INFORMATION REQUEST RESPONSE

EA No: 0809-001 **Information Request No: Review Board #07**

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Linkage to Other IRs

Review Board IR #05

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Request

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.

Question:
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.

Reference to DAR (relevant DAR Sections):

S.5.1.4 Stability of Arsenic Trioxide Dust Storage Area Crown Pillars
S.5.1.5 Stability of Arsenic Trioxide Dust Storage Area Bulkheads
S. 6.2.4.1 Bulkheads
S. 6.2.4.2 Crown Pillars
S. 6.2 Arsenic Trioxide Dust Storage Areas

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".

Reference to the EA Terms of Reference:

S.3.3 Arsenic Containment

Summary

Freezing of the chambers may cause cracking of the bedrock resulting in some degradation of the rock quality. The crown pillars most at risk are located in the B1 Pit, where prior to freezing, the voids beneath the pillars will be backfilled and fill will be placed above the pillars. As a result, any cracking of the crown pillar will be supported, and the risk of collapse mitigated

Prior to freezing, all drifts leading to or from the base of the arsenic chambers and stopes will be plugged. Freeze pipes will be located through each plug and the plugs will be frozen as part of the initial development of a frozen shell. If a bulkhead fails during the subsequent freezing within the shell, the arsenic dust will be contained by the frozen plugs.

The risks of planned thaw, including failure of the crown and sill pillars, are discussed in Review Board Information Request #5 (IR#5).

Response A

Crown pillar stability in the event of a planned thaw is discussed in the response to IR#5.

Freezing of the chambers may cause cracking of the bedrock resulting in some degradation of the rock quality. This effect increases the risk of failure of both the crown and sill pillars during a planned thaw. The final design of the backfilling of the voids between the crown pillar and the voids is still to be determined and any planned thaw would include mitigation measures to minimize the risk of failure such as those described in IR#5.

During a planned thaw, the crown pillar would likely be thawed prior to the saturated arsenic (and the backfilled void). If the crown pillar failed, the risk of an arsenic dust release to the surface is unlikely as it would be supported by the backfilled void and overlying fill material.

The risk of a sill pillar failure is more likely to occur than a crown pillar collapse. If the mine is re-flooded, there is a risk of the movement of the backfill which supports the sill pillars due to fluctuations in the water level at depth. The mine level fluctuations would be caused by seasonal storage and during de-watering of the mine that would occur prior to the planned thaw. Further investigations of the sill pillar stability are planned prior to the final design to reduce the uncertainty. The risk of a sill pillar failure is further discussed in the response to IR#5.

Response B

Section 6.2.4.1 of the Development Assessment Report (DAR) (pg. 6-13) states that the long-term stability of these bulkheads is questionable and the short-term stability of some of them is also a source of concern. Due to the freezing process, a loss of bulkhead strength is possible. However, in order to complete the frozen shell around each chamber and stope, drift plugs will be installed. The design of the drift plugs has not yet been finalized. However, they are all located outside of the bulkheads. Freeze pipes will be strategically located to freeze the plugs, allowing them to be frozen during the development of the frozen shell, i.e. well before any freezing of the bulkheads. Any arsenic dust releases caused by subsequent failure of the bulkheads will be contained by the plugs with no escape of arsenic.

Response C

Freezing of the tunnels outside the dust storage areas may lead to some localized spalling of the bedrock, but not to the degree that will cause instability.

Details of the drift plugs and the backfill for voids between the dust and crown pillars are still under discussion as part of the design process. It is worth noting that drift plugging and void backfilling are common operations in underground mining, and a number of well-proven methods exist.

Response D

Table 5.1.7 of the DAR states that a crown pillar collapse for chambers B208, B212, B213, and B214 is possible. All of these chambers are located by B1 Pit that is to be backfilled prior to freezing. Before the pit is backfilled, Section 6.4.3 of the DAR states that the voids between the crown pillars and the arsenic trioxide dust are to be stabilized. Several materials are being considered for use as backfill material in the void, including coarse rock, cemented aggregate, and foam cement. Additional cost and constructability analyses are needed before a selection is made. In addition, Highway #4 will be relocated prior to freezing of the chambers near the present highway. As a result, there is no direct risk to public safety.

As a result of the stabilization and backfilling that occurs before the freeze begins, any cracking of the crown pillar will be supported, and the risk of collapse mitigated.