ABB Underground Electric Mining Haulage Trucks

Presentation Topics

- NIOSH observations
- MSHA regulations
- Benefits of the ABB electric trucks
- Truck Data
- Summary
- References
- ABB total customer commitment
- K635ED Video
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NIOSH Observations

- Short-term overexposure to diesel exhaust has been linked to health effects such as eye and nose irritation, headaches, nausea, and asthma.

- Based on a combination of chemical data, genotoxicity, and experimental carcinogenicity, NIOSH has determined that diesel exhaust is a potential human carcinogen.

- The International Agency of Research on Cancer regards diesel exhaust as a probable human carcinogen.

- The Environmental Protection Agency considers long-term exposure to diesel exhaust likely to cause cancer and environmental concentrations of diesel exhaust to potentially cause health problems.

- Underground miners can be exposed to over 100 times the typical environmental concentration of diesel exhaust and over 10 times that of other workplace exposures.

- About 34,000 underground miners and 200,000 surface miners are exposed to diesel exhaust, as are more than 1 million other workers in the United States alone.

References: http://www.cdc.gov/niosh/mining/highlights/programareas/highlights8.htm

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MSHA Regulations

- Improving workplace health and safety by legislative reduction of DPM via total carbon limits

- MSHA will issue a noncompliance citation when valid personal total carbon (TC) exposure measurement demonstrates noncompliance with the 160TC μg/m³ personal exposure limit at a high level of confidence

- For purposes of enforcement, Total Carbon (TC) is defined as the sum of Elemental Carbon (EC) and Organic Carbon (OC). Both EC and OC are measured by NIOSH Method 5040.1

- Diesel particulate filters and disposable filter elements, while effective at the reduction of total particles, in some cases, could actually increase the quantity of smaller particles

References:
- www.msha.gov/01-995/TotalCarbonPersonalExposureLimit.pdf
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Assumptions

- Dissipation of underground diesel truck emissions to ensure compliance typically requires ventilation rates of 100 to 150 CFM per installed brake horsepower.
- Typical ventilation costs are in the range of $5.75 per CFM
- Reducing TC, improves underground air quality and can reduce the CFM requirement which reduces operational costs

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Proven System

- First established in the 1950’s in Kiruna Sweden
- DC versions replaced with modern AC trucks in 2007
- Truck availability over 85%
- ABB Canada obtained product responsibility in late 2008 for the North American Market
- Continuous improvement from customer feedback
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Benefits - General

- Minimal demand on ventilation systems
- Fast speeds
  - Shorter cycle times
  - More production
  - Fewer trucks for same haulage
- Quick installation on non dedicated ramps
- Regenerative braking down ramp adds power back to the network
- Fast benefit of production increase and early return on capital employed
- Long asset life approx. 60,000 hours
- Environmental, health and safety friendly
  - Minimal diesel fumes
  - Low noise level
  - Low heat generation
- Flexible and expandable solution

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Benefits – Compared to Diesel

- Fewer trucks for same haulage (roughly half)
- Environmental friendly – Minimal exhaust fumes
  Fleet of 6 x 50 tonne diesel trucks @ 650 Hp each. $3,363,750 / year ventilation costs
  Fleet of 3 x 50 tonne electric trucks @ 120 Hp each. $310,500 / year ventilation costs
  OPEX Savings: $3,053,350 EVERY YEAR for SAME PRODUCTION!!
  Ventilation rate:150cfm/hp, $5.75/cfm/year
  - Less heat, less noise compared to diesel trucks
  - Lower operating cost on a fleet by fleet basis (about half)
  - Fewer drivers
  - Energy typically costs less than diesel fuel
  - Dynamic breaking on AC trucks generate power down ramp
- Can use steep ramps (shorter tunnels)
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Benefits – Compared to Conveyors

- Flexible
  - No re-loading
  - Easy to extend
- No mobile crushers needed
- Redundancy (more than one truck for the production)
- Dedicated ramp not required / less width
- Early start of production
- Reuse trucks at next ore zone

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Truck Family

K635ED
35-tonne
2WD
0-3% grade
Rear dump
Side dump
4WD
0-20% grade
Rear dump

K1050ED
50-tonne
2WD
0-3% grade
Rear dump
Rear dump
4WD
0-18% grade
Rear dump
Side dump

= on request
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**Truck Data**

- **K635ED, 35-tonne (38.6 short ton) net load**
  - Power: **480** kw (2x200kw+80kw) (270hp main motors)
  - Speed: **18** km/h (11 mph) uphill loaded in ramp +15% grade
  - Speed: 21.6 km/h (13.42 mph) empty down ramp

- **K1050ED, 50-tonne (55 short ton) net load**
  - Power: **800** kw (2x355kw+90kw) (483hp main motors)
  - Speed: **19** km/h (12 mph) uphill loaded in ramp +15% grade
  - Speed: 21 km/h (13 mph) downhill empty

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**Tunnel Dimensions**

- **35 Tonne**
  - 690 volt AC
  - 3.1m 10’
  - 4.2m 13’8”

- **50 Tonne**
  - 690 volt AC
  - 3.55m 11’8”
  - 4.8m 15’8”
ABB Underground Electric Mining Haulage Trucks
K635ED – 35 tonne haulage capacity

ABB Electric Underground Haulage Trucks
K635ED – 35 tonne haulage capacity
ABB Underground Electric Mining Haulage Trucks

Challenges – Engineering / manufacturing modules

- Fast speeds up steep inclines
- Minimal stress on existing ventilation systems
- Regenerative braking adds power back to the network
- Well proven system
- Proven availability
  - Truck availability over 85%
- Flexible layout
- Low OPEX costs
Experience / reference installations
Mining is a Core ABB Business
North America based support
World wide system support
Standard electrical and mechanical parts
Special Features
- Automatic trolley connection / disconnection
- Diesel motor / generator for off line duty
- Diagnostic system

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Summary – ABB Strength

Reference - Zinkgruvan Mine
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Reference – Vale Coleman Mine

- Feasibility study
- Calculation of optimum grade, width and height of ramp
- Preparation of layouts for loading, dumping, turning and passing areas
- Assistance with approval by mining authorities
- Design, delivery and installation of trolley line and power supply
- Installation and commissioning of system
- Training of operators and maintenance staff
- Performing inspections and maintenance
- World wide system support

K635ED Video