Mackenzie Valley Review Board

February 9, 2011

Giant Mine Remediation Project EA (EA 0808-001)

Dear Parties,

Re: Revised Information Request deadline, Review Board Information Requests

On Feb. 3rd, 2011, the Review Board received a letter from Indian and Northern Affairs Canada requesting a further two-week extension to the deadline for parties to submit Information Requests. The Review Board has considered this, and has decided to extend the deadline from Feb. 14th, 2011 to Feb. 28th, 2011 as requested. It does so to help ensure that parties have meaningful opportunities to use their participant funding when they prepare Information Requests. The Review Board is also extending the deadline for Indian and Northern Affairs Canada's responses to March 31st, 2011 accordingly.

The Review Board is now issuing its own Information Requests to Indian and Northern Affairs Canada (attached). Parties are encouraged to read these carefully to avoid repeating the same questions.

I will be unavailable from Feb. 11th to Feb. 25th, 2011. During that time, please address any questions to Environmental Assessment Officer Nicole Spencer at 766-7062 or by e-mail at nspencer@reviewboard.ca .

Sincerely,

Alan Ehrlich
Senior Environmental Assessment Officer

Mackenzie Valley Environmental Impact Review Board

Box 938, #200 Scotia Centre 5102-50th Avenue Yellowknife, NT X1A 2N7 Phone 867-766-7050 Fax 867-766-7074 Toll Free 1-866-912-3472

February 9th, 2011

Mackenzie Valley Environmental Impact Review Board
Round One Information Requests to Indian and Northern Affairs Canada
EA 0809-02: Giant Mine Remediation Project

Review Board IR# 1 Applying freeze study results

Reference

DAR, s. 6.2. Arsenic Trioxide Dust Storage Areas, p.6-5 – 6-46

Terms of Reference Section

ToR s.3.3 Arsenic Containment

Preamble

The DAR makes much reference to the ongoing Freeze Optimization Study (FOS), which was initiated in June 2009 to investigate and optimize the active / passive / hybrid freezing options. Objectives of the study are presented in DAR s. 6.2.9.1. However, in order to address various points listed in the ToR, the DAR states:

- "Advantages and disadvantages of the two approaches are being further investigated in the FOS that commenced in June 2009". (DAR s.6.2.3, p. 6-12)
- "A program to test methods for creating backfill plugs forms part of the FOS". (DAR s. 6.2.5.2, p.6-17)
- "The FOS is expected to result in improvements to the parameter estimates, which could lead to changes in pipe spacing, drillhole numbers and total lengths". (DAR s.6.2.5.3, p.6-22)
- "Surface drilling methods under investigation in the FOS include mud rotary, downhole hammer and coring". (DAR s.6.2.5.3. p 6-23)
- "An alternative hybrid system that is being tested in the FOS involves the delivery of primary coolant directly to the point of heat exchange with the carbon dioxide". (DAR s.6.2.5.5., p. 6-26)
- "Several instrument types are being tested in the FOS. […] Methods for handling the expected large volumes of monitoring data are also being tested in the FOS". (DAR s. 6.2.5.6., p 6-27)
- "The most effective methods to accomplish each step remain under investigation, principally through the ongoing FOS. […] However, results of the FOS are required before those estimates can be confirmed or improved. […] Results of the FOS will allow improved modelling of the freezing process. The target criterion of -5°C is not expected to change, but revisions to the modelling may indicate slower freezing rates". (DAR s.6.2.6, p 6-29 – 6-30)
- "As noted above, results of the FOS will be assessed to confirm or improve the parameters used in the 2006 modelling". (DAR s.6.2.7.2, p 6-31)
- "The ability to overcome these limitations is being tested in the FOS". (DAR s.6.2.8.3, p 6-39)

The freeze technology is extremely important to the success of the remediation program. One and a half years of data should now be available from the study.

Request

Please present the initial results, findings and conclusions of the Freeze Optimization Study to date. It is understood that this is an ongoing study and not all questions may be answered at this point. However, the study is expected to provide important information relevant to many of the predictions in the DAR. Please apply the most recent data from the FOS in answering ToR s 3.3 (Arsenic Containment), points 1, 2 and 8.

Review Board IR# 2   Initial freeze

Reference
DAR, s.6.2.6 Initial Freeze, p. 6-27

Terms of Reference Section
ToR s.3.3 Arsenic Containment, Point 2
"A detailed explanation on the saturation procedure of the arsenic trioxide dust before freezing and a demonstration that the frozen dust will be compact and ice saturated, (i.e. no loose cold regions and frozen bridges occur that could jeopardize the stability of the system)"

Preamble

The DAR makes reference to the FOS (see IR 1 above), but does not clearly state how the frozen block is created and controlled. In particular, the creation of a frozen (not sub-zero) curtain in the surrounding rock is still unclear. The DAR states:

"Step 1 Creating the Frozen Wall […]
The objective of the first step will be to create a frozen zone around each storage area that is wide enough to prevent any outflow of water or soluble arsenic trioxide when the chamber or stope is flooded".

"Step 2 Wetting the Dust
Complete […] saturation of the dust is not required; the "frozen block" concept only requires that a large mass of frozen water be developed somewhere within each chamber or stope. […] The dust is thought to be quite open, with porosity estimated at up to 60%. The high porosity and the high latent heat of freezing water means that if water at even 1 or 2°C is added to the dust, it will infiltrate before it freezes. On the other hand, tests to date indicate that the dust has a relatively low hydraulic conductivity, estimated at $7x10^{-7}$ m/s. Based on these estimates, simply adding water to the surface of the dust and allowing it to infiltrate would be feasible but slow, taking up to several months in the larger chambers".

Requests

1. The frozen wall concept appears to be based on the assumption that potential water will freeze in-situ if it reaches the -10°C curtain as the chambers and stopes are wetted. Please clarify why the creation of the frozen wall appears to be based only on temperature and not on the existence of actual ground ice.
2. Please clarify why the "frozen block" concept only requires that a large mass of frozen ground, and provide any references to potential models, concepts or laboratory investigations that would support this statement. Please clarify the meaning of "large" in this context.
3. There seems to be a contradiction between the high porosity requirement for non-saturated conditions and the low hydraulic permeability. The DAR states that water will infiltrate before it freezes because of the latent heat effect, but on the other hand, the hydraulic conductivity is relatively low. Please present analytical data, numerical models or laboratory investigations to support this assumption.

Review Board IR# 3 Freeze system performance, thermodynamics

Reference

DAR s. 6.2.7 Long-term Freeze Maintenance, p. 6-30/31
DAR, s. 6.2.8.2 Thawing and Climate Change, p. 6-37

Terms of Reference Section

ToR s.3.3.1 Arsenic Containment – Detailed Description of Frozen Block, Point 1. b/c
"With the best available information, a prediction of the amount of active freezing, the amount of passive freezing, power requirements, numbers and general locations of thermosyphons that will be necessary to achieve stability (referring here to a state where active management of the site is no longer necessary)."

"An illustration of the stability of the proposed system for a duration of at least 100 years after converting the active freezing system into a passive system."

Preamble

The DAR provides some general comments on the long-term behavior of the frozen block:

- "[…]even after 100 years of sustained global warming, the currently assumed number of thermosyphons is likely to be adequate to counteract thawing."
- "[…] It is recognized that the developer's activities on site will continue in some form in perpetuity" (DAR, p. 3-6).

Based on the current DAR it is difficult to predict the potential effort required in the future to maintain the arsenic trioxide encapsulated in frozen block. No considerations, general sensitivity or hazard analysis were presented that would allow for a better assessment of the long-term risks associated with the assumption that the frozen block will exist for perpetuity.

Request

1. Please provide results of sensitivity analysis, that, independent on any assumed climate change scenario,
    a. show the minimum air freezing index / average seasonal air temperatures required for the frozen block to remain frozen using the passive cooling method;
    b. provide information on the energy consumption required as a function of various air temperatures for an active / hybrid system; and
    c. provide estimates of thaw times as a function of various air temperatures, assuming that active, hybrid or passive systems fail.
2. Please present a series of graphs showing these trends.
3. Please provide electricity demands and related costs if active or hybrid freezing is required over the long term.
4. Please provide a best estimate on the sensitivity of these initial analyses based on current FOS findings. Because the final design strongly depends on the results of the FOS, it is recognized that the results will be initial estimates.

5. Please describe in detail the assumptions about groundwater volume, velocity, temperature and thermodynamics underlying the expectation that passive cooling will be adequate for the long term. Describe available management options should this be the case, and discuss their financial feasibility and implications.
6. Discuss the probability and consequence of a combination in increased groundwater, hydraulic connectivity by unidentified drill holes and voids, thermal loading from saturation water escaping from voids, leaked saline coolant from ruptured pipes, or other factors preventing the initial freeze.

Review Board IR# 4   Ground freezing and thawing

Reference
DAR, s. 6.2.6 Initial Freeze, p.6-29 – 6-30
DAR, s. 6.2.8.2 Thawing and Climate Change, p. 6-33 – 6-37
various other locations in DAR

Terms of Reference Section
ToR s. 3.3 Arsenic Containment, Point 1
"A detailed description of how the frozen block method will be done […]"

Preamble

Certain additional technical details are required to properly evaluate the freezing properties of the arsenic block and surrounding ground. This freezing is fundamental to the project. The frozen block concept requires that the ground is frozen, meaning that the all pore water in the ground is completely frozen and the hydraulic permeability is reduced to a very small value. The following values can be found in the DAR:

- **"**Thermal Conductivity**,** Frozen = 0.093 W/(mk); Unfrozen = 0.100 W/(mk)" (DAR, p. 5-3)
- **"**Freezing point of saturated solution -0.7ºC" (DAR, p. 5-3)
- "Thermodynamic considerations show that the most important component of that resistance would be the transition from about -1ºC to just above 0ºC (i.e., the point where the ice would have to be melted). Cooling of the block below that range provides little additional benefit. For that reason, the target of -5ºC has been selected as the criterion for declaring the chambers and stopes to be adequately "frozen" and "safe for the environment". (DAR, p. 6-30)

However, the DAR does not present a detailed assessment on temperature dependent hydraulic or thermal conductivities and does not seem to consider that the phase change is likely at a range different than the stated *-1ºC to just above 0ºC*. Laboratory tests presented by SRK (Memo entitled: "Physical properties of overburden, bedrock and arsenic dust", 5.9.2005) show that at temperatures of -8°C, the unfrozen water content can be as high as 8 Vol.-%, which affects its hydraulic permeability. In addition, a chemical rejection is to be expected, potentially changing the arsenic trioxide concentration as the chambers freeze, further affecting the freezing point of the ground.

This uncertainty is also reflected in the utilization of the term "thaw". It is unclear whether this means unfrozen conditions, i.e. >-0.7ºC, assuming the conditions in the ground are homogeneous everywhere and similar to the ones of the sample tested in the lab, or if thaw simply refers to >0ºC. E.g. in the long-term stability assessment the developer writes: "After 20 or more years of the above conditions, the dust at the top of some of the chambers would just be beginning to thaw" (DAR, p. 6-33). Further, natural changes in groundwater levels may, in combination with thaw of the frozen block (controlled or uncontrolled), result in hydraulic gradients that would allow seepage through the frozen wall and potential contamination of the environment. The temperature dependent, frozen hydraulic conductivity of the materials need to be known in order to assess the long-term behavior.

Request

1. Please clarify:

    a. the potential of change in freezing point depression as a function of freezing rate;
    b. the factor of safety associated with the -5ºC criterion and point of completely frozen conditions (no unfrozen water present);
    c. the change in hydraulic permeability as a function of negative temperature and degree of saturation;
    d. the assessment of the potential seepage through the frozen block assuming best estimates for the frozen hydraulic permeability; and
    e. the use of the term "thaw" within the DAR and a clear definition, which preferentially is defined on an acceptable hydraulic permeability, hence unfrozen water content).

Review Board IR# 5 Controlled thaw, future options

Reference
DAR, s. 6.2.8.2 Thawing and Climate Change, p. 6-33 – 6-37
DAR, s. 6.2. Arsenic Trioxide Dust Storage Areas, p.6-5 – 6-46

Terms of Reference
ToR s.3.3.1 Arsenic Containment – Detailed Description of Frozen Block

Preamble

Any impacts of a controlled thaw, should it be required in the future, would potentially result from the proposed freezing. It may be necessary or desirable to thaw the frozen block at some point in the future, for example due to emergence of new remediation technologies or the development of different uses for arsenic trioxide. Item 2 of the Dec. 13th 2010 deficiency response generally suggests some of the existing risks, but does not examine these in sufficient detail. The response suggests that impacts of a controlled thaw would be the subject of a future environmental assessment. However, the risks of controlled thaw arise because of the proposed freezing, and must be assessed before it is frozen.

Because of the perpetuity conditions stated in the DAR, the possibility and potential consequences need to be assessed, particularly with regards to the thermal, mechanical, and hydraulic characteristics of the thawed arsenic trioixide and the stability of bulkheads and crown pillars.

Request

1. Please provide a detailed description of the preferred methods for a controlled thaw of the frozen block should the need arise.
2. Please describe the risks of a controlled thaw, examining the probabilities and severity of associated impacts. This should include an assessment of risks of potential failure of crown pillars and bulkheads, and settlements associated with thaw consolidation, among others.
3. Please describe the potential opportunity costs of saturating the dust and filling in voids below crown pillars, in terms of limiting future options for arsenic removal (eg, pneumatically, mechanically).

Review Board IR# 6 Dust saturation and project design

Reference

DAR, s 5.1.2.2 Physical Properties, p.5-3
DAR, s 6.2.6 Initial Freeze, p.6-29

Terms of Reference

ToR s.3.3.1 Arsenic Containment – Detailed Description of Frozen Block, Point 2
"A detailed explanation on the saturation procedure of the arsenic trioxide dust before freezing and a demonstration that the frozen dust will be compact and ice saturated, (i.e. no loose cold regions and frozen bridges occur that could jeopardize the stability of the system)"

Preamble

In order to assess the impacts of this project, the Review Board needs to understand the extent of saturation proposed for the underground arsenic before freezing. The concept behind the non-saturated frozen block needs clarification. The following statements presented in the DAR seem to be contradictory with respect to the role of the frozen block and the immobilization of the arsenic trioxide:

- "[…] Immobilization of arsenic trioxide through ground freezing (the frozen block method)" (DAR, p. 2-3)
- "[…] The frozen conditions will be maintained over the long-term, and the large volume of ice in the frozen block will provide additional protection against thawing" (DAR, p. 6-11)
- "[…] Complete and uniform saturation of the dust is not required; the "frozen block" concept only requires that a large mass of frozen water be developed somewhere within each chamber or stope." (DAR, p. 6-29)
- "[…] However, the primary role of the frozen block is to provide a mass of frozen water that will resist any future increases in temperature." (DAR, p. 6-29)

Request

Please clarify the above and confirm that these unsaturated conditions have been considered in all the thermal analysis, describing how these varying conditions, which influence thermal and hydraulic ground parameters, have been duly considered in project design.

Review Board IR# 7 Stability issues

Reference
DAR 5.1.4 Some crown pillars are unstable
DAR 5.1.5 Some bulkheads are unstable
DAR, s. 6.2.4.1 Bulkheads, p. 6-13
DAR, s. 6.2.4.2 Crown Pillars, p. 6-15
DAR, s. 6 6.2 Arsenic Trioxide Dust Storage Areas, p. 6-5

Dec. 13, 2010 Deficiency Response, reply to item 1, page 1

> "The most potentially significant issues pertain to the stability of some of the bulk heads and certain crown pillars. However, these risks are associated with the site in its current condition (i.e., they are not caused by the Project) and the risks will be mitigated through the implementation of the Project".

Terms of Reference
ToR s.3.3 Arsenic Containment

Preamble

SRK 2005(b) identified the possible failure of four crown pillars above arsenic containing stopes. The developers recognize the current instability of several of the bulkheads and crown pillars. This is reflected at various sections within the DAR:

- "[…] An initial review […] found that all chambers have relatively thick crown pillars, and failures appear to be unlikely. However, the crown pillars above the stopes are not as thick, and their stability is a concern […]" (DAR, p. 5-18)
- "[…] The long-term stability of these bulkheads is questionable and the short-term stability of some of them is also a source of concern […]" (DAR, p. 5-20)
- "A second and more immediate concern is the physical stability of the dust storage areas. Several of the bulkheads below the chambers and stopes have been identified as having moderate to high failure risks" (DAR, p. 6-5)
- "[…] All bulkheads will be incorporated within the frozen zone around each chamber and stope." DAR, p. 6-13)
- "[…] Following freezing, all crown pillars will be supported by the frozen dust, ice, or fill placed prior to freezing." (DAR, p. 6-15)

The DAR does not provide enough detail on the effect of this instability on the freezing, and the effects of the freezing on the unstable structures.

Request

Please describe:

a. Potential effect on the stability of the crown pillars in the stopes due to saturation and freezing of the arsenic trioxide, assuming that the block will have to be thawed in the future for a different remediation measure.

b. Potential impacts and risks associated with the freezing of the bulkheads, such as risk of frost jacking or loss of strength of the bulkheads due to the freezing of the stopes.
c. Potential impacts and risks associated when freezing the tunnels outside the arsenic trioxide dust storage. Details on the saturation, the backfill and associated freezing front penetration are to be provided.
d. Potential impacts of crown pillars above arsenic containing stopes collapsing during initial freezing before dust saturation.

Review Board IR# 8 Monitoring and risks

Reference

DAR, s. 6.2.5.6 Instrumentation, p. 6-26 – 6-27

Terms of Reference

ToR s.3.3 Arsenic Containment, Point 1e / Point 8c

- "A description of the monitoring and maintenance requirements of the thermosyphons, the conditions that would require their replacement, and the expected frequency of replacement."
- "A discussion of the challenges involved, monitoring systems employed, maintenance efforts required, and why some systems had failed in the past."

Preamble

Adequate monitoring is essential to adaptive management of the project to help mitigate future risks. As indicated in the DAR, the main parameter being monitored to assess the completeness of the frozen wall is temperature: "In general, these will be temperature monitoring devices." (DAR, p. 6-27) The proposed application of artificial ground freezing is unique with respect to technology (e.g. generating of a frozen wall in unsaturated conditions). It carries unique risks associated with potential non-closure of the frozen wall. Therefore, additional and improved monitoring measures should be considered.

Request

1. Please present additional monitoring and QA/QC measures that consider the unique situation. These measures must make it possible to evaluate whether:
    a. the freeze pipes have been installed according to design (e.g. borehole depth / orientation) and,
    b. complete closure condition of the frozen wall has been achieved.
2. Please provide a detailed assessment of the risks if the frozen wall does not seal off completely.

Review Board IR# 9 Tailings dams and cover

Reference
DAR, s. 5.5 Tailings and Sludge Containment Areas, p. 5-41 – 5-47
DAR Table 10.4.1 p10-11 Erosion of tailings cover or perimeter dams release tailings to surface water

Recent assessments of the tailings dam completed in 2004 showed no immediate safety concerns. "The detailed review identified no immediate safety concerns, but made recommendations to assess dam performance in more detail, and improve operating, maintenance and surveillance procedures." (DAR, p.5-42)

"To prevent or mitigate reduced cover performance or deterioration (of tailings perimeter dames and tailings cover), the Project Team will require that covers and dams are monitored and maintained within the temporal scope as defined by regulatory authorizations". (Table 10.4.1 p10-11)

"To prevent or mitigate vegetation penetrating the tailings cover, the Project Team will monitor the revegetation of the tailings and sludge areas, including the chemical uptake of the plants during the temporal scope as defined by the Review Board. (Table 10.4.1 p10-11)

Terms of Reference
ToR 2.3 Temporal Scope
"(T)he Review Board has set a limit on the duration of **activities** that it can meaningfully assess... For the purposes of this EA, **the development activities** are those occurring within 25 years and extending to any further time required to stabilize the site. This assessment will not consider the **impacts of activities** occurring after that period". *(emphasis added)*

ToR s. 3.2.4 Development Description, Point 8
"A detailed description of the proposed method(s) and location(s) of tailings disposal and/or containment, including a description of any technologies or materials that may be used, and any temporary or permanent measures to control fugitive dust from tailings disposal areas."

Preamble

The stability of containment structures is important to evaluating and managing long-term risks. The DAR does not present an assessment for the long-term (in perpetuity) stability and potential remediation measures that may be required. The risk assessment (DAR s10) does not describe likelihood or severity of failures. The temporal scope defines the activities assessed, not the duration of effects of the project to be considered. The Board assesses what happens *because of* development activities occurring within that time, not only the effects that happen *during* that time. Long-term stability of the tailings dam(s) and tailings cover are important aspects of the project.

Request

1. Please provide an assessment of the long-term performance of the tailings dam, and provide a risk assessment that includes any scenarios under which the tailings dams, tailings cover or both could fail, including a description of the likelihood and severity of failures over the long-term.
2. Please describe whether monitoring of chemical uptake by plants on the tailings cover will extend to include establishment of climax species that will dominate over the long-term, and describe what the Project Team will do if arsenic uptake is observed.

Review Board IR# 10 Settlement of tailings ponds

Reference
DAR, s. 5.5 Tailings and Sludge Containment Areas, p. 5-41 – 5-47

Terms of Reference
ToR s. 3.2.4 Development Description, Point 8
"A detailed description of the proposed method(s) and location(s) of tailings disposal and/or containment, including a description of any technologies or materials that may be used, and any temporary or permanent measures to control fugitive dust from tailings disposal areas."

Preamble

To evaluate the proposed remediation of tailings ponds, the Board requires more information on their current state and predicted physical changes. No information on the current state of tailings consolidation or predicted additional future consolidation settlements of the tailings ponds was available in the DAR.

Request

Please provide best estimates of current and future consolidation settlements, if any, of the tailings ponds that may also be relevant to surface water flow and pond cover integrity.

Review Board IR #11 Financial Sustainability

Reference (DAR)

DAR s.6.13.6 page 108
Dec. 13, 2010 Deficiency Response, reply to item 1 page 4

> "Again assuming no response, the above situation would continue indefinitely, with ever-increasing water treatment costs, but no uncontrolled release of arsenic into the surrounding environment."

Terms of Reference (or Other Document) Section

TOR 3.2.4 14

> Estimated capital, operating, monitoring and maintenance costs (the latter presented by year for the life of the development) of the approval process.

Preamble

The feasibility of the proposed project depends in part on financial resources. The certainty of cost predictions and committed financial resources are important in evaluating project feasibility. The DAR mentions a fixed, and very precise, budget of the running costs (i.e. 1.91M$/yr). This figure is based on several assumptions, such as the adequacy of passive freezing to maintain the frozen block over the long term. However, in Document J and other texts there are numerous references to uncertainties and adaptation without ever estimating any variability in project costs.

Request

1. Please describe the uncertainties linked to these costs estimates.
2. Is it possible to define an order of magnitude of variability?
3. Please describe how project financing will cope with possible variations in costs for perpetuity.
4. Please reconcile possibility of ever-increasing water treatment cost (Dec. 13, 2010 Deficiency Response, reply to item 1, page 4) with the very precise budget and scheduling defined in the report.

Review Board IR #12   Risk assessment

Reference
DAR s9 Effects of the Environment on the Project
DAR s10 Assessment of Accidents and Malfunctions
The risk assessment considered "credible" events as those that have a reasonable probability of occurring during the 25 year period of developer's activities.

Terms of Reference
2.3 Temporal Scope
"(T)he Review Board has set a limit on the duration of **activities** that it can meaningfully assess... For the purposes of this EA, **the development activities** are those occurring within 25 years and extending to any further time required to stabilize the site. This assessment will not consider the **impacts of activities** occurring after that period". *(emphasis added)*

3.2.5 Accidents & Malfunctions
"The developer is required to:
1. Analyze risks for this development, including components, systems, hazards, and failure modes.
2. Assess likelihoods and severity of each risk identified".

Preamble

The DAR section on accidents and malfunctions only examines failures of individual elements of the project in isolation. It describes what would happen assuming all design features, mitigation measures and emergency response plans are functioning ideally. It does not address likelihoods and severity of each risk. It provides no scenarios of larger events that could cause compound failures of several elements, or consequences of domino effects within overall systems. This includes the larger events described in section 9.

The risk assessment defines "credible" events as those that have a reasonable probability of occurring within the first 25 years, based on the temporal scope of the EA. However, the temporal scope defines the activities assessed, not the duration of effects of the project to be considered. The Board assesses what happens *because of* development activities occurring within that time, not only the effects that happen *during* that time.   The developer's definition of "credible" appears to exclude all long-term risks and low probability events.

Request

1. Please identify risks for the life of the project, beyond those occurring during initial development activities.
2. Please identify scenarios for events in short and long-term which could cause multiple failures of components of the project.
3. Please evaluate probabilities and severities and consequences (including costs) resulting from those scenarios.
4. Please describe how failures of individual components would affect the larger systems they are a part of.
5. Please describe probabilities, severities and consequences (including costs) for the events discussed in section 10 plus any additional long-term risks identified (see point 1, above).

Review Board IR #13 Seismicity

Reference

DAR s.9.2.2.1

"Based on this information, it is anticipated that seismic events will not cause adverse effects that would compromise the overall performance of the Remediation Project. As a precautionary measure, the occurrence of an earthquake with a magnitude of 5.0 or greater will prompt a geotechnical inspection of the tailings covers, dams, conveyance channels and other potentially vulnerable structures".

DAR s.9.2.3

"Free standing structures will be designed and built to meet applicable earthquake standards in the National Building Code."

(SEE http://www.crcnetbase.com/doi/abs/10.1201/NOE0415444019-c196)

DAR s.7.2.2.7

"Understanding of seismicity in the stable shield or core regions of continents has lead to revised seismic values… This increased understanding has lead to the assumption that a large earthquake could occur anywhere in the Canadian Shield, albeit rarely. The probabilistic hazard values correspond to a… 2% probability of exceedence in 50 years".

Terms of Reference

ToR 2.3 Temporal Scope

"(T)he Review Board has set a limit on the duration of **activities** that it can meaningfully assess... For the purposes of this EA, **the development activities** are those occurring within 25 years and extending to any further time required to stabilize the site. This assessment will not consider the **impacts of activities** occurring after that period". *(emphasis added)*

ToR 3.3 9.

"a. A thorough analysis and discussion of diverse scenarios that may lead to partial or complete failure of the freezing system, and the risks associated with thawing for each scenario, including scenarios caused by external variables (such as prohibitive fuel costs, wildfires, warming of ground water, changes in the surface energy balance from ground water flow regimes influencing the ground surface vegetation, etc.) and internal engineering risks (such as crown pillar deformations, shearing of thermosyphons, stope collapses, etc.);"

Preamble

Assessment of risk requires considering both probability and consequences of events. The earthquake scenario is dismissed because it is "highly unlikely". However, the costs of consequences could be catastrophic especially during construction. Other parts of the same section of the DAR (9.2.2) specify that it considered risks only over a 25-year time period, the temporal scope of the assessment. However, the temporal scope defines the activities assessed, not the duration of effects of the project to be considered. The Board assesses what happens *because of* development activities occurring within that time, not only the effects that happen *during* that time. Long-term stability is an important aspect of the project.

Request

1. Please provide seismic scenarios with earthquakes of various sizes (including Richter magnitudes of 5.0-5.9. 6.0-6.9 and 7.0 to 7.9) hitting the partially frozen system (eg. cavities' perimeters are frozen with unfrozen dust; cavities perimeter frozen, saturated unfrozen dust; etc) and the frozen system.
2. Please evaluate probabilities and consequences on natural geological features, man made structures and their environment, with as well as buildings, pipes etc.
3. Please provide possible drainage scenarios in the aftermath of an earthquake.
4. Please define "credible" seismic event over the duration of the project (instead of the 25 year period considered elsewhere in section 9.2.2).

Review Board IR #14 Stability

Reference

DAR s.6.2.6 page 6-29

> "The dust is thought to be quite open, with porosity estimated at up to 60%. The high porosity and the high latent heat of freezing water means that if water at even 1 or 2°C is added to the dust, it will infiltrate before it freezes. On the other hand, tests to date indicate that the dust has a relatively low hydraulic conductivity, estimated at 7x10-7 m/s. Based on these estimates, simply adding water to the surface of the dust and allowing it to infiltrate would be feasible but slow, taking up to several months in the larger chambers. ... Wetting methods remain in concept at this time and additional tests are planned as part of further design… Other alternatives are also under consideration. One method would involve lowering a high pressure nozzle into the dust… Water would then be jetted into the dust…"

Dec. 13, 2010 Deficiency Response, reply to item 2

> "One risk that could in fact be heightened by a sequence of freezing and then deliberate thawing is the risk of bulkhead failure. The current risk is described in Section 10.6.1 of the DAR. However, the thawing of water in the frozen blocks could, if not controlled, lead to significantly increased pressures on the lower bulkheads, thereby increasing both the risk of a bulkhead failure and the amount of arsenic trioxide dust that could be expelled into the lower reaches of the mine".

Dec. 13, 2010 Deficiency Response, reply to item 1, page 1

> "The most potentially significant issues pertain to the stability of some of the bulk heads and certain crown pillars. However, these risks are associated with the site in its current condition (i.e., they are not caused by the Project) and the risks will be mitigated through the implementation of the Project".

DAR s. 5.1.4

> "The crown pillar above stope C212 was concluded to be unlikely to fail. However, any disturbance of the C212 crown pillar could have resulted in Baker Creek being funnelled directly into the stope. The subsequent relocation of Baker Creek away from stope C212 in 2006 has greatly reduced that risk".

Dec. 13, 2010 Deficiency Response, reply to item 2

> "It is likely, for example, that some of the risks that the frozen block method seeks to mitigate, such as the risk of bulkhead failure, would need to be carefully managed in any thawing program. However, the investigation, design and environmental assessment of the thawing program would presumably address those risks, along with many others that would arise from the thawing equipment, installation, operation, monitoring, etc".

Terms of Reference

3.2.5 Accidents & Malfunctions

"The developer is required to:

3. Analyze risks for this development, including components, systems, hazards, and failure modes.
4. Assess likelihoods and severity of each risk identified".

Preamble

In evaluating risks or accidents and malfunctions, the Review Board must consider any stability issues arising from the proposed arsenic saturation and freezing method. The DAR raises the possibility of moving or agitating the water and arsenic dust during saturation while the perimeters of the chambers and stopes are already frozen, and may be swollen by the freezing.

Request

1. Please provide a stability analysis to prove that cavities will remain stable during perimeter freezing, saturation of dusts, freezing of dust.
2. Please describe drainage scenarios and any other potential releases or arsenic in the event of a collapse or bulkhead failure.

Review Board IR #15 Risks of flow from chambers as they freeze

Reference

DAR s.6.2.8.1 page 266

At Giant Mine, the initial freezing will therefore take place in rock that is well above the groundwater table. As discussed further in Section 6.8.3, the mine area is currently dewatered to the 750 Level, more than 100 m below the lowest portion of the freezing zones, and will continue to be dewatered to at least 20 m below the frozen blocks throughout the freezing period. The initial freezing will therefore take place in rock that has no groundwater flow.

DAR s.6.2.8.1 page 265

Experience with ground freezing projects elsewhere has shown that groundwater is the most common source of problems. Groundwater flow carries heat and, if the flow is sufficiently large, it is not possible to freeze the ground. A local groundwater velocity in the range of 1 to 2 m per day is often cited as the flow rate at which active ground freezing becomes difficult.

DAR s.6.2.5.2 page 251

All mine drifts leading to a frozen block zone will be plugged. Backfill plugs will also be installed wherever freeze pipes need to pass through open drifts or other voids. The plugs will provide a thermal connection to the walls of the drift or void, allowing the freeze wall to form without unfrozen gaps. A program to test methods for creating backfill plugs forms part of the FOS.

DAR s.6.2.8.1 page 266

The introduction of water into the dust during the wetting stage will create a potential for water to flow out of the frozen zones.

DAR s.5.2 page 177

The other underground mine workings form a network of connected voids, including horizontal drifts, inclined raises, vertical shafts, ramps, chutes and ore stopes. In addition, many thousands of exploration drill holes intersect the workings.

DAR 5.26, p 5-35

There are approximately 27,000 known historic exploration and production diamond drill holes on the Giant Mine site… There is no information suggesting that any of them have been filled.

DAR s.6.2.8.1 page 267

The plugged drifts and frozen zones around the arsenic trioxide dust will have overall hydraulic conductivities that are several orders of magnitude lower than the open drifts and voids located elsewhere in the mine. As a consequence, the frozen zones are not expected to experience any significant groundwater flow.

Terms of Reference

ToR s.3.3 2.

"A detailed explanation on the saturation procedure of the arsenic trioxide dust before freezing and a demonstration that the frozen dust will be compact and ice saturated, (i.e. no loose cold regions and frozen bridges occur that could jeopardize the stability of the system)".

Preamble

The proposed project involves saturating and freezing chambers with water, despite the possible presence of many unidentified holes and open voids. The project description in the DAR suggests that although detected and pluggable holes will be filled with fine-granular material, pre-existing undetected or unpluggable holes will remain open until the caverns are saturated with water. It is unclear how this may affect the freezing process, and whether it may cause other potential impacts.

Request

With respect to holes and voids in chambers during freezing:

1. Please define scenarios which include the presence of variable number/section of undetected/unpluggable holes
2. Please verify that freezing will be possible under flow
3. Please describe potential impacts and implications, such as possible losses of contaminants, over-costs of pumping/treatment, etc.

Review Board IR #16   Deformation

Reference

Document J (page 6) recognizes deformation of the rock mass, and states on page 34 “If necessary, water would be added in stages to control the effects of expansion caused by freezing.”

Terms of Reference

3.2.5 Accidents & Malfunctions

“The developer is required to:

- Analyze risks for this development, including components, systems, hazards, and failure modes.
- Assess likelihoods and severity of each risk identified.”

Preamble

Stability of the chambers during freezing is an important part of the proposed project. The DAR identifies that possibility of crown pillar collapse in some chambers. The Board needs to evaluate the risks related to freezing and structural stability. Presumably expansion of the cavity by freezing saturated dust will exert pressure on the wall. Further description is required of the effects on unstable crown pillars and bulkheads during freezing and during possible thawing in the future. Further description is also required of potential changes to surface drainage patterns due to changes related to freezing.

Request

1. Please verify possible deformations during the freezing process, such heave, differential freezing etc.
2. Please compare deformations to natural drainage patterns and check alterations.
3. Please describe potential impacts of instability or failure of crown pillars and bulkheads due to differential expansion and other changes that may occur during freezing.
4. Please describe potential impacts of instability or failure of crown pillars and bulkheads due to thawing and reductions of pressure.

Review Board IR #17 Wildlife

Reference

DAR s.7.5.3.1

> "Birds that are "At Risk" are the common nighthawk and olive-sided flycatcher while the harlequin duck, yellow rail, rusty blackbird and American white pelican are classified as "May Be At Risk'".

DAR s.7.5.4.4

> "The survey showed that no duck broods were present on the disturbed sites during the summer, likely due to the lack of emergent vegetation along the shoreline. However, gulls and terns preferred disturbed sites over control sites. While no ducks were observed in Baker Creek Pond, shorebirds nested in the area. A breeding bird survey conducted as part of the study during the summer reported a total of 79 species present on site from mid-May to mid-October, most associated with the wetlands on the site, followed by the mesic forests".

DAR s. 7.1.4.3 and Fig. 7.1.7

> "Sediments from Baker Pond had total arsenic concentrations in the range of a few hundred µg/g to over 3,500 µg/g".

Reference Supporting document N1 Tier 2 RA under 2.2.1 Potential Future Releases Associated with Remediation Case state:

> "No surface ponds will be present on site with the exception of the treated water storage pond. The arsenic concentration in the pond is expected to average approximately 0.38 mg/L, but the pond will be fenced. Therefore, it will be inaccessible".

Terms of Reference

ToR 3.5.4 (2)

> "The effects of each development component on each wildlife and wildlife habitat component"

ToR 3.5.4 (3).

> "The potential effects of the development operations on rare, threatened or endangered species including Peregrine falcon (*anatum* subspecies) and species listed by the Committee on the Status of Endangered Wildlife in Canada, including plans for monitoring species listed as "at risk" or "may be at risk" in the NWT General Status Ranks".

Preamble

To assess impacts on wildlife, the Board considers the effectiveness of proposed mitigations. The DAR and accompanying materials suggest that the treated water storage pond will be fenced to make it inaccessible

Request

Please describe if the treated water storage pond will be covered with fencing to keep water birds from landing on it. If not, please describe if and how water birds will be kept away.

Review Board IR#18 Habitat creation in Baker Creek

Reference
DAR s.6.1.1 Remediation Objectives #5: Restore Baker Creek to a condition that is as productive as possible

DAR s.6.1.2 Re: Baker Creek: "The selected approach… will improve both the quality and quantity to habitat… expected to result in a gradual increase in numbers and diversity of fish, animals, wildlife and native vegetation in the drainage area of the creek. At the discretion of DFO, catch and release fishing could continue. Food fisheries may need to be discouraged, depending on he level of residual arsenic concentration.

DAR s.6.9.3 p6-88
"Contaminated sediments are present throughout the creek, but there is evidence that reaches are biologically productive. The extent and severity of effects to the existing aquatic life in the creek from current contaminated sediment levels is unknown... A final determination has yet to be made whether removing and/or covering contaminated sediments will outweigh the disruptions to current biological functions…. Baker Pond contains tailings and contaminated natural sediments, but is also believed to be an important source of nutrients and food for fish". INAC is considering creating or enhancing wetlands in Reach 5 and 6 of Baker Creek.

Baker Creek sediments contain thousands of parts per million arsenic, well over applicable criteria. Among the highest concentrations are in Reach 5 and 6 (DAR 7.1.4.3 p7-19 and Fig. 7.1.7). There is a potential for adverse effects from arsenic on both predator and forage fish within Baker Creek (DAR 8.9.4.2 p8-79). There is an abundance of superior habitat in the Local Study Area and Regional Study Area" (DAR 8.8.2.3)..

DAR Table 12.3.1 p12-23
Re: Elimination of wildlife habitat on structures
Given that such structures may pose… chemical risk to wildlife that nest in them, the elimination of wildlife habitat through the demolition… will not result in a significant adverse effect"

Terms of Reference
3.5.2 Fish and Aquatic Habitat
"Potential effects to fish and fish habitat were identified as issues of concern during the Review Board's scoping exercise. Public concern focused on the development's potential to contribute to the contamination of local fish stocks and aquatic habitat, including concerns about health impacts on traditional harvesters and other harvesters of fish"

Preamble
The ecological benefits of creating attractive breeding habitat for fish and other wildlife in the form of enhanced wetlands (p6-88) in highly contaminated areas of Baker Creek are unclear. Wetlands in Baker Creek will likely attract fish, water birds, and semi-aquatic furbearers. The DAR recognizes that fish in Baker Creek may be unsafe to eat, and that muskrat and mink will likely exceed toxicity reference values (p8-80). The DAR states that superior habitat is locally abundant. The DAR predictions on terrestrial wildlife recognize that habitat is not as valuable when it poses a chemical risk to the species using it.

Request
Please explain the reasoning behind creating wetland habitat that is attractive to fish, water birds and fur-bearers in contaminated setting of Baker Creek.

Review Board IR#19 Future technologies

Reference

DAR s.6.2.2.4
"The Project Team remains open to improvements in the frozen block method, and will re-evaluate alternatives if technologies advance or if monitoring data indicate unforeseen emerging risks to the environment and/or humans".

Terms of Reference

ToR 3.3
3.(Include) a discussion of whether the developer contemplated a reconsideration of the frozen block method should a technological advance or change in the environment make it either necessary or advantageous to do so.

Preamble

The DAR establishes that the project has thoroughly examined best available technologies, and that it is open to improvements if technologies advance. It is unclear how future technologies will be recognized and considered.

Request

Please provide details on how emergent technologies will be considered in the future, and the frequency with which this will occur.

Review Board IR#20 **Long term resilience**

Reference
DAR s.6.9.1 p6-75 Baker Creek- Key Concerns
DAR s.9.2.2. Evaluation of Potential Effects of the Environment on the Project

In the event of a storm greater than 1 in 500 year event, channel wall failure alongside A2, B1 or C1 pits would likely cause Baker Creek to flow into a pit, causing uncontrolled flooding of the mine (p6-75). 1 in 370 year event would overtop A2 pit (p9-6). Ice and debris jamming could make this worse. The predicted high winter temperature increase is 4.8°C (p9-5) and the predicted general precipitation increase is a maximum 13% (p9-6) for the25 year period of initial development activity. Groundwater flow rates may increase as freezing shuts off other areas (p6-32).

DAR s.7.2.2.7
"Understanding of seismicity in the stable shield or core regions of continents has lead to revised seismic values… This increased understanding has lead to the assumption that a large earthquake could occur anywhere in the Canadian Shield, albeit rarely. The probabilistic hazard values correspond to a… 2% probability of exceedence in 50 years".

DAR s. 9.2.2.2 p9-5 Temporal scope of climate change considered predicted climate changes over 25 years "for the 2050s period (2041-2070)".

Terms of Reference

2.3 Temporal Scope
"(T)he Review Board has set a limit on the duration of **activities** that it can meaningfully assess... For the purposes of this EA, **the development activities** are those occurring within 25 years and extending to any further time required to stabilize the site. This assessment will not consider the **impacts of activities** occurring after that period". *(emphasis added)*

3.1.2 Assessing the Impacts of the Environment on the Development
"Consideration should be given to the impact of the environment, such as the impact of extreme weather events or climate change, on the development in each of the sections of 3.2, where applicable.

3.3 (10) An account of how climate change predictions and observations affect the risk level in the long-term based on "best estimate" and "high estimate" scenarios, including discussion of risks in light of the current climate predictions as set out in the *Fourth Assessment Report* of the Intergovernmental Panel on Climate Change

Preamble

This project is proposed for perpetuity, but is not engineered for perpetuity. For example, important components such as the Baker Creek channel wall above the pits are only expected to withstand up to a one in 370 year flood event. Although infrequent, a major earthquake can be reasonably foreseen over the long term. A project intended for perpetuity must be engineered to withstand infrequent high consequence events.

Long-term impacts of climate trends on temperature and precipitation have not been considered beyond the initial 25 years. The temporal scope of 25 years defines the activities assessed, not the duration of effects of the project to be considered. The Board assesses what happens *because of* development activities occurring within that time, not only the effects that happen *during* that time. Stability of the project considering long-tem climate projections is an important aspect of the project.

Request

1. Please describe how INAC can model long term climate change (including changes in temperature and precipitation, and systemic effects on groundwater), and for how long INAC can reasonably guarantee that the system and its components work.
2. Please provide scenarios and describe the implications in terms of 1) effectiveness of passive freezing over the long term and 2) water management, with management options, funding implications and related risks.
3. Please describe the limits of project systems with respect to increased precipitation extremes. For example, suppose the pumping or water treatment systems fail during an extreme precipitation event, and that the same event causes increased surface water volume, increased groundwater and a channel wall failure above the C1 pit causing the creek to enter the pit. How long would it take for the water storage pond, underground water storage and pits to fill before contaminated water is released to the surrounding environment?
4. Please explain why INAC expects the project to last for perpetuity when it appears to be designed to shorter term tolerances.

Review Board IR#21 **Arsenic intakes and sediment**

Reference

DAR 7.1.2.3 p7-9 Surface water quality-Local study area
DAR 8.9.5 Arsenic Intakes by Human receptors

Terms of Reference

ToR 3.4.2 Health and Human Safety
ToR 3.5.1 Water
ToR 3.5.2 Fish and Aquatic Habitat

Preamble

It is assumed that the assessment of human health risks is based partly on surface water quality. The project proposes to release arsenic through a diffuser year round into Yellowknife Bay or Back Bay. People swim in many locations in those bays. Ingestion of water by users of the bays is not limited to clear water, but includes sediment in turbid water. Arsenic loading of sediment in Back Bay and Yellowknife Bay is recognized in the DAR. This should be reflected in the assessment of human health risks.

Request

1. Does the measurement of surface water quality in the LSA include arsenic on sediment in turbid water, to indicate total arsenic in the water column, or was analysis conducted only after particulates from sediment had settled?
2. Do the health and human safety assessments include accidental ingestion of, and topical exposure to, sediments in Ndilo, Latham Island, Back Bay, Yellowknife Bay (houseboat community) and Dettah? If not, please include it in a revised assessment.

Review Board IR#22 **Project effects on cancer risks**

Reference

DAR Table 8.9.2 Estimated Intake of Arsenic by Human Receptors
DAR Fig. 8.9.6 Comparison of Arsenic Intakes
DAR Fig 8.9.6 Comparison of Cancer Risks

Terms of Reference

ToR 3.4.2 Health and Human Safety

Preamble

Arsenic is carcinogenic. The health impact of the project on people is an important consideration for the Review Board. The DAR attempts to show how project would affect cancer rates of people in the project area. More details on arsenic exposure are needed to compare arsenic uptakes with averages, and to contrast cancer risks with general cancer risks in the NWT. The figures in the DAR present average cancer rates for the NWT. However, cancer risks for smokers and non-smokers differ by up to an order of magnitude. Statistically, the large standard deviation from averaging the two groups, with their very different risk levels, does not meaningfully evaluate the actual risk for most people. Presenting cancer risks controlling for this variable will allow a more meaningful comparison of any increased risks from the receptors identified in the DAR.

Request

1. Please provide the curve showing the statistical distribution for typical arsenic exposure in Canadian adults (indicated as a section on Fig. 8.9.5). The current graphic only indicates the range of values, not their distribution.
2. Table 8.9.2 shows the mean toxic arsenic intakes by receptors 1-4. What are the maximum estimated arsenic levels for the receptors?
3. Please provide figures that graphically illustrate relative cancer risk of study receptors (as per Fig. 8.9.6) that separately indicates cancer risks for smokers and non-smokers. Describe how these separate cancer risk levels compare with the incremental lifetime risk of developing internal cancer for receptors with the highest arsenic intake in the Yellowknife area.

Review Board IR #23 **Approach to assessing significance**

Reference

DAR s12.2.2 Significance Determination
"If any of the Primary Criteria (magnitude, spatial extent or duration) was assigned a "low" ranking, then the residual effects would immediately be considered a minor adverse effect (not significant)".

Terms of Reference

ToR s.3.1 Considerations
"… the developer must apply the impact prediction criteria in the Review Board's EIA Guidelines…. The developer will provide its views on the significance of predicted impacts…"

Preamble

In reaching its predictions about the significance of impacts, the developer considered whether the magnitude, duration or spatial extent were ranked "low". If any one was, the developer did not consider the frequency, probability, reversibility, VC ecological importance or VC social value for any predicted impacts. These are latter criteria are not necessarily secondary considerations. For example, with the method used, a highly probable impact on a highly valued component, with high magnitude and high spatial extent would automatically be considered "not significant" if duration is low.

Request

1. Please explain the detailed reasoning behind using only three of seven criteria to evaluate the significance of most predicted impacts.
2. Please provide an updated Table 12.3.1 in which a ranking of "high" in any of the "Primary Criteria" results in the consideration of remaining criteria.

Review Board IR#24 Diffuser details

Reference

DAR Fig. 6.8.4

INAC describes the plan to discharge treated water containing arsenic into Great Slave Lake via a diffuser in Back Bay or Yellowknife Bay, in one of three locations. At the point of outfall, the water will exceed CCME water quality guidelines for the protection of aquatic life and drinking water quality guidelines (s6.8.6, p6-81), but will quickly be diluted. Currently, effluent enters the lake from Baker Creek, and no effluent is discharged in winter.

The DAR (s8.10.1,s8.10.2, p8-93) recognizes that "certain types of remediation activities have the potential to generate concern which, in turn, may lead to adverse effects on community well-being" and identifies "community perceptions of environmental health" as an evaluation criteria for adverse effects on Aboriginal communities. This may occur "regardless of the positive effects of the remediation project" (s.8.10.2..1 p8-94). Table 8.10.2 states that "the discharge of treated mine water into North Yellowknife Bay may generate concern among traditional land users who fish there".

DAR p8-22 Table 8.4.5 Heat carried from discharge water could thin the ice above it, posing a safety risk in Yellowknife Bay. Heat is expected to be rapidly reduced by mixing. INAC will also consider Access restrictions in the vicinity of the diffuser.

Terms of Reference

ToR 3.4.2 Health and Human Safety

"During scoping, many participants raised concerns about potential adverse impacts to human health and safety linked to exposure to arsenic trioxide. Both real and perceived risks to human health and safety can have a significant impact on the populations that live in proximity to the Giant Mine site."

ToR 3.5.1 Water

ToR 3.5.2 Fish and Aquatic Habitat

Preamble

The DAR lacks details necessary to understand the effects of the diffuser outflow on public concern, safety and water quality.

Request

1. For each diffuser location, please describe and illustrate the currents in the bay in the various seasons, at a scale that encompasses the local study area, to identify where effluent ultimately travels. Does this water go to Ndilo, Latham Island, Back Bay, Yellowknife Bay (houseboat community) or Dettah? Describe the potential, over the long term, for this to result in arsenic sediment loading in any of these areas.
2. Please provide the model, if any, that is the basis for conclusion that "thermal loading is not expected to be an issue", considering currents during ice conditions. If there is no model, please provide a detailed analysis.
3. Is INAC able to restrict access to the surfaces of frozen water bodies, as identified as a possible mitigation in Table 8.4.5? If so, please describe how.

Review Board IR#25 Mercury

Reference

DAR 4.3.3	Ore processing included mercury amalgamation.
DAR 7.4.2.2	Effluent from Giant Mine contributed elevated levels of mercury in Yellowknife Bay.
DAR 14.2.3	Fish tissue samples will be analyzed for mercury.
DAR 14.2.4.1	Vegetation and soil samples will be analyzed for mercury.

Terms of Reference Section
ToR s 3.5.2 Fish and Aquatic Habitat
ToR s 3.4.2.1 (1) Human Health and Safety

Preamble

The release of mercury into aquatic food chains by the project could be relevant to the Review Board. In addition to the arsenic contamination of the Giant Mine it is important to consider the mercury amounts in the area as large quantities of the element were used in the mercury amalgamation process in the early history of the mine. The remediation project could remobilize the mercury by exposing it to the weather conditions. This may be relevant in of itself, or cumulatively in addition to other sources of mercury in food chains.

Request

Please describe:

1. the fate of on-site mercury contamination in light of the rehabilitation project;
2. the potential effects on the aquatic environment and human health;
3. any efforts to measure mercury concentrations in the local aquatic food chain, and the results of these studies; and,
4. the potential of the remediation project to remobilize mercury by exposing it to weather conditions

Review Board IR#26 Arsenic reacting with carbon dioxide in soil

Reference

DAR ES1

The site contains approximately 16 million tonnes of tailings containing arsenopyrite on the surface.

DAR 5.5.5.1

Tailings contain arsenopoyrite and soluble arsenic.

Terms of Reference Section

ToR s. 3.4.2 Human Health and Safety,
ToR s. 3.3 (3) Arsenic containment point
ToR s. 3.5.1 (3) Water)

Preamble

To evaluate the impacts of the project, the Board needs to ensure that all sources of arsenic have been duly considered. Arsenic trioxide reacts easily with carbon dioxide to form highly mobile arsenite. Any arsenic trioxide in wastes that have been covered or capped with soil can become mobilized by reacting with carbon dioxide in soil gas. Some evidence for this phenomenon comes from the fact that the arsenic levels in pore waters of Baker Creek marsh and pond are much higher than the concentration of arsenic in tailings decant used in loading estimates.

Request

1. Provide an analysis of the redox sensitivity of arsenic minerals in the environment and the related mobility of arsenic after remediation.
2. Describe how this affects future loading estimates.

Review Board IR#27 Independent monitoring

Reference

DAR 14.1.6, p14-5
"(I)nput from Aboriginal communities and the public will continue to be sought throughout the life of the Remediation Project… As the implementation of the Remediation Project advances, and in response to monitoring results, the public and Aboriginal communities will be engaged in the review of monitoring results and the identification of adaptive management approaches needed to address any environmental issues identified through the monitoring program".

DAR s.6.2.2.4
"The Project Team remains open to improvements in the frozen block method, and will re-evaluate alternatives if technologies advance or if monitoring data indicate unforeseen emerging risks to the environment and/or humans".

Terms of Reference

ToR 3.6 Monitoring, Evaluation and Management

The continued surveillance of the environment at and around the Giant Mine site was a source of interest for participants throughout the scoping phase of the environmental assessment. To address this concern the developer shall provide:

1. A detailed description of the monitoring program proposed by the developer, including at a minimum a description of:
   h. Plans to periodically review of the efficacy of the proposed monitoring program and technologies used and a reevaluation of the goals and benchmarks of the monitoring program
   i. Plans to engage with local communities in the development, implementation and review of monitoring activities

Preamble

Considering the multiple roles of INAC and the public concerns expressed regarding this project, the Review Board is interested in INAC's views on establishing an independent monitoring agency for the duration of the Giant Mine Remediation Project, to provide stakeholder involvement in overseeing environmental management

Request

1. Please describe any plans being considered for establishing an independent monitoring agency for the duration of the Giant Mine Remediation Project, specifying who might participate, and in what capacity.
2. How might such agency be engaged in any future examination of emerging technologies (per IR#19 above)?