

Practical Methods for Reducing Tailings Storage Risk

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Barr Engineering Co.

Minneapolis, MN

outline

- affected stakeholders
- industry trends
- methods for reducing risk

affected stakeholders

- operators



Business Markets World Politics TV More

ENVIRONMENT JANUARY 28, 2019 / 7:47 AM / A YEAR AGO

Vale stock plunges after Brazil disaster; \$19 billion in market value lost

Paula Laier

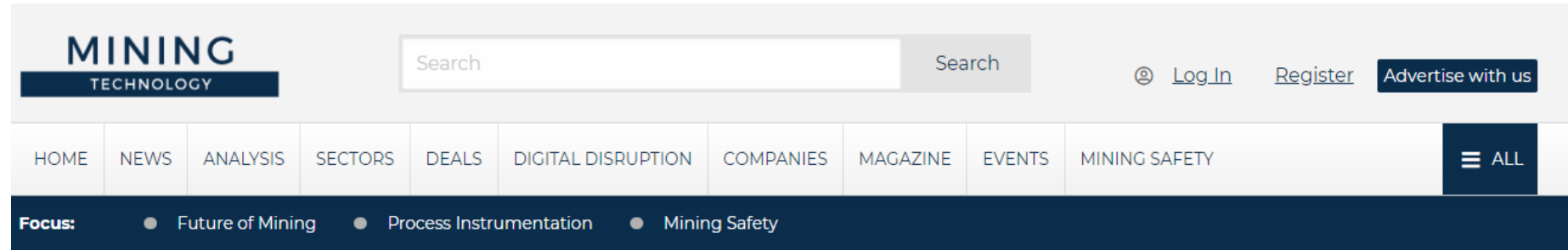
4 MIN READ



SAO PAULO (Reuters) - Brazilian miner Vale SA's shares plunged on Monday, wiping out 71.34 billion reais (\$18.96 billion) in market value, after a tailing dam collapse on Friday killed scores of people at one of its mines, less than four years after a similar disaster.

affected stakeholders

- operators



3 APRIL 2019 ANALYSIS

Licence to operate: understanding the biggest challenge for mining in 2019

By Heidi Vella SHARE

A recent survey by EY Mining & Metals found that more than half of global mining companies believe that licence to operate, or acceptance and permission from communities and society, is the biggest risk to their business – jumping seven places up the list from last year. Heidi Vella finds out why this issue is a rising concern and how firms can adapt.

affected stakeholders

- operators
- investors

NS ENERGY

MINING	COMPANIES	DISRUPTORS	EVENTS	WEBINARS
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Analysis

Investor concerns over safety of tailings dams at global mining operations

By Andrew Fawthrop 31 Oct 2019

MINING SAFETY

affected stakeholders

- operators
- investors
- consultants



Three engineers to face disciplinary hearings in Mount Polley disaster

affected stakeholders

- operators
- investors
- consultants
- regulators

affected stakeholders

- operators
- investors
- consultants
- regulators
- public



<https://www.telegraph.co.uk/business/2016/08/30/bhp-boss-foregoes-bonus-after-samarco-disaster-in-brazil/>

affected stakeholders

- operators
- investors
- consultants
- regulators
- public
- environment



<https://www.cbc.ca/news/canada/british-columbia/mount-polley-mine-disaster-5-years-later-emotions-accountability-unresolved-1.5236160>

outline

- affected stakeholders
- industry trends

industry trends

- renewed call for safety and transparency
 - driven by wide range of stakeholders
 - move towards BATs following Mount Polley
 - upstream construction ban in some geographies

industry trends (cont.)

SAFETY

A MINE OF INFORMATION

Knowledge on tailings storage facilities is essential for understanding risks to people and environment



DISCLOSURES

This portal brings together all of the disclosures that mining companies have made about their tailings storage facilities. It gives communities, investors, regulators and the media unprecedented access to information about mine waste.



98

MINING COMPANIES



162

PARTNER COMPANIES



304

MINING OPERATORS



764

MINE SITES



1938

TAILINGS STORAGE
FACILITIES

industry trends (cont.)

- renewed call for safety and transparency
- public corporate commitment



Tailings Management and Stewardship Summary

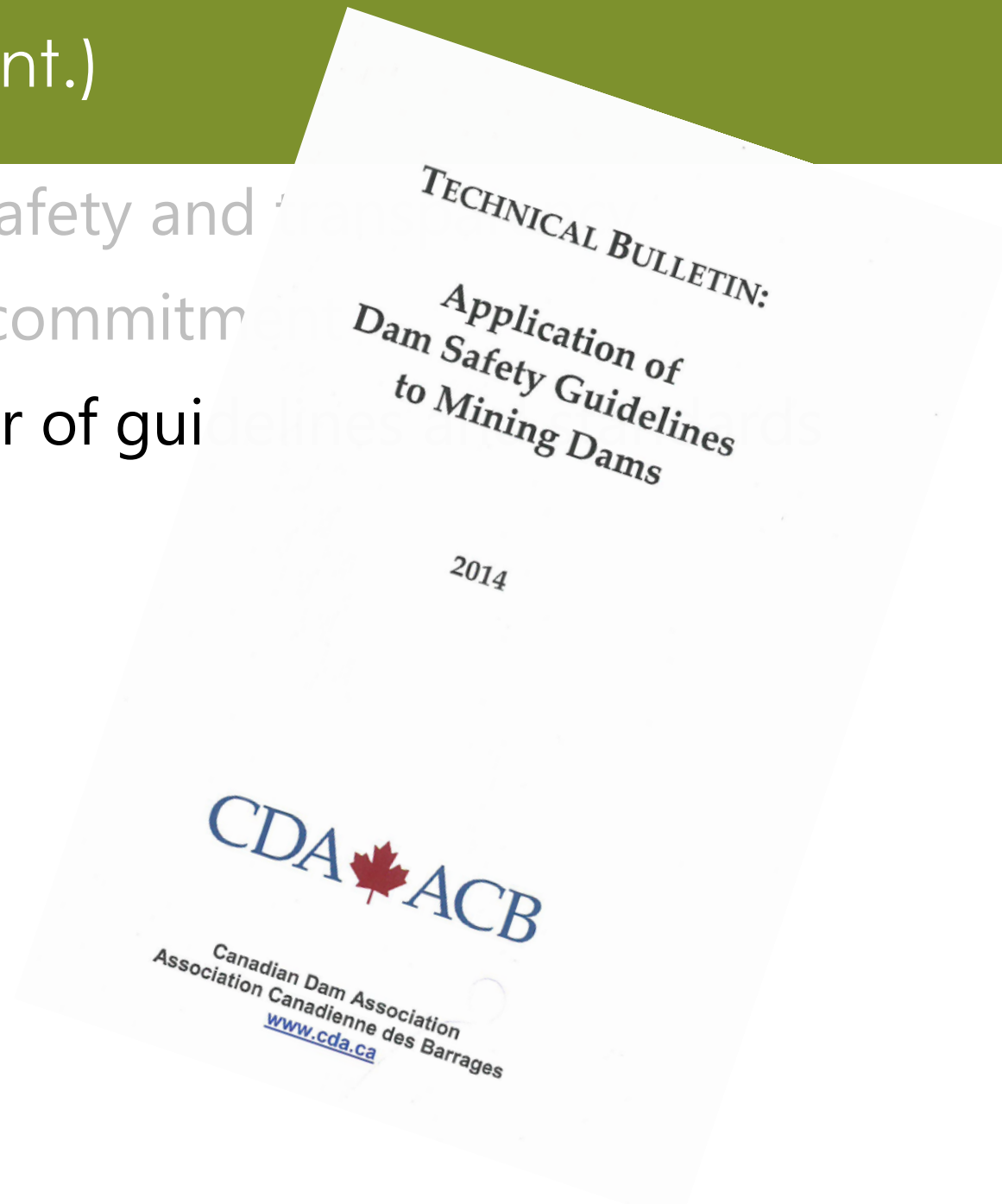
Affiliates of our company currently operate 18 tailings storage facilities (TSFs), 16 in the U.S. and two in Peru, and manage 58 in the U.S. that are inactive or reclaimed. Our inventory of TSFs comprises 13 active and 52 inactive or reclaimed facilities with an upstream design, five active and five inactive with a centerline design, and one reclaimed facility with a downstream design. After a detailed review of corporate records, we have recently increased the number of reported facilities to account for legacy operations that were reclaimed several decades ago.

industry trends (cont.)

- renewed call for safety and transparency
- public corporate commitment
- increasing number of guidelines and standards

industry trends (cont.)

- renewed call for safety and
- public corporate commitment
- increasing number of guidelines



industry trends (cont.)

- renewed
- public
- increasing



industry trends (cont.)

- renewed
- public
- increasing



DRAFT REVISION

TECHNICAL BULLETIN: APPLICATION OF DAM SAFETY GUIDELINES TO MINING DAMS

FOR CDA CALGARY CONFERENCE WORKSHOP ON SLOPE STABILITY

The CDA Mining Dams Committee has prepared this revision to Section 3.5.4.1 of the *Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams*. This section deals with the target Factor of Safety for mining dams. The guidance provided in this section is intended for mining dams and supplements the guidance provided by the CDA 2013 Dam Safety Guidelines.

This guidance has been developed over three years, with extensive input and review from CDA members as well from international stakeholders.

The CDA welcomes feedback on our technical publications as a means of ensuring they remain current in describing good industry practice. The feedback can take the form of direct input to the CDA Mining Dams Committee or Dam Safety Committee. For ease of reference, the text that is currently in the Mining Dams Bulletin that was issued in 2014 is attached. Note that Section 3 in the Mining Dams Bulletin dealt with the operation, construction, and transition phases. Section 4 addressed closure. The table numbering in this revision starts at Table 3-4 as Tables 3-1 to 3-3 are previously referenced in Section 3 of the Mining Dams Bulletin.

3.5.4 Geotechnical

3.5.4.1 Targets for Factor of Safety

Overview

This section provides minimum recommended targets for the factor of safety against slope failure of mining dams during the design, construction, operation, and transition phases. It also provides guidance on the strength parameters to be used.

Target factor of safety values are provided for

- Static Loading Conditions
- Seismic Loading Conditions
- Post Peak Strength Conditions

Tables 3-4 to 3-6 provide the target factors of safety for each of these conditions. If these targets are met, this can be generally viewed as acceptable practice. However, if they are not met, further investigation and analyses, supplemented by comprehensive use of the observational method, can be used to reduce uncertainty and support lower targets.

The guidance provided in Tables 3-4 to 3-6 are typical or default minimum recommended targets for the factor of safety and are applicable to dams that are designed, constructed, and operated in accordance with a normal standard of care for dam engineering.

industry trends (cont.)

- renewed
- public
- increasing

ICOLD
Committee on Tailings Dams and Waste Lagoons
Tailings Dam Safety

PRELIMINARY DRAFT
CONFIDENTIAL
ISSUED FOR INTERNAL DISCUSSION
UNCONTROLLED DOCUMENT UNTIL PUBLISHED

200121.Tailings Dam Safety Bulletin - Preliminary Draft for Review.docx
C09875A01

REVISION

APPLICATION OF DAM SAFETY GUIDELINES TO MINING DAMS

CONFERENCE WORKSHOP ON SLOPE

January 21, 2020

The Committee has prepared this revision to Section 3.5.4.1 of the *Technical Bulletin on Dam Safety Guidelines to Mining Dams*. This section deals with the target factor of safety for mining dams. The guidance provided in this section is intended for mining dams that are designed in accordance with the guidance provided by the CDA 2013 Dam Safety Guidelines.

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industry trends

- renewed
- public
- increasing

GlobalTailings
Review.org

GLOBAL TAILINGS STANDARD Draft for Public Consultation

November 2019



Technical Bulletin:
Application of Dam Safety Guidelines to Mining Dams
2019 Sept 30

REVISION

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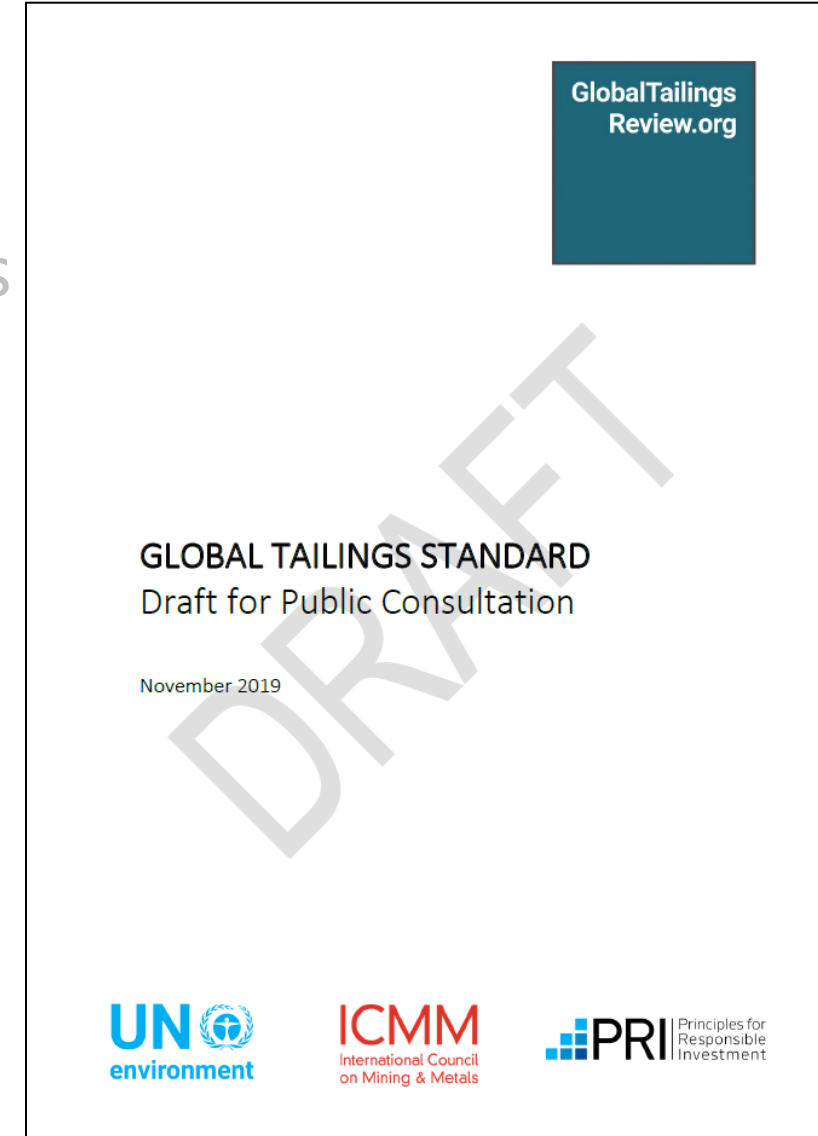
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1 of 20



industry trends (cont.)

- renewed call for safety and transparency
- public corporate commitment
- increasing number of guidelines and standards
- future regulations?



outline

- affected stakeholders
- industry trends
- methods for reducing risk

methods for reducing risk

source of risk	risk mitigation measures
human factors	• make corporate commitment • acknowledge bias • empower staff • resist the "normalization of deviance"

methods for reducing risk

source of risk	risk mitigation measures
human factors design	• establish EOR • build the story • identify and design out PFMs • analyze USSA, ESSA, LIQ • assume triggering • perform dam breach analysis

methods for reducing risk

source of risk	risk mitigation measures
human factors design construction	• involve EOR • thorough QA/QC • timely reporting • adhere to IM thresholds • document and vet deviations

methods for reducing risk

source of risk	risk mitigation measures
human factors	• minimize water storage • maintain appropriate beach • compact beach • install pipeline leak detection • inspect frequently • monitor instrumentation
design	
construction	
operation	

methods for reducing risk

source of risk	risk mitigation measures
human factors design construction operation (cont.)	• maintain low phreatic surface • perform PFMA • train staff • maintain continuity • establish review board • operate with closure in mind

methods for reducing risk

source of risk	risk mitigation measures
human factors	• eliminate pond • maintain physical and geochemical stability • monitor instrumentation • move towards a landform • remember perpetuity
design	
construction	
operation	
closure	

thank you



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resourceful. naturally.

