Group Procedure

D5 – Management of tailings and water storage facilities

March 2017

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Direct linkages to other relevant Policies, standards, Group procedures or guidance notes: *Rio Tinto Management System Standard; D5 Tailings and water storage facility management standard, D3 Management of slope geotechnical hazards standard and group procedure; E13 Chemically reactive mineral waste control Standard; E14 Land disturbance and rehabilitation control Standard; E11 Water quality protection and water management standard; Closure Standard; HSEC risk management Group procedure*				
Document purpose: *This Group procedure specifies the mandatory requirements for the management of tailings and water storage facilities including ancillary works.*				

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SECTION I- OVERVIEW

INTRODUCTION

The safety standard D5 - Management of tailings and water storage facilities (the D5 Standard) has been developed to manage hazards associated with tailings storage facilities (TSFs) and water storage facilities (WSFs) at Rio Tinto managed business units, closed and legacy sites.

This Group Procedure is a mandatory component of the D5 Standard and together these two documents are referred to as the Standard in this document. The Standard describes the minimum Rio Tinto requirements for the management of tailings and water storage facilities including ancillary works and must be implemented to ensure conformance to the Standard.

A Guidance Pack is available to further elaborate the Standard requirements. A self-assessment spreadsheet is also available for operations to undertake gap analysis for the Standard.

The HSEC assurance processes assess business unit conformance to the Standard. Technical details and the adequacy of inputs into TSF and WSF management are not assessed by these processes. These are assured through the design peer review process and the independent review requirements set out in the Standard.

SCOPE AND INTENT

The Standard applies to all Rio Tinto projects, business units and managed operations, including new acquisitions, closed and legacy sites. It covers all development phases from planning, design through construction, operation, closure and, post-closure where applicable. Facilities inherited from mergers or acquisitions are required to comply with the Standard within 12 months of acquisition.

TSF comprises:

- the entire impoundment structure including the embankments, storage basin, placed tailings, foundations, drainage and liner systems; and
- the tailings delivery and distribution systems and return water piping and decant systems.

The battery limits for a TSF are the discharge flange of the tailings delivery pumps or tank outlet flange, in the case of gravity discharge, at the process plant and the discharge point of the return water pipe at the process/raw water tanks or ponds or at the point of environmental release. The battery limit for filtered/dry stacked tailings is the filter discharge point.

WSF comprises:

- the impoundment and its confining structures including the embankments, abutments, and spillways; and
- diversion/drainage dikes with a Class II or higher risk.

Examples of application of this Standard include, but are not limited to:

- Planning and design of a TSF/WSF at the project development stage;
- Construction of a new TSF/WSF;

- Operation of an existing TSF/WSF including active and inactive facilities;
- Expansion or raising of an existing TSF/WSF;
- An existing TSF/WSF where design is changed for any reason such as modification of storage capacity, realignment of embankment, addition of a stability buttress etc.;
- Curtailed or partially curtailed facilities; and
- Closed and legacy facilities where the residual risk is a Class III or IV.

TSF and WSF risks covered by this Standard are grouped under two broad classes:

1. Uncontrolled release of water/tailings –includes loss of life, environmental damage, and contamination caused by uncontrolled subsurface (foundation) seepage beyond design expectations and/or leakage from a TSF/WSF, tailings or return water pipework, and uncontrolled surface releases either though emergency spillways or the result of overtopping. Design/regulated discharge through operational spillways is not considered to be an uncontrolled release in this Standard.

2. Embankment failure –includes loss of life, environmental damage, and direct and indirect economic losses caused by a TSF/WSF embankment (wall) failure and release of tailings and water.

These risks, along with their impact on Rio Tinto reputation and license to operate, must be considered in determining the risk class for application of this Standard.

All operating (active and inactive) TSFs are classed as Major and must comply with all clauses of the Standard. Closed and/or legacy TSF sites with a Class III or IV risk are Major and are required to comply with all clauses of the Standard. Closed and/or legacy TSF sites with a Class II risk are required to comply with clauses 1.1 and 1.29 whereas those with a risk class I are not required to comply with the Standard.

WSFs with a Class III or IV risk are classed as Major and are required to comply with all applicable clauses of the Standard whereas existing WSFs with a risk Class II are required to at least comply with clauses 1.1 and 1.29. New WSFs (built after August 2016) with a Class II risk must comply with the clauses given in Table 1. WSFs with a risk class I are not required to comply with the Standard.

Table 1: Applicable clauses for new WSFs with Class II risk

D5 Standard Clause No.	D5 Standard Requirements
1.1	Nominated Manager required
1.3	Nominated Manager and Qualified Site Representative could be one person.
1.8	Design report prepared by Design Engineer[1]
1.12	Industry accepted design criteria and regulatory requirements
1.15	OMM[1,2] required for safe operations. Generic OMM manual covering multiple WSFs is acceptable.
1.22, 1.25	Construction supervised and recorded[2]
1.29	Site inspection and fit for purpose assessment required

[1] Could be one report for multiple dams.

[2] Rigour depends on complexity of structure and consequences of dam failure.

In addition to the above, the following must be taken into consideration in the application of the Standard.

1. Where there is a risk of interaction between a TSF/WSF and surface or underground mining (pit excavation, blasting, underground shaft construction, etc.) this Standard will apply in managing the TSF/WSF risks. The mining risks will be managed by the application of the D1 and D3 mining safety standards.

2. Closure planning for TSF & WSF's. Closure must be planned and implemented in accordance with the Rio Tinto Closure Standard.

3. Environmental risks associated with chemical/ geochemical nature of the tailings must be managed by controls in the Environment performance standards, in particular, the E13 standard – Chemically reactive mineral waste control and the E11 standard – Water quality protection and water management. When chemical/geochemical risks arise due to TSF operational issues, the D5, E11 and E13 standards will apply.
4. Co-disposal in waste dumps and in-pit disposal facilities. These facilities must consider the safety aspects of the D3 standard – Management of slope geotechnical hazards.
5. Hydro-electric and water dams under direct control of an operation are WSFs.

It is acknowledged that due to some special/unique conditions it may not be feasible for a certain operation to comply with a particular clause of this Standard. In such cases, the operation could apply to the G&I Vice President HSE for a variance to a particular clause. The application for the variance must be supported by a justification, risk assessment and a review of alternative options. Guidance on obtaining variance to a standard clause is presented in Rio Tinto Management System standard, Clause 0.3 – Non-Implementation and Variance.

Additional and possibly more stringent requirements must be considered, dependent upon the location and prevailing laws in the area of operation. Technical and operational guidelines are available from relevant NGO's and government agencies.

TERMS

The definitions for all technical terms within this document are located in the HSEC definitions database. The HSEC definitions database is found on the Rio Tinto Health, Safety, Environment and Communities intranet portal page.

SECTION II- PROCESS STEPS

PLANNING

1.1 Appoint accountable Nominated Manager

The operation or business unit General Manager must assign a Nominated Manager to be accountable for site's compliance with the Standard. Multiple Nominated Managers may be appointed in large operations with multiple facilities with one Nominated Manager for each facility.

Roles and responsibilities for key personnel identified in the Standard are defined in Table 2.

Table 2: Role responsibilities/accountabilities

Role	Responsibilities/ accountabilities
Site/Operations General Manager	***Responsible for:*** • Appointing Nominated Manager who is accountable for implementation of the Standard.
Nominated Manager* Must have good understanding of the TSF/WSF and its expected performance. Must have good understanding of operational limitations of the design, and be able to recognise when performance limitations unduly impact the safety of the TSF/WSF.	***Responsible for:*** • Appointing Qualified Site Representative • Selecting Design Engineer and develop design criteria • Reporting quarterly on the health of the TSFs/WSFs on site by responding to the Facility Health Questionnaire ***Accountable for:*** • Arranging development of *Tailings Management Plan* (TMP) and/or Water Storage Plan (WSP) • Carrying out risk assessments • Arranging independent design reviews • Implementing construction activities • Implementing Management of Change • Training and maintaining competencies of operating and maintaining staff • Arranging independent operational reviews
Qualified Site Representative* Must be familiar with the requirements of the OMM** manual, ERP***, and the site risk register. Must be suitably trained and deemed competent to recognise and identify potential risks associated with the facility such that they can be addressed and corrected in a timely manner.	***Responsible for:*** • Managing day to day operations of the TSF/WSF • Keeping Nominated Manager informed of the performance of the TSF/WSF ***Accountable for:*** • Arranging collection, evaluation and reporting of monitoring data as per the OMM manual.

Table 2: Role responsibilities/accountabilities (cont.)

Role	Responsibilities/accountabilities
Design Engineer Qualification and level of experience are as defined in Clause 1.8	***Responsible for:*** • Providing design services for the facility including design report, construction drawings and technical specification(s) • Participating in risk assessments • Responding to independent design reviews and significant incident reports • Certifying compliance of construction with design intent • Reviewing facility monitoring data and respond to abnormal issues and providing written confirmation that the facility is being operated in accordance with the OMM** manual.
Construction Supervisor A representative of the Design Engineer or other individual qualified to monitor construction of the facility. Requires demonstrated experience in construction supervision and quality assurance/quality control.	***Responsible for:*** • Ensuring that the construction of the facility meets the full intent of the design • Referring changes in site conditions to the Design Engineer • Preparing construction report ***Accountable for:*** • Implementing quality assurance/quality control procedures
Independent design reviewer(s)/specialist(s) and/or Independent operational reviewer(s)/specialist(s) Independent (3rd party) individuals who have specific industry recognised expertise relevant to the facilities being reviewed. Independent means: "*not reviewing their own work*". Could be the same person for repeated reviews.	***Responsible for:*** • Reviewing design/construction reports • Carry out independent operational reviews • Reviewing risk assessments • Signing Record of Inspection • Verifying that detailed staged design(s) are aligned with the facility design

Notes:

** The Nominated Manager and the Qualified Site Representative can be the same person.*
**OMM manual – *Operations, monitoring and maintenance manual*
***ERP – *Emergency response plan specific to the TSF/WSF*

1.2 Documents required

a) Tailings management plan (TMP) and/or Water storage plan (WSP) where required. (Clauses 1.5, 1.6).

b) TSF/WSF facility design report(s) and detailed TSF stage design reports; (Clauses 1.7 through 1.14 and 1.19 -1.21)

c) Construction and quality control / quality assurance (QA/QC) reports, (Clause 1.25)

d) Operations, monitoring and maintenance (OMM) manual. (Clauses 1.14,1.15)

1.3 Qualified Site Representative.

Reference role description in Table 2.

1.4 No reliance on TSFs for excess water storage

TSFs must be designed to store tailings and not be used as WSFs. This clause does not preclude the development of supernatant ponds, as the core functions of clarification, storm surge and ponds for the recycle of process water are allowed, provided they are within the limits defined in the site water balance and the OMM manual.

Where existing TSFs have a volume of water stored outside the limits defined in the site water balance or OMM, a risk assessment must be completed with participation from the Design Engineer to identify the additional risks resulting from excess water storage. In this case, an operational plan and schedule must be developed to reduce the stored water to an acceptable volume. A review of possible alternative water storage options must be included.

In some cases additional water storage may be required to limit sulphide oxidation. In such cases, attempt must be made to limit the volume of stored water and the facility must be designed to safely accommodate the additional water. Where storage of excess water is necessary due to process commissioning, topography, hydrological and/or geochemical issues, an application to the G&I Vice President HSE, for a variance to this clause, supported by a justification, risk assessment and a review of alternative options, is required.

1.5 Tailings Management Plan / Water Storage Plan

A Tailings Management Plan (TMP) must be developed and implemented for any project that includes a TSF and any site with operating tailings facility(s). A TMP is not required for a closed or legacy TSF unless there are ongoing capital works planned. The TMP is a site specific plan for all existing and future facilities at the site.

The Water Storage Plan (WSP) must be developed and implemented for operations requiring multiple water storage facilities developed over the life of the operation. The WSP is a site specific plan for all existing and future facilities at the site – each WSF is not required to have a separate WSP. WSP is not required for a single WSF.

The TMP/WSP must include planning, resources and capital forecasts for the management of tailings/water in the short term – 1 to 2 years, medium term – 5 years and Life of Mine (LoM).

The TMP/WSP must include the arrangements/concepts and analyses of viable storage options, schedules for the design, approval and construction activities, and high level capital and operating cost estimates. The TMP/WSP must be developed in tandem with the Life of Mine plan using production rates and the mining schedule presented therein.

The TMP must include the range of tailings production data from the mine/ concentration process. This must include the expected ranges of the slurry solids content, throughput, particle size distribution and mineralogy. This data forms a fundamental part of the TSF design criteria and the impact of any changes of the data on the design or operation of the TSF must be fully evaluated before implementation.

The TMP/WSP must identify key technical risks and include discussion of viable closure options and where possible, reference a closure plan as per the Closure Standard.

The plan must be agreed and signed off by the responsible General Manager or equivalent.

1.6 Annual review and update of TMP/WSP

Actual TSF/WSF performance must be compared with the TMP/WSP on an annual basis and the plan(s) must be updated using a management of change (MoC) process. The TMP must be revised when a projection of future mine production indicates an impacting change in the requirements for TSF storage capacity. Similarly, the WSP must be revised with anticipated mine water storage requirements.

Any changes to the plan must be agreed and signed off by the responsible General Manager or equivalent. The TMP/WSP must be reviewed as part of the independent operational reviews (Clause 1.29).

1.7 Facility Designs

A facility design for each TSF/WSF is required that sets out the final ultimate design for the facility. For facilities built in stages the facility design must include the anticipated stages of construction and must be to a level of detail that establishes the technical feasibility, stability and operational requirements for the facility. The facility designs must be implemented by detailed TSF stage designs. Facility design and detailed stage designs could be presented in the same or separate reports. WSFs are generally not constructed in stages and hence the facility design of WSF includes the detailed design.

1.8 Designs prepared by suitably qualified and experienced Design Engineers and presented in Design Reports

A Design Engineer must be appointed to develop the TSF and/or a WSF designs and must have the following minimum levels of education and experience:

- 10 years direct and continuous experience in the design and construction and operation of TSFs/WSFs;
- Graduate university degree in civil/ geotechnical engineering; and
- Registration(s)/ membership of professional associations in their country/state base of operation.

The Design Engineer must take full responsibility for the prepared design and its impact on the overall facility design.

1.9 Risks identified and included in the operations HSEC risk register

Risk assessments must consider the availability of sufficient technical data regarding foundation characterisation, hydrology, groundwater, tailings characterisation, climatic conditions, embankment construction, results from the slope stability analyses, and other operational constraints to clearly understand the risks involved in construction and operation of the facility.

The risk assessment team must include individuals with appropriate technical skills and knowledge of the design and operational limitations of the facility.

The risk assessment must take into account the requirements of site closure, rehabilitation and post closure monitoring that will evolve over the life of the facility. Major findings from the risk assessment must be included in the site risk register.

Consideration must be given to the likely failure impact zone(s) when developing mining/infrastructure facilities including underground workings near to a TSF/WSF. A dam break analysis/inundation map is required to determine the people at risk and the potential impacts on communities, the environment and infrastructure in the event of a failure, for consideration in the risk assessment.

1.10 Industry standard geological, geotechnical, hydrological, groundwater, climatic, seismic and tailings characterisation studies

The Design Engineer is responsible for coordination of all input into to the design of the facilities. The design must be based on geological, geotechnical, groundwater, geochemical, hydrological, seismic, climatic, and tailings characterisation data collected to accepted industry standards. The level of site information and data collected must reflect the complexity of the regional geology and the size and level of risk of the proposed facility. Expert studies from the following must be considered:

- process/thickener engineers,
- mechanical pump and pipeline designers,
- geotechnical engineers,
- seismologists,
- hydrogeologists,
- hydrologists/hydraulic engineers,
- environmental and geochemical scientists, and
- dam designers.

Slope stability analyses must account for drained and undrained material behaviour and loading conditions. Unconsolidated, undrained (UU) analysis must be carried out using pre-construction shear strengths for the determination of short term, construction stability only, and account for construction generated pore pressures. These strengths must be determined by field or laboratory measurements.

Long term stability analyses must consider fine grained materials, where appropriate, that are contractive and generate pore pressures on shearing. These materials must always be modelled in accordance with the Undrained Strength Analysis (USA) approach of Ladd, 1991[1], known as the c_u/p' approach. An accurate estimate of effective stresses must be made in the application of the USA approach.

Pseudo-static stability analyses are not appropriate for the determination of seismic stability and shall only be used to estimate the yield coefficient for potential sliding mass displacement calculations such as Bray (UCB)[2] or Jibson (USGS)[3]. Where warranted, more sophisticated Finite Element or Finite Difference methods such as FLAC[4] should be used with appropriate and well documented input parameters. The post seismic stability must be assessed using post seismic strengths including liquefaction residual strengths of the embankment and foundation materials,

[1] Ladd, C.C., "Stability Evaluation during Staged Construction" ASCE Journal of Geotechnical Engineering, Vol. 117, No4, April 1991.

[2] Bray, JD 2007, 'Simplified Seismic Slope Displacement Procedures', in *4th International Conference on Earthquake Geotechnical Engineering*.

[3] Randall W. Jibson and Matthew W. Jibson, Slope Performance During an Earthquake, USGS Open-File Report 03-005.

[4] FLAC, Computer program for advance geotechnical analysis of soil and rock. Itasca Consulting Group, Minneapolis, Minnesota.

where appropriate, to determine the factor of safety against flow slides.

Hydrological investigations and modelling must consider the risk to the facility of extreme precipitation and/or drought events. A seismic hazard study is required to determine the magnitude and return periods of earthquakes that must be considered in design. The seismic hazard study must consider both probabilistic and deterministic approaches where applicable and select the design criteria that meets jurisdictional requirements and reduces operational and closure risk.

1.11 Application of the Environment (E11, E13, and E14) and Closure standards

E11 – Water quality protection and water management: Governs the management of water abstraction, discharge and use to limit the impacts and risks to surrounding water resources, ecosystems and communities. Water management infrastructure is required to safely manage the predicted variability in flows and volumes, and to control the risk of catastrophic failure or release of contaminated water.

E13 – Chemically reactive mineral waste control: Governs the management of mineral wastes including tailings which are chemically reactive due to issues such as acid rock drainage, contained salinity or radioactivity. The standard seeks to control geochemical risks through characterization, prediction, design and monitoring. If significant geochemical hazards exist, a four-yearly external review of the mineral waste management program is required.

E14 – Land disturbance control and rehabilitation: Governs the management of lands under our control and the rehabilitation of disturbed lands. Facilities should be located and designed to minimize new impacts. New and expanded mineral waste storage facilities (such as tailings impoundments) must also be constructed in a manner that facilitates successful rehabilitation.

Closure standard: Describes specific minimum requirements for closure and post-closure planning for all operations including TSFs and WSFs. The D5 Standard is not intended to modify or supersede the Closure standard requirements.

1.12 Industry-accepted design criteria and regulatory requirements

The design basis including key assumptions and design criteria must be clearly set out in the design report. The design must apply the design criteria required by applicable regulatory agencies as a minimum. The minimum acceptable factors of safety for embankment stability are given in Table 3.

Table 3: Minimum Factors of Safety for Embankment Stability

Loading Condition	Minimum Factor of Safety
Long term, drained and/or undrained	1.5

Short term, construction loading	1.3
Rapid drawdown*	1.2
Post seismic flow slide	>1.0

* Water dams only

In assessing slope/embankment stability, results from conventional Factor of Safety (deterministic) approach must be presented and considered for all design cases in the decision making process. Probabilistic approaches alone must not be used as stability criteria.

Incorporation of higher risk design elements into a TSF/WSF, including perforation of embankments by pipelines, use of geotextiles for critical applications, decant towers, etc., must include special risk reviews by the Design Engineer to evaluate the safety and cost/benefit of applications over the long term.

A risk assessment for the facility must be carried out according to the *HSEC risk management group procedure*.

The minimum dam safety design criteria for flood and seismic design for TSFs must not be less than that provided in Table 4. These criteria are intended to prevent failure of the facility resulting in release of the stored contents.

Operational criteria could be adopted for serviceability requirements on the basis of risk assessment. Operational criteria are intended to limit damage so that operations could continue after repairs to the facility. Each facility must be designed with dam safety criteria as outlined in this Group Procedure and any operational criteria.

All operating and new TSFs must have the ability to either safely store or release a 1:5,000 AEP 72 hr flood through an emergency spillway to protect the dam. The emergency spillway must be designed for a 1:5,000 AEP peak flow developed from critical storm derivation. Operational spillways (different than emergency spillways) should be designed as per the applicable regulatory requirements

Table 4: Minimum hydrologic and earthquake design criteria for TSFs[3]

Risk Class	Min Annual Exceedance Probability for IDF*	Min. Design Earthquake Return Period	Min. Design Earthquake Return Period Post Closure***
Class III/Class IV [3]	1/5,000 [4]	5,000 year [4]	MCE**
Class II	1/1000	1,000 year	MCE
Class I	1/100	100 years	MCE

*IDF – Inflow Design Flood for freeboard/emergency spillway design

**MCE – Maximum Credible Earthquake

***Or file for variance: See guidance under Scope and Intent.

Notes: 1. The earthquake design criteria provided is for the maximum design earthquake (MDE) or design basis earthquake (DBE) and not for the operating basis earthquake (OBE).
2. The annual exceedance probability for floods refers to individual storm events. The requirement for return periods for precipitation over long periods, for example tropical wet seasons, spring thaw/freshets are lower and are usually set by regional regulation.
3. All operating TSFs are a Class III/Class IV risk facilities. Closed and legacy sites can have lesser risk class.
4. In Australia, ANCOLD Guidelines must be adopted.

The minimum dam safety design criteria for WSFs must be determined on the basis of risk. The assessment must include the size of the facility and the incremental consequence of failure. The IDF must not be less than 1/100 year and the return period for the MDE not less than 1:475 year for WSFs.

During design of TSFs for new mine developments where there is limited access to tailings samples from metallurgical testing for physical testing, a conservative interpretation of the characteristics of the tailings must be adopted including anticipated tailings deposit densities and tailings beach slopes. The design of subsequent stages of the TSF must be refined on the basis of characterisation and the site behaviour of production tailings.

The design basis must be presented by the designer and accepted by the Nominated Manager or Project prior to commencement of the design. Any changes in the design basis must be subject to a MoC process.

The design reports must include the following:

- Summary of construction and foundation material and strength characterisation including drained and undrained strength characterisation;
- Deposition plan and water management;
- An assessment of seepage and seepage management measures:
- An assessment of tailings consolidation and safe rate of rise;
- Detailed stability assessment of all stages of development and closure;
- Quantifiable performance objectives;
- Design drawings;
- Geotechnical and operational monitoring program specifying instruments with threshold values to be included in construction and operations monitoring programs;
- Supporting appendices of foundation investigations, laboratory testing, stability analysis and other evaluations completed; and
- A summary of assumptions regarding the operating criteria (throughput, deposition solids content, tailings grind) and factors that may change during the life of the facility.

1.13 Management of risk during construction, operation, closure and post-closure

The design of facilities must address the risks associated with construction, operation and closure. A constructability assessment and a construction safety review of the design must be completed. The design must consider operator safety, seasonal and extreme weather, the effect of process upsets, seepage, etc. The design must consider the operational practices that will achieve the final closure landform (Clause 1.11).

1.14 Operate to meet design intent

The design report must include the operational requirements to meet the intent of the design and quantifiable performance objectives. The design must be based on realistic assumptions as to how the facility will be operated and how the design assumptions would be verified during operations. All assumptions, quantifiable performance objectives and requirements for the operation, monitoring and maintenance of the facility must be clearly stated in the OMM manual.

1.15 The Operations, Monitoring and Maintenance (OMM) Manual

The OMM manual is a live document that describes the means and methods of operating and maintaining the facility. The OMM must contain procedures that evaluate the conformance of the facility to the design. Requirements for monitoring, inspection and observations must include:

- Deposition plan including water and seepage management principles;
- The frequency and responsibility for inspecting, monitoring, evaluating and reporting TSF/WSF performance;
- Acceptance and response trigger levels for monitoring results.
- The conformance of slopes and footprints to design;
- The effectiveness of specific quantitative performance objectives (rate of rise, deposition cycles, reclaim pond management) on TSF / WSF performance, especially pore pressure performance.
- Timing, scope, and procedure for design verification testing.
- TSF/WSF locations must be periodically surveyed to ensure adequate buffer zones are maintained for public safety, social or environmental reasons.
- Triggering criteria for ERP specific to uncontrolled release of tailings/water from the TSF/WSF

Changes or operational improvements must be reflected in periodic updates or revisions to the manual.

1.16 Independent design review of facility design

The facility design must be reviewed by an independent tailings specialist prior to the implementation of the design. A technical review panel should be engaged if warranted by the level of risk and/or complexity of the facility. A review panel must be formulated for a facility with a Class IV risk category and/or a catastrophic consequence category. Findings of the review must be addressed and closed and changes made must be referred back to the reviewer(s) for verification prior to implementation of the design. The reviewer(s) must be recognised in the industry as having the knowledge and experience to carry out the reviews.

The review shall be carried out in accordance with the *"Independent design review of major tailings and water storage facilities guidance note*".

1.17 Emergency response plan (ERP)

The specific section in the site ERP must include the following for TSF/WSF:

- Response plans to triggers identified in the OMM manual related to uncontrolled release of tailings and/or water based on site observations (excessive seepage, cracking, settlement, loss of free board etc.) or an extreme event (large rainfall/flood event, large earthquake event etc.)
- Inundation map that identifies people, property, infrastructure and environment values at risk from a failure of the facility. The inundation map must be determined by a dam break analysis carried out by the Design Engineer,
- Sequence of response, notifications, role specifications and responsibilities of responders, both at site and in corporate Rio Tinto,
- A schedule of resources, mobile equipment, stockpiled materials, local contractors. available to respond to an emergency,
- A community and government notification process with contact information. These must include local residents in the inundation area, police and emergency services, government agencies and departments with control over mining, environment and emergency services.

This information must be updated annually or when triggered by information change.

1.18 Management of change (MoC) processes

A formal MoC process must be carried out where significant changes are proposed to the design, construction or operation of the facility including change of consultant. The process must consider potential change in risk due to increased likelihood of impacts on production, long term costs, safety, and/or regulatory non-compliance. Changes accepted must be incorporated in the TMP. Nominated Manager is accountable for implementing MoC.

Significant changes must be reviewed by the Design Engineer. Significant changes include, but are not limited to:

- Change in Nominated Manager
- Change in Design Engineer
- Change in the designed geometry of the facility
- Change in the construction / embankment raising methodology
- Change in the designed tailings depositional strategy including during start-up phase
- Change in operational practices including those that can impact size and location of the pond
- Change in monitoring scope and/or practices
- Other changes that have a material impact on the performance of the facility

IMPLEMENTATION AND OPERATION

1.19 Detailed design, construction drawings and technical specifications for each stage

Requirements for each stage/raise for TSFs must be identified in the TMP and facility design, with the detailed design of each stage based on experience with past construction and operation of the facility.

The detailed design must be presented in a detailed stage design report that provides the technical basis for the design, technical specifications and drawings suitable for construction of the stage/annual raise. The detailed stage designs must align with the facility design or formal MoC

needs to be carried out to modify the facility design.

Where a TSF is being constructed continuously (i.e. construction using hydro-cyclones), the detailed design is included in the facility design report. Hence, separate detailed designs for ongoing stages are not required. In this case the facility design must meet all of the requirements for detailed design.

1.20 Meeting design objectives during construction

Construction of the facilities must comply with the design and design intent. The Design Engineer must develop technical specifications that outline construction performance acceptance criteria including material selection and construction requirements.

The technical specifications must include a QA/QC program that clearly sets out the types and frequency of field and laboratory testing. The program must include a clear reporting and response procedure for nonconforming test results including the requirements for retesting, and reworking.

1.21 Independent design reviews of detailed stage designs

Each detailed stage design must be reviewed by an independent tailings specialist prior to construction. A technical review panel should be engaged if warranted by the level of risk and/or complexity of the facility. A review panel must be formulated for a facility with a Class IV risk category and/or a catastrophic consequence category. Findings of the review must be addressed and closed and changes made must be referred back to the reviewer(s) for verification prior to implementation of the design. The independent reviewer must evaluate the technical aspects of the design and ensure that the stage designs align with the facility design. The review shall be carried out in accordance with the *"Independent design review of major tailings and water storage facilities guidance note*".

1.22 Construction supervised by a Construction Supervisor

All stages of TSF construction must be supervised by a Construction Supervisor. The Construction Supervisor must have direct experience in construction supervision and a good understanding of the intent and details of the design to ensure construction is in compliance with the approved design. The Construction Supervisor is responsible for the interpretation and implementation of the technical specifications and must be able to assess site conditions and determine if they are consistent with the design.

Where site conditions during construction vary from those identified during site investigations, the Construction Supervisor must consult with the Design Engineer to identify design modifications, if needed, to meet actual site and material conditions. Procedures must be in place to document new information as it becomes available and as construction progresses (i.e. from field observations, survey, measurement of performance).

Where a TSF is being constructed continuously using hydro-cyclones, the Construction Supervisor is not required to be continuously present on site. In such cases, quality of construction must be maintained using the QA/QC programs.

1.23 Review and certification as conforming to the intent of the approved design

Significant changes to the scope or deviations of construction from the design must be approved by the Design Engineer and subject to a formal MoC process. A risk assessment must be carried out to determine the impact of the changes, including assessment of the impact of the change on the TMP and operational strategy. The Design Engineer must inspect construction at least periodically and review documentation in order to certify that construction conforms to the intent of the design.

1.24 Quality control (QC) and quality assurance (QA)

QC must involve the actual testing of materials to confirm the facility is constructed in accordance with the technical specifications provided by the Design Engineer.

QA must involve a review of the QC data to ensure testing is representative of the earthwork completed. QA must involve additional testing to verify certain QC results. Results from the QA/QC test work including statistical analysis of the data, log of non- conformances, and any deviations from the design must be included in the construction report.

1.25 Construction report for each stage

A detailed construction report must be prepared for each stage/annual raise of construction of a TSF/WSF by the Construction Supervisor. The construction report must provide all details of the construction including a summary of the results of the QA/QC program, a pictorial record, records of any changes to the design and associated MoC records and As-Built drawings.

The construction report must provide input into the design and construction of subsequent stages.

1.26 Trained and competent personnel

Personnel who carry out day-to-day operations of the facilities must be familiar with the OMM manual, ERP, the quantitative performance objectives, and the site risk register, with specific focus on the requirements for water management, freeboard and free water pond control and intent of the operational methodology.

The personnel must be trained in the operating requirements and obtain a level of competency that enables the identification of potential risks associated with the facility. These risks include signs of embankment instability such as slumping, bulging of the embankment toe, piping or internal erosion, seepage, uncontrolled releases, abnormal monitoring results and other issues outside the operating parameters of the facility. The training must be relevant to TSF/WSF operation and be documented.

MONITORING

1.27 Monitoring and design verification

Personnel that carry out monitoring, survey and other design verification must be trained and familiar with the quantitative performance objectives contained within the design report and OMM, the interpretation of monitoring data in regards to stability, seepage and TSF/WSF performance. Monitoring personnel must prepare reports of embankment performance at the frequency specified in the OMM, but not less than annually.

The Design Engineer must inspect operations at least annually and review operational documentation in order to provide written confirmation that operation conforms to the intent of the design.

The monitoring reports must be reviewed by the Design Engineer and the Design Engineer must provide written confirmation that the facility is operating within the design constraints. Unusual or unexpected monitoring data must be immediately shared with the Design Engineer and appropriate actions implemented.

1.28 All significant incidents and non-conformances investigated, addressed and recorded.

All significant incidents must be recorded along with actions, accountabilities and schedule for mitigation. A significant incident or non-conformance is one that would have a material impact on the operation, cost or risk level of the facility.

Significant incidents and non-conformances identified in the monitoring, observations or reviews of the TSF/WSF must be reported to the Design Engineer for review, investigation and action. The Nominated Manager and the site General Manager must be immediately informed of each significant incident/non-conformance.

Examples of significant incidents include, but are not limited to:

- Appearance of cracks, subsidence, wet spots, surface seepage, bulging, movement, sinkholes, etc.
- Damage to monitoring instruments
- Unusual or unexpected monitoring results including reading that have exceeded or are likely to exceed design threshold values
- Loss of beach i.e water encroaching towards the embankment
- Significant increases in the size of the decant pond
- Damage to return water system including breakdown of decant pumps.
- Unauthorised construction on or in the vicinity of the TSF/WSF.

1.29 Independent operational reviews

Independent operational reviews must be completed to identify physical risks (as opposed to chemical/geochemical risks) associated with geotechnical, hydrological, and operational performance of the facility. The review shall be carried out in accordance with the *"Independent review of major tailings and water storage facilities guidance note*".

The independent reviewer must:

- be a subject matter specialist in the main area of tailings / water facility risk being reviewed: Class II facilities may use a local/regionally recognised specialist while Class III and higher facilities must use nationally or internationally recognised experts.
- not review their own work.
- not be a Rio Tinto employee.

The reviewer could be engaged by Rio Tinto on other projects and could be the same person for repeated reviews. The review must be in the form of a risk assessment with certification of safety of the facility by the reviewer required.

The independent reviewer must:

- Carry out a detailed review of facilities that, for historical reasons do not have the documentation for their design and construction. The detailed review is only required once for the current state of the facility;

- Provide advice and guidance on technical issues associated with the design, construction, operation and closure of the TSF/WSF;

- Provide independent advice to the business unit and its owners in relation to the current and proposed TSF/WSF and their ability to meet accepted design criteria and operational guidelines;

- Complete a risk evaluation and identify significant risks; and

- Complete and sign the *Record of Inspection*. A pro forma copy of the Record of Inspection is attached to the guidance note.

For WSFs with Class II risk, the review shall only comprise a site inspection and a fit for purpose assessment.

Government or regulatory inspectors do not qualify as independent reviewers. Independent operational reviews must be carried out at a frequency of not less than once every two years and more frequently for high consequence facilities. All significant findings of the review, defined as Class III or IV risks, must be reported along with action plans and schedules for implementation. The review report must be provided to the operational General Manager with significant findings communicated to the business unit Managing Director.

The report must be submitted to the Growth and Innovation Tailings Team for central storage.