CENTER for SCIENCE in PUBLIC PARTICIPATION
224 North Church Avenue, Bozeman, MT 59715
Phone (406) 585-9854 / Fax (406) 585-2260 / web: www.csp2.org / e-mail: csp2@csp2.org
"Technical Support for Grassroots Public Interest Groups"

July 27, 2016

Province of British Columbia
Ministry of Energy and Mines
Secretariat for the Code Review
CodeReview@gov.bc.ca

Re: Comments on the Code Review Changes to Part 10, Mine Health Safety and Reclamation Code for Mines in British Columbia

The Center for Science in Public Participation provides technical advice to public interest groups, nongovernmental organizations, regulatory agencies, mining companies, and indigenous communities on the environmental impacts of mining. CSP2 specializes in hard rock mining, especially with those issues related to water quality impacts, reclamation bonding, and tailings dam safety.

As a result of the failure of the Mt Polley tailings dam in August, 2015, the British Columbia Mines and Petroleum Resources, Mining and Minerals Division (MEM) has undertaken a major revision to the Mine Health Safety and Reclamation Code for Mines in British Columbia, Part 10 – Reclamation and Closure. MEM has accepted the recommendations from the Independent Expert Engineering Panel investigation, the Chief Inspector of Mines Investigation into Mount Polley, and the Auditor General's report on the Mining Sector.

These comments address only the recommendations from the "Report on Mount Polley Tailings Storage Facility Breach," Independent Expert Engineering Investigation and Review Panel, Province of British Columbia, January 30, 2015.

MEM has identified seven recommendations from the Mt Polley Expert Panel, and its responses are contained in the "Update on Implementation of Recommendations from the Expert Panel Report, the Chief Inspector of Mines Investigation Report and Auditor General's Report on Mining," July 19, 2016.

Dr. Chambers also reviewed the Expert Panel Report, and has identified a somewhat different grouping of twelve Expert Panel recommendations, which are reviewed in these comments. The comments are organized in the order the recommendations appear in the Expert Panel Report, and the relevant sections of the Code (2016) and Guidance Document (2016) are listed following the Expert Panel recommendations. Following these direct quotes from the relevant documents, a comment section discussing any differences between the Expert Panel recommendations and the Code/Guidance Document responses is given.

Thank you for the opportunity to comment on the Code revisions. If you have any questions on my comments, please feel free to call at any time.

Sincerely:

David M. Chambers, Ph.D., P. Geop.

SECTION-SPECIFIC COMMENTS

Mt Polley Expert Panel Recommendation

8.3 Panel Assessment

The EOR is responsible for the overall performance of the structure as well as the interpretation of site conditions. The Regulator has to rely on the expertise and the professionalism of the EOR as the Regulator is not the designer. … The relationship between the Regulator and the EOR can result in different opinions being expressed that are not easy to resolve without independent input. In such circumstances, independent external advice could be sought as further described in section 9.0.

MEM Code/Guidance Document Response

Guidance Document, 2.1 Roles and Responsibilities

There are several key roles required under the Mines Act (the Act) and the Code to manage, design, build, operate and close a tailings storage facility (TSF).

Prior to conducting any work on a mine site, a mine owner must designate a Mine Manager under Section 21 of the Act, who must be present onsite daily and who is ultimately responsible for application of all requirements of the Code on the site. As such the Mine Manager is ultimately responsible for the safety of all TSFs on the site. The Code also requires the Mine Manager to designate a person to fulfill the role of a TSF Qualified Person, ensure each TSF has an Engineer of Record, ensure an Independent Tailings Review Board has been convened and fulfills its mandate, and is answers to the Chief Inspector on all issues of compliance with the Code on the mine site. (emphasis added)

CSP2 Comment

The Code has been significantly strengthened with the addition of requirements and definitions for an Engineer of Record (a qualified consultant), a TSF Qualified Person (a company employee), and an Independent Tailings Review Board (as called for by the Expert Panel). In addition, the role and requirements for the Mine Manager have been expanded.

The Engineer of Record has “professional responsibility” for insuring the safe construction and operation of the dam and tailings storage facility (TSF). British Columbia Ministry of Energy and Mines (MEM) does not define what professional responsibility entails, and is probably leaving this up to the relevant professional organization, in this case the Association of Professional Engineers and Geoscientists of BC.

The issue of professional accountability has been a concern in mining for decades, more so in the area of predicting water quality impacts than with tailings dam design, but the fundamental issue is the same. At this point no individual or firm working on a mine has lost their professional accreditation due to faulty predictions or practices. The issue of sanctioning faulty or fraudulent practices has been left to the market (who would want to employ an individual or firm involved with such practices?) or the courts (the owners of the Mt Polley tailings dam that failed in 2014 are litigating against the engineering firms that consulted on the dam construction and operation). Unfortunately, we continue to see ‘overly optimistic’ predictions about water quality impacts, and tailings dam design and operation that push the limits of credibility, largely because of financial pressures on both mine operators and consultants.

Mt Polley Expert Panel Recommendation

9.1 Performance of B.C. Tailings Dams

The Panel firmly rejects any notion that business as usual can continue.

and;

9.3.1 BAT Principles

The goal of BAT for tailings management is to assure physical stability of the tailings deposit. This is achieved by preventing release of impoundment contents, independent of the integrity of any containment structures. In accomplishing this objective, BAT has three components that derive from first principles of soil mechanics:

1. *Eliminate surface water from the impoundment.*
2. *Promote unsaturated conditions in the tailings with drainage provisions.*
3. *Achieve dilatant conditions throughout the tailings deposit by compaction.*

MEM Code/Guidance Document Response

Guidance Document, 3.1 Alternatives Assessment

The following guidance on setting objectives and targets are provided for consideration in design and operations:

- *Physical stability is of paramount importance, and options that require a compromise to physical stability should be discarded,*
- *…*
- *All available technologies should be considered*
- *Effort to reduce and remove water from containment within tailings facilities should be made,*
- *Alternatives to water covers should be considered in planning stages.*

CSP2 Comment

While the changes to the Code give general guidance that follows the recommendations of the Expert Panel, there is still too much latitude in the requirements of the Code for Alternatives Assessment to guide mine proposals and permit issuance. Instead of "*eliminate(ing) water from the impoundment*" as recommended by the Mt Polley Expert Panel, the Code requires only that an "*effort to reduce and remove water from containment within tailings facilities should be made*" and that "*alternatives to water covers should be considered in planning stages*." This leaves the door wide open for site-specific considerations, which inevitably will include cost, to trump real change to present practices.

Real change will cost more than present practices. For example, if physical stability were of paramount importance then upstream-type dam construction would not be allowed. Centerline dam construction would be allowed only if the tailings would be completely drained on closure. Downstream dam construction (with an impoundment liner) would be required if, in an extremely limited number of cases, water covers would be required to prevent acid and neutral leaching. The Code guidance does not go far enough to truly implement the Expert Panel recommendations for tailings dam stability.

Additionally, the Code is particularly weak on the Expert Panel's recommendation to "*eliminate surface water from the impoundment*." Other than the Code's requirement for an "*effort to reduce and remove water*" and to 'consider' alternatives to water covers, the discussion in the Code is on how to manage saturated tailings, not on how to eliminate saturation.

The Expert Panel further explained its recommendation that water be eliminated from tailings impoundments by recognizing the additional considerations, and costs, that must be incurred to achieve this goal:

> *"The Panel recognizes that eliminating water from the tailings deposit will not eliminate the need for storage of mine and processing water elsewhere." (Expert Panel 2015, p. 121)*

There is effectively no discussion or guidance offered of water retention in tailings facilities. It may be implicit in considering precipitation and water balance that minimizing incident and run-on stormwater is imperative, but it must be made explicit in the regulations. The Code requires a consideration of water balance in the multiple accounts analysis (Guidance Document 2016, p. 13),[1] and requires special procedures for dams that impound saturated tailings or use water covers (Guidance Document 2016, p. 19), but requiring special considerations if a water cover is used or saturated tailings impounded is not "*eliminat(e) surface water from the impoundment*."

The Expert Panel recommendation is clear - "*Eliminating surface water from the impoundment*." The Part 10 Revisions of July 20, 2016 do not address this issue/recommendation of the Expert Panel. As written, the Code will not only allow business as usual, it will continue to countenance it.

Recommendation: The Code should explicitly require that in the planning stage the design should: (1) eliminate surface water from the impoundment; (2) promote unsaturated conditions in the tailings with drainage provisions; and, (3) achieve dilatant conditions throughout the tailings deposit by compaction. Guidance then needs to be offered on these requirements should be implemented. For example, saturated tailings deposited behind a tailings dam must be de-pyritized to achieve a non-acid generating sulfur content, and then drained on closure; pyritic or neutral-drainage waste should be dry-stacked in a lined impoundment to minimize infiltration and drainage; water covers should only be used behind centerline-type dams in a lined impoundment.

This approach would offer much stronger guidance than the "*effort to*" and 'consider' requirements of the present Code.

Mt Polley Expert Panel Recommendation

9.2 Getting to Zero

In risk-based dam safety practice for conventional water dams, some particular level of tolerable risk is often specified that, in turn, implies some tolerable failure rate. The Panel does not accept the concept of a tolerable failure rate for tailings dams. To do so, no matter how small, would institutionalize failure. (emphasis added)

Appendix I, B.C. Tailings Dam Failure Frequency and Portfolio Risk, 5.0 Portfolio Risk

[1] Guidance Document 2016. "Guidance Document," Health, Safety and Reclamation Code for Mines in British Columbia, Version 1.0, Updated July 2016

The language of the Panel's Terms of Reference also gives rise to the following inferences:

The aim is to prevent future failures, where all such failures are equally undesirable. Accordingly, risk is taken here as the probability of future failures regardless of the nature or magnitude of failure consequences.

MEM Code/Guidance Document Response

Guidance Document, 3.2 Risk Assessment

… r*isks should be identified, documented and managed to a level appropriate to the structure's consequence classification.*

While risk assessments are required for all TSFs under the Code, MEM expects that facilities with a consequence classification of "High" or above will be subjected to a formal risk assessment performed by a suitably qualified, independent facilitator experienced with such facilities.

….

The International Organization for Standardization (ISO) provides the general process in ISO 31000, Risk Management – Principles and Guidelines … Elements for consideration should be selected as appropriate for the scope and complexity of the structure and the site, and may include the following consequence categories:

- …
- *Safety and health*
- …
- *Financial Impacts*

CSP2 Comment

It is not clear why a risk assessment, when conducted, would not be managed by a "… qualified, independent facilitator …" This qualification puts the objectivity of risk assessments for dams with ratings lower than High at issue.

In addition, the Mt Polley Expert Panel noted:

"Tailings dams are complex systems that have evolved over the years. They are also unforgiving systems, in terms of the number of things that have to go right. Their reliability is contingent on consistently flawless execution in planning, in subsurface investigation, in analysis and design, in construction quality, in operational diligence, in monitoring, in regulatory actions, and in risk management at every level. All of these activities are subject to human error." (Expert Panel 2015, p. 119)

and;

"Without exception, dam breaches produce tailings releases. This is why best practices can only go so far in improving the safety of tailings technology that has not fundamentally changed in the past hundred years." (Expert Panel 2015, p. 119)

Recommendation: In addition to requiring a risk assessment for all dams, and dam expansions, MEM should require that ALL risk assessments be conducted by a qualified, independent professional/organization.

Unlike "3.1 Alternatives Assessment" where physical stability is to be given "*paramount importance*," in "3.2 Risk Assessment" safety is only a category that 'may be included'.

The Mt Polley Expert Panel also considered its mandate to prevent future failures of tailings dams (Expert Panel 2015, Appendix I, 5.0 Portfolio Risk, p. 9). While MEM does not acknowledge this mandate in the Code or Guidance Document, MEM does not dispute it either.

In the risk assessment process establishing the importance for the categories for which risk will be minimized is left to the facilitators. This is of concern because present practice gives economic considerations the most importance, so lacking additional guidance the risk assessment process may give financial impacts more explicit or implicit priority than safety and health.

Recommendation: Because of its importance, MEM should give clear guidance that for a risk assessment physical stability (i.e. safety) is the primary concern, and should be given more weight than other factors in the risk assessment.

Mt Polley Expert Panel Recommendation

9.3.2 BAT Methods

The overarching goal of BAT is to reduce the number of tailings dams subject to failure.

Appendix I, B.C. Tailings Dam Failure Frequency and Portfolio Risk, 5.3.3 Combined Approach

The limited efficacy of either failure frequency or inventory reduction alone suggests that both are needed to meet safety goals. One such combined approach might consist of:

- *reducing the historic failure frequency by a factor of 10 to $1.7x10^{-4}$, somewhat below water-dam benchmark values*
- *halving the active dam inventory from 120 to 60*

Reducing the current inventory of active tailings dams can be brought about from attrition by eliminating surface water at closure. Restricting future growth of the inventory can be achieved through tailings technologies that avoid water storage in the first place.

MEM Code/Guidance Document Response

Code, Definitions

"best available technology" means the site specific combination of technologies and techniques that most effectively reduce the physical, geochemical, ecological and social risks associated with tailings storage during all stages of operation and closure. (Code 2016, p. 1)

Guidance Document, 3.2 Risk Assessment

- *Risk Reduction: Employ Best Available Technology to mitigate or eliminate the risks and conduct additional work to reduce uncertainly and fill gaps. (Guidance Document 2016, p. 14)*

CSP2 Comment

The Code does not address the Expert Panel goal to "*reduce the number of tailings dams subject to failure*," at least not directly. In the Code's definition of best available technology permit holders are required to "*reduce the physical, geochemical, ecological and social risks associated with tailings storage*

during all stages of operation and closure," and in the Guidance Document risk is to be reduced by employing best available technology.

This somewhat circular approach to reducing the risk of dam failure may meet the Expert Panel's goal of reducing failure frequency. However, it does not address the Expert Panel's goal of reducing the number of active tailings dams subject to failure (which is all tailings dams) by half. This is quantitative goal recommended by the Expert Panel. This goal can only be achieved by aggressively pursuing alternatives to tailings dams, primarily (but not exclusively) dry tailings.

The Expert Panel has also stated that with regard to dry tailings and best available technology (BAT – Expert Panel 2015, p. 122):

> *"... surface storage using filtered tailings technology is a prime candidate for BAT."*

and;

> *"There are no overriding technical impediments to more widespread adoption of filtered tailings technology."*

and;

> *"The Panel recognizes that creating dry tailings may increase the amount of water requiring treatment or storage."*

By delving so deeply into an explanation of the use of dry tailings (and presumably similar dry closure technologies) the Panel has clearly emphasized the intent behind its goal of reducing the number of tailings impoundments.

Recommendation: The Code should clearly state that reducing the number of tailings facilities that could fail by one-half is goal of the Code (as well as the Expert Panel). This will also need some guidance, in particular with the potential application of dry tailings. For example: (1) underground mines should prioritize backfill and dry stack for tailings; (2) open pit mines should utilize dry tailings for potentially acid-generating waste, and non-acid generating waste should be drained/dewatered at closure. Subaqueous disposal of waste should only be employed when, from a physical stability standpoint, dry disposal would pose more risk than wet closure.

Mt Polley Expert Panel Recommendation

9.3.3 BAT for Closure

It can be quickly recognized that water covers run counter to the BAT principles defined in section 9.3.1. But the Mount Polley failure shows why physical stability must remain foremost and cannot be compromised. ... No method for achieving chemical stability can succeed without first ensuring physical stability: chemical stability requires above all else that the tailings stay in one place.

MEM Code/Guidance Document Response

Guidance Document, 3.1 Alternatives Assessment

The following guidance on setting objectives and targets are provided for consideration in design and operations:

- *Physical stability is of paramount importance, and options that require a compromise to physical stability should be discarded,*

- ….

CSP2 Comment

Perhaps the most difficult pill to the mining industry, regulators, and consulting industry to swallow in the Mt Polley Expert Panel report is that of eliminating surface water from the impoundment. Eliminating water from the surface of the impoundment is a double-barreled hit mine economics. It likely requires the construction of additional water storage capacity, and/or the construction of additional water treatment capacity. Excess tailings impoundment capacity is almost universally used to store excess precipitation (i.e. stormwater), which can appear in voluminous amounts. If the impoundment cannot be used as a storage buffer for this water, then either an alternative temporary storage facility must be built, or essentially all stormwater not incident on the impoundment must be diverted. Any excess water due to incident precipitation on the mine facilities, including the tailings impoundment, must be treated and discharged as soon as possible. Engineering for this necessity would be easy, and paying for it would be expensive. However, not following this approach would likely lead to another Mt Polley or Fundao/Samarco–type failure. And, if safety/physical stability are to be paramount, it is difficult to defend any other basic approach. The Code does not adequately reflect the "*eliminat(e) surface water from the impoundment*" approach recommended by the Mt Polley Expert Panel.

Recommendation: The Code should clearly state that in order to achieve physical stability, surface water should be eliminated from the impoundment, as recommended by the Mt Polley Expert Panel. Examples of guidance to implement this approach might be: (1) use of dry tailings disposal wherever possible; (2) the aqueous deposition of (non-PAG) tailings, (a) incident stormwater reporting to the tailings pond must be minimized, and (b) water recycling should minimize tailings pond pool size, including the construction of temporary storage ponds for return makeup water.

Mt Polley Expert Panel Recommendation

9.3.4 BAT Recommendations

Implementation of BAT is best carried out using a phased approach that applies differently to tailings impoundments in various stages of their life cycle.

- For existing tailings impoundments. Constructing filtered tailings facilities on existing conventional impoundments poses several technical hurdles. Chief among them is undrained shear failure in the underlying saturated tailings, similar to what caused the Mount Polley incident. Attempting to retrofit existing conventional tailings impoundments is therefore not recommended, with reliance instead on best practices during their remaining active life.
- For new tailings facilities. BAT should be actively encouraged for new tailings facilities at existing and proposed mines. Safety attributes should be evaluated separately from economic considerations, and cost should not be the determining factor.
- For closure. BAT principles should be applied to closure of active impoundments so that they are progressively removed from the inventory by attrition. Where applicable, alternatives to water covers should be aggressively pursued.

MEM Code/Guidance Document Response

Guidance Document, 3.1 Alternatives Assessment

The alternatives assessment provides a comparative analysis of options considering the following sustainability factors:

- *Environment*
- *Society*
- *Economics*

The assessment typically utilizes a multiple-accounts analysis procedure by which each alternative is rated using qualitative and quantitative indicators of the above factors.

….

Constraints should be clearly stated, incorporated into the project design criteria or operating or closure performance criteria, and documented in the project design report or site OMS manual. Examples of constraints include, but are not limited to, the following:

- …
- *Economics and financial feasibility (emphasis added)*

CSP2 Comment

The primary concern with the Code's implementation of the Mt Polley Expert Panel recommendations for best availability technology (BAT) is related to how environmental and societal considerations weigh-in with economic considerations. Today economics drives alternatives assessment, risk assessment, and multiple-accounts analysis. Using economic factors as a primary driver for risk considerations is not unreasonable, but it is not compatible with a goal/priority of safety/physical stability. The Expert Panel attempted to define how economics should be integrated into the alternative assessment/best available technology evaluation process:

> *"Full consideration of life cycle costs including closure, environmental liabilities, and other externalities will provide a more complete economic picture. While economic factors cannot be neglected, neither can they continue to pre-empt best technology." (Expert Panel 2015, p. 123)*

"*Economics and financial feasibility*" are not defined in the Part 10 Revisions of July 20, 2016. As a result, how economics and financial feasibility will weigh into the alternatives assessment process is left to those who conduct the assessment. The Expert Panel clearly recommends that financial feasibility include existing externalities and full life-cycle costs. Without explicitly stating that existing externalities and full life-cycle cost must be considered in "*economics and financial feasibility*" considerations, the result of these analysis will remain business as usual.

> *"The chief reason for the limited industry adoption of filtered tailings to date is economic. Comparisons of capital and operating costs alone invariably favour conventional methods. But this takes a limited view. Cost estimates for conventional tailings dams do not include the risk costs, either direct or indirect, associated with failure potential. ... Nor do standard costing procedures consider externalities, like added costs that accrue to the industry as a whole, some of them difficult or impossible to quantify. Full consideration of life cycle costs including closure, environmental liabilities, and other externalities will provide a more complete economic picture. While economic factors cannot be neglected, neither can they continue to pre-empt best technology." (Expert Panel, p. 123)*

MEM's implementation of the Mt Polley Expert Panel's suggestions for Best Available Technology (BAT) falls short of Expert Panel's recommendations. The Panel clearly stated that:

"BAT should be actively encouraged for new tailings facilities at existing and proposed mines. Safety attributes should be evaluated separately from economic considerations, and cost should not be the determining factor." (Expert Panel, p. 125)

This approach is not followed in MEM's 3.1 Alternatives Assessment. Merely saying that Environment, Society, and Economic factors must be 'considered' as a part of the BAT analysis does not provide the guidance required to prioritize the considerations necessary to drive a safety-first design approach. The Expert Panel clearly said that safety should be the paramount consideration (Expert Panel, p. 125). Giving economics equal consideration with safety would be business as usual, and as stated now business as usual for Best Available Technology assessment is implicit in this guidance document.

Recommendation: The Code should clearly state that safety/physical stability has priority over other factors to be considered in the alternatives assessment process.

Mt Polley Expert Panel Recommendation

9.4.1 Corporate Governance

… mining operations in B.C. proposing to operate a tailings storage facility (TSF) should either be required to be a member of MAC (Mining Association of Canada) —ensuring adherence to the TSM (Towards Sustainable Mining) —or be obliged to commit to an equivalent program, including the audit function.

MEM Code/Guidance Document Response

Code, 10.4.4 Annual Reporting

Code, 10.5.1 Construction of Tailings and Water Management Facilities *(as-built reports)*

Code, 10.5.2 Operations, Maintenance and Surveillance (OMS) Manual

Code, 10.5.3 Annual Dam Safety Inspection *(reporting)*

Code, 10.5.4 Dam Safety Reviews

Code, 10.6.7 Closure (plan) of a tailings storage facility or dam

CSP2 Comment

MEM has added a significant number of reporting layers and corporate reporting requirements to the Code. MEM should evaluate the adequacy of these requirements over a defined time period to determine whether the new requirements provide MEM with the appropriate level and amount of information to assure periodic audits of a mine can insure that the operation is functioning at a level that provides the maximum safety/physical stability.

Recommendation: The Code should provide for an audit of the corporate reporting procedures after 5 years to determine the viability of these requirements in assuring the safety/physical stability of mine waste facilities.

Mt Polley Expert Panel Recommendation

9.4.2 Corporate TSF Design Responsibilities

1) A detailed evaluation of all potential failure modes associated with:

- *The geological conditions of the site*

- *The uncertainties associated with this evaluation*
- *The role of the Observational Method to manage residual risk*
- *Mitigation measures in case worse than anticipated conditions are encountered.*

This evaluation should be updated and incorporated into MEM requirements for annual inspection and construction review. …

2) Detailed cost analyses of BAT tailings and closure options, so that alternative means of achieving BAT can be understood and accommodated. As discussed in section 9.3.2, this assessment should recognize that indirect and unquantifiable costs cannot be fully incorporated and hence the results of the cost analyses should not supersede BAT safety considerations.

3) A detailed declaration of QPOs (Qualitative Performance Objectives, beyond those associated with regulatory compliance and ordinary design criteria. Examples of QPOs are numerical values and limits associated with:

- *Beach widths*
- *Calibration of impoundment filling schedule*
- *Water balance audits and calibration*
- *Construction material availability and scheduling to ultimate height of structure*
- *Instrumentation adequacy and reliability*
- *Trigger levels for response to instrumentation*
- *Performance data gathering, interpretation, and reporting intervals*

MEM Code/Guidance Document Response

Guidance Document, 3.1 Alternatives Assessment

Constraints should be clearly stated, incorporated into the project design criteria or operating or closure performance criteria, and documented in the project design report or site OMS manual. Examples of constraints include, but are not limited to, the following:

- …
- *Geology*
  - *Geochemistry of tailings*
  - *Foundation conditions (faults, strength, etc.)*
  - …
- …

Guidance Document, 3.3.1 Design Criteria

Table 3-2 Minimum Design Criteria for Tailings Dams

Dam Class	Annual Exceedance Probability – Floods[2]	Annual Exceedance Probability - Earthquakes
Low	1/3 between 1/975 and PMF	1/2475
Significant	1/3 between 1/975 and PMF	1/2475
High	1/3 between 1/1000	1/2475
Very High	2/3 between 1/1000 and PMF	½ between 1/2475 and 1/10,000 or MCE
Extreme	PMF	1/10,000 or MCE

*In addition, the "**Revisions to Part 10 Effective as of July 20, 2016**" also state that for:*

Code, 10.1.8 Seismic and Flood Design Criteria

(1) Seismic and flood design criteria for tailings storage facilities and dams …

(b) for tailings storage facilities that cannot retain water or saturated tailings,

(i) the minimum seismic design criteria shall be a return period of 1 in 975 years, and …

Guidance Document, 2.1 Roles and Responsibilities, TSF Qualified Person

- …
- *Provides QPOs for operational and maintenance activities for inclusion in the OMS.*
- …

CSP2 Comment

Alternatives Assessment – Geochemistry

"*Geochemistry of tailings*" is listed as a constraint, but the Mt Polley Expert Panel recommendation that stability be given priority over geochemistry (Expert Panel, p. 124) is not reflected in the alternative assessment constraints.

Determining the geochemistry of tailings (and waste rock!) is of prime importance, but MEM is not giving any guidance on how to prioritize this information. On the other hand, the Mt Polley Expert Panel clearly states that impoundment safety should trump water-closure type impoundments.

> *"It can be quickly recognized that water covers run counter to the BAT principles defined in section 9.3.1. But the Mount Polley failure shows why physical stability must remain foremost and cannot be compromised. ... No method for achieving chemical stability can succeed without first ensuring physical stability: chemical stability requires above all else that the tailings stay in one place." (Expert Panel, p. 124)*

It is not clear how "*constraints*" are to be balanced against "*objectives and targets*" in the alternative assessment process.

Recommendation: The Guidance document should provide more clarity on how "constraints" are to be balanced against "objectives and targets" in the alternative assessment process. For example; safety/physical stability cannot be compromised by property boundaries or cumulative effects. If these constraints interfere with safety/physical stability, then this interference would be basis on which to deny a project.

Design Criteria – Seismic Risk

MEM has recognized that the Canadian Dam Association hazard ratings for water supply dams is not appropriate for tailings dams. Among the reasons are that tailings dams must be designed for perpetuity, while water management dams are not, and that the construction approaches for tailings dams are much different, and for the most part riskier, than for water management dams. The Canadian Dam Association has five category ratings for dams – Low, Significant, High, Very High, and Extreme. For the most part these hazard ratings are based on the number of potential fatalities that would be caused by a dam failure.

MEM has raised the requirements for the minimum design-flood and design-earthquake for Low and Significant hazard classification. However, the requirements for the High, Very High, and Extreme hazard categories remain the same as for water management dams. But, water management dams do not have to stand in perpetuity like tailings dams. In addition, a High dam classification would allow: (1) up to 10 fatalities; (2) significant loss or deterioration of important fish and wildlife habitat; (3) restoration or compensation in kind highly possible; and (4) high economic losses affecting infrastructure, public transportation, and commercial facilities (Guidance Document 2016, 3.4 Consequence Classification). Is preventing these potential impacts not worth requiring the most conservative design requirements for floods and earthquakes, especially when we are making this decision for future generations, as well as for our time?

The Low and Significant hazard classifications involve essentially no fatalities and no significant loss or deterioration of fish or wildlife habitat (Guidance document 2016, Table 3-3 Dam Classification), so there is a significant separation in consequence from Significant to High.

High and Very High dam hazard classifications should have the same flood and earthquake requirements as Extreme because tailings dams must last forever, and it is not appropriate for us to pass potentially significant consequences down to future generations, who will receive no benefit from today's mining.

Recommendation: MEM should adopt, as the minimum design event, the PMF for floods and the MCE for earthquakes for High, Very High, as well as Extreme tailings dam hazard classifications.

Revisions to Part 10 Effective as of July 20, 2016 – 10.1.8 Seismic and Flood Design Criteria

MEM's seismic criteria for "*tailings storage facilities that cannot retain water or saturated tailings*" (which are essentially dry tailings facilities) uses the 1/975-year earthquake as the long-term design event. If human health and environmental safety are to be strong considerations, as is the case with seismic risk for tailings facilities that will be temporarily or permanently saturated, then the Maximum Credible Earthquake (1/10,00-years) should be used as the design event. Utilizing the 1/975-year event, even for a dry tailings facility (or a rock dump), is virtually guaranteeing that at some in the future the facility will fail, and that future generations will be left with the cost of cleaning it up.

Recommendation: All waste storage facilities that will need to stand in perpetuity should be engineered for the Probably Maximum Flood and the Maximum Credible Earthquake not only to enhance safety for human health and the environment, but also to minimize cost to future generations.

Qualitative Performance Objectives (QPOs)

Under the Code QPOs are be developed by the TSF Qualified Person. From as asset allocation standpoint this may make sense, since mine regulators do not have time to develop individual plans, and consultants are expensive. However, the Engineer of Record is likely to be the most qualified to develop qualitative performance objectives, and also bears the most responsibility for proper operation of the facility. Rather

than leaving the development of QPOs entirely to the TSF Qualified Person, who is nominally an employee of the mine, and may not have the background necessary to develop a surveillance and monitoring program from scratch, the Engineer of Record should have responsibility for developing the QPOs.

Recommendation: Qualitative Performance Objectives should be developed by the Engineer of Record, in consultation with the TSF Qualified Person.

Mt Polley Expert Panel Recommendation

9.4.3 INDEPENDENT TAILINGS REVIEW BOARD (ITRB)

The appointment of ITRBs to provide third-party advice on the design, construction, operation and closure…

INDEPENDENT TAILINGS REVIEW BOARD (ITRB)

In a mining context, an ITRB could be asked to provide opinions on the following:

- *Whether the design, construction and operation of the TSF are consistent with satisfactory long-term performance.*
- *Whether design and construction have been performed in accordance with the Board's expectation of good practice.*
- *Whether safety and operation of the TSF conform to the Board's expectation of good practice.*
- *Whether there are weaknesses that would reasonably be expected to have a material adverse effect on the integrity of the TSF, human health, safety, and successful operation of the facility for its intended purpose.*

… While it is essential that the Board be organized by Mine Operations, it is equally essential that its reports go to senior corporate management and Regulators.

MEM Code/Guidance Document Response

Guidance Document, 2.1 Roles and Responsibilities

Independent Tailings Review Board

Made up of independent subject matter experts not currently involved in or responsible for the design, operation or construction of the facility.

- *Provides an independent assessment to senior mine management and regulators whether the tailings storage facility is designed, constructed and operated appropriately, safely and effectively.*
- *Provides the site team with practical guidance, perspective, experiences and standard/best practices from other operations.*
- *Reviews and comments on the planning and design process, monitoring programs, data analysis methodology and work performed by site team and/or contract consultants.*
- *Provides non-binding advice and guidance, but does not direct the work or perform the role of the Engineer of Record.*

- *Size and make-up of the ITRB based on complexity of the tailings system, in terms of risk, consequence and disciplines of substance.*

CSP2 Comment

The Mt Polley Expert Panel, in recommending that ITRBs be implemented, noted:

> *Experience has shown that the effectiveness of an ITRB in specific circumstances depends on the following:*
>
> *• That it not be used exclusively as a means for obtaining regulatory approval.*
>
> *• That it not be used for transfer of corporate liability by requesting indemnification from Board members.*
>
> *• That it be free from external influence or conflict of interest.*
>
> *• That there be means to assure that its recommendations are acted upon. (emphasis added)*

It is the last bullet from the Expert Panel that is of some concern. If the Code's ITRB's recommendations follow MEM guidance of "*Provides non-binding advice and guidance, but does not direct the work or perform the role of the Engineer of Record*", then some of the ITRB's recommendations could be altered or ignored. In addition, the Expert Panel noted:

> *"No ITRB can function successfully without unqualified support and commitment at the highest corporate levels. While it is essential that the Board be organized by Mine Operations, it is equally essential that its reports go to senior corporate management and Regulators." (Expert Panel, p. 130)*

In order to avoid undermining the competency of the ITRB, the chief inspector should publicly disclose any ITRB recommendation that is altered, or not implemented, by either the mine operator or regulators.

It should also be noted that waste rock storage is only given minimal consideration in section 3.5.3 Waste Rock Storage Facilities. If the reference in the Guidance Document is to "Operation and Monitoring of Mine Dumps, Interim Guidelines, BC Mine Dump Committee, May 1991" then not only does this reference need to updated, but there are no requirements for seismic stability, which is a necessity for waste rock dumps that will remain in perpetuity.

Recommendation: The chief inspector should publicly disclose any ITRB recommendation that is altered, or not implemented, by either the mine or regulators.

Mt Polley Expert Panel Recommendation

> ***9.4.4 Ministry of Energy and Mines (MEM)***
>
> *With recent inspections of TSFs in the province in hand, the short-term need is to evaluate these facilities with respect to the following potential failure modes, in order of importance:*
>
> ***1. Undrained shear failure** for dams with silt and clay foundation soils.*
>
> ***2. Water balance adequacy,** including provisions and contingencies for wet years.*
>
> ***3. Filter adequacy,** especially for dams containing broadly graded soils or mine waste.*

MEM Code/Guidance Document Response

> ***Guidance Document, 3.3.1 Design Criteria***
>
> *Failure modes that are to be assessed with specific analyses for both operating and closed facilities include, but are not limited to:*

Geotechnical:

- *Internal erosion and piping*
- *Static and dynamic liquefaction*
- *Characterization of the footprint area as well as upstream areas,*
- *(and others)*

Hydrotechnical:

- *Water balance*
- *(and others)*

CSP2 Comment

COMMENT

One of the reasons the MT Polley Expert Panel probably expressed these three specific concerns is that each was, or could have been, a critical contributing factor to the dam failure at Mt Polley. The Mt Polley dam failed due to undrained shear failure (Expert Panel 2015, p. 102). Water balance inadequacy let to actual overtopping of the Mt Polley dam, although it did not cause a dam failure (Expert Panel 2015, p. 72). The Expert Panel also noted that dam could have been in the process of failing due to internal erosion (Expert Panel 2015, p. 126).

The Code appears (assuming the geotechnical and hydrotechnical requirements equate to the Expert Panel's descriptions) to adequately cover the recommendations/concerns of the Expert Panel for analysis of potential failure modes.

Recommendation: None

Mt Polley Expert Panel Recommendation

9.4.5 Professional Practice

… calls for a concerted effort to improve professional practice in th(e) area. of … the overall adequacy of the site investigation and characterization of ground conditions… The Association of Professional Engineers and Geoscientists of British Columbia (APEGBC) … appears to be well-suited for this task.

MEM Code/Guidance Document Response

Guidance Document, 3.3.2 Site Characterization Guidelines

The Professional Practice Guidelines – Site Characterization Assessments for Dam Foundations in BC has been developed by the Association of Professional Engineers and Geoscientists of BC (APEG BC) in response to Recommendation 6 in the Report on Mount Polley Tailings Storage Facility Breach prepared by the Independent Expert Engineering Investigation and Review Panel (Panel Report).

CSP2 Comment

The Code, through application of newly prepared Professional Practice Guidelines – Site Characterization Assessments for Dam Foundations in BC, Association of Professional Engineers and Geoscientists of BC, appears to adequately cover the recommendations/concerns of the Expert Panel for analysis of site characterization.

Recommendation: None

Mt Polley Expert Panel Recommendation

9.4.6 Canadian Dam Association (CDA) Guidelines

The Panel considers that tailings dam guidelines and criteria tailored to conditions in B.C. would more effectively meet the needs of the Province in protecting public safety.

MEM Code/Guidance Document Response

Guidance Document, 3.3.1 Design Criteria

CSP2 Comment

In the Guidance Document, 3.3.1 Design Criteria, MEM has developed and/or strengthened its own guidelines and criteria for tailings dams in British Columbia. The other major area of guidelines and criteria are the Qualitative Performance Objectives. If the QPOs are developed by the Engineer of Record, as recommend in this document, the QPCs should adequately cover the intent of the Expert Panel. If the QPCs are developed by the TSF Qualified Person, and only reviewed by the Engineer of Record and MEM, something could be missed.

Recommendation: Qualitative Performance Objectives should be developed by the Engineer of Record, in consultation with the TSF Qualified Person.

FINANCIAL SURETY

Even though a detailed cost estimate is required by MEM as a part of the reclamation plan (Revisions to Part 10 Effective as of July 20, 2016, Closure of a tailings storage facility or dam, 10.6.7), there is no discussion by the MEM of the requirement for a financial surety in these regulations. The Ministry of Energy and Mines does require a financial surety for mines under its authority from the Mines Act (Section 10.4 and 10.5 – http://www.bclaws.ca/civix/document/id/complete/statreg/96293_01#section10, accessed 22Jul16).

Mines Act

[RSBC 1996] CHAPTER 293

Section 10 Permits

10.4: (4) The chief inspector may, as a condition of issuing a permit under subsection (3), require that the owner, agent, manager or permittee give security in the amount and form, and subject to conditions, specified by the chief inspector

(a) for mine reclamation, and

(b) to provide for protection of, and mitigation of damage to, watercourses and cultural heritage resources affected by the mine.

10.5:(5) If required by the chief inspector, the owner, agent, manager or permittee, in each year, must deposit security in an amount and form satisfactory to the chief inspector so that, together with the deposit under subsection (4) and calculated over the estimated life of the mine, there will be money necessary to perform and carry out properly

(a) all the conditions of the permit relating to the matters referred to in subsection (4) at the proper time, and

(b) all the orders and directions of the chief inspector or an inspector respecting the fulfillment of the conditions relating to the matters referred to in subsection (4).

However, in some situations, such as mine sites where the company's financial strength materially exceeds the estimated liability, the ministry may accept less than full security. The ministry reviews the liability status of such mine sites and reduces bonding liability short-falls over time, as determined by ministry analysis (Mine reclamation security in British Columbia, Fact Sheet, Ministry of Energy and Mines, May 20, 2016).

This "*financial strength materiality*" consideration that allows the chief inspector the discretion to accept than the full value of the financial surety required for reclamation and closure not only places the public at significant financial risk, the very purpose of the financial surety, but also gives a financial competitive advantage/subsidy to large mining companies over small companies.

Recommendation: For these reasons it is appropriate that MEM: (1) require payment of the full financial surety, with no "financial strength materiality" considerations; and, (2) make the rules for financial sureties explicit in the Rule 10 Revisions so that these requirements are readily available to the public and the mining industry.

REFERENCES

Code 2016. "Health, Safety and Reclamation Code for Mines in British Columbia for Mines Act, Revisions to Part 10 Effective as of July 20, 2016"

Code 2008. "Health, Safety and Reclamation Code for Mines in British Columbia," Ministry of Energy, Mines and Petroleum Resources, Mining and Minerals Division, Victoria, British Columbia, 2008

Expert Panel 2015. "Report on Mount Polley Tailings Storage Facility Breach." Independent Expert Engineering Investigation and Review Panel, Province of British Columbia, January 30, 2015

Guidance Document 2016. "Guidance Document," Health, Safety and Reclamation Code for Mines in British Columbia, Version 1.0, Updated July 2016

Mines Act 2016. Mines Act [RSBC 1996] Chapter 293, (accessed 22Jul16) http://www.bclaws.ca/civix/document/id/complete/statreg/96293_01