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**Underground Real Time Diesel Exhaust Gas Sampling  
2013 MDEC Conference Up-date**

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## **AGENDA**

**Gas monitoring project review**

**Phase I outcomes**

**Phase II Project**

**Preliminary Results**

**Live Stream data**

**Conclusion**

**Acknowledgements**



### Underground Real Time Diesel Exhaust Gas Monitoring Project

- Vale Canada committed to a Real-Time Diesel Exhaust Gas Monitoring Project in 2009
- The first phase of the project was to develop a hand held unit to test diesel exhaust.
- Phase I objectives
  - Hand-held instrument designed for purpose
  - Economic price
  - Ease of use
  - Results applicable for monitoring engine health
  - Meet then proposed Ontario emission testing regulations for CO
- Phase I Deliverables
  - Commercially available hand-held device suitable for monitoring undiluted and untreated diesel exhaust gas.



### Underground Real Time Diesel Exhaust Gas Monitoring Project

#### Phase II Project

- Determine if a real-time monitor can take gas samples that meet Ontario Regulations

#### Objectives

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



## Underground Real Time Diesel Exhaust Gas Monitoring Project

### Ontario Regulations Summary

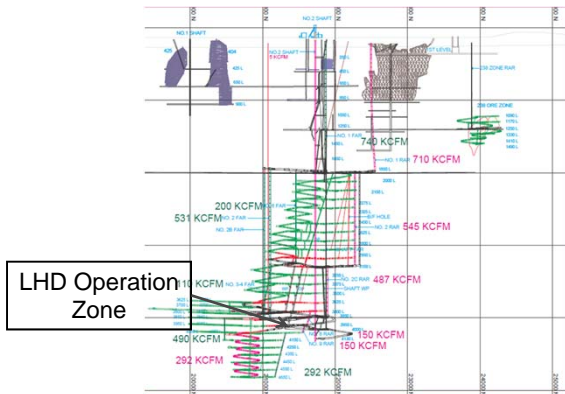
- 2012 OHS, Mining Regulation 854
  - 182. (5) Undiluted CO exhaust levels < 600 ppm
  - 183.1 (5)(a) Reduce the TWA exposure to EC x 1.3 but < 400 µg/m<sup>3</sup> TC
  - 183.2 3. (1.1)
    1. Develop & implement testing measures and procedures in consultation with the JHSC....
    2. Each individual piece of equipment must be tested under consistent conditions so that results from different tests can be compared.
    3. Testing must be carried out, as far as is practical, on equipment under full load.



## Underground Real Time Diesel Exhaust Gas Monitoring Project

### Project Test Site for Real-Time Monitoring System

- The site selected for this test is the Totten Mine Project located in Sudbury, Ontario
- The selected equipment are two Caterpillar R1600G Load Haul Dump (scoop tram) units equipped with a Caterpillar 3176C ATTAC engine @ 201kW. These units are located in a ramp access zone where active mine development is taking place from 3625 level to 4150 level with the main ore/waste dumps on 3850 level horizon.
- The data transfer can also be made from the Wireless Access Point (WAP) at the dump location.



### Underground Real Time Diesel Exhaust Gas Monitoring Project

#### SenzLogic Real-Time Onboard Gas Monitor - Horizontal Installation



### Underground Real Time Diesel Exhaust Gas Monitoring Project

#### SenzLogic Real-Time Onboard Gas Monitor - Vertical Installation



### Underground Real Time Diesel Exhaust Gas Monitoring Project

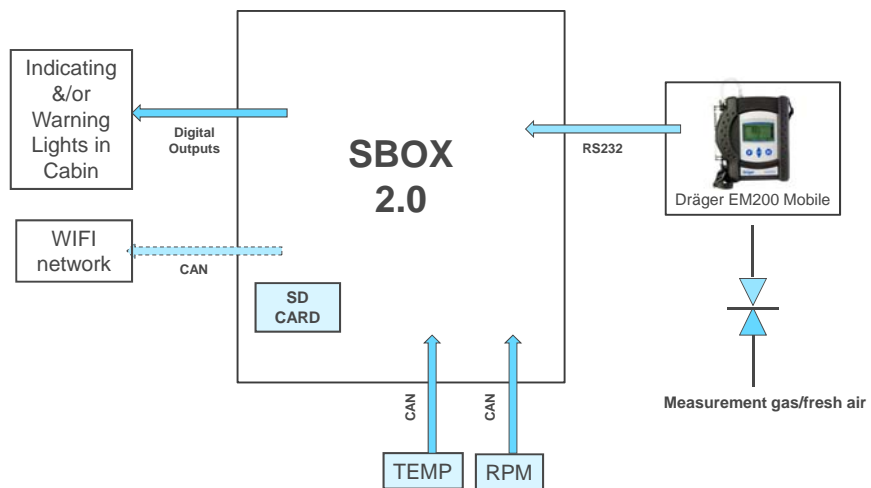
#### SenzLogic Gas Monitoring System Operation

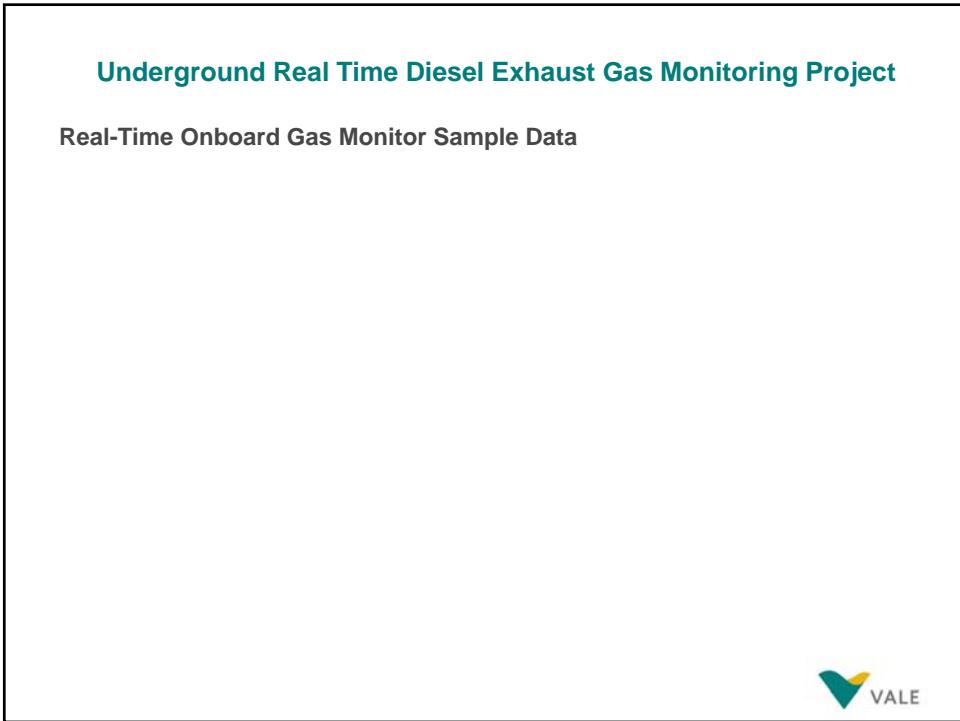
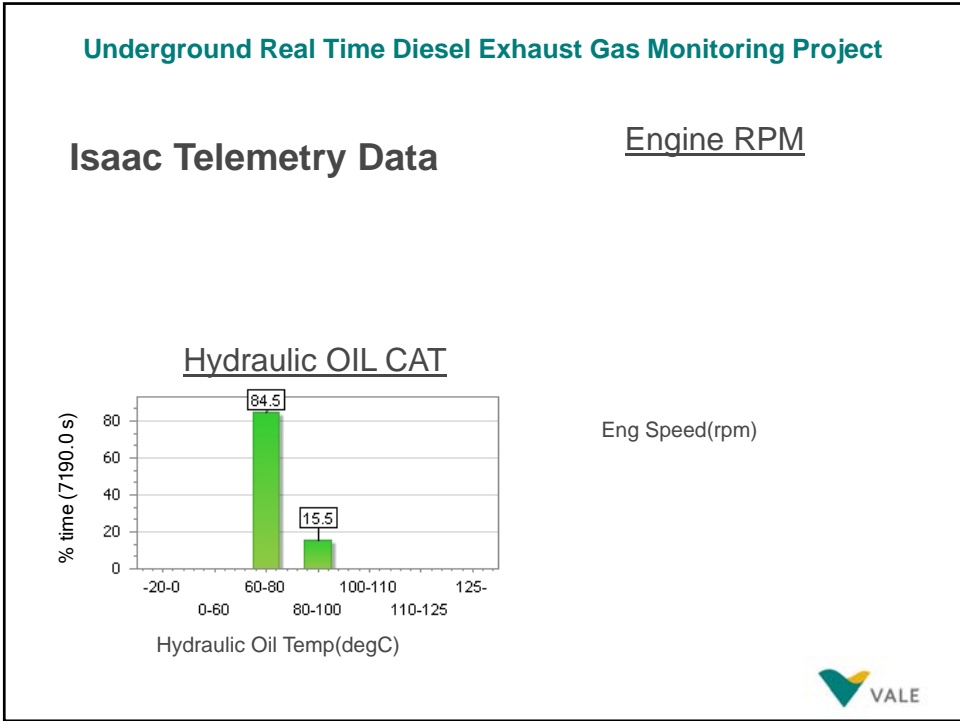
<b>RS-232</b>	for acquisition data and control of the Dräger EM200 Mobile gas sampling unit
<b>CAN (Input)</b>	for acquisition data of RPM and temperature via CAN J1939
<b>Digital Outputs</b>	responsible to signalize status of the system via indicating/warning Lights in Cabin
<b>CAN (Output)</b>	responsible to send data via CAN J1939 - Proprietary B PGN to ISAAC unit
<b>SD CARD</b>	Rolling Data log - Backup data



### Underground Real Time Diesel Exhaust Gas Monitoring Project

#### SenzLogic Gas Monitor





## Underground Real Time Diesel Exhaust Gas Monitoring Project

### Phase II Results to-date

- Data results from the 2 units at Totten Mine has confirmed the operation of the equipment including wireless telemetry, reliability and robustness of the monitoring system.
  - **Go to Live feed from Totten Mine.**



## Underground Real Time Diesel Exhaust Gas Monitoring Project

### Path Forward

- Continue the testing of the unit at Totten Mine to achieve a higher level of “engine to emissions” data analysis and correlation of the results providing a greater understanding of engine operation & maintenance efficiency.
- Re-engineer the SenzLogic into two separate & smaller components for ease of installation, service and repair. The two components would be a) Dräger gas monitor & filters, b) Sbox Control module which can be swapped – no down time.
- Refinement of the sampling protocol based on collected data with respect to duration and frequency for reliable readings
- Evaluate the SenzLogic system at the CANMET Laboratory in November 2013



## Underground Real Time Diesel Exhaust Gas Monitoring Project

### Conclusion

- The co-operation between project participants over the past several years has proven to be very successful in developing a fit for purpose instrument for obtaining reproducible gas measurements from undiluted diesel exhaust.
- A mobile on-board system has been developed which facilitates non-intrusive real time data collection that can be used for preventative maintenance
- The SenzLogic unit has the capability to integrate vehicle diagnostic data such as engine telemetry as a stand alone or through existing telemetry providers such as Isaac Instruments and Symboticware (both successfully demonstrated at Totten test site).
- There is potential for Occupational Exposure Monitoring (ambient sensor) and new technologies applications such as Ventilation on Demand (VOD).



## Underground Real Time Diesel Exhaust Gas Monitoring Project

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- Pattern Discovery
- KPI Industrial Controls Incorporated
- Toromont/Caterpillar
- Isaac Instruments Limited
- Symboticware Incorporated





# Thank you!

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