Update on Electric U/G Equipment

Borden Gold

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WSN Conference
1. **Background on Borden Gold (battery electric vehicle)**

2. **Why Electric Mine?**

3. **Process**
   1. BEV Literature/Industry Review
   2. Eng. Trade-Off (Diesel vs Electric)
   3. Analysis of Other Considerations
   4. Decision Point – BEV or not?
   5. Acquiring Equipment
   6. Other Opportunities
   7. Operational Planning & Implementation

4. **Experience – 5 Months On**
1 - Geography & Lands
1 - Aerial Photography of Site

Borden Gold - Safe – Simple – Green – Silent – Invisible & Inclusive Project

Portal

Workshop

Water Pond

Workshop

Offices

Dry

Mine Rock Stockpile (MRS)
1 - Timeline

- **Discovery of Borden OP deposit**
- **Discovery of Borden UG deposit**
- **April – Acquisition of Probe**
- **January – Min. Reserves**
- **AE Permits received**
- **April – PFS complete**
- **15th May – 1st Round UG**
- **August – 275m UG**

- **2010**
- **2014**
- **2015**
- **2016**
- **2017 Q1**
- **2017 Q2**
- **2017 Q3**

- **PFS ongoing**
- **Permitting**
- **Decision for BEV**
- **MRMR**
- **AE Permit submissions**
- **Flow-through spending**
- **Vision towards BEV**
2 – Why Electric Mine?

- **Vision for future**
- **Sustainability** *(safety, environment, community)*
- **Economic** *(energy & cost reduction)*
- “Greener”
- **Improved social acceptance**
- **Technologically feasible**
1. **Review of BEV in underground mining**
   a. Historically: trolley trucks & tethered LHDs
   b. Locally: battery at KL Gold (small size), etc…
   c. Block cave: large, tethered LHDs on drawpoint horizon

2. **Equipment from OEMs**
   a. Availability on market & in development (proven vs concept, lead times, etc…)
   b. Capability (size, duty cycle, etc…)

3. **Other factors**
   a. Battery technology developing rapidly
   b. Interest from government and regulators
   c. Industry trend towards reduction of contaminants in air underground
1. **Advantages of BEV** Safety & sustainability, lower OPEX & CAPEX, project benefits

2. **Challenges of BEV** Initial CAPEX, engineering & operations, purchasing & maintenance, change

3. **Ideal mine for BEV**
   a. Long mine life
   b. Haul down ramp (loaded for regeneration)
   c. Deep & hot (vent. infrastructure)

   **Applies to Borden?**
   - ✗
   - ✗
   - ✓
1. **Challenge to establish engineering criteria**
   a. Ventilation requirements (not direct as with diesel)
   b. No empirical data for new equipment
      i. Power load estimation
      ii. Productivity
      iii. Maintenance
      iv. Safety requirements

2. **Hired consulting firms & Goldcorp sites**
   a. AMC and Hatch
   b. Benchmarking with conventional equipment
   c. OEMs provided estimations
   d. Produced financial models for comparison
   
   Error – Auxiliary ventilation was excluded from all scenarios

**Ventilation Criteria for Electric**

What determines requirement?

a. No DPM/NOx
b. No heat issues from estimation
c. Dust – min./max. air velocities
d. Other considerations?
e. Benchmark vent. regulations for non-diesel (interprovincial, international)

- 0.25 m/s under usual operation
- Sized larger for blast clearing & VOD
- Planned for VOD on contaminants
• **Equipment needed to be ordered prior to PFS completion**
  • Rental of equipment not possible
  • Lead times for equipment

• **GIF process adapted to project**

• **Data presented to IC for approval of funding BEV equipment**
1. **Support from corporate procurement team**
   - Direct conversation with suppliers individually

2. **Typical RFP process considered less effective**
   - Started during trade-off studies
   - Great interest in coming to market
   - Different philosophies & designs
   - R&D timelines
   - Reality vs Sales

3. **Engage with OEMs**
   - Started during trade-off studies
   - Great interest in coming to market
   - Different philosophies & designs
   - R&D timelines
   - Reality vs Sales
Other Opportunities

1. **Subsidies & Grants**
   a. Federal & Provincial governments (various programs)
   b. Utility companies (IESO) – rebate

2. **Corporate branding**
   a. Idea City – Designing Mines of the Future
   b. BNN interviews

3. **Leadership in updating standards/regulations**
   a. Fill a “void”
1. **Operational redesign for equipment**
   a. Tethered LHD
   b. Power reticulation (more lines, charging locations, 1kV, etc…)
   c. Cold climate parking (u/g, surface)

2. **“Training Camp” at Hoyle Pond UG Mine**
Experience – 8 Months In

1. General
   a. It worked relatively quickly!
   b. Industry inquiring on project
   c. Catalyst for Goldcorp sites

2. Detail
   a. LHD is slower than expected
   b. New habits: plug in after shift!
   c. Difficulties with charging
   d. LHD cable challenges
Experience – 8 Months In

Employee Satisfaction Survey conducted to determine the Miner’s perspective. Two of the questions and answers below.

<table>
<thead>
<tr>
<th>Question</th>
<th>The same</th>
<th>Somewhat better</th>
<th>Significantly better</th>
<th>A huge improvement</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compared with an all diesel fleet of equipment, is the air quality at Borden's all-electric project...</td>
<td>0</td>
<td>1</td>
<td>15</td>
<td>28</td>
<td>44</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question</th>
<th>I wouldn't recommend working at Borden</th>
<th>I might recommend Borden</th>
<th>I would recommend Borden more than other places I've worked</th>
<th>I would strongly recommend Borden because there is a huge difference in air quality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Considering ONLY the all-electric fleet, would you recommend working at Borden, over other diesel equipped mines?</td>
<td>0</td>
<td>9</td>
<td>11</td>
<td>23</td>
<td>43</td>
</tr>
</tbody>
</table>
Recap on Key Process & Lessons Learned

1. Equipment is stealth quiet U/G
2. Workers pleased about air quality
3. Major support from equipment vendors
4. Opportunities “outside the box”
5. Learning curve was steep but new technology embraced
Q & A