APPENDIX E03

Pad B / Power Plant Pile Design Technical Memorandums

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Memo

To:	Daniel Chen, Stephen Fader	**Date:**	July 11, 2011
Company:	Hatch	**From:**	Lowell Wade, Maritz Rykaart
Copy to:	Gerry Schwab, Calvin Goldschmidt, Bob Prince-Wright	**Project #:**	1CH008.033.0360
Subject:	Doris North – Pad B Power Plant Exhaust Stack Foundation Design		

1 Introduction

SRK was requested to provide a foundation design for the four 20 m stacks of the 1.45MW Doris North Project generators that are to be constructed on Pad B. Forces acting on the stacks were supplied by Hatch, and can be summarized as follows:

- Live load = 15 kN
- Live load due to ice = 93 kN
- Live load due to wind (perpendicular) = 120 kN
- Live load due to wind (diagonal) = 148 kN
- Moment due to wind (perpendicular) = 1,250 kN
- Moment due to wind (diagonal) = 1,500 kN
- Dead load = 120 kN

The stack will be fixed to a concrete footing measuring at least 2.8 m wide x 2.8 m long and 1 m thick. Foundation conditions beneath the footings stacks can be summarized as follows:

- About 4 m of run-of-quarry engineered and compacted fill overlying up to 5 m of saline, ice-rich, cold permafrost marine silt and clay. Competent basalt bedrock is encountered about 9 m below the pad surface;
- There is no permanent phreatic surface present, but a seasonal perched phreatic surface may be encountered at the interface between the engineered fill and permafrost overburden.

2 Design Concept

Two foundation designs were considered:

- A spread footing design;
- A pile foundation design.

2.1 Shallow Spread Footing Design

Using a Factor of Safety of 2, the allowable bearing capacity of the engineered fill on Pad B is 250 kPa. A spread footing appropriately sized to avoid overturning while still meeting the allowable bearing capacity criteria must be designed. Actual footing design and size would be by others, but by way of example a footing measuring 6.4 m length x 6.4 m width x 1.6 m height would meet the criteria.

2.2 Pile Foundation Design

The EPCM Contractor has stipulated that the pile design must use an available stock of about 100, 9 m long piles consisting of 4.5-inch diameter Schedule-40 steel pipes. These piles will be installed in a pre-bored 8.5-inch hole, and grouted in with 30 MPa arctic concrete.

The factored axial loading of individual piles has been calculated taking into consideration the following:

- Frictional resistance only for the upper portion of the pile passing through engineered fill;
- Adfreeze bond only for the middle portion of the pile passing through permafrost soil; however, due to high salinity, the allowable adfreeze bond is reduced by 90%;
- Axial loading dominated by socketing piles into competent bedrock, proving frictional resistance and end bearing capacity.

The corresponding factored allowable axial loading of an individual pile is 267 kN in compression and 174 kN in tension, confirming that a pile group is required to handle both the axial and lateral loads. The lateral loads are however dominating the design. The pile group will consist of 16 piles per footing, spaced 0.933 m apart in all directions. To withstand lateral loads, the outer 12 piles must be battered outward at a minimum angle of 14 degrees. The remaining 4 piles remain vertical. Each pile must be socketed into bedrock at least 1 m.

For the four footings, based on the pad geometry and bedrock isopach maps, this will require a total of 64 piles, with lengths ranging from 10 to 13 m. assuming an average length of 11.5 m, this means about 726 m of drilling and steel pipe. The available steel piles would be sufficient; however, every pile will have to be lengthened on site.

3 Conclusion

Either foundation design will meets the design requirements for 20 m exhaust stacks. Should the height of the exhaust stack change, or any of the other load requirements change, these designs will have to be re-evaluated.

Regards

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