Initiative for Responsible Mining Assurance

Excerpt from the DRAFT Standard for Responsible Mining and Mineral Processing 2.0

Chapter 4.X – Management of Physical Stability

Context & Disclaimer on IRMA DRAFT Standard 2.0

IRMA DRAFT Standard for Responsible Mining and Minerals Processing 2.0 is being released for public consultation, inviting the world to join in a conversation around expectations that drive value for greater environmental and social responsibility in mining and mineral processing.

This draft document invites a global conversation to improve and update the 2018 IRMA Standard for Responsible Mining Version 1.0. It is not a finished document, nor seeking final review, but rather is structured to invite a full range of questions, comments and recommendations to improve the IRMA Standard.

This IRMA DRAFT Standard for Responsible Mining and Minerals Processing (v.2.0) has been prepared and updated by the IRMA Secretariat based on learnings from the implementation of the Standard (v.1.0), experience from the first mines independently audited, evolving expectations for best practices in mining to reduce harm, comments and recommendations received from stakeholders and Indigenous rights holders, and the input of subject-specific expert Working Groups convened by IRMA in 2022.

IRMA's Standard has a global reputation for comprehensive in-depth coverage addressing the range of impacts, as well as opportunities for improved benefit sharing, associated with industrial scale mining. This consultation draft proposes a number of new requirements; some may wonder whether IRMA's Standard already includes too many requirements. The proposed additions are suggested for a range of reasons (explained in the text following), including improving auditability by separating multiple expectations that were previously bundled into a single requirement, addressing issues that previously weren't sufficiently covered (e.g. gender, greenhouse gas emissions), and providing more opportunities for mining companies to receive recognition for efforts to improve social and environmental protection.

Please note, expert Working Groups were created to catalyze suggestions for solutions on issues we knew most needed attention in this update process. They were not tasked to come to consensus nor make formal recommendations. Their expertise has made this consultation document wiser and more focused, but work still lies ahead to resolve challenging issues. We encourage all readers to share perspectives to improve how the IRMA system can serve as a tool to promote greater environmental and social responsibility, and create value for improved practices, where mining and minerals processing happens.

The DRAFT Standard 2.0 is thus shared in its current form to begin to catalyze global conversation and stakeholder input. It does not represent content that has been endorsed by IRMA's multistakeholder Board of Directors. IRMA's Board leaders seek the wisdom and guidance of all readers to answer the questions in this document and inform this opportunity to improve the IRMA Standard for Responsible Mining.

IRMA is dedicated to a participatory process including public consultation with a wide range of affected people globally and seeks feedback, comments, questions, and recommendations for improvement of this Standard. IRMA believes that diverse participation and input is a crucial and determining factor in the effectiveness of a Standard that is used to improve environmental and social performance in a sector. To this end, every submission received will be reviewed and considered.

The DRAFT Standard 2.0 is based on content already in practice in the IRMA Standard for Responsible Mining Version 1.0 (2018) for mines in production, combined with the content drafted in the IRMA Standard for Responsible Mineral Development and Exploration (the 'IRMA-Ready' Standard – Draft v1.0 December 2021) and in the IRMA Standard for Responsible Minerals Processing (Draft v1.0 June 2021).

Chapter Structure

BACKGROUND

Each chapter has a short introduction to the issue covered in the chapter, which may include an explanation of why the issue is important, a description of key issues of concern, and the identification of key aspects of recognized or emerging best practice that the standard aims to reflect.

OBJECTIVES/INTENT STATEMENT

A description of the key objectives that the chapter is intended to contribute to or meet.

SCOPE OF APPLICATION

A description of the conditions under which the chapter may or may not be relevant for particular mines or mineral processing sites. If the entity can provide evidence that a chapter is not relevant, that chapter will not need to be included in the scope of the IRMA assessment. A requirement is 'not relevant' if the issue to which a requirement relates is not applicable at the site. For example, requirements related to the use of cyanide would not be relevant at a site at which cyanide is never used.

TERMS USED IN THIS CHAPTER

This is a list of the terms used in the chapter ■ Each term is separated with ■

Terms listed here are identified in the chapter with a dashed underline. And they are defined in the Glossary of Terms at the end of the chapter.

Chapter Requirements

X.X.X. These are criteria headings

X.X.X.X. And these are the requirements that must be met for an IRMA assessment to be issued and subsequently maintained by a site. Most criteria have more than one requirement. All requirements must be met in order to comply fully with the criterion.

a. Some requirements consist of hierarchical elements:
   i. At more than one level.
   ii. Operations may be required to meet all elements in a list, or one or more of the elements of such a list, as specified.

NOTES

Any additional notes related to the chapter and its requirements are explained here.

GLOSSARY OF TERMS USED IN THIS CHAPTER

Terms used in the chapter are defined here.

ANNEXES AND TABLES

Annexes or Tables are found here.

IRMA Critical Requirements

The 2018 IRMA Standard for Responsible Mining v. 1.0 includes a set of requirements identified as being critical requirements. Operations being audited in the IRMA system must at least substantially meet these critical requirements in order to be recognized as achieving the achievement level of IRMA 50 and higher, and any critical requirements not fully met would need to have a corrective action plan in place describing how the requirement will be fully met within specified time frames.

The 2023 updates to the 2018 Standard may edit some critical requirements in the process of revising and therefore there will be a further review specific to the language and implications of critical requirements that follows the overall Standard review.

Associated Documents

This document is an extract of the full DRAFT IRMA FOR RESPONSIBLE MINING AND MINERAL PROCESSING (Version 2.0) – DRAFT VERSION 1.0, released in October 2023 for a public-comment period. The English-language full version should be taken as the definitive version. IRMA reserves the right to publish corrigenda on its web page, and readers of this document should consult the corresponding web page for corrections or clarifications.

Readers should note that in addition to the DRAFT Standard, there are additional policies and guidance materials maintained in other IRMA documents, such as IRMA's Principles of Engagement and Membership Principles, IRMA Guidance Documents for the Standard or specific chapters in the Standard, IRMA Claims and Communications Policy and other resources. These can be found on the IRMA website in the Resources section. Learn more at responsiblemining.net

Comment on the IRMA Standard

> Comments on the IRMA Standard and system are always welcome.
>
> They may be emailed to IRMA at: comments@responsiblemining.net

Additional information about IRMA is available on our website: responsiblemining.net

Chapter 4.X (NEW)
Management of Physical Stability

NOTES ON THIS CHAPTER: This is a new chapter being proposed to clearly delineate requirements to manage physical stability risks associated with some facilities that are present at mines and mineral procession operations. In the 2018 Mining Standard, the chapter on Waste and Materials Management included the management of both physical and chemical stability risks.

A review of the 2018 Mining Standard requirements that were in place to manage physical stability risks revealed some gaps including: 1) how to determine which facilities may have a potential for catastrophic failure; 2) no explicit requirement outlining the process for determining a "failure consequence classification" (i.e., a rating of the severity of the human, environmental and economic consequences if a facility were to experience a catastrophic failure).

Additionally, in 2020 the Global Industry Standard for Tailings Management (GISTM) was released.[1] The standard was the culmination of a two-year-long multi-stakeholder effort, which included discussions with IRMA. There is considerable overlap between the GISTM and the IRMA Standard, although because the GISTM focuses only on the management of tailings it is by nature much narrower in scope than the 26-chapter IRMA Standard.

IRMA held discussions with an Expert Working Group to receive input on whether or not IRMA should try to fully align its own waste-related requirements with the GISTM requirements, or possibly even remove its tailings-management-related requirements and simply require that entities be audited against GISTM. There was unanimity that IRMA not attempt to fully align with or adopt GISTM at this point in time, as GISTM is still new in its implementation, and has yet to develop a consistently applied assurance process. There will, no doubt, be a lot to learn from the first companies that are in the process of trying to implement the GISTM Standard. As more information and learning is shared from those companies, IRMA will continue to consider how to move forward.

IRMA's working group did, however, recognize that there were some new best practice elements that should be considered for integration in the IRMA Standard, and so some of the changes proposed below reflect their suggestions.

The intent of this proposed chapter is not to duplicate the efforts of GISTM or other industry standards such as the Mining Association of Canada's Toward Sustainable Mining tailings protocol, but rather to align on important requirements and apply them in a manner that encompasses the needs of, and provides transparency to, all stakeholders. The intent is also to recognize that many mining and mineral processing facilities, not just tailings facilities, have inherent risks related to physical stability that can result in both catastrophic failures and less severe but still damaging stability failures, and that those inherent risks need to be recognized and addressed. Finally, it is also the intent of this chapter to provide more prescriptive standards and specificity, with provisions for exceptions, in order to provide more consistent expectations for all facilities.

Glossary:

- We are proposing other new/revised definitions for several glossary terms. The 'Terms Used In This Chapter' box shows which terms are new, and the proposed definitions can be found in the glossary at the end of the chapter requirements (and before the Annexes). Feedback on definitions is welcome.

[1] Global Tailings Review. 2020. Global Industry Standard on Tailings Management. https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf

BACKGROUND

Mining, mineral processing and chemical processes, and remediation of those activities, require facilities that, if mismanaged, create risks to human rights, human health and safety, and the environment.

Underground mines are subject to subsidence of the overlying surface due to voids created by mining. The subsidence can result in significant impacts on surface features and hydrology. Open pit and cast mines are subject to catastrophic failures and mass wasting as a result of pit highwalls and other features.

Most mined material will remain on the site as wastes in two general forms: soil and rock removed during mining that will not be processed for minerals (e.g., overburden, waste rock, sub-economic ore, etc.), and wastes from mineral, metallurgical and chemical processing (e.g., tailings, spent heap leach piles, process residue storage ponds, etc.). Mines may also require water storage facilities to supply fresh and process water storage requirements.

Proper storage of fluids and wastes is required primarily to ensure worker/employee safety. However, these facilities may also pose a risk to nearby communities, as the storage of large volumes of any material behind tailings or water dams and/or in constructed impoundments holds the potential for catastrophic failure.

There are existing and emerging technologies and practices for mining, mineral processing, and ancillary facilities that aim to prevent or greatly reduce the potential for physical stability related failures, including, importantly, catastrophic failures. This chapter incorporates those technologies and practices.

TERMS USED IN THIS CHAPTER.

■ Accountable Executive NEW ■ Affected Community ■ As Low As Reasonable Practicable (ALARP) NEW ■ Best Available/Applicable Practice (BAP) ■ Best Available Technology (BAT) ■ Breach Analysis NEW ■ Brine NEW ■ Closure ■ Collaboration ■ Competent Professional ■ Construction Versus Design Intent Verification NEW ■ Contamination NEW ■ Credible Failure Mode NEW ■ Credible Method NEW ■ Critical Facility NEW ■ Critical Control ■ Cultural Heritage ■ Cumulative Impacts ■ Design Basis Report NEW ■ Ecosystem ■ Engineer of Record (EOR) NEW ■ Entity NEW ■ Exploration NEW ■ Facility ■ Failure Consequence Classification NEW ■ Hazard NEW ■ Hazardous Waste NEW ■ Heap Leach ■ Host Country Law ■ Independent Dam Safety Review NEW ■ Independent Review NEW ■ Independent Review Board (IRB) NEW ■ Independent Senior Technical Reviewer NEW ■ Livelihood ■ Mineral Processing NEW ■ Mining NEW ■ Mitigation ■ Multi-Criteria Alternatives Analysis ■ Non-Critical Facility NEW ■ Operation NEW ■ Pollution NEW ■ Post-Closure ■ Practicable ■ Process Water ■ Project NEW ■ Responsible Critical Facility Engineer (RCFE) NEW ■ Root Cause Analysis NEW ■ Risk Control ■ Scoping NEW ■ Site NEW ■ Stakeholder ■ Tailings ■ Trigger Action Response Plan (TARP) NEW ■ Unwanted Event NEW ■ Waste Rock ■ Water Balance ■ Worker

These terms appear in the text with a dashed underline. For definitions see the Glossary of Terms at the end of the chapter.

OBJECTIVES/INTENT OF THIS CHAPTER

To manage wastes, materials and facilities in a manner that minimizes their short- and long-term physical risks, and protects workers as well as the human rights, health and safety of communities and future land and water uses.

SCOPE OF APPLICATION

RELEVANCE: The first criterion in chapter (4.X.1 'Scoping of Facilities with Potential Physical Stability Risks) is applicable to all exploration, mining and mineral processing projects and operations.

Based on the outcome of scoping:

- For facilities with low or significant failure consequence classifications but no potential loss of life the requirements of criteria 4.X.1 and 4.X.2 are applicable, and criteria 4.X.3 through 4.X.6 are not applicable.
- For facilities with significant failure consequence classifications that include potential loss of life, and facilities with higher consequence classifications, the requirements of criteria 4.X.1, 4.X.2.1.a, and 4.X.3. through 4.X.6. are applicable.

NOTE ON SCOPE OF APPLICATION: This proposed version of the IRMA Standard is meant to apply to exploration, mining, and mineral processing projects and operations (see definitions of project and operation), but not all requirements will be relevant in all cases. We have provided some high-level information below, but the IRMA Secretariat will produce a detailed Scope of Application for each chapter that will indicate relevancy on a requirement-by-requirement basis (and will provide some normative language where the expectations may slightly differ for proposed projects versus operations, or for mining versus mineral processing, etc.).

CRITICAL REQUIREMENTS

A risk assessment has been done to evaluate physical risks associated with critical facilities (4.X.3.2).

NOTE ON CRITICAL REQUIREMENTS: The 2018 IRMA Standard includes a set of requirements identified as being critical. Projects/operations being audited in the IRMA system must at least substantially meet all critical requirements in order to be recognized at the achievement level of IRMA 50 and higher, and any critical requirements not fully met need a corrective action plan for meeting them within specified time frames.

INPUT WELCOME: The proposed revisions to the 2018 Standard have led to new content, as well as edits of some critical requirements in the process. Therefore, there will be a further review of the language and implications of critical requirements prior to the release of a final v.2.0 of the IRMA Standard. During this consultation period we welcome input on any existing critical requirement, as well as suggestions for others you think should be deemed critical. A rationale for any suggested changes or additions would be appreciated.

Management of Physical Stability Requirements

4.X.1. Scoping of Facilities with Potential Physical Stability Risks

NOTE FOR 4.X.1: This is a new criterion. This section requires identification of all proposed and existing site facilities subject to potential physical instability. It also requires evaluation of the credible failure modes and consequences for each site facility in terms of impacts to human rights, health, safety, environment and communities (for existing facilities, robust supporting information is required in terms of geology, hydrology, and climate together with geotechnical and impacts assessments to ensure rigorous analysis of credible failure modes). This section also requires identification of facilities with low or significant potential consequences but no potential loss of life and also requires identification of "critical facilities" with significant or higher potential consequences including potential loss of life.

The requirements in 4.X.1 do not apply to all facilities on a mine site or mineral processing site. The facilities of potential concern are those that are created during mining (e.g., roads, open pits and underground mines) or used to store or dispose of relatively large volumes of fluids and/or solid materials or wastes such that, if there were to be a stability failure, could lead to the presence of unstable conditions that create safety issues and could result in the release of the contents in a manner that could affect workers, communities or the environment.

We are using the term scoping because it aligns with terminology in other chapters. The objective of scoping in this case is to determine of the highest failure consequence classification for each facility (considering all credible failure modes, defined below), and based on that, determine "non-critical facilities" and "critical facilities" in terms of physical stability risks (discussed below).

That classification must be completed for proposed facilities, and we are proposing that it also be revisited after each facility is constructed, and during operations, when real-world data (e.g., geotechnical characteristics at the final location, the actual materials used in construction, data on tailings properties that could affect runout estimates, etc.) will enable more accurate determination of the level of risk for each facility.

4.X.1.1. The entity identifies each proposed and existing facility that may have physical stability risks that could impact the health, safety or human rights of workers and communities, or the environment, including, but not limited to:

a. Access roads;
b. Surface mines including pit highwalls and other associated features;
c. Underground mines;
d. Fluid extraction areas or facilities (e.g., for brine or groundwater pumping/dewatering);
e. Storage or disposal facilities for wastes from underground and surface mines (e.g., waste rock, overburden, rejects material, soil, and other stockpiles);
f. Storage or disposal facilities for wastes from mineral processing, chemical processing (e.g., tailings, sludges and residues, and above-ground-level process water);
g. Hazardous and remediated waste storage facilities;
h. Storage facilities for extracted fluids (e.g., brine) or ore; and
i. Water reservoirs.

4.X.1.2. Each proposed and existing facility is characterized to inform an analysis of physical stability risks as follows:

a. The proposed dimensions, proposed location, preliminary design, operational lifespan, and closure objectives are documented for each facility, and if relevant, the storage or disposal capacity, existing and planned future contents and their chemical characteristics (as identified in Chapter 4.1); [2]
b. The following environmental factors that may influence the physical stability of proposed facilities are documented by competent professionals, including documentation of any uncertainties due to climate change:
    i. Soil characteristics: soil type, particle sizes, pore water pressure, hydraulic conductivity soils at the site;
    ii. Geology: seismicity, geologic and lithic subsurface conditions beneath the site and within 2 km of the site, including the thickness of each geologic unit and identification of which geologic units are water bearing;
    iii. Hydrology: subsurface conditions for all water bearing zones beneath the site including maximum and minimum depths to ground water, direction of groundwater flow, hydrologic gradients, transmissivity and storativity; and surface waters including average and seasonal levels and flow rates, gradients, and storage features within 2 km of the site; and
    iv. Climate: mean annual temperature, precipitation, evaporation, maximum precipitation events, predicted probable maximum precipitation events (e.g., 24-hour, annual, 10-year, 100-year, 500-year), trends in past events and predicted trends in future events; and
c. The location of all facilities with physical stability risks are mapped in relation to:
    i. Topographical contours;
    ii. Geological data;
    iii. Watercourses and other surface water features;
    iv. The most recent 100-yr and 500-yr flood zones; and
    v. Residential populations, individual households, and public and private infrastructure (including bridges, irrigation systems, and water supplies) within a 5 km radius and 100 km downstream of the site.

[2] Information on storage or disposal capacity and contents would only be relevant for those facilities storing or disposing of fluid- and/or solid materials or wastes.

The chemical characteristics of the fluids and wastes are required to be determined in Chapter 4.1, criterion 4.1.1. These characteristics, such as the presence of contaminants of potential concern, will feed into the failure consequence classification evaluation in 4.X.1.7.

NOTE FOR 4.X.1.2: This requirement outlines the minimum information that should be gathered to inform the credible failure modes assessment, tailings breach analysis (if necessary), and ultimately the failure consequence classification.

4.X.1.3. Additionally, for each existing facility the following characterizations further inform physical stability risks:

a. A detailed description of the facility location that includes site-specific data on geomorphology, geology, seismicity, including potential or actual faults, hydrogeology and hydrology, and climate, including documentation of any uncertainties due to climate change;
b. As relevant, a characterization of physical properties of the facility foundation materials, stored materials and wastes, and borrow or other materials used in construction of embankments or other features intended to provide physical stability of internally stored materials and wastes;
c. If relevant, actual volumes and updated estimates of future volumes of materials or wastes (solids and liquids), and the placement and/or fill plans and schedules (short and long-term) for the facility life cycle;[3] and
d. More detailed geotechnical investigations, as applicable, including:
    i. Geohazard assessment;
    ii. Seepage analysis;
    iii. Stability assessment;
    iv. Seismic assessment;
    v. Sensitivity analysis;
    vi. Water balance; and
    vii. Flooding assessment.

NOTE FOR 4.X.1.3: At existing operations where facilities already exist, a more detailed characterization of the facility is possible, and will provide a more reliable basis to inform the credible failure modes assessment in 4.X.1.4. If new credible failure modes are found once a facility is constructed and operational, then the failure consequence classification would need to be updated.

4.X.1.4. A multi-disciplinary team of competent professionals identifies all credible failure modes for each proposed and existing facility, taking into consideration the information in 4.X.1.1, 4.X.1.2 and, if relevant, 4.X.1.3. Depending on the facility, credible failure modes may include, but are not limited to:

a. Shallow and deep failures within the facility;
b. Foundation failures;
c. Internal erosion failure (e.g., piping);
d. Ground-subsidence-related failures;
e. Slope failures;
f. Pit highwall or slope failures;
g. Failures due to storm events;
h. Construction- and operations-related failures;
i. Upstream/upgradient off-site failures that may affect a facility (e.g., upstream dam or landslide); and
j. Cascading failures (e.g., if there are upstream and/or downstream facilities or structures).

NOTE FOR 4.X.1.4: NEW. In the 2018 Mining Standard, there was no explicit mention of credible failure modes, although IRMA guidance for Chapter 4.1 did mention the need to develop critical controls for credible failure modes.

[3] Note that initial volume estimates should have been done in 4.X.1.2 to inform the potential consequence evaluation. This information would be updated once the final design is selected.

This requirement assumes that the determination of credible failure modes will occur for proposed facilities, but also again, after a facility is constructed and more information is available about the actual materials used in construction of foundations, more geotechnical investigations have taken place, characterizations of actual wastes and slurries can take place, etc., so there is more empirical data to inform a more accurate assessment of credible failure modes.

We are proposing to adopt the GISTM definition of **credible failure modes**:

> Refers to technically feasible failure mechanisms given the materials present in the structure and its foundation, the properties of these materials, the configuration of the structure, drainage conditions and surface water control at the facility, throughout its life cycle. Credible failure modes can and do typically vary during the life cycle of the facility as the conditions vary. A facility that is appropriately designed and operated considers all of these credible failure modes and includes sufficient resilience against each. Different failure modes will result in different failure scenarios. Credible catastrophic failure modes do not exist for all tailings facilities. The term 'credible failure mode' is not associated with a probability of this event occurring and having credible failure modes is not a reflection of facility safety.

4.X.1.5. For tailings facilities, water dams and any other facilities with the potential for runout of the facility contents, competent professionals complete a facility breach analysis and runout or inundation analyses for the loss of all tailings and/or fluids. Analyses are conducted for the worst-case "sunny day" and worst-case storm-event scenarios, and for the worst-case credible failure mode scenarios in terms of rate and volume of discharge from the facility. For each case, the analysis determines:

a. The estimated physical area that may be impacted;
b. Flow arrival times, velocities, and depth of material deposition;
c. Estimated potential and likely consequences in terms of loss of human life, impacts to public and private infrastructure and vital services, environmental impacts, and economic cost.

NOTE FOR 4.X.1.5: REVISED. Both IRMA's 2018 Mining Standard (requirement 4.1.3.3.j) and GISTM require tailings breach analyses. These analyses inform failure consequence classification in 4.X.1.5. This requirement adds more detail than what was in the 2018 Mining Standard.

We are proposing to adopt the GISTM definition of **breach analysis:**

> A study that assumes a failure of the tailings facility and estimates its impact. Breach analyses must be based on credible failure modes. The results should determine the physical area impacted by a potential failure, flow arrival times, depth and velocities, duration of flooding, and depth of material deposition. The breach analysis is based on scenarios which are not connected to probability of occurrence. It is primarily used to inform emergency preparedness and response planning and the consequence of failure classification. The classification is then used to inform the external loading component of the design criteria.

4.X.1.6. The entity shares information with affected communities and other relevant stakeholders on the factors that may affect the physical stability of proposed and existing facilities, including credible failure modes and, if relevant, the facility breach analysis, and consults with them to establish and document:[4]

a. The local social, economic, environmental context of areas, including any uncertainties due to climate change; and

[4] These discussions may have been done during the environmental and social impact assessment process. See Chapter 2.1 (Environmental and Social Impact Assessment and Management), requirement 2.1.3.2.

Other relevant stakeholder might include government officials, academics or expert who are not from the affected communities but have information or expertise to aid in the understanding of the local, social, environmental context and resources that may be affected.

b. The social (e.g., human rights, ecosystem services, commercial and residential property, businesses, etc.), cultural heritage, and environmental resources that may be negatively impacted by a physical stability failure at any of the identified facilities.[5]

NOTE FOR 4.X.1.6: NEW. The concepts in this requirement are aligned with GISTM [2.1 and 1.3], which require identifying the local social, economic, and environmental context, and that project-affected people are meaningfully engaged in building the knowledge base.

4.X.1.7. For each facility determined to have credible failure modes, a multi-disciplinary team of competent professionals carries out an evaluation of the consequences of a facility failure (hereafter referred to as "failure consequence classification") that includes:[6]

a. Estimation of incremental impacts/losses related to each credible failure mode, including:
   i. Potential population at risk;
   ii. Potential loss of life;
   iii. Potential impacts on the environment;
   iv. Potential impacts on health, social and cultural resources; and
   v. Potential impacts on infrastructure and economics;

b. The estimation of impacts includes consideration the chemical characterization of the contents that would be released upon facility failure (as identified in Chapter 4.1), and potential for short- and long-term contamination or pollution of water, soils, and ecosystems, and effects on human health and livelihoods;[7]

c. Determination of the facility's failure consequence classification (e.g., low, significant, high, very high or extreme) based on the matrix provided in Table 4.X-1. All categories of incremental impact/loss (e.g., population at risk, environment, economics, etc.) are considered equally important, and the failure consequence classification aligns with category with the worst potential consequences.[8]

NOTE ON 4.X.1.7: REVISED. Requirement 4.1.3.3 in the 2018 Mining Standard included a requirement for facility classification based on risk level or consequence of failure. This proposed requirement adds more detail on the method used to determine the failure consequence classification (and does not base it on risk, which incorporates the probability a failure). The probability of failure is not taken into account in the failure consequence classification.

We are proposing a definition of a **failure consequence classification** as:[9]

> A rating or ranking (e.g., low, significant, high, very high, extreme) based on losses, damages or impacts on downstream populations, the environment, the economy, cultural values, property and infrastructure if there were to be a loss of stability or integrity in a facility or its appurtenances that leads to an uncontrolled release of all or part of its contents. Failure consequence classifications are carried out for all credible failure modes.

[5] This information should feed into assessments of risks in other chapters. See the table called Cross-References to Other Chapters at the end of this chapter.

[6] This exercise is informed by information from 4.X.1.1, 4.X.1.2, 4.X.1.3, 4.X.1.4, 4.X.1.5 and 4.X.1.6.

[7] The chemical characterization in Chapter 4.1, criterion 4.1.1, determines whether or not there are hazardous properties to the fluids or wastes, and particular contaminants of potential concern. If contents may cause harm to people or the environment, that information must be taken into consideration when determining the risks to human health, potential impacts on the environment, potential impacts on local economies, etc.

[8] For example, if a particular facility presents a LOW risk to human life, but could result in incremental environmental losses that are considered to be HIGH, the consequence classification would be HIGH." (Source: British Columbia Ministry of Forests, Lands and Natural Resource Operations. 2017. "Downstream Consequence of Failure Classification Interpretation Guideline." p. 2. https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/dam-safety/con_class_guidelines_for_owners-2017.pdf)

[9] See source in previous footnote.

4.X.1.8. Each facility's failure consequence classification is reviewed and, if necessary, updated. Reviews take place every five years or sooner, for example, when:

a. There are proposed changes to the facility, including changes in the operational parameters of the facility;

b. New or more accurate data relating to risks to the stability of the facility (e.g., geological, hydrological, climate change, newly identified credible failure modes) become available;

c. Changes in the social or environmental context have the potential to change the nature or scale of potential impacts associated with a facility.

NOTE ON 4.X.1.8: This requirement aligns with 4.1.3.4 and 4.1.4.1.c in the 2018 Mining Standard. The five-year (or sooner) review also aligns with GISTM [4.2.C].

4.X.2. Management of Physical Stability at Non-Critical Facilities

NOTE FOR 4.X.2: In the 2018 Mining Standard, all mine waste facilities needed to undergo risk assessment to determine the risks to human health, safety or environment, and the risks needed to be managed. This section generally deals with the management of risks related to physical stability of facilities that are not considered to be 'critical facilities.' As with other IRMA chapters, it includes a management plan and monitoring requirements.

We are proposing the following definition of **non-critical facility**:

> A facility that, if a physical stability failure of the facility were to occur, would not lead to the loss of life, and would have only low or significant impacts that could be mitigated within a short period of time (e.g., 1 – 5 years) at a reasonable cost (e.g., <10 Million $US).

And a proposed definition of **critical facility**:

> A facility that has a high, very high or extreme failure consequence classification, or a significant consequence classification that includes potential loss of life.

Note that Chapter 4.1 addresses the risks related to potential contamination from all facilities.

4.X.2.1. Any proposed or existing facility that has a failure consequence classification of low or significant with no potential loss of life (as identified in 4.X.1.7) is considered a "non-critical facility." For each non-critical facility that has one or more credible failure modes:

a. The use of best available/applicable practices and best available technology (see Annex 4.X-A) are incorporated in the design and operation of each facility; and

b. For proposed facilities that have one or more credible failure modes:

   i. At least one qualified independent reviewer reviews the proposed design report to identify deficiencies, and any deficiencies are corrected prior to design finalization;[10] and

   i. Quality assurance/quality control (QA/QC) and independent oversight occurs during the construction phase to ensure proper incorporation of planned engineering measures.

NOTE ON 4.X.2.1: REVISED. The requirement to use best practices and technologies aligns with requirements 4.1.5.1 in the 2018 Mining Standard. We have started to develop some guidance (see Annex 4.X-A) for entities, auditors and stakeholders on current best practices and technologies to ensure that non-critical facilities with a credible failure mode are designed, constructed, operated and closed in a manner that protect short-term and long-term physical stability.

Note that the best practices in Annex 4.X-A are meant to be applicable for critical facilities also (see 4.X.4.2.a.ii).

[10] Qualified independent reviewers are objective, third-party, competent professionals with at least 15 years of experience in the specific area of review in this case, facility design. (This aligns with requirement 4.X.5.4)

CONSULTATION QUESTION 4.X-1: Do you agree with the proposal to create guidance to better inform auditors' assessments? If not, how do you suggest auditors determine whether or not the measures at a site are sufficient to prevent or mitigate physical instability?

If you agree with the approach, please indicate if you agree with any of the proposed best practices and technologies in Annex 4.X-A, and/or suggest alternative practices and technologies, including for facilities not identified in the draft Annex.

Would you be interested in being part of a working group to help work on this guidance? If so, please contact IRMA (comments@responsiblemining.net) and we will be in touch as we move forward with this process.

4.X.2.2. A management plan (or equivalent) is developed and implemented by competent professionals that includes:

a. Key operational actions to be taken to mitigate risks to physical stability;
b. Key parameters to monitor to detect potential physical stability issues; and
c. Maintenance measures to protect the integrity of engineering and other mitigation measures;
d. Assigns implementation of actions, or oversight of implementation, to responsible staff;[11]
e. Includes an implementation schedule; and
f. Includes estimates of human resources and budget required and a financing plan to ensure that funding is available for the effective implementation of the plan.

4.X.2.3. At least once a year monitoring data are reviewed to determine the effectiveness of mitigation measures. If deviations in expected performance are observed:

a. The deviations are documented; and
b. Remedial measures are developed and incorporated into an updated management plan.

4.X.3. Initial Assessment, Siting and Design of Critical Facilities

NOTE FOR 4.X.3: This section provides comprehensive requirements for all existing and/or proposed "critical facilities" with significant or higher potential consequences including potential loss of life. The section requires that a multi-criteria alternatives analysis and a risk assessment be conducted to inform the siting and design of critical facilities and the selection of facility management practices. Prescriptive design criteria are also required for new and existing critical facilities, including the use of conservative geotechnical factors of safety, and seismic and storm event criteria. Existing critical facilities that don't current meet best practice design must have a remedial plan in place to immediately address and within a reasonable period upgrade to best practice criteria.

4.X.3.1. For facilities where the failure consequence classification significant and there is potential loss of life, or the classification is high, very high or extreme (as identified in 4.X.1.4), hereafter referred to as "critical facilities," a multi-criteria alternatives analysis[12] (MCAA) or similar process is conducted and documented as follows:

a. For proposed critical facilities, MCAA is used to inform the siting, design, and the selection of management practices, while for existing critical facilities, MCAA is used to inform management practices, at minimum, when there are proposed major changes to facilities such as expansions, that may require a change in design or management practices; and

[11] If work is carried out by third party contractors, then there needs to be a staff employee responsible for overseeing the quality of work, timelines, etc.

[12] Alternatives assessment is a process to identify and objectively and rigorously assess the potential impacts and benefits (including environmental, technical and socio-economic aspects) of different options so that an informed decision can be made.

For more on alternatives assessment see: Environment Canada. 2016. Guidelines for the Assessment of Alternatives for Mine Waste Disposal. https://www.canada.ca/en/environment-climate-change/services/managing-pollution/publications/guidelines-alternatives-mine-waste-disposal/chapter-2.html; and Mining Association of Canada. 2017. Guide to the Management of Tailings Facilities, p. 46. http://mining.ca/sites/default/files/documents/MAC-Guide-to-the-Management-of-Tailings-Facilities-2017.pdf

b. All MCAA:
    i. Are carried out by a multi-disciplinary team of competent professionals;
    ii. Have the objective of selecting an alternative that minimizes risks to people and the environment throughout the facility life cycle, and minimizes the volume of fluids and/or wastes placed in critical facilities.
    iii. Identify minimum specifications and performance objectives for each facility throughout the facility life cycle (including closure objectives and post-closure land and water uses);
    iv. Identify possible alternatives for initial siting, design and management of critical facilities to prevent, and if that is not possible, minimize risks from all credible failure modes and for all phases of each facility's life cycle, avoiding *a priori* judgements about the alternatives;
    v. Include a screening or "fatal flaw" analysis to eliminate alternatives that fail to meet minimum specifications;
    vi. Assess remaining alternatives using a rigorous, transparent decision-making tool, such as Multiple Accounts Analysis or its equivalent, that takes into account environmental, technical, socio-economic and project economics considerations, inclusive of risk levels and hazard evaluations, associated with each alternative; and
    vii. Include a sensitivity analysis to reduce potential that biases will influence the selection of final site locations, design specifications and facility management practices.

NOTE FOR 4.X.3.1: REVISED. This was 4.1.4.2 in the 2018 Mining Standard. It has been restructured to make it clear that MCAA are required for proposed facilities, but for existing facilities they only need to be done if there is a major change that would result in a change in the design or management practices.

Previously, we referred to these assessments as "alternatives assessment," but we are proposing to use the term "multi-criteria alternatives analysis" to align with the language used in GISTM [3.2].

4.X.3.2. (Critical Requirement)
For each critical facility, a risk assessment is carried out to evaluate the risks to human rights and the health and safety of communities and the environment from all credible failure modes identified in 4.X.1.4. Risk assessments:

a. Are carried out and documented by a multi-disciplinary team using a credible methodology;
b. Identify credible failure modes for which design elements and critical controls must be prioritized, and a rationale is documented; and
c. Are updated every three years or sooner (e.g., if there proposed changes in the design or operation of facilities, or changes in operational, social, environmental, or local context that have the potential to increase the probability or severity of consequences of any identified risk).

NOTE FOR 4.X.3.2: REVISED. Requirement 4.1.4.1 in the 2018 Mining Standard included a risk assessment to evaluate risks to health, safety and the environment related to physical and chemical risks at facilities, and it was a critical requirement (for more on critical requirements see the note that accompanies 'Critical Requirements In This Chapter,' above).

GISTM [10.1] includes a requirement for risk assessment. This proposed revised requirement combines elements of the two requirements, and some additional detail.

4.X.3.3. A summary of risks assessment findings for critical facilities is made public, and stakeholders are provided with the opportunity to provide input on the findings.

NOTE FOR 4.X.3.3: NEW. We have added this based on GISTM [15.1], which includes a requirement to make the risk assessment summary public. We are proposing that stakeholders also have the opportunity to provide input to the entity on the risk assessment findings to promote continued dialogue.

4.X.3.4. Initial facility designs and the refinement of the designs of critical facilities:

a. Are informed by the outcome of the multi-criteria alternatives analysis and the risk assessment;
   i. Use design criteria that are appropriate to minimize risk to as low as reasonably practicable for:
   ii. All credible failure modes;[13] and

b. All phases of construction over the facility life cycle (e.g., start-up, partial raises, interim configurations, final raise, and all closures stages);

c. Proposed and existing facilities use the flood, seismic and slope stability design criteria (see Tables 4.X-2 through 4.X-5) that are consistent with the facility's failure consequence classification, or, if not originally applied at existing facilities entities demonstrate that a plan to meet the applicable criteria has been developed, has undergone independent review and is being implemented; and

d. The designs and design criteria are publicly available.

NOTE FOR 4.X.3.4: NEW. Sub-requirements 4.X.3.2.a, b and e align with GISTM [5.1, 5.4 and 15.1].

We are proposing to use the GISTM's definition of **As Low As Reasonably Practicable**

> *All reasonable measures are taken with respect to 'tolerable' or acceptable risks to reduce them even further until the cost and other impacts of additional risk reduction are grossly disproportionate to the benefit.*

CONSULTATION QUESTIONS 4.X-2

Background: In 4.X.3.2.c, we are proposing design criteria (our Tables 4.2, 4.3, 4.4 and 4.5) that are not fully in alignment with GISTM. The criteria in our proposed tables are from the Canadian Dam Association (2014). It is not clear where GISTM values (in Tables 2 and 3 in that standard) were drawn from, and there are no slope stability factors of safety included in GISTM.

Question: Do you agree that IRMA's best practice design criteria follow the well-established Canada Dam Association criteria? If not, why not? Or are there other design criteria that have emerged as best practice criteria? Do you agree with the inclusion of slope stability criteria? If not, why not?

CONSULTATION QUESTIONS 4.X-3

Background: We are proposing that design specifications related to flood, seismic and slope stability need to be met at all proposed and existing critical facilities because of the potential loss of life if these facilities were to fail. However, for existing facilities that did not originally use the design criteria, we are allowing time for an upgrade plan to be developed, undergo independent review, and time for implementation.

This is a slightly different approach than GISTM, which allows that new facilities can, over time, upgrade to meet criteria for higher consequence classifications [4.2.C]. Existing facilities are expected to apply appropriate design criteria except for aspects where "the Engineer of Record (EOR), with review by the ITRB or a senior independent technical reviewer, determines that the upgrade of an existing tailings facility is not viable or cannot be retroactively applied. In this case, the Accountable Executive shall approve and document the implementation of measures to reduce both the probability and the consequences of a tailings facility failure in order to reduce the risk to a level as low as reasonably practicable (ALARP)." [GISTM 4.7]

Question: As with GISTM, should IRMA make additional allowances for existing facilities if they can demonstrate that upgrade to the best practice design criteria is not viable or cannot be retroactively applied? If so, then like GISTM, should IRMA require demonstration that upgrades still take place to minimize risk to as low as reasonably practicable (ALARP) at those sites?

Perhaps if sites do not meet all of the design criteria but can demonstrate that risks have been reduced to ALARP, IRMA could cap a site's rating for this requirement at substantially meets (i.e., they would never be able to fully meet the requirement), so that the sites that have implemented best design practices are able to distinguish themselves. Is that an approach that you would support?

[13] Credible failure modes may relate to the facility structure, its foundation, abutments, reservoir (tailings deposit and pond), reservoir rim and appurtenant structures.

4.X.4. Management of Physical Stability Risks at Critical Facilities

NOTE FOR 4.X.4: This section requires governance and management accountability structures that ensures responsibility begins at the site level for decisions with regard to existing and/or proposed critical facilities but it ultimately lies with the highest levels of the company. It also requires that for each existing and/or proposed critical facility, the entity develop and implement an Operation, Maintenance and Surveillance (OMS) manual (or its equivalent) to ensure best practices are maintained during the operational phase of critical facilities.

4.X.4.1. For sites that have one or more critical facilities, a system of accountability, responsibility and personnel management is in place that:

a. Clearly defines and documents the entity personnel, executives, and members of the entity's Board of Directors that are accountable for decisions and actions related to the management and safety of critical facilities, and clearly defines and documents the roles, responsibilities, and lines of communication between those involved in the management of those facilities. This information is shared with all personnel who have a role in the facility's management, and if requested, shared publicly;

b. Identifies one or more accountable executive(s) to be accountable for implementation of system to manage critical facilities in a manner that minimizes risks to human rights and the health and safety of the environment and communities;

c. Identifies appropriate qualifications and experience requirements for all personnel with safety-critical roles in the design, operation, and management of critical facilities, and ensures that incumbents of these roles have the identified qualifications and experience;

d. Has succession plans in place for key personnel such as the Engineer of Record (EOR) and the Responsible Critical Facility Engineer (RCFE) or equivalent;

e. Provides mechanisms to receive and incorporate workers' experience-based knowledge into planning, design, and operations for all phases of the critical facility life cycle;

f. Recognizes, rewards, and protects from retaliation, workers, employees, and contractors who report problems or identify opportunities for improving critical facility safety or management, provides a timely response to whistleblower complaints, and communicates actions taken and their outcomes to the accountable executive;[14] and

g. Includes mechanisms such that incentive payments or performance reviews for personnel with some level of responsibility for the safety or management of the critical facility, that are based, at least in part, on public safety and the integrity of the facility.

NOTE FOR 4.X.4.1: NEW. IRMA's Expert Working Group on waste management recommended that we add more requirements relating to accountability, so we are proposing these, which have been adapted from GISTM [various requirements].

The definition for Responsible Critical Facility Engineer (RCFE) in 4.X.4.1 has been adapted from GISTM's definition of 'Responsible Tailings Facility Engineer' to make it applicable to the engineer responsible for any critical facility.

The proposed **RCFE** definition is:

> An engineer appointed by the entity to be responsible for the critical facility. The RCFE must be available at all times during construction, operations and closure. The RCFE has clearly defined, delegated responsibility for management of the critical facility and has appropriate qualifications and experience compatible with the level of complexity of the critical facility. The RCFE is responsible for the scope of work and budget requirements for the critical facility, including risk management. The RCFE may delegate specific tasks and responsibilities for aspects of critical facility management to qualified personnel but not accountability.

[14] Chapter 3.1, requirement 3.1.5.2, also requires that workers have whistleblower protection (i.e., non-retaliation for reporting issues such as an employee that is willfully ignoring safety standards). But that requirement does not address rewards or recognition for such reporting.

4.X.4.2. For each critical facility, an operations, maintenance, and surveillance (OMS) manual (or equivalent) is developed, documented and implemented by competent professionals that includes:

a. A risk management plan (or its equivalent) that:[15]
    i. Outlines critical controls to minimize the probability and potential consequences of a facility failure to as low as reasonably practicable (ALARP);
    ii. Includes other risk controls and actions necessary for safe operation of facilities, including use of best available/applicable practices and best available technologies (see Annex 4.X-A);
    iii. Documents specific and measurable performance objectives, indicators, criteria, and performance parameters for critical controls and risk controls;
    iv. Includes a trigger action response plan (TARP), or its equivalent, that describes pre-defined trigger levels for performance criteria, and actions to be taken if trigger levels are exceeded, i.e., if performance is outside of expected range;
    v. Assigns implementation of controls and actions, or oversight of implementation, to responsible staff;[16]
    vi. Includes an implementation schedule; and
    vii. Includes estimates of human resources and budget required and a financing plan to ensure that funding is available for the effective implementation of the plan;
b. A maintenance program that includes routine, predictive and event-driven maintenance to ensure that all relevant parameters (e.g., all civil, mechanical, electrical and instrumentation components of critical facilities) are maintained in accordance with performance criteria, host country law and sound operating practices;
c. A comprehensive and integrated performance surveillance/monitoring program that:
    i. Includes a procedure for regular inspections of facilities that includes monitoring of performance objectives, indicators, criteria, and performance parameters (see 4.X.4.1.a.iii), and recording and evaluating the data at appropriate frequencies to confirm that existing controls and strategies remain effective to manage risk throughout the facility life cycle;
    ii. Includes a procedure for a comprehensive and integrated engineering monitoring system that is appropriate for verifying design assumptions and for monitoring potential failure modes, including full implementation of the observational method for non-brittle failure modes;
    iii. Includes a procedure for analysis of technical monitoring data at the frequency recommended by the EOR, and assessment of the performance of the facility, clearly identifying evidence on any deviations from the expected performance and any deterioration of the performance over time. The procedure shall also include promptly submitting evidence on deviations to the EOR for review, promptly addressing performance outside the expected ranges through TARPs or critical controls, and updating the risk assessment and design, if required; and
    iv. Includes a procedure for review and approval of technical monitoring reports by the EOR and responsible critical facility engineer (RCFE), and reporting of the surveillance program results to the entity annually.

NOTE FOR 4.X.4.2: REVISED. An operations, maintenance, and surveillance manual was required in 4.1.5.5 in the 2018 Mining Standard.

Although a specific requirement for risk management plan was not explicit in the 2018 Mining Standard, requirement 4.1.5.5 did require risk management strategies, critical controls and risk controls, and TARP-like expectations. The additional risk management plan expectations in 4.X.4.2.a are consistent with other IRMA chapters that have management plans.

[15] This may be integrated with the OMS manual in 4.1.4.3.

[16] If work is carried out by third party contractors, then there needs to be a staff employee responsible for overseeing the quality of work, timelines, etc.

More detail has been added to the surveillance/monitoring expectations in 4.X.4.2.c based on similar expectation in GISTM [7.2, 7.4, 7.5].

4.X.4.3. Personnel involved in the operations of each critical facility:

a. Have access to the OMS manual; and

b. Receive training on the OMS manual.

NOTE FOR 4.X.4.3: NEW. This requirement aligns with GISTM [6.4], although we have not specified who trains the personnel (in GISTM it is the Responsible Tailings Facility Engineer).

4.X.4.4. The OMS manual is reviewed annually, and critical controls, risk controls and OMS programs are updated as necessary, e.g., if monitoring/surveillance (see 4.X.4.2.c) reveals that performance criteria are not being met, or other information reveals that critical facilities are not being effectively operated or maintained in a manner that protects human health and safety and prevents or otherwise minimizes harm to the environment and communities.

NOTE FOR 4.X.4.4: REVISED. This was requirement 4.1.5.7 in the 2018 Mining Standard but referred only to the OMS. We have added that the risk management plan also be reviewed and updated if management measures are not being effective. This aligns with expectations in many other IRMA chapters.

4.X.4.5. The entity implements a change management process that includes:

a. A system to track and document changes in the design, construction, operation or monitoring of critical facilities over their life cycles;

b. Periodic review and assessment by the EOR of the cumulative impact of changes on the risk level of as-constructed critical facilities, and, if necessary, recommended measures to reduce the level of risk to ALARP and updates to the design, OMS manual and technical monitoring program; and

c. Review of the EOR's assessment and recommendations by the accountable executive, and documentation of a rationale for why any EOR recommendations will not be implemented.

NOTE FOR 4.X.4.5: NEW. This change management requirement is based on GISTM [6.5]. We are proposing to add it to highlight the importance of documenting, evaluating and responding appropriately to changes and deviations from planned designs and actions.

4.X.5. Critical Facility Oversight and Review Processes

NOTE FOR 4.X.5: This is a new criterion, specifically developed to consolidate all oversight, quality control, and review requirements in one place (other than those contained in the surveillance requirements in 4.1.5.1.d).

It includes oversight by the Engineer of Record and through the use of competent independent reviewers throughout the facility life-cycle. There are also internal review and reporting requirements.

4.X.5.1. The entity implements a program to oversee the quality of engineering work for all critical facilities, including:

a. Review and sign-off on construction records reports by the EOR and the RCFE; and

b. Quality control, quality assurance and construction versus design intent verification, to ensure that the design intent has been implemented and is still being met if the site conditions vary from the design assumptions.

NOTE FOR 4.X.5.1: NEW. Requirement 4.X.5.1, and has been included to highlight the importance of oversight of engineering and construction as a means of improving the safety of critical facilities. It aligns with GISTM [6.2 and 6.3].

4 X.5.2. Independent reviews take place for all critical facilities as follows:

a. For critical facilities with a failure consequence classification of very high or extreme, the entity appoints an independent review board (IRB) consisting of three or more members, and for all other critical facilities an IRB or a senior independent technical reviewer carries out the reviews;
b. Independent reviews occur throughout the project/operation life cycle (e.g., during planning, siting, design, construction, operation, maintenance, management and monitoring, closure, and post-closure), and include review of:
    i. Credible failure mode assessments, breach analyses, evaluations to determine failure consequence classifications, and geotechnical assessments;
    ii. Risk assessments and identification of risks requiring critical controls (see 4.X.3.2);
    iii. Performance reviews of facility construction, annually, or more frequently, if required;
    iv. Proposed facility sites and designs to ensure that the proposed sites and designs incorporate the outcomes of the multi-criteria alternatives analysis (see 4.X.3.1);
    v. Design basis reports and construction record reports;
    vi. Proposed updates to facility designs;
    vii. Facility water balances and mass balances;
    viii. Surveillance/monitoring reports; and
    ix. Documentation related to facility performance and risk management.
c. IRBs and/or the senior independent technical reviewers report to the operation's general manager and an accountable executive; and
d. The entity reviews commentary, advice and/or recommendations from all independent reviews and: [17]
    i. Develops an action plan with a schedule to implement improvements based on the advice and recommendations;
    ii. Documents a rationale for any advice or recommendations that will not be implemented;
    iii. Tracks progress of the action plan's implementation; and
    iv. Shares this information with the accountable executive.

NOTE FOR 4.X.5.2: Requirement 4.X.5.2.a was 4.1.6.2 in the 2018 Mining Standard; 4.X.5.2.b aligns with 4.1.6.1, 4.X.5.2.c aligns with 4.1.6.4, and 4.X.5.2.d aligns with 4.1.6.5.

4.X.5.3. An independent dam safety review (DSR) or equivalent safety review of technical, operational and governance aspects of critical facilities is conducted as follows:

a. Reviews take place at least every five years for critical facilities with very high or extreme failure consequence classifications, more frequently if recommended by the IRB, and at least every 10 years for all other critical facilities;
b. Reviews draw attention to any deficiencies or non-conformities in information (e.g., identification of hazards, failure modes, geotechnical and hydrotechnical assessments, or the inputs or outcomes of failure consequence classifications), in facility construction, operation, maintenance, surveillance, emergency preparedness and response plans, responses to incidents, and governance (e.g., roles, responsibilities, authorities and activities are clearly assigned, peresonnel are competent and trained);
c. Every review of a particular facility is carried out by a different independent contractor; and
d. Commentary, advice, and recommendations from the DSR review are shared with the accountable executive.

[17] All of this information, as well as the independent review reports, shall be made available to IRMA auditors. Non-disclosure agreements will be signed by IRMA auditors, but even so, confidential business information may be withheld as long as the company provides to auditors a description of the confidential information or materials that are being withheld and an explanation of the reasons for classifying the information as confidential; and if a part of a document is confidential, only that confidential part shall be redacted, allowing for the release of non-confidential information. (See Chapter 1.1 (Legal Compliance), requirement 1.1.4.1).

NOTE FOR 4.X.5.3: REVISED. 4.1.3.3.h in the 2018 Mining Standard required an annual dam safety inspection report. This requirement adds more detail based on GISTM [10.5], and the elements in 4.X.5.2.b are drawn from a review of dam safety checklists.[18]

We are proposing to define **independent dam safety review** as:

> Independent review of the safety of a critical facility covering technical, operational and governance aspects, conducted by an independent technical specialist according to established best practices. It is conducted at intervals based on the failure consequence classification and the complexity of its condition or performance. It is regulatory requirement in many jurisdictions. (Adapted from GISTM)

4.X.5.4. All IRB members, senior independent technical reviewers, and DSR contractors:

a. Are objective, third-party, competent professionals with at least 15 years of experience in the specific area of review (e.g., facility design, operations, closure, environmental or social aspects or other specific topic of concern); and

b. Have attested in writing that they follow best practices to avoid conflicts of interest.

NOTE FOR 4.X.5.4: REVISED. Requirement 4.X.5.4.a is aligned with 4.1.6.5 in the 2018 Mining Standard, but we have added that competent professionals must have at least 15 years of experience in the topics of concern, which aligns with GISTM; and 4.X.5.4.b aligns with GISTM [8.7 and 10.5].

4.X.5.5. The entity implements and documents an annual management review process to facilitate continual improvement in the management of critical facilities. The process includes:

a. Review of:

    i. The status of continual improvement actions identified in the previous review, if any;
    ii. The current effectiveness of critical control and risk control measures in 4.X.4.2.a;
    iii. Maintenance and surveillance/monitoring data, and the current effectiveness of OMS manual and surveillance/monitoring procedures in 4.X.4.2);
    iv. Any regulatory non-compliance issues, unwanted events, root cause analyses, and corrective actions since the previous review;
    v. Any commentary, advice, and recommendations from the EOR, IRB, senior independent technical reviewer or DSR contractor since the previous management review, and responses taken by the entity;
    vi. Whether or not critical facilities continue to meet their design intent, including any deviations from the design or expected conditions since the previous management review;
    vii. Any changes in facility operating conditions (e.g., production rates), social, environmental, or local economic context, legal requirements, industry best practice or emerging technologies, that may have a bearing on the critical facilities;

b. A documented summary of significant issues related to the overall performance of the critical facilities based on the information reviewed and discussed, and recommended actions for improvement;

c. Reporting of results to an accountable executive.

NOTE FOR 4.X.5.5: REVISED. This was 4.1.5.8. in the 2018 Mining Standard.

Previously, this requirement referred to aligning "with the steps outlined in the Mining Association of Canada's Tailings Management Protocol or a similar framework." We have revised it to include more detail, so that it can be audited in a consistent manner.

[18] For example, see: Government of British Columbia. 2015. "Dam Safety Review Check Sheet." https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/dam-safety/dsr_check_sheet_-_september_2015.pdf

Banque Ouest Africaine de Développement. 2014. Dam Safety Reviews manual. https://www.boad.org/wp-content/uploads/2016/12/boad_dam_safety_reviews_manual.pdf

4.X.6. Reporting and Disclosure

NOTE FOR 4.X.6: This section address reporting to stakeholders on the management of physical stability, and disclosure requirements.

4.X.6.1. The entity publishes and updates plain language summaries for the following information on critical facilities,[19] and any exclusion of information is documented and approved by the accountable executive:

a. An up-to-date description of all critical facilities, their failure consequence classifications and the entity's rationale for the classification;
b. The rationale for the basis of the facility design and site selection;
c. Risk assessments;
d. Planned and implemented mitigation measures; and
e. Results of surveillance/monitoring program.

NOTE FOR 4.X.6.1: NEW. This requirement partially aligns with GISTM [15.1].

4.X.6.2. At least once a year, the entity meets with relevant stakeholders to:[20]

a. Report on critical facility management, surveillance/monitoring and findings from independent reviews;[21] and
b. Seek feedback on the entity's management approach to critical facilities.

NOTE FOR 4.X.6.2: REVISED. Some of this content (i.e., feedback on management approaches) was included in requirement 4.1.7.1 and 4.1.7.4 in the 2018 Mining Standard. It has been revised to include ongoing engagement throughout the facility life cycle as per GISTM [1.3].

4.X.6.3. To facilitate effective stakeholder engagement, the entity offers to provide assistance to stakeholders from affected communities to select and hire independent experts to advise them on physical stability risks and the management of critical facilities.

NOTE FOR 4.X.6.3: NEW. This proposed requirement came out of discussions in IRMA's expert working group on mine waste management. The management of physical stability risks related to wastes and materials such as tailings, waste rock or brines involve many technical issues and jargon that most community members cannot immediately understand. Communities often lack funds to hire independent experts to advise them on issues such as risks related to tailings dams and other complex technical topics, which prevents their meaningful engagement on tailings and waste issues, which are often the primary mine-related concern for these communities.

The IRMA Standard has similar requirements in other chapters where legal or technical advice are critical for ensuring that communities' rights and interests can be upheld (e.g., see Chapter 2.4 on resettlement, or Chapter 2.2 on FPIC, Chapter 4.2 on water), and aligns with requirement 1.2.3.1 in Chapter 1.2 related to strengthening stakeholders' capacity to engage. We are proposing that access to independent experts is the most reasonable means of ensuring meaningful and effective stakeholder engagement on the physical stability issues (rather than, for example, trainings or other types of capacity building).

This requirement also aligns with GISTM requirement [1.3] to "Demonstrate that project-affected people are meaningfully engaged throughout the tailings facility life cycle in building the knowledge base and in decisions that may have a bearing on public safety and the integrity of the tailings facility."

GISTM's definition of meaningful engagement includes that, "Meaningful engagement involves measures to overcome structural and practical barriers to the participation of diverse and vulnerable groups of people.

[19] Including proposed facilities for which the regulatory authorization process has commenced, and operating facilities.

[20] Relevant stakeholders would include, at minimum, stakeholders who may be affected by a physical stability failure at a critical facility.

[21] E.g., reviews carried out by IRB and/or independent senior technical reviewers, as well as independent dam safety reviews.

Strategies for addressing barriers must be appropriate to the context and the stakeholders involved, and may include, for example, logistics and other support to enable participation."

NOTES

This revised chapter has incorporated elements from the Global Industry Standard for Tailings Management (GISTM),[22] as well as elements of the Mining Association of Canada's (MAC) 2017 Tailings Management Protocol and Guide to the Management of Tailings Facilities (Tailings Guide).[23] The IRMA Standard, however, goes beyond both of those resources, as its requirements apply to tailings facilities and other large mine waste facilities such as waste rock dumps or heap leach facilities (which are used to process/extract metals from ores, but also end up as long-term waste sites), as these also need to be managed to protect human health, safety, the environment and communities in the short- and long-term.

CROSS REFERENCES TO OTHER CHAPTERS

This table will be added when the new content for all chapters is finalized and approved.

GLOSSARY OF TERMS USED IN THIS CHAPTER

PROPOSED NEW DEFINITIONS

Accountable Executive

One or more executive (s) who is/are directly answerable to the CEO on matters related to this chapter, communicates with the Board of Directors, and who is accountable for the safety of critical facilities and for minimizing the social and environmental consequences of a potential critical facility failure. Accountable executive(s) may delegate responsibilities but not accountability.

Source: Adapted from Global Industry Standard on Tailings Management. https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf

As Low As Reasonably Practicable (ALARP)

All reasonable measures are taken with respect to 'tolerable' or acceptable risks to reduce them even further until the cost and other impacts of additional risk reduction are grossly disproportionate to the benefit.

Source: Global Industry Standard on Tailings Management. https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf

Breach Analysis

A study that assumes a failure of a critical facility and estimates its impact. Breach analyses must be based on credible failure modes. The results should determine the physical area impacted by a potential failure, flow arrival times, depth and velocities, duration of flooding, and depth of material deposition. The breach analysis is based on scenarios which are not connected to probability of occurrence. It is primarily used to inform emergency preparedness and response planning and the consequence of failure classification. The classification is then used to inform the external loading component of the design criteria.

Source: Adapted from Global Industry Standard on Tailings Management. https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf

---

[22] Global Tailings Review. 2020. Global Industry Standard on Tailings Management. https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf

[23] Mining Association of Canada. 2017. Toward Sustainable Mining (TSM) Tailings Management Protocol. http://mining.ca/towards-sustainable-mining/protocols-frameworks/tailings-management-protocol; and Mining Association of Canada. 2017. A Guide to the Management of Tailings Facilities (Third Ed). http://mining.ca/documents/guide-management-tailings-facilities-third-edition

Brine

Groundwater, surface water or sea water that contains valuable dissolved minerals at sufficient concentrations to be economically extractable.

Construction Versus Design Intent Verification

Intended to ensure the design intent is implemented and still being met if the site conditions vary from the design assumptions. The CDIV identifies any discrepancies between the field conditions and the design assumptions, such that the design can be adjusted to account for the actual field conditions.

Source: Global Industry Standard on Tailings Management. https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf

Contamination

The presence of a substance where it should not be or at concentrations above background, but not necessarily high enough to have an adverse impact on ecosystem and/or human health. See also 'Pollution'.

Source: Chapman, P. 2006. "Determining when contamination is pollution," Environ. Int. https://doi.org/10.1016/j.envint.2006.09.001

Credible Failure Mode

Refers to technically feasible failure mechanisms given the materials present in a facility's structure and its foundation, the properties of these materials, the configuration of the structure, drainage conditions and surface water control at the facility, throughout its life cycle. Credible failure modes can and do typically vary during the life cycle of a facility as the conditions vary. A facility that is appropriately designed and operated considers all of these credible failure modes and includes sufficient resilience against each. Different failure modes will result in different failure scenarios. Credible catastrophic failure modes do not exist for all facilities. The term 'credible failure mode' is not associated with a probability of this event occurring and having credible failure modes is not a reflection of facility safety.

Source: Adapted from Global Industry Standard on Tailings Management. https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf

Credible Method/Methodology

A method/methodology that is widely recognized, accepted, and used by experts and practitioners in a particular field of study.

Critical Facility

A facility that has a high, very high, or extreme failure consequence classification, or a significant consequence classification that includes potential loss of life. See also 'Non-Critical Facility'.

Cultural Heritage

Refers to (i) tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic, and religious values; (ii) unique natural features or tangible objects that embody cultural values, such as sacred groves, rocks, lakes, and waterfalls; and (iii) certain instances of intangible forms of culture that are proposed to be used for commercial purposes, such as cultural knowledge, innovations, and practices of communities embodying traditional lifestyles.

Source: Adapted from IFC Performance Standard 8.

Design Basis Report

Provides the basis for the design, operation, construction, monitoring and risk management of a critical facility.

Source: Adapted from Global Industry Standard on Tailings Management. https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf

Discharge

A permitted release of treated mine-influenced water or compliant water to surface water, groundwater, or the land. See also 'Release'.

Engineer of Record (EOR)

The qualified engineer responsible for confirming that a facility is designed, constructed, and decommissioned with appropriate concern for integrity of the facility, and that it aligns with and meets applicable regulations, statutes, guidelines, codes, and standards. The engineer of record may delegate responsibility but not accountability.

Source: Adapted from Global Industry Standard on Tailings Management. https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf

Entity

A company, corporation, partnership, individual, or other type of organization that is effectively in control of managing an exploration, mining or mineral processing project or operation.

Exploration

A process or range of activities undertaken to find commercially viable concentrations of minerals to mine and to define the available mineral reserve and resource. May occur concurrent with and on the same site as existing mining operations.

Failure Consequence Classification

A rating or ranking (e.g., low, significant, high, very high, extreme) based on losses, damages or impacts on downstream populations, the environment, the economy, cultural values, property and infrastructure if there were to be a loss of stability or integrity in a facility or its appurtenances that leads to an uncontrolled release of all or part of its contents. Failure consequence classifications are carried out for all credible failure modes.

Source: Adapted from various, including British Columbia Government. 2017. Downstream Consequence of Failure Classification Interpretation Guideline. https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/dam-safety/con_class_guidelines_for_owners-2017.pdf and Global Industry Standard on Tailings Management. https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf

Hazard

A potentially dangerous phenomenon, substance, human activity or condition. It may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Source: International Federation of Red Cross and Red Crescent Societies. https://www.ifrc.org/document/hazard-definitions

Independent Dam Safety Review (DSR)

Independent review of the safety of a critical facility covering technical, operational and governance aspects, conducted by an independent technical specialist according to established best practices. It is conducted at intervals based on the failure consequence classification and the complexity of its condition or performance. It is regulatory requirement in many jurisdictions.

Source: Adapted from Global Industry Standard on Tailings Management. https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf

Independent Review

Independent, objective, expert commentary, advice, and, potentially, recommendations to assist in identifying, understanding, and managing risks associated with critical facilities.

Source: Adapted from Global Industry Standard on Tailings Management. https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf

Independent Review Board (IRB)

A board of at least three members that provides independent technical review of the design, construction, operation, closure and management of critical facilities. The independent reviewers are third-parties who are not, and have not been directly involved with the design or operation of the particular critical facility. The expertise of the ITB members reflects the range of issues relevant to the facility and its context and the complexity of these issues.

Source: Adapted from Global Industry Standard on Tailings Management. https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf

Independent Senior Technical Reviewer

A professional who is either an in-house employee or an external party with in-depth knowledge and at least 15 years' experience in the specific area of the review requirements, e.g., tailings design, operations and closure, environmental and social aspects or any other specific topic of concern.

Source: Adapted from Global Industry Standard on Tailings Management. https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf

Mineral Processing

Activities undertaken to separate valuable and non-valuable minerals and convert the former into an intermediate or final form required by downstream users. In IRMA this includes all forms of physical, chemical, biological and other processes used in the separation and purification of the minerals.

Mining

Activities undertaken to extract minerals, metals and other geologic materials from the earth. Includes extraction of minerals in solid (e.g., rock or ore) and liquid (e.g., brine or solution) forms.

Non-Critical Facility

A facility that, if a physical stability failure of the facility were to occur, would not lead to the loss of life, and would have only low or significant impacts that could be mitigated within a short period of time (e.g., 1 – 5 years), at a reasonable cost (e.g., <10 Million $US). See also 'Critical Facility'.

Operation

The set of activities being undertaken for the purpose of extracting and/or processing mineral resources, including the running and management of facilities and infrastructure required to support the activities, and the ongoing legal, environmental, social and governance activities necessary to maintain the business endeavor.

Pollution

Contamination that results in or can result in adverse biological effects to human or ecosystem health. All pollutants are contaminants, but not all contaminants are pollutants. See also 'Contamination'.

Source: Chapman, P. 2006. "Determining when contamination is pollution," Environ. Int. https://doi.org/10.1016/j.envint.2006.09.001

Preliminary Design

A design performed to a level of detail sufficient to determine the differences between viable designs that adopt different external loading design criteria in terms of required footprints, volumes and drainage requirements.

Source: Adapted from Global Industry Standard on Tailings Management. https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf

Project

The development phases before a mining or mineral processing operation can begin (e.g., exploration, pre-feasibility, feasibility, conceptual design, planning, permitting). Includes all desk-top and field-based activities, including exploration activities, needed to inform and develop a project proposal, support the environmental and social impact assessment of a proposal, generate information necessary to fulfill regulatory and permitting requirements, engage with stakeholders and rights holders, and maintain the entity's business endeavor.

Release

An unintentional, unpermitted emission of mine-influenced water to the environment. See also 'Discharge'.

Responsible Critical Facility Engineer (RCFE)

An engineer appointed by the entity to be responsible for the critical facility. The RCFE must be available at all times during construction, operations and closure. The RCFE has clearly defined, delegated responsibility for management of the critical facility and has appropriate qualifications and experience compatible with the level of complexity of the critical facility. The RCFE is responsible for the scope of work and budget requirements for the critical facility, including risk management. The RCFE may delegate specific tasks and responsibilities for aspects of critical facility management to qualified personnel but not accountability.

Source: Adapted from Global Industry Standard on Tailings Management. https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf

Root Cause Analysis

Root cause analysis seeks to identify the primary cause of a problem that allowed a NC to occur. By identifying the root cause, a NC can be effectively addressed and recurrence can be avoided.

Source: Adapted from Aluminum Stewardship Initiative Glossary. https://aluminium-stewardship.org/wp-content/uploads/2022/05/ASI-Glossary-V1-May2022.pdf

Scoping

The process of determining potential issues and impacts and producing information necessary to inform decision-making regarding whether additional evaluation and actions are necessary.

Site

An area that is owned, leased, or otherwise controlled by the entity and where mining-related activities are proposed or are taking place.

Trigger Action Response Plan (TARP)

A tool to manage risk controls, including critical controls. TARPs provide pre-defined trigger levels for performance criteria that are based on the risk controls and critical controls of the critical facility. The trigger levels are developed based on the performance objectives and risk management plan for the critical facility. TARPs describe actions to be taken if trigger levels are exceeded (performance is outside the normal range), to prevent a loss of control. A range of actions is predefined, based on the magnitude of the exceedance of the trigger level.

Source: Adapted from Global Industry Standard on Tailings Management. https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf

Unwanted Event

A situation or condition where there may be or is a loss of control of a hazard that leads to harm.

Source: Adapted from the Government of Western Australia, Department of Mines, Industry Regulation and Safety. https://www.dmp.wa.gov.au/Safety/What-is-a-hazard-and-what-is-4721.aspx

EXISTING DEFINITIONS

Affected Community

A community that is subject to risks or impacts from a project/operation.

REVISED. Changed wording from project to project/operation.

Best Available Technology (BAT)

Site-specific combination of technologies and techniques that are economically achievable and that most effectively reduce risks (e.g., physical, geochemical, ecological, social, financial, and reputational) to an acceptable level during all stages of operation and closure, and support an environmentally and economically viable mining operation.

Source: Adapted from Mining Association of Canada. 2017. A Guide to the Management of Tailings Facilities (3rd Ed). http://mining.ca/documents/guide-management-tailings-facilities-third-edition

Best Available/Applicable Practice (BAP)

Encompasses management systems, operational procedures, techniques and methodologies that, through experience and demonstrated application, have proven to reliably manage risk and achieve performance objectives in a technically sound and economically efficient manner. BAP is an operating philosophy that embraces continual improvement and operational excellence, and which is applied consistently throughout the life of a facility, including the post-closure period.

Source: Adapted from Mining Association of Canada. 2017. A Guide to the Management of Tailings Facilities (3rd Ed). http://mining.ca/documents/guide-management-tailings-facilities-third-edition

Closure

Refers to the post-reclamation activities that are required to close and secure a site to maintain compliance with environmental and health and safety regulations. It includes interim fluid and site management in addition to post-reclamation monitoring and maintenance during the period when the success of reclamation measures to achieve site-safety, stability, revegetation, and water quality as well as other reclamation objectives is measured and maintained. The closure period is finite and typically no more than ten years in duration.

REVISED. Changed term from 'Mine Closure' to 'Closure', as the term can also apply to stand-alone mineral processing facilities, and some language changed to be less mining-specific.

Collaboration

The process of shared decision-making in which all stakeholders constructively explore their differences and develop a joint strategy for action. It is based on the premise that, through dialogue, the provision of appropriate information, collectively defined goals, and the willingness and commitment to find a solution acceptable to all parties, it is possible to overcome the initially limited perspectives of what is achievable and to reach a decision which best meets the interests of the various stakeholders. At this level, responsibility for decision-making is shared between stakeholders.

Source: Adapted from South Africa Dept. of Env. Affairs and Tourism. *Stakeholder Engagement*.

Competent Professionals

In-house staff or external consultants with relevant education, knowledge, proven experience, and necessary skills and training to carry out the required work. Competent professionals would be expected to follow scientifically robust methodologies that would withstand scrutiny by other professionals. Other equivalent terms used may include: competent person, qualified person, qualified professional.

REVISED. Deleted reference to Chapter 4.1.

Consultation

An exchange of information between an entity and its stakeholders that provides an opportunity for stakeholders to raise concerns and comment on the impacts and merits of a proposal or activity before a decision is made. In principle the entity should take into account the concerns and views expressed by stakeholders in the final decision.

Source: Adapted from South Africa Department of Environmental Affairs and Tourism. Stakeholder Engagement.

Control

An act, object (engineered), or system (combination of act and object) intended to prevent or mitigate an unwanted event.

Source: ICMM. 2015. *Health and Safety Critical Control Management: Good Practice Guide.*

Critical Control

An action, object (engineered) or system (combination of action and object) put in place to prevent or reduce the likelihood of an unwanted event, or to minimize or mitigate the negative consequences if an unwanted event occurs, in particular for high-consequence risks.

Sources: Adapted from ICMM. 2015. *Health and Safety Critical Control Management: Good Practice Guide, and Mining Association of Canada.* 2017. *A Guide to the Management of Tailings Facilities (3rd Ed)*.

Cumulative Impacts

Additive, synergistic, interactive or nonlinear outcomes of multiple development or disturbance events that aggregate over time and space. Examples of cumulative impacts (or effects) may include reduction of water flows in a watershed due to multiple withdrawals; increases in sediment loads to a watershed over time; interference with migratory routes or wildlife movement; or more traffic congestion and accidents due to increases in vehicular traffic on community roadways.

Source: Adapted from International Association for Impact Assessment. 2005. *Biodiversity Impact Assessment.* Special Publication Series No. 3, with examples from IFC. 2012. *Performance Standard 1*, page 4, footnote 16.

Ecosystem

A dynamic complex of plant, animal, and micro-organism communities and their non-living environment interacting as a functional unit.

Source: United Nations Environment Programme, Convention on Biological Diversity 1992, Art. 2. Available at https://www.cbd.int/convention/

Facility

Refers to any land, building, installation, structure, equipment, conveyance, or area that alone or together serve a particular purpose. In the IRMA Standard, the term may be associated with a specific type of facility that is self-described (e.g., tailings facility), but other examples of facilities are open pits, access roads, water dams, waste disposal sites, underground mine workings, beneficiation plants, brine ponds, slag piles, etc. See also 'Associated Facility'.

REVISED. Updated to be more descriptive.

Heap Leach/Heap Leaching

An industrial mining process to extract precious metals, copper, and other compounds from ore. Typically, mined ore is crushed and heaped on an impermeable leach pad, and chemicals (reagents) are applied that percolate through the ore and absorb specific minerals and metals. The solution is collected and target metals are recovered from the solution.

Host Country Law

May also be referred to as national law, if such a phrase is used in reference to the laws of the country in which a project or operation is located. Host country law includes all applicable requirements, including but not limited to laws, rules regulations, and permit requirements, from any governmental or regulatory entity, including but not limited to applicable requirements at the federal/national, state, provincial, county or town/municipal levels, or their equivalents in the country where the project/operation is located. The primacy of host country laws, such as federal versus provincial, is determined by the laws of the host country.

REVISED. Changed wording from mining project to project or operation.

Livelihood

The full range of means that individuals, families, and communities utilize to make a living, such as wage-based income, agriculture, fishing, foraging, other natural resource-based livelihoods, petty trade, and bartering.

Mitigation

Actions taken to reduce the likelihood of the occurrence of a certain adverse impact.

Multi-Criteria Alternatives Analysis

Generally, a process to identify and objectively and rigorously assess the potential impacts and benefits (including environmental, technical and socio-economic aspects) of different options so that an informed decision regarding a final option can be made. For IRMA purposes, it refers to a process to assess options for locating tailings or other waste facilities, and for selecting the site-specific best available technologies and practices for managing wastes throughout the life cycle. Technologies and practices may need to be reassessed during different stages of the life cycle, for example if there is a proposed expansion that requires additional waste storage and processing.

Sources: Adapted from: Environment Canada, 2016. *Guidelines for the Assessment of Alternatives for Mine Waste Disposal*, Chapter 2; and Mining Association of Canada. 2017. *Guide to the Management of Tailings Facilities.*

REVISED. Changed term from 'Alternatives Assessment' to 'Multi-Criteria Alternatives Analysis' to align with the Global Industry Standard for Tailings Management.

Post-Closure

The period after reclamation and closure activities have been completed, and long-term management activities (e.g., ongoing monitoring and maintenance, and, if necessary, water management and treatment) are occurring to ensure that a site remains stable and ecological restoration objectives continue to be achieved. This phase continues until final sign-off of site responsibility and relinquishment of post-closure financial assurance can be obtained from the regulator.

REVISED. Changed to be less focused on financial assurance and provide more description of the activities that are taking place.

Practicable

Practicable means giving equal weight to environmental, social, and economic benefits and costs. This is not a technical definition. It is the discussion between the affected parties on the balance between these interrelated costs and benefits that is important.

Process Water

Water that is used to process ore using hydrometallurgical extraction techniques. It commonly contains process chemicals.

Risk Control

An action, object (engineered), or system (combination of action and object) put in place to prevent or reduce the likelihood of an unwanted event, or to minimize or mitigate the negative consequences if an unwanted event occurs.

Stakeholders

Individuals or groups who are directly or indirectly affected by a project/operation, such as rights holders, as well as those who may have interests in a project/operation and/or the ability to influence its outcome, either positively or negatively.

REVISED. Changed wording from persons to individuals, and from project to project/operation.

Tailings

The waste stream resulting from milling and mineral concentration processes that are applied to ground ore (i.e., washing, concentration, and/or treatment). Tailings are typically sand to clay-sized materials that are considered too low in mineral values to be treated further. They are usually discharged in slurry form to a final storage area commonly referred to as a tailings storage facility (TSF) or tailings management facility (TMF).

Waste Rock

Barren or mineralized rock that has been mined but is of insufficient value to warrant treatment and, therefore, is removed ahead of the metallurgical processes and disposed of on site. The term is usually used for wastes that are larger than sand-sized material and can be up to large boulders in size; also referred to as waste rock dump or rock pile.

Water Balance

An accounting of the inflow to, outflow from, transfers and storage changes of water over a fixed period.

Source: Adapted from *Global Acid Rock Drainage Guide* Glossary.

Worker

All non-management personnel directly employed by the entity.

REVISED. Added that personnel are directly employed by the entity.

ANNEXES AND TABLES

ANNEX 4.X-A: Best Practices for the Management of Physical Stability

NOTE FON ANNEX 4.X-A: The purpose of this proposed annex is to create a resource of best practices that will help to ensure physical stability of facilities at mines and mineral processing operations. IRMA is proposing the addition of such an annex because many jurisdictions lack the regulatory requirements or guidelines and professional personnel to ensure the stability of facilities. Thus, without such guidance, it will be difficult for auditors, who cannot be experts on every type of facility associated with a mining or mineral processing, to confidently or consistently assess whether the mitigation measures being proposed and implemented by sites are consistent with best practices.

The intention is that auditors will review information from sites as per requirement 4.X.2.1.a and that entities could either demonstrate alignment with the best practices in this annex or provide auditors with a rationale as to why those practices are not appropriate for their situation or provide evidence that alternative approaches are as effective at managing physical stability (e.g., existing regulatory requirements may be sufficient, or there may be technical or other valid site- or facility-specific reasons to utilize alternatives).

In Annex 4.X-A, Sections 1 and 2 ('Stability analysis' and 'Permanent stormwater conveyances, ditches, channels and diversions') are intended to be relevant for all applicable facilities. Other sections of 4.X Annex 1 are facility specific.

The practices contained in the sections below were derived from preliminary research, but as you will see much more research needs to occur to identify current best practices for all facilities. We recognize that some guidance is old, and there may be other jurisdictions with more recent guidance that may be better than what we have proposed, and encourage interested stakeholders with technical expertise to participate in this review and provide input into the development of this annex.

CONSULTATION QUESTION 4.X-3 (repeated from above): Do you agree with the proposal to create guidance to better inform auditors' assessments? If not, how do you suggest auditors determine whether or not the measures at a site are sufficient to prevent or mitigate physical instability?

If you agree with the approach, please indicate if you agree with the proposed best practices and technologies, and/or suggest alternative practices and technologies, including for facilities not identified in the draft Annex.

Would you be interested in being part of a working group to help work on this guidance? If so, please contact IRMA (comments@responsiblemining.net) and we will be in touch as we move forward with this process.

Contents

1. Stability Analysis

2. Permanent stormwater conveyances, ditches, channels and diversions

3. Access roads and other project site and/or ancillary features

4. Surface mines including pit highwalls and other associated features

5. Underground mine subsidence

6. Subsidence from underground fluid extraction

7. Facilities storing/stockpiling wastes from underground and surface mines

8. Waste storage facilities associated with mineral processing, chemical processing and waste remediation

9. Water reservoirs

1. Stability analysis

Stability analysis is conducted for all relevant facilities and includes evaluation for static and seismic induced liquefaction.

- Facilities are designed for an operational factor of safety of 1.1 or greater and long-term static factor of safety of 1.3 or greater. Facilities are also designed for a factor of safety of 1.1 or greater under pseudostatic analysis.[24]
- A minimum static factor of safety of 1.3 for impoundments embankments will be maintained.[25]

2. Permanent stormwater conveyances, ditches, channels and diversions

To prevent stability failures:

- Design to convey the peak flow generated by the 200-year return interval storm event.[26]
- The appropriate design storm duration is selected based on the maximum peak flow generated using generally accepted flood routing methods. This methodology requires access to accurate and site-analogous storm event hydrographs which are not available in some regions. However, given the increasing intensity of

[24] A Global Standard for stability analysis of mine facilities such as waste rock piles, heap leach facilities and other similar facilities has not been identified. However, regionally various requirements for minimum design factor of safety have been proposed for these types of mine facilities since at least 1991 [1] and continue to be a part of many regulatory frameworks [2].

[1] See: Mined Rock and Overburden Piles, Investigation and Design Manual, Interim Guidelines, British Columbia Mine Waste Rock Pile Research Committee, May 1991 Table 6.4, p. 100. http://mssi.nrs.gov.bc.ca/Geotechnical/minedrockoverburdenpile_investigationdesignmanual.pdf

[2] See Stability Requirements for Heap Leach Pads, Bureau of Mining Regulation and Reclamation, Nevada Division of Environmental Protection, 2021, https://ndep.nv.gov/uploads/land-mining-regs-guidance-docs/20210308_StabilityReq_HLPs_ADA.pdf

[25] This practice is intended to apply specifically to process water and chemical solution ponds and similar facilities with constructed embankments that are not determined to be critical facilities.

[26] The general standard or approach has been to apply a 100-year return interval storm event to mine stormwater conveyance designs. In response to climate change mines in British Columbia, Canada and other jurisdictions have been required to apply a 200-year event (see Legislated Flood Assessments in a Changing Climate in BC, Engineers & Scientists British Columbia, version 2.1, August 28, 2018. https://www.egbc.ca/getmedia/f5c2d7e9-26ad-4cb3-b528-940b3aaa9069/Legislated-Flood-Assessments-in-BC.pdf.aspx)

storm events due to anthropogenic climate change and the need to size flood routing for peak flow this is considered an important best practice.[27]

3. Access roads and other project site and/or ancillary features

Identify all reasonable potential physical/geotechnical stability failure modes including but not limited to surficial and deep slope and foundation failures due to undercutting and over-filling and failures due to storm events.

- Use bests practice to prevent or mitigate all reasonable potential physical stability failure modes. For mine roads best practice could include regulatory specifications for design and construction of mine roads. Examples could be drawn from:
  - Mines Safety and Health, Department of Natural Resources, Mines and Energy, State of Queensland. 2019. Recognized Standard 19, Design and Construction of Mine Roads. https://www.resources.qld.gov.au/__data/assets/pdf_file/0008/1453175/recognised-standard-19-mine-roads.pdf
  - Tannant, D., Regensburg, B., Guidelines for Mine Haul Road Design, 2001. https://open.library.ubc.ca/media/download/pdf/52383/1.0102562/1
  - United States Department of Agriculture, Forest Service. August 1996. Forest Service Specifications for Construction of Roads & Bridges. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5360208.pdf

4. Surface mines including pit highwalls and other associated features

Identify and address all reasonable potential physical/geotechnical stability failure modes including but not limited to: highwall and/or slope failures; long-term stability over the entire facility life-cycle including post-closure.

- Mining methods maintain wall, bank, and slope stability in places where work or travel in performing their assigned tasks. When benching is necessary, the width and height is based on the type of equipment used for cleaning of benches or for scaling of walls, banks, and slopes.[28]
- The following measures are taken in relation to ground control— (a) adequate consideration is given to local geological structure and its influence on wall stability; and (b) adequate consideration is given to shear strength; (c) a proper analysis is carried out of rain water inflow, surface drainage pattern, groundwater regime and mine de-watering procedures and their influence on wall stability over time; (d) where necessary, appropriate designs of rock reinforcement are applied and used, and the quality of installation is verified; (e) analysis is carried out of open pit wall stability for the projected geometry of the pit; (f) appropriate drilling and blasting procedures are used to develop final walls; and (g) appropriate methods of open pit wall monitoring are used over a period of time to determine wall stability conditions. [29]

[27] See Chapter 4, Storm Rainfall Depth and Distribution, Part 630 Hydrology National Engineering Handbook, US Department of Agriculture, Title 210 – National Engineering Handbook 210-630-H, Amend. 88, Aug 2019. https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=43924.wba

[28] See Title 30, Chapter I, Subchapter K, Part 56, Subpart B, Mining Methods, US Code of Federal Regulations. https:/ecfr.gov/current/title-30/section-56.3130

[29] Mines Safety and Inspection Regulations, Western Australia, Version 06-dO-03 January 2017. https://faolex.fao.org/docs/pdf/wa130385.pdf

5. Underground mine subsidence

Identify and address all reasonable potential for underground mine subsidence and related physical/geotechnical stability failures affecting hydrology, surface features and infrastructure over the entire facility life-cycle including post-closure.[30]

- Apply best practice consistent with regional regulations, guidelines or equivalent. There is limited information pertaining to best practice to address subsidence from other than coal mining, however, the same concerns and best practices are applicable to all underground mines on a site-specific basis. Examples may be drawn from:
  - Subsidence Advisory NSW, NSW Government Australia. https://www.nsw.gov.au/subsidence-advisory
  - Lee, F.T., Abel, J. 1983. Subsidence from Underground Mining Environmental Analysis and Planning Considerations, U.S. Geological Survey Circular 876. https://pubs.usgs.gov/circ/1983/0876/report.pdf

6. Subsidence from underground fluid extraction

Identify and address all reasonable potential for brine or other types of groundwater depletion including project dewatering and off-site groundwater sources to cause ground subsidence and related physical/geotechnical stability failures affecting hydrology, surface features and infrastructure over the entire facility life-cycle including post-closure.[31]

- Subsidence Control Underground and in situ solution mining activities are planned and conducted, to the extent technologically and economically feasible, to prevent subsidence which may cause material damage to structures or property not owned by the entity.[32]
  - Underground and in situ solution mining activities near any aquifer that serves as a significant source of water supply to a public water system shall be conducted so as to avoid disruption of the aquifer and consequent exchange of ground water between the aquifer and other strata.
  - Underground and in situ solution mining activities conducted beneath or adjacent to any perennial stream must be performed in a manner so that subsidence is not likely to cause material damage to streams, water bodies and associated structures.

7. Facilities storing/stockpiling wastes from underground and surface mines

Identify all reasonable potential physical/geotechnical stability failure modes for wastes from mines including any waste rock, overburden, rejects material, soil and other stockpiles subject to physical instability over the entire facility life-cycle including post-closure.

- The design, layout, construction and maintenance of any dump or stockpile take into account the following factors to minimize any potential for instability of the dump or stockpile — (a) the nature of the material dumped; (b) the size and weight of the equipment used; (c) the site conditions, including stability of the area on which the dump is built; (d) the drainage conditions; and (e) the weather conditions.[33]

[30] See 30 CFR § 817.121 - Subsidence control. https://www.law.cornell.edu/cfr/text/30/817.121

[31] See Oil, Gas and Salt Resources of Ontario, Provincial Operating Standards, Part 9. Solution Mining. https://www.ontario.ca/document/oil-gas-and-salt-resources-ontario-provincial-operating-standards/solution-mining

Michigan Administrative Code, Department - Environmental Quality Oil, Gas & Minerals Division, Mineral Wells, Part 7 – Operation of Brine Production and Solution Mining Wells, Section R. 299.2407 - Subsidence monitoring above a cavity created by solution mining. https://regulations.justia.com/states/michigan/environmental-quality/oil-gas-amp-minerals-division/mineral-wells/part-7/section-r-299-2407/

[32] New Mexico Administrative Code, Title 19 Natural Resources and Wildlife, Chapter 10 Non-Coal Mining, Part 6 New Mining Operations, 603 Performance and Reclamation Standards and Requirements. https://www.srca.nm.gov/parts/title19/19.010.0006.html

[33] Mines Safety and Inspection Regulations 1995, Western Australia, Version 06-dO-03 January 2017. https://faolex.fao.org/docs/pdf/wa130385.pdf

8. Waste storage facilities associated with mineral processing, chemical processing and waste remediation

Identify all reasonable potential physical/geotechnical stability failure modes for waste storage facilities including tailings storage facilities; sludge and residue storage facilities; hazardous and remediated waste storage facilities; above ground level process water and brine ponds, and any other waste storage facilities associated with mineral processing or waste remediation subject to physical instability over the entire facility life-cycle including post-closure.
• TBD

9. Water reservoirs

Identify and address all reasonable potential for water reservoirs operated by or specifically constructed for the purpose of the mining and/or mineral processing operations subject to physical instability over the entire facility life-cycle including post-closure.
• TBD

Table 4.X-1. Failure Consequence Classification Matrix

Facility Failure Consequence Classification	Incremental Losses				
	Potential Population at Risk	Potential Loss of Life	Environment	Health, Social and Cultural	Infrastructure and Economics
Low	None	None expected	Minimal short-term loss or deterioration of habitat or rare and threatened or endangered species.	Minimal effects and disruption of business and livelihoods. No measurable effect on human health. No disruption of heritage, recreation, community or cultural assets.	Low economic losses (<US$1M). Area contains limited infrastructure or services.
Significant	1 – 10	Unspecified	No significant loss or deterioration of habitat. Potential contamination of livestock/fauna water supply with no health effects. Process water low potential toxicity. Tailings not potentially acid generating and have low neutral leaching potential. Restoration possible within 1 to 5 years.	Significant disruption of business, service or social dislocation. Low likelihood of loss of regional heritage, recreation, community, or cultural assets. Low likelihood of health effects.	Losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes <US$10M.
High	10 – 100	Possible (1 – 10)	Significant loss or deterioration of critical habitat or rare and threatened or endangered species. Potential contamination of livestock/ fauna water supply with no health effects. Process water moderately toxic. Low potential for acid rock drainage or metal leaching effects of released tailings. Potential area of impact 10 km2 – 20 km2. Restoration possible but difficult and could take > 5 years	500-1,000 people affected by disruption of business, services or social dislocation. Disruption of regional heritage, recreation, community or cultural assets. Potential for short term human health effects.	High economic losses (<US$100M) affecting infrastructure, public transportation, and commercial facilities, or employment. Moderate relocation/compensation to communities.
Very High	100 – 1000	Likely (10 – 100)	Major loss or deterioration of critical habitat or rare and threatened or endangered species. Process water highly toxic. High potential for acid rock drainage or metal leaching effects from released tailings. Potential area of impact > 20 km2. Restoration or compensation possible but very difficult and requires a long time (5 years to 20 years).	1,000 people affected by disruption of business, services or social dislocation for more than one year. Significant loss of national heritage, community or cultural assets. Potential for significant long-term human health effects.	Very high economic losses (< US$1B) affecting important infrastructure or services (e.g., highway, industrial facility, storage facilities, for dangerous substances), or employment. High relocation/compensation to communities.
Extreme	> 1000	Many (>100)	Catastrophic loss of critical habitat or rare and threatened or endangered species. Process water highly toxic. Very high potential for acid rock drainage or metal leaching effects from released tailings. Potential area of impact > 20 km2. Restoration or compensation in kind impossible or requires a very long time (> 20 yrs).	5,000 people affected for years by disruption of business, services or social dislocation. Significant national heritage or cultural assets destroyed. Potential for severe and/or long- term human health effects.	Extreme economic losses (>US$1B) affecting critical infrastructure or services, (e.g., hospital, major industrial complex) or employment. Very high relocation/compensation to communities and very high social readjustment costs.

Source: Adapted from GISTM, 2020[34]

[34] Global Tailings Review. 2020. Global Industry Standard on Tailings Management. Table 1: Consequence Classification Matrix. (Available at: https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_EN.pdf)

Table 4.X-2. Target Levels for Flood Hazards, Standards-Based Assessments, for Construction, Operation, and Transition Phases

Dam Classification	Annual Exceedance Probability – Floods [1]
Low	1/100
Significant	Between 1/100 and 1/1,000 [2]
High	1/3 Between 1/1,000 and PMF [3]
Very High	2/3 Between 1/1,000 and PMF [3]
Extreme	PMF [3]

Acronyms: PMF, Probable Maximum Flood; AEP, annual exceedance probability

Notes: Values in the table align with those in the Canadian Dam Association (CDA). 2013. Dam Safety Guidelines. (Available for purchase at: https://cda.ca/publications/cda-guidance-documents/dam-safety-publications). Some values overlap with those in the Global Industry Standard on Tailings Management. Table 2: Flood Design Criteria.

[1] Simple extrapolation of flood statistics beyond 10^{-3} AEP is not acceptable.

[2] Selected on basis of incremental flood analysis, exposure, and consequences of failure.

[3] PMF has no associated AEP.

Table 4.X-3. Target Levels for Earthquake Hazards, Standards-Based Assessments, for Construction, Operation, and Transition Phases.

Dam Classification	Annual Exceedance Probability – Earthquakes [1]
Low	1/100 AEP
Significant	Between 1/100 and 1/1,000
High	1/2,475 [2]
Very High	1/2 Between 1/2,475 [2] and 1/10,000 or MCE [3]
Extreme	1/10,000 or MCE [3]

Acronyms: MCE, Maximum Credible Earthquake; AEP, annual exceedance probability

Notes: Values in the table align with those in the Canadian Dam Association (CDA). 2013. Dam Safety Guidelines. (Available for purchase at: https://cda.ca/publications/cda-guidance-documents/dam-safety-publications). Some values overlap with those in the Global Industry Standard on Tailings Management. Table 3: Seismic Design Criteria.

[1] Mean values of the estimated range in AEP levels for earthquakes should be used. The earthquake(s) with the AEP as defined above are then input as the contributory earthquake(s) to develop the Earthquake Design Ground Motion (EDGM) parameters as described in Section 6.5 of the *Dam Safety Guidelines* (CDA 2013).

[2] This level has been selected for consistency with seismic design levels given in the National Building Code of Canada.

[3] MCE has no associated AEP.

Table 4.X-4. Target Factors of Safety for Slope Stability in Construction, Operation, and Transition Phases - Static Assessment.

Loading Condition	Minimum Factor of Safety	Slope
During or at end of construction	> 1.3 depending on risk assessment during construction	Downstream (typically)
Long term (steady state seepage, normal reservoir level)	1.5	Downstream
Full or partial rapid drawdown	1.2 to 1.3	Upstream slope where applicable

Notes: Values in the table align with those in the Canadian Dam Association (CDA). 2013. Dam Safety Guidelines. (Available for purchase at: https://cda.ca/publications/cda-guidance-documents/dam-safety-publications).

Table 4.X-5. Target Factors of Safety for Slope Stability in Construction, Operation, and Transition Phases - Seismic Assessment.

Loading Condition	Minimum Factor of Safety
Pseudo-static	1.0
Post-earthquake	1.2

Notes: Values in the table align with those in the Canadian Dam Association (CDA). 2013. Dam Safety Guidelines. (Available for purchase at: https://cda.ca/publications/cda-guidance-documents/dam-safety-publications).