

# Achieving MSHA Noise Standards on Draglines

December 18 & 19

## **Purpose of meeting:**

- \* Share information on steps taken to date to meet MSHA occupational noise exposure standards**
- \* Share information on noise control methods**
- \* Discuss strategies to achieve noise standards**

## Key Stakeholders

### Mine Companies:

Alcoa

BHP

Kennecott

North American Coal

Peabody

TUMCO

### Government Agencies:

MSHA

NIOSH

## Key Stakeholders

<b>Equipment Suppliers:</b>	<b>Bucyrus International</b>
	<b>General Electric</b>
	<b>Aerovent Fans</b>
	<b>Chicago Blower</b>
	<b>Dynavane Filter</b>
<b>Consultants:</b>	<b>Acoustical Systems</b>
<b>Organizations:</b>	<b>National Mining Assoc</b>
<b>Miners:</b>	<b>IUOE*</b>
	<b>UMW*</b>
	<b>Non-union*</b>

\* not present

## Problem Statement

Miners continue to suffer hearing loss at a rate above that of the general population, despite the use of hearing protection during the last twenty years. MSHA has instituted new noise standards to protect miners' hearing by controlling noise levels in the working environment on draglines. Mining companies must find a way to achieve these noise standards in a practical, cost effective manner. How do we do it?

## Definitions

Summary of definitions and MSHA regulations:

dbA - The "A" means sound level the human ear is exposed to audible range 20 - 20,000 Hertz.

AL – Action Level:  $TWA_8 \geq 85$  dbA

PEL – Permissible Exposure Level:  $\leq 90$  dbA

Dual Hearing Protection Required:  $TWA_8 \geq 105$  dbA

No exposure allowed:  $TWA_8 \geq 115$  dbA

“Feasible” noise control: 3 dbA reduction in noise level to permissible level.

## Definitions

Time at sound level exposures:

8 hours 90 dbA 100% of PEL

4 hours 95 dbA 100% of PEL

2 hours 100 dbA 100% of PEL

1 hour 105 dbA 100% of PEL

Need to prioritize the noise sources:

80 dbA + 80 dbA = 83 dbA

86 dbA + 81 dbA = 87 dbA

If the secondary source of 81 dbA is lowered to 61 dbA then the final additive sound is still 87 dbA.

## MSHA Regulations Review

Keith Watson

MSHA Arlington, Virginia Health Division

Oversees noise regulation rules

Keith presented an overview of the new regulations:

- \* The rule requires performance based monitoring by operators.
- \* The new rule has a new action level set at 85 dbA.
- MSHA has issued 180 to 190 citations in the last two (2) months in coal but not any yet on draglines.
- MSHA is focusing on full shift survey and not directly on maximum dbA level.
- Training can be done at same time as Part 48 training. However, noise training can't replace any part of Part 48 training.

## MSHA Regulations Review

Keith Watson

\* MSHA has taken a two phase approach to deal with the rule for compliance.

Phase I - Targeting certain operator sites where MSHA would achieve more results or "More bang for the buck".

Phase II - Broadening the operator sites; look at survey data and determining where they want to go.

## MSHA Regulations Review

- \* MSHA has 30 people working full time in 6 teams doing surveys.
- \* One of the 6 teams is for draglines, shovels, drills and air arcing. On shovels and drills, the mines didn't do full shift surveys but only identified sound levels.
- \* Surveys on 250 operators done from 10/99 to 8/00.
  - 64% below AL
  - 23% between AL and PEL and miner is enrolled in training.
  - 13% above PEL, however, 1/2 of these could be brought into compliance.
- \* Dosimeter is left on for the duration of the miners' normal shift (4 - 12 hours).

## MSHA Regulations Review

\* "P" code has been granted in the metals mining industry and will likely be appropriate in coal industry. MSHA recognized there are certain compliances that cannot be achieved. There are two cases where "P" codes can be granted:

1) Exposure greater than 92 dbA and all feasible controls are implemented, but cannot get below 92 dbA.

2) Issue citation and do what operator and inspector agree is possible but cannot get exposure below 92 dbA.

\* Recognize there are some cases where it's extremely costly to achieve less than 92 dBA and "P" code granted.

\* MSHA is not anticipating issuing "P" codes now because operators have not exhausted all controls. (Note: "P" code is similar to a petition)

## MSHA Regulations Review

- \* MSHA will expect new technology to be utilized and MSHA is taking a "reasonable" approach. If noise control can achieve a 3 dBA reduction then that's reasonable.
- \* MSHA will enforce over exposure and not how much noise a dragline produces.
- \* MSHA will not dictate how operators comply with the law. Operators can use either the administrative or engineering controls.
- \* Lower frequencies, i.e. 500 cps, contribute less to hearing damage.
- \* Concentrate on addressing the higher frequencies to reduce overall noise levels.

## NIOSH Research Review

David Podobinski

Pittsburgh Research Laboratory

Dave reviewed hearing loss prevention research in the Mining Industry:

\* 90% of coal miners hearing will be affected by age 50.

\* There are two ways to control the miner's exposure to noise:

1) Engineering controls to function with equipment to redirect noise source or reduce noise source by utilizing barriers, enclosures and silencers.

2) Administrative control functions with personnel by short shifting, avoiding high noise areas and by modifying a miner's shift duties.

## NIOSH Research Review

David Podobinski

Pittsburgh Research Laboratory

- \* A noise contour shows the intensity pattern of the noise environment. Noise contours in draglines show high dBA levels towards the back of the machine. On a dragline NIOSH tested, 99 dBA was the maximum noise level.
- \* Noise profiling of equipment using SLM's (sound level meter) pinpoint exact contributors to worker noise exposure.
- \* Time and motion studies characterize worker tasks and equipment operations responsible for exposures by determining why miner is in area of high noise. Also determines acoustic shadows.

## NIOSH Research Review

- \* HPD (Hearing Protection Devices) - Are earplugs and/or earmuffs worn properly? Items that affect the effectiveness of earmuffs are facial hair, hardhat liners, a person's ear size, face or head size.
- \* NIOSH is looking to partner with various mine operators by performing research data collection and documenting of existing controls.

# Bucyrus

Dev Malik

Chief Engineer of Draglines

Dev discussed what Bucyrus has done to address dragline noise levels:

- \* BI became involved last spring through various customer requests.
- \* How should BE target goals? What is achievable and what is not achievable?
- \* It is estimated that at least one to two years will be required to develop/design solutions for existing draglines. Operators and BI suppliers must be involved.
- \* Inserted sound barrier walls may restrict airflow (MG sets) and may cause non-compliance on electrical panels.
- \* Noise modeling of draglines is not a BI capability.

## Bucyrus

Dev Malik

Chief Engineer of Draglines

- \* Operators must pay for research and design work. All contribute \$ to the work, then select one dragline for implementation and test purposes. The results of the testing would then be available for implementation on all contributors draglines.
- \* First step is to identify sources of noise and then to develop a plan.
- \* Bucyrus is not expert in noise control. Bucyrus will be advisor to determine if noise control modifications may affect other areas of machine function, (i.e. heating, cooling, air circulation, electrical code compliance and mechanical functions.) Need to work as a team.

## Bucyrus

\* Bucyrus has not addressed the issue of noise reduction on old draglines. Various ideas require investigation and cost estimation. This would have to be a joint effort with mine operators.

\* Major sources of noise are:

1) MG sets (Westinghouse noisier than GE)

2) House fans

Marion draglines - centrifugal

Bucyrus draglines - axial fans (noise levels are 5 dbA higher)

3) Motor cooling fans

4) Exhaust fans

5) Drive gear boxes

## Bucyrus

- \* Noise can be direct or reflected.
- \* Noise barrier considerations include:
  - 1) Noise reduction performance
  - 2) Air flow for effective cooling
  - 3) Operating factors
  - 4) Accessibility and maintenance factors
  - 5) Code compliance

## Bucyrus

- \* Noise reduction is a very complex problem.
- \* Noise reduction modifications must be tested on an operating dragline.

## General Electric

Steven Baade

Steve discussed GE's dragline noise control work to date:

- \* GE has not yet done any significant work on MG set noise control.
- \* On new draglines, the MG sets could be re-engineered from the current 1200 rpm to 600 rpm. bigger?
- \* Enclosing the MG sets on current draglines can be detrimental to the thermal life of the generators.

## Ventilation Fans and Dynavane Filters

Combined presentation

Aerovent Fans - BE draglines (vane axial)

Chicago Blower - Marion draglines (centrifugal)

Dynavane Filter - BE & Marion

The vendor comments were:

- \* The fan vendors have an agreement exclusively through Bucyrus and have not worked directly with users/operators.
- \* They have been working with Bucyrus for the past six months.
- \* The fan vendors don't know what effect the fans have on the overall sound levels on the draglines due to the additive effect of all the equipment on board and within the machinery house.
- \* It is possible that even with the fan noise levels reduced there may not be an appreciable decrease in the overall sound levels (MG sets).
- \* Must start by taking the highest sound level source and decreasing it and then test/measure what affect this has on the overall noise level.

## Ventilation Fans and Dynavane Filters

### Noise levels:

Centrifugal fan - 88 dbA at 5'.

Vane Axial fans - 98 dbA at 5' on the 75 yd. class draglines

- 102 dbA at 5' on the 100 yd. class draglines

\* Fan air velocity is approximately 3000 - 3500 cfm. Most of the noise coming from fans is caused by the change in air velocity from slow to high speed.

\* When a group of fans are located together as on the dragline then the sound will increase as much as 7 dbA.

\* Making centrifugal fans quieter:

Bigger fans at lower air velocity are quieter - space?, cost?.

Fans currently have ducts on inlets and outlets, which help reduce noise. Can add attenuators to the outlet to further reduce noise - increases pressure drop?, reduces cooling capacity?

The casing of the centrifugal fans can be a double wall construction, which would provide sound absorption inside each unit.

## Ventilation Fans and Dynavane Filters

### \* Making vane axial fan quieter:

Replace transition from fan outlet to the inlet of Dynavane filter with an attenuator (packing material). ~ 10-dBA reduction in sound, .25" pressure drop (blades adjusted to maintain flow), can't be cleaned & finite life?

A blade angle change will reduce noise about 1 dbA.

### Dynavane Inertial filters:

- \* Keep the dust out of the machinery house
- \* Dynavane unit is a velocity sensitive (inertial) device.
- \* Requires laminar airflow on the inlet side.
- \* Best location for attenuator is on outlet side. Clearance?, filtration efficiency reduced with reduced velocity?

## Steps Taken to Date by Operators and Organizations

### TXU, BHP, Peabody, North American, Alcoa

- \* MSHA surveys and studies
- \* Internal dragline surveys and studies
- \* Audiograms on miners taken for reference levels
- \* Administrative controls
- \* No engineering controls
- \* Oilers now with double ear protection (TXU)
- \* Oilers maintain log on time spent in machinery house (Alcoa)
- \* Put effort into mobile equipment (Alcoa)
- \* Budgeting \$ on one project per mine (Kennecott)
- \* Time/work studies (Peabody)
- \* Acoustical Systems survey on draglines and recommendations for engineering solutions (BHP)

## Round Table Planning for Future Compliance with MSHA

### Questions:

Do we have a compliance problem?

What should the strategy be?

### Strategy developed by the group of mine operators

- \* The purpose is to protect miners hearing, not to reduce noise on draglines.
- \* Consensus of the group is this goal can be achieved through Administrative Controls.
- \* Form an organization with NMA as the coordinator and organize studies through NIOSH. Define whether there is a problem and develop necessary steps if there is a problem.
- \* Bruce Watzman, NMA (National Mining Association) to be coordinator.
- \* Have NIOSH perform equipment noise and time/motion studies on equipment examples. Turn a list of equipment (draglines and mobile) examples to Bruce Watzman for NIOSH study.
- \* NIOSH to outline a proposed study program.
- \* Bruce Watzman to set up a meeting to organize NIOSH studies and obtain operator approval.

## Round Table Planning for Future Compliance with MSHA

Directions for Bucyrus at this time are as follows:

- \* Continue design work on new equipment with noise reduction as a goal
- \* Mine operators to share surveys/studies with Bucyrus
- \* Develop noise control expertise/capabilities (internal and external)
- \* Bucyrus to share with Bruce Watzman the new noise control design features being incorporated into the new shovel being development.
- \* Answer question - How would Bucyrus design a new dragline for an 80 to 85 dbA maximum sound level?