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# Underground Real Time Diesel Exhaust Gas Sampling

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## Presentation

- Test Project
  - Equipment
  - System Components
- Progress in 2011
- Current Status
- Challenges
- Successes
- Next Steps
- Acknowledgements

## Underground Real Time Diesel Exhaust Gas Monitoring Project

### Introduction

- Vale is a global mining company with operations in several countries around the world
- Vale Canada operates 6 base metal mines in the Sudbury, Ontario region; Thompson , Manitoba as well as a Potash mine in Saskatchewan
- Vale is committed to **Safe Production**.
- Research & Project initiatives are techniques used to continually improve how we attain our Safe Production goal

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## Underground Real Time Diesel Exhaust Gas Monitoring Project

**This project in partnership with Draeger Canada/Wireless Sensor Networks Canada**

Development of a cost effective, unit to sample, store and transmit real-time exhaust emission data. that has the ability to provide accurate and reproducible engine exhaust tests

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## Real-Time Onboard Gas Monitor Design Parameters

- exhaust (pre & post treatment devices) measurements during operation
- Ambient CO measurement at the operator
- function without compromising the safe operation of the diesel unit or the engine and associated exhaust treatment devices
- operate without operator intervention or dependency
- have programming capability (sampling time/duration)
- include data storage capacity and is downloadable for data management and analysis
- The system must be able to wirelessly transfer data to the existing communication network and/or have the ability for manual download if required.

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## Real-Time Onboard Gas Monitor Protocol

**Operation**

- Interface Control Module unit integrates the components of the:
  - Dräger EM200-RMD and
  - Exhaust sampling system, power supply and data storage components
  - Internal control Unit (ICU) controls the EM200-RMD, switching between manifold, and tailpipe monitoring points.
- The Symbot polls the ICU for exhaust gas and ambient CO monitoring data
- Symbot polls info from the Engine Control Module (for engine data such as engine temp, rpm, oil temp, back pressure, etc.)
- Data is transferred wirelessly from machine Symbot to surface computer

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### Potential Uses of Onboard System

- Meet OSHA Reg. 182 (5) and 183.2(1.1) – emission testing and repeatable sampling
- Application for Occupational Health Monitoring Programs – ambient operator personal exposure levels
- Ventilation On Demand Systems – compliance to OEL's and potential reduced ventilation (certification cfm)
- Engine Health Indicator – pre exhaust treatment devices
- Performance Evaluation of Exhaust After-Treatment Devices – pre & post exhaust treatment device sample

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### 2011 Progress

- Bench test comparison at CANMET Lab against their standard gas monitoring equipment used in engine certification.
- Developed a protocol specification for integration with the Symboticware "Symbot" unit
- Conducted a "bench" test with Draeger/Symbot integration process
- The On-board monitor is currently installed on an MTI – LT650 LHD unit equipped with a Mercedes OM906LA engine @ 220 hp (168 kW). This LHD is located at the MTI Surface Demonstration Facility in Lively, Ontario

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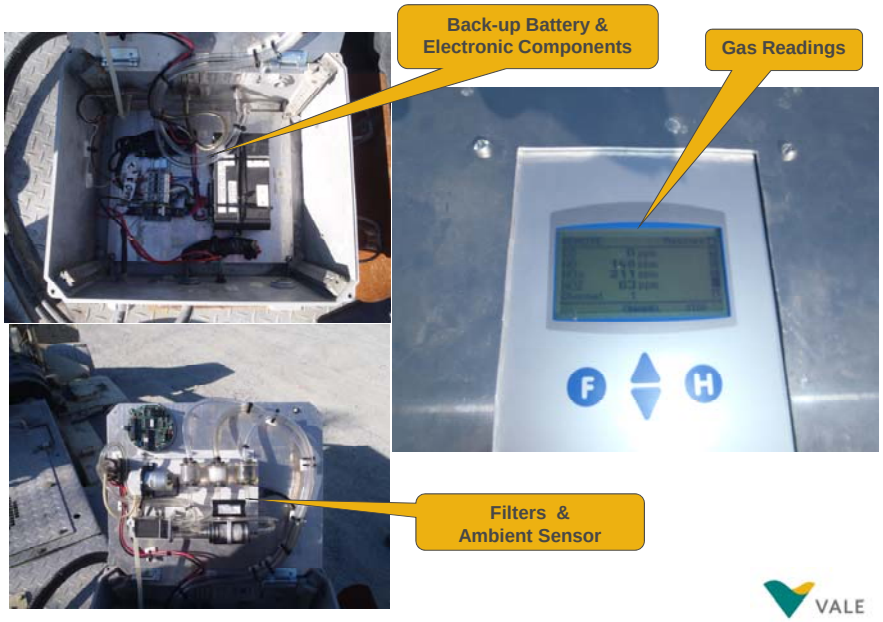
## CANMET Testing


## MTI Surface Demonstration Site Installation

## MTI Surface Demonstration Site Installation

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### Current Status

- Test unit is installed on the MTI scoop which is working in their surface demonstration facility used in development mucking.
- Collecting Real-time exhaust gas data – pre & post after treatment devices

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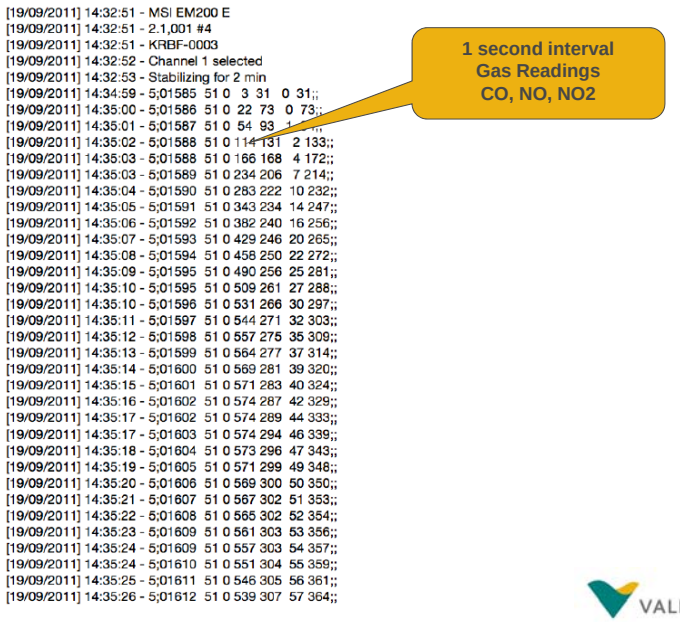
## Underground Real Time Diesel Exhaust Gas Downloads

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## Underground Real Time Diesel Exhaust Gas Monitoring Project

### Challenges

- Change in scope
  - Vale directive to integrate with Symboticware
  - Test at MTI vs Totten Mine
- Complexity increased with multiple stakeholders
  - Different priorities
  - Lines of Communication
  - Scheduling
- Availability of Test Vehicle
  - Single test unit (all of the eggs in 1 basket)
  - Limited access to unit in production
- Fitting existing technology into production equipment (field fitting, one of a kind, creative thinking)

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### Successes to Date

- On-board diesel exhaust gas monitor is working well
- WSN Programming and data collection working well
- System integration with Symboticware
- Real-time emission data is being collected for analysis

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## Underground Real Time Diesel Exhaust Gas Monitoring Project

**Prototype unit on Surface LHD**


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## Underground Real Time Diesel Exhaust Gas Monitoring Project

### Next Steps

- Collection and analysis of field exhaust gas emission data and correlating them to engine parameters (Symbot).
- Determination of gas readings vs duration at low idle, high idle and full load conditions
- Analysing data
  - Engine diagnostics – pre after treatment device gas readings
  - Exhaust gas treatment device evaluation – pre & post gas readings
  - Establish reliable & repeatable – post exhaust treatment gas readings
  - Calculate and evaluate ventilation rates based on engine performance
- Revise required sampling frequency based on data analysis

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### Next Steps – cont'd

- Tracking of gas sensor life expectancy and reliability (calibration frequency)
- Determine the gas sensor best suited for this requirement
- System improvements (redesign to micro size the components) for a better fit on LHD (better protected and less visible)
- Retest revised system at CANMET Lab
- Initiate multiple test sites
  - Different equipment, engines, duty cycles
  - Increase data for analysis

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## Underground Real Time Diesel Exhaust Gas Monitoring Project

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- Vale

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# Thank you!

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