Review of Dust Control Strategy Optimisation using Real-time Respirable Dust Monitoring

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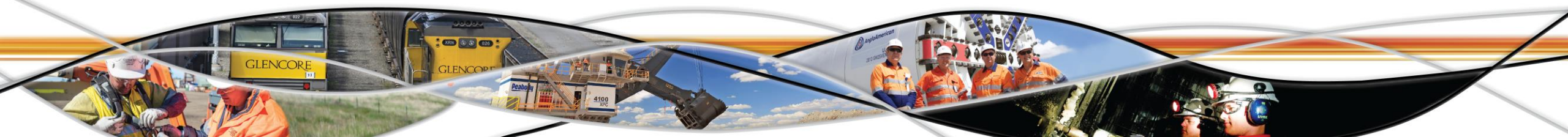

Outline

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- Review of Dust Controls and Monitoring
- Case Studies
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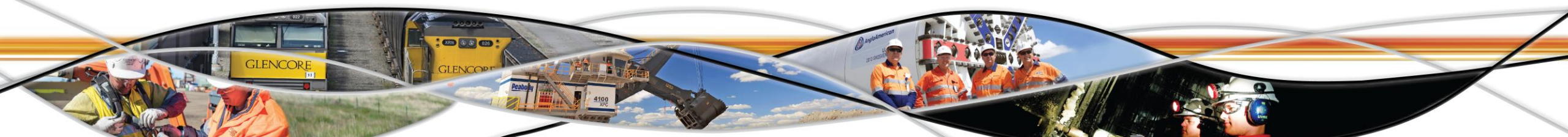
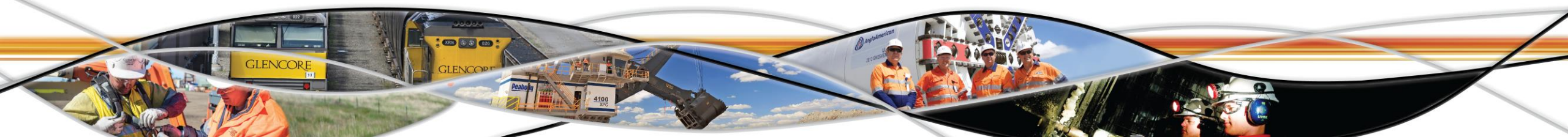


Introduction

- Respirable dust is a continuing problem in mines where it adversely affects the safety, health of workers and productivity.
- The recent detection of several Queensland coal miners with black lung or Coal Workers' Pneumoconiosis (CWP) has led to industrial actions at some Queensland coal mines.
- CWP has been a major concern in the U.S. over the last few years despite recorded conformance to exposure level legislation.
- MSHA has recently reduced the shift averaged permissible exposure limit for respirable coal dust.
- From February 2016 MSHA requires Continuous Personal Dust Monitor (CPDM) to measure respirable dust exposure in certain conditions.

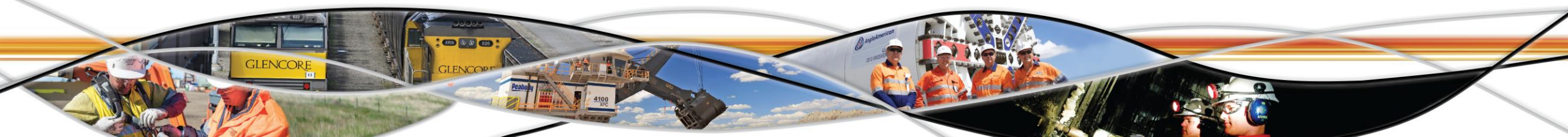


Recent Australian Longwall Production Records

Monthly Production Records			Annual Production Records		
Year	**Mine**	**tonnes**	**Year**	**Mine**	**tonnes**
2000	Oaky Creek	772,029	**2005**	Beltana	7,627,644
2005	Beltana	955,049	**2009**	Newlands North	8,318,421
2009	Newlands North	961,891	**2015**	Grasstree	10,000,000
2009	Oaky North	1,146,721	**2015**	Narrabri (Projected)*	10,000,000
2015	Grasstree	1,200,537	** projected in July 2015 International Coal News article*		

Dust Sources at Longwall

- Past researches highlight at least six important dust sources on an average longwall production face. These dust sources are
  - intake roadways,
  - outbye conveyor belts,
  - crusher/beam stage loader (BSL),
  - shearer,
  - longwall face support shield (or chock) advance and
  - dust resulting from falling goaf or over pressurisation of the goaf
- Longwall shearer and chocks are the main dust sources on longwall faces representing up to 80 per cent of the total dust make.



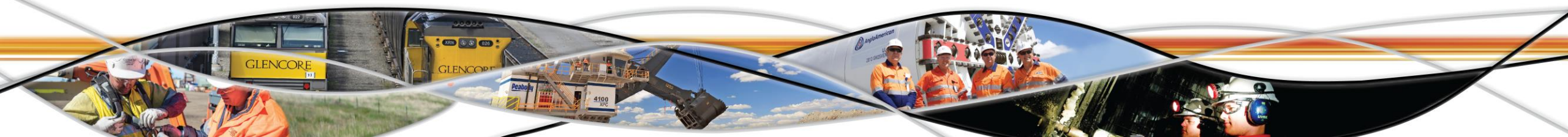
Longwall Dust Control Approaches

- Administrative controls or work practices

  To minimise the exposure of individual workers by positioning them in the work area in such a way as to limit the time they are exposed to a particular dust source.

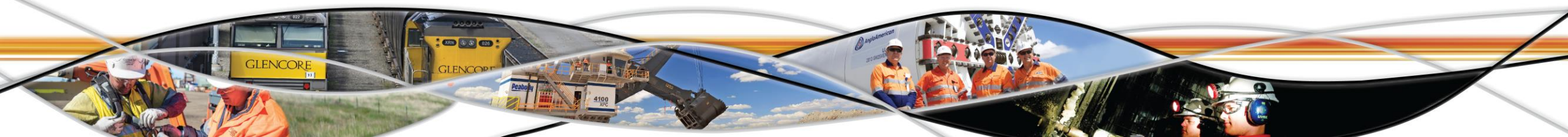
- Engineering controls

  To lower the levels of respirable dust in the mine atmosphere by either reducing dust generation or by suppression, dilution, or capturing and containing the dust.



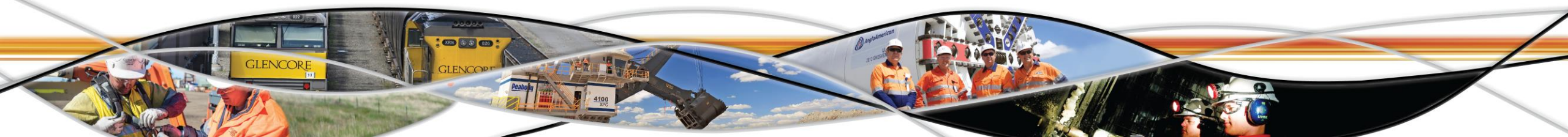
Longwall Dust Control Methods

- Ventilation controls,
- Water sprays mounted on shearer drums,
- Deep cutting,
- Modified cutting sequences,
- Shearer clearer,
- Shearer dust scrubber,
- Water infusion,
- Use of scrubbers at beam stage loader/belt transfer points.



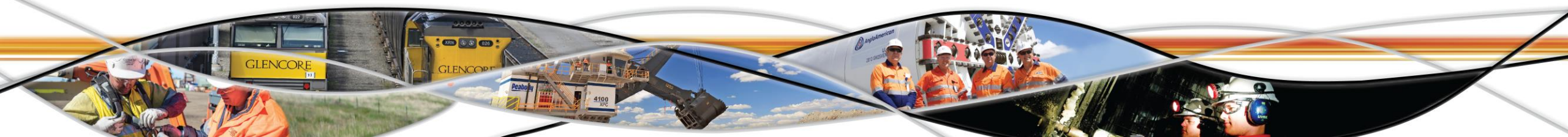
Longwall Dust Control Issues

- Inadequate air volume and velocity;
- Insufficient water quantity and pressure;
- Poorly designed external water spray systems;
- Lack of dust control at the stage loader and crusher;
- Dust generated during support movement; and
- Cutting sequences that position face workers downwind of the cutting machine.



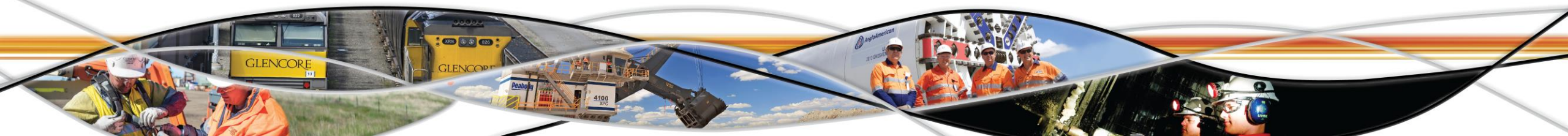
Dust Monitoring

- The current statuary dust monitoring regime in Australia using a single figure for shift average respirable dust exposure levels.
- This method provides an accurate measurement for the total dust exposure for the period sampled.
- However, it does not always accurately reflect the source, quantity and timing of respirable dust entering the longwall from different dust sources.
- US had a similar statuary dust monitoring approach up until recently. US sampling is using the “portal to portal” approach whereas in Australia it is “cribroom to cribroom”.



Recent US Dust Rules

- Since 1st February 2016, US coal mine operators have been required to use the CPDM to sample for respirable dust on working sections of underground coal mines and other areas.
- In addition, the CPDM must be used to sample air for all Part 90 miners (miners who have evidence of Black Lung).
- US concentration limits for respirable coal mine dust is reduced on 1st August 2016,
  - The overall respirable dust standard in coal mines is reduced from 2.0 to 1.5 mg/m^3 of air.
  - The standard for Part 90 miners and for air used to ventilate places where miners work is reduced from 1.0 to 0.5 mg/m^3.

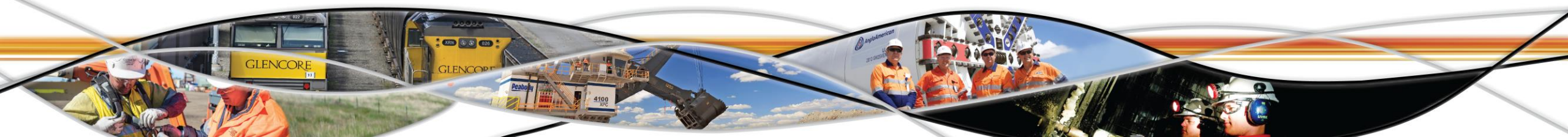


Continuous Personal Dust Monitor

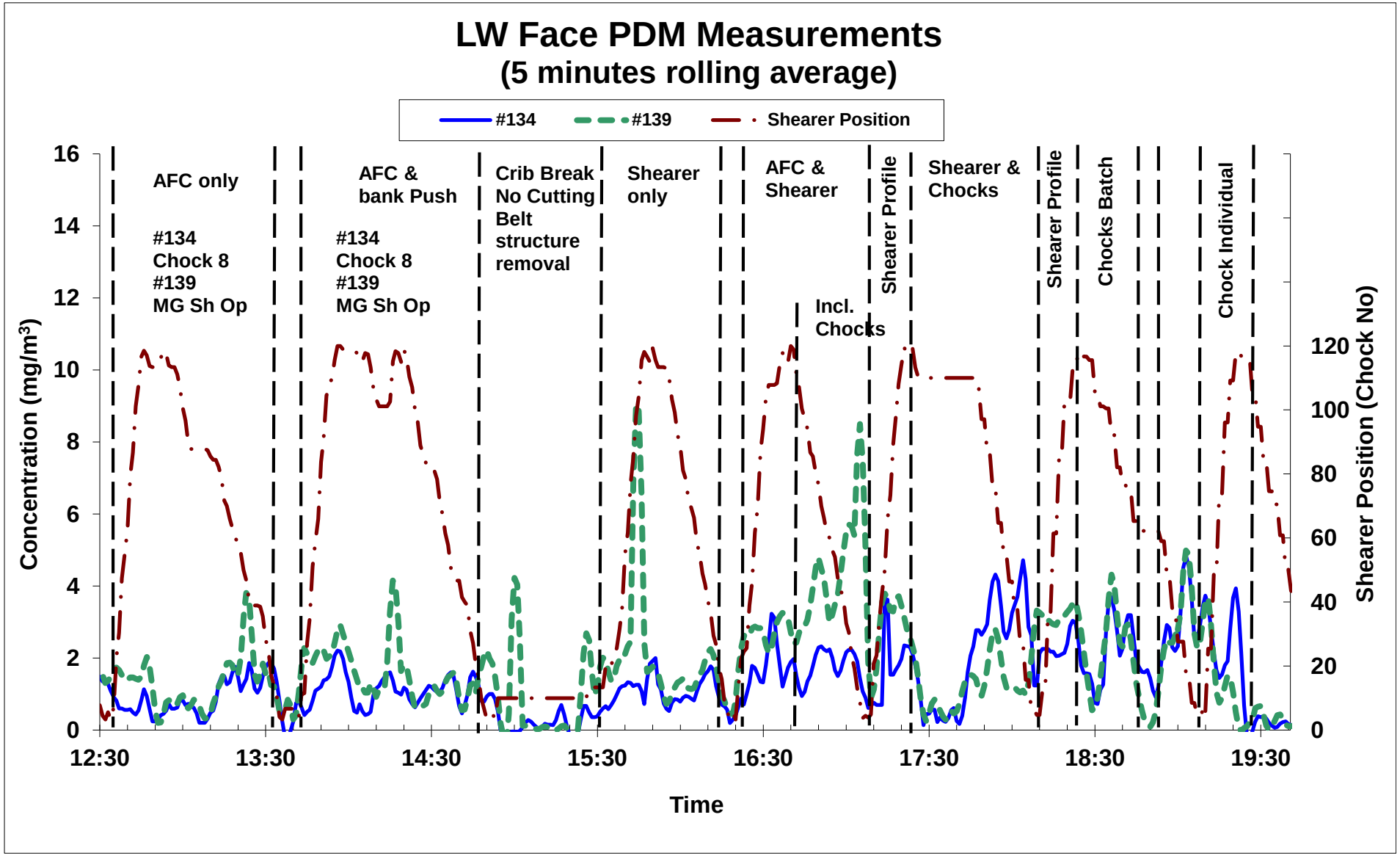
- Enable miners take immediate action to avoid excessive exposure.
- provides more immediate, full-shift exposure data.
- represents a major improvement in respirable dust sampling technology.

Case Study – Mine A

- Mine A is a gassy longwall mine with extraction height about 4.0 m. Typical longwall panels were 200 m wide with 114 chocks and 2.8 to 3.8 km long.
- Ventilation air quantities at longwall production faces were ranging from 70 to 90 m^3/s. Uni-di shearer cutting was used.
- Detailed real-time dust surveys were taken to assist in evaluating dust sources.
- Survey results show contributions from major dust sources and the cumulative dust levels faced by workers at different locations in the longwall panel.



Real-time shearer positions and dust levels

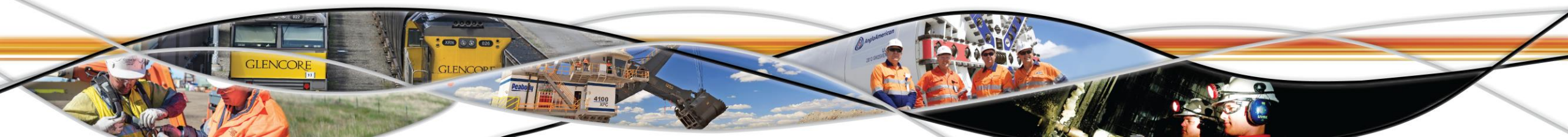


Dust readings of different sources

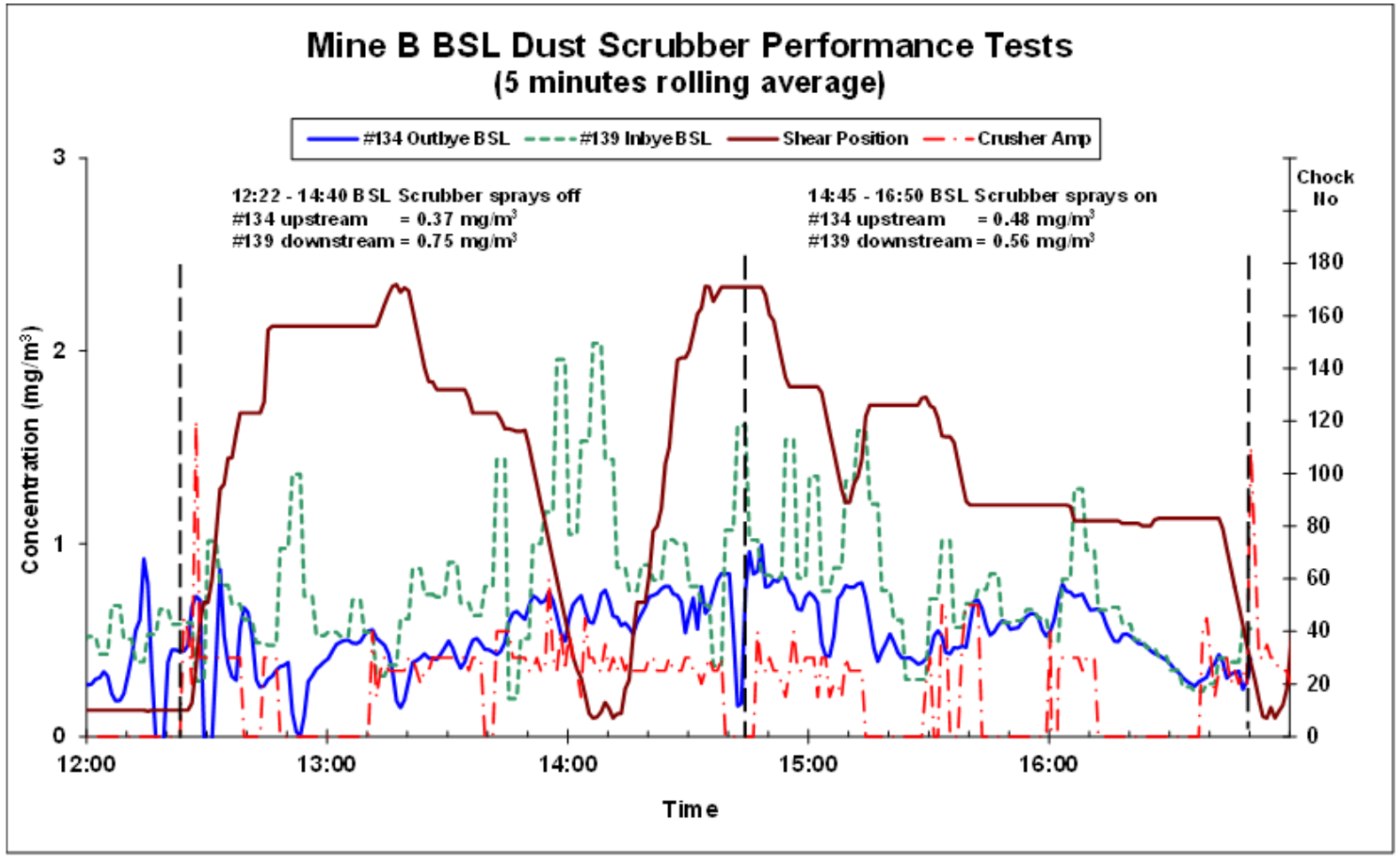
Test No	Chock #8	MG Operator	TG Operator	Chock Operator	Inbye Chock Operator	Chock #110	Comments
1		1.00	1.12				Shadowing MG & TG operators
2		1.11		1.52			Shadowing MG & Chock operators
3						3.90	Fixed position test
4		1.53				4.57	Shearer Clearer off
5		1.58				4.65	Shearer Clearer off (repeat)
6	0.89	1.29					AFC dust only
7	1.12	1.62					AFC and Bank Push dust
8	1.64				4.26		AFC, Shearer & Chock dust
9		1.51			3.18		Shearer & Chock dusts
10			1.53				Outside airstream (5 min ave)
11			1.47				Outside airstream (30 min ave)
Average	**1.22**	**1.38**	**1.37**	**1.52**	**3.72**	**4.37**	

Case Study – Mine B

- Mine B is also a gassy longwall mine with mining heights ranging from 4.1 to 4.5 m using uni-di shearer cutting.
- Typical longwall panels are 250 m wide using 151 two-leg large and heavy chock shields and about 2.5 to 4.0 km long with twin heading gate roads.
- Over a period of five years, eight series of real-time dust surveys at Mine B's longwall faces were conducted
  - to assess the baseline dust situations and
  - to optimise the effectiveness of various dust controls.



BSL Dust Scrubber performance test results



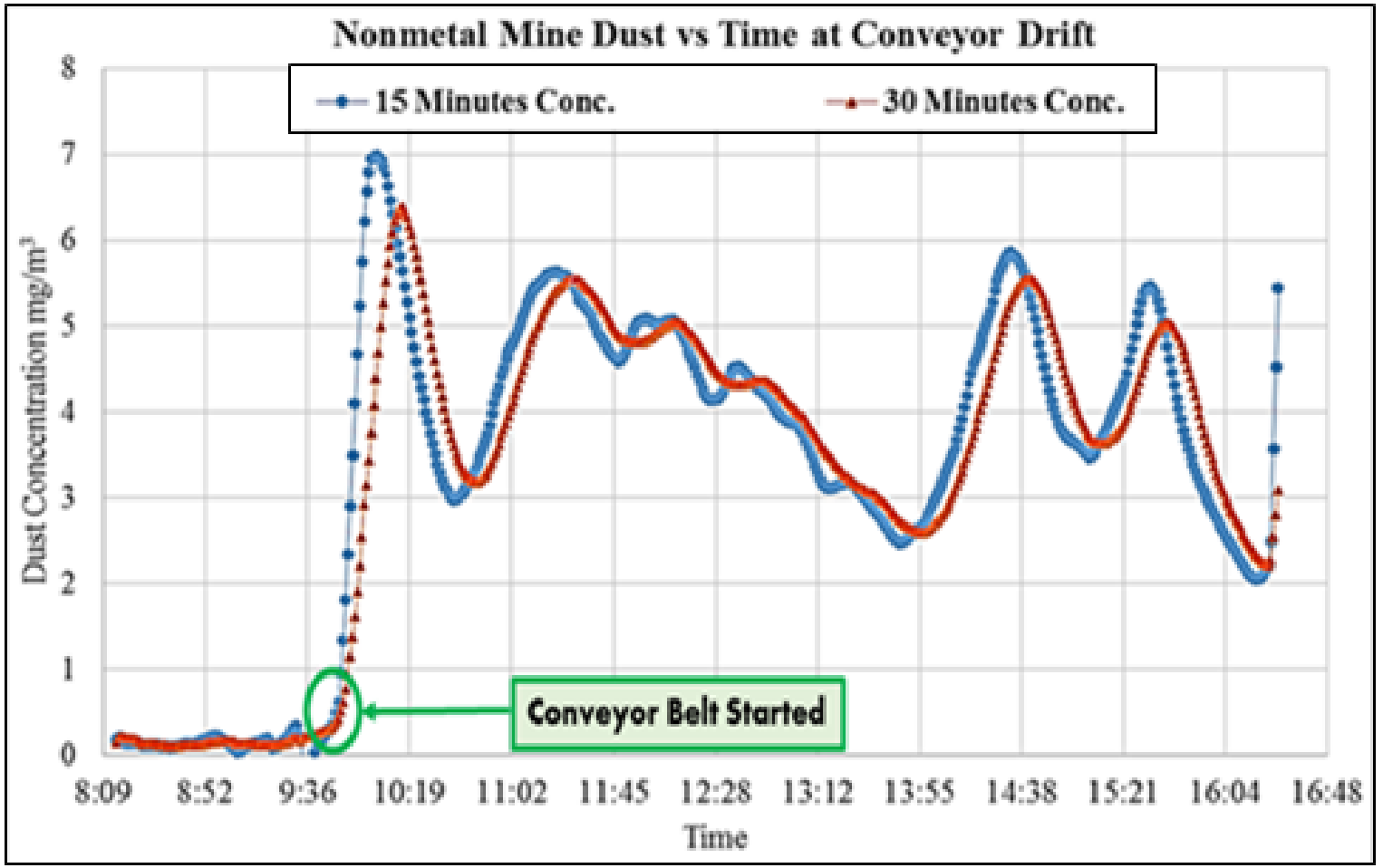
- Tests with the scrubber water sprays off and on.
- The overall filtration efficiency is about 47%.
- Filtration efficiency is reduced to about 21% when mining was active.
- When mining is not active, the filtration efficiency is increased to about 78%.

Evaluation of dust situations

	Average Dust Levels (mg/m³)			
	Face Q m³/s	**Outbye**	**MG Chock #8**	**MG Shearer Operator**
Baseline - Standard	63.4	0.28	2.54*	1.91
Improved Condition 1 ***1.Improved face air quantity*** ***2.New finer shearer sprays (50%)*** ***3.New sails installed at MG Drive*** ***4.Good housekeeping***	71.2	0.30	1.16	1.33
Improved Condition 2 ***1.Full finer shearer sprays,*** ***2.Chock water Mist Venturi system***	70.5	0.30	0.62	0.91

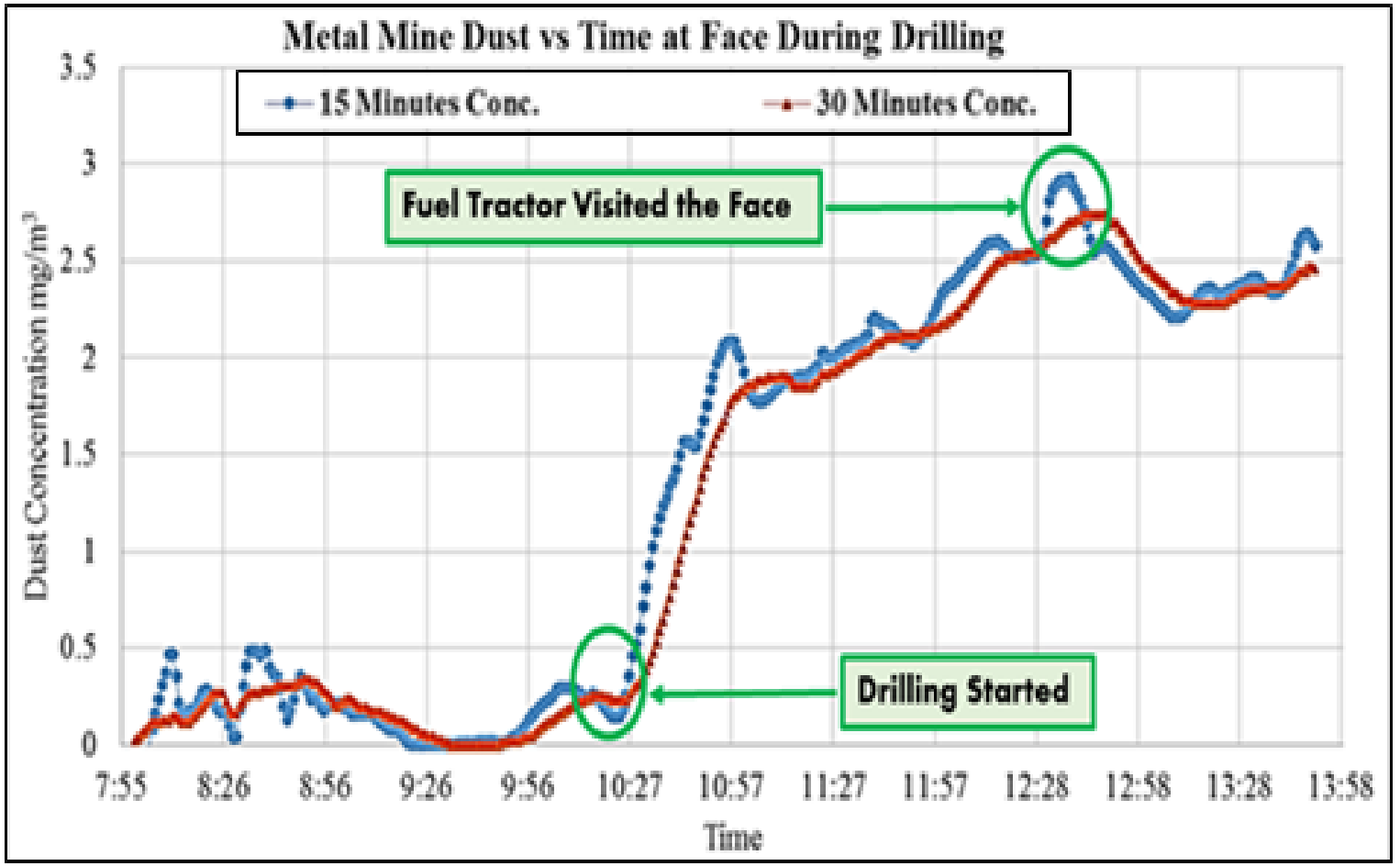
* *Unusual local high dust level experienced was a direct result of additional dust created by strata stress loaded MG chocks (No 1 to 5) advancements.*

Case Study – Mine C US Nonmetal



- Real-time dust sampling done at the mine entry of a longwall mining operation.
- PDM unit placed in the conveyor belt entry to assess the effect of belt operation on dust accumulation.
- The peak value was 7.0 mg/m^3 and average around 4.5 mg/m^3.
- The belt was not operating at the beginning of measurement.

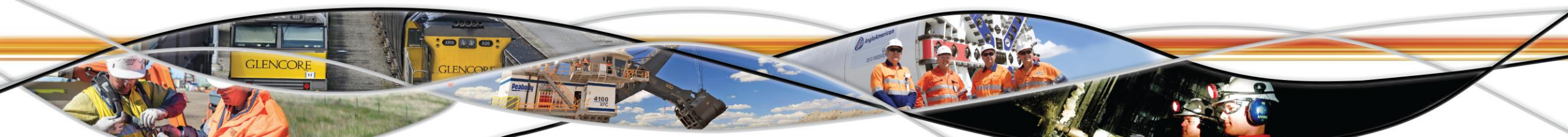
Case Study – Mine D US Metal



- Real-time dust sampling done during face drilling operation.
- A jumbo drill was operating at the face. One diesel powered scalar was nearby.
- Sudden increase in dust level when drilling started at 10:25.
- The peak value was 2.9 mg/m^3 for a 3.5 hour period.
- Air velocity at face was quite low so the dust started accumulating.

Real-time Respirable Dust Monitoring

- Four case studies with applications of real-time respirable dust monitoring in Australian and US mines were presented.
- Real-time dust sampling technique has particular application for
  - determining high source locations,
  - efficiency of engineering means of dust suppression and
  - other approaches to handling the problem.
- Real-time dust monitoring provides mine operators with comprehensive dust signatures and allow implementation of more efficient controls at individual dust sources.



Conclusions and Recommendations

- Benefits of real-time respirable dust monitoring were presented.
- Real-time monitoring as an engineering tool can evaluate impacts of dust controls effectively and efficiently.
- Shift-averaged dust monitoring will still have its roles but it is unable to assist the optimisation of dust mitigation in a practical way.
- Efficiency of some dust controls can reduce significantly in thick seam mines and under high production conditions.
- High dust levels at belt conveyor were observed in a US nonmetal mine.
- As the current trend is to substantially increase production levels, there is an urgent need for detailed investigation of various dust control options and development of appropriate dust management strategies.