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Testimony to DOL

TESTIMONY OF THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH ON THE MINE SAFETY AND HEALTH ADMINISTRATION'S REPORT, "BELT ENTRY VENTILATION REVIEW"

30 CFR Part 75

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NIOSH recognizes that its role in occupational safety and health matters is as a risk assessor who evaluates and make recommendations from the best scientific and technical information, whereas, MSHA has its role primarily as risk manager who considers the NIOSH recommendations along with economic feasibility and experience gained under this and other health and safety laws.

NIOSH is submitting these additional comments on the Belt Entry Ventilation (BEV) Report in order to clarify the NIOSH position [NIOSH 1989] on the recommendations and conclusions of that report.

INTRODUCTION

NIOSH views the regulatory modification of 30 CFR 75.326, prohibiting the use of air coursed through the belt entry, in terms of the impact of this modification on the design and development of mine ventilation systems. NIOSH is not commenting on the present MSHA practice of granting variances to use belt entry ventilation after an MSHA review of the specific circumstances relating to a particular mine.

However, if two intake entries and two return entries are necessary for adequate ventilation and escape, the mine will require five entries--two for intakes, two for returns, and one for the conveyor belt. NIOSH is not aware of any studies that indicate reducing the number of entries by placing the conveyor belt in either the return or the intake will consistently result in safer and more healthful conditions for the miner underground.

NIOSH is aware that in specific mines, conditions may exist, or may develop, that require modification of safety standards in order to provide the maximum protection to the miner. NIOSH recognizes that these situations may be best handled on a case-by-case basis using variances. The presence of unstable roof conditions is an example of such specific mine conditions. Data do exist that indicate in the event of certain roof conditions the least dangerous mining method available may be a two entry development with the conveyor in the return--a procedure completely prohibited by the MSHA proposed rule. NIOSH would note here that we are not criticizing MSHA's decision to categorize certain mining methods as inadequately protective of the miner's safety and health even though on a relative basis those methods may be the "least dangerous" available for the conditions encountered. In other mines, problems may develop due to excessive methane gas liberation after a section is developed which would warrant the use of belt haulageways for additional air intakes.

NIOSH is concerned that the proposed rule does not address specific conditions where belt air usage may be required and does not address the appropriate control technology measures to be employed in those specific instances. Instead, the proposed rule would allow a major change in ventilation design requirements predicated only on the installation of an Atmospheric Monitoring System (AMS).

According to the data that MSHA furnished to the United Mine Workers of America, 53 underground coal mines ventilate with belt air while 1560 do not [UMWA/Exhibit 54-4-15]. MSHA has indicated to NIOSH that these 53 mines are not actually known to be using belt air but are authorized to use belt air. According to MSHA, a number of these mines which are authorized to use belt air do not in fact use belt air at all times. The data furnished to NIOSH by MSHA indicate that 29 of the 53 mines are longwall mines that were actually using belt air for some period of time in the first half of fiscal year 1989. If these data are correct, less than 4% of mines (53/1613) use belt air ventilation and greater than 96% of the mines, regardless of the mining method employed, provide adequate ventilation without using the belt entry as an intake aircourse.

ATMOSPHERIC MONITORING SYSTEMS

NIOSH supports the use of atmospheric monitoring systems (AMS). The data presented in the BEV report and a number of BOM reports indicate that AMS are superior in performance to point type heat sensors. NIOSH interprets these data as indicating that AMS systems should be required to supplement or replace heat sensors in all fire detection uses except those where the potential fire source is stationary and the heat sensor can be placed in close proximity to maximize the heat sensor's effectiveness.

NIOSH interprets the data presented in the BEV report as indicating there are problems in the application of carbon monoxide (CO) monitoring systems. These problems are related to specific conditions in individual mines, the reliability of some models of sensors, and the warning and alarm levels selected. These problems are also confirmed by comments to the BEV docket [BethEnergy 1990/Exhibit 54-4-27]. Although the problems encountered in the specific applications of CO monitoring systems may impair their potential effectiveness, these monitors appear still to be a substantial improvement over point type heat sensors [BOM 1988a].

NIOSH supports MSHA in their proposed reduction in the required CO monitoring spacing and in including auxiliary smoke detectors at designated locations. NIOSH considers the work performed by the BOM in this area to be definitive [BOM 1988a].

NIOSH is opposed to the inference in the BEV report that CO monitors are sufficiently reliable to overcome the fire safety considerations that weigh against using belt entries as intake air courses in all mines. CO monitoring systems may be a substantial safety improvement that MSHA may consider in granting variances to allow the use of the belt entry as an intake air course based on compelling safety considerations in individual mines. Adverse roof conditions or unexpectedly high methane liberation are examples of such compelling safety considerations. NIOSH concludes from the available data that CO monitoring systems do not perform well enough to allow the use of the belt haulageway as an intake aircourse in the majority of the nation's mines.

It is important to note the need to define criteria to determine when an underground coal mine fire becomes a hazard. The development of a fire can be progressive with time and fires can develop from small incidents that are readily extinguished, to large fires that cannot be controlled. NIOSH considers all underground coal mine fires, without regard to size or time of burning, to be potential hazards. NIOSH recommends that all miners be withdrawn from inby a fire before fire-related IDLH conditions develop or before any designated escapeway is made impassable by the fire. NIOSH concurs with BOM in the finding that a smoke obscuration value greater than 14 percent at one foot severely impairs a person's ability to escape [BOM 1986a].

A critical time element exists with regard to two separate conditions for a fire in the belt entry. The first element is the time from the alarm level to when IDLH conditions are reached at the working place. The second element is the time from the alarm level to when an escapeway becomes compromised by the fire. The BOM noted in the conveyor belt flammability test:

> "Large quantities of smoke were generated by the burning belts and vision was severely limited except for a narrow region near the gallery floor." [BOM 1987]

Even with air velocities up to 800 fpm in the 1986 Lake Lynn tests, the BOM commented:

> "Large quantities of dense black smoke were generated by burning belts in all the tests." [1986a]

IDLH conditions due to smoke carried to the working face by conveyor belt intake ventilation may occur early in a fire's development. Both heat and smoke from a fire may compromise the use of a conveyor belt entry as an escapeway a significant period of time before flame begins to propagate on the conveyor belt.

AIR VELOCITY IN BELT ENTRIES

The present MSHA policy on air velocities in belt entries used as intake air course restricts the maximum air velocity to 300 feet per minute (fpm). The proposed rule has removed this restriction and imposes no maximum velocity restriction.

NIOSH continues to be concerned that the data and studies cited in the BEV report indicate that there are several reasons to continue to impose a maximum velocity restriction on belt entries used as intake air courses.

If velocities in excess of 800 fpm are not necessary and do not occur, as indicated by MSHA and the mine operator comments on the BEV report, shouldn't the maximum air velocity be restricted to below these levels?

NIOSH recognizes that control methods exist for reducing the generation and entrainment of both float coal dust and respirable coal dust in the conveyor belt entry [BOM 1986b]. It is not possible, however, to project the effect of these control methods unless the specific methods or a specific performance standard for belt entry ventilation is proposed by MSHA. The present standards and those modifications presently proposed by MSHA would allow intake air dust levels to reach 1 mg/m^3 which is significantly higher than the present national average for intake air of 0.2 mg/m^3 cited in the BEV report.

BOM respirable dust studies on longwall mines indicate that a 1 mg/m^3 dust level in intake air is not compatible with a 2 mg/m^3 operator exposure while maintaining efficient longwall production. This raises the inference that there is a high probability of excessive dust exposure at the longwall working face if the intake air is not restricted to less than 0.5 mg/m^3 [BOM 1986b; Jankowski et al. 1990].

NIOSH redirects attention to the dust dispersal study that was submitted with our post hearing comments on mine ventilation. This study indicates that increased air velocities result in increased dust dispersion for the size particles (0.20 micrometers) and air velocities (0.838 meters per second [m/s] to 1.855 m/s) covered in the study [Bhaskar et al. 1988].

The charts presented in the Bhaskar et al. paper [1988] address the issues of dust deposition and dust entrainment at the test conditions. For bituminous coal dust, over 55% of the respirable fraction remained in the air at distances greater than 300 meters from the source when the air velocities of 1.855 m/s (365 fpm) and 1.525 m/s (300 fpm) were used. Less than 20% of the respirable fraction remained in the air at the 300 meter distance when the 0.835 m/s (165 fpm) velocity was used.

The Bhaskar et al. paper [1988] is in agreement with statements in BOM publications addressing air velocities at the face in longwall mines:

> "Airflow can also affect dust concentrations. If the air velocity along the face is maintained in a moderate range, from 350 to 600 fpm, good dust diffusion and dilution can be achieved some distance downwind from the generating source, as shown in figure 7 (3). Below this range dust levels can be significantly higher because of inadequate dilution and diffusion. Above this range, dust levels can be significantly higher because of dust entrainment at higher airflows..." [BOM 1985]

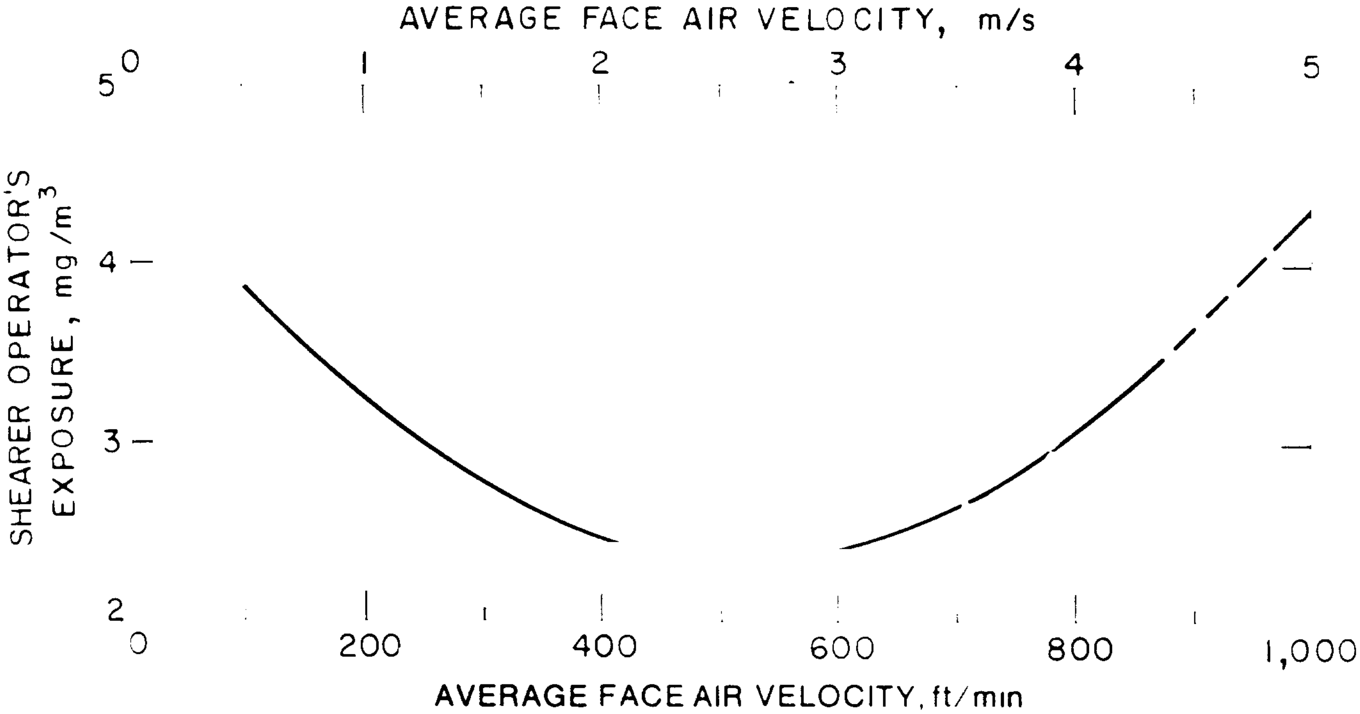

FIGURE 7. - Relationship between face air velocity and dust levels at the face (3).

NIOSH continues to be concerned about the effects of air velocities greater than 300 fpm on fires which develop in belt entries. The data in the BEV report indicate that there is a peak velocity at which belt flame propagation reaches a maximum. The magnitude of the effect of this peak velocity for flame propagation is dependent on the composition of the belt and may be dependent on the ignition source [BOM 1987]. The data in the BEV report do not address the other important aspects of a mine entry fire relative to the air velocity, including the effects of air velocity on involvement of the coal on the belt or of coal on the roof, ribs, and floor. Conventional wisdom in mining and previous tests conducted in full-size test tunnels indicate that increasing air velocity increases the spread and intensity of fires [Nagy 1987]. The BEV report does not present sufficient data to negate the results of previous tests and experience on the effect of ventilation velocities greater than 300 fpm on fires in underground coal mine entries.

The BOM fire tests cited in the BEV report and subsequent work reported by the BOM do raise three important inferences that must be considered. First, the present conveyor belt flammability test specified in 30 CFR 18.65 is not predictive of the flammability behavior of the belting under large-scale test conditions at 300 fpm. The BOM has developed a more predictive test (Attachment 1). Second, the present 300 fpm maximum velocity allowed in belt entries appears to represent the worst possible velocity condition in terms of conveyor belt flame propagation for many belt materials [BOM 1987]. Third, the interrelationships must be investigated between the belt flame propagation and the involvement of other combustible materials present in the conveyor belt haulageways at velocities greater than 300 fpm. The BOM data indicate that some flame retardant belts actually perform better in the Lake Lynn large-scale fire test gallery at velocities of 800 fpm than at velocities of 300 fpm or less. However, the data do not address the effect of these velocities on the other combustible materials that are present in the belt entry. Therefore, it is not possible to predict the overall impact of velocities of 800 fpm or greater in an underground coal mine conveyor belt haulage entry.

The BOM studies clearly indicate that the BOM Laboratory Scale Ventilated Tunnel Fire Test can identify commercially available conveyor belts that are flame resistant at a 300 fpm velocity (Attachment 1). NIOSH recommends that MSHA promulgate regulations requiring the use of flame-resistant conveyor belting passing the BOM test.

NIOSH recognizes that in unusual circumstances in specific mines there may be compelling safety and health reasons to employ high velocity air in a belt entry used as an intake air course and that it may be appropriate for MSHA to issue a variance under these circumstances. NIOSH maintains, however, that the majority of the Nation's underground coal mines can be designed and developed with sufficient intake and return entries to adequately ventilate the mine without using the belt entry for ventilation. NIOSH maintains that ventilating with sufficient intake and return entries to isolate the belt haulage entries is superior to allowing the mine ventilation system to be designed and developed with the belt entry as a ventilating air course, especially where the mine ventilation design requires velocities in excess of 800 fpm in the belt entry.

RESPIRABLE DUST DATA

NIOSH previously submitted comments on the respirable dust section of the BEV report [NIOSH 1989]. NIOSH was concerned that the various tables of data did not appear consistent, nor did they appear to contain the expected number of dust samples.

MSHA has furnished NIOSH with the operator dust sample data on longwall mines and individual mining units that were used to calculate the data in Tables two and six of Appendix D of the BEV report. Having reviewed the individual sampling data, NIOSH continues to be concerned that some of the data presented in Appendix D are incorrect. The tables appear mathematically inconsistent with the actual data. The number of operating longwall mining units as reported in the BEV report is inconsistent with the number of operating longwall mining units as reported in the Coal Magazine Longwall Survey (Attachment 2). At a recent meeting, MSHA had presented to NIOSH that this Coal Survey was definitive of the number of operating longwall mines (January 17, 1990). The grouping of belt air versus non belt air longwall mines by district appears inappropriate in terms of the confounding factors relative to coal seam height, tonnage mined per shift, type of longwall operation, and percentage of belt air employed at the face. After reviewing the individual sample values, NIOSH also is greatly concerned about the number of mines reporting sequential dust levels of less than 0.2 mg/m^3 and greater than 2.0 mg/m^3 on consecutive full production shifts (Exhibit a). These concerns are addressed in the following section.

Individual Mine Profiles

NIOSH has prepared the profiles of the mines in district 2 included in Tables 2 and 6 of Appendix D of the BEV report by combining the data available from the fiscal year 1989 data on respirable dust furnished to NIOSH by MSHA (Attachments 3, 4, 5, and 6) and the descriptive data available from the Coal Survey. The profiles of the individual mines in district 2 are in Appendix A.

The MSHA data was used for the belt ventilation status, the respirable dust data, the mine i.d. number, the mechanized mining unit (mmu) i.d. number, the number of tons of coal produced per sampling shift, and the mine name and location. The Coal Survey was used to determine the type of longwall mining machine, the coal seam height, the seam of coal being mined, and the number of mmus available at a given mine.

The MSHA data was matched to the Coal Survey data by using the mine name and county location from the MSHA data and matching those to the Coal survey mine name and mine location.

NIOSH recognizes several limitations with this method. The accuracy of the NIOSH analysis is dependent on the accuracy of the MSHA and Coal Survey data. The matching process did not always produce a definite match. The matching process would not identify specific mmus in the coal survey when more than one mmu of the same type was in use in a single mine. District 2 was selected on the basis of being the first district on Table 2.

These profiles suggest several problems with presenting the MSHA respirable dust data solely on the basis of belt entry ventilation status. A number of significant factors in respirable dust generation in longwall mining operations may be identified in these profiles. Among these are: the type of longwall cutting machine [BOM 1988b], the rate at which coal is being cut [Jankowski et al. 1990], and the particular coal seam being mined [The University of Utah/Exhibit 54-4-32].

A number of other important parameters affecting the respirable dust level are not identifiable with these data. Among these are: total ventilation volume rates in the mine, the percentage of belt entry air in the ventilation volume actually employed at the face, the level of respirable dust in the belt entry air, and the effectiveness of the techniques used to control dust in the individual mines.

NIOSH would first address the data as presented in Tables 2 and 6 of the BEV report in terms of precision in depicting the raw data.

Data Inconsistencies

The BEV report consistently introduces levels of precision into the dust sampling figures that are not consistent with standard scientific practice on significant figures. The dust sampling data are reported in increments of 0.1 mg/m^3 [MSHA 1989]. Average values should be rounded to the appropriate level of significance. For example, the national average dust level for mmus using belt air should be reported as 1.8--not 1.78, and the national average for mmus not using belt air should be reported as 1.5--not 1.51 on Table 2 (page D-13).

There appear to be a number of mathematical errors in the tables. The following are examples:

1) The totals in Table 2 are not the sums of the number of samples given in Table 2. The total number of belt samples given is 772--not 780; the number of intake air samples is 190--not 187, and the total number of nonbelt samples is 1090--not 1070;

2) The raw data indicates there are 19 samples < 2.0 for belt entry mines in district 2--not 25 as indicated in Table 6;

3) The raw data indicates the total number of samples for belt entry mines in district 2 is 79--not 84 as indicated in both Tables 2 and 6.

The total number of longwall mines reported for district 2 by MSHA is 14. The total number of longwall mining units reported in the Coal Survey is 12. The comparison of mines and mmus is:

MSHA	Coal Survey
BethEnergy, Cambria Slope 33, 3 units	2 units, third noted
BethEnergy, Eighty Four Complex, 1 unit	1 unit
Consolidation Coal, Bailey, 2 units	2 units
Consolidation Coal, Dilworth, 1 unit	1 unit
Cyprus Coal, Emerald #1, 2 units	1 unit
Gateway Coal, Gateway, 1 unit	1 unit
U.S. Steel, Cumberland, 1 unit	1 unit
U.S. Steel, Maple Creek, 2 units	2 units
Helen Mining, Helen Mine, 1 unit	none
	Helen Mining, Homer City, 1 unit

Grouping by Belt Entry Ventilation Status

NIOSH would next address the confounding factors that are suggested upon reviewing the individual mine and mmu profiles for belt entry mines.

One of the belt entry mines--3600936, mmu 0070--is either a plow or a Colmil. Plows contribute significantly less dust to the face than shearers [BOM 1988b]. NIOSH has no data on the respirable dust performance of a Colmil. This mine also produces a relatively low tonnage of coal per sampling shift.

Another of the belt entry mines--3600840, mmu 0010--is a single drum fixed shearer. This mine, along with mine 3600926, mmu 0070, samples the 041 operator as the designated operator as opposed to the 044 operator normally sampled on double ended ranging drum shearers.

The lumping of the five belt entry mines together in a single group for purposes of determining means and samples > 2.0 mg/m^3 and < 0.2 mg/m^3 is very questionable. As noted, one of the mines (3600926, mmu 0070) is either a Colmil or a plow, and one of the mines (3600840, mmu 0010) is a single fixed shear. Furthermore, there is a total of 19 samples > 2.0. mg/m^3 (not 25 as reported in the BEV report) and 18 of these samples are from 2 of the mines. There are 16 samples $\leq$ 0.2 mg/m^3 and 13 of these samples come from one mine.

A sample reading of 0.1 mg/m^3 represents the lowest value reported with the method used to determine respirable coal mine dust [MSHA 1987]. Therefore, mine 3600906 is an example of a belt entry intake mine using a high production coal winning technique that, on 50% of the operator samples (10/20) for the 044 operator, controls dust levels to the lowest reported value and on 65% of the operator samples (13/20) controls dust levels to less than the national average for primary intakes. NIOSH suggests that MSHA investigate the techniques being used by this operator to maintain such low dust levels.

Alternate Dust Data Grouping

The confounding factors in the data groupings as presented by MSHA raise questions about any conclusions that may be based on the respirable dust data as presented in the BEV report. A cursory review of the data supplied to NIOSH would suggest that the following treatment of the data may be more appropriate.

The Helen Mining Company (3600926) data should be isolated since it is not clear from the data available if mine 3600926 is a plow or a Colmil, and in either case, this mine has a very low average tonnage (477), and is the only longwall mine in district 2 operating in the Freeport seam.

The Gateway mine (3600906) data should be isolated due to the high number of dust samples with very low concentrations occurring at high tonnage production. These data could indicate a high level of dust control technology that is not typical of double ended ranging shearers, unusual behavior of the coal in the seam, or aberrant dust sampler performance. Further study of this particular mine should be conducted to determine feasibility of other longwall mines achieving this level of dust control.

There are three MSHA reported longwalls operated by BethEnergy at the Cambria Slope No. 3 mine (3600840). The Coal Survey reports two operating longwalls at this mine, but notes that a third "similar system is available." We will assume that 3 systems were in operation--mmus 0010, 0740, and 0890. All three mmus are operating in the same mine, in approximately 50-inch high coal. There are two different coal seams involved--the upper Kittaning and the lower Kittaning, but the data are not clear as to which mmu is on which seam. All units are single fixed drums. All dust samples are of the 041 operator. The mean dust concentrations and tonnages by unit and ventilation technique are:

mmu	mean dust level (mg/m^3)	average tonnage per sample shift
0010	1.4	1159 (belt entry intake)
0740	0.7	1245
0890	0.9	1292

The belt entry ventilation mmu appears to be much dustier than the other two nonbelt ventilated mmus. This comparison lacks the significant data on the ventilation parameters, especially the total ventilation volumes, number of intake entries, the percentage of the intake volume coursing through the belt entry for mmu 0010, and the number of samples from mmu 0010 that were taken while belt entry intake ventilation was in effect.

Attempts to compare the samples from the mines and mining units in district 2 using double ended ranging drum shearers on the basis of belt entry ventilation status also present a number of problems.

All 10 of these mmus operate in the Pittsburgh seam and mine from coal heights from 63 to 78 inches.

Three mmus are on belt entry ventilation:

mine i.d.	mmu i.d.	mean dust (mg/m^3)	mean tonnage	number of samples
3600906	0800	0.4	2602	20
3600958	0410	2.6	3855	10
3605018	0110	1.6	3075	25

Mine 3600906 exhibits highly non-typical dust sampling data as addressed above. Mine 3600958 has no samples below 2.0 mg/m^3 and could be presumed to have not been in compliance and may not have been in continuous operation. Without further information on mine 3600958, it would appear to be inappropriate to include these samples in a comparison study as they may not represent actual production conditions. This leaves only one mine, 3605018, and mining unit as a comparison example representative of the double ended ranging drum shearers on belt entry intake in district 2.

Four mines with 7 mmu's are operating double ended ranging shearers without belt entry ventilation in district 2:

Mine 3600970, mmu 0150, reports 6 out of 15 samples as < 0.2 mg/m^3 and should be isolated as discussed above.

mine i.d.	mmu i.d.	mean dust (mg/m^3)	mean tonnage	number of samples
3604281	0130	0.9	2793	15
3605466	0130	1.4	2816	10
3605466	0150	1.7	1705	5
3600970	0150	1.0	2310	15
3600970	0160	1.1	1926	22
3607230	0110	1.4	5132	20
3607230	0090	1.5	5717	15

Respirable Dust - Dilution Effects

The BEV report states that the dilution effect associated with introducing additional air volume by coursing air through the belt intake will more than compensate for any additional respirable dust levels contributed by the belt entry (BEV page D-5).

NIOSH has several concerns with this statement. First, the existence of a dilution effect assumes that an existing belt entry is being converted to an additional intake in an existing ventilation system and does not address the issue of designing and developing a ventilation system with the conveyor belt in an intake aircourse. For example, if a mine is designed and developed with two entries for intake aircourses and a third isolated entry for the conveyor belt, there is no "dilution effect" in comparison to a mine designed and developed with two entries for intake aircourses, one of which contains the conveyor belt. Second, the concept of dilution must be correlated to the actual volume rate increases achieved by using the belt entry as an intake and the mass weight of respirable dust from the belt haulageway being added to the face generated dust sources.

The contribution of various dust sources to the longwall environment has been studied by the BOM [1986b]. The BOM states:

> "It is not unusual to find longwalls with an inadequately regulated belt entry and a poorly maintained or nonexistent check curtain where the belt entry airflow is towards the face, contaminating the intake air. On some two-entry longwalls, where a portion of the intake air is brought up the belt entry to ventilate the face (under an MSHA variance), dust contamination can be significant.
>
> The significance of belt panel dust contamination of the intake air to the face can be shown by some data from a Bureau study of stageloader-crusher dust controls...
>
> Although the stageloader-crusher was the dominant dust source, the 0.5 mg/m^3 dust from the panel belt is significant because it is usually constant throughout the shift and represents 25 pct of the Federal compliance limit."

Respirable Dust - Conclusion

NIOSH is concerned that available data indicate neither the conditions under which belt entry ventilation may be beneficial, nor the conditions under which belt entry ventilation may be detrimental.

The data presented in the respirable dust section of the BEV report are not adequate to support a conclusion that belt entry ventilation is equivalent to the present standard in terms of risk of exposure to dust levels in excess of 2 mg/m^3 respirable coal mine dust for miners working at the coal face. The data likewise are not adequate to demonstrate the controls and conditions under which belt entry ventilation may be an appropriate means to reduce dust or methane levels.

The data do not indicate the effect of dust controls in the belt entry, nor the levels of dust in the belt entry air and the percentage of contribution of belt entry air to the total volume of air supplied to the face. NIOSH assumes that the intake air samples presented in Table 2 of the BEV report are the samples taken pursuant to 30 CFR 70.100(b) and represent the intake air 200 feet outby the working face and further represent the dust level of the intake air after the primary intake air and the air from the belt entry have been mixed.

The data on longwall mines employing belt entry ventilation do not indicate if the variance (or District Manager approval) to employ this ventilation method was sought because of unstable roof conditions, excessive methane generation, excessive dust levels at the face, or other conditions. NIOSH would submit that widely varying conditions may result in a petition for, and a grant of, a variance to employ belt entry ventilation, and that these initial conditions may have major impacts on the respirable dust levels achieved.

CONCLUSIONS

The data available in the BEV report relative to the use of conveyor belt entries as intake air courses in underground coal mines are not sufficient to make a complete analysis of the health and safety consequences of this ventilation technique. The report fails to directly address the critical issues involved in a decision to modify a mandated standard in terms of the impact on the safety and health of coal miners.

The critical issues that must be addressed in order to modify the present standard on intake ventilation are: 1) are belt entries employed as intake aircourses probable sources of toxic fumes and vapors to miners at the working face in the event of a fire in the belt entry? 2) are belt entries acceptable as secondary escapeways? and 3) are belt entries sources of respirable dust to the extent that they will increase the risk of miners for contracting respiratory disease?

The answers to these critical issues depend in large part on the characteristics of individual mines. Let us consider as examples three classes of longwall entry developments: class one--the mine is developed with one intake and one return; class two--the mine is developed with two intakes and one or more returns; class three--the mine is developed with three or more intakes and one or more returns.

In class one, the conveyor must be placed in either the return or the intake and the belt will necessarily be in either the primary or secondary escapeway. If the belt is placed in the intake, a fire in the belt haulageway would result in impassibility of the primary intake escapeway, and the working face and secondary escapeway would become contaminated with smoke and toxic products of the fire. All of the intake air will pass through the belt haulageway.

In class two mines, if the belt is placed in an intake, that intake would normally be the secondary escapeway. In the event of a fire in the belt haulageway, the secondary escapeway would be blocked, and the primary escapeway may be subject to some smoke and toxic contamination from the fire depending on several factors including the fire size and duration, leakage between the entries, and the integrity of the stoppings between the entries. A portion of the intake air will pass through the belt haulageway.

In class three mines, if the belt is placed in an intake, the primary and secondary escapeways can both be independent of the belt haulage. In the event of a fire in the belt haulageway, there will remain some potential for smoke and toxic contamination from the fire in the escapeways but two escapeways are available. The risk of smoke and toxic contaminants of a fire reaching the working face remain. A portion of the intake air will pass through the belt haulageway but is likely that it will be a smaller fraction than in mines in class two above.

Clearly, there are significant differences in the risk factors associated with placing the belt haulageway in one of the intake entries in these three classes of mines. There seems to be general agreement that placing the belt in the intake in mines of class one is an unacceptable fire risk.

Belt entry mines, in both class 1 and class 2, present a safety and health risk to miners underground that would be reduced if they were developed with an additional neutral entry to contain the conveyor belt haulageway. This reduction in risk would occur because the escapeway protection would be enhanced, the potential for smoke and toxic fire products contaminating the working face would be reduced, and the respirable dust generated or entrained from the conveyor belt haulageway would not be transported to the working face. These benefits may, in specific mines, be balanced against risks generated by the additional entry when unstable roof conditions are a factor. Definitive data on the risk of fatalities and injuries in longwall mines due to roof falls in developed entries with roof support and roof bolting is needed in order to evaluate these risks.

In class three mines, a belt haulageway fire does not necessarily block either the primary or secondary escapeway. There is some risk of contamination of the escapeways with smoke and toxic fire products, but it is problematical if this risk is greater than that associated with maintaining the belt entry on a neutral air split. There is a risk of contamination of the working face but the BOM data on fire sensors indicate that this risk can be substantially reduced by a properly designed AMS employing both CO and smoke detectors [BOM 1988a]. The impact of the dust generated in the belt haulage entry on the respirable dust at the working face needs to be carefully studied in this class of mines. There may be levels of dust control achievable in the belt entry in class 3 mines that, in combination with either gains in total volume of air flowing to the face or in reductions of velocity in primary intake air and subsequent reductions of dust entrainment in those entries, would result in lower dust levels at the face. The data presented in the BEV report do not allow this important determination.

In summary, based on the data presently available to NIOSH, NIOSH makes the following recommendations:

- AMS systems should be required to replace heat sensors in all underground coal mines.
- Conveyor belts for use in underground coal mines should be required to pass the new BOM flammability test.
- NIOSH concurs with MSHA that class one mines should be prohibited.
- Placing the conveyor belt haulageway in an intake aircourse in class two mines should be prohibited.
- Placing the conveyor belt in an intake aircourse in class 3 mines should be prohibited until further research is available to define the respirable dust hazards associated with this ventilation method.
- NIOSH is not recommending that conveyor belts be placed in return aircourses. NIOSH is recommending that mines be designed and developed with sufficient entries that the conveyor belt haulageway is not required as an intake or return aircourse for the working face.

APPENDIX A

In district 2, MSHA indicated to NIOSH there were 5 longwall operations on belt air. These units are as follows:

-- mine 3600840; mmu 0010; single ended fixed shearer; number of samples, 15; average tonnage per sampling shift, 1159; mean dust level, 1.4; samples > 2.0, 0; samples ≤ 0.2, 0; occupation code 041

-- mine 3600926, mmu 0070, plow; number of samples, 9; average tonnage per sampling shift, 477; mean dust level, 0.9; samples > 2.0, 0; samples ≤ 0.2, 2; occupation code 041(the Coal Survey reports no plow in the "Homer City Mine" but does note a Colmil operating in the "Helen Mine". These may be the same units.)

-- mine 3600906; mmu 0800; double ranging drum shearer; number of samples, 20: average tonnage per sampling shift, 2602; mean dust level, 0.4; samples > 2.0, 1; samples ≤ 0.2, 13; occupation code 044

-- mine 3600958; mmu 0410; double ended ranging drum shearer; number of samples, 10; average tonnage per sampling shift, 3855; mean dust level, 2.6; samples > 2.0, 10; samples ≤ 0.2, 0; occupation code 044

-- mine 3605018; mmu 0110; double ended ranging drum shearer; number of samples, 25; average tonnage per sampling shift, 3075; mean dust level, 1.5; samples > 2.0, 8; samples ≤ 0.2, 1; occupation code 044

MSHA has furnished data to NIOSH indicating there are 9 district 2 longwall mines not on belt entry ventilation. These mines are described as follows:

-- mine 3604281; mmu 0130; double ended ranging drum shearer; number of samples, 15; average tonnage per sampling shift, 2793; mean dust level 0.9; sample > 2.0, 0; samples ≤ 0.2, 0; occupation code 044

-- mine 3605466; mmu 0130; double ended ranging drum shearer; number of samples, 10; average tonnage per sampling shift, 2816; mean dust level, 1.4; samples > 2.0, 1; samples ≤ 0.2, 0; occupation code 044

(**NOTE**--According to the 1989 longwall survey, Emerald Mine No. 1, Mine I.D. 3605466 operates only 1 longwall; therefore, entity 0150 may be identical to entity 0130 above.)

-- mine 3605466; mmu 0150; double ended ranging drum shearer; number of samples, 5; average tonnage per sampling shift, 1705; mean dust level, 1.7; samples > 2.0, 2; samples ≤ 0.2, 0; occupational code 044

-- mine 3600970; mmu 0150; double ended ranging drum shearer; number of samples, 15; average tonnage per sampling shift, 2310; mean dust level, 1.0; samples > 2.0, 2; samples ≤ 0.2, 6; occupation code 044

-- mine 3600970; mmu 0160; double ended ranging drum shearer; number of samples, 22; average tonnage per sampling shift, 1926; mean dust level, 1.1; samples > 2.0, 0; samples ≤ 0.2, 2; occupation code 044

-- mine 3607230; mmu 0110; double ended ranging drum shearer; number of samples, 20; average tonnage per sampling shift, 5132; mean dust level, 1.4; samples > 2.0, 2; samples ≤ 0.2, 0; occupation code 044

-- mine 3607230; mmu 0090; double ended ranging drum shearer; number of samples, 15; average tonnage per sampling shift, 5717; mean dust level, 1.5; samples > 2.0, 4; samples ≤ 0.2, 0; occupation code 044

-- mine 3600840; mmu 0890; single drum fixed shearer; number of samples, 15; average tonnage per sampling shift, 1289; mean dust level, 0.9; samples > 2.0, 0; samples ≤ 0.2, 2; occupation code 041

-- mine 3600840; mmu 0740; single drum fixed shearer; number of samples, 16; average tonnage per sampling shift, 1245; mean dust level, 0.7; samples > 2.0, 0; samples ≤ 0.2, 2; occupation code 041

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