



Spray System for Dust Control (Patent Pending)

An Innovative Spray System for Control of Dust around a Continuous Miner

It utilizes scientifically designed water sprays to minimize worker exposure to respirable dust in active mining areas. It is designed to reduce coal workers pneumoconiosis (CWP) while improving mining productivity.

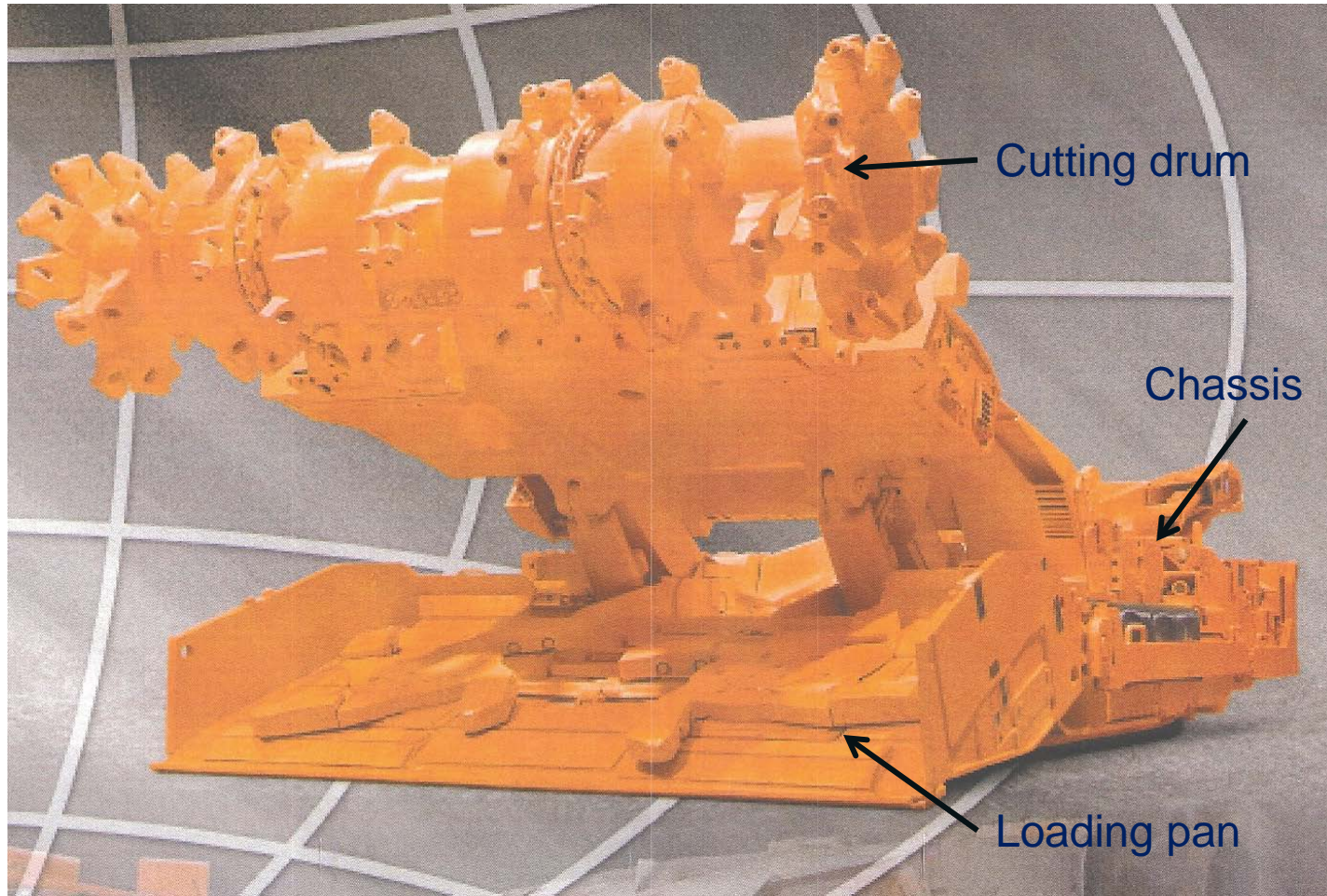
Southern Illinois University Carbondale

Yoginder P. Chugh

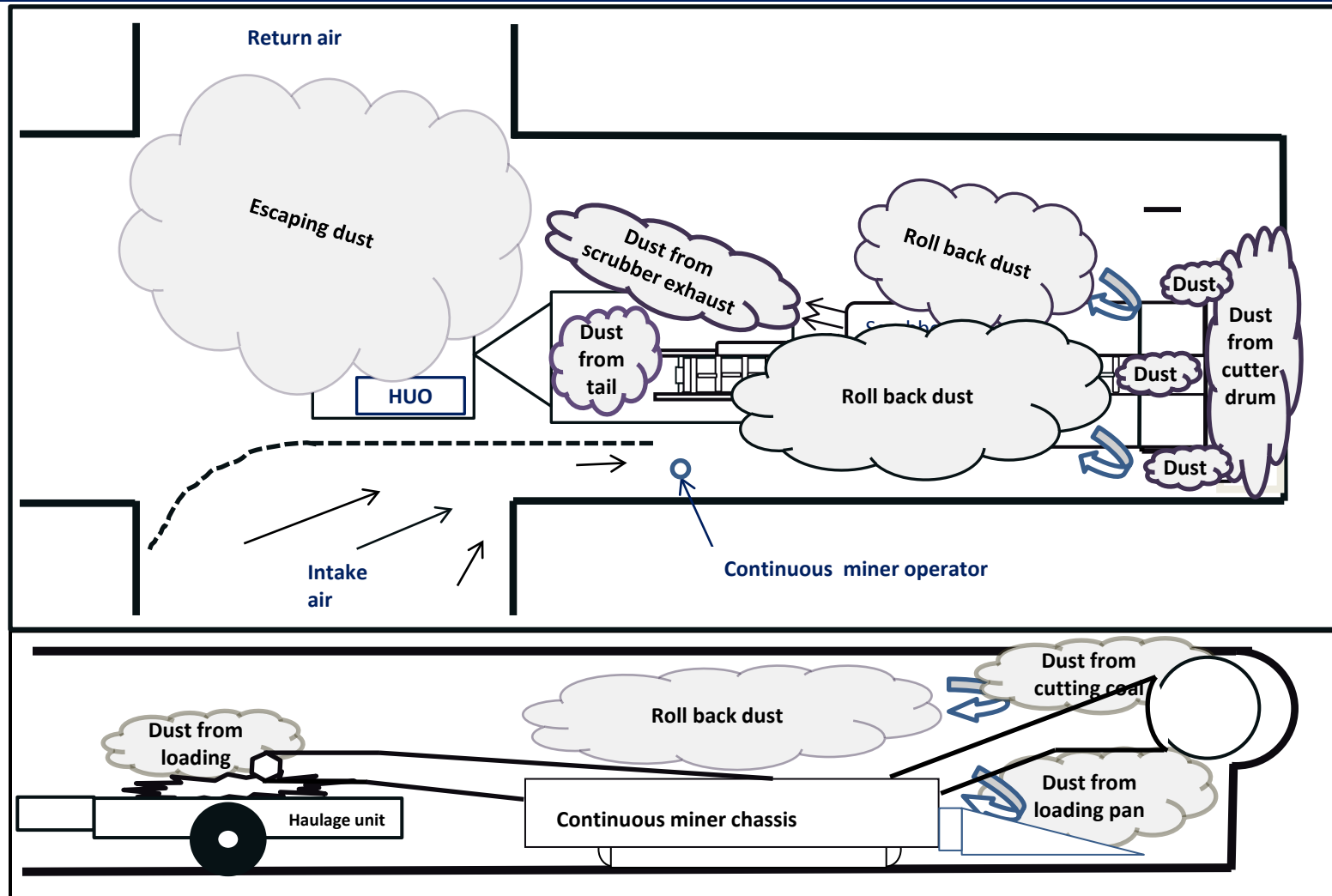
Professor, Mining and Mineral Resources Engineering

**Developed primarily with financial support from
Illinois Clean Coal Institute**

Continuous miner



Sources of dust around a continuous miner



Current spray block design



Multiple spray orientations with minimal spacing

Limitations of Current Spray Systems Design

- Spatially, sprays are located to control dust mostly in one vertical plane.
- Randomly oriented sprays resist air movement.
- Different sprays intercept each other to create large water droplets inefficient for dust control.
- High spray pressure tends to blow dust away and reduce possibility of colliding with water.
- Dust aerosol is not contained within the face area to be sucked in within the wet scrubber.
- Residence time for interaction between dust aerosol and water droplets is small.

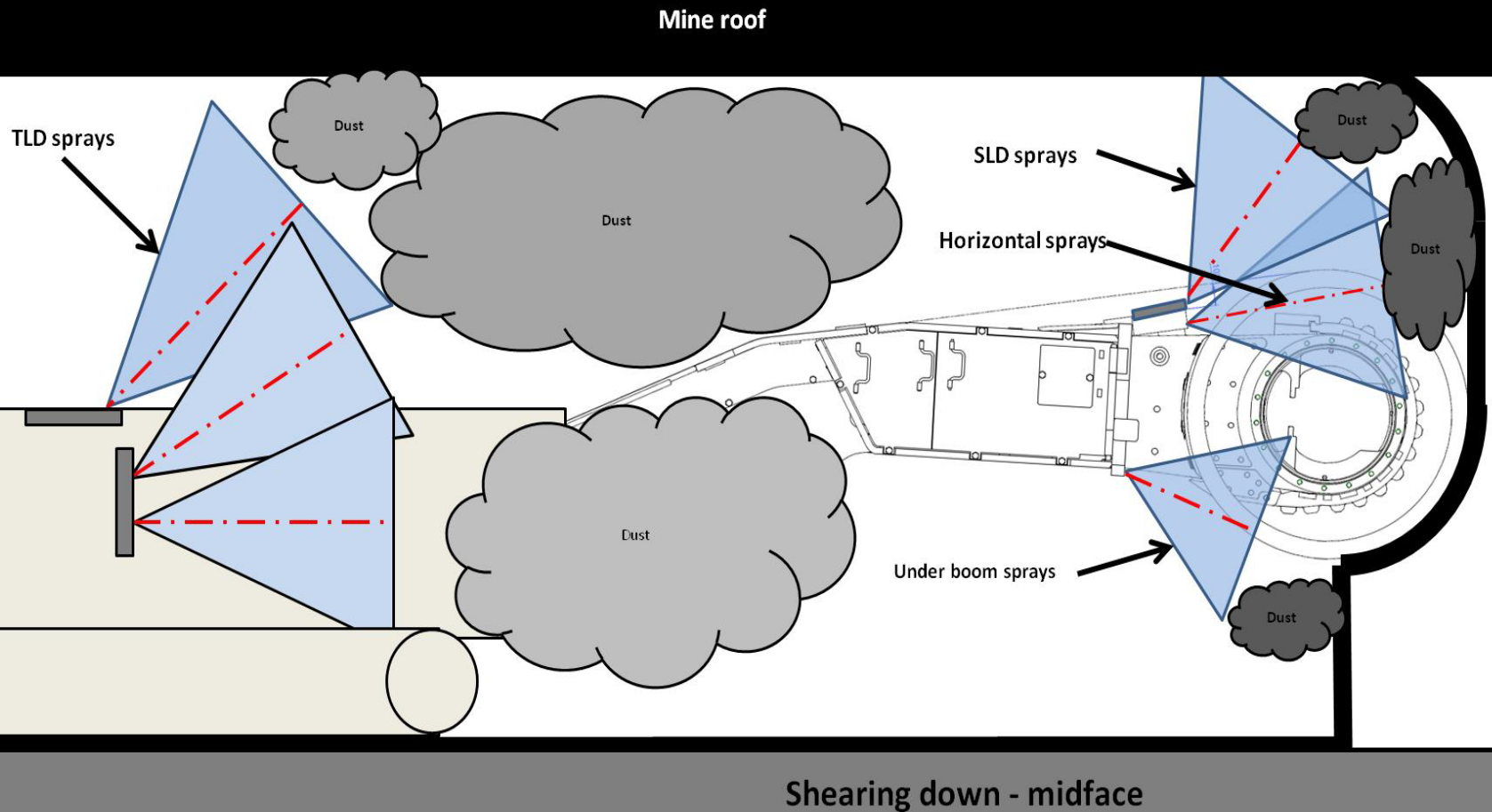
Dust wettability characteristics affect dust control



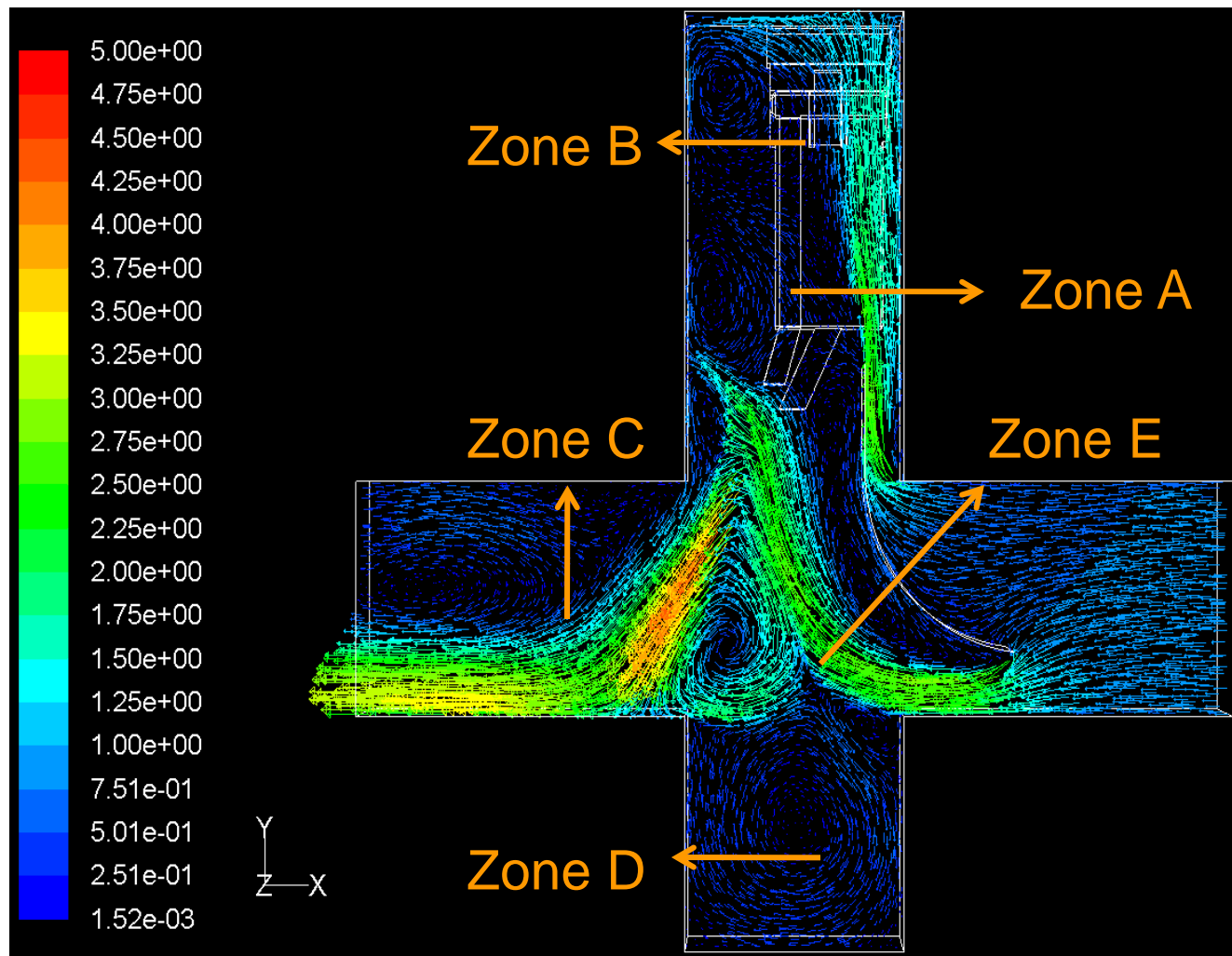
Developed Technology Summary

- **Description:** The technology creates engineered, spatially distributed hydraulic shrouds or curtains around a mining machine to contain and wet the dust and minimize its escape toward workers.
- **Inventor-** Dr. Y. Paul Chugh
- **Potential applications:** Surface and underground mining machines, material discharge points, material crushing and grinding facilities, highway concrete and asphalt cutting machines.
- **Licensing opportunities:** Engineering and manufacture of spray blocks and marketing for different applications and industries.

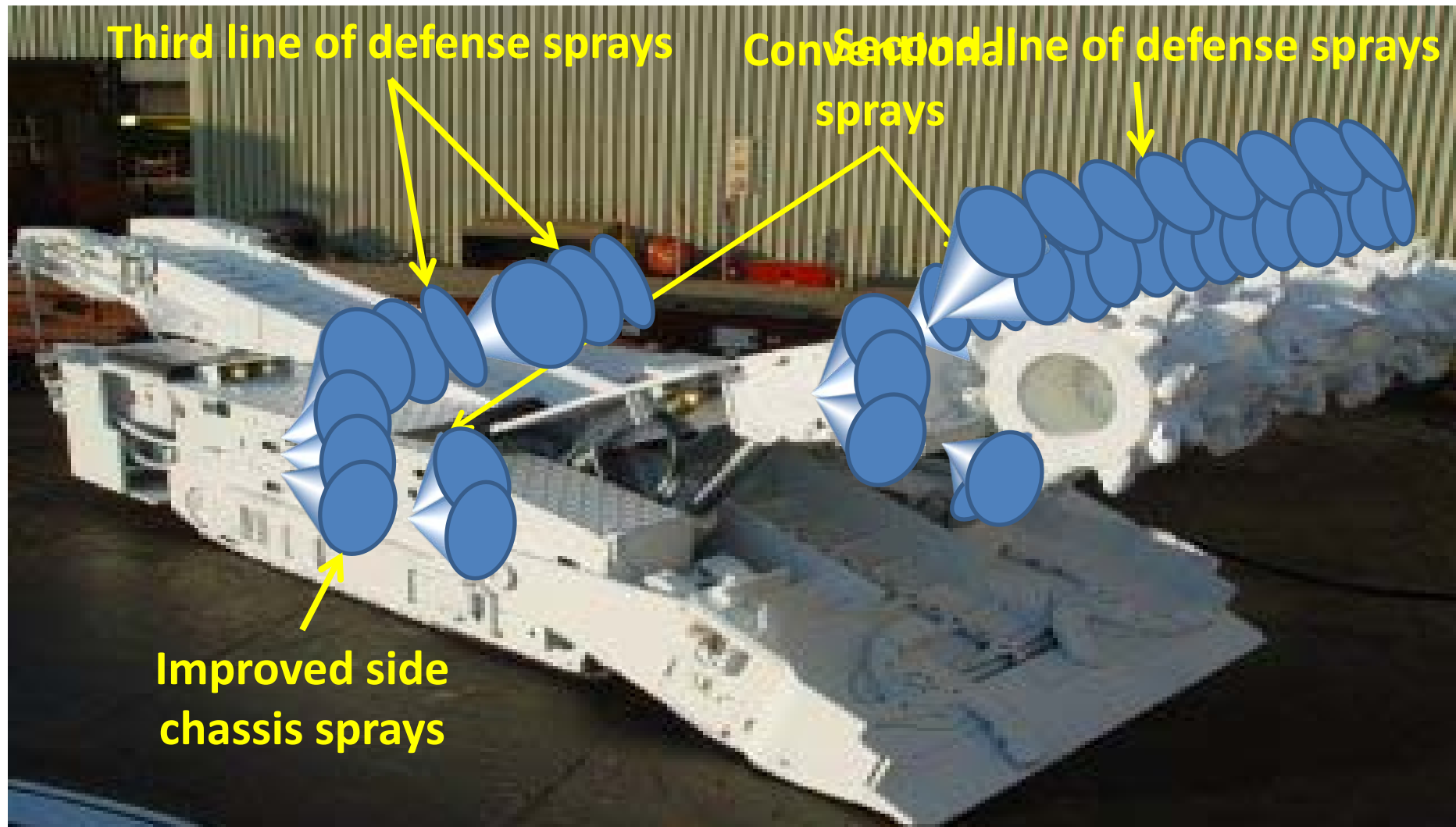
Some concepts of SIUC spray system



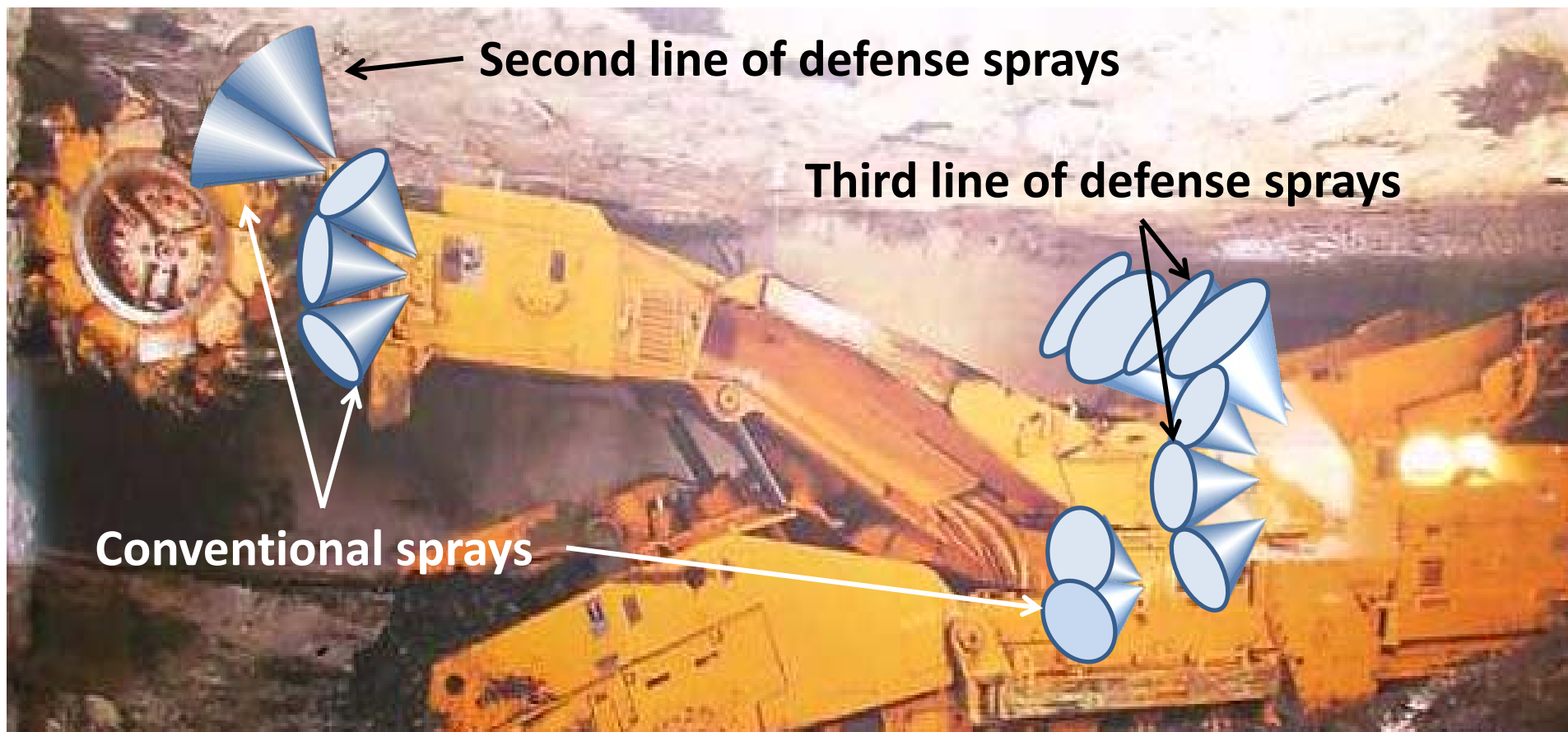
Background: Air flow Distribution in the Mining Area (Box cut with scrubber operating)



SIUC spray system - isometric view



Second and third line of defense sprays



Design and installation of SIUC spray system

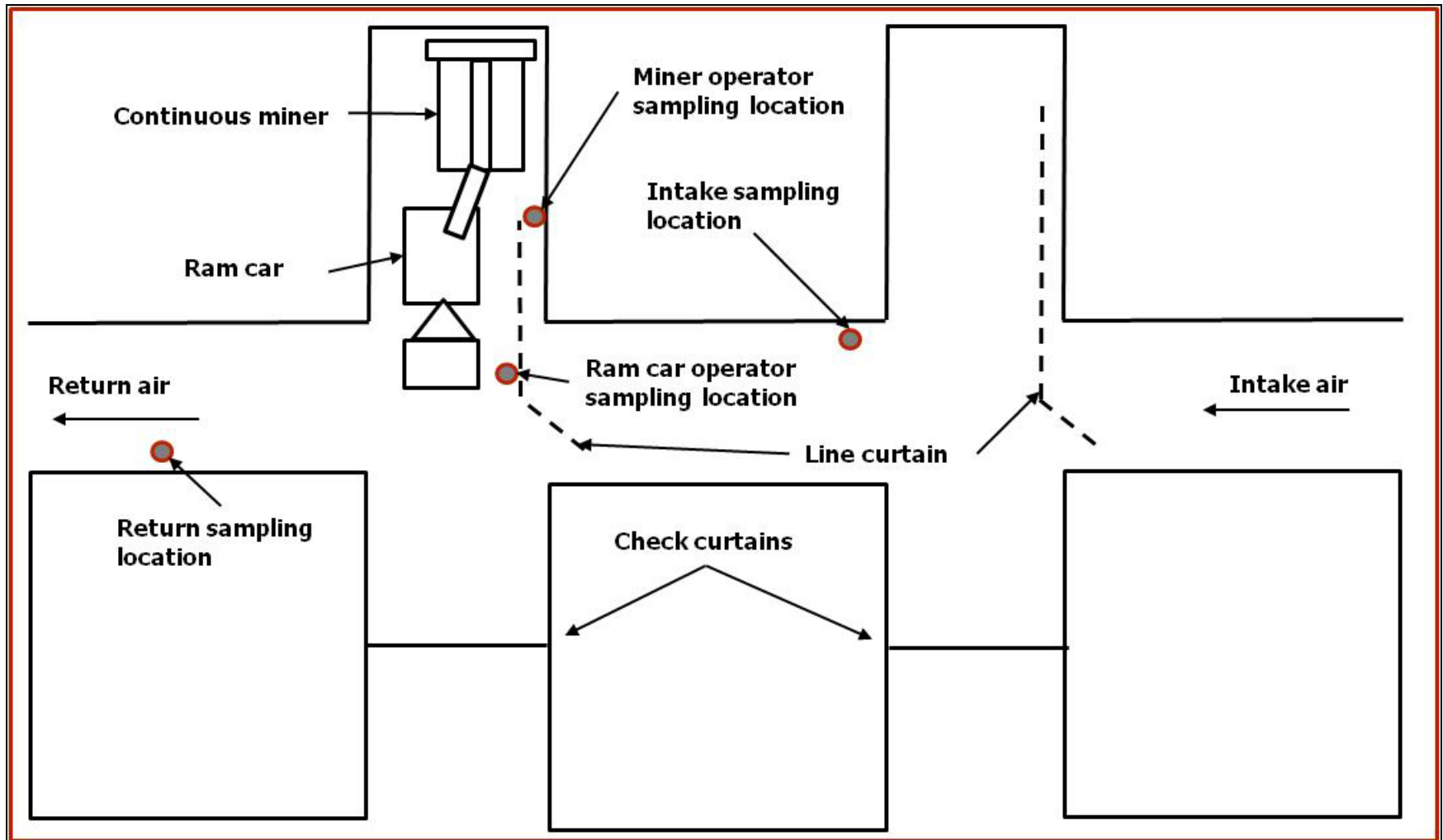


Engineering the sprays system at Knight Hawk mine before shipping the CM to rebuild

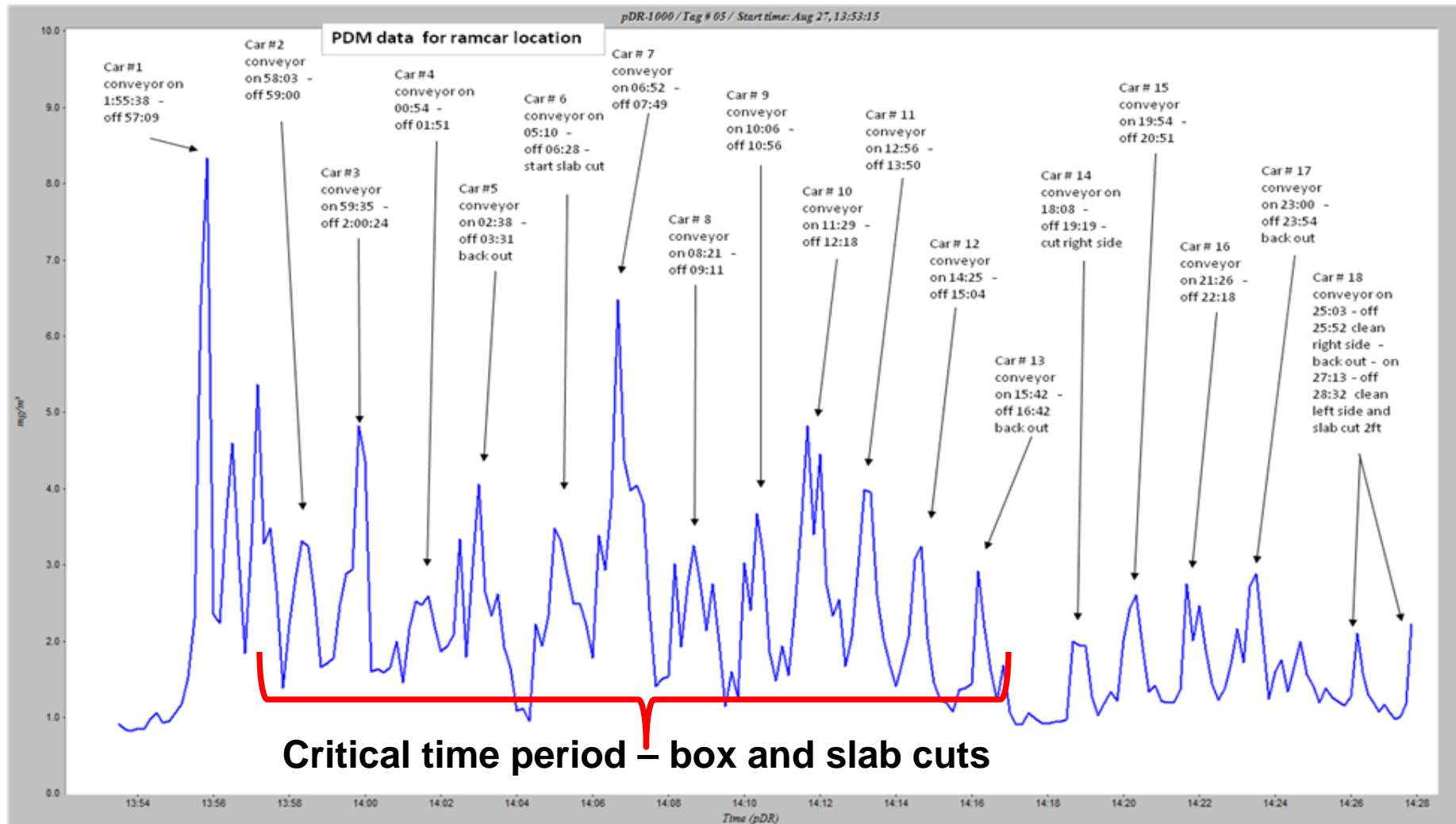
Installation of sprays at JOY rebuild center



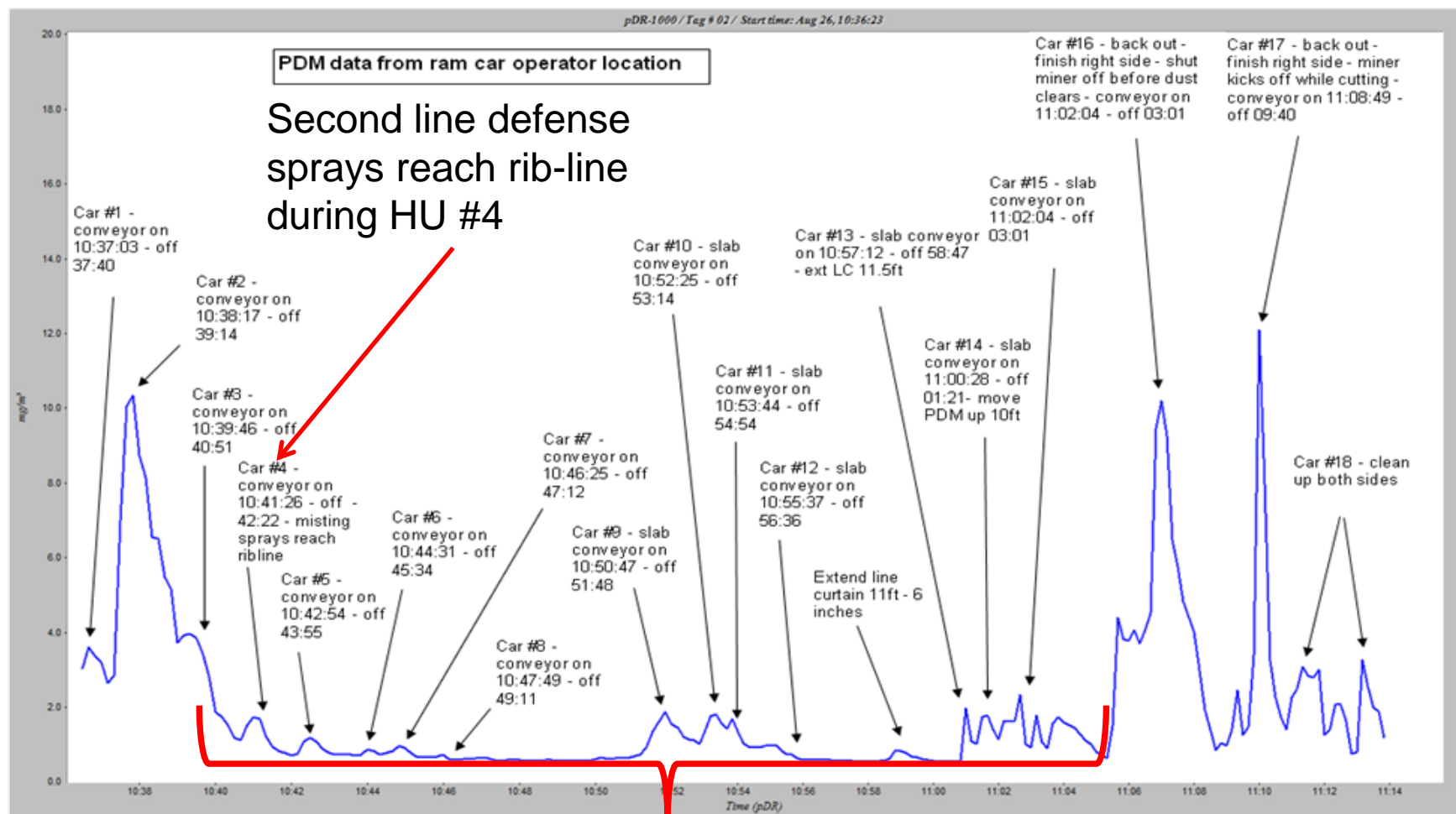
Typical dust sampling locations



PDM data – HO location for unmodified miner cut J1



PDM data HO location for modified miner cut B2



Critical time period – box and slab cuts



Summary of Dust Control Comparison Data for SIUC Innovative Sprays (gravimetric sampling)

Sampling location	Miner		Percent (%) improvement	
		Number of cuts	Corrected for intake dust	Corrected for intake dust and air volume
Continuous miner operator	CM - SIUC MOD-NIS	35	20.7	35.8
	CM - SIUC MOD - IS	37		
Haulage unit operator	CM - SIUC MOD-NIS	35	15.7	16.5
	CM - SIUC MOD - IS	36		
Return - inby rib	CM - SIUC MOD-NIS	35	11.2	18.3
	CM - SIUC MOD - IS	37		
Return - outby rib	CM - SIUC MOD-NIS	35	15.5	25.7
	CM - SIUC MOD - IS	37		

Summary Comparison of Production Rate for All Cuts

Miner	HUs loaded	Load time (seconds)	Wait time (seconds)	Load rate face advance (tons/min)	Tons per HU	Percent OSD (%)	Mean load rate (tons/min)
NIS	18.8	48.5	68.5	13.65	10.81	10.26	5.63
IS	17.9	46.2	58.3	14.19	11.21	7.98	6.15
CON	16.9	47.3	57.0	14.14	11.04	7.41	6.28

Summary Assessment Based on SIUC Analyses

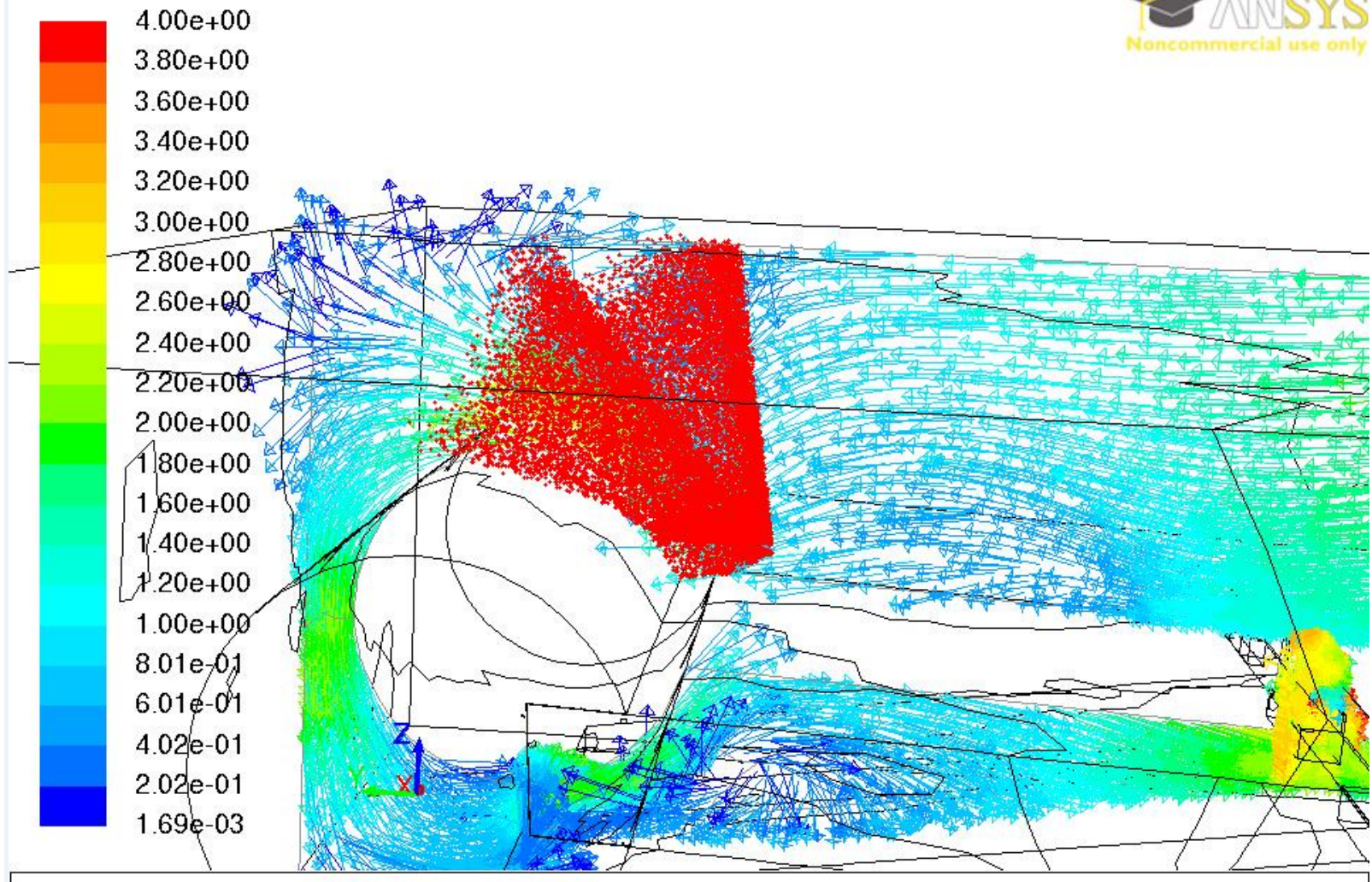
- **Peak dust concentration (PDM data) is reduced 43% at the CMO location, 23% at the HUO location and 33% at the Return location.**
- **Overall dust exposure at the CMO location is reduced 35%.**
- **Similar data for HUO is 17% and in the LOXC return 23%.**
- **Visible dust is also significantly improved downwind of the CM. This is evident when the TLD sprays reach the un-slabbed face.**
- **Dust control is greatly improved when cutting roof rock.**
- **Most of the dust remains in the face area for scrubber to pull it in.**



OVERALL ASSESSMENT (KNIGHT HAWK COAL COMPANY)

- **Prototype 14CM15 back from Rebuild in June 2011 with Innovative Spray System Installed**
- **New 14Cm15 to be Received September 2011 with Innovative Spray System Installed**
- **Rebuild 14CM15 to be Received October 2011 with Innovative Spray System Installed**
- **Remaining Fleet to be equipped with Innovative Spray System at Rebuild and/or Original Manufacture Date**

Velocity vectors at vertical cross-section ($x = 1.14$ m) – bottom and top



Current Development Status

- **Progress to date: About 80% of the developed concepts implemented on commercial machines and demonstrated in the field. The technology is currently being used by three mining companies with very good results.**
- **Development hurdles:**
 - 1) **Mine Safety and Health Administration (MSHA) should allow the use of technology routinely without seeking experimental studies on each machine to demonstrate technology effectiveness.**
 - 2) **The technology has not been demonstrated yet in eastern and western US coal mines. About \$ 750 K to \$ 1.0 million in further development cost is needed for technology to be used extensively in the USA.**

Intellectual Property Protection

- **Provisional application filed in July 2010.**
- **Final application filed in July 2011.**
- **Current experimental manufactured parts have marked “SIU Patent Pending”.**
- **The patent application is generic and covers all fields.**
- **Available for Licensing**

The Applications

- **Continuous miners, road headers, tunneling machines, highway concrete and asphalt cutting machines.**
- **Extend the concepts to longwall shearers. Surface mining equipment**
- **Crushing and grinding plants**
- **Material transfer points such as conveyors, truck dump points, loading points in non-coal mines.**

The Competition

- Competing technologies: Use of chemicals in water to improve wetting of dust, Joy Wet-Head Miner
- Shortcomings of current technologies: Chemicals in water negatively impact material processing technologies, and water treatment requirements. Wet-Head Miner technology is expensive to implement and maintain.
- Advantages: The developed technology is cheap, easy to maintain, and flexible to adopt and engineer in different applications.

Technology Market

- **The market for continuous miners alone in the US and other major coal producing countries- China, India, S. Africa is very large.**
- **The technology concepts could be extended to longwall shearers, and other rock cutting machines in coal and non-coal mines. However, this would require additional development.**
- **The technology profit potential is good. About 35-50% return on investment is possible.**

Technology Opportunities

- **Commercialization could occur by type of machine (continuous miner, shearer, road headers, etc.), type of industry (coal, non-coal, tunneling, highway, etc.), by application (mining, processing, material handling, etc.)**
- **The technology can be implemented in conjunction with existing technologies.**
- **Fields of use: Mining, tunneling, processing, materials handling, etc.**

Technology Opportunities (contd.)

- **Business opportunities exist to develop the technology for commercialization in different fields (mining, tunneling, highway, etc.)**
- **An agreement developed with a local-area machine shop to fabricate designed spray blocks for use in coal industry.**
- **Start-up company formed to seek License from SIU for manufacturing and marketing the technology in all fields.**



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- For more information:

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- Questions or comments!!

Thank you!!

That's all folks!!