and return pumps	
Reservoir and freeboard levels esp. 'Mandatory Reporting Levels' (MRL)	Reservoir gauges – freeboard levels (MRL), hydrographic surveys
Condition of adjacent excavations, stockpiles, water storage lagoons etc.	Groundwater levels and quality
Adequacy of traffic routing and edge protection (against vehicle impact)	All-weather accessibility to pumps etc.
Monitoring equipment including power supplies – piezometers etc.	Groundwater contamination Use of slope stability radar for monitoring of the dam wall movement (In case of a very large TSF and if there is potential for social impact) should be considered.
Installation of power supply to decant pumps	
Any seismic event should trigger an immediate inspection (local or regional).	

Appendix 3 - TSF Example Audit template

Hazard rating	Standard met	Comments	Reference
1. A hazard rating has been assigned to the Tailings Storage Facility, using current TSF methodologies and state/national law. Construction and operational control reflect this hazard rating.			Reg.s5-9
2. Changes in the operation of the TSF or the surrounding infrastructure have resulted in a re-evaluation of the TSF hazard rating.			Act s42 (A), Reg.s5-9

Design and construction	Standard met	Comments	Reference
1. The TSF has been constructed in accordance with the design (during initial build and for each lift / modification).			Act s42 (A), Reg s45, s98
2. Annual operating audits are submitted.			Reg s9
3. Changes from the original design were documented during construction.			Reg s11, s45
4. Records of construction quality control checks are available.			Act s42 (A), Reg s98
5. The specified monitoring equipment is installed, and working.			Reg s44 (2) (e)
6. Modifications are assessed and verified by a qualified engineer.			Reg s6 (2)(c), s95 (2)

Operation	Standard met	Comments	Reference
1. There is a TSF Operating Plan.			Reg s5
2. The Operating Plan describes the deposition methodology. Deposition as per plan was verified on the day of the audit.			Act s42, s44, s108. Reg s5, s45 (b)(viii)

Operation	Standard met	Comments	Reference
3. The Operating Plan describes the measures for pond control and water management. These were observed on the day of the audit/inspection.			Reg s9, s108, s114
4. The Operating Plan specifies the method of seepage control. Observed on the day of the audit/inspection.			Reg s114, s116
5. The Operating Plan specifies the pipeline management system. Observed on the day of the audit/inspection.			Reg s45
6. The Operating Plan describes the TSF geometry at all stages of its life.			Reg s45
7. The Operating Plan includes provision for dust control. Observed on the day of the audit/inspection.			Reg s45
8. Modifications to the Operating Plan are documented when they occur. Observed on the day of the audit/inspection.			Reg s45, s98, s114, s118
9. The actual operating characteristics of the TSF have been assessed against the original design assumptions. Observed on the day of the audit/inspection.			Reg s45
10. Annual geotechnical and engineering reports are submitted as outlined in the 'Guidelines on the safe design and operating standards for tailings storage'. Observed on the day of the audit/inspection.			Reg s44
11. The recommendations included in the annual geotechnical and engineering reports have been acted upon. Observed on the day of the audit/inspection.			Reg s44
12. The TSF site is secured against access by unauthorised personnel. Observed on the day of the audit/inspection.			Reg s43
13. Roads on and around the TSF are designed for the (maximum sized) equipment using them. Observed on the day of the audit/inspection.			Reg s46
14. Access to the TSF is restricted.			Reg s43, s114
15. The TSF roads are demarcated by windrows, railings or other such indicators of safe travel limits. Observed on the day of the audit/inspection.			Reg s43, s114
16. The TSF roads are controlled by suitable signage indicating speed limits, direction etc. Observed on the day of the audit/inspection.			Act s36 Reg s43

Operation	Standard met	Comments	Reference
17. Traffic control measures on the TSF are effective at night. Observed on the day of the audit/inspection.			Reg s46
18. Where there is deep water in a TSF, rescue equipment is provided. Observed on the day of the audit/inspection.			Reg s32 (1) (c) s33
19. There is a TARP for the TSF.			Reg s5-9
20. Catastrophic events are addressed in the TARP. Observed on the day of the audit/inspection.			Reg s5-9
21. Management, supervisors and workers are aware of the TARP and have been trained in the use of the TARP.			Reg s5-9
22. There is an alert system in place to warn workers/persons downstream in case of a dangerous TSF occurrence.			Reg s5-9
23. Supervisors and Workers have received appropriate training and education in operating the TSF. Observed on the day of the audit/inspection.			Reg s93, s95
24. Management of the TSF is reflected in the mines management structure. Observed on the day of the audit/inspection.			Act s50

13. References

1. World Information Service on Energy, 'Chronology of major tailings dam failures' (8 July 2017). See http://www.wise-uranium.org/mdaf.html
2. Queensland *Mining and Quarrying Safety and Health Act 1999*. See https://www.legislation.qld.gov.au/view/html/inforce/current/act-1999-040
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4. Department of Environment and Heritage Protection, 'Manual for Assessing Consequence Categories and Hydraulic Performance of Structures'. ESR/2016/1933 Version 5 Effective: 29 Mar 2016. See https://www.ehp.qld.gov.au/assets/documents/regulation/era-mn-assessing-consequence-hydraulic-performance.pdf
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