Dust control technology research at NIOSH

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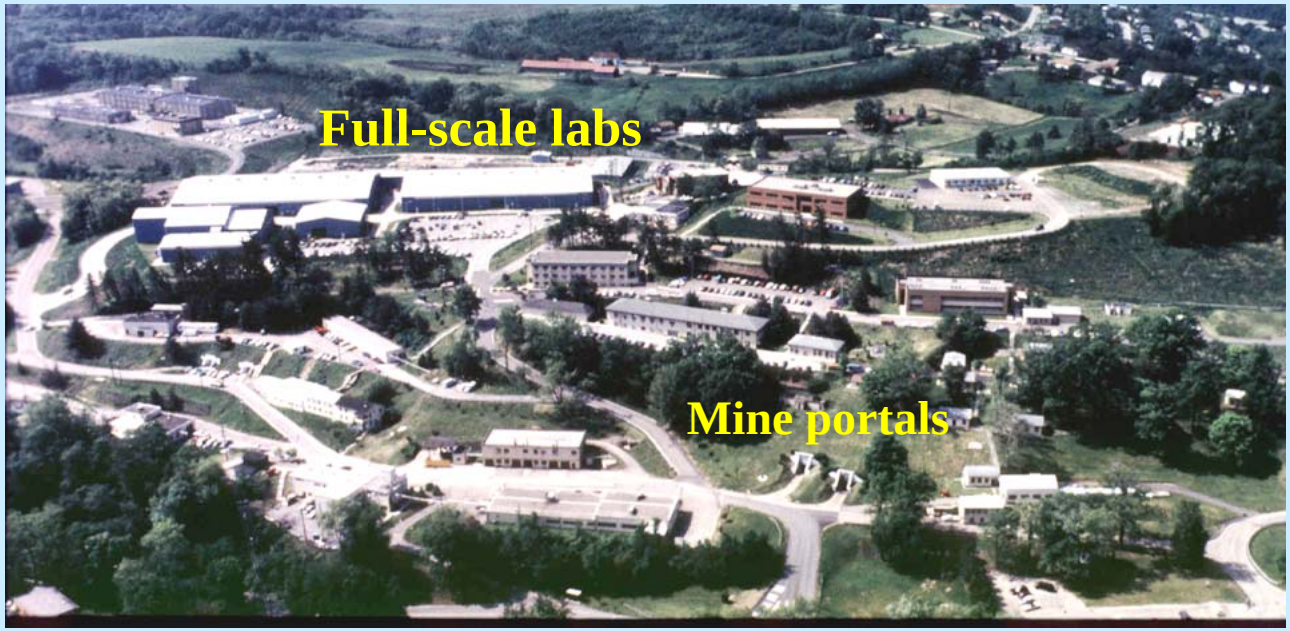


Respiratory Hazards Control Branch

- Mission….eliminate the adverse health effects to mine workers resulting from exposure to dust, diesel emissions and workplace contaminants.

- 30 employees

- Three areas of research:
  - Dust control technology
  - Instrumentation development
  - Diesel research

Unique laboratory facilities….

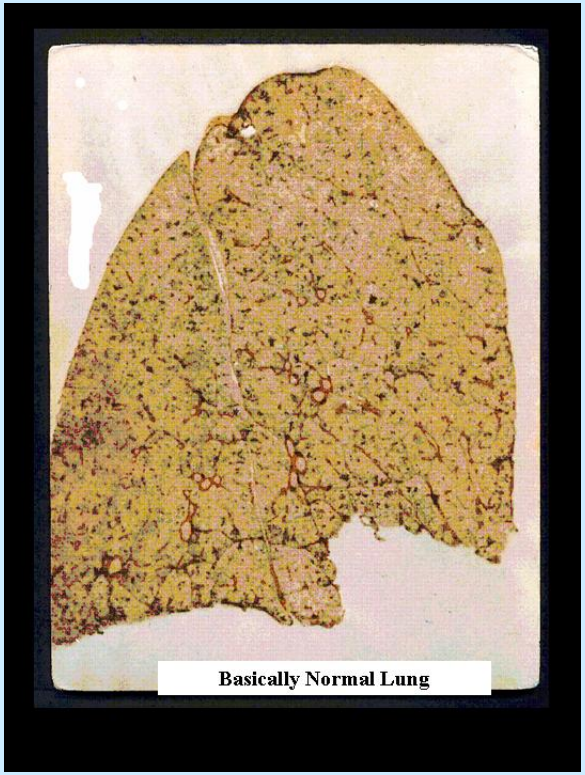
Longwall gallery

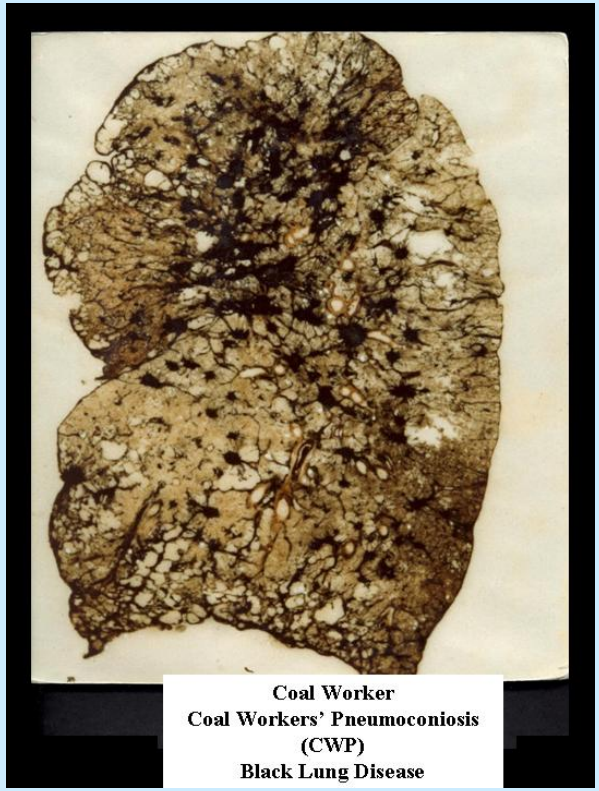
Dust chamber

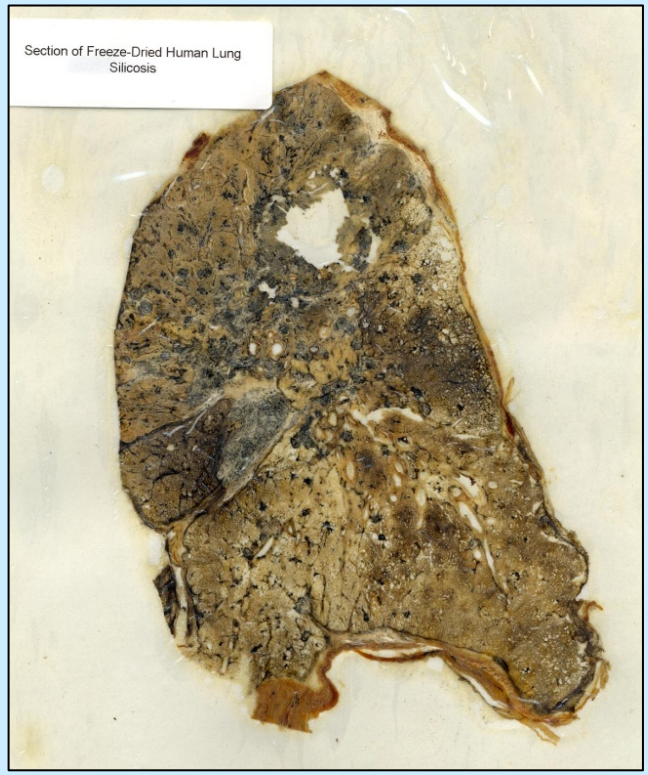
Continuous miner gallery

Weighing lab

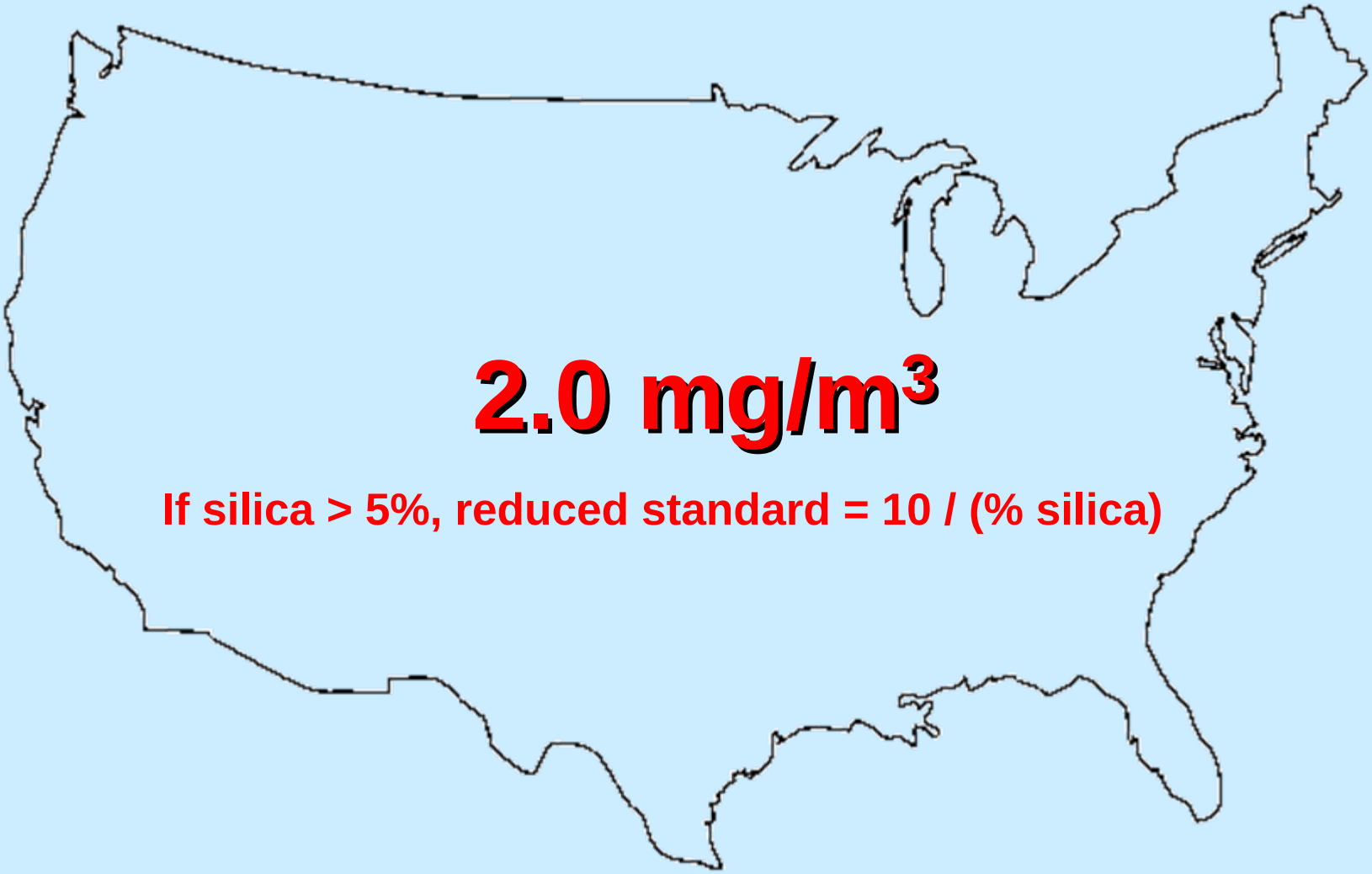
Impact of overexposure to respirable dust in mining







Respirable dust standard for coal mining



2.0 mg/m^3

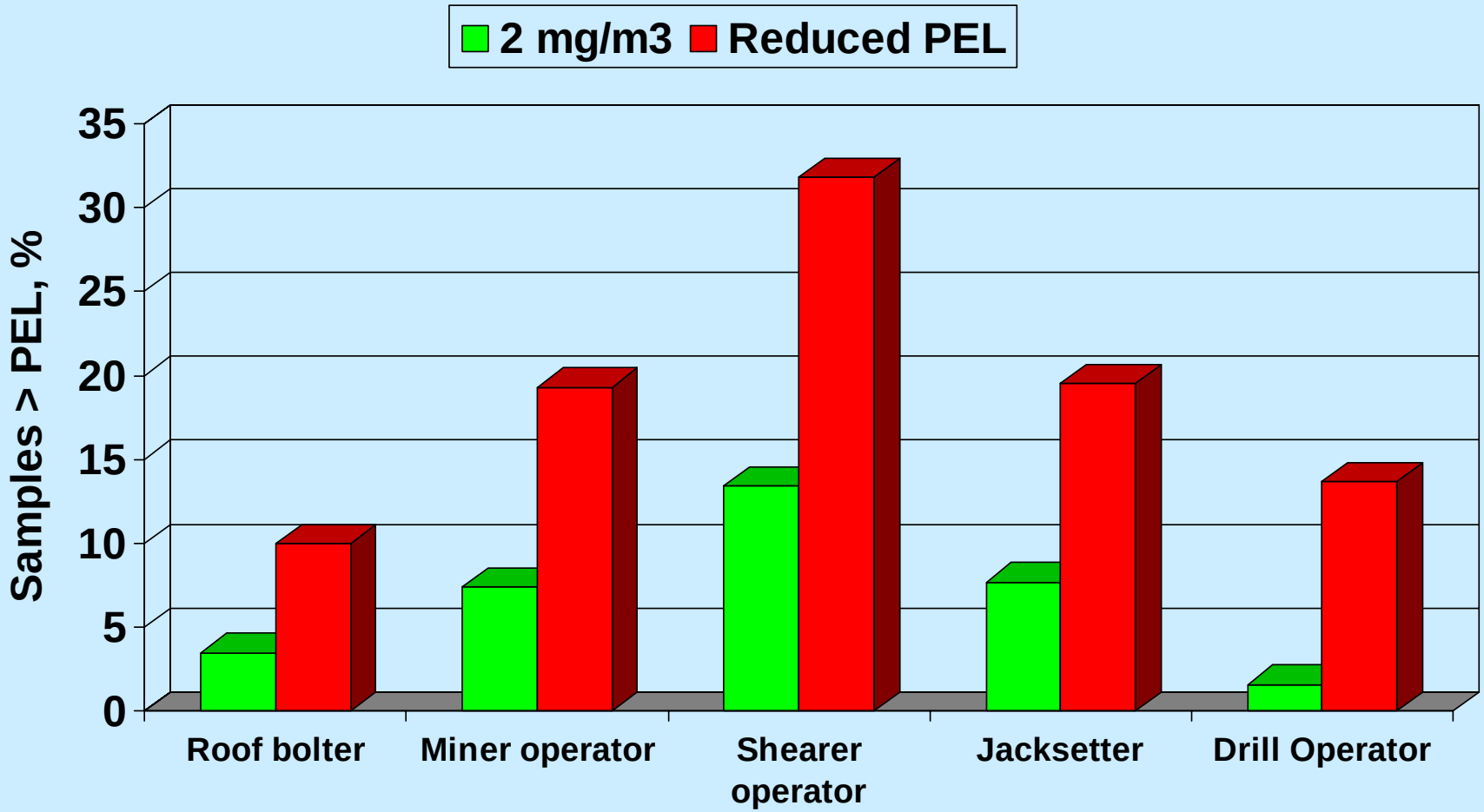
If silica > 5%, reduced standard = 10 / (% silica)

Ongoing challenges in dust control…

- Continued dust overexposures, particularly for high-risk occupations
- Upturn in CWP cases and identification of rapidly accelerating cases
- Proposed reductions in dust standards and new sampling procedures (S-Miner legislation)
- Difficult geologic conditions (rock)
- New workforce/inspectors unfamiliar with dust controls and lung disease

Overexposures for high risk occupations

(MSHA Inspector Sampling Data from 2003 – 2007)

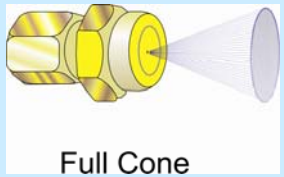


Examples of past research….

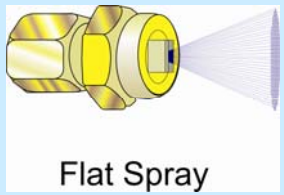
- Spray characterization and utilization
- Flooded bed scrubber performance
- Longwall dust control technologies
- Enclosed cab research

Water spray application….

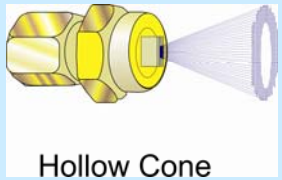
- Spray types
- Spray pressures
- Spray locations
- Air moving ability



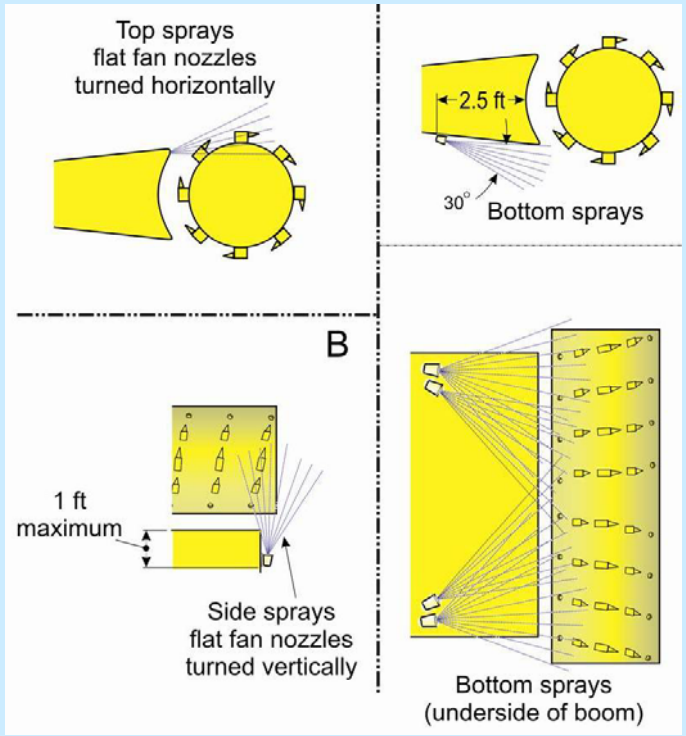
Full Cone



Flat Spray



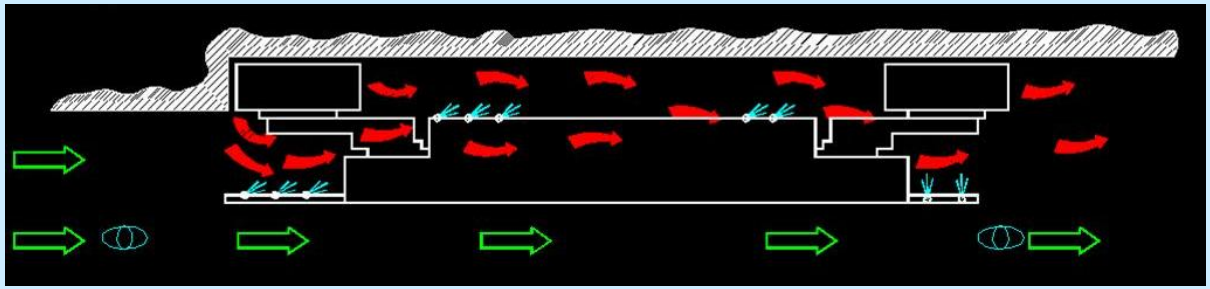
Hollow Cone

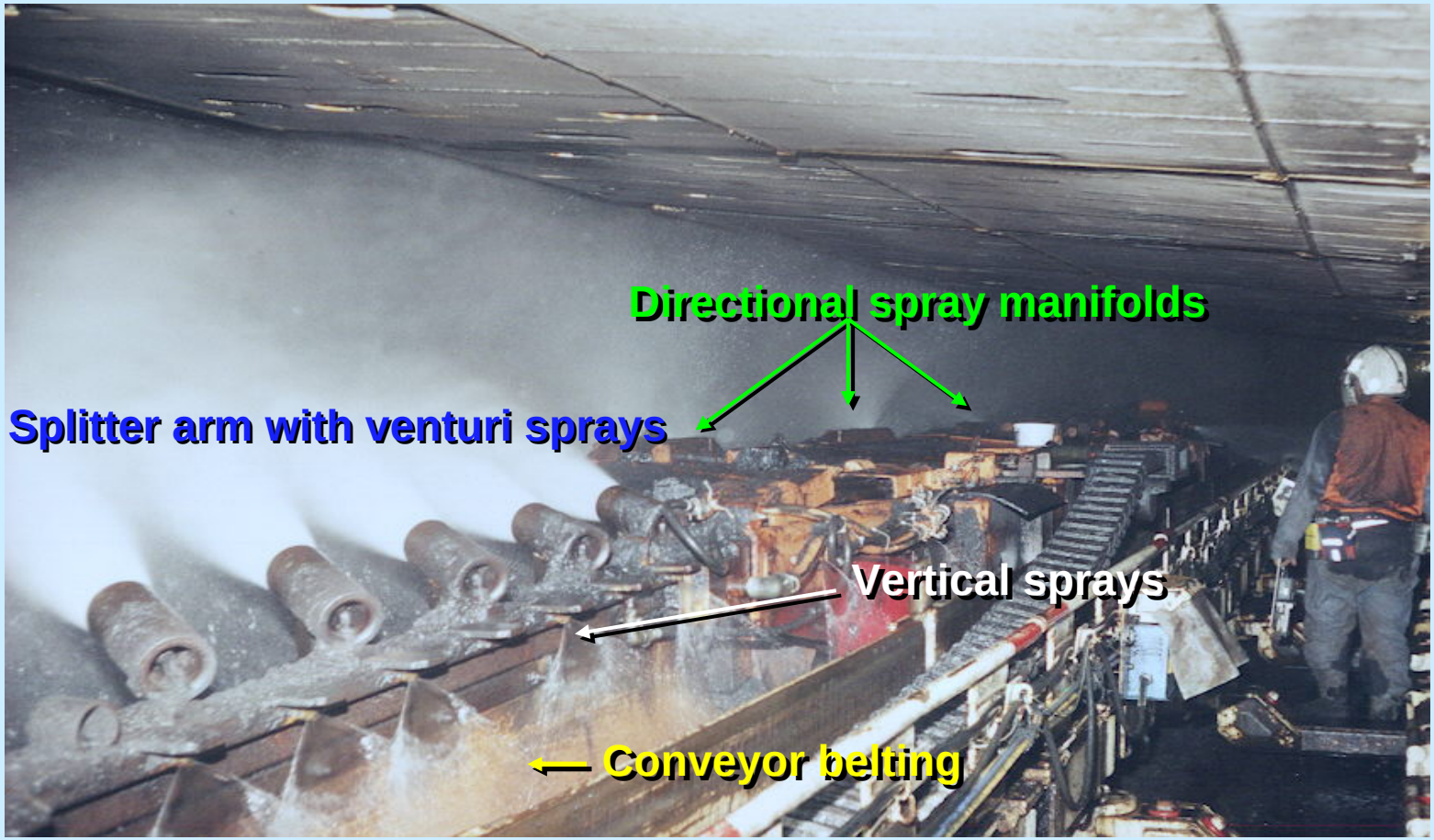


Improved dust control with side sprays on miner

- Utilize “blocking sprays” to prevent dust rollback and improve capture of scrubber

Directional “shearer clearer” spray system on shearer

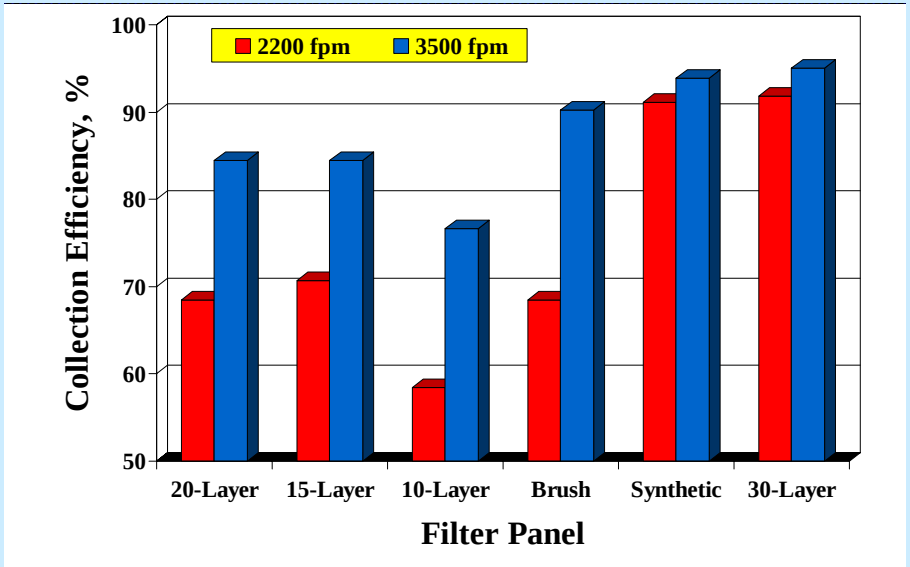




Effective directional spray systems

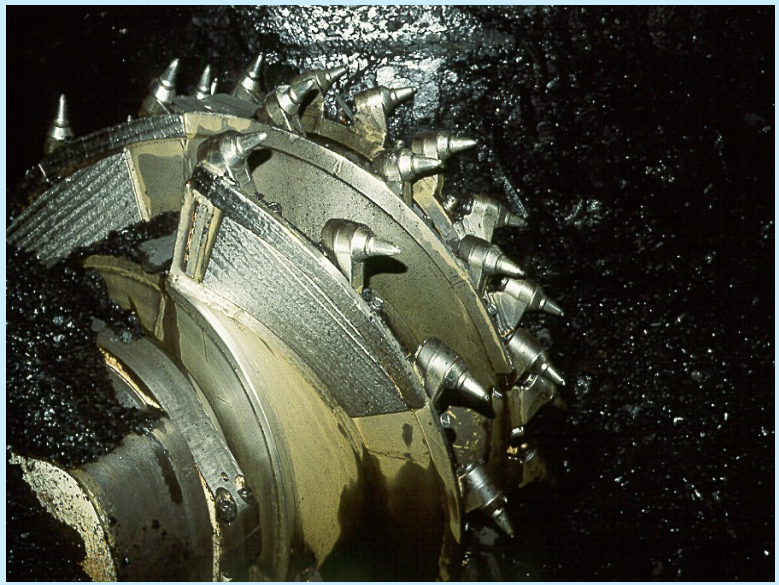
Flooded bed scrubber research…

- Operating velocities
- Filter performance

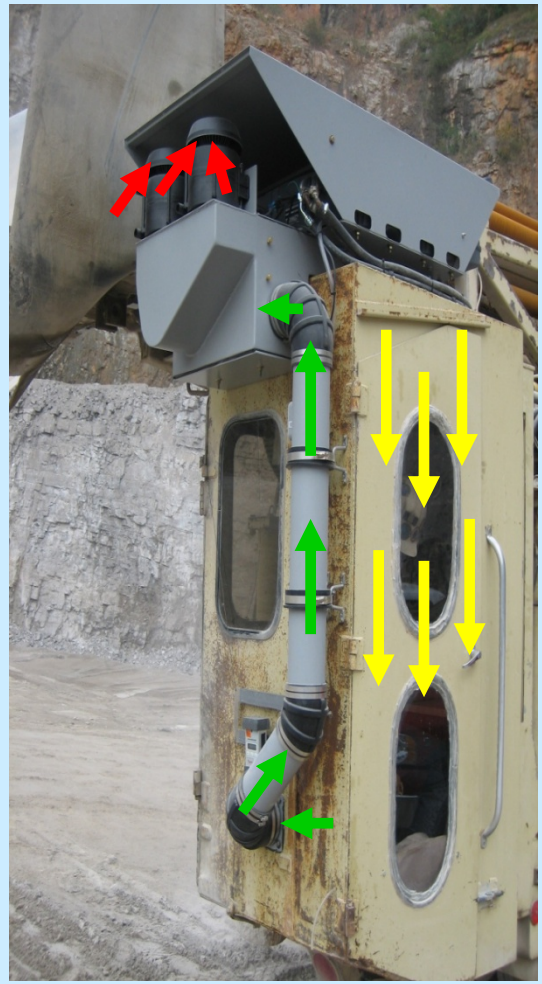


Longwall dust control…

- Crusher/stageloader controls
- Drum design guidelines
- Shearer clearer sprays
- Ventilation practices



Retrofit filtration/pressurization systems on enclosed cabs…



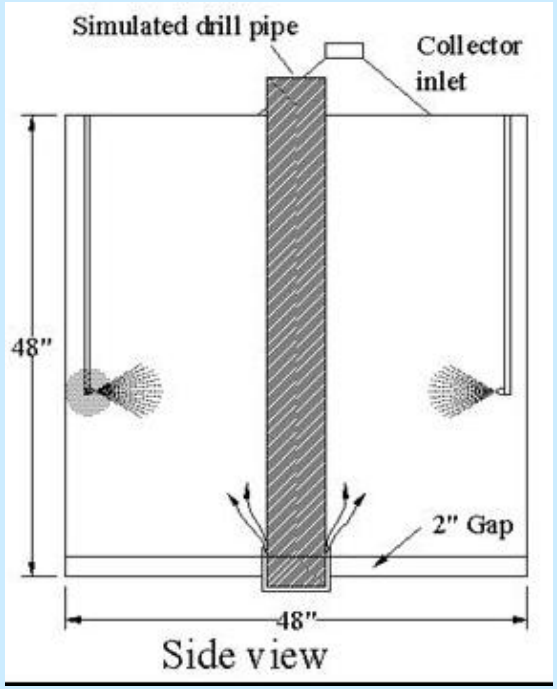
Ongoing research

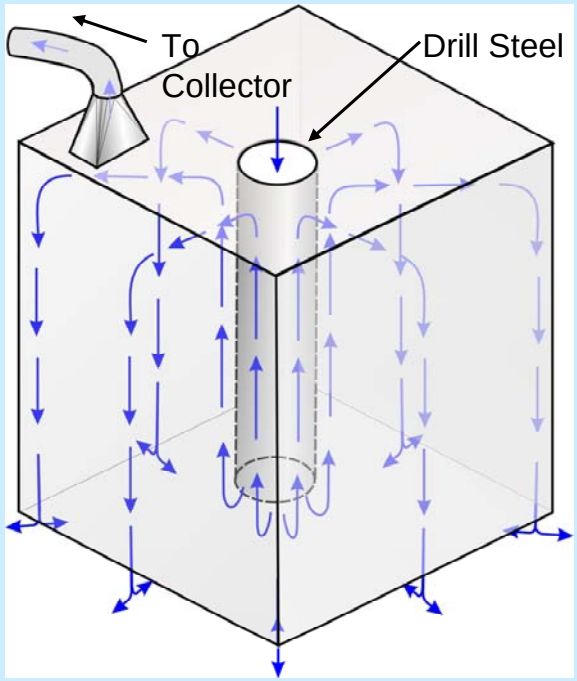
- Surface drill dust controls
- Hotspots research
- Wet head continuous miners
- Extended cuts
- Roof bolter dust controls
- LW benchmarking surveys
- PDM:
  - quartz analysis
  - software

Controls for surface drills

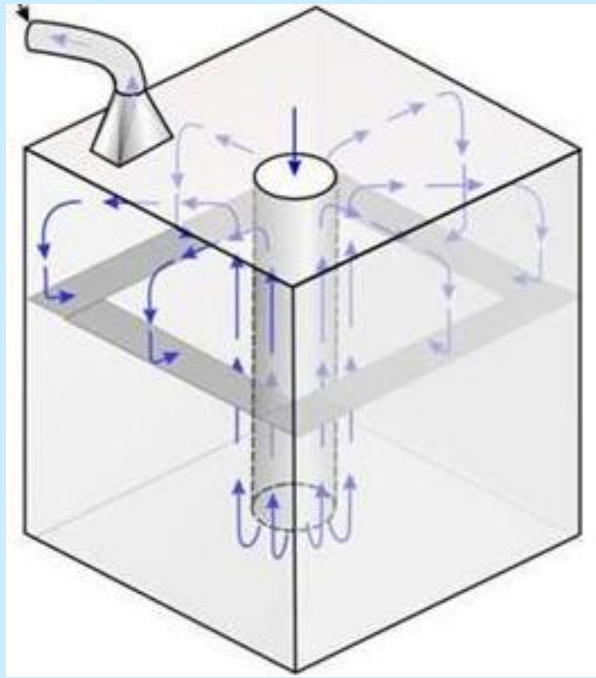
- Improving dust capture under drill shroud

(50% reduction in lab)



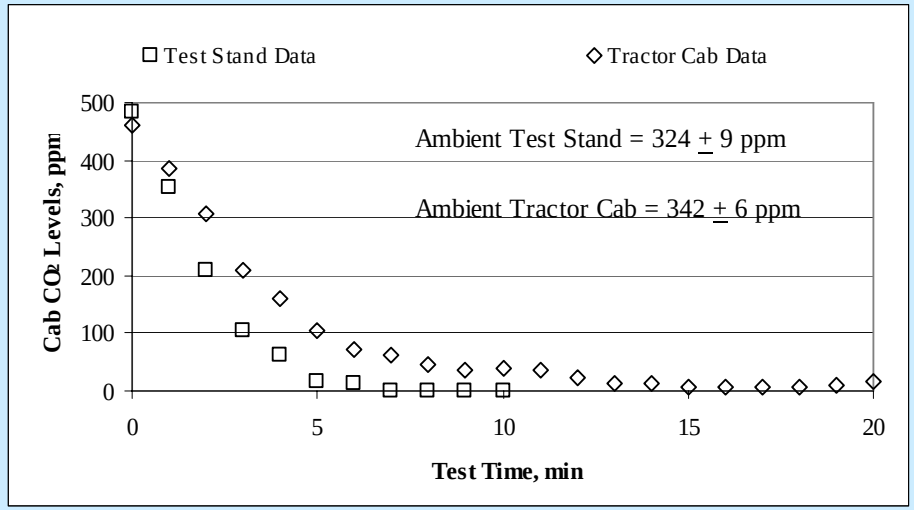


(80% reduction in lab)



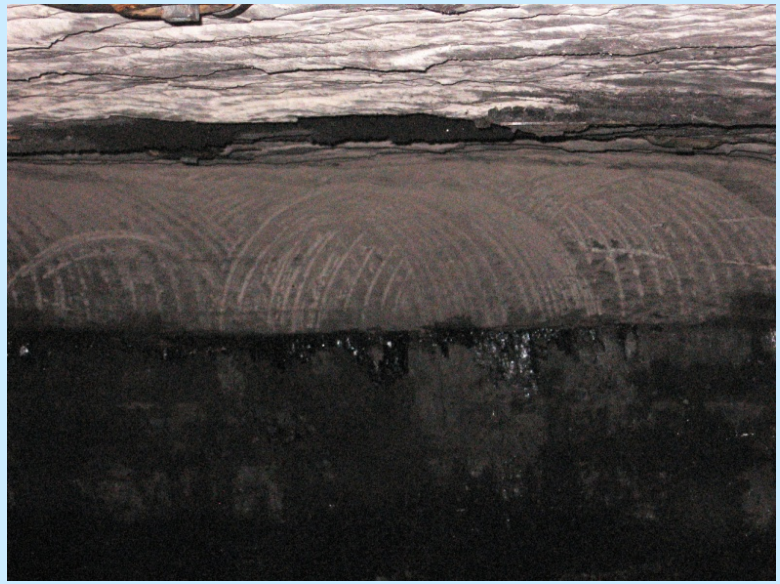
Controls for surface drills

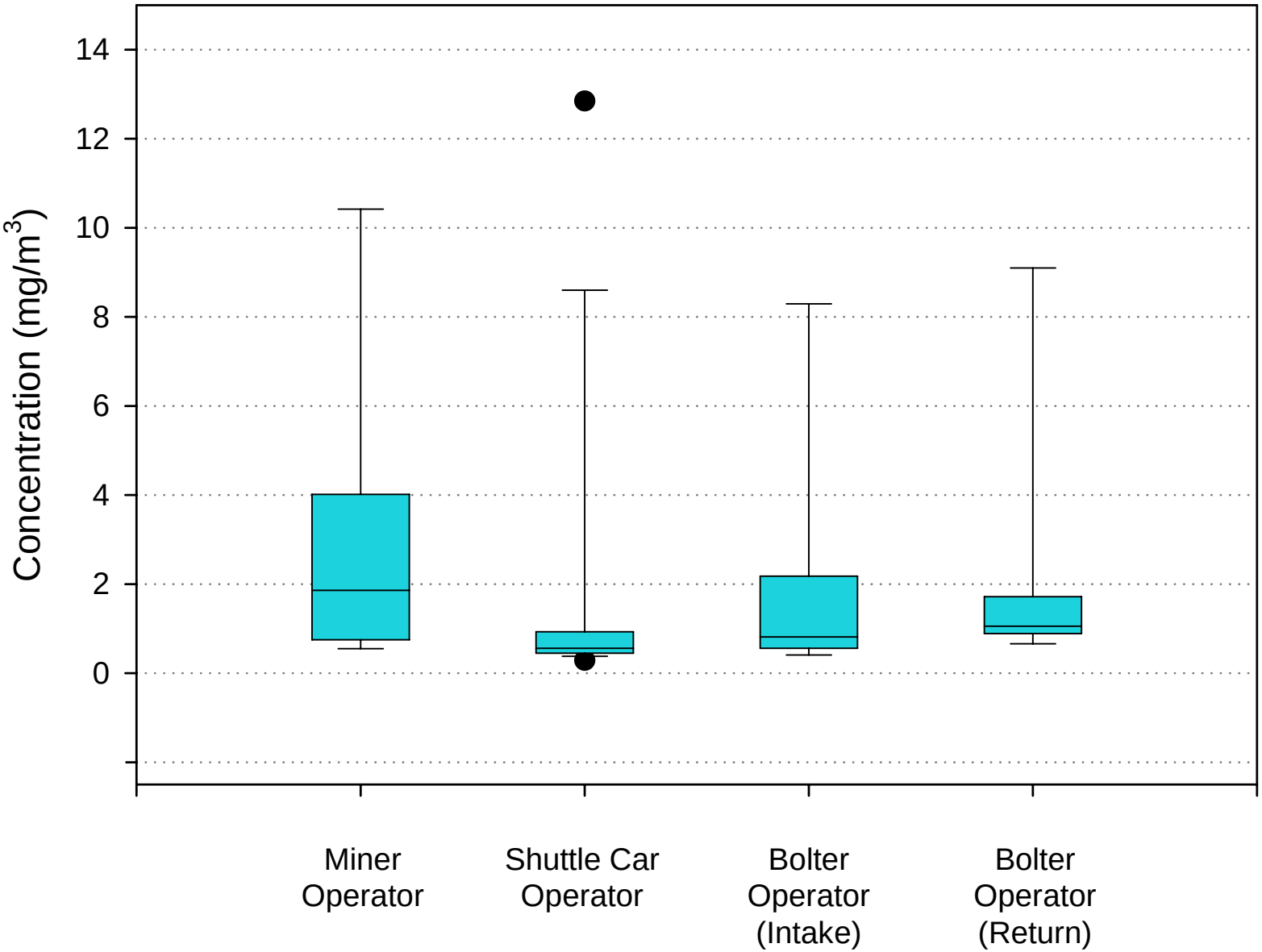
- Evaluated operating parameters to provide guidelines for effective cab performance (RI published)
- Developed field-capable leak test method for filtration systems (Patent pending). Ambient CO_2 gas used as test medium

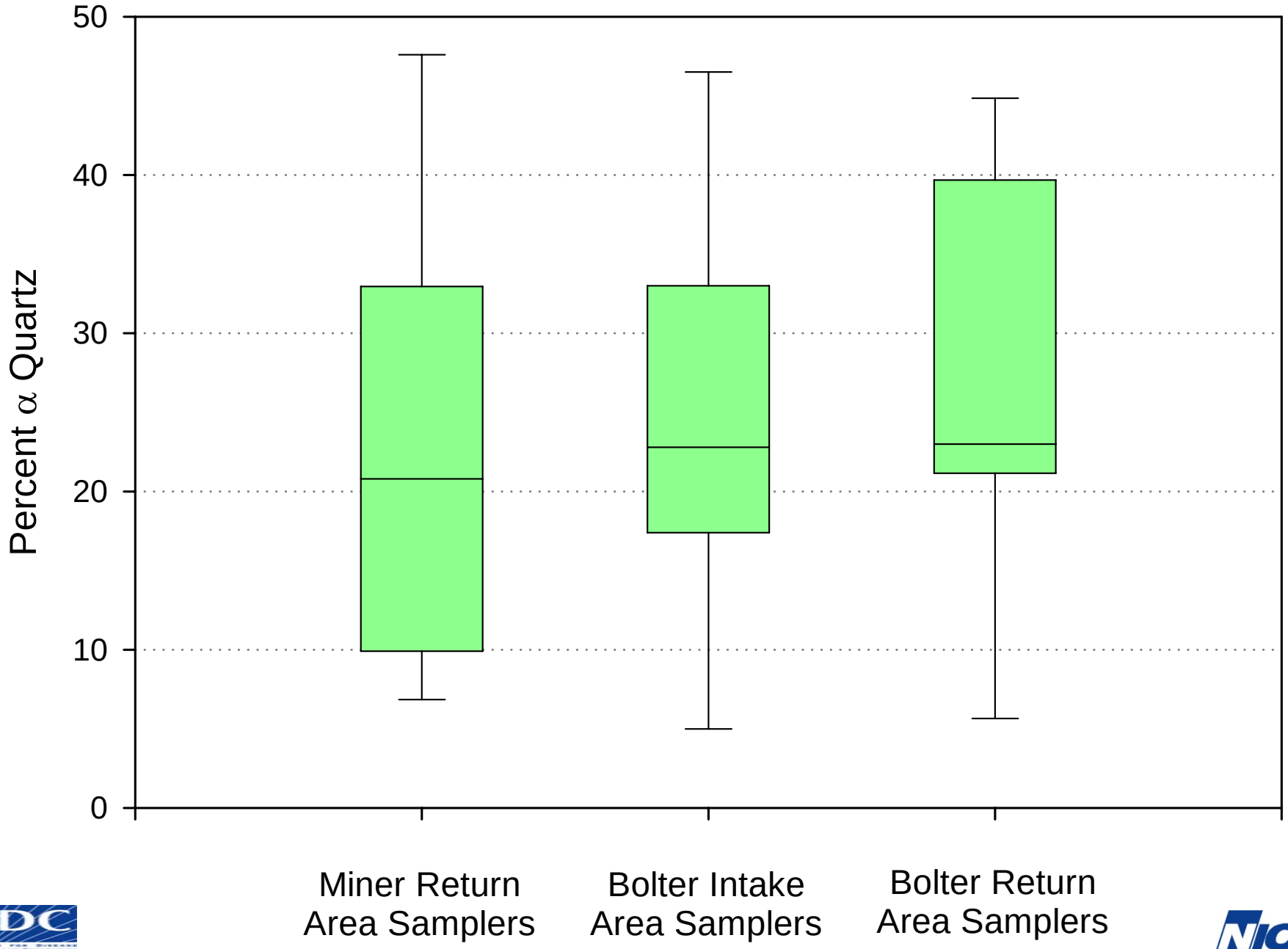


Hotspots research

- Evaluated MSHA dust sampling and inspector data for over 60 mines
- 7 mines surveyed to date
- Cutting between 12 – 24 inches of rock
- At one mine, silica ranged from 26 – 42%
- Maintenance of dust controls is a key factor in minimizing exposures




Concentration (mg/m3)
14
12
10
8
6
4
2
0
Miner Operator
Shuttle Car Operator
Bolter Operator (Intake)
Bolter Operator (Return)


50
40
30
20
10
0
Percent α Quartz
Miner Return Area Samplers
Bolter Intake Area Samplers
Bolter Return Area Samplers

Wet head continuous miners

- Potential for improved dust control
- Multiple surveys completed
- Marginal dust reductions observed

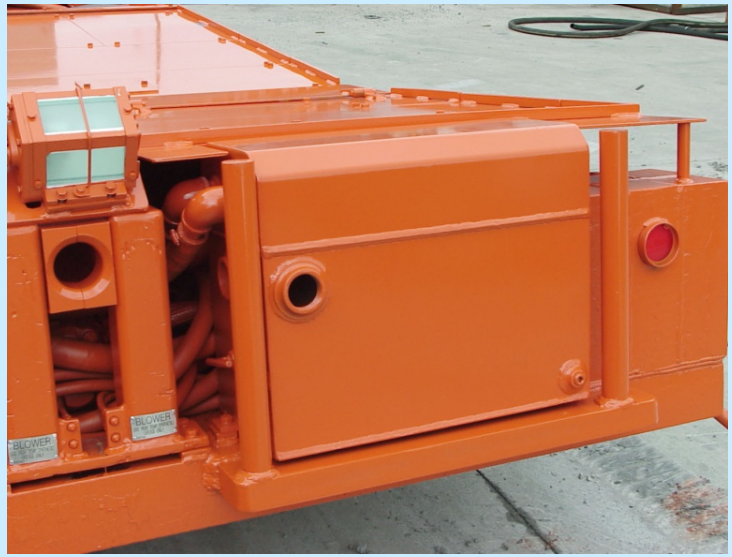
Dust levels in extended cuts

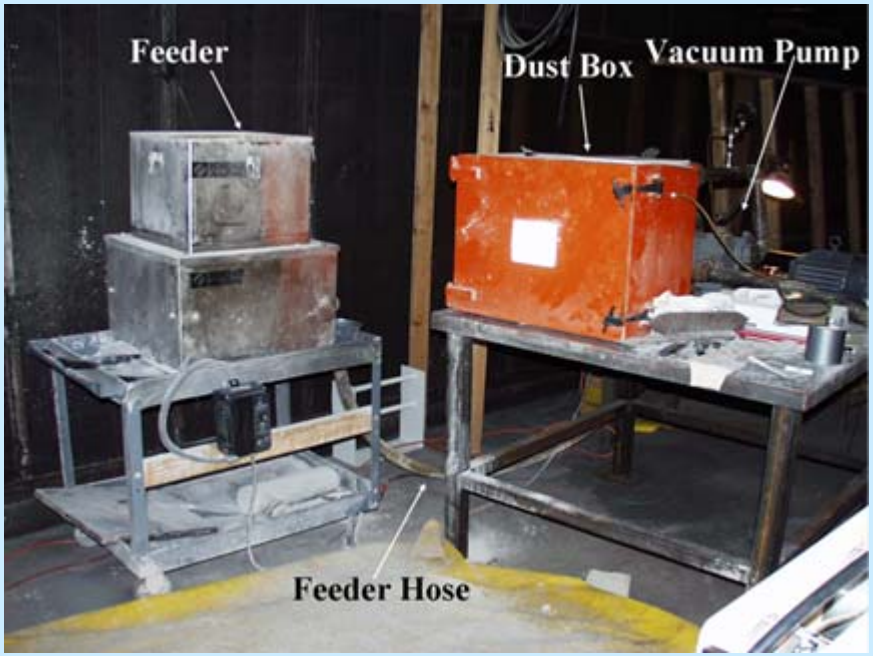
- Quantify dust levels throughout the cut
- Monitor performance of flooded bed scrubbers and roof bolter dust collector
- Conduct surveys at 6 mines with varying operating conditions
- Completed one survey to date

Roof bolter dust controls

- Dust collector performance
  - Collector bags
  - Pre-dumps
  - Water baths

- Canopy air curtain





Roof bolter collector bags

- Collector bags evaluated with over 50% reduction in exhaust dust
- Pre-dump cyclones

Roof bolter pre-dump cyclones

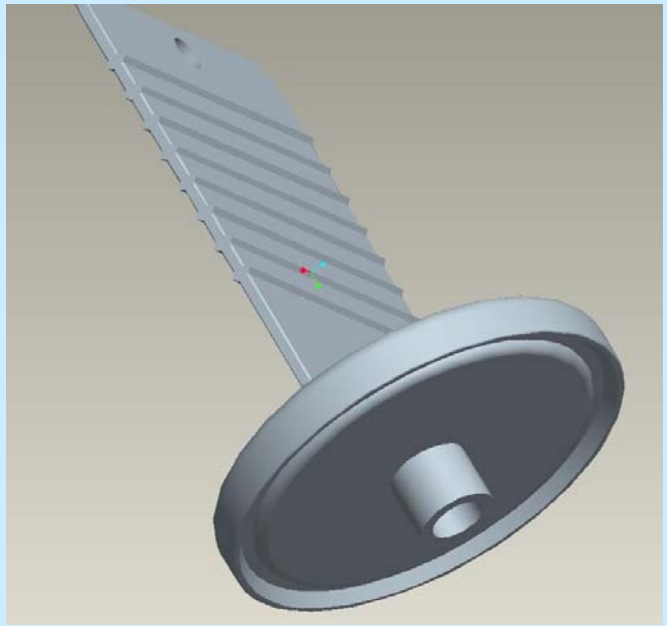
- MSHA inspectors collected pre-dump samples
- 40 samples collected from Districts 4, 5, 6, and 7
- NIOSH had samples analyzed for size and silica content
- Approximately 25% respirable in bulk samples (airborne ??)
- Conduct in-mine sampling to determine amount that gets airborne

LW Benchmarking surveys

- 10 mines surveyed
- Quantify dust sources
- Identify successful controls and operating practices

PDM filter holder for maintaining sample integrity for quartz analysis

- Place capsule over PDM filter when TEOM removed from PDM – secures sample with one-way, tamper-evident lock
- Use capsule as filter removal tool
- Send to lab, remove finger tab, ash capsule



PDM analytical software

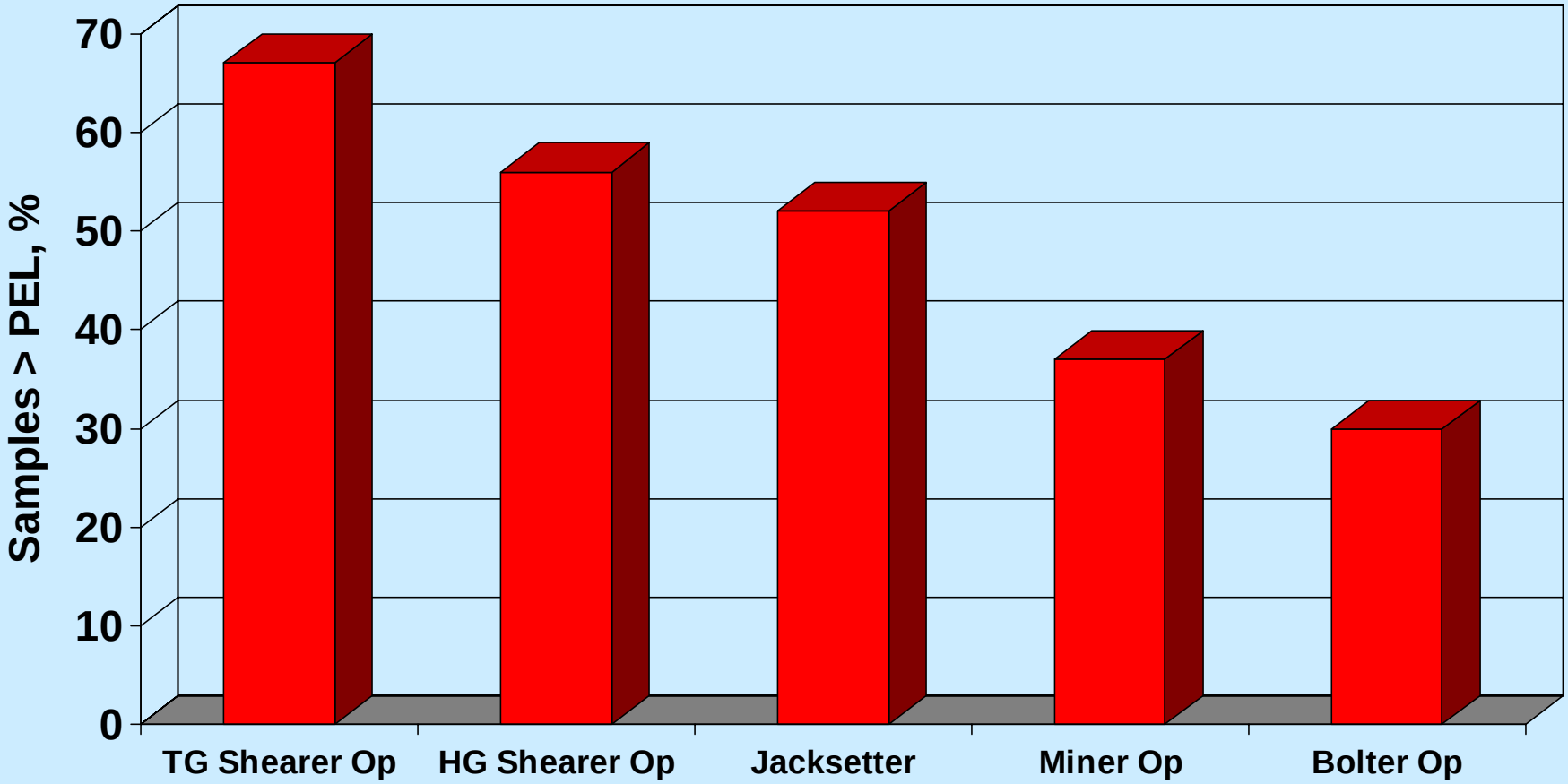
- Compile output from PDM samplers
- Provide user-selected summaries for multiple samplers
- Provide graphing capabilities

Proposed S-Miner Bill

- Reduce coal dust standard to 1 mg/m^3
- Establish silica dust standard of 50 µg/m^3
- Require use of PDM for compliance sampling

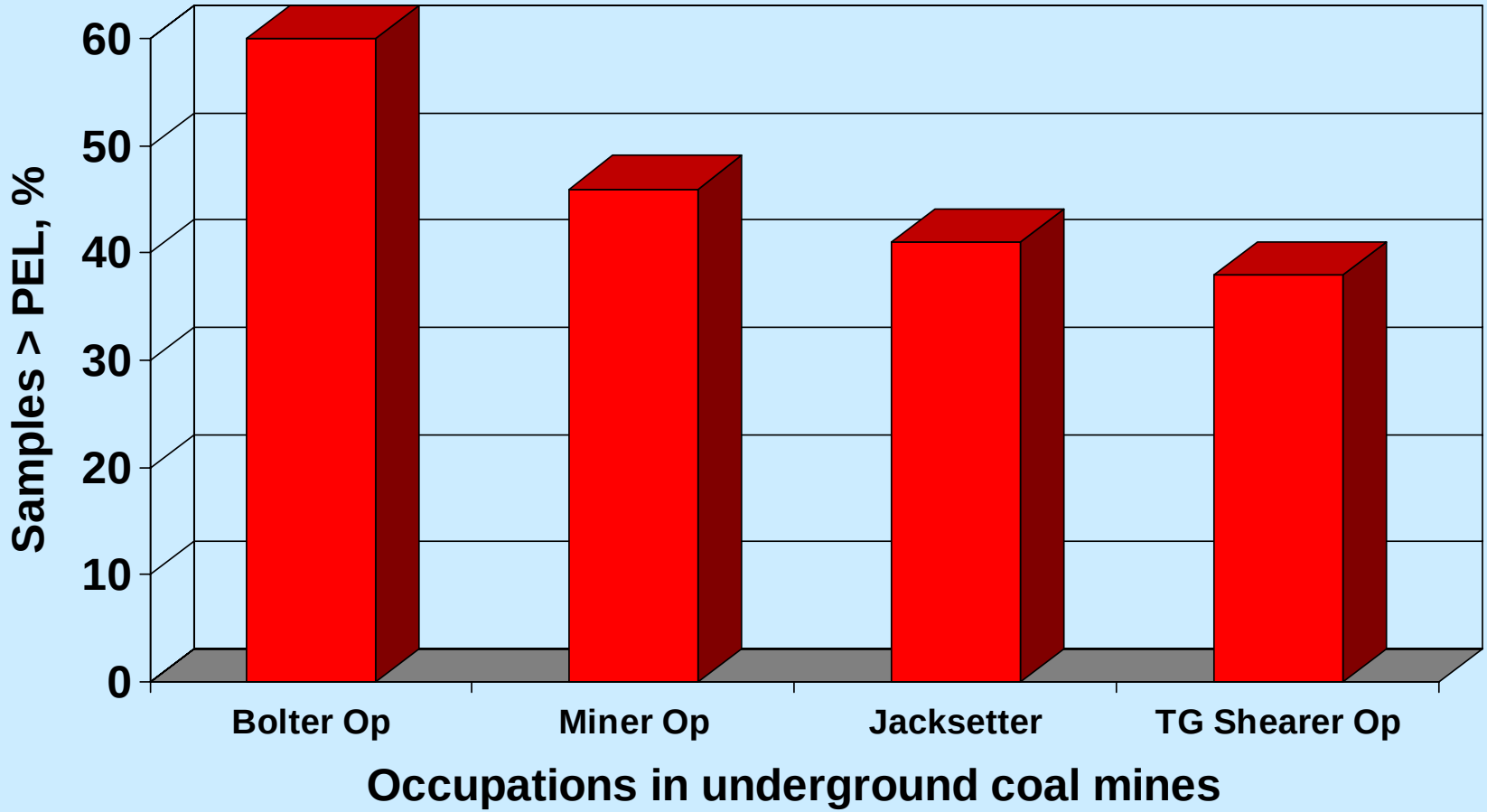
MSHA compliance samples exceeding 1 mg/m^3

(TeraData from 2002 – 2006)



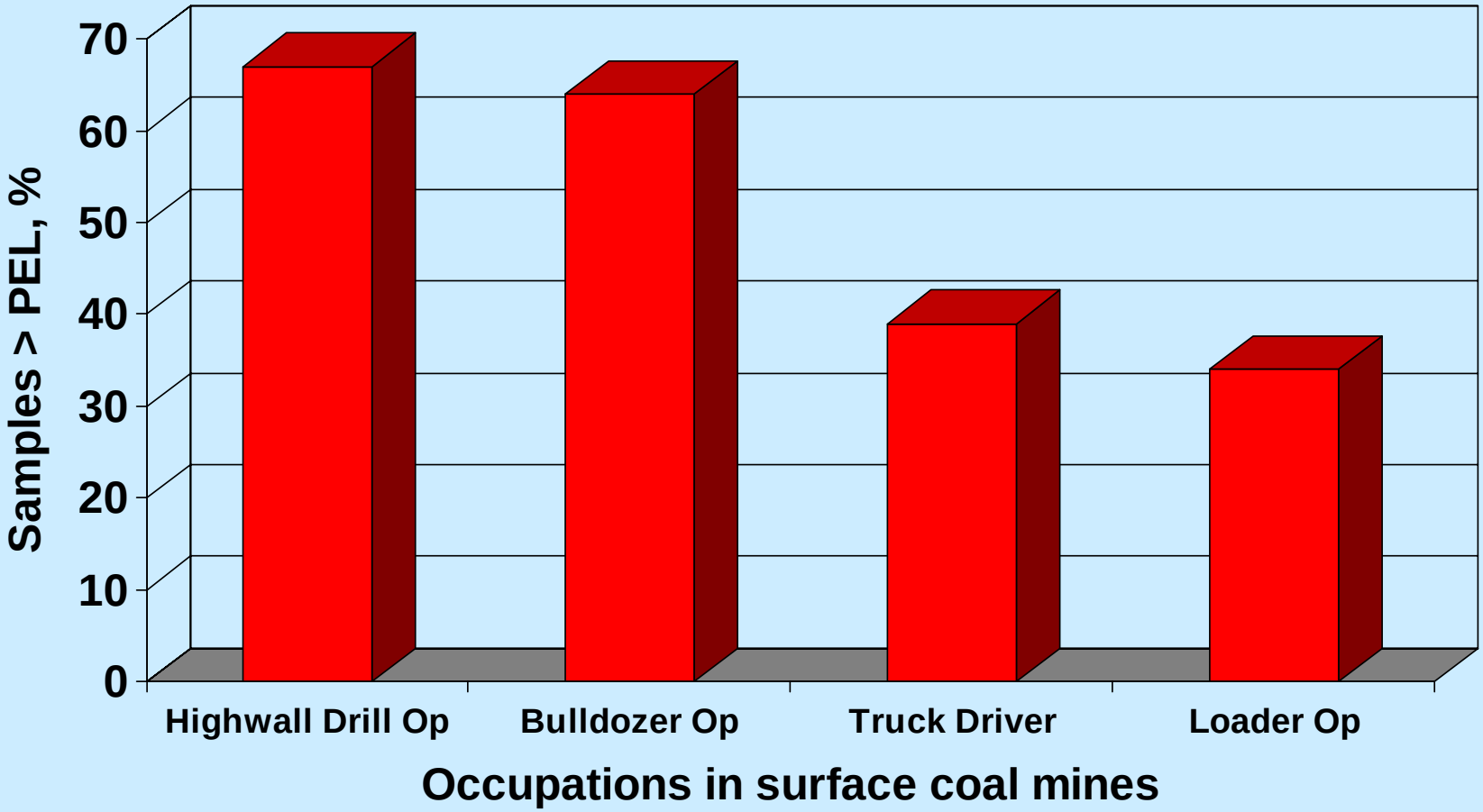
MSHA compliance samples exceeding 50 µg/m^3 of silica

(TeraData from 2002 – 2006)



MSHA compliance samples exceeding 50 µg/m^3 of silica

(TeraData from 2002 – 2006)



Research approach for lowering dust exposures

- Short term – Best practices guides/workshops
- Intermediate – Review previous technologies
- Longer term – New technology development

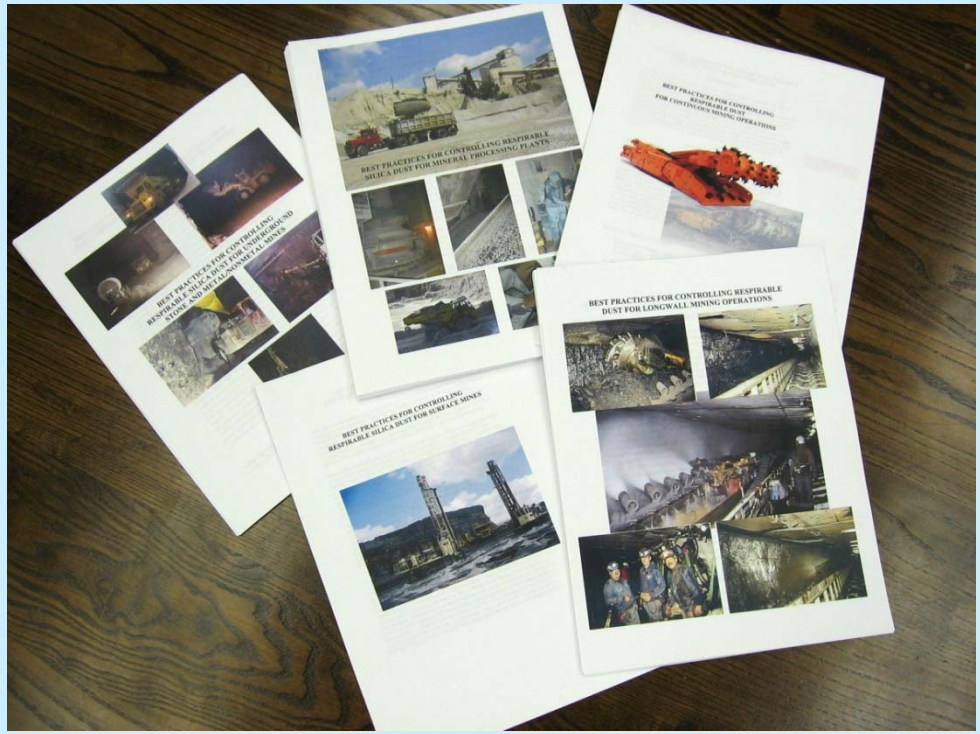
“Best Practices” tech transfer

- Summarize applicable control technologies in NIOSH IC for both coal and metal/nonmetal mining
- Provide brief descriptions of these controls
- Provide references for follow-up detail
- Information serves as basis for regional workshops

“Best Practices” Information Circulars

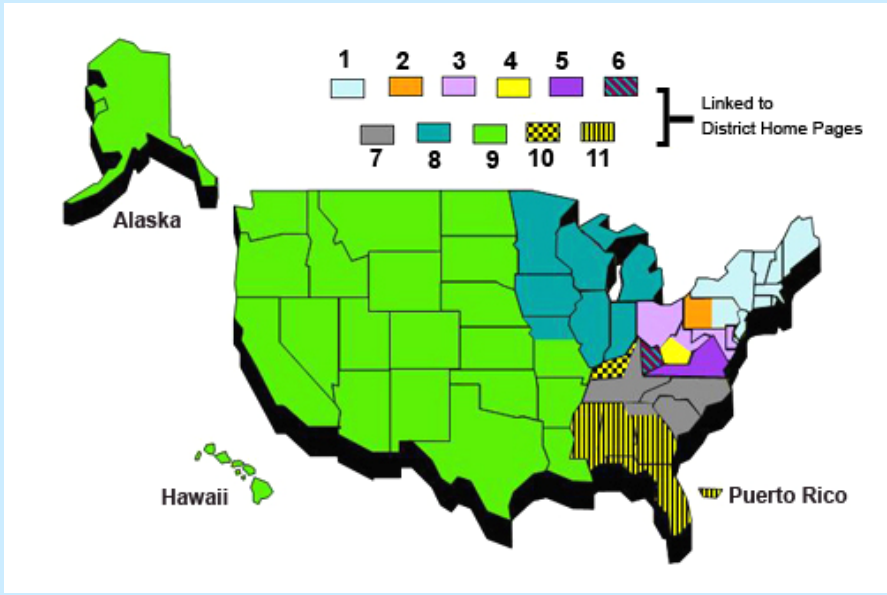
CHAPTERS

- Health effects
- Dust sampling
- Longwall
- Continuous mining
- Surface mining
- Underground M/NM
- Mineral Processing

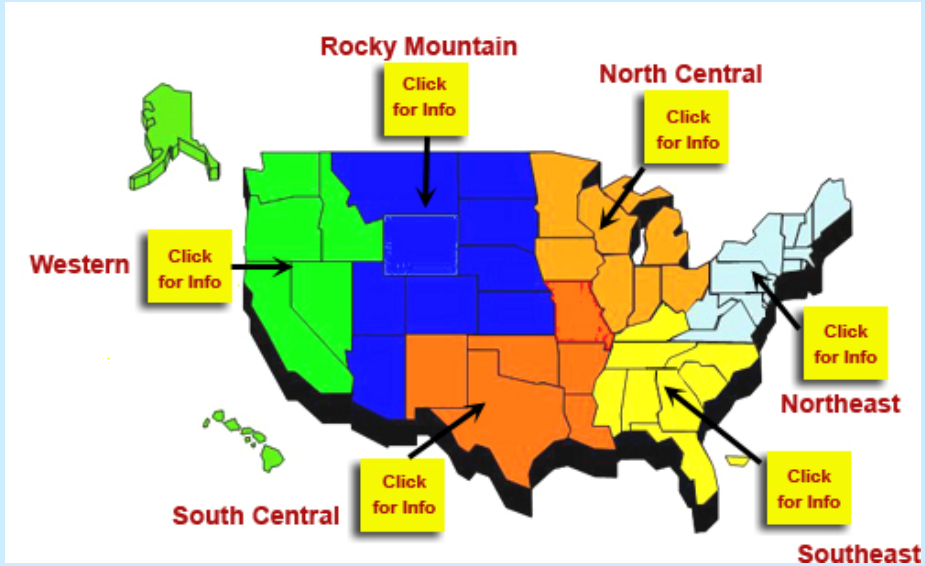


Regional workshops in MSHA districts

Coal Mining Districts



Metal/Nonmetal Districts

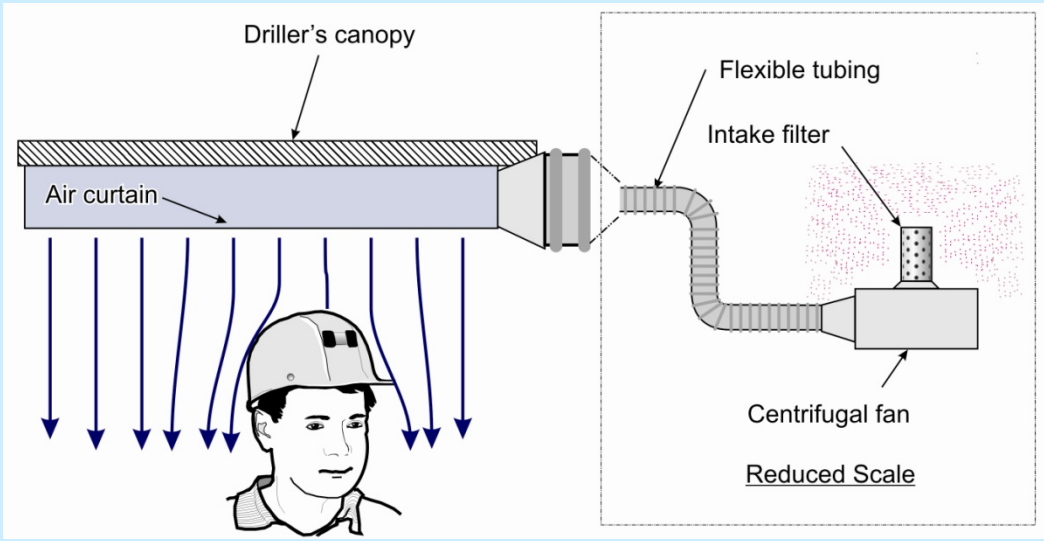


Intermediate technologies

- Canopy air curtain (ongoing)
- Foam
- Ventilated drums
- High pressure sprays
- Enclosures/barriers

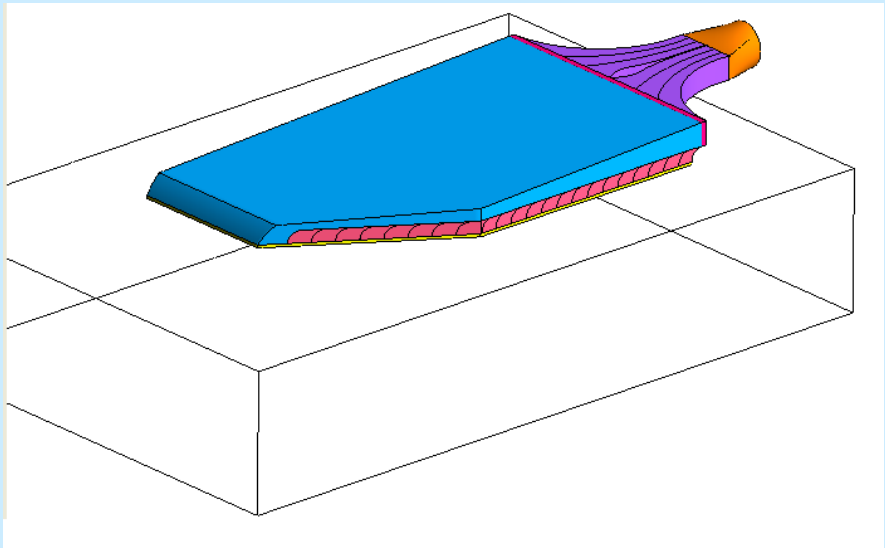
Canopy air curtain

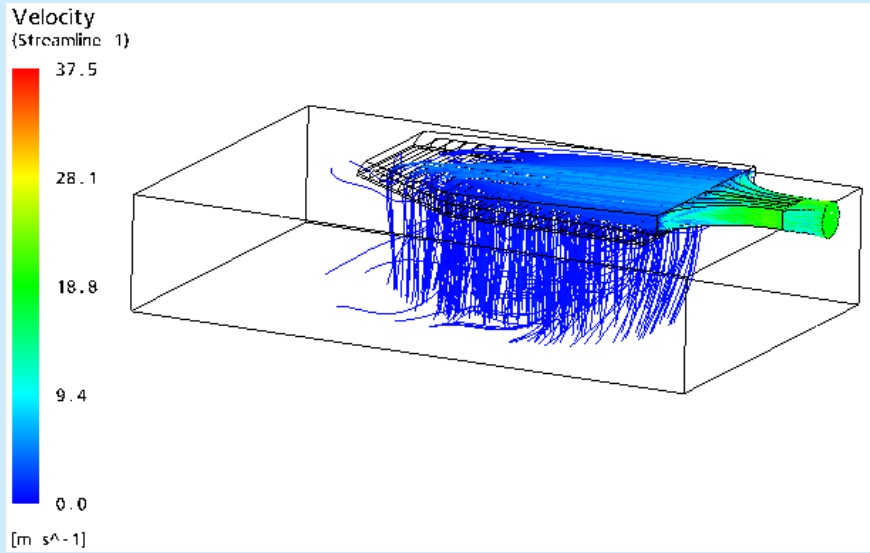
- Filter entry air and deliver clean air over bolter operator
- Best suited for use in lower air velocities
- Air plenum mounted on underside of bolter canopy



Canopy air curtain

- Maximized curtain size
- CFD used to improve flow characteristics





Long term research (brainstorming)

- End-of-shift silica analysis (initiated)
- Shield dust controls (initiated)
- CFD analysis (initiated)
- Shearer scrubber
- Drums redesigned for cutting rock
- Wet roof bolting improvements
- Stand-alone scrubbers
- Self-regulating dust controls (sensors)

Thank you for your attention!

We welcome your ideas!

Questions?

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