

Installing a live ventilation network monitoring system to improve safety

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Overview

- Background and expected outcomes of the project
- Mine description
- Equipment installation strategy
- Installation challenges
- System integration
- Conclusions

See every moment

- What is live ventilation network monitoring?

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- Predict and visualise the ventilation status of the mine with only a few real-time measurements

See every moment

- What is live ventilation network monitoring?
- Predict and visualise the ventilation status of the mine with only a few real-time measurements
- Different philosophy to monitoring the whole mine all of the time

Background

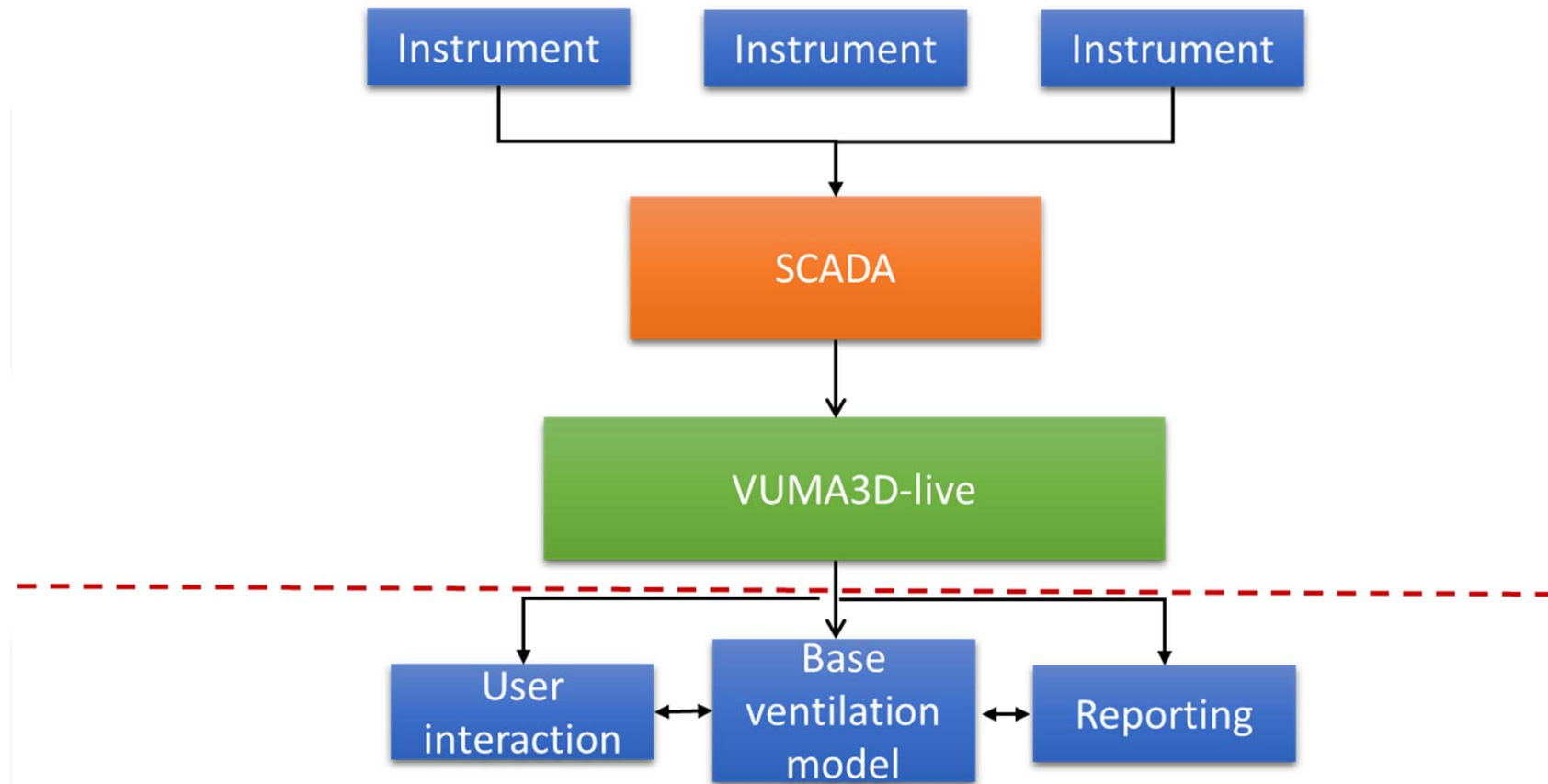
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- Narrow tabular mining method with multiple levels
- Stoping areas are confined with harsh conditions
- Large scale mine with remote working places
 - Environmental monitoring limited
 - Static monitoring for CO and smoke only
 - Measurements mostly by trained personnel as safety check
 - Potentially require large number of instruments
 - Maintenance and calibration is a big challenge
- Poor general acceptance of monitoring equipment

Expected outcome of project

- Monitor the mine with a only a few measuring stations and predict all underground conditions
- Improve visualization and increase awareness
- Raise alarms, rapidly identify problems
- Ride the learning curve on instrumentation
- Expansion to other parameters
- First step introducing active and automated controls
- Energy management and control in the next phase

Installation strategy



Challenges

- Workforce perception that instruments are used for surveillance and hence are stolen or damaged



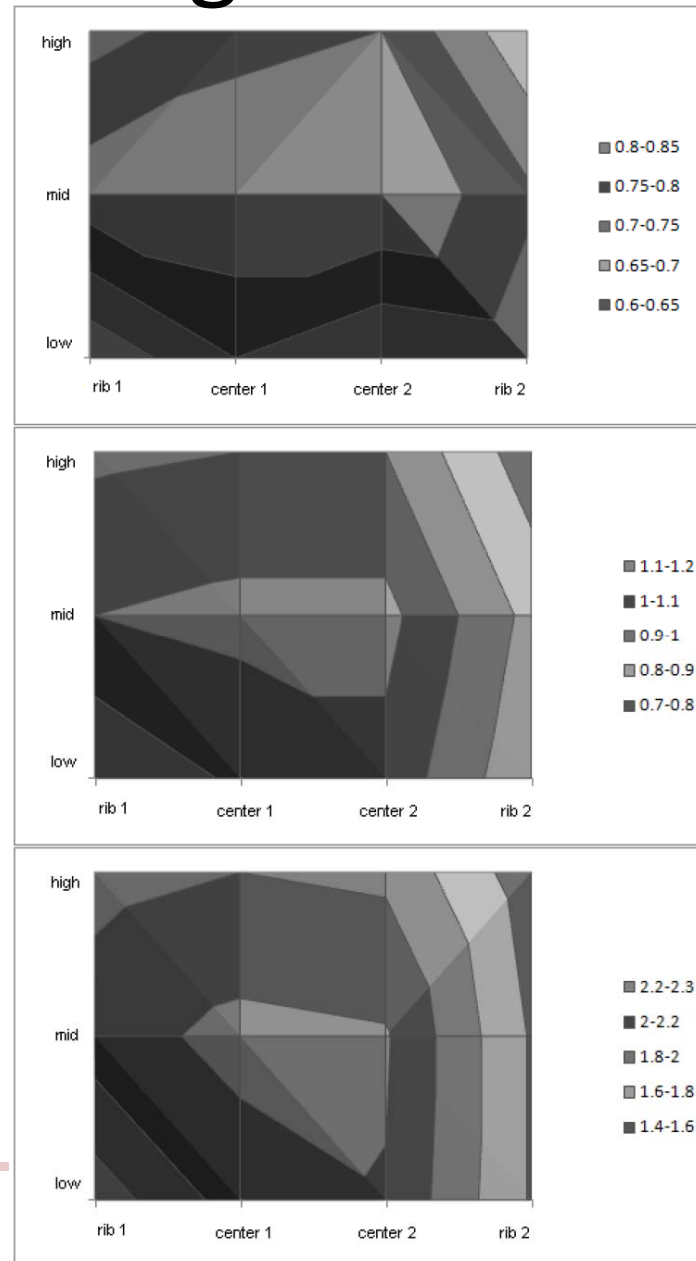
Challenges

- Maintenance of instruments in return airways
 - Dust buildup
 - Restricted access



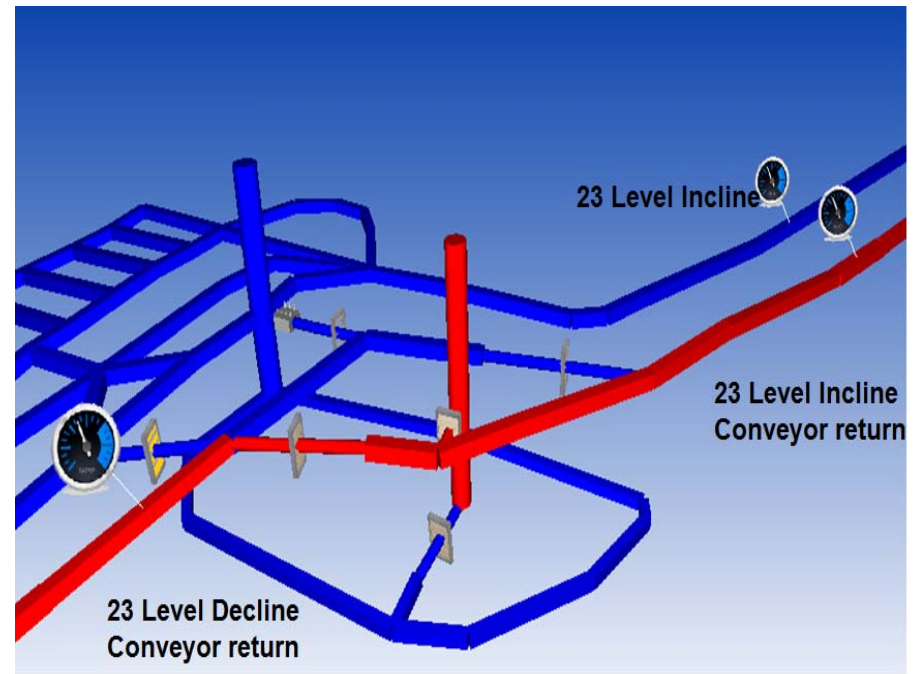
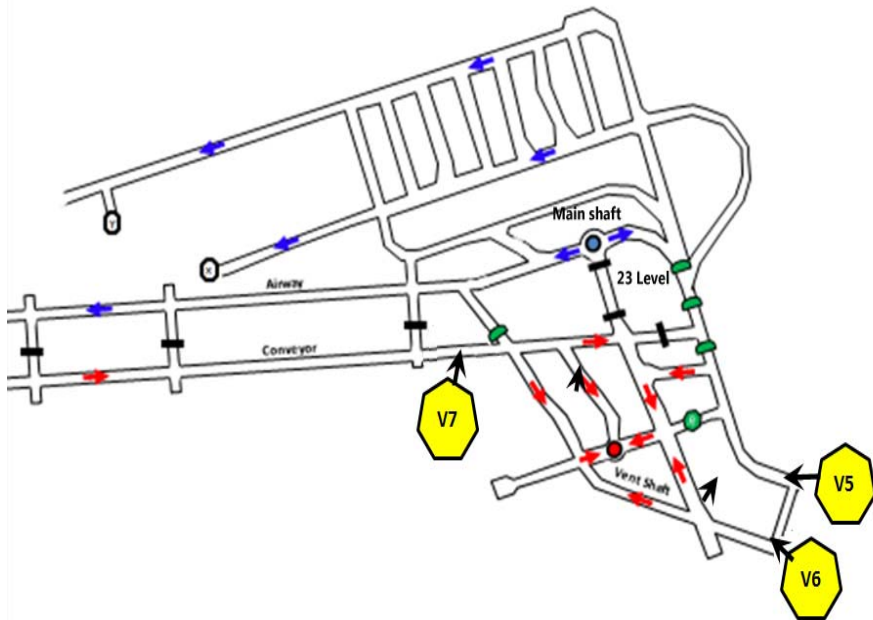
Challenges

- Calibration of velocity



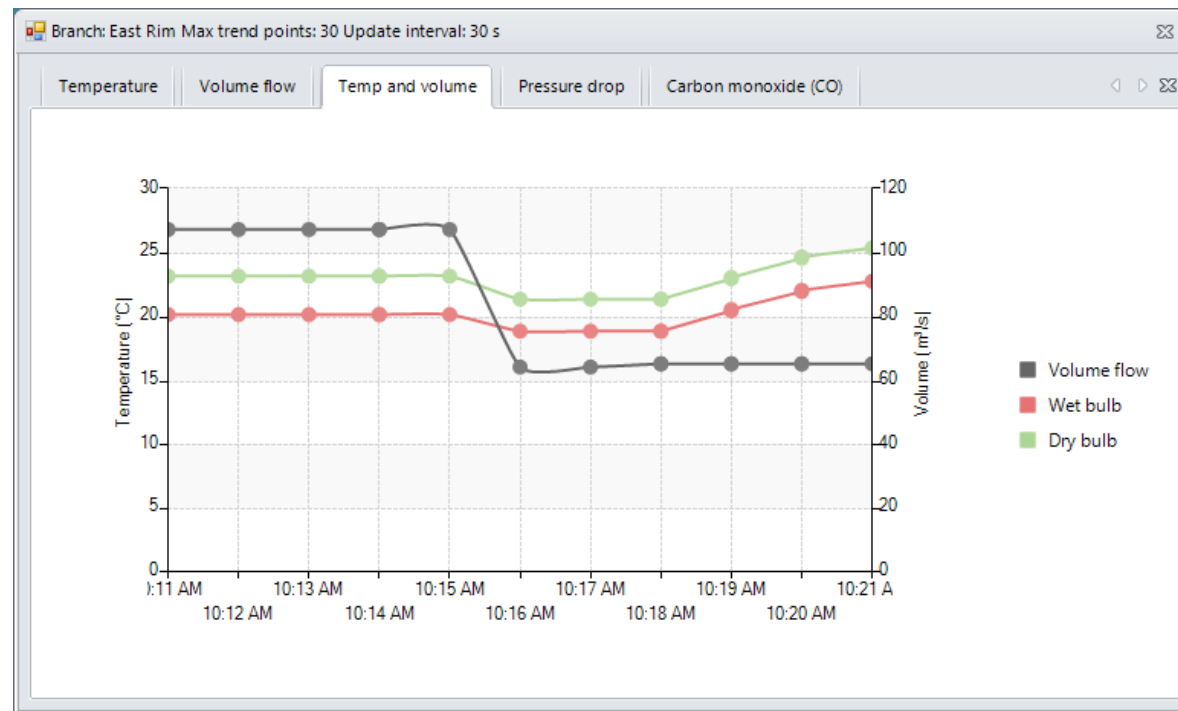
System Integration

- Develop vent network model & calibrate
- Map instruments to ventilation model



System Integration

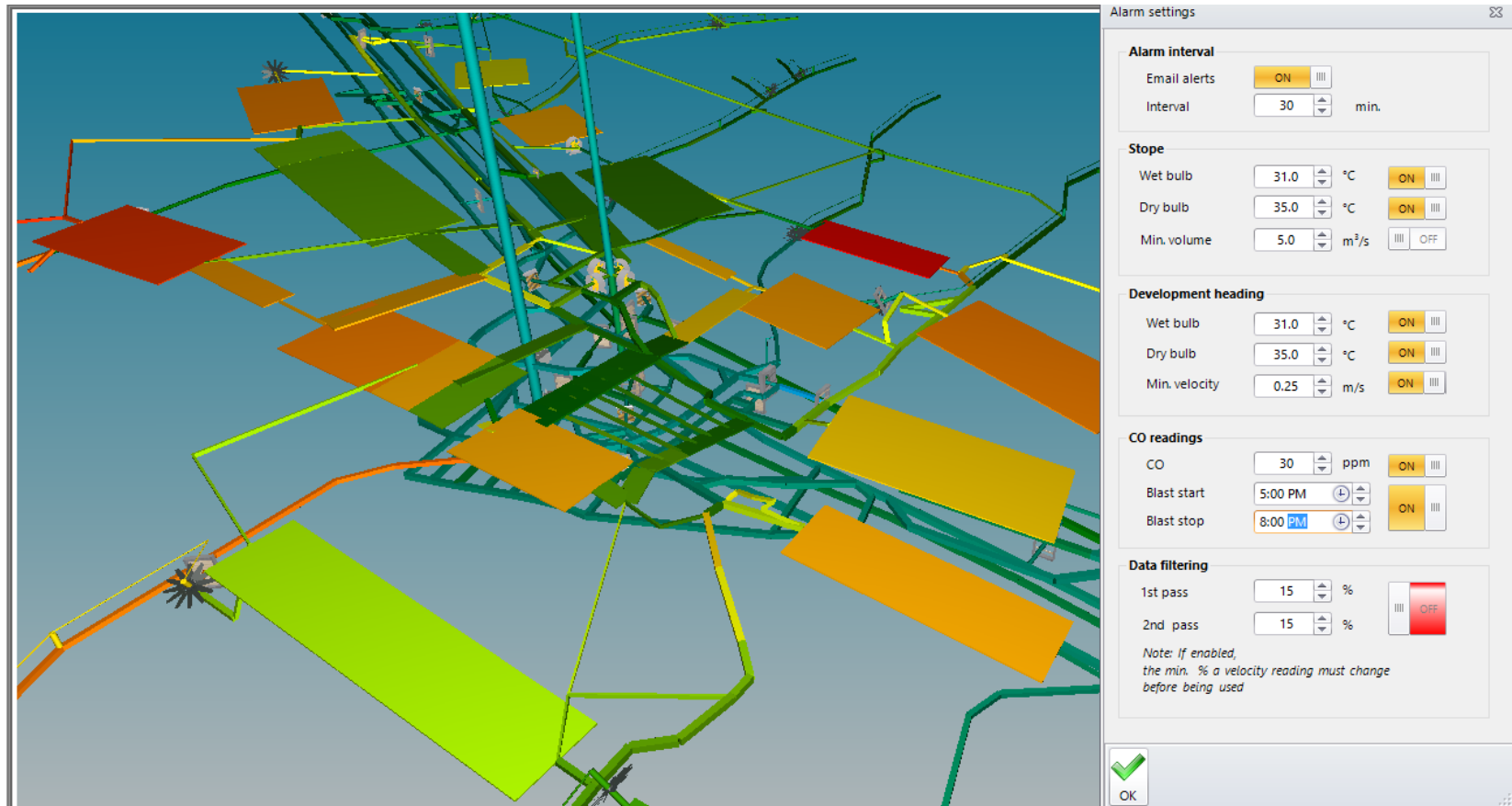
- Calibrate Instrument reading to actual measurements
- Calibrate model to underground conditions utilizing real-time data
- Real-time data output



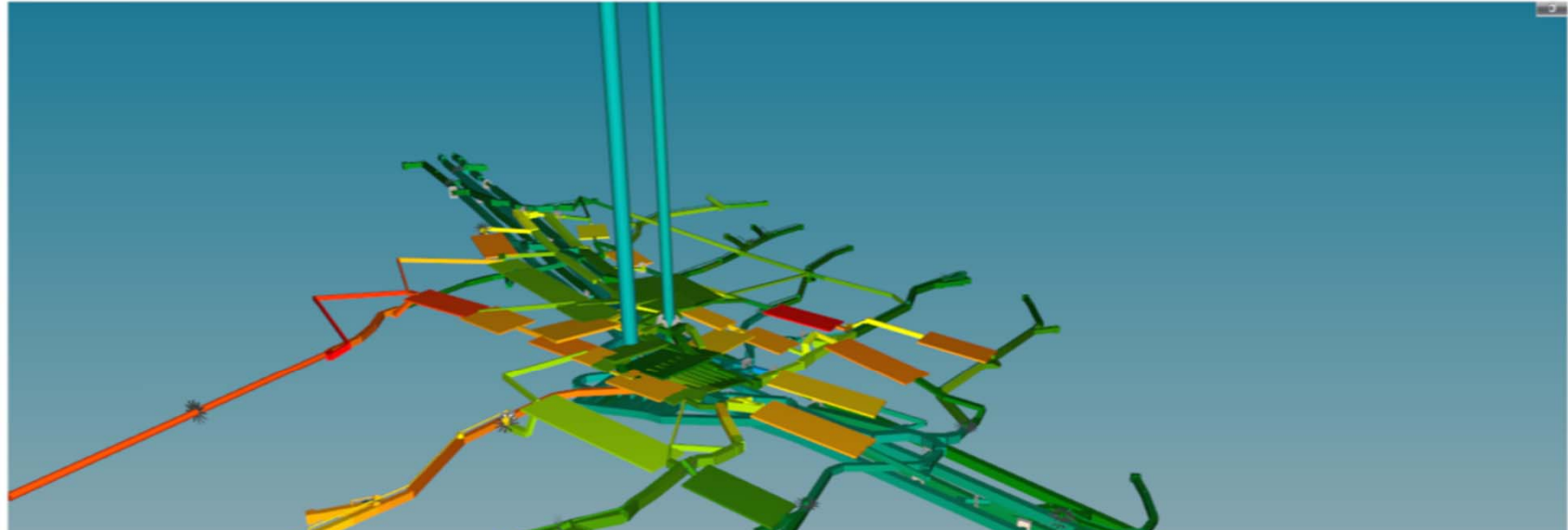
Data available for all branches in the ventilation model

System Integration Reporting

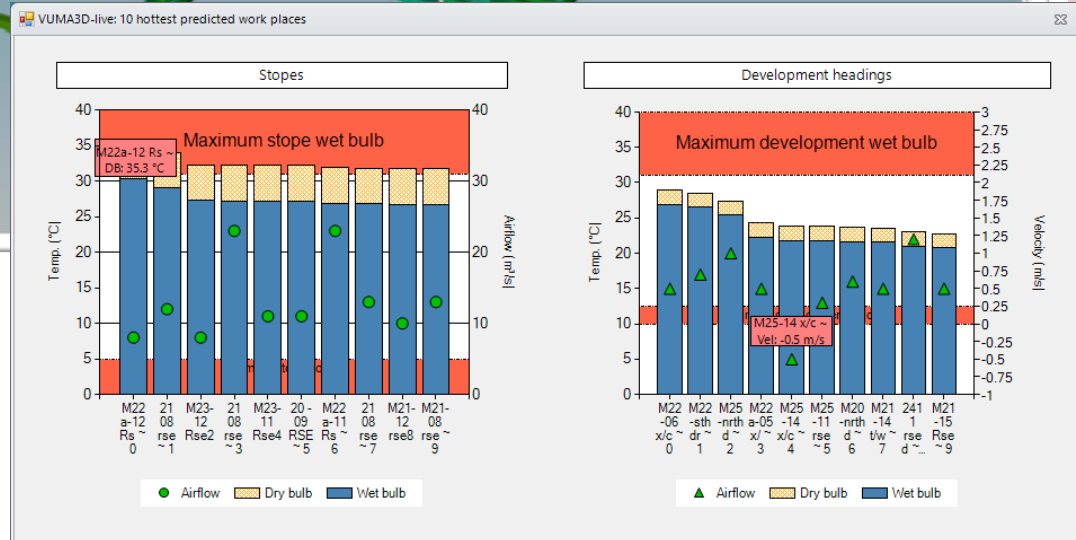
- Alarm level configuration



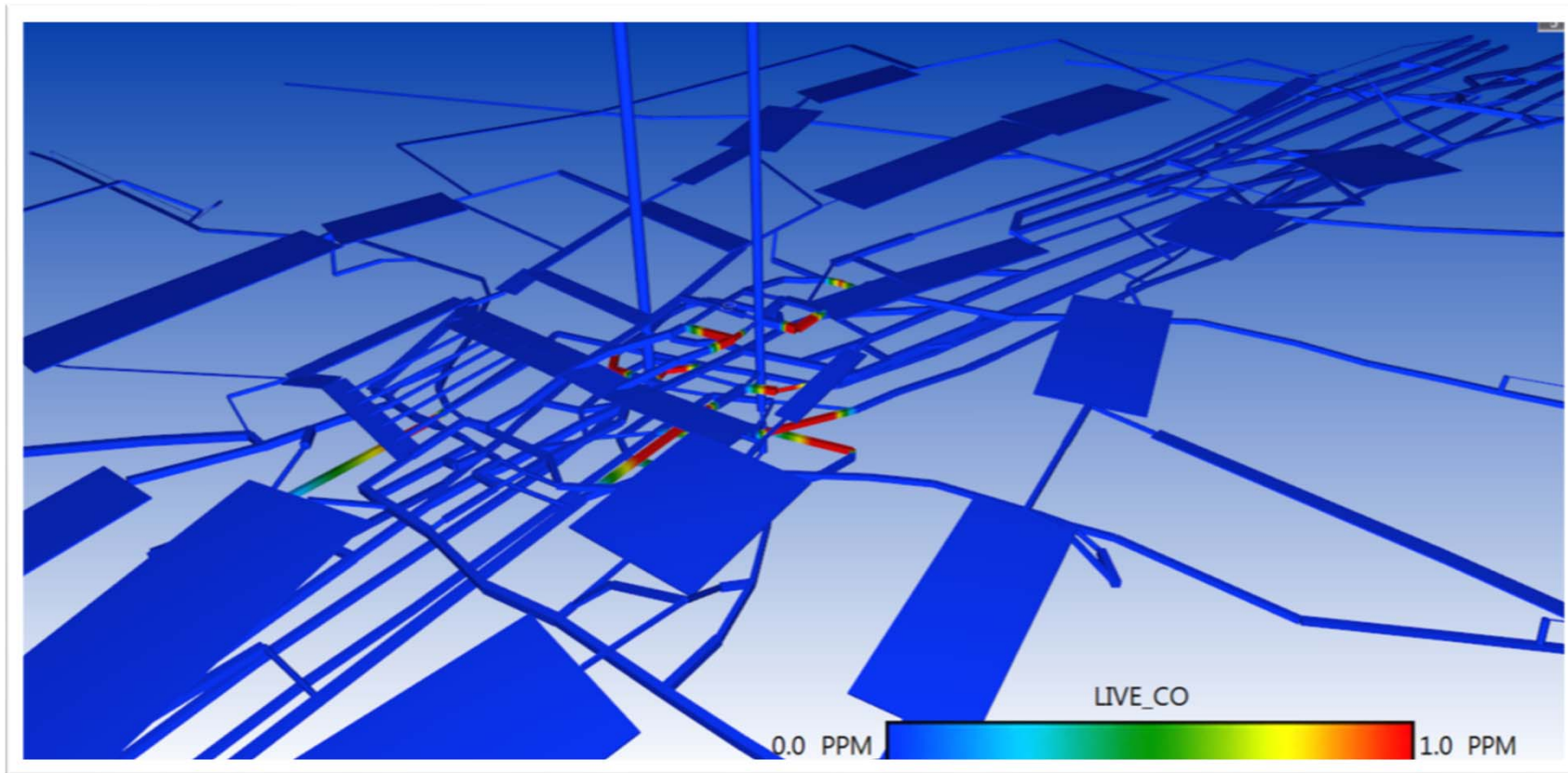
System Integration



Overview of the predicted hottest work places



System Integration



CO sensors monitored
by the live system



System Integration Reporting

- Daily reports

Start: 02 Nov 2016 06:03

Generated: 06 Jun 2017 10:54

End: 03 Nov 2016 06:00

Estimated blast clearance: 189 minutes

Ave. surface: 18.4 °C (wb) 27.6 °C (db)

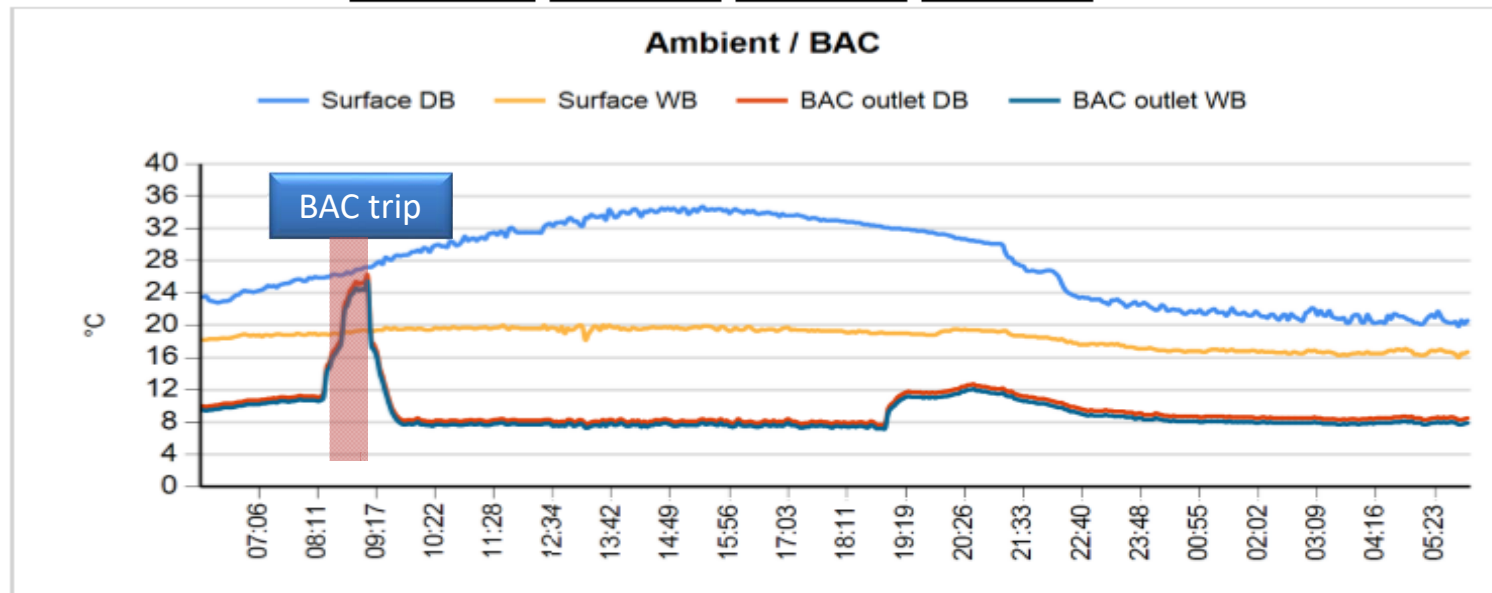
Ave. BAC: 9.4 °C (wb) 9.6 °C (db)

BAC on

Fan 1 On

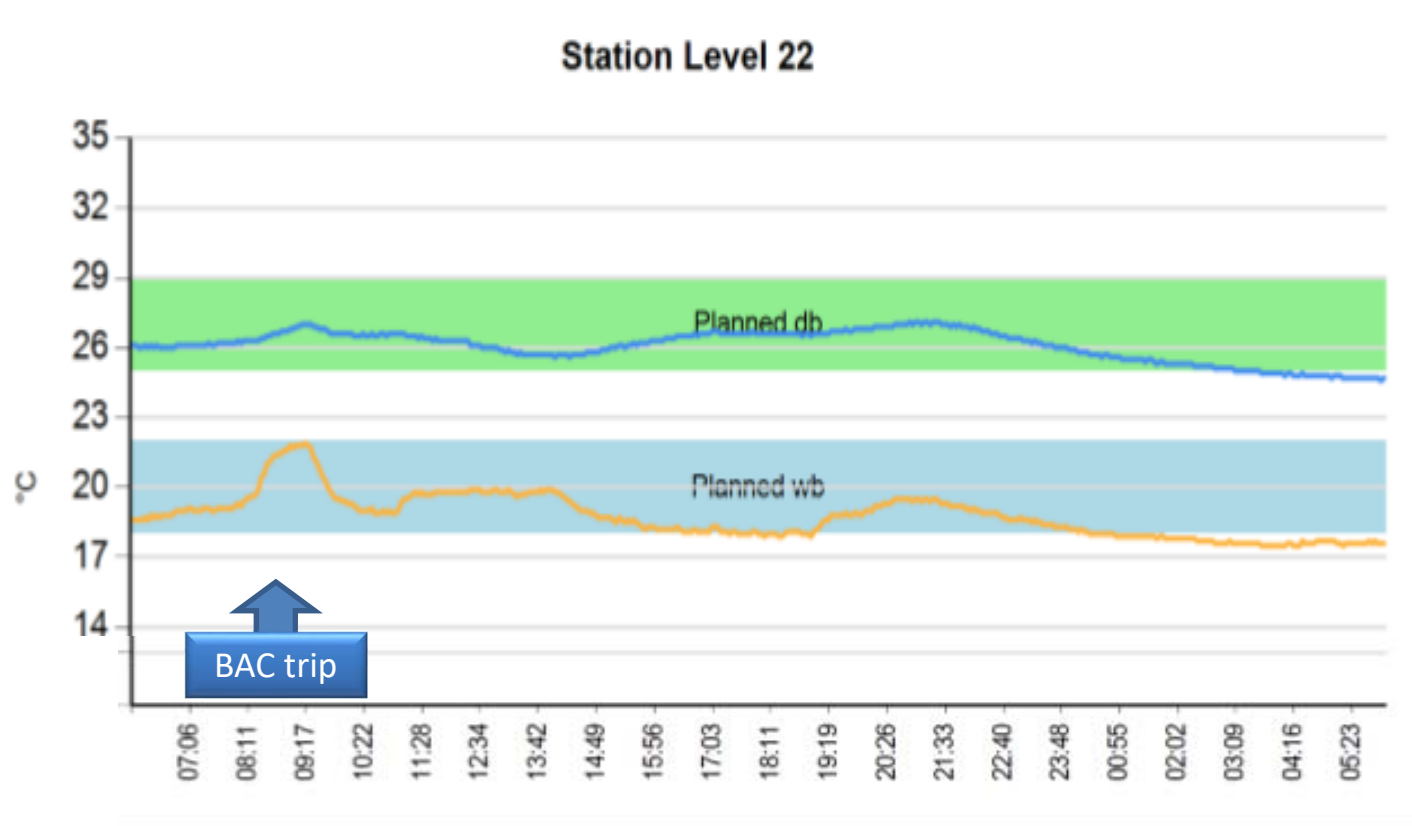
Fan 2 Off

Fan 3 On



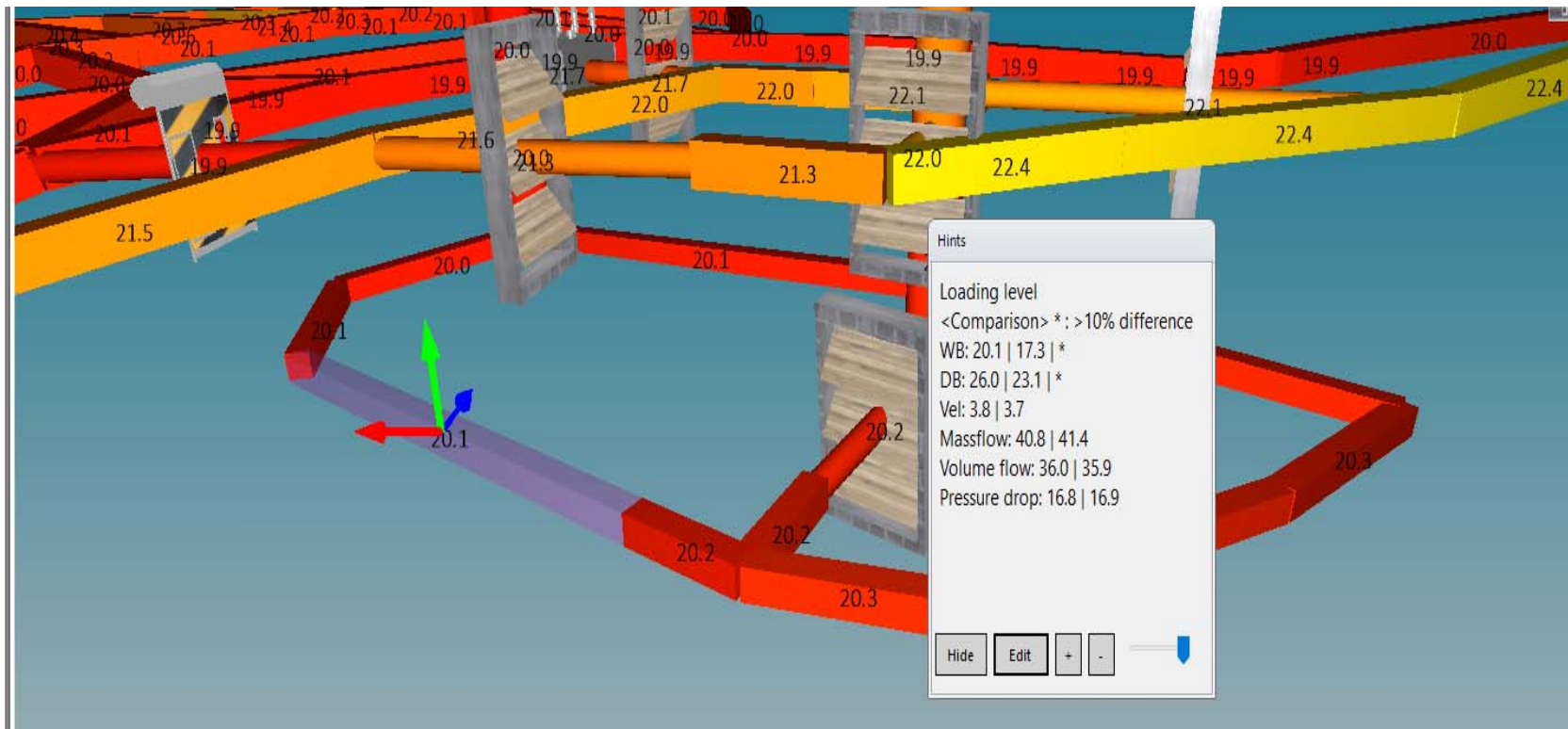
System Integration Reporting

- Daily reports



System Integration Reporting

- Compare calibrated to actual conditions



System Integration Reporting

- Alarm notifications

FW: VUMA3D-live: 2 CO alarm levels exceeded - Message (HTML)

File Message Insert Options Format Text Review Tell me what you want to do

To: Control Room

Subject: VUMA3D-live: 2 CO alarm levels exceeded

Attached: 20BL_FD1.live 6 KB

VUMA3D-live: Alarm levels exceeded at 09:00 PM

Main intakes
Surface mix: 9.6 °C (wb) | 12.9 °C (db)
22# Station: 13.0 °C (wb) | 24.7 °C (db)
23# Station: 20.0 °C (wb) | 25.0 °C (db)

Main Upcast: Airflow history
630.0 | 629.0 | 631.0 | 626.0 | 623.0 | 622.0 | 626.0 | 622.0 | 622.0 | 622.0 | 627.0 |

STOPE ALARM LEVELS Wet bulb 31.0 °C | Dry bulb 35.0 °C | Volume flow 5.0 m³/s
DEVELOPMENT ALARM LEVELS Wet bulb 31.0 °C | Dry bulb 35.0 °C | Airflow 0.3 m/s
CARBON MONOXIDE (CO) ALARM TIGGERED

Node : (CO2) 21 Level On-reef bottom has a reading of 55 ppm CO
CO history : 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
Node : (CO3) 22 Level Station intake has a reading of 44 ppm CO
CO history : 1.0 | 10.0 | 1.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

CO ALARM LEVEL: 30 ppm Blast time: Start: 05:00 PM | End: 08:00 PM

Reports are limited to one every 30 minutes, except if the number of exceptions varies
Total time running 84.1 hrs

Outcomes accomplished

- Mine-wide monitoring system confirmed
- Identified optimal number of instruments to better pinpoint problem areas or adapt to changing conditions
- Improve safety (desktop access)
- Importance of continuous maintenance and calibration which should be outsourced if necessary
- Too frequent alarms ignored

Conclusion

Successful installation

- Improved safety
- Improved mine-wide real time information
- Live vizualization of conditions

Future work

- Main fan control
- BAC control
- Ventilation control
- Energy saving