What is Ventilation on Demand?

- Ability to direct ventilation air in an underground mine to the area that requires it, at the quantity need for the local activities at the time.
- Requires fan and louvers controls, sensors to measure workplace environment, “tags” to identify where equipment is operating, and a computer control to manage air flow.
Background

• Discussions with NRCan in May’09 regarding suitability of a Ventilation on Demand project for Community Assistance Fund (CAF) program
• Note from CANMET with a rough outline of a VOD project and suggestion for CEMI to proceed with an application to the CAF program
• CEMI with assistance from CANMET, Vale and Xstrata Nickel submits application to CAF on June 12, 2009
• Aug 24, 2009 announcement that CEMI awarded funding

Project scope

• Purchase and install equipment at:
  – Vale Inco’s Coleman Mine
  – Xstrata Nickel’s Nickel Rim South Mine

• Undertake 3 “Demonstration Projects”
Technical Team

- Purpose: to ensure all the objectives of the technical projects are achieved
- Objectives:
  - Contribute to development of detailed scope of work for the demonstration projects
  - Recommend resources required to collect and analysis data which support the demonstration projects
  - Review on-going work and make recommendations for any changes required.
  - Advise on future research activities that could arise from this project
Demonstration Projects

• The purpose of each is as follows;
  1. To Validate Ventilation on Demand Objectives
  2. Analyze data to support the ventilation of mines using air quality criteria
  3. To develop guidelines for sensors used to measure underground air environment
• Budget for the projects is $1.3 Million and the work will be undertaken at both mine sites
• The extra sensors installed at both locations are to support the work of the projects

Project Details

• Field Study
• Model/Business Case
• VOD Justification Study
Bridging Underground and Laboratory Testing

Laboratory Testing

- Controlled environment
- Controlled cycle - repeatability
- High level of monitoring precision
- Controlled intake
- Controlled exhaust
Steady State Test Cycle

<table>
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<tr>
<th>Torque</th>
<th>Low idle</th>
<th>Peak Torque</th>
<th>Rated</th>
<th>High idle</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>75%</td>
<td>50%</td>
<td>10%</td>
<td></td>
</tr>
</tbody>
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Source: CANMET Mining and Mineral Sciences Laboratory

Underground Reality

- Difficult to Control
- Difficult to Monitor
- Unpredictable
- But REAL
CAF VOD Field Studies

- Project to determine financial benefits of VOD investment to mining operations
- Determine the benefits of a Quality Criteria

CAF VOD Methodology

- Perform in field testing in operating mines
  - Nickel Rim South Xstrata
  - Coleman 153 Vale
- Validate in production/ventilation model
Current Mining Ventilation Models

- Focus on determining Airflow (Static)
- Specifying Fan requirements
- Focus on primary network

Investment vs. Savings

Potential Savings

- Coleman
- Nickel Rim
- Retrofit
- New Install
- Investment in VOD
WHY MODEL?

- Excel cannot capture dynamic nature of mining
- Allow scenarios that we have not yet thought of

Model Development

Data Input Interface ➔ Mining Process Model ➔ Generate Demand & Run Scenarios
- Mining Methods
- Extraction Sequence
- Production Rates
- Schedule
- Production Fleet

Agent Rules Utility ➔ Generate Air Volume Demand
- Auxiliary System
- Primary System
- Time-of-Day
- Activity-Based
- Full VOD

Ventilation Solver ➔ Solve/Balance Ventilation System
- Fan Power
- Energy Consumption
- Energy & Cost Savings

Baseline Data ➔ Vent Component Data

DYNAMIC

STATIC
Dynamic Vent Modeling

- Models production
  - Including load on production equipment
- Includes primary/secondary
- Provides changes over time

In-Field Monitoring

Symbot

- Real time data collection
- Wi-Fi Transfer
- Open data transfer

Interface to Engine Controller

Provide ambient sensors

Provide exhaust monitoring
Goals

• Measure actual U/G production cycles
  – ECU data
  – Ambient gas monitoring
• Replicate on Dyno
• Determine Load
• Integrate in model

Peer Review

• Held June 17, in conjunction with the Ventilation Symposium
• Attended by
  – Rick Brake, MVA, Australia
  – Keith Wallace, MVS, US
  – John Vergunst, MOL
  – CAF Technical Team
Peer Review

- Key Points
  1. A systematic major hazard review is required
  2. Will need to re-evaluate future contaminants (not NOx, more heat or DPM)
  3. Objectives optimistic, given timeframe
  4. World moving to quality from quantity
  5. Quality based system will require significant control/monitoring
  6. Analysis of data will occur mainly after project
  7. Did not identify others doing similar work

Development of Best Practices Guide

- Draft of topics developed with the Technical Team
  - Reference working document
Current Status

• System Installation nearing completion
• Ventilation Model nearing completion
• Ready to begin the detailed field studies

Why Project is Relevant?

• Demonstration projects will provide useful information for any underground mining company
• Funding of equipment purchase that will improve the energy usage at 2 local mines
• Support of local companies
• Building of local capability and capacity
• Recognition opportunity for CEMI
Next Steps – VOD 2

- Need to start the planning for the next phase of the work
  - Mine energy savings?
  - Continue the Quality vs. Quantity project?
  - Enhancements to VOD systems?
  - Detailed study of the data?

Acknowledgements

- Vale and Xstrata Nickel
- CANMET
- FedNor
- Bestech and Simsmart
Thank You

• Questions