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Brad Thompson
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CRITERIA FOR DRILLHOLE DESIGN

Dear Mr. Thompson,

This letter summarizes the design guidelines used for the collar and breakthrough locations of the 2013/2014 IUS paste delivery and observation boreholes.

In some instances, following the guidelines for the drilling of specific boreholes was not possible given the geometry of the site, i.e., surface access and underground workings. In these special circumstances the issues encountered were discussed with the paste design group and modification to the design was done for that specific borehole.

Drilling Design Guidelines

1) Design Guidelines for Large Diameter Surface Boreholes:

- Designed at -60 to -90 degrees below horizontal.
- Cased over the full length with 200 mm (\pm 10mm) inside diameter Schedule 40 nominal thickness casing (A-106, API-5LPT or L-80 steel).
- Borehole breakthrough points spaced to accommodate an assumed 25 m unobstructed flow radius in the stopes and drifts.
- Boreholes which were greater than 40 m in length used for the purpose of delivering paste to a pipe in an underground stope or drift were angled at -65 to -70 degrees to reduce risk and wear on underground connection.
- Outer casing installed from ground surface into bedrock. Bedrock/overburden contact grouted to reduce groundwater flow into the underground voids.



2) Design Guidelines for Small Diameter Surface Boreholes:

- Designed at -50 to -90 degrees below horizontal.
- 96.1 mm borehole diameter, uncased from bedrock contact to end of hole.
- Outer casing installed from ground surface into bedrock. Bedrock/overburden contact grouted to reduce groundwater flow into underground voids.

3) Design Guidelines for Large Diameter Underground Boreholes:

- Designed at any orientation, +90 to -90 degrees above or below horizontal.
- Cased over the full length with 150mm (\pm 10mm) inside diameter Schedule 40 nominal thickness casing (A-106, API-5LPT or L-80 steel).
- Borehole breakthrough points spaced to accommodate an assumed 25 m unobstructed flow radius in the stopes and drifts.

4) Design Guidelines for Small Diameter Surface Boreholes:

- Designed at any orientation, +90 to -90 degrees above or below horizontal.
- 96.1 mm borehole diameter, uncased from collar to end of hole.

For all drilling conditions, a drilling accuracy of 1% horizontal deviation to vertical depth was assumed for target locations.

Yours very truly,

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

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