STANDARD GUIDANCE

(COP 37) Tailings and Waste Rock

A. Definitions and applicability

Mining wastes are those wastes generated during the extraction, beneficiation, and processing of ore. **Waste rock** and overburden are the materials that are removed to access the ore. **Tailings** consist of ground rock and effluents that are generated during processing of the ore.

Source:

- *What are Tailings?*
  www.tailings.info/tailings.htm

The **Tailings and Waste Rock** section of the COP is applicable to all tailings and waste rock generated by Members in the Mining Sector. The **Tailings and Waste Rock** provisions should be implemented in conjunction with the COP provisions on **Hazardous Substances** and **Impact Assessment**.

B. Issue background

Tailings and waste rock facilities are an integral part of many mining operations and one of the mining industry's key challenges to achieving improvements in environmental performance. Diamond, gold and platinum group metal mining operations involve a range of different types of mining processes in very different environments, requiring site-specific approaches to management of these large volume mine wastes.

Tailings are created where mined ores are processed into a concentrate or a final product by physical operations such as screening, crushing, grinding, and concentrating or by methods involving chemicals, heat and pressure such as leaching. The basic requirement of tailings management is to provide safe, stable and economical storage of tailings so as to protect human health and the environment.

Waste rock is also a mine residue that typically consists of overburden and material displaced to access the ore body. Waste rock may even contain very low grades of ore but at levels which cannot be processed profitably. Waste rock management basically involves its removal and storage, which may be temporary or long-term.

Some mine tailings and waste rock do not pose exposure risks and so do not require special treatment, reuse restrictions or geochemical monitoring. Such wastes can be used for landform reconstruction, road and dam construction, and may be suitable substrates for vegetation covers and similar rehabilitation measures upon mine closure. However some types of mine tailings and waste rock contain, or may result in the generation of, hazardous substances and require monitoring, treatment and secure disposal.

There are three main types of impacts that can result from managing tailings and waste rock:

- Site choice can significantly alter the environmental and social impacts. Creation of the initial footprint has unavoidable impacts, and thus site selection is the design factor with the most profound influence on operational impacts, rehabilitation costs and post-closure liability.
- Tailings and waste rock may contain entrained liquors, acid-generating compounds and/or mobile metal contaminants, and these can seep into groundwater or emerge in surface streams, with ecological impacts.
- Geotechnical failure, which happens rarely, can have catastrophic impacts. Good design and construction, along with management and monitoring systems, will minimize the likelihood of accidents occurring.

Tailings and waste rock may be managed in a variety of ways, depending on their physical and chemical nature, the site topography, climatic conditions, national regulation and the socio-economic context in which the mine operations and processing plant are located.

Tailings storage and disposal methods used by the mining industry include the following:

- **Terrestrial storage** is the most common method used. The main types are:
    - Impoundment storage: Tailings are discharged into an impounding structure as a slurry and the excess water is removed via decant ponds, toe drains and under-drains. Impounding structures can include engineered earthen dams, natural topographical depressions or valleys, or mine pits.
    - Dry stacking: Tailings are dewatered using vacuum or pressure filters so the tailings can then be stacked into a dense and stable structure.
    - Storage in abandoned mines: This approach involves thickening the tailings, sometimes with the addition of waste aggregate and cement, to create a paste-like product that can be used to backfill underground voids or open pits.
    - Creation of tailings dams: The same paste-like product used to backfill underground mines or open pits, may be used to construct new, or extend the life of, tailings dams.
    - Permanent heap leach pads and heap leach spoils: A constructed stockpile of agglomerated ore is prepared for the purpose of leaching by means of percolating a solvent though the ore. The stockpile is placed on a lined solution collection and containment pad.
- **Sub-aqueous storage:** In countries where precipitation exceeds evaporation, such as Canada and Norway, water-retaining dams and diversion structures can be created around existing water bodies to allow tailings to be placed below the water surface. This method can be used to prevent oxidation of sulphidic tailings and related acid drainage.
- **Submarine tailings disposal** is sometimes used in very site-specific conditions, for example where land based disposal would cover lands with very high biodiversity, economic or cultural value, for materials with high acid rock drainage risk, and/or in areas where rugged topography, high rainfall and high seismic risk would make conventional tailings dam failure a significant risk. **Deep submarine tailings disposal** typically involves treating tailings to achieve a specified discharge standard, de-aerating and mixing with seawater (to reduce buoyancy) and then pumping tailings through a submerged pipe prior to discharge onto the sea floor, below the surface thermocline and euphotic zone, so the tailings form a 'density current' that descends to the depths of the ocean. However, **shallow submarine tailings disposal** is not considered good practice for chemically reactive tailings which could pose exposure risks to human health or the shallow marine environment.
- **Dredged separation spoils disposal** is used for sea-based diamond mining. It involves discharging inert dredge spoils, composed of seawater and sorted dredge material from a ship directly overboard.
- **Riverine tailings disposal**: This involves using active rivers to disperse tailings. The practice is not common and is not considered good practice. It is currently used at only three sites in Papua New Guinea and Indonesia where high rainfall, mountainous terrain and seismic activity ruled out other storage or disposal options.

Tailings disposal is at the forefront of the debate concerning the trade-off between the benefits that mining activity can bring to society and the cost of impacts associated with those activities. Decisions on tailings management are most commonly reached through an Environmental and Social Impact Assessment carried out prior to development approval. An ESIA usually covers methods and key issues, the regulatory framework, the consultation process, the social and environmental baseline, consideration of alternatives, prediction and evaluation of significant social and environmental impacts, mitigation or offset measures, and environmental and social management and monitoring plans.

Waste rock is often managed by dumping it onto formed heaps or on hillsides. Depending on its physical characteristics, waste rock can be used for land forming including road base aggregate, footings or for landscape restoration.

A long-term approach to the planning of tailings and waste rock storage is essential and should take the following into account:

- Compliance with regulations.
- A cost-benefit analysis that accounts for environmental performance.
- A good understanding of the site location.
- The profound negative social, environmental and economic consequences of failure or poor performance of tailings and waste rock storage facilities.

- Cumulative and long term effects including bio-accumulation of metals in plants and animals, contamination of soil and groundwater, and human health impacts.
- The main causes of reported tailings and waste rock failure incidents are due to severe weather events, seismic activity, and/or a general lack of understanding of the features that control safe operations.
- Where the design and management of tailings and waste rock storage facilities involves circumstances of scientific uncertainty and threat of serious and irreversible damage, the precautionary principle should apply.
- Early and ongoing consultation, information sharing and dialogue with stakeholders are essential.

C. Key regulations and initiatives

International

The International Commission on Large Dams (ICOLD) is an international non-governmental organization which provides a forum for the exchange of knowledge and experience in dam engineering. ICOLD leads the profession in ensuring that dams are built safely, efficiently, economically, and without detrimental effects on the environment. Extensive guidance is provided to designers, owners and operators of large dams, including tailings dams.

The International Council on Mining and Metals (ICMM), in partnership with UNEP and UNCTAD, host a website of 'Good Practice Mining' resources. There is a specific section on tailings management.

National

Each jurisdiction has its own legislative and/or regulatory framework on tailings storage and management of other mine wastes that governs the design of storage facilities, licensing, monitoring, reporting and closure. It is essential for Members to comply with Applicable Law.

The Mining Association of Canada's (MAC) "Towards Sustainable Mining" initiative includes performance indicators for tailings management. A self assessment and verification protocol has been developed to evaluate conformance of management practices with the tailings management framework in the MAC "Guide to the Management of Tailings Facilities". While developed for the Canadian context, these resources can assist mines to plan for effective tailings management.

The Mine Environment Neutral Drainage (MEND) Program in Canada was implemented to develop and apply new technologies to prevent and control acid rock drainage. Canada has lead a focused research program to address acid rock drainage and metal leaching directed by a committee of industry, government and NGO representatives.

MEND is part of a global alliance for acid rock drainage research that also includes the International Network for Acid Prevention (INAP), the US Acid Drainage Technology Initiative, the South African Water Research Commission and the Partnership for Acid Drainage Remediation in Europe.

D. Suggested implementation approach

Members with Mining Facilities should ensure that a comprehensive plan or system is in place for tailings and waste rock management. A guiding principle should be continual improvement in operational, safety and environmental performance, supported by periodic review and evaluation, and early and ongoing consultation, information sharing and dialogue on tailings and waste rock management with stakeholders.

Documented processes should be established for:

- Materials handling, containment and control processes for tailings and waste rock;

- Location, design, construction, operation, maintenance and closure of tailings and waste rock storage facilities such that structures are stable, water quality is protected and the contents are managed and in compliance with regulatory requirements;
- Identification, assessment monitoring, management and/or remediation of contaminated sites.

In addition, records need to be maintained that identify:

- roles and responsibilities of personnel;
- the minimum knowledge and competency requirements for each position with defined responsibilities;
- characteristics and properties of the tailing and waste rock;
- records of inspections and geotechnical assessments regarding integrity and stability of tailings and waste rock storage facilities.
- the key components and location of the tailings and mine waste storage;
- procedures and processes for managing change;
- requirements for analysis and documentation of the performance of the tailings and mine waste storage;
- reporting requirements (statutory and stakeholder).

Appropriate training must be provided to all personnel working at the tailings facilities and waste rock facilities, including contractors and suppliers. All relevant personnel should have an understanding of the tailings and mine waste management plan, their respective roles and responsibilities – particularly in the role of visual indications of storage performance. Consult with affected communities and stakeholders in the identification, assessment and management of any significant economic, public health and safety, social, and environmental risks associated with the tailings and waste rock facilities. Consultation should extend to emergency resources and agencies for foreseeable emergency scenarios involving facilities for the management of tailings and waste rock facilities (also see guidance for **Emergency Response**).

- ***COP 37.1: Tailings and waste rock characterisations***: *Members in the Mining Sector shall carry out physical and geochemical characterisations of mine tailings and waste rock.*
  Points to consider:
  - When designing facilities for tailings and waste rock, the shear strength is often the most important characteristic to determine. This may involve conducting stability and strength tests. Other important stability-related characteristics should, at a minimum, consider:
    - Particle size and distribution.
    - Moisture content.
    - Density, consolidation and porosity.
    - Plasticity and permeability.
  - Records pertaining to these characterisations should be kept up to date for all tailings and waste rock sites at the Mining Facility, and should be carried out by competent personnel. This may involve the use of expertise external to the Mining Facility.

- ***COP 37.2: Tailings and waste rock facilities:*** *Members in the Mining Sector shall design, construct, maintain, monitor and close all tailings and waste rock facilities and supporting infrastructure to:*
  a. Ensure structural stability and, where applicable, controlled discharge;
  b. Protect the surrounding environment and local communities from potential impacts of acidification, metal leaching, loss of containment or contamination, including contamination of groundwater.
  Points to consider:
  - Design of dams and storage facilities needs to take into account foreseeable extreme flood events, based on statistics such as the probable maximum flood or a 'one in a thousand year' event. See the Finnish "Dam Safety Code of Practice", for example, for information pertaining to flood events.
  - Periodic inspections and assessments should be conducted to confirm structural stability of facilities and supporting structures for tailings and waste rock storage and management. At a minimum, inspections and assessments should consider:
    - Daily or weekly visual inspections for instability evidence including erosion, corrosion, cracks or loss of containment.

    - Geotechnical assessments which accounts for local geology, meteorological conditions as well as the current and planned mining activities.
    - Groundwater monitoring hydraulically located upstream and downstream of the tailings and waste rock facilities that detect potential for seepage and contamination.
  - A risk assessment should be completed and periodically updated to help identify, prioritise and improve engineering design and/or management controls. The assessment should identify the potential site-specific impact pathways and risks associated with the location, construction, operation and closure of any tailings or waste rock storage facility or other tailing management technologies. The results of the assessment should be used to scope an alternatives analysis, and identify any impacts that may require mitigation through design of the facility/ies.
  - The risk assessment should, at a minimum, consider:
    - Location and proximity of tailings and/or waste rock storage facilities to sensitive environments, including groundwater, and affected communities.
    - Volume of tailings to be managed, retained and stored, and the capacity of storage facilities for tailings and/or waste rock over the life of the mine.
    - Impact on storage facilities during major natural events such as earthquakes or severe rainfall events.
    - Effectiveness of containment integrity management controls, such as tailings wall inspections for leaks, cracks and subsidence.
    - Effectiveness of waste rock stockpiling methods to minimise effects of erosion including dust entrainment, sediment run-off and loss of topsoil.
    - Mitigation controls that minimise impacts to the wellbeing of personnel, the community and the surrounding environment resulting from a failure of a tailings or waste rock facility. This should be carried out in accordance with **Emergency Response**.

- ***COP 37.3: Riverine disposal:*** *Members in the Mining Sector shall not use riverine disposal of tailings or waste rock at new Mining Facilities. Any Mining Facilities that currently use riverine tailings disposal shall be excluded from the Member's Certification Scope, but all other relevant COP provisions still apply to that Facility.*
  Points to consider:
  - For the avoidance of doubt, this does not apply to the disposal of waste rock and tailings materials in conventional waste rock dumps or tailings dams, which may be constructed within the catchments of a river system, where such structures are designed to retain and bind the waste materials in a manner that prevents contamination of the river system.
  - Any Mining Facilities that currently use riverine tailings disposal should be documented as such and these shall be excluded from the Certification. However, it is expected that the Mining Facilities with riverine tailings disposal maintain practices will meet the requirements of all other relevant COP provisions. These other relevant provisions can be audited as part of the Verification Assessment.

- ***COP 37.4: Marine disposal: Members in the Mining Sector shall not use marine tailings and waste rock disposal for land-based Mining Facilities, unless:***
  a) *a thorough inventory has been conducted of existing marine resources that would be impacted by the marine waste disposal, and*
  b) *a thorough environmental and social analysis of alternatives was conducted which showed that marine tailings disposal creates fewer environmental and social impacts and risks than a land-based tailings facility, and*
  c) *it can be scientifically demonstrated that a significant adverse effect on coastal or marine resources or ecosystems does not result, and*
  d) *submarine tailings disposal is released in seawater below the surface thermocline and euphotic zone.*

  Points to consider:
  - The general requirements for tailings and waste rock disposal under 37.2 still apply.

- The decision for marine disposal of tailings and waste rock may be driven by a lack of space on land and where the impacts to the marine environs can be shown to be less detrimental than tailings disposal on land. This may be demonstrated through a thorough risk assessment which involves:
    - Characteristics of the tailings and waste rock that is subject to marine disposal.
    - Identification of marine resources including marine life and habitat, fishing resources, corals, sea beds and coastal features that may be impacted.
    - An analysis conducted by competent personnel which accounts for seasonal effects, socio-economic factors and cumulative impacts associated with the marine disposal;
    - A benchmark assessment comparing the risks and impacts of marine disposal against land based disposal.
    - Establishment of controls to prevent and mitigate any short and long term impacts associated with the marine disposal
- Mining Facilities with marine disposal need to demonstrate that the disposal occurs below the surface thermocline and euphotic zone. The surface thermocline is the layer in a large body of water, such as a lake, that sharply separates regions differing in temperature, so that the temperature gradient across the layer is abrupt. The euphotic zone is where there is sufficient penetration of sunlight that supports a net positive photosynthesis rate and biological production is regulated by nutrient input. Below this euphotic zone is the aphotic zone where there the sunlight levels are such that there is a net negative photosynthesis rate and biological production is limited by a lack of sunlight.

Check:

- ✓ Do you have a comprehensive plan or system in place for tailings and waste rock management; is it understood by all relevant personnel, and is it part of your ongoing consultation and information sharing with stakeholders?
- ✓ Do you have up to date records on physical and geochemical characterisations tailings and waste rock at your mining facilities?
- ✓ Can you provide the auditor with evidence to demonstrate that all tailings and waste rock facilities and supporting infrastructure are structurally stable, and protect the surrounding environment and local communities? Have you conducted a risk assessment?
- ✓ If your land-based mining facilities use marine tailings and waste rock disposal, can you demonstrate that it will result in fewer negative impacts and risks, and will not result in significant adverse effects on coastal or marine resources or ecosystems?

E. Further information

The following websites have further information on tailings and mine waste management:

- Acid Drainage Technology Initiative (ADTI) Metal Mining Initiative
  ese.mines.edu/adti/
- Dam Safety Code of Practice, Finnish Ministry of Agriculture and Forestry (1988)
  www.vyh.fi/eng/orginfo/publica/electro/damsafet/damsafe.htm
- Global Acid Rock Drainage (GARD) Guide (2012)
  www.gardguide.com/index.php/Main_Page
- International Commission on Large Dams
  www.icold-cigb.net/
- International Council on Mining and Metals (ICMM) - Good Practice Guidance for Mining and Biodiversity (2006)
  www.icmm.com/page/1182/good-practice-guidance-for-mining-and-biodiversity
- International Finance Corporation (IFC) Environmental Health and Safety Guidelines – Mining (2007)
  www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_Mining/$FILE/Final+-+Mining.pdf
- International Network for Acid Prevention (INAP)
  www.inap.com.au/

- Leading Practice Sustainable Development Program for the Mining Industry (Australia) - Tailings Management (2007)
  www.ret.gov.au/resources/Documents/LPSDP/LPSDP-TailingsHandbook.pdf
- Management of Tailings and Waste Rock In Mining (2009)
  www.eippcb.jrc.es/reference/mmr.html
- Mining Association of Canada (MAC) - A Guide to the Management of Tailings facilities (1998)
  www.mining.ca/www/media_lib/TSM_Documents/TSM_Publications/tailingsguide.pdf
- Mining Association of Canada (MAC) - Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities
  www.mining.ca/www/media_lib/MAC_Documents/omsguideeng.pdf
- Mining Association of Canada (MAC) – Tailings Assessment Protocol (2007)
  www.mining.ca/www/media_lib/TSM_Documents/2007_Protocols/TAILINGS_PROTOCOL_2007.pdf
- Minerals Council of Australia – Enduring Value Guidance document (2005)
  www.minerals.org.au/file_upload/files/resources/enduring_value/EV_GuidanceForImplementation_July2005.pdf
- Mine Environment Neutral Drainage (MEND) Program – Canada
  www.mend-nedem.org/Default-e.aspx
- Nevada Division of Environment Protection – Statutes and Regulations
  ndep.nv.gov/ADMIN/NRS.HTM
- Partnership for Acid Drainage Remediation in Europe (PADRE)
  www.padre.imwa.info
- South African Water Research Commission (WRC of South Africa)
  www.wrc.org.za