Consultation response

Part 1: Your details

Original language of response: English

Name: Robert Snow

Country of residence: United States

Are you willing to let us publish your response publicly on the Global Tailings Review website? Yes

Please select which stakeholder group you are representing: Consultant (geotechnical)

If 'Other', please specify below:

Are you responding on behalf of an organization? Yes

Please give the name of the organization: D'Appolonia Engineering Divison of Ground Technology, Inc.

Your level within the organisation: Other

Part 2: Your views on each of the Principles and Requirements in the Standard

Topic I: Knowledge Base

Principle 1

In your view, will compliance with this Principle and its Requirements contribute to the prevention of catastrophic failure of tailings facilities?
Yes

Which aspects of Principle 1 do your comments relate to?

Your comments on Principle 1

Principle 2

In your view, will compliance with this Principle and its Requirements contribute to the prevention of catastrophic failure of tailings facilities?
Partially

Which aspects of Principle 2 do your comments relate to?

Your comments on Principle 2

Topic II: Affected Communities

Principle 3

In your view, will compliance with this Principle and its Requirements contribute to the prevention of catastrophic failure of tailings facilities?
Yes

Which aspects of Principle 3 do your comments relate to?

Your comments on Principle 3

Topic III: Design, Construction, Operation and Monitoring of the Tailings Facility

Principle 4

In your view, will compliance with this Principle and its Requirements contribute to the prevention of catastrophic failure of tailings facilities?
Partially

Which aspects of Principle 4 do your comments relate to?
Requirement 4.1,Requirement 4.3

Your comments on Principle 4
Requirement 4.1: Rebuttal of Consequence Classification of ""Extreme"" should be broadened to also include a Potential Failure Modes Analysis (PFMA) or Failure Modes and Effects Analysis (FMEA) or similar methodology with additional failure modes, including ones involving water management. Presuming that the intent of ""no potential for impactful flow failures"" is that if flow failure (defined as loss of shear strength with increasing stress) can occur, it does not impact downstream conditions beyond the proposed Consequence Classification, then recommend such analysis be based on site specific information and testing data and complemented with published information on the same or similar tailings materials, and supported by performing a FMEA.
Requirement 4.3: Recommend change to eliminate reference to reducing risks to ""the greatest extent possible,"" and have a more definable standard of implementing risk reduction measures, and continuing to evaluate potential failure modes and conduct risk assessment every 3 years to identify/implement additional risk reduction measures. To allow for existing facilities that operate as low or significant hazard potential impoundments to continue, and that may not have established ITRB, add ""independent senior technical reviewer"" as an alternative.
Definition – Tailings Facility Lifecycle: Recommend clarifying definition of closure and post-closure lifecycle states, and principle for ""relinquishment"" from a dam safety perspective to revise Requirement 5.6 and others. Permanent closure should include elimination of the excess surface water not required for treatment or cover systems of the structure and the conversion to a mine waste containment structure, with transition to post-closure and a state where FMEA and if required deformation analysis demonstrate that potential failure modes do not impact downstream conditions.

Principle 5

In your view, will compliance with this Principle and its Requirements contribute to the prevention of catastrophic failure of tailings facilities?
Yes

Which aspects of Principle 5 do your comments relate to?
Requirement 5.1,Requirement 5.6,Requirement 5.4

Your comments on Principle 5
Requirement 5.1: Qualify the term ""minimize"" by reference to ""alternative and impact analysis in Requirement 2.1 and 2.2,"" and to also ensure a broader focus of this requirement for waste minimization. Requirement 5.4 and 6.1: Avoid term ""credible failure modes"" without definition, and recommend referencing FMEA with the evaluation of failure modes and risks. Requirement 5.6: Include construction cost estimate for closure to demonstrate feasibility, and timeline for closure. The design needs to address post-closure status, and based on a well-crafted definition, and relinquishment would be aimed at meeting the requirements of a landform that averts potential failure modes including flow failures that impact downstream conditions.

Principle 6

In your view, will compliance with this Principle and its Requirements contribute to the prevention of catastrophic failure of tailings facilities?
Partially

Which aspects of Principle 6 do your comments relate to?
Requirement 6.1,Requirement 6.3,Requirement 6.2

Your comments on Principle 6:
Requirement 6.1: Avoid term "credible failure modes" without definition, and recommend referencing FMEA with the evaluation of failure modes and risks. Requirement 6.2: Encourage probability analysis along with the application of suitable factors of safety. Requirement 6.3: Design criteria should include reference to factors of safety, and in some situations designing to limit deformation may be a more direct approach. Revise reference to "minimize" by substituting reference to averting its role in potential failure modes.

Principle 7

In your view, will compliance with this Principle and its Requirements contribute to the prevention of catastrophic failure of tailings facilities?
Yes

Which aspects of Principle 7 do your comments relate to?
Requirement 7.4,Requirement 7.5,Requirement 7.6

Your comments on Principle 7
Requirement 7.4: The OMS Manual should be prepared or approved by the EOR to ensure it is consistent with the design intent. Requirement 7.5 and 7.6: Changes in tailings production or water storage for the mine can affect the tailings facility and lead to the need for associated changes in design, construction, operation and

monitoring.

Principle 8

In your view, will compliance with this Principle and its Requirements contribute to the prevention of catastrophic failure of tailings facilities?
Yes

Which aspects of Principle 8 do your comments relate to?
Requirement 8.1

Your comments on Principle 8
Requirement 8.1: Recommend citing the OMS Manual and FMEA to ensure they provide a basis for the monitoring program.

Topic IV: Management and Governance

Principle 9

In your view, will compliance with this Principle and its Requirements contribute to the prevention of catastrophic failure of tailings facilities?
Yes

Which aspects of Principle 9 do your comments relate to?
Requirement 9.1,Requirement 9.2

Your comments on Principle 9
Requirement 9.1 and 9.2: Rather than unqualified reference to '"minimize the consequences,"' the Board should be presented with steps to control risk and reduce consequences based on FMEA application and independent expert review through the ITRB or equivalent. There are generally more opportunities to reduce the risks (i.e., the likelihood) than the consequences at an existing facility. The DSR includes potential failure modes analysis, and evaluation of risks and risk reduction measures, and with review by the ITRB it should ensure that feasible measures are identified to achieve significant risk reduction. This also avoids using the term '"minimize"'.

Principle 10

In your view, will compliance with this Principle and its Requirements contribute to the prevention of catastrophic failure of tailings facilities?
Yes

Which aspects of Principle 10 do your comments relate to?

Your comments on Principle 10:

Principle 11

In your view, will compliance with this Principle and its Requirements contribute to the prevention of catastrophic failure of tailings facilities?

Yes

Which aspects of Principle 11 do your comments relate to?
Requirement 11.4

Your comments on Principle 11:
Requirement 11.4: The DSR should include review and update of the FMEA with evaluation of risks and potential risk reduction measures.

Principle 12

In your view, will compliance with this Principle and its Requirements contribute to the prevention of catastrophic failure of tailings facilities?
Yes

Which aspects of Principle 12 do your comments relate to?

Your comments on Principle 12:

Principle 13

In your view, will compliance with this Principle and its Requirements contribute to the prevention of catastrophic failure of tailings facilities?
Partially

Which aspects of Principle 13 do your comments relate to?
No

Your comments on Principle 13:

Principle 14

In your view, will compliance with this Principle and its Requirements contribute to the prevention of catastrophic failure of tailings facilities?
Partially

Which aspects of Principle 14 do your comments relate to?

Your comments on Principle 14:

Topic V: Emergency Response and Long-Term Recovery

Principle 15

In your view, will compliance with this Principle and its Requirements contribute to the prevention of catastrophic failure of tailings facilities?
Yes

Which aspects of Principle 15 do your comments relate to?

Your comments on Principle 15:

Principle 16

In your view, will compliance with this Principle and its Requirements contribute to the prevention of catastrophic failure of tailings facilities?
No

Which aspects of Principle 16 do your comments relate to?
Comments on the Principle itself,Requirement 16.2,Requirement 16.1

Your comments on Principle 16:
Principle 16: Recommend using post-emergency rather than '"long term,"' with Operator commitments to strategies for recovery Requirement 16.1: Document planned post-emergency recovery strategies in the Emergency Preparedness and Response Plan (EPRP), or separate operator commitment. Requirement 16.2: Update the post-emergency recovery strategies in accordance with a schedule provided in the EPRP, and in the event of a tailings facility failure with downstream impacts, establish plans to implement the EPRP strategies.

Topic VI: Public Disclosure and Access to Information

Principle 17

In your view, will compliance with this Principle and its Requirements contribute to the prevention of catastrophic failure of tailings facilities?
Partially

Which aspects of Principle 17 do your comments relate to?

Your comments on Principle 17:

Part 3: Your views on the Standard

Your view as to whether the content of the Standard meets your expectations

Your view as to whether the content of the Standard meets your expectations (closed question):
3: Meets my expectations

Please summarize why you chose this option:
Comprehensively addresses dam safety requirements including Engineer of Record, independent review, surveillance and monitoring, and emergency preparedness and response.

Your view on whether the Standard will create a step change for the industry in the safety and security of tailings facilities

Your view on whether the Standard will create a step change for the industry in the safety and security of tailings facilities (closed question):
5: Will deliver a step change in all aspects of the safety and security of tailings facilities

Please summarize why you chose this option:

Does the content of the Standard address all aspects of tailings facility management adequately?

Does the content of the Standard address all aspects of tailings facility management adequately (closed question)?
Yes

Please explain why and/or what is missing:

Part 4: Suggestions for topics to be included in the accompanying Recommendations Report

On which topics would you expect to have further clarification or guidance in this document?
The information on Consequence Classification, Table 1 and 2 should be included in the Recommendations Report, and removed from the Standard. These parts of the document should be reworked as guidance, and include reference to available guidance from other recognized dam safety organizations. A consultation process should also be provided for the Recommendations Report before finalizing.

Other information

Non-fitting response text (text submitted which did was not in response to one of the questions above)

Attachment 1 reference (if applicable)

ref:0000001137:Q83

Attachment 2 reference (if applicable)

December 30, 2019

Dr. Bruno Oberle
Chair, Global Tailings Review
Via email: consultation@globaltailingsreview.org

SUBJ: Comments on Draft Global Tailings Standard
Consultation Process
Global Tailings Review

Dear Dr. Oberle:

D'Appolonia Engineering Division of Ground Technology, Inc. (***D'Appolonia***) appreciates the opportunity to submit comments on the Draft Global Tailings Standard (GTS) which contain important steps for improving the safety of tailings dams. D'Appolonia is an engineering consulting firm that has performed exploration, design and analysis, construction oversight, instrumentation and surveillance, and risk assessment for tailings impoundments since our inception in 1956. D'Appolonia and its staff are members of the US Society on Dams (USSD) and the Society on Mining, Metallurgy and Exploration (SME), and participated in the preparation of comments submitted by those organizations through their technical committees. We support the comments from these organizations, and are transmitting the following selected comments prepared by D'Appolonia to emphasize their importance.

Requirement 4.1: Rebuttal of Consequence Classification of "Extreme" should be broadened to also include a Potential Failure Modes Analysis (PFMA) or Failure Modes and Effects Analysis (FMEA) or similar methodology with additional failure modes, including ones involving water management. Presuming that the intent of "no potential for impactful flow failures" is that if flow failure (defined as loss of shear strength with increasing stress) can occur, it does not impact downstream conditions beyond the proposed Consequence Classification, then recommend such analysis be based on site specific information and testing data and complemented with published information on the same or similar tailings materials, and supported by performing a FMEA.

Requirement 4.3: Recommend change to eliminate reference to reducing risks to "the greatest extent possible," and have a more definable standard of implementing risk reduction measures, and continuing to evaluate potential failure modes and conduct risk assessment every 3 years to identify/implement additional risk reduction measures. To allow for existing facilities that operate as low or significant hazard potential impoundments to continue, and that may not have established ITRB, add "independent senior technical reviewer" as an alternative.

Requirement 5.1: Qualify the term "minimize" by reference to "alternative and impact analysis in Requirement 2.1 and 2.2," and to also ensure a broader focus of this requirement for waste minimization.

Requirement 5.4 and 6.1: Avoid term "credible failure modes" without definition, and recommend referencing FMEA with the evaluation of failure modes and risks.

Requirement 5.6: Include construction cost estimate for closure to demonstrate feasibility, and timeline for closure. The design needs to address post-closure status, and based on a well-crafted definition, and relinquishment would be aimed at meeting the requirements of a landform that averts potential failure modes including flow failures that impact downstream conditions.

Requirement 6.2: Encourage probability analysis along with the application of suitable factors of safety.

Requirement 6.3: Design criteria should include reference to factors of safety, and in some situations designing to limit deformation may be a more direct approach. Revise reference to "minimize" by substituting reference to averting its role in potential failure modes.

Requirement 7.4: The OMS Manual should be prepared or approved by the EOR to ensure it is consistent with the design intent.

Requirement 7.5 and 7.6: Changes in tailings production or water storage for the mine can affect the tailings facility and lead to the need for associated changes in design, construction, operation and monitoring.

Requirement 8.1: Recommend citing the OMS Manual and FMEA to ensure they provide a basis for the monitoring program.

Requirement 9.1 and 9.2: Rather than unqualified reference to "minimize the consequences," the Board should be presented with steps to control risk and reduce consequences based on FMEA application and independent expert review through the ITRB or equivalent. There are generally more opportunities to reduce the risks (i.e., the likelihood) than the consequences at an existing facility. The DSR includes potential failure modes analysis, and evaluation of risks and risk reduction measures, and with review by the ITRB it should ensure that feasible measures are identified to achieve significant risk reduction. This also avoids using the term "minimize".

Requirement 11.4: The DSR should include review and update of the FMEA with evaluation of risks and potential risk reduction measures.

Requirement 16.1: Document planned post-emergency recovery strategies in the Emergency Preparedness and Response Plan (EPRP), or separate operator commitment.

Requirement 16.2: Update the post-emergency recovery strategies in accordance with a schedule provided in the EPRP, and in the event of a tailings facility failure with downstream impacts, establish plans to implement the EPRP strategies.

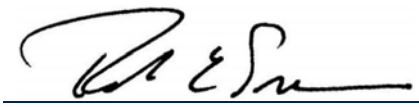
Footnote 20: For the purpose of Requirement 4.1 and closure, revise footnote to address broader requirements including requirements for Closed and Post-Closure status, and allow flow failures to be addressed by satisfying static and seismic conditions, recognizing that Consequence Classification may still exist due to susceptibility of tailings to flow failure. To move out of Post-Closure status and monitoring and maintenance, the susceptibility to flow failure would need to be addressed, or the Consequence Classification must be less than "Low".

Definition – Robust Design: Encourage probability analysis be part of Robust Design, and recognize the sensitivity of stability analysis to material variability and tailings production/deposition rate, as well as importance of water management and balance analysis.

Definition – Tailings Facility Lifecycle: Recommend clarifying definition of closure and post-closure lifecycle states, and principle for "relinquishment" from a dam safety perspective to revise Requirement 5.6 and others. Permanent closure should include elimination of the excess surface water not required for treatment or cover systems of the structure and the conversion to a mine waste containment structure, with transition to post-closure and a state where FMEA and if required deformation analysis demonstrate that potential failure modes do not impact downstream conditions.

D'Appolonia appreciates the opportunity to submit our comments on the draft standard, and supports the Global Tailings Review initiative.

Respectfully Submitted,
D'Appolonia Engineering Division of Ground Technology, Inc.



Robert E. Snow, P.E.
Senior Principal Engineer