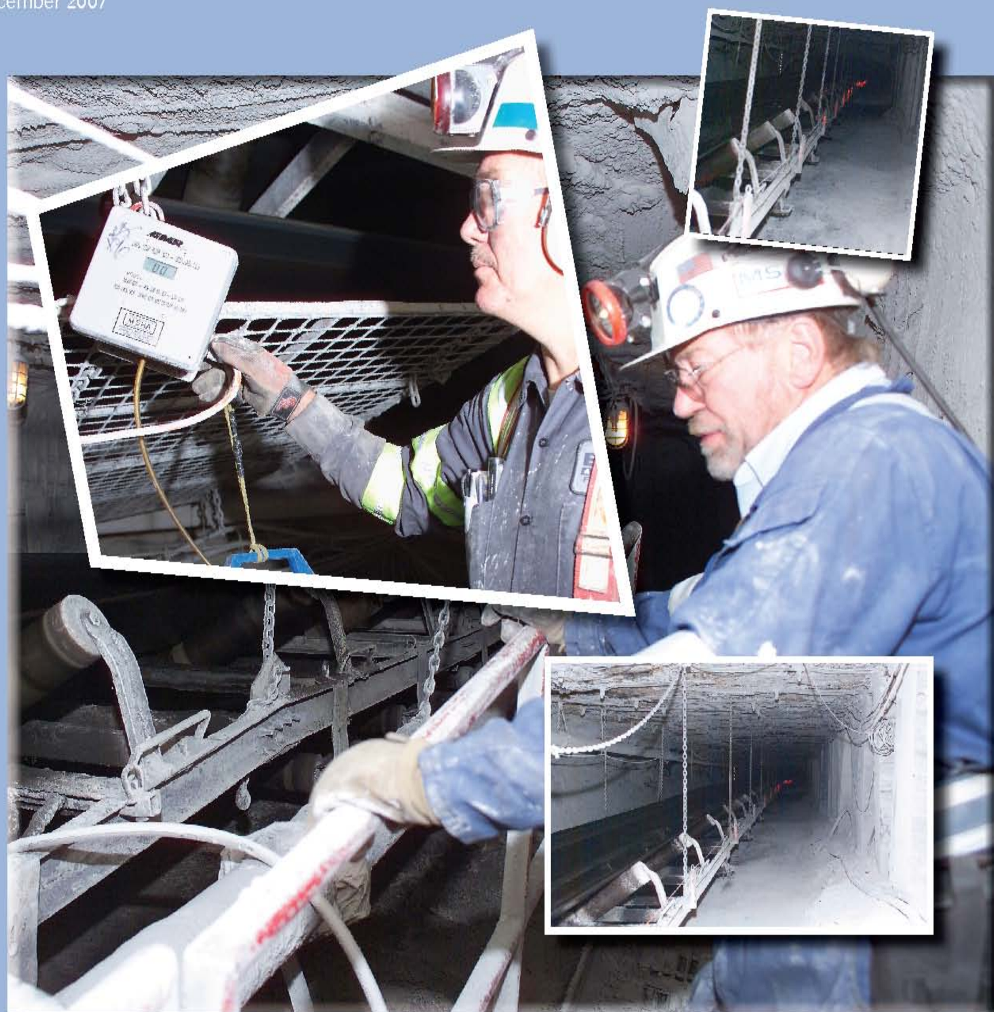
Final Report of the Technical Study Panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining

December 2007



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December 20, 2007

The Honorable Elaine L. Chao
Secretary of Labor
Washington, D.C. 20210

The Honorable Michael O. Leavitt
The Secretary of Health and Human Services
Washington, D.C. 20201

Senator Edward M. Kennedy, Chairman and
Senator Michael B. Enzi, Ranking Member
The Committee on Health, Education, Labor, and Pensions
428 Senate Dirksen Office Building
Washington, DC 20510

Representative George Miller, Chairman and
Representative Howard P. "Buck" McKeon, Ranking Member
The Committee on Education and Workforce of the House of Representatives
2181 Rayburn House Office Building
Washington, DC 20515

Dear Madam and Sirs:

We are pleased to transmit to you the report of the Technical Study Panel on the Utilization of Belt Air and The Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining.

The report, which is the final product of the Technical Study Panel, contains the Panel's consensus recommendations. These recommendations are the result of many hours of discussion and debate and reflect our best judgment on how to ensure the safety and health of our nation's coal miners.

We believe that the recommendations contained in this report are worthy of serious and immediate attention.

Sincerely,

Dr. Jan M. Mutmansky, Chair

Dr. Jürgen F. Brune

Dr. Felipe Calizaya

Mr. Thomas P. Mucho

Dr. Jerry C. Tien

Dr. James L. Weeks

EXECUTIVE SUMMARY

The Technical Study Panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining (hereafter referred to as the Panel or the TSP) was established by Section 11 of the Mine Improvement and New Emergency Response Act of 2006 (MINER Act). The Panel was charged with providing "independent scientific and engineering review and recommendations with respect to the utilization of belt air and the composition and fire retardant properties of belt materials in underground coal mining." The TSP was impaneled by the Honorable Elaine L. Chao and commenced its work on January 9, 2007. At this first meeting, Mr. Richard E. Stickler, Assistant Secretary of Labor for Mine Safety and Health, asked the Panel to report on many issues including how recent technological advances could be applied to atmospheric monitoring systems, point-type heat sensors, current state of fire-resistant vs. fireproof belt materials, and belt fire suppression systems to improve miner safety. In addition, Mr. Stickler asked the Panel to review belt air velocity limitations.

The Panel members attended 12 days of public meetings over a nine-month period. Three of the public meetings were scheduled for the Panel to hear from technical experts and those persons or organizations interested in providing input. The meetings were held in Coraopolis, Pennsylvania with emphasis on belt fires, belt maintenance, belt flammability and toxicity, ventilation, and escape issues; in Salt Lake City with emphasis on ground control and convergence issues; and in Birmingham with emphasis on fire detection, sensors and atmospheric monitoring systems.

National Institute for Occupational Safety and Health (NIOSH) researchers, Mine Safety and Health Administration (MSHA) personnel, representatives of the major belt conveyor manufacturers and a representative of the National Mining Association provided discussions at the Coraopolis meeting. In Salt Lake City, Utah, MSHA district managers and ventilation specialists, a member of the Aracoma Mine No. 1 investigation team, a representative of the Bureau of Land Management, and industry and consulting representatives of the Utah Mining Association and the Colorado Mining Association made presentations. In Birmingham, Alabama, atmospheric monitoring system representatives, NIOSH researchers, representatives of coal mining companies, and UMWA workers from two Alabama mining companies made presentations. In addition, a staff member of The Center for Regulatory Effectiveness also presented comments to the Panel. In conjunction with the meetings in Salt Lake City and Birmingham, three-member subcommittees of the Technical Study Panel made field visits to the Skyline Mine, the Aberdeen Mine, and the Jim Walter Resources Mine No. 4. The mine visits were scheduled to see first-hand the mining conditions under which belt air was being utilized as an additional source of intake air for working sections.

The analysis of belt air usage issues was initiated by the Panel working in three-person subcommittees. Each subcommittee was assigned a block of topics and charged with proposing recommendations to be considered by the entire Panel. On September 17-19, 2007, the Panel held its final public meeting in Reston, Virginia, to evaluate and vote on the recommendations. The Panel members engaged in discussions of each draft recommendation, negotiated changes in wording or emphasis of some recommendations, combined other recommendations, and then voted on each of the redrafted recommendations. It is important to emphasize that all 20 recommendations were passed by unanimous (6-0) votes of the Panel.

The basic recommendations on belt entry air used in working sections are summarized below. However, it should be noted that the recommendations are coupled to other recommendations to ensure that belt air used to ventilate working sections is as safe as or safer than not using belt entry air to ventilate working sections. The two basic recommendations are summarized as follows:

- The Panel recommends that the mines using belt entry air to ventilate working sections must be held to a higher standard that involves the use of
    - an atmospheric monitoring system (AMS) and/or other suitable monitoring instruments to detect smoke, CO and other signs of a belt fire early and reliably,
    - belt conveyor materials that meet the flame resistance requirements specified in the NIOSH/MSHA-developed Belt Evaluation Laboratory Test (BELT) and other test standards recommended by the Panel, and
    - more rigorous inspection procedures by MSHA inspectors.

- The Panel recommends that MSHA evaluate the use of belt entry air coursed to the working sections as part of the approval process of the mine ventilation plan. The District Manager must, as part of this recommendation, take special care to evaluate whether the belt air can be routed to working sections in a manner that is as safe as or safer than not using belt entry air to ventilate working sections.

Perhaps the most important safety recommendation made by the Panel was the recommendation that deals with the application of improved belt flammability standards to belt materials use in U.S. underground coal mines. The aim of the BELT is to prevent belt entry fires and not merely to suppress them. The Panel found that belt fires continue to occur on MSHA-accepted belts, that the BELT standard more closely resembles real in-mine conditions, and that underground mining conveyor belt flammability standards world-wide are more stringent than the standard applied in the United States. Thus the Panel recommends that the more rigorous BELT standards should be applied to belt materials used in underground coal mines. Other recommendations that pertain to belt conveyor usage and maintenance are outlined in the four paragraphs below:

- Because frictional heating is a common cause of belt fires, the Panel recommends that MSHA evaluate a drum friction test. This test would be mandated for a period of two years to determine if such a test would contribute to conveyor belt safety beyond that provided by the BELT. This test could then be incorporated into flame test acceptance requirements if MSHA determines that such a test would benefit miner safety.

- Because belt fires also occur in mines that do not use belt entries for face ventilation and because the application of a different flame-resistant acceptance standard for conveyor belting in those underground coal mines that do not use belt air to ventilate working sections would be an untenable situation, the Panel recommends that MSHA extend the protection provided by the BELT and other belt flammability standards recommended in this report to all underground coal mines.

- Because of the number of reportable fires in belt conveyor entries, the Panel recommends that MSHA rigorously enforce existing standards on conveyor belt maintenance and fire protection. This recommendation applies to general housekeeping, training of the belt, belt fire suppression systems, firefighting equipment, sensors and alarm systems, and training of personnel for fighting mine fires.

- Because of the number of different belt testing standards used throughout the mining world, the Panel recommends that MSHA staff involved in belt fire resistance testing establish contacts and maintain dialogue with their counterparts in other key mining countries with the goal of working toward more universal standards.

A considerable amount of Panel time and thought was given to the efficacy of atmospheric monitoring systems including the level of training the AMS operator receives, the specific tasks assigned to the AMS operator, and the type of electronic sensors used in such a system. The AMS-related recommendations are:

- That all AMS operators be certified and that the highest priority of the AMS operator must be the proper operation of and response to the AMS,
- That regular, periodic reviews of the AMS records be conducted by MSHA to analyze type and number of false alarms and measures taken by the operators to minimize the occurrences of such false alarms,
- That diesel-discriminating sensors be required in mines where diesel engine usage was resulting in excessive numbers of false alarms,

- That rulemaking be initiated for discontinuing point-type heat sensors used for fire detection in belt entries,
- That rulemaking be initiated to require the use of smoke detectors, and
- That rulemaking be initiated to revise 30 CFR §§ 75.1100-1103 to update the rules, particularly those in § 75.1103, and take advantage of more effective modern technology.

The Technical Study Panel also considered a significant number of related topics that are peripheral to the use of belt entry air to ventilate working sections. These topics have importance because they affect the mine ventilation efficiency, the mine atmosphere, the possibility of escape, or the inspection of mines where belt entry air is used to ventilate working sections. Relating to these topics, the Panel unanimously makes these recommendations for mines that ventilate working sections using belt entry air:

- That the ventilation air velocity be between 100 feet per minute and 1000 feet per minute in the belt entry with certain exceptions,
- That existing lifeline requirements be improved and made uniform throughout the U.S. to indicate the existence of doors, SCSR caches, and impediments to travel,
- That existing escapeway design, escape planning, and training of miners be improved,
- That dust concentrations be better controlled in working sections,
- That methane concentrations in working sections are not increased by methane concentrations in belt entries being vented into working sections, and
- That MSHA mine inspectors perform their inspection duties with greater efficiency and reduced chance of overlooking safety hazards.

The Panel also recommends that research be conducted on alternate methods of enhancing escape, methods of reducing leakage through improved ventilation designs, and possible use of booster fans in underground coal mining operations. The underground coal mines of the future are likely to be deeper than today's mines and with increasing depth, ground control problems become more significant. It is imperative that research be performed to help our mining operations deal with the conditions that need to be addressed in the future.

Finally, the Panel suggests that Congress consider increased funding for MSHA and NIOSH to implement these recommendations. Many of the measures that the Technical Study Panel is suggesting will require additional resources such as inspection personnel, research equipment and personnel, and support services. Increased funding will help ensure the success of any additional measures taken to increase mine safety and keep the new safety measures from diluting the enforcement of existing regulations.

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TABLE of CONTENTS

APPENDICES

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REPORT OF THE TECHNICAL STUDY PANEL ON THE UTILIZATION OF BELT AIR AND THE COMPOSITION AND FIRE RETARDANT PROPERTIES OF BELT MATERIALS IN UNDERGROUND COAL MINING

I. INTRODUCTION

The Technical Study Panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining was created under Section 11 of the Mine Improvement and New Emergency Response Act of 2006 (MINER Act)(Public Law 109-236), and was chartered under the provisions of the Federal Advisory Committee Act (FACA). [See the Technical Study Panel's Charter, included as Appendix A of this Report; and the *Federal Register* Notice of Establishment of the Panel (71 FR 77069, December 22, 2006), included as Appendix B of this Report].

Congress established this Technical Study Panel (referred to in this document as the 'Panel' or the 'TSP') to provide independent scientific and engineering review and recommendations with respect to the utilization of belt air and the composition and fire retardant properties of belt materials in underground coal mining. Membership of the Panel was composed of—

"(1) two individuals… appointed by the Secretary of Health and Human Services, in consultation with the Director of the National Institute for Occupational Safety and Health and the Associate Director of the Office of Mine Safety;

(2) two individuals… appointed by the Secretary of Labor, in consultation with the Assistant Secretary for Mine Safety and Health; and

(3) two individuals, one appointed jointly by the majority leaders of the Senate and House of Representatives and one appointed jointly by the minority leaders of the Senate and House of Representatives…."

Congress determined that at least four of the six individuals appointed to the Panel must possess a masters or doctoral level degree in mining engineering or another scientific field demonstrably related to the subject matter. No individual appointed to the Panel could be an employee of any coal or other mine, or of any labor organization, or of any State or Federal agency primarily responsible for regulating the mining industry.

The Panel's charge was to prepare and submit to the Secretary of Labor, the Secretary of Health and Human Services, the Committee on Health, Education, Labor, and Pensions of the Senate, and the Committee on Education and the Workforce of the House of Representatives a report concerning the utilization of belt air and the composition and fire retardant properties of belt materials in underground coal mining. This report is due by December 20, 2007, within a year of the Panel members' appointments.

In the course of its deliberations, the Panel requested extensive material which was provided, primarily by MSHA and NIOSH. See Appendix D of this Report for a list of materials provided to the Panel. In addition, speakers having technical expertise in mine ventilation, conveyor belt composition, and other pertinent areas presented information and responded to questions by members of the Panel.

The Panel is indebted to the miners at the Skyline Mine and the Aberdeen Mine in Utah and JWR No. 4 Mine in Alabama who provided valuable information during the Panel's visits. The Panel also wishes to thank members of the public, including both labor and industry, who attended the Panel's meetings and demonstrated a genuine interest in the health and safety of the nation's miners.

Staff experts from MSHA and NIOSH were present at each TSP meeting to assist the Panel as necessary. The Panel heard presentations from manufacturers of conveyor belts and atmospheric monitoring systems (AMS), as well as industry and labor representatives. MSHA and NIOSH technical staff made presentations to the Panel on a number of related health and safety concerns. Specifically, the Panel heard from the following parties:

1) MSHA personnel, who addressed belt air history and regulations, belt flammability, use of belt air—health aspects, laboratory-scale flammability testing and belt fire historical data, the Aracoma Alma Mine No. 1 accident investigation report, and MSHA Coal Mine Safety and Health District Managers and senior ventilation specialists on their experience with belt air issues;

2) NIOSH personnel, who addressed belt flammability research (large and laboratory-scale studies), belt toxicity issues, using belt air at the face/ belt velocity limits, mine escape issues, belt fire detection sensors and state-of-the-art smoke sensors, effective training techniques for emergency response preparedness (for AMS operators and in general for underground);

3) Miners who are members of the United Mine Workers of America (UMWA);

4) Representatives of the National Mining Association (NMA), Colorado Mining Association, Utah Mining Association (including Hamid Maleki, Ph.D. - President, Maleki Technologies, Inc.), the Alabama Mining Association, and mine operators during mine tours;

5) Belt manufacturers: Goodyear, Fenner-Dunlop, and Phoenix;

6) Engineers who have knowledge of western mine ground control and convergence issues and two- entry versus other multiple entry systems (Agapito and Associates);

7) AMS manufacturers: American Mine Research, Conspec Controls, Pyott-Boone, and Rel-Tek Corporation;

8) Jim Walter Resources, who addressed a mine operator-developed AMS and conducted a mine tour;

9) Bureau of Land Management, Utah State Office; and

10) The Center for Regulatory Effectiveness

The Panel members attended 12 days of public meetings over a nine-month period. They also toured the Skyline Mine and the Aberdeen Mine in Utah and JWR No. 4 Mine in Alabama to obtain additional first-hand experience with the issues surrounding the safe use of belt air and flame-resistant conveyor belting.

The Panel meetings were conducted by the Chair, Dr. Jan M. Mutmansky. Notice of each meeting was duly published in the *Federal Register* (FR). Each meeting was open to and attended by members of the public. Time was made available for members of the public to address the Panel each day during all but the first and last meetings. A verbatim transcript of each meeting was created. The background material and all of the presentations and associated documents, including the transcripts, were made available to the public. The official record of the meetings is housed at MSHA headquarters. Members of the public can review these documents at: Office of Standards, Regulations, and Variances, Mine Safety and Health Administration, 1100 Wilson Boulevard, Room 2350, Arlington, Virginia 22209. In addition, the documents are posted on the Agency's single source webpage titled "The Technical Study Panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining Single Source Page." The Single Source page is located at http://www.msha.gov/BeltAir/BeltAir.asp.

In the course of addressing the issues, the Panel considered a significant amount of data and information. This background material encompassed the entire belt air rulemaking record, including the proposed and final rules; the *Report of the Advisory Committee on the Use of Air in the Belt Entry to Ventilate the Production (Face) Area at Underground Coal Mines and Related Provisions* (1992 Advisory Committee report); MSHA's *Belt Entry Ventilation Review: Report of Findings and Recommendations* (BEVR); extensive presentations and comments submitted during the meetings; a number of studies conducted by research organizations, primarily NIOSH; and historical data from MSHA on belt fire incidence. To enable the Panel to address thoroughly the large volume of material and the wide range of issues, the Panel established subcommittees to address AMS, conveyor belt issues, fire safety, training, and escapeways. (See Appendix E.) For brevity, this Report is limited to summary documentation and discussions supporting the conclusions and recommendations and is not meant to be a treatise of the deliberations of the Panel.

Consistent with the requirements of the MINER Act, the membership of the Panel was as follows:

Selected for Appointment by the Secretary of Health and Human Services:

Dr. Jürgen F. Brune, Director, Spokane Research Laboratory, National Institute for Occupational Safety and Health, Spokane, Washington.

Dr. Felipe Calizaya, Associate Professor, University of Utah, Mining Engineering, Salt Lake City, Utah.

Selected for Appointment by the Secretary of Labor:

Dr. Jan M. Mutmansky, Professor Emeritus of Mining Engineering, the Pennsylvania State University, University Park, Pennsylvania.

Dr. Jerry C. Tien, Associate Professor, Department of Mining Engineering, University of Missouri-Rolla, Rolla, Missouri.

Selected for Appointment Jointly by the Majority Leaders of the Senate and House of Representatives:

Mr. Thomas P. Mucho, Thomas P. Mucho & Associates, Inc., Mining Consultancy, Washington, Pennsylvania.

Selected for Appointment Jointly by the Minority Leaders of the Senate and House of Representatives:

Dr. James L. Weeks, Director, Evergreen Consulting, LLC, Silver Spring, Maryland.

Staff assistance was provided to the Panel by MSHA and NIOSH. A list of staff members follows:

<u>MSHA Staff</u>
Linda F. Zeiler, Designated Federal Officer
Deputy Director, Technical Support
Arlington, Virginia

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II. GOALS OF THE TECHNICAL STUDY PANEL

The Technical Study Panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining (Panel) was created under Section 11 of the Mine Improvement and New Emergency Response Act of 2006, also known as the MINER Act (Public Law 109-236). The Congress established the Panel to provide independent scientific and engineering review and recommendations with respect to the utilization of belt air and the composition and fire retardant properties of belt materials in underground coal mining. Relative to their mandate, Mr. Richard E. Stickler, Assistant Secretary of Labor for Mine Safety and Health, asked the Panel to focus on a variety of issues including on how recent technological advances in atmospheric monitoring systems, point-type heat sensors, fire-resistant versus fireproof belt materials, and belt fire suppression systems could be used to improve miner safety. In addition, Mr. Stickler asked the TSP to review the belt air velocity limitations.

During the initial meetings of the Panel, the tasks to be undertaken were assumed to include the manner in which belt air is used in working sections and the variables that ensure the safety of miners in these working sections. This includes belt entry and conveyor belt maintenance, the possible use of smoke detectors in belt entries, the use of diesel discriminating sensors for intelligent detection of fires in belt entries, the training of atmospheric monitoring system (AMS) operators, escapeways for working sections where belt air is used at the face, lifelines for escape purposes, point-feeding systems for ventilation of belt conveyors when using belt air in working sections, respirable dust and methane transport to working sections, inspection of working sections utilizing belt air for ventilating working faces, and research that may help in producing safer ventilation plans for working sections. In each of these subtasks, the Panel attempted to keep their investigations within the scope outlined by Congress.

History of Belt Air Utilization

In initiating the study of this problem, the Panel reviewed the history of belt air usage in the working section, the changes in the technology of coal mining that instigated changes in the regulations, and the previous studies of belt air usage through the presentations at its first meeting on January 9, 2007. A summary of the historical background is presented by listing of the primary events in the belt air history below. For a more detailed history, readers may refer to the reports issued by the Belt Entry Ventilation Review Committee (MSHA, 1989) and by the Belt Air Advisory Committee (Belt Air Advisory Committee, 1992). The major events in the belt air history in U.S. coal mines are as follows:

Pre-1969 The Pennsylvania Bituminous Coal Mine Act of 1961, 52 P.S. §701-242(c) require that the belt entry must be separated from the intake and return but did not require that the air be diverted directly to the return.

1969 The Federal Coal Mine Health and Safety Act of 1969 was passed and requires that the belt air be separated from the intake and return air courses and the quantity be limited to the amount necessary to provide an adequate supply of oxygen and keep the methane below 1.0 percent. At this time, the requirement was that the belt air be diverted directly to the return. Mines opened prior to the effective date of the Act were exempted.

1975 The first successful petition for modification permitting belt air usage at the face was granted, opening the door to increased use of belt entry air in the working section.

1975-2003 About 172 petitions for modification were granted to allow mines the use of belt entry ventilation air in the working section.

1989 The Belt Entry Ventilation Review Committee, consisting of MSHA employees, finds the use of belt air to be at least as safe as other ventilation methods if a CO monitoring system is used. They also recommend that the use of pipe overcasts to carry belt air to the return be discontinued. They provide additional recommendations to make the practice of using belt entry air safer.

1992 The Belt Air Advisory Committee, an independent committee of government, academic, and industry personnel, concludes that belt haulage entries can be safely used as intake air courses providing that an early warning fire system is in place and the miners are properly trained. The committee also outlines additional practices to ensure safe use of belt entry air.

2003 MSHA proposed a rule to eliminate the petition for modification process for the use of belt entry air in the working section for mines with three or more entries in longwall mines and most other mines. Public hearings are held to provide input on the proposal.

2004 MSHA promulgated the final rule on belt air, allowing the use of belt entry air in the working section in most mines. The rule also requires that mines opened prior to the effective date of the 1969 Act must also comply with the final rule.

2006 The mine fire of January 19 at the Aracoma Coal Company Alma Mine No. 1 to some degree reopened the question about the safety of using belt entry ventilation air in working sections.

2006 Congress passes the MINER Act of 2006 which requires the establishment of a Technical Study Panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining.

The history provided the Panel with a sense of the importance of the belt air rule in mine safety and set the stage for establishing the Panel goals.

Outline of Panel Goals

The Panel interpreted the MINER Act, the charge to the committee by Secretary of Labor Elaine L. Chao, and the comments of Assistant Secretary of Labor Richard E. Stickler in defining the problems to be evaluated. It was clear that there were two primary questions to be answered. The first is the question of whether belt entry ventilation air should be permitted to be coursed to the working section to supplement the primary intake ventilation air. The second primary question is what requirements should be enforced on belt flammability and use of the AMS to reduce the hazards of carrying combustion products to the working face in mines using belt air at the face. There were also many auxiliary questions that were to be considered to ensure that the belt air utilization was carried out without endangering the miners. These included proper use of sensors to control the hazards, minimum and maximum velocity of air in the belt entries, control of dust and gas from the belt entry, proper utilization of escapeways and lifelines, training of miners and AMS operators, design of point-feeding systems, maintenance of the belt conveyor and the belt entry, inspection of mines utilizing belt air in the working sections, and research that would help in making the mining of coal safer as time moves forward.

Many of these questions continue to be of importance because of the many technological changes that occur over time in mining systems, in the characteristics of underground coal mines, and in the many technologies that serve the mining community. In attempting to provide answers to the questions that must be answered in this study, the Panel listened to experts and the public comments on the issues. However, the Panel's decision-making was initiated only after all of the data gathering and public input meetings were completed. Until that time, the Panel members refrained from discussions related to decision making and discussed only the specifics of the data and input provided by MSHA, the invited speakers, and the members of the public who addressed the Panel. The next section of the report provides a summary of the four public meetings that were held during the data gathering phase of the Panel activities.

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III. REPORT OF PANEL ACTIVITIES

The Panel met in Washington, D.C.; Coraopolis, Pennsylvania; Salt Lake City, Utah; Birmingham, Alabama; and Reston, Virginia. Panel members visited underground coal mines in Utah and Alabama.

<u>First Meeting</u>

The first meeting of the Panel was held on January 9 and 10, 2007, in Washington, D.C. At the beginning of the meeting, MSHA provided references to the Panel that included the Belt Entry Ventilation Review (BEVR) Report (MSHA 1989), the Department of Labor's Belt Air Advisory Committee Report (Belt Air Advisory Committee, 1992) , the final belt air rule (MSHA, 2004) , the 2006 MINER Act, the Panel's charter, and other relevant documents (a list can be found in Appendix D). In addition to the Panel and staff, 20 members of the public were in attendance during the two day meeting.

Mr. Richard E. Stickler, Assistant Secretary of Labor for Mine Safety and Health, welcomed the Panel members and introduced them as part of his opening statement. The Panel members elected Dr. Jan Mutmansky as Panel chairman by voice vote.

Dr. Jeff Kohler, Associate Director for Mining in the Office of Mining and Construction Safety and Health for the National Institute for Occupational Safety and Health (NIOSH), presented to the Panel a packet of information that contained more than 85 relevant reports and publications on belt air and conveyor belt issues. Many of these reports and publications were published by the former U.S. Bureau of Mines, NIOSH, and MSHA.

Bill Knepp, Assistant District Manager for Technical Services in MSHA's District 9, and Bill Francart, Mining Engineer at MSHA's Pittsburgh Safety and Health Technology Center, made presentations on the history of the belt air issue and rulemaking in MSHA. Mike Kalich, a Senior Mining Engineer with MSHA's Coal Mine Safety and Health Safety Division, presented a discussion of the background and history of MSHA's belt air final rule and issues surrounding industry compliance with the rule. Mark Schultz, a Supervisory Mining Engineer at MSHA's Pittsburgh Safety and Health Technology Center, made a presentation on the health aspects of the use of belt air, specifically how the use of belt air affects dust levels in working sections. Harry Verakis, General Engineer with MSHA's Approval and Certification Center in Triadelphia, West Virginia, gave a presentation on conveyor belt flammability.

Second Meeting

The second meeting of the Panel was held in Coraopolis, PA on March 28-30, 2007. Prior to the meeting, MSHA provided numerous documents to the Panel covering such topics as the use of belt air and violations related to the use of conveyor belts. These documents are listed in Appendix D. The agenda for the second meeting addressed belt flammability and toxicity research conducted by NIOSH, presentations by belt manufacturers, MSHA laboratory-scale flammability testing and belt fire historical data, belt air velocity limits, mine escape issues, comments by the National Mining Association (NMA), and a discussion of the 1992 Belt Air Advisory Committee report. A question and answer session followed each discussion. Twenty-three members of the public attended the three-day meeting.

On the first day of the meeting, Mr. Timko, the Manager of NIOSH's Dust and Diesel Monitoring Team, presented an overview of NIOSH research on the use of belt air, belt entries, conveyor belt flammability, and related issues, including ground and dust control and mine escape. Chuck Lazzara discussed belt flammability research, including large-scale gallery fire tests and laboratory-scale studies (e.g., the belt evaluation laboratory test, also known as the BELT). He also addressed fire suppression systems along belt lines. C. David Litton discussed the related issues of belt fume and smoke toxicity. Mr. Litton stated that smoke from a fire causes a visibility hazard well before a toxicity hazard develops.

Three conveyor belt manufacturers presented information on contemporary belt composition, construction, testing, and flammability. The three companies were Goodyear, Fenner-Dunlop, and Phoenix. The conveyor belt panel included the following:

- David J. Maguire, Director, Global Technology Engineered Products, The Goodyear Tire and Rubber Company, Akron, Ohio.
- Geoff Normanton, Vice President, Technology, Fenner-Dunlop Americas, Scottdale, Georgia.
- Brian Rothery, C.Chem M.R.S.C., Head of Development and Quality Assurance, Fenner-Dunlop, Europe, United Kingdom.
- Bernd Küsel, Executive Vice President, Phoenix Conveyor Belt Systems, GMBH, Hamburg, Germany.

They addressed improvements in belt quality, performance (durability), and safety over the past 15 years, since the publication of the 1992 Belt Air Advisory Committee Report. Many of the belts manufactured currently have improved flammability resistance that exceeds the flame test of conveyor belting specified in MSHA's regulations at 30 CFR § 18.65. Over the last 15 years the flame retardant added to rubber materials has been upgraded. Manufacturers make thicker and stronger conveyor belts that are more durable. In part, this move to stronger, more flame-resistant belts has been driven by international standards that are more stringent than the existing MSHA standard. The BELT originally developed by the U.S. Bureau of Mines (USBM) and MSHA as a laboratory-scale flammability test, has been used as the basis of similar European standards. A more flame-resistant belt will still burn if there is enough coal dust and grease to start a fire. Thus, maintenance of the belt line is very important.

Goodyear has not sold any belts in the U.S. that meet the BELT requirements. However, in order to sell conveyor belts in China, they have to meet full-scale gallery tests. Goodyear manufactures large quantities of these belts for sale in China.

Fenner-Dunlop has operations in many countries that mine coal and, due to different standards; the products it makes can differ in flame resistance, depending on the market.

Phoenix does not produce conveyor belts in the U.S. currently, yet is a major supplier of MSHA-accepted textile belts to the production coal fields. It also supplies steel cord belts for slope and drift conveyors, and has been active in the U.S. coal mines for about 10 years. Mr. Küsel estimated that self-extinguishing belts would cost 10 to 30 percent more than existing MSHA-accepted belting. Phoenix stated that the benefits of increased safety and better operation and performance of self-extinguishing belts compensate for their increased costs.

On the second day of the meeting, Harry Verakis, Senior Projects Engineer at MSHA's Approval and Certification Center (A&CC), presented information on the BELT method and on studies that were conducted in support of the test in the late 1980s and 1990s. Terry Bentley, Acting Special Assistant to the Administrator of Coal Mine Safety and Health, presented historical belt fire data. Robert Krog, a NIOSH Associate Service Fellow from Pittsburgh spoke on using belt air at the face in three-entry mines and belt velocity limits. Dr. Fred Kissell, formerly of NIOSH, spoke on factors that affect escape from underground coal mines during fires. Tom McNider of JWR spoke on behalf of the NMA.

On the third day of the meeting, Dr. Raja Ramani, Emeritus Professor of Mining Engineering at Pennsylvania State University, addressed the development and recommendations of the 1992 Belt Air Advisory Committee.

<u>Third Meeting</u>

The third meeting of the Panel was held in Salt Lake City, Utah on May 16 and 17, 2007. The agenda for the meeting focused on the issues of MSHA's experience with belt air ventilation and ground control issues in deep Western mines. A question and answer session followed each discussion. Twenty-five members of the public were in attendance.

Prior to the beginning of the third meeting, three Panel members, Dr. Mutmansky, Dr. Tien, and Dr. Weeks, and MSHA staff visited the Skyline Mine and the Aberdeen Mine in Utah. These mines are two-entry mines that, as part of their granted petitions for modifications, use belt air to ventilate working sections. They are also deep mines, with the Aberdeen Mine reaching a maximum depth of mining of 2900 feet.

On the first day of the meeting, a group of MSHA District Managers, Assistant District Managers, and ventilation specialists spoke about their experience with belt air issues and answered Panel members' questions. MSHA staff included:

- Kevin Stricklin, Administrator for Coal Mine Safety and Health (CMS&H), Arlington, Virginia.
- Bill Knepp, Assistant District Manager for Technical Services, CMS&H District 9, Denver, Colorado.
- Bill Francart, Mining Engineer at the Pittsburgh Safety and Health Technology Center, Pittsburgh, Pennsylvania.
- Carlos Mosley, Assistant District Manager, CMS&H District 3, Morgantown, West Virginia.
- Allyn Davis, District Manager, CMS&H District 9, Denver, Colorado.
- Bill Reitze, Supervisory Mining Engineer, CMS&H District 9, Denver, Colorado.
- Bill Crocco, Accident Investigations, Analysis and Prevention Manager for CMS&H, Arlington, Virginia.

After the Panel's questions were answered, Bill Francart reported on MSHA's Aracoma Alma Mine No. 1 accident investigation and answered questions.

Public input late on the first day included comments from the Bureau of Land Management (BLM) and the Colorado Mining Association. Jeff McKenzie and Steve Rigby of the Utah State Office of the BLM spoke about the responsibility of the agency for leasing of coal deposits that are on Federal property (referred to as "federal coal") to the mine operators in Utah. There are ten operating coal mines in the state that have some federal coal. Of seven longwall mines, six operate under a two-entry system on development and retreat due to deep cover conditions that affect ground control. They stated that two-entry mining is the only proven safe method available to recover these coal reserves.

Link Derick spoke on behalf of the Colorado Mining Association saying that underground coal mines have safely utilized belt air for many years. He said that continued use of belt air for ventilating working faces, coupled with the improvements in atmospheric monitoring systems, only enhance miner safety. Mr. Derick encouraged the panel to support its continued use.

On the second day of the meeting, Gary L. Skaggs of Agapito Associates, Inc., spoke at the request of the Panel concerning western mine ground control and convergence issues and two-entry versus other multiple-entry mining systems.

Next to present was a group representing the Utah Mining Association, which included:

- David Litvin, President.
- Laine Adair, General Manager of UtahAmerican Energy.
- George Kenzy, Senior Mining Engineer with Arch Coal.
- Kevin Tuttle, Safety Manager at Deer Creek Mine of Energy West.
- Charles Reynolds, President and General Manager from CW Mining.
- Wendell Christensen, Electrical Maintenance Manager from UtahAmerican Energy.
- James Poulson, a Safety Manager for UtahAmerican Energy.
- Gary Leaming, Safety Manager for SUFCO Mine.
- Carl Pollastro, Director of Technical Services for Interwest Mining.
- Doug Johnson, Corporate Services Director for UtahAmerican Energy.

Dr. Hamid Maleki, President, Maleki Technologies, Inc. spoke on behalf of the Utah Mining Association concerning the severe ground control issues involved in mining coal in deep Utah mines, including a discussion on stiff, yield, and barrier pillars and the alternate panel-barrier gateroad system. Dr. Maleki summarized that the use of a two-entry yield pillar system in high bump-prone environments significantly reduces the risk of pillar bursting, bump-prone related roof falls, and floor heave.

David Litvin moderated the remainder of presentations of several Utah coal operators who discussed the need in Utah for the continued use of the belt air two-entry system due to the deep mining depths and the surrounding geology.

Laine Adair presented additional information on the geology of Utah and the need to mine using a two-entry method due to the deep cover. He summarized MSHA's Two-Entry Task Force report issued in 1985, which concluded that the two-entry mining system with additional requirements is the safest overall design for mining in the Wasatch and Book Cliff coal fields. Some of the requirements included the use of AMS and belt air to ventilate working sections. If three-entry systems were used to mine these deep coal deposits, there would be better ventilation; however, ground control problems could result in bad roof, cave-ins, floor heave, rib sloughage, and compromised escapeways. A two-entry system results in significantly improved gateroad systems. Escapeway ventilation is also better than if a three-entry system is used.

George Kenzy spoke about his experience with the safety of longwall gateroad development as it relates to roof and rib control, ventilation, and AMS. His experience with both two-entry and three-entry gateroads indicates that the use of belt air in both mains and ingate roads has resulted in the increased use of AMS. He also stated rock dusting the beltlines increased dust exposures to miners in the working faces, unless dusting was reserved for the off shift, the idle shifts, and dampened curtains were used. He said that on the longwall, flooded-bed scrubbers were used at the crusher and on the stage loader, as well as on the section dump point to pro-actively control potential dust sources in these areas. The current generation of AMS monitors the atmosphere throughout the mine, active and inactive workings, and reacts quickly to any upset condition at any location underground. The use of sensor packages called diesel discriminators provides the ability to differentiate between carbon monoxide sources, whether related to diesel usage, cutting and welding, or fire.

Kevin Tuttle summarized the history of legislation, petitions, and rulemaking as they relate to belt air usage. He stated that doing away with the belt air standard could put a burden on many mines using belt air either through the previously approved petition process or the belt air standard. The belt air standard provides protection when using the point-feed system.

Charles Reynolds testified that the ground control conditions are responsible for bounces and bumps in his mine. Fewer entries mined results in more stable ground conditions, providing less potential for floor heaves, rib rolls, rib cutters, roof failures, overrides, and pillar bursts. He stated that his company's studies and experience with many mines in Utah have shown that using belt air provides the following general safety improvements. First, additional air to the working face can increase the total air quantity in the working section and reduce leakage. This helps to reduce methane levels, dust, and diesel emissions. Second, the comprehensive AMS requirements of the two-entry petitions are much more effective in providing additional protection to miners at all times. Finally, the use of belt air provides two escapeways in intake air, rather than escaping through return air.

Wendell Christensen discussed the maturation of AMS technology. Mine monitoring systems have matured from initial carbon monoxide and methane sensors 25 years ago to systems that now interface with environmental monitors, powerline communication equipment, and processors to monitor and control the mine. This includes state-of-the-art graphical interfaces, fiber optic trunk lines, and radio and wireless technology that can monitor more than 32,000 points in a single mine. He emphasized that current systems now include continual self-diagnostic capabilities.

The system monitors its own status and reports if there are any problems with it. The mine-wide monitoring system also has the ability to control devices underground, stopping conveyor belts and removing electrical power from selected areas. The system is monitored by an individual trained to respond to alarms, and to analyze conditions that may indicate possible problems before they have a chance to escalate into alarm conditions.

James Poulson emphasized that the elimination of the belt air standard would be adverse to the safety of Utah's underground miners. He stated that from a safety perspective, overall miner safety is improved when belt air can be used at the working face, due to the control of ground conditions, dust, and dangerous gases. Operators who want to use two-entry mining systems must file petitions to modify the existing standard. If granted, these petitions obligate the operator to implement a number of additional requirements.

Gary Leaming described the practice of ventilating working sections using belt air. He said that using belt air increases quantities of air reaching the working face without greatly increasing pressure on the ventilating system. He added that using the belt entry as an intake air source provides a second intake escapeway which is more valuable than a return escapeway in the event of an emergency. Many mines also supply firefighting water to their working sections through the belt entry. Hooking up and routing fire hoses is safer and accomplished quickly in a smoke-free atmosphere, which intake air more than likely will provide.

Carl Pollastro spoke on the ability to maintain a gateroad that is safe and effective for both development and retreat mining depending on the use of either a two- or three-entry development. His conclusion was that with two-entry development the mine can be maintained in a safer condition than with three-entry systems because multi-seam mining involves severe ground control issues since the top seam is mined first followed by deeper seams that are mined in sequence.

Doug Johnson addressed the ventilation aspects of two-entry gateroads and belt air at the face. He outlined the following five points as the advantages of two-entry mining in Utah. First, two-entry development has proven itself over more than 50 years as a successful way to mine the deep reserves in Utah. Second, using belt air is an important component of two-entry mining. Third, modern AMS systems are reliable, dependable, and comprehensive. Fourth, the existing belt air requirements result in a safe and healthy environment for underground miners, if the rules are followed. And finally, the use of belt air, if systems are properly maintained and operated, offers benefits in the event of a fire due to increased fire-fighting capabilities.

Fourth Meeting

The fourth meeting of the Panel was held in Birmingham, Alabama, on June 20 and 21, 2007. The meeting in Birmingham included discussions on AMS, including belt fire detection sensors and state-of-the-art smoke sensors. A question and answer session followed each discussion. Thirty-seven members of the public were in attendance.

Prior to the beginning of the fourth meeting, three Panel members, Dr. Brune, Dr. Calizaya, and Mr. Mucho, and MSHA staff visited the Jim Walter Resource's No. 4 Mine. This mine was one of the first mines to use belt air to ventilate working sections under a petition for modification granted in 1979.

On the first day of the meeting, a panel of AMS manufacturers gave presentations and answered questions asked by Panel members. These manufacturers included:

- David Graf, Manager of Business Development, American Mine Research (AMR).
- Bob Saxton, General Manager, AMR.
- Jim Gunnoe, Engineering Manager, AMR.
- Doug Coon, Sales and Engineering Director, Pyott-Boone Electronics.
- Al Ketler, President and CEO, Rel-Tek Corporation.
- Rob Albinger, Vice President, Conspec Controls.

These manufacturers discussed the systems they make, sell, and install in underground coal mines. Currently Rel-Tek and Conspec systems can use an Ethernet connection and fiber optic cable. This allows the use of off-the-shelf software packages. Two of the companies have ionization smoke monitors, and two of them are researching the use of a photo-electric smoke monitor.

A couple of different variations of smoke monitors exist: a regular stand-alone smoke monitor and a carbon monoxide/smoke combination monitor that uses ionization technology. The companies also make diesel discriminating and hydrogen discriminating sensors to reduce the incidence of nuisance alarms from diesel equipment or electric charging stations, respectively. In response to a Panel question concerning which sensor provides better early detection, a manufacturer stated that generally, a smoke sensor is a good alternate fire detection device for belt entries. A manufacturer stated that a combination of sensors would be better than either because the system would have the benefits of both. There's an additional cost because there are two sensors, two channels (Input/Output), and two telemetry events.

A manufacturer stated that based on its testing and communication with customers, smoke sensors, regardless of type (ionization or optical), can be either unreliable or maintenance nightmares. A Panel member responded that from NIOSH experience, all optical sensors have issues with mine dust, float dust, and rock dust. Belt entries tend to be heavily rock dusted. That is a problem in any optical system. If rock dust gets into the system, the system can compensate to a certain degree; however, the receptor elements will eventually clog up and need to be cleaned.

The manufacturer stated that air moving at 50 feet per minute could take, depending on the location of the fire, up to 20 minutes to reach a sensor. The sensors can detect a fire before flame appears. Furthermore, hydrogen, methane, carbon monoxide, carbon dioxide, and oxygen are all odorless and tasteless gases. The sensors could already be in alert or alarm status by the time miners smell the products of combustion.

All manufacturers agreed that qualified people are needed to operate and maintain the monitoring system. One stated that probably 10 to 20 percent of mines are probably having difficulty in maintaining their AMS the way manufacturers would like to see them maintained.

After the AMS manufacturers completed their discussions, personnel from Jim Walter Resources (JWR) gave presentations on the JWR Mine No. 4 tour, JWR Mine No.4 Mine belt air issues, and JWR's AMS. The panel from JWR included:

- Tom McNider, General Manager for Mining Engineering for JWR.
- Keith Pylar, Safety Associate at Jim Walter Resource's No. 7 mine.
- Randy Watts, Manager of Electrical Engineering for JWR.

Tom McNider stated that the use of belt air in eastern mines is primarily due to the need for increased ventilation for methane and dust control. Although JWR's mines have been using degasification systems for years, there is still a great need to use all available air courses to carry as much intake (ventilation) air to the working face. JWR's No. 7 mine operates two fans in parallel on each return shaft in order to provide adequate ventilation to control the remaining methane liberation. All the mines that operate in Alabama's Blue Creek seam use belt air at the face. The amount of air that is needed in these mines requires large pressure differentials from intake to return, using all available air courses. To restrict the ventilation on the belt air course with a regulator such as a bulkhead would create high air velocity across the bulkhead and creates a float dust and respirable dust problem. Also, restricting the belt air course pressurizes it and creates leakage from the belt to the primary intake escapeway, potentially contaminating the escapeway.

Mr. McNider stated that strata control is a secondary issue to ventilation in eastern coal mines. The most effective way to ventilate gassy mines that require large quantities of air is to use all available air courses and have positive, one-way ventilation on the belt. Respirable dust on the belt lines, another concern in high velocities, has not been a problem at JWR's mines and can be controlled through water sprays and proper chutes.

Keith Pylar testified that he believes that coal mining that uses belt air to ventilate working faces is safe. An advantage to using belt air is that the JWR mine-wide monitoring system has been able to detect smoldering situations, bearings going out on rollers, hot rollers, and unaligned belts well before a fire develops. Early detection, notification of affected miners, and action to address the problem enhances the safety of the miners at the mine. The other advantage of using the belt air on the face is that even though it is not dedicated as an escapeway, it gives miners another intake entry to use to get out of the mine in an emergency.

Randy Watts stated that JWR's early experiences with AMSs caused the company to design, seek and obtain MSHA approval of their own AMS. Their system uses JWR-generated software and fiber optic cable. The system is fast and tolerant to noise. It uses a structured query language (SQL) database to store information. Underground hardware includes an individual address for each device. A complete scan of every address on the system is performed every one or two seconds. Sensor readings are scanned every one and a half seconds, as is the status of each sensor to assure that they are working as they're designed. The system has built-in redundancy, with two computers running in parallel at all times, with one computer doing all of the scanning. JWR uses the term "Mine-Wide Monitoring System," rather than just "AMS system" because the system not only monitors atmospheric conditions; but also much of the other equipment in the mine. The AMS screen continuously shows the status of all the carbon monoxide sensors on all the underground belts.

Mr. Watts also stated that the system would not be effective if it were not for the people who monitor and maintain the system. In their control room, AMS operators, are all experienced miners and certified foremen, and have all the tools they need, including the mine map, computers, video, two-way communications, and access to the technicians that they need at any time to assure that the system operates correctly. These technical personnel address any problems that the AMS operators may have; therefore the AMS operators do not have to know how to troubleshoot the system.

JWR supports a higher specification belt, but it must meet the operational needs of the mines and be durable enough to withstand the rigors of underground use. They currently use a National Coal Board NCB 158 belt. Before this belt, JWR primarily used a PVC belt, which was not as durable and did not perform adequately. In 1992, the BELT specification was proposed, and JWR tried a higher grade belt. It was a rubber belt with a specific compound added to meet the BELT flame-resistant specifications. That belt also had an operational problem; there were numerous points where the belt would run out of alignment and create shavings that would drop onto the footwall and result in AMS alarms, an operational hazard.

The National Mining Association (NMA) and Alabama Coal Association panel included the following individuals:

- Bruce Watzman, Vice President of the NMA.
- Pramod Thakur, Manager of Coal Seam Degasification for CONSOL Energy.
- David Decker, General Manager of the Brooks Run Mining Company.
- Patrick Leedy, Manager of Engineering for Lone Mountain Processing, Incorporated.
- Greg Dotson, Mine Manager at Mingo Logan Coal Company.
- Bill Olsen, Safety Director at Mountain Coal Company's West Elk Mine.
- Jim Poulson, Manager of Safety at Utah American Energy, Inc.
- Gary Hartsog, President of Alpha Engineering Services.

Bruce Watzman stated that belt air has been, and continues to be, a safe practice to improve the working conditions for miners at the face. He said that operators demonstrated at the Salt Lake City meeting the absolute necessity and safety advantages of using belt air to reduce the number of injuries and to sufficiently dilute, render harmless, and carry away methane and dust from the working face in two-entry mines. JWR and other mine operators have demonstrated that the use of belt air is equally essential to control methane and dust where ventilation resistances preclude doing so in its absence.

Dr. Pramod Thakur stated that belt air traveling in the same entries as water flow provides a safer and faster access to water lines in an emergency. He concluded that belt air should be used to ventilate working faces because it makes underground coal mining and escape from longwall face fires much safer.

David Decker stated that the ability to use belt air to ventilate active faces provides flexibility that enhances mining in a mature coal field. The use of belt air allows the company to minimize roof control issues associated with greater entry widths and number of entries, by using the belt entry to provide a greater overall volume of air with fewer entries. There is also more air pressure at the face, less total pressure, less leakage between airways, and a better ventilation balance. In conjunction with the use of AMSs, it is a safe way to ventilate coal mines and provide a higher pressure and volume where it's needed the most, at the mine face.

Patrick Leedy also spoke about the issues involved with multi-seam mining. He stated that this was an important reason to allow belt air to be used at the working face.

Greg Dotson stated that belt air gives additional air to help dilute the methane and harmful gases and it enhances their ventilation system, helps mines overcome geologic challenges, and is safe when used with AMS.

Bill Olsen supported the comments from the NMA, Colorado Mining Association, Utah Coal Operators, and the Alabama Coal Association and their member companies. Mr. Olsen's mine experiences deep cover, high horizontal stress, faults, spars, and multi-seam mining. Two of the most difficult challenges are maintaining methane concentrations at acceptable levels and reducing the potential for spontaneous combustion throughout the mine. Fan pressures would have to be increased to over 15 inches water gauge in order to maintain an equivalent air quantity in the section. Mr. Olsen stated his belief that the increased pressure differential, specifically across the pillars and gobs, increases the likelihood for spontaneous combustion to occur as the air passes through the natural cleats and fractures of the pillars and within the caved area where there is a demonstrated history of spontaneous combustion. AMS sensors detect fires at the incipient stages as compared to point-type heat sensors still used in mines where belt air is not used.

Mr. Olsen stated that fire fighting capabilities in the belt entry are enhanced when belt air is used. Use of belt air allows fire fighting to be conducted from the upwind side with the air flow and water flow in the same direction, minimizing the potential for damage to the water supply line. It also allows for the alternate escapeway to be ventilated with intake air, rather than using a neutral or return air split for escapeway purposes. He also stated that methane levels and the potential for spontaneous combustion have been reduced by the use of belt air.

Jim Poulson stated that ground control, dust control, dilution of dangerous gases, and overall miners' safety are improved when belt air is used at the working face. He also provided dust sampling data and comparisons of two-entry mining systems to multiple-entry mining systems, including the following chart compiled by the Utah mine operators, which demonstrates the reduction in reportable roof falls per 1000 feet for two-entry versus three entry gateroads in Utah mines .

Comparison of Two-Entry vs. Three-Entry Gateroads

Mine Name	No. Entries	Feet of Gateroads	No. of Reportable Roof Falls	Reportable Roof Falls per 1000 feet
Skyline Mine No. 2	2	43,110	0	0.000
Skyline Mine No. 3	2	24,596	0	0.000
Cottonwood	2	99,453	9	0.090
Trail Mountain	2	106,019	5	0.047
Deer Creek	2	362,635	3	0.008
West Ridge	2	91,074	0	0.000
Aberdeen	2	99,211	0	0.000
Crandall	2	83,686	0	0.000
South Crandall	2	12,145	0	0.000
Total		921,929	17	0.018
Skyline Mine No. 1	3	293,058	16	0.055
Skyline Mine No. 2	3	226,723	21	0.093
Skyline Mine No. 3	3	226,723	25	0.110
West Ridge	3	0	0	0.000
Aberdeen (at > 1,500” cover)	3	0	0	0.000
Crandall (at > 1,500” cover)	3	0	0	0.000
South Crandall	3	3,793	0	0.000
Total		749,696	62	0.083

Gary Hartsog stated that the use of belt air is important, and sometimes critical, to the coal mining industry. He stated that the use of belt air is not for every mine. It is, however, an extremely important tool and an option that needs to be available with proper monitoring and safeguards for all mines, and most especially for those mines with the more difficult conditions and greater distances to ventilate.

Mr. Hartsog also stated that longwall gate development consists of driving three- or four-entry gateroads for some distance until a block of coal has been isolated for mining with the longwall. These gateroads can become difficult to ventilate, especially if there is significant methane liberation. The use of belt air in the working face allows leakage to be minimized between the intake and the belt entry and more intake air to be delivered to the working faces.

During the public comment phase on the first day of the meeting in Birmingham, Dave Maguire, the Director of Technology for Goodyear Engineer Products, reported to the Panel the results of research on submitting Goodyear’s halogen-free and halogenated belts to flame-testing using the BELT standard. Mr. Maguire also reported on smoke density and toxicity of the gases and particulates emitted during the flame tests.

On the second day of the meeting, C. David Litton of NIOSH gave a presentation on belt fire detection sensors and state-of-the-art smoke sensors. He recommended that mines that do not use diesel equipment could install simple inexpensive smoke detectors.

Launa Mallett of NIOSH's Pittsburgh Research Laboratory provided information on effective training techniques for emergency response preparedness (specifically for AMS operators and in general terms for all underground miners). Dr. Mallett stated that emergency decision-making involves the following steps: detection of the problem, definition/diagnosis, consideration of options, choosing from options, and execution of the decision. She stated that the process is impacted by miners' skills, knowledge, and attitudes, uncertainty, stress, and the complexity of the situation. Lastly, she outlined the potential content for Emergency Response Training, which should include routine functioning of the system, diagnosing non-routine situations, giving and receiving emergency warnings, and the impact of stress during and after emergencies.

The United Mine Workers of America (UMWA) panel included the following speakers:

- Joe Weldon, Chairman of the Safety Committee for Shoal Creek Mine, Drummond Coal Company
- Dwight Cagle, a union miner at JWR's No. 7 Mine,
- Larry Turner, UMWA safety representative at the JWR No. 4 Mine,
- Glen Loggins, UMWA Safety Committee member for JWR's No. 4 Mine, and
- Tom Wilson, UMWA International Representative.

Mr. Weldon spoke about the duties of AMS operators at his mine. The AMS operators do far more than just monitor the AMS. AMS operators receive calls on a number of issues that are unrelated to the operation and monitoring of the AMS. They also have to monitor the operation of the fans at the mines and receive calls on the mine pager phone with people traveling to and from different areas of the mines. He also said that if there is an accident in the mine, the AMS operator notifies the paramedics and the ambulance service or the Medevac. The AMS operator also monitors the carbon monoxide sensors and relays any messages to the proper people. Mr. Weldon stated the UMWA position that a mine needs a responsible person whose sole job is to monitor the AMS to ensure the health and safety of each and every person in this mine and who is trained and certified to do so. This action would result in a reduction of miners' exposure to smoke or gas is in the mines in the event of a fire or an explosion. Also, the withdrawal time would be less, and the probability of someone surviving these events would be greater.

Mr. Cagle spoke on training, maintenance, and fire prevention. He stated that the best AMS in the world is useless and will not benefit the miners unless it is properly installed, monitored, and maintained. At his mine, the AMS operators are carbon monoxide technicians. Each AMS operator is also a responsible person under MSHA's standards. Mr. Cagle also said the UMWA would like to see an additional person employed to assist with the duties assigned to the AMS operator positions, because one person can not handle all of these tasks. He also thought that more AMS operators should be required due to the use of belt air, fire-resistant belts, and the installation of more sensors.

Mr. Turner addressed the number of citations for float coal dust accumulations. JWR mines have crews that are dedicated to cleaning the belt lines; but, for a variety of reasons, high levels of dust occur. He stated that there should be stricter regulations on how much air could be on a particular belt taking air to working sections and that citations be increased if there is a pattern of violation. Also, he stated that AMS sensors should be installed along all belts, not just those that take intake air to the working sections, and that since the monitoring systems are not perfect, then other requirements need to be put into place such as flame-resistant belt material, and placement of sensors through the mine for optimal monitoring.

Mr. Loggins stated that there is a need for more training on how to evacuate mines expeditiously. The current rule requires that when an alarm occurs, work crews are to retreat outby the alarming sensor. He stated that the fire could be outby that sensor due to the required 1000 foot spacing and that when an alarm occurs, miners should be trained to evacuate all the way to the surface. He stated that all miners, AMS operators, and foremen need training in this area.

Mr. Wilson spoke on issues surrounding the safe use of belt air to ventilate working faces since its use can expose miners to the following hazards: products of combustion, reduced number of escape routes, and higher levels of respirable dust and methane. Mr. Wilson stated that if these hazards are not controlled, the use of belt air reduces the protection afforded miners under the existing rule. He stated it was essential to control fuels, sources of ignition, and air to prevent fires to ensure a means of detecting and controlling fires should they occur and a means to escape. He stated that some of these conditions can be controlled, but not eliminated, by using flame-resistant belts and lubricants, by monitoring and controlling methane, and removal of combustibles. He stated that the Panel address the following recommendations: flame-resistant belts and lubricants, noncombustible standing roof support, better design of belt headers and transfers, improved automatic fire suppression systems, assure required belt maintenance, increased dust controls, existence of physical and pressure separation between the intake escapeway and the conveyor belt entry, standardized installation of AMS components (including the actual location of sensors), and training.

Public comment was provided by Mr. Bruce Levinson of the Center on Regulatory Effectiveness and Mr. Dale Byram of Jim Walter Resources, Inc.

Mr. Levinson discussed how other agencies' standards address the issue of flame-resistance and smoke. These agencies include the Federal Railway Administration, the Federal Aviation Administration., the National Aeronautics and Space Administration, the State Department, the Department of Energy's Sandia National Laboratory, and the Department of the Navy. These agencies use both flame-resistant and smoke-density standards; such as ASTM 162 and E662a. Materials used by these agencies are required and tested to be self-extinguishing and non-propagating. Also, a variety of countries; including, Australia, France, Italy, Japan, Korea, New Zealand, and the United Kingdom have all moved to halogen-free materials in cable construction. The U.S. standards are weaker than almost all other international standards in addressing three issues: fire resistance, smoke density, and toxicity.

Mr. Byram spoke to clarify the duties and responsibilities of AMS operators and miners who work for Jim Walter Resources. After the AMS operator is notified of an emergency, a salaried support person is made available to handle all other calls and business while the AMS operator focuses strictly on dealing with the emergency.

Fifth Meeting

The fifth, and final, meeting of the Panel was held in Reston, Virginia on September 17-19, 2007. Twelve members of the public were in attendance. The panel discussed 21 draft recommendations. The Panel ended the meeting with 20 final recommendations. All 20 final recommendations were passed by a unanimous 6-0 vote. These recommendations and their supporting discussions are contained in section V of this report.

IV. THE PANEL AND SUBCOMMITTEE WORK AGENDA

The Panel began the decision-making phase of its activity in a closed meeting held following the conclusion of the public meeting in Birmingham, Alabama. At that time, the Chairman presented a list of suggested topics to be considered by subcommittees. These topics were as follows: belt fire-resistance certification requirements, other belt testing requirements (friction tests, static charges, etc.), maintenance requirements on belts, coordination of belt testing requirements with other mining countries, sensor technology assessment, sensor spacing, smoke density monitor utilization, fire vs. diesel discrimination, early warning system design, AMS operator training, use of belt air at the face (yes or no), review of belt air petitions, primary escapeway static pressure, belt and track in single or separate airways, leakage issues, lifeline requirements, dust and gas control at the face, escapeways, minimum/maximum velocity, early warning system training, SCSR training, MSHA/NIOSH cooperation, communication systems improvement, and SCSR improvements.

These topics were organized into five categories. The Panel discussed the topics and decided to reduce the number of topics to be considered because some of the topics were considered to be outside the scope of the Panel's charge. The Department of Labor solicitors aided the Panel in defining the scope of the charge and made suggestions to help the Panel focus on the topics to be addressed. This resulted in the topics being arranged into four categories. The Chairman then made suggestions as to who would serve on each subcommittee and who would serve as the Chairman of each subcommittee. All decisions as to subcommittee makeup and the chairman of each subcommittee were made by consensus. The initial decision-making was conducted in three-person subcommittees. The four subcommittees and the members of each subcommittee are provided below with the chairman of each subcommittee listed first:

(1) The Belt Characteristics Subcommittee (T. Mucho, J. Weeks, and J. Brune)

(2) The AMS Technology Utilization Subcommittee (T. Mucho, J. Weeks, and J. Brune)

(3) The Ventilation Issues Subcommittee (J. Mutmansky, F. Calizaya, and J. Tien)

(4) The Training Subcommittee (J. Mutmansky, F. Calizaya, and J. Tien)

Much of the work in the subcommittees was conducted via e-mail with the chairman of each subcommittee setting the agenda and the order in which topics were considered. The suggested topics for each of the subcommittees was advisory only and the individual subcommittees used their discretion to add, alter, or combine topics within their subcommittee's list. The subcommittee members were permitted to contact members of the Panel outside their subcommittee on a person-to-person basis to ask questions or request data. This discretion was exercised a number of times to allow for a free exchange of data and technical information.

During the process of subcommittee deliberations, the Designated Federal Officer and members of the MSHA staff were contacted numerous times to request data on mining operations, safety statistics, publications from the MSHA and NIOSH libraries, opinions of the Department of Labor solicitors, and interpretations and opinions of the MSHA technical personnel. All requests of the Panel were addressed promptly.

The work of formulating and voting on recommendations was completed within the subcommittees over a period of about eleven weeks. The Chairman of the Panel encouraged the members of the subcommittee to work toward recommendations that could be presented to the entire Panel with unanimous support of the subcommittee. All recommendations presented to the Panel on September 17, 2007, came with the full support of the subcommittee members.

As part of the subcommittee duties, the subcommittee chairman appointed one member of the committee to write a discussion section that outlines the recommendation's logic and provides supporting arguments and documents that pertain to the recommendation. These discussion sections were then circulated to the subcommittee members to gather their comments and provide a discussion that would satisfy each member of the subcommittee.

When the subcommittee work was completed, 21 recommendations were forwarded for consideration of the entire Panel. From September 17 through September 19, the Panel completed its final meeting in Reston, Virginia. The Panel initiated discussion of all 21 recommendations, one at a time. In each case, the member of the Panel who wrote the discussion section for the recommendation presented the arguments in favor of the recommendation and answered questions presented by other members of the Panel. Refinement of the wording of the recommendations was common. In addition, some of the recommendations were combined to satisfy Panel members and to move toward unanimous concurrence. In the final voting on the first two days of the meeting, 20 recommendations were passed by the Panel, each with a unanimous 6-0 vote of the Panel in favor of the recommendation. On the third day of the meeting, the Panel reworked the discussion sections to reflect the opinions of the Panel and to strengthen the logic of each recommendation. The entire transcript of the final meeting in Reston is available on the MSHA website (http://www.msha.gov/BeltAir/BeltAir.asp). The recommendations of the Panel and the discussions of each recommendation are presented in the next section of this report.

V. OUTLINE AND DISCUSSION OF PANEL RECOMMENDATIONS

This section of the Report presents the 20 recommendations passed by the Panel and the discussions in support of each recommendation. It is not meant to be exhaustive of all Panel discussion of the recommendations. The reader is referred to the transcripts of the Panel meetings for the full discussion by the Technical Study Panel. The Panel emphasizes that the discussion portion of the report should carry equal weight with the captioned portion of the recommendations and cautions against using isolated statements taken out of context and altering the intent of the Panel.

Readers of this report should note that the references cited in the Discussion section of each Recommendation are provided immediately after the Discussion for convenience purposes. The references at the end of the report are all of the materials provided to the Panel for study.

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RECOMMENDATION NUMBER 1 - CONVEYOR BELT FLAMMABILITY TESTING AND APPROVAL

The Technical Study Panel strongly recommends that MSHA move post-haste to revise (as suggested elsewhere in this report) and re-propose and implement the Proposed Rule - Requirements for Approval of Flame-Resistant Conveyor Belts (*Federal Register*, Dec. 24, 1992, Vol. 57, No. 248) that was withdrawn in 2002 (*Federal Register*, July 15, 2002, Vol. 67, No. 135). The objective is to significantly reduce the frequency and hazard of conveyor belt fires in mines that elect to course belt air to the working face. The Panel believes that current requirements for testing and approval of flame-resistant conveyor belt have proven to be outdated and inadequate to provide an acceptable level of flame resistance and, therefore, safety for U.S. miners, based on both the historical record of conveyor belt fires in the U.S. and in comparison to general standards of the global mining community.

Discussion

Preventing Belt Fires

Section 303(y)(1) of the Mine Act of 1977, an interim mandatory safety standard for underground coal mines, provided that entries with conveyor belts should not be used to ventilate working places. The rationale behind this prohibition is that if there is a fire in a belt entry, the products of combustion will go directly to the face area where miners work and it will contaminate the belt entry as a potential escapeway.

Inadequate maintenance is a contributing factor to the occurrence of belt fires, resulting in the accumulation of fuels and creation of sources of ignition. The most common source of ignition is frictional heating. It can occur if idler rollers seize or if the belt becomes misaligned. There are thousands of load-bearing rollers for each mile of belt and if any one breaks or seizes, a belt continuing to pass over the roller can cause frictional heating. Frictional heating has also occurred if belts become misaligned and rub against adjacent structures, rib, roof, or floor. Heat generated by friction may be sufficient to ignite grease, accumulated coal dust, or other combustible materials. When the belt stops, there may be sufficient heat to ignite the belt itself. Other sources of ignition include sparks from welding or from malfunctioning electrical equipment. Fuel for combustion can be the belt, coal or coal dust, lubricants, or other combustible materials such as wood, trash, etc.

Poor maintenance on the belt and of the belt entry itself is an important underlying cause of fires on belt entries in other ways too, contributing both fuels and sources of ignition. Since freshly cut coal is carried by the belt, float coal dust is common in belt entries. If it is not removed on a regular basis, it may become fuel for a fire. Other combustible materials may accumulate. If the ribs of a belt entry are not adequately rock-dusted, the coal that constitutes these ribs may also ignite. Citations for such violations (e.g., accumulation of combustible materials, inadequate belt maintenance, failure to rock-dust, and others) are common. Accumulation of combustible materials (30 CFR § 75.400) was, in fact, the most frequent of all citations in 2006. The numbers of citations for violations pertaining to belt maintenance in 2006 were as follows:

CFR Section	Belt Maintenance Related Violation	No. of Citations
75.400	Accumulation of combustible materials	8201
75.1104	Accumulation of combustible materials	599
75.1725 (a)	Machinery & equipment	1566
75.402	Rock dusting	197

Criteria for New Standards under the Mine Acts of 1969 and 1977

The interim mandatory standard that prohibited the use of belt entries for ventilating working sections (Sec. 303 (y)(1)) was intended to prevent smoke from belt fires from reaching the face areas where miners work. Prior to MSHA's promulgation of its final belt air rule, mine operators petitioned to modify this standard in order to use belt entries for face ventilation. Most of these petitions were granted. Then in 1988, MSHA proposed a rule that would modify much of the ventilation standards for underground coal mines and included provisions for the use of belt air under limited conditions (MSHA, 1988). This culminated in a final rule in 2004 (69 Fed. Reg. 17480, April 2, 2004). Did this rule satisfy the requirements of Sec. 101 (a)(9) of the Mine Act? It is not the purpose of this Panel to answer that question. Indeed, the District of Columbia Court of Appeals rejected the UMWA challenge to MSHA's final rule allowing operators to use belt air to ventilate working sections and rendered a decision that, " . . . the Secretary compared the safety of the work environment created by compliance with the new Belt Air Rule with the previous interim standard . . . [and] MSHA followed with a section-by-section analysis to demonstrate that through new technological advances and the interrelationship between the various existing and new standards under the new Belt Air Rule, the new rule maintained or improved miner safety." *International Union, United Mine Workers of America v. Mine Safety and Health Administration,* 407 F.3d 1250, 1256 (May 24, 2005). Nevertheless, the statutory requirements provide a useful framework for discussion.

Section 101(a)(9) of the Mine Act prohibits any new standard from reducing the protection afforded miners by the existing standard. In this case, the standard that was superseded was the interim mandatory standard in the Mine Act that prohibits the use of a belt entry from ventilating active working places (Section 303(y)(1)). The purpose of this prohibition is to prevent smoke from a fire in a belt entry from reaching the working section. While the MSHA rule (30 CFR §§ 75.350-351) requires improved methods of fire detection and thus improves the rapidity of fire suppression, it does little to prevent fires in belt entries and thereby, little to prevent smoke from contaminating a working section. Accordingly, we make several recommendations that are designed to prevent fires in belt entries: improve the criteria for testing and accepting flame-resistant belts, add a drum friction test for accepting belts, and improve maintenance in belt entries. These are all discussed in more detail in this and in other sections. Elsewhere, we also suggest that if a mine operator intends to use a belt entry to ventilate a working section there should be specific gains in mine safety to offset the loss inherent in allowing smoke from a belt fire to be carried to a working section.

Preventing Fires in Belt Entries by Using Fire-Resistant Belts

In a belt entry, there are abundant sources of fuel (coal, the belt, trash, lubricants, wood posts), sources of ignition (frictional heating, sparks from welding or malfunctioning electrical components) and an abundant source of air. That is, the belt entry has all the necessary and sufficient conditions for a fire to occur. Yet with this knowledge, it is also possible to prevent fires in belt entries by applying the conventional approach to fire prevention, i.e., by removing fuel, sources of ignition, or oxygen.

One such application is to require that belts be fire or flame resistant. The current test protocol for evaluating belt material for flammability is described in 30 CFR § 18.65. It is commonly referred to as the 2G test because it was previously part of Schedule 2G (Verakis, 1993). Though its date is listed as 1968, it derives from a test protocol developed in 1955 as Schedule 28(3) (Verakis, 1989; USBM, 1955; Polack, 1956). This was confirmed by testimony provided to this Panel (see Pittsburgh transcript on the MSHA website). Presently, the 30 CFR § 75.1108 requires that "On and after March 30, 1970, all conveyor belts acquired for use underground shall meet the requirements to be established by the Secretary for flame-resistant conveyor belts." 30 CFR § 18.65(d) specifies the laboratory testing procedures for conveyor belt material fire resistance.

The current Schedule 2G testing for fire-resistant belting is performed using small belt samples 6 inches long by 0.5 inches wide. A sample is positioned horizontally in a test cabinet, with the transverse axis inclined at 45 degrees. One end is exposed to the flame from a Bunsen type burner in still air. After one minute, the burner flame is removed and a ventilating fan turned on to provide an air current of 300 fpm. The duration of the belt sample flame and afterglow is measured. A belt passes the test if 4 samples of the same belt do not exhibit either duration of flame exceeding an average of 1 minute, or duration of afterglow exceeding an average of 3 minutes.

In developing Schedule 28(3), the Bureau of Mines reviewed tests for fire resistance used in the UK, Germany, France, and the Netherlands as well as tests by DuPont, the Rubber Manufacturers Association, and the American Society for Testing Materials (Standard D635-44) and in the end, adopted the ASTM test with some modifications. The criteria for making this selection were not described, and there was no reference to its relevance to in-mine conditions. Although the Bureau of Mines evaluated a drum- friction test, as used by the British National Coal Board, it was not included in the final test protocol (Polack, 1956).

It is reasonable to expect that if a belt is "fire-resistant," it should not burn in an underground mine. By this criterion, the 2G test has not been successful. Belt fires have persisted and are well documented in underground coal mines from at least 1970. The frequency of fires in haulage entries (track, trolley, and belt entries) was assessed in 1990 (Luzik and Desautels, 1990) to aid in the construction and placement of water lines in underground coal mines. Of the 293 mine fires reported from 1970 to 1988, 65 (22%) occurred in belt entries. During this time period, there was a transition from track haulage to belt haulage and, as a result, fires in belt entries became more numerous in the second half of this time period compared to the first half. Of the fires in belt entries, 22 (34%) occurred as a result of frictional ignition, and the causes of 18 (28%) were unknown.

A similar report was prepared in 2004 in order to provide MSHA and NIOSH with a " ... better understanding of the causes and hazards of mine fires … " (DeRosa, 2004). From 1990 to 1999, there were a total of 87 reported fires in underground coal mines. These fires were classified in a variety of ways including by the source of ignition and by the burning material, both of which are pertinent to an assessment of belts as a source of ignition and as a fuel. Of these fires, 15 (17%) resulted from frictional ignition and for 13 (15%), the belt itself was the principal fuel. The proportion that occurred as a result of frictional ignition was slightly less than the proportion reported from 1970 to 1988 (17% vs. 22%).

In neither of these reports did the investigators mention the belt material, whether natural rubber, synthetic rubber (styrene-butadiene [SBR]), chloroprene (neoprene), or polyvinyl chloride (PVC) or the fabric core. In all cases, belts were accepted as flame-resistant. As part of the investigation of mine fires, sections of the affected belt are tested again for flame resistance.

In addition to these demonstrable shortcomings, engineers at the Bureau of Mines criticized the 2G test for its lack of similarity with in-mine conditions as early as 1967 and developed a testing protocol in its experimental mine and in an experimental gallery. (Mitchell et al., 1967). The gallery test was conducted using a four-foot diameter corrugated steel pipe, 60 feet long, and ventilated with an exhaust fan on top of a 20-foot-high stack. The belt sections for both the experimental mine and the test gallery were 15 feet long and were 10 in., 30 in., or 42 in. wide. They varied in thickness from 1/8 to 3/8 inch. (Belts currently used in mines are significantly wider and thicker than these belts, used forty years ago.) These experimental conditions were significantly different from those used in the 2G test and more closely resembled in-mine conditions. They also produced different results.

Belts were new and typical of those used in coal mines.[1] They were made of rubber, neoprene, or PVC. In general, all ignited but flame propagation was significantly slower for the neoprene and PVC belts than for the rubber belts. The investigators found that many belts marked as "fire resistant" under the 2G test in fact burned. Ignition and flame propagation varied with the intensity of the ignition source (a propane burner), air velocity, and thickness of the belt.

Mitchell and other researchers continued their investigations, examining the association of flame propagation with air velocity, belt width, and cross-sectional area of the test apparatus (Mitchell et al., 1967; Kuchta et al., 1981). They found, among other matters, that air velocity greater than 100 fpm increased flame propagation, that there was no relation of propagation with belt width, and that propagation was associated with the cross-sectional area of the test gallery. Of relevance to the use of belt entries for ventilation, they suggested (pg. 8) that "In practice, consideration might be given to limiting air flow in belt installations."

Given the manifest deficiencies of the 2G test, the Bureau of Mines, in cooperation with MSHA's Approval and Certification Center, developed a test that more closely resembled an underground mine (the so-called, full-scale gallery test) and based on that experience, developed a scaled-down laboratory-based test. The laboratory-based test used an apparatus that was smaller than the full-scale gallery test and larger than that used in the 2G test and, for this reason, was sometimes referred to as the intermediate-scale test. It has been evaluated, revised, and re-evaluated many times.

Experiments similar to those undertaken by Mitchell et al., indeed many using the same apparatus continued at the Bureau of Mines, followed, often in collaboration with the MSHA Approval and Certification Center. (Sapko et al., 1981). Perzak et al. (1982) developed a single flammability index (FI) for each type of belt that combined findings on each test. Verakis (1989) presented results of the full-scale test

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[1] Mitchell et al. also reported on experiments in the Netherlands in 1949 that showed that flammability was increased on used belts, belts under tension, and thin belts.

and preliminary results using the laboratory scale test. The two tests were in substantial agreement and noted, among other findings, there was a maximum flame propagation at an air velocity of 1.5 m/sec (= 300 fpm), that none of six SBR belts passed, about half of the PVC belts passed (14 passed, 12 failed), most of the neoprene belts passed (18 passed, six failed) and few of the composite belts passed (three passed, 20 failed). MSHA's Approval and Certification Center developed test evaluation criteria for belt manufacturers (Verakis, 1989; Verakis and Dalzell, 1988). In preparation for rule-making adopting these tests, MSHA described the test on which both MSHA and the Bureau of Mines had been collaborating (Verakis, 1993; Luzik, 1989). Lazzara and Perzak (1990) compared results of experiments with the full-scale gallery with a laboratory-scale test and found they gave the same results on 19 different styles of belt.

The Belt Evaluation Laboratory Test (BELT)

Testimony before the Panel detailed that the BELT (See also Lazzara and Perzak 1990; Verakis, 1991; USBM, 1989) was developed by the U.S. Bureau of Mines, in cooperation with MSHA, to address the limitations of the 2G test by providing for a sample size and test conditions that lead to results that align more closely with those of the full-scale gallery test. Yet, the test is conducted in a relatively simple laboratory setting that does not require a full-scale belt fire gallery.

Presentations to this Panel showed that belts that pass this 2G small-scale test procedure do not pass the flammability testing under more realistic large-scale conditions. In fact, it has been demonstrated that belt materials that pass the 30 CFR § 18.65 test may burn completely in a full-scale belt gallery test conducted at the NIOSH (former USBM) Lake Lynn Laboratory, as recounted to the Panel by expert presenters (also see Lazzara and Perzak, 1987; Lazzara and Perzak 1990). In that series of tests, 13 synthetic rubber belts and eight PVC belts were tested in 42-inch wide by 3/8 to 1 inch thick configurations. Nineteen of these 21 belts passed the 30 CFR § 18.65 test but only two rubber and four PVC belts exhibited fire-resistant behavior, i.e. limiting fire damage to the ignition area. Fifteen belts failed the large-scale belt fire gallery test, showing that the fire damage extended to the end of the 30-foot test sample and leaving no portion of the sample undamaged across the entire belt width. Over the next decade, the Belt Evaluation Laboratory Test (BELT) was refined, revised, and validated and the Bureau of Mines issued its Technology News announcing the test complete with drawings and test methods (USBM, 1989; USBM, 1991; USBM, 1989).

The BELT is conducted in a 5.5-foot-long by 1.5-foot-square ventilated tunnel. The belt material sample size is 5 feet long by 9 inches wide. The sample is ignited by applying a gas burner to the front edge of the belt sample with the flames distributed equally on the top and bottom surfaces of the sample. After five minutes, the burner is removed, and the belt sample allowed to burn until the flames are out. A belt passes the BELT if, in three separate trials, there remains a portion of the 5-foot sample that is undamaged across its entire width. If, in any of the three trials, fire damage extends to the end of the sample, the conveyor belt formulation fails the test. Comparison testing showed excellent agreement for 19 of the belts between the pass/fail results of the large-scale fire gallery test and the BELT. The USBM concluded that conveyor belts that pass the BELT have improved fire resistance. MSHA (1999) determined that the introduction of more stringent BELT fire resistance requirement would not have a significant economic impact on the mining industry, including consideration of the impact on small mines and on small manufacturers. MSHA (1999) further concluded that "serious risk of fires in the belt entry will be reduced, as would the potential for disaster" if all belts used in underground mines were using conveyor belts that pass the BELT criteria.

This BELT was evaluated by Canadian and British investigators and found to produce results that are in agreement with methods used there. The Canadian evaluation found "good correlation with MSHA on a series of three rubber/fabric belts" (Mintz, 1993; Mintz, 1995) but that passing or failure of rubber/steel cord and PVC belts was dependent on belt thickness. This was a useful finding, suggesting that belt thickness be considered in the belt approval and use process. This test apparatus was also evaluated by investigators in the UK to test conveyor belting for flammability since a full-scale test facility in the UK had closed (Yardley et al., 2004). These investigators suggested that the BELT, with modified ignition geometry, serve as a substitute for its propane gallery test.

Based on the BELT, MSHA published its proposed rule in 1992 (MSHA, 1992). This notice of proposed rule-making was independent of any rule change concerned with using belt entries for face ventilation. MSHA's Belt Entry Ventilation Review (BEVR) concluded "Fire hazards to miners can be reduced by the use of improved belt materials. Additionally, belt entry fires can be prevented through belt maintenance, belt entry clean-up, and rock-dusting" (pg. 2) but did not recommend use of "improved belt materials," recommending instead, "Increased emphasis should be placed on belt maintenance, belt entry clean-up, and rock-dusting" (pg. 3). MSHA's Belt Air Advisory Committee (BAAC) concluded that ". . . current standards (i.e., 30 CFR § 18.65) and testing for conveyor belt material are inadequate" (pg. 74) then went on and "... strongly recommends that MSHA develop approval criteria for the following: conveyor belting installed in all underground coal mines ..." (pg. ii). They based this recommendation, in part, on the conclusion that improved fire-resistant conveyor belts, if used in all mines, would significantly reduce the risk of serious belt fires and that other effects (of air flow and fire sensing mechanisms) were "... second-order effects compared to the results that would be achieved through the use of fire-resistant conveyor belt material" (pg. 74). The Panel agrees. It is better to prevent fires than to limit attention to detecting and suppressing them.

But ten years after it proposed a rule to improve the flame-resistance of conveyor belting, MSHA withdrew it (MSHA, 2002) and did not address belt flammability testing in its belt air proposed rule (MSHA, 2003). The principal rationale for not proposing an improved test for belt flammability was that the frequency of belt fires had decreased. But this depends on how the numbers are interpreted. It is true that the *number* of belt fires had decreased over the past decade, but the *rate* (i.e., the number of fires per thousand mines) has remained constant, owing in part to high variability (Francart, 2006). During this same time period, however, underground coal production has increased so that the number of belt fires per 100 million tons has decreased, although there was high variability from year to year ($p = 0.02$, adjusted $R^2 = 0.19$).

The MSHA Belt Air Standard

MSHA's principal response to products of combustion going to the face when using the belt entry for face ventilation has been to require mine operators who use the belt entry for this purpose to use Atmospheric Monitoring Systems (AMS) (Mine Safety and Health Administration, 2004). Available devices can detect heat, smoke, and carbon monoxide. As discussed elsewhere in this report, the CO detector has emerged as the best detector. Early problems with false alarms have essentially been solved both by setting alert and alarm levels in relation to the ambient concentration of CO and by integrating devices to simultaneously discriminate CO in diesel exhaust from CO from a fire (by measuring the concentration of oxides of nitrogen which occur in diesel exhaust but not otherwise in mines)(Edwards et al., 2003; Edwards et al., 1999).

But what does the AMS system provide? The most basic protection provided by AMS systems is to give early warning of fires. By "early" we mean before a fire is detected by other means, e.g., by smell or sight. In principle, how "early" detection occurs can be measured in minutes, but to our knowledge, there are no estimates. MSHA reports on detection of 75 reportable fires in belt entries (i.e., at least 30 minutes from the time they were detected under 30 CFR Part 50 regulations), showed that in all circumstances when they were in use, the AMS systems detected the fire (MSHA, 2003). In contrast, when point-type heat sensors (PTHS) were in use, fires were often detected by sight or smell, illustrating one serious weakness of the PTHS-based systems. However, in 13 non-reportable fires using atmospheric monitoring systems, six were detected by sight or smell rather than by the AMS system (MSHA, 2003). This series is hardly a representative sample because reporting of non-reportable fires is voluntary, even though it was solicited. Nevertheless, it suggests that there are circumstances under which the AMS does not in fact provide warning before a fire is detected by sight or smell, i.e., it does not provide an *early* warning.[2]

There are no estimates, to our knowledge, of the duration or distribution of the time interval between detecting a fire by the atmospheric monitoring system or by sight or smell. It is likely to be highly variable because it depends on a person being in a position to smell the smoke (i.e., inby the fire), the sense of smell is highly variable between individuals, and smell is a wholly subjective test.

The atmospheric monitoring system provides, however, other advantages. In addition to early detection, AMS detectors are placed at set intervals along the belt entry making it possible to identify the location of a fire with greater precision than can a miner. And it is linked to a communications system making it possible to warn miners, to withdraw them from dangerous areas, and to coordinate fire control efforts. When a trained AMS operator reacts decisively to an early detection, additional time is gained both for escape and fire control. How much time is gained is not clear.

However objective, systematic, and comprehensive it is, the only improvement provided by an AMS is early warning of a fire. Smoke from a belt fire *will* contaminate the face, with or without the AMS. The mine operator and miners still have to find the fire, bring it under control, evacuate anybody who is inby, and decide whether to evacuate the mine. The atmospheric monitoring system does not *prevent* fires from occurring: it does not result in controlling combustible materials or sources of ignition, and it does not prevent the products of combustion from being conveyed to the face. And like all mine entries, belt entries will have an abundant supply of air.

One implication of this line of reasoning is that the reporting requirement should be changed so that *all* fires (from the moment they are detected) are reported. This would require development of objective and unambiguous criteria for determining what, in practice, constituted a "fire." If the duration of reported fires is included in the report, it would be possible to maintain continuity in data for fires that last more than thirty minutes, as was (until recently) required in the past (30 CFR § 50.20-5(a)). Now, reportable fires in underground mines are those that last more than ten minutes from discovery.

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[2] At the Aracoma fire, smoke and glowing embers were seen approximately nine minutes *before* the AMS system detected elevated levels of CO (Mine Safety and Health Administration, 2007, pp. 10-11). In that situation, the AMS system failed to provide "early" fire detection.

Fire Resistance Standards in Other Countries

Testimony and the documentation provided to the Panel demonstrate that there are a number of different standards and tests required for mine conveyor belts in the majority of other coal-producing countries. Manufacturers have adapted their product lines to meet specific belt designs that adhere to the relevant standards and tests specific to the country where the belt is sold. The following table (Küsel, 2007) notes different types of tests and whether or not these types of tests are used in the countries noted.

Test	China	USA	India	Australia	Europe	South Africa	Russia
Drum Friction	yes	no	yes	yes	yes	yes	yes
Propane Grate Burner	yes	no	yes	yes	yes	no	yes
High-Energy Propane Burner	yes	no	no	no	yes	no	no
Large Scale Gallery	no	no	no	no	yes	no	no
Laboratory Scale Gallery	no	proposed	no	no	yes	no	yes
Bunsen/Spirit Burner	yes	yes	yes	yes	yes	yes	yes
Surface Resistance	yes	no	yes	yes	yes	yes	yes
Toxicity	no	no	no	no	yes	no	yes
Oxygen Index	no	no	no	yes	yes	no	yes

It is obvious from the comparison that the requirements for belt fire resistance in the United States are among the lowest in the world with only a small-scale Bunsen burner laboratory test required.

All other countries require a drum friction test and most countries also require a larger-scale propane grate burner test. A large-scale gallery test is only required in Europe but a laboratory-scale gallery test is required in both Europe and Russia. This test is similar to the BELT developed in the United States.

Considering the foregoing discussion of conveyor belt fires, the potential impact in belt air mines, and the inadequacy of current U.S. standards and testing compared with most other major coal producing countries, the Technical Study Panel strongly recommends that MSHA move immediately to revise 30 CFR § 18.65 to include the BELT either as a regulation under part 18 or as a separate regulation section. This would significantly reduce the frequency and hazard of conveyor belt fires in all

U.S. underground coal mines, not just those that use belt air to ventilate working faces.

Conclusion

All members of the Panel affirmed the recommendation.

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RECOMMENDATION NUMBER 2 - Other Belt Tests

The Technical Study Panel recommends that MSHA adopt a drum friction test to be utilized for a period of two years to evaluate and assess the contribution to conveyor belt fire safety of such a test. Continuance of this test would be based on the MSHA evaluation at the end of this time period.

Discussion

Frictional ignitions are a common source of belt fires, accounting for approximately 20% of all belt fires. Therefore, it is appropriate to test belts specifically for this type of ignition potential, as is done in most other coal-mining countries.

Drum Friction Tests

Drum Friction Tests for conveyor belts are widely-used tests that simulates a belt slipping over a jammed pulley or a pulley rotating under a stationary belt. Friction creates large amounts of heat which the belt has to dissipate. The test is passed if the belt surface temperature remains below a certain temperature and no flame or glow is visible. Unlike the proposed BELT, which gages the resistance of a belt to propagate flame, the drum friction test purports to measure the affinity for a belt to self ignite or ignite other materials in the frictional setting described above. In the U.S. in 1955, a drum friction test was included, along with a flame test, under Schedule 28 for the acceptance of fire resistant conveyor belts. However, a drum friction test was not included when Schedule 28 was consolidated into Schedule 2G (Title 30, Code of Federal Regulations, Part 18) and approved on March 19, 1968. Apparently, there were issues with the U.S. drum friction test (Verakis, 2007). However, other countries have developed drum friction tests in the interim which, along with their experiences, may provide a template for adopting a drum friction test methodology and procedures that would address past issues. The Panel is recommending that that a drum friction test be assessed to determine if it could complement the recommended BELT method. These two tests evaluate different belt properties: the flame gallery test presumes belt ignition (indeed, it causes ignition) and evaluates the degree and extent of flame propagation, while the drum friction test evaluates a belt's ignitability from friction. Frictional ignition depends on belt surface properties (related to friction) and its ability to dissipate heat, among others. Given the frequency of frictional ignition (e.g., the Aracoma fire), belts should be tested specifically for this feature.

The Panel feels that the main objective of a fire resistant belt is to ensure that a belt would not ignite from frictional heating or other heat source and that if ignited, an existing fire would not be propagated by the belt itself irrespective of the original source of the heating. The BELT exposes the belt to a gas flame which is turned off after the end of the belt has been lit to demonstrate that the flames will extinguish quickly and would not propagate along the belt with the original heat source removed. The drum friction test would test whether the belt would ignite having been subjected to frictional heating.

Other Conveyor Belt Tests

The Propane Burner Test (EN 12881 et al.) is a large-scale test that also demonstrates whether conveyor belts propagate fire. For this test, a belt specimen (1.5 - 2.5 m long x 1200 mm wide) is ignited by a propane burner. After the ignition source has been removed, the flames must self-extinguish and a defined undamaged length must remain. These test conditions are similar to those used by USBM (NIOSH) for their full-scale belt flammability test. The belt sample size lies between that for a full scale (10 m long) and the BELT (1.67 m).

The Laboratory Scale Gallery Test (DIN 22100 and 22118) subjects a 1200 mm long x 120 mm wide belt specimen is placed over a propane burner. Very similar to the BELT, after the ignition source has been removed, the flames must self-extinguish and a defined undamaged length must remain.

A number of other countries also use some type of static electricity test. These were also examined and considered by the Panel. However, no evidence has been shown in U.S. mines that conveyor belts pose an electrostatic hazard.[i]
All of the above tests seem to be adequate gages of belt fire resistance, however, the Panel feels that the correlation between the BELT and the full scale gallery tests performed by the USBM is evidence that the BELT laboratory scale gallery test, along with a drum friction test, will sufficiently determine whether a belt is fire-resistant for use in U.S. underground coal mines.

Conclusion

All members of the Panel affirmed the recommendation.

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RECOMMENDATION NUMBER 3 – IMPROVED FIRE RESISTANCE STANDARDS FOR ALL UNDERGROUND COAL MINES

The Panel feels strongly that the conveyor belt flame-resistance testing and standards recommendation in this report for mines that course belt air to the working section shall also be extended by MSHA to <u>all</u> underground U.S. coal mines.

<u>Discussion</u>

It is obvious from the previous discussion of conveyor belt flame resistance by the Panel and from the testimony and facts presented to the Panel that current U.S. conveyor belt flame-resistance testing and standards are inadequate to correctly determine the full-scale fire resistance of conveyor belt and below global mining conveyor belt flame-resistance testing and standards. Therefore, it is only reasonable that all U.S. underground coal miners should be afforded the same measure of conveyor belt fire safety as that recommended for belt air mines.

Improving the fire resistance of belt material such that the belt passes the BELT is an important step towards preventing belt fires at all mines, not just those that direct belt air towards the working section. Permitting belts of less flame-resistant properties in mines that ventilate belt air outby would miss an important opportunity to prevent belt fires in the first place.

Allowing belts of different types in the same mine depending on whether the belt air flows toward the face or away from the face would be confusing and unmanageable from a logistics and maintenance perspective.

<u>Conclusion</u>

All members of the Panel affirmed the recommendation.

RECOMMENDATION NUMBER 4 – COORDINATING BELT TESTING WITH OTHER COUNTRIES

The Panel recommends that those in MSHA who perform or are involved in belt fire resistance testing and approval establish contacts and maintain dialogue with their counterparts in other key mining countries.

Discussion

The Panel contemplated a recommendation in this area to recommend strong coordination with global mining conveyor belt testing and standards. However, noting that the European Community has not been able to accomplish this given the impetus to do so that they have, the Panel did not believe a meaningful, practical recommendation could be made. The Panel acknowledges that this is and always has been done to some degree by MSHA, but by this recommendation would like to ensure regular discourse and exchange regarding conveyor belt testing, acceptance, and fire experience with other key mining countries.

Conclusion

All members of the Panel affirmed the recommendation.

RECOMMENDATION NUMBER 5 – BELT ENTRY AND CONVEYOR BELT MAINTENANCE

The Technical Study Panel strongly recommends that the Federal Mine Safety and Health Administration (MSHA) rigorously enforce existing standards on underground conveyor belt maintenance and fire protection. The Panel anticipates that rigorous enforcement by MSHA will result in more consistent compliance by all operators to these standards. This applies especially with regard to the availability and functionality of belt fire suppression systems; the availability and proper working order of firefighting equipment; the function of smoke, carbon monoxide and other sensors and alarm systems designed to detect fires in belt entries; and the training of mine personnel for fighting mine fires, such as conveyor belts. This also applies to the other conveyor belt fire prevention and maintenance items noted in the discussion section.

MSHA should pay particular attention to required examinations of the belt lines by mine examiners and ensure (1) each belt line is kept in good working order at all times to prevent belts from rubbing stands, (2) damaged rollers are replaced immediately, (3) belt lines are adequately rock dusted, and (4) flammable materials such as fine coal, coal dust, oil, grease and trash are not permitted to accumulate along belt lines.

<u>Discussion</u>

Prevention of belt fires is a critical element in improving miners' safety. Proper belt maintenance and regular inspections will reduce the likelihood for fires due to bad rollers, poor belt alignment and other malfunctions.

The Aracoma fire in 2006 (MSHA, 2007) "occurred as a result of frictional heating when the longwall belt became misaligned in the 9 Headgate longwall belt takeup storage unit. This frictional heating ignited accumulated combustible materials." Root causes for this fire were, among others, neglect in belt maintenance in that "the mine operator failed to maintain the 9 Headgate longwall belt in a safe operating condition and did not remove it from service as required." Furthermore, "mine examiners did not identify existing hazardous conditions."

The Panel stresses the need for adequate visual inspection by walking all belt lines as required in 30 CFR § 75.362 (2)(b) "During each shift that coal is produced, a certified person shall examine for hazardous conditions along each belt conveyor haulageway where a belt conveyor is operated."

Examiners must ensure that the belt is properly aligned and trained to prevent frictional heating where the belt rubs against stands or other structure elements. The need to ensure proper alignment is amply illustrated in the Aracoma fire. The underlying question is why neither the operator nor the MSHA inspectors took the required action to fix the misaligned belt before the fire. This is not a subtle or obscure problem and the belt was known to be misaligned before the fire.

Damaged rollers must be identified so that they can be replaced as soon as possible before the damage leads to frictional heating that can result in a fire.
No accumulations of combustible materials such as coal, oil, grease or trash can be permitted. Operators should use flame-resistant grease and other lubricants.

Fire detection and suppression systems and equipment must be tested in accordance with 30 CFR §§ 75.1101 and 75.1103, and MSHA PPL No. P06-V-5.

Conclusion

All members of the Panel affirmed the recommendation.

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RECOMMENDATION NUMBER 6 - SPECIAL REQUIREMENTS FOR THE USE OF BELT AIR

The Panel recommends that the mines using belt air on a working section must be held to a higher standard that involves use of (1) an atmospheric monitoring system (AMS) and suitable monitoring instruments, (2) belt materials that meet the BELT and other test standards recommended by this Panel, and (3) more vigorous inspection procedures by MSHA inspectors. In addition, we recommend that the BELT and other test standards recommended by this Panel be applied to all belt conveyors used in underground coal mines.

<u>Discussion</u>

The possible use of belt ventilation air in a working section has been an important consideration in the U.S. coal industry for several decades. A number of technical studies have previously been completed studying safety issues surrounding the use of belt air in a working section. The Belt Air Ventilation Review completed by MSHA personnel (MSHA, 1989) was the first comprehensive review of this concept. This was followed a few years later by the review of the Belt Air Advisory Committee (Belt Air Advisory Committee, 1992). In each case, the concept of using belt air in the working section was considered to be sound in some situations. However, both reports specified that where belt air is used in the working section, extra measures need to be implemented to better protect the workers in case a fire would occur in the belt entry. The primary requirement was that an atmospheric monitoring system (AMS) would be implemented in each mine to detect the existence of a fire or other CO-producing conditions.

Initially, the belt air could be used in a working section only after the mine petitioned MSHA and presented arguments that indicated their belief that the miners would be safer using the belt air. After a number of years of using this plan, new rules were adopted in 2004 (MSHA, 2004) that permitted mines with three or more entries to use belt air in the working section without going through the petition process.

A close review of the safety statistics for belt air usage shows that quite a few fires have occurred in belt conveyor entries over the years. Based on MSHA data, the number of conveyor belt reportable fires between 1980 and 2006 was 65 with frictional heating, flame cutting and welding, and electrical malfunctions being the primary causes (Lazzara, 2007). Three deaths over that time period were associated with belt fires. The first occurred in 1986 at the Florence No. 1 Mine. In that belt fire, a miner died of a heart attack while fighting the belt fire. In 2006, the belt fire at the Aracoma Coal Company Alma Mine No. 1 resulted in the deaths of two miners. The belt air at the Alma Mine No. 1 was used in the working section, but the primary causes of the two deaths were a variety of other failures, not the fact that belt air was used in the working section (MSHA, 2007). The Technical Study Panel concludes that belt fires are a significant hazard and that belt air cannot be readily used in the working section without proper design of the ventilation system and careful monitoring of the belts.

The Technical Study Panel recognizes that a valid argument for the use of belt air in the working sections in coal mines can be made in a number of specific mining situations that occur in U.S. underground coal mines. The first of these situations is in western coal mining operations where deep cover and bump-prone coal seams are being mined. In these mines, the coals are often extracted by longwalls where the geologic and rock mechanics problems make it difficult to mine the coal using more than two entries in the headgate and tailgate entry systems. These difficult conditions and the amounts of methane gas encountered at the working faces make the mining process more dangerous without using belt air at the face because three entries (instead of two) would ordinarily be required to supply sufficient ventilation air to the face. Under these conditions, bumps and roof control problems in the headgate entries, at the working face, and in the tailgate entries would most assuredly be more hazardous to miners on the section than the possible hazards added due to use of belt air at the face. This conclusion assumes that the belt air is properly monitored and that mine management is dedicated to keeping the ventilation and AMS working as designed.

The second situation where belt air usage in the working section is deemed to be justifiable is in the deeper high-methane mines found in some of the eastern states. These mines have methane emission rates that challenge the ventilation systems even after more than half of the in-seam methane has been removed via degasification techniques. In these mines, the added ventilation air provided by the belt entry most likely reduces the overall hazards of mining operation. Once again, the mining company must be held to a higher standard of safety if the use of belt air in the working section is to be safer than not using the belt air.

In mines outside these two categories, it is not always obvious that belt air should be used. The reason for this conclusion is very simple. The use of belt air in the working section enables combustion products produced by fires or explosions in the belt conveyor entry to reach the working section. If using belt air in the working section does not eliminate or reduce other conditions deemed to be more hazardous, there is no justification for using belt air in the working section. The Technical Study Panel therefore suggests that the process for granting permission to use belt air in the working section become part of the ventilation plan review. In addition, the Panel recommends that the MSHA District Manager be charged with the responsibility of carefully scrutinizing each plan for use of belt air in the working section and denying those that do not have evidence of a safer mining environment than not using belt air at the face. In addition, the Technical Study Panel recommends that the District Manager be charged with delivering a decision on the ventilation plan within six months.

In summary, the Technical Study Panel concludes that the use of belt air in the working section must be associated only with mines where using belt air is safer than not using belt air in the working section and where higher standards of safety are applied when using belt air.

Conclusion

All members of the Panel affirmed the recommendation.

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RECOMMENDATION NUMBER 7 - BELT AIR APPROVAL RECOMMENDATION

The Panel recommends that MSHA evaluate the safety of the use of belt air coursed to the working face as part of the approval of the mine ventilation plan. The District Manager must take special care to evaluate whether the belt air can be routed to the working face in a manner that is safe for all miners involved.

Discussion

The Technical Study Panel recognizes that the conditional use of belt entry air in the working sections in underground coal mines in the United States has been a very helpful practice in certain coal regions where coal would not be able to be safely and easily mined without using belt entry air in the working section.

Initially, the belt entry air could be used in a working section only after the mine petitioned MSHA for approval. MSHA's approval was granted only after it was determined that the alternate method guaranteed no less than the same degree of protection afforded by the standard ventilation method, or that application of the existing standard will not result in a diminution of safety for miners. After over 20 years of using this process, new rules were adopted in 2004 (MSHA, 2004) that permitted longwall mines with three or more entries to use belt air in the working section without going through the petition process. However, the Panel is convinced that not all mines with three-entry longwalls are safer when using belt entry air in the working section. Unless some significant hazards are avoided by using belt entry air at the working face, the safety of the miners may be diminished rather than improved.

The Panel recognizes that a valid argument for using belt entry air in the working section can be made in at least two specific situations: (1) in western United States longwall mining operations where deep overburden and bump-prone coal seams require that the number of gateroad entries be minimized to significantly reduce the possibility of bumps, and (2) in deep, high-methane mines in the eastern United States coal fields where, even after systematic methane drainage, methane is still too high for mining operations to be both efficient and safe. The first of these situations involves reducing the hazard of coal bumps in the working sections. If the added hazard of using belt entry air in the working sections is demonstrably less than the hazards of coal bumps in the working section, then the use of belt entry air at the face is justifiable. The second situation is again justifiable only if the hazards of using belt entry air in the working sections are less than the added hazards of methane occurrences when not using belt entry air at the working sections. This conclusion assumes that the belt air is properly monitored and AMS properly installed. In these two situations, the added belt entry air would most likely reduce the overall hazards and provide a higher standard of safety.

A close examination of some of the belt air petitions provided to the Panel indicates that, after over a period of 20 years, the belt air petitioning application has become a routine process providing only general statements and requests without specific convincing justifications for using belt air. The Panel concludes that there is a considerable sense that the relaxed practice of allowing belt air usage in the working section is often failing to provide the same degree of protection as a ventilation system that does not use belt entry air in the working section. It appears that in some mines the 2004 rule may result in a diminution of safety in these coal mines. The Panel recommends that any plan for the use of belt entry air in coal mine working sections be considered as part of the ventilation plan approval. The District Manager should be charged with the responsibility of ensuring that the belt air used in the working sections provides no less than the same degree of protection as the alternative of not using belt entry air in the working section. The Panel felt that a District Manager with technical and mining expertise would be better able to judge the merit of belt air usage than an Administrative Law Judge who knows the law but does not know how to ventilate a mine.

Conclusion

All members of the Panel affirmed the recommendation.

References

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Technical Study Panel. (2007). Special Requirements for the Use of Belt Air (see Recommendation 6).

RECOMMENDATION NUMBER 8 – DISCONTINUING POINT-TYPE HEAT SENSORS

Except as stated below, the Panel recommends that MSHA initiate rulemaking that would discontinue the use of point- type heat sensors currently required under 30 CFR § 75.1103-4(a)(1) for early warning and detection of conveyor belt fires in U.S. underground coal mines. The Panel does not recommend discontinuing the use of point-type heat sensors for activation of belt fire suppression systems.

Discussion

The Panel was requested in opening remarks by Richard Stickler, Assistant Secretary, MSHA, to provide their thoughts on the use of Atmospheric Monitoring Systems, or AMS, instead of point-type heat sensors for conveyor belt fire detection. Even a cursory technical review of point-type heat sensors by the Panel revealed their inherent inadequacies for early warning and reliable belt fire detection; e.g. the amount of heat required to activate the sensor (stage of fire), and the possible location relative to fire location (at 125-ft spacing). Also a body of research performed comparing fire detection capabilities using AMS type sensors for conveyor belt fire detection (such as CO sensors) versus the traditional point-type heat sensors have consistently shown the superiority of the AMS sensors over point-type heat sensors; see for example USBM RI's 9412 (Conti and Litton 1992) and 9572 (Conti and Litton 1995) . In addition, general coal mining industry experience with the various belt fire detection sensors has demonstrated the superiority of the AMS type sensors over point-type heat sensors. The Panel does not recommend discontinuing the use of point type for activation of belt fire suppression systems.

While in belt air mines the requirement for AMS systems dictates the use of these types of sensors for conveyor belt fire detection, it is obvious to the Panel that the enhanced safety improvement that these systems bring to those mines should be a requirement for all U.S. underground coal mines. The Panel believes that the record is clear that the use of the less-effective point-type sensors should have already been discontinued in favor of the more reliable and earlier warning detection afforded by AMS based sensors. The Panel also notes that requiring the use of AMS systems for conveyor belt fire detection would greatly facilitate the use of these systems for other coal mine safety enhancements.

Conclusion

All members of the Panel affirmed the recommendation.

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RECOMMENDATION NUMBER 9 – SMOKE SENSORS

The Panel recommends that MSHA consider rulemaking that would require the use of smoke sensors, in addition to CO sensors, in mines that use belt air on the working section, to provide for earlier warning and possibly more reliable detection of conveyor belt fires in these mines. MSHA should also consider rulemaking to revise 30 CFR §§ 75.1100-1103, Fire Protection, which was promulgated in 1972, in order to take advantage of advances that have occurred in fire detection and fire prevention technology.

Discussion

The Panel heard presentations regarding fire detection and the early warning of conveyor belt fires. This generated considerable discussion regarding reliable fire detection and the need for as early warning of these events - even in the incipient stage - as possible. A considerable body of research has shown that smoke sensors can be more sensitive to the early detection of mine fires than the CO sensors currently used in most AMS systems (see the first seven references below). The advantages of smoke sensors over CO sensors for early warning is partly due to the origins/mode of the conveyor belt heating/fire and the materials involved, e.g. producing significant smoke but little CO. It is obvious that multiple sensor types, used in combination, could provide earlier and more reliable detection. Given the concern for these goals in belt air mines, MSHA should consider requiring the use of smoke sensors in addition to CO sensors at three locations on belt lines directing belt air to the face:

(1) not more than 100 feet downwind of each belt drive unit, each tailpiece transfer point, and each belt take-up. If the belt drive, tailpiece, and/or take-up for a single transfer point are installed together in the same air course they may be monitored with one sensor located not more than 100 feet downwind of the last component;

(2) at or near the mid-point of the belt line; and

(3) at or near the working section belt tailpiece in the air stream ventilating the belt entry. In longwall mining systems the sensor must be located upwind in the belt entry at a distance no greater than 150 feet from the mixing point where intake air is mixed with the belt air at or near the tailpiece.

The Panel recognizes that the use of smoke sensors has been limited in coal mining applications due to:

(1) the rigorous environment in which they would be used, e.g. changing and high humidity, dusts, rock dusting, etc., and

(2) the response and susceptibility of the sensor due to the environment with conditions depending upon the smoke sensor type - for example, ionization or optical based.

As a result, reliability and maintenance issues have been problematic with previous smoke sensors evaluated in coal mines, especially along conveyor belt entries. However, NIOSH testified that they are currently evaluating newer, commercial smoke sensors that are being used in other harsh industrial environments that have the potential to better address past reliability and service life issues. Other smoke sensors under development with an eye toward improved functionality in the underground environment may also be available in a reasonable time frame. As a result, the Panel recommends that MSHA require the use of smoke sensors as part of the AMS installed along conveyor belts in mines where belt air is coursed to the working face with some delayed effective date to permit in-mine evaluation of the newest generation of smoke sensors. MSHA could include a phased implementation date to permit in-mine evaluation of the newest generation of smoke sensors. The Panel also recognizes that mandating the use of smoke sensors will create a small, but needed, market to encourage commercial development of coal mine-worthy smoke sensors which could ultimately upgrade coal mine fire protection systems in the future.

The Panel recommends modifying the existing requirement for AMS usage to include smoke sensors as well as CO sensors under 30 CFR § 75.351(c)(2). Also, we recommend that 30 CFR § 75.351(d)(2) and (e) that currently only require the use of either CO or smoke sensors be modified to require the use of both CO and smoke sensors. In addition, this Panel strongly recommends that MSHA undertake rulemaking to revise Subpart L of 30 CFR on Fire Protection given the enormous technological advances in fire detection and fire prevention technology that have occurred since this Subpart was promulgated 35 years ago in 1972.

<u>Conclusion</u>

All members of the Panel affirmed the recommendation.

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[1]Transcript June 21, 2007. Technical Study Panel Meeting, Birmingham, AL, Dave Litton, NIOSH.

RECOMMENDATION NUMBER 10 – USE OF DIESEL DISCRIMINATING SENSORS

The Panel recommends that MSHA perform regular, periodic reviews of the AMS records required by 30 CFR. § 75.351(o) at mines using belt air to ventilate working sections. During these reviews at mines that also use diesel equipment, MSHA should evaluate the number of occurrences of false alarms due to diesel exhaust. In those instances where such false alarms are excessive, MSHA should require the use of a system of diesel discriminating sensors.

Discussion

The Panel is aware that historically one of the problems in using a CO-based AMS is the occurrence of false alarms (i.e. not a real fire). The Panel is also aware that an excessive number of false alarms can be detrimental to mine safety in that miners can become complacent to alarms and not respond appropriately when an alarm actually requires quick reaction. Presentations and references provided to the Panel strongly indicate that technological advances in these systems since their introduction in underground coal mines have greatly reduced the occurrence of false alarms. However, information presented was unclear as to the occurrence of false alarms at underground mines that utilize diesel equipment that may or may not use diesel discriminating sensors as part of their AMS. Therefore, the Panel recommends that MSHA conduct regular, periodic reviews of the AMS records required by 30 CFR § 75.351(o) at mines using belt air to ventilate working sections. One of the objectives of the record review should be to note the number and source of false alarms. During these reviews at mines that also use diesel equipment, MSHA should note the number of occurrences of false alarms due to diesel exhaust interaction. In those instances where such false alarms are excessive, MSHA should require the use of diesel discriminating sensors, as part of the AMS. Requiring the use of diesel discriminating sensors at diesel mines, where the diesel interference results in excessive alarms, should result in the development of improved AMS system capabilities that minimize this common reason for false alarms.

Conclusion

All members of the Panel affirmed the recommendation.

[1] Francart, W. (2003). MSHA Survey- Atmospheric Monitoring Systems in U.S. Underground Coal Mines. Preprint 05-27. SME Annual Mtg., Feb. 28-Mar. 2, 2005, Salt Lake City, Utah, 5 pages.

RECOMMENDATION NUMBER 11 – REVIEW OF AMS RECORDS

The Panel recommends that MSHA perform regular, periodic reviews of the AMS records required by 30 CFR § 75.351(o) at mines using belt air to ventilate working sections. During these reviews, MSHA should evaluate the number of false alarms due to sensor or system malfunction or due to other gases such as hydrogen that may affect the function of carbon monoxide sensors. In those instances where such false alarms are excessive, MSHA shall require appropriate steps to improve system maintenance and durability and, as needed, installation of sensors that are not subject to influence from other gases.

<u>**Discussion**</u>

Similar to the discussion following Recommendation 10, it is important that both the mine operator and MSHA review the AMS records for false alarms and other system malfunctions. For example, if the ambient CO reading in a mine is 3 parts per million (ppm), a reading of zero ppm is equally indicative of a malfunction as a false alert of 9 ppm. Both conditions must be addressed by proper system maintenance, calibration and testing, and malfunctioning sensors must be replaced as soon as possible to ensure continuing protection by the AMS.

The Panel suggests that the review of AMS records for false alarms be conducted at least quarterly, concurrent with regular MSHA inspections.

Critical reviews of AMS records fulfill an important surveillance function as they indicate trends of both improving and worsening system information quality and document to both the mine operator and MSHA how well the system is being maintained.

The Panel is aware that an excessive number of false alarms can be detrimental to mine safety in that miners can become complacent to alarms and not respond appropriately when an alarm actually requires quick reaction. Presentations and references provided to the Panel indicate that technological advances in these systems since their introduction in underground coal mines have greatly reduced the occurrence of false alarms.

As indicated by Francart (2003), certain types of sensors produce cross sensitivities to the presence of other gases such as hydrogen, leading to false indications of the gas concentration that is to be measured. Also, AMS systems are complex in nature and require maintenance through specially trained personnel.

Therefore, the Panel recommends that MSHA conduct regular, periodic reviews of the AMS records required by 30 CFR § 75.351 (o) at mines using belt air to ventilate working sections. One of the objectives of the record review should be to note the number and source of false alarms. MSHA inspectors should require mine operators to tune, calibrate and maintain their AMS systems properly in order to reduce the number of false alarms to an acceptable minimum. This also includes appropriate communication between maintenance personnel, the AMS operator and mine personnel to create awareness about maintenance and testing operations performed on the AMS, such that alarms intentionally set off during calibration and testing are not misinterpreted as real alarms.

Conclusion

All members of the Panel affirmed the recommendation.

[1] Francart, W. (2003). MSHA Survey- Atmospheric Monitoring Systems in U.S. Underground Coal Mines. Preprint 05-27. SME Annual Mtg., Feb. 28-Mar. 2, 2005, Salt Lake City, Utah, 5 pages.

RECOMMENDATION NUMBER 12 - AMS OPERATOR TRAINING CERTIFICATION

The Panel recommends that MSHA commence rulemaking that would require the qualification and certification of AMS operators as defined by 30 CFR § 75.301. The highest priority of the AMS operator is operating the AMS.

Discussion

The Panel reviewed some of the recent mine emergency events involving AMS operations (most notably the Aracoma mine fire event of early 2006). One aspect that stood out in many of these events was the critical actions (or non-actions) of the AMS operator. In some cases, mine operators may also assign the AMS operator to be the "Responsible Person" required to take charge during mine emergencies under 30 CFR § 75.1501 – Emergency evacuations. In general, AMS operators involved in emergencies discussed during the TSP meetings and in accident investigation reports reviewed by the Panelists have not had sufficient training to unequivocally handle mine emergencies that occurred. The Panel believes that it is imperative that the AMS operator have the background, experience, training, and authority to ensure that proper actions are taken in response to all AMS signals, including alerts, alarms, and malfunctions to provide the utmost assurance of safety of all affected miners. AMS operator duties and responsibilities are contained in 30 CFR § 75.351-Atmospheric monitoring systems and 30 CFR § 75.352 -Actions in response to AMS malfunction, alert, or alarm signals. Specifically, AMS operator training requirements are contained in 30 CFR § 75.351(q) - Training. It requires that "All AMS operators must be trained annually in the proper operation of the AMS. A record of the content of training, the person conducting the training, and the date the training was conducted, must be maintained at the mine for at least one year by the mine operator." The Panel concludes that there is no system in place to ensure that the AMS operator understands and retains the training elements to appropriately react to situations that may impact miner safety. In addition, there are no minimum qualifications, knowledge, or experience required to perform these duties. The training of the AMS operators is critical, especially if the AMS operator is not the responsible person under 30 CFR § 75.1501 and there is a delay in establishing contact with the responsible person, as happened during the Sago mine explosion. Thus, MSHA should establish a plan for training, certification, and re-certification of all AMS operators.

The Panel notes that in the history of coal mine health and safety there is an established system of certification/qualification for miners directing or performing duties that directly relate to their safety or the safety of others, as required by existing 30 CFR § 75.100 – Certified person. This is true of mine foremen, assistant foremen, mine examiners, shot firers, machine runners, and the miners themselves.

This certification/qualification has generally been handled by some governmental agency charged with or involved in coal mine safety. Therefore, the Panel feels it only stands to reason that some governmental agency should in some manner certify that AMS operators, who have such a key role in maintaining miner safety, have the basic qualifications and knowledge to perform their duties and responsibilities. The Panel also notes that the same might be said for the responsible person required in 30 CFR § 75.1501. In addition to the training the AMS operator receives on the proper operation of the AMS system and the requirements contained in 30 CFR relating to AMS systems, the Panel would also recommend that for those AMS operators, who do not spend some days underground, that MSHA require that at least a day be spent on a semi-annual basis by such AMS operators to familiarize themselves with the physical underground mine environment, as well as the particular mine infrastructure installations and mining practices.

During field trips by Panel members, issues were raised regarding AMS operators concerning the length of their work day, i.e., long shifts, and the number and type of other job duties assigned to them not related to the AMS system. This resulted in a number of discussions among panel members and questions to Panel meeting presenters regarding these topics. Given the individuality and variance of these issues among coal mining operations, the Panel could not determine specific recommendations to address these possible concerns. However, the Panel concluded that it should be clear, given the key safety role of the AMS operator, that the highest priority of the AMS operator is operating the AMS.

Conclusion

All members of the Panel affirmed the recommendation.

RECOMMENDATION NUMBER 13 - MINIMUM AND MAXIMUM AIR VELOCITIES

Minimum Air Velocity: In mines using AMS as a condition for using the belt entry to ventilate working sections, the minimum air velocity in the belt entry should be 100 feet per minute (fpm).

Maximum Air Velocity: In mines using AMS as a condition for using the belt entry to ventilate working places, the maximum air velocity should be 1,000 feet per minute (fpm).

The District Manager may approve exceptions to the minimum and maximum air velocity recommendations in the mine ventilation plan.

Discussion

The main issues considered for establishing a minimum air velocity of 100 fpm are: (1) the transport time for products of combustion to reach the CO or smoke sensors, (2) the possibility of methane layering near the roof in gassy mines, and (3) the loss of visibility due to fog formation within the belt entry.

Since the main objective of having an AMS is to detect fires and methane, there should be a minimum air velocity to transport the products of combustion from the fire source to the sensor. If the air is not moving at this minimum velocity and in the direction intended, then detecting the fire will be delayed. Further, due to the buoyancy force, there is a strong propensity for the layering of methane and smoke at low air velocities.

In gassy mine airways with low air velocities, methane layering can also be a major concern. Methane, due to its low specific gravity (0.55 in relation to air) may accumulate at or near the roof of an entry at low air velocities to the point that it may reach explosive levels. The problem has been investigated by numerous authors and all of whom suggested that it can be prevented by considering a suitable Layering Number in the ventilation system design (McPherson, 1993; Hartman et al., 1997). This number combines the effects of three variables: methane emission rate, air velocity and width of an airway. For horizontal openings, this layering number should be equal to 5 (Bakke and Leach, 1962). In nearly all cases, the methane emitted from the coal on the belt conveyor would be mixed by the ventilation air and the belt movement and thus will not layer. However, methane originating from roof fissures or other high-methane sources may be a problem in the conveyor entry. While the 100 fpm recommendation is primarily for CO detection purposes, the additional velocity will also help ensure that the methane will not layer.

In deep underground mines (with cover depths greater than 2,500 ft) heat becomes an important factor in determining the ventilation needs. In openings with low air velocities and suspended dust particles, the strata heat may excite the water molecules and cause fogging (a safety hazard for belt maintenance workers due to frequent occurrences of poor visibility). This problem is magnified in belt entries with various sources of dust. The problem can be overcome by maintaining the air velocity in the belt entry equal to or greater than 100 fpm. At higher air velocities both evaporation and mixing of fog droplets will take place, thus helping to dissipate the fog (Gillies and Schimmel, 1983).

The main reason for establishing a maximum velocity of 1,000 fpm is the physical discomfort created by the dust particles to the mine personnel and the added possibility of re-entrainment of dust from the moving belt (McPherson, 1993). Excessive air velocities will entrain settled dust and transport it for long distances within an airway. In belt entries with several sources of dust (stage crusher, transfer points, etc.), the distance over which these particles are carried by the air stream depends on the air velocity and the aspect ratio of the particles. Coal dust particles of larger aspect ratio will remain suspended in the air at high velocities. When this air is used to ventilate working sections, it will increase the dust concentration and cause discomfort among the workers (see Recommendation 17).

Another reason for limiting the maximum air velocity to 1000 fpm is the fact that when the belt entry is used to ventilate a working section, it is likely that the conveyor belt and the air current will be moving in opposite directions in the belt entry. This will increase the relative velocity of the air (sum of air velocity and belt velocity). This increased velocity will result in a greater entrainment of dust particles. It will also increase the concentration of respirable dust and may require limitations to prevent exposure to excess levels of respirable dust (see Recommendation 17). This effect can be reduced but not eliminated by establishing this maximum air velocity.

Increasing air velocity in the belt entry not only reduces the transport time from a CO source to the AMS sensor, it also dilutes the concentration of the CO. This requires lower alert and alarm levels in the AMS in order to get the same level of sensitivity to detecting a fire in the entry. If the mine operator intends to implement an air velocity above 1000 fpm in a belt entry where the air is coursed to a working section, the Panel recommends that the operator should still be required to get approval in the mine ventilation plan as currently required (30 CFR § 75.350 (a)(2)).

Increasing air velocity in the belt entry not only reduces transport time from a source of CO to the AMS, it also dilutes the concentration of CO. This requires lower alert and alarm levels in the AMS in order to get the same level of sensitivity to detecting a fire in the entry.

While the Panel wishes to limit the minimum and maximum air velocity on the belt conveyor where belt air is used in the working section, the Panel also recognizes that the maximum and minimum velocity recommended here may present some problems in certain areas of a coal mine. Specifically, we note that the minimum velocity may be hard to achieve in the outby air split near a point-feed regulator. In addition, the maximum air velocity can be exceeded where the air meets a partial obstruction like an airway constriction at an overcast or undercast. The Panel therefore recommends that the District Manager be granted the authority to approve exceptions to the minimum and maximum velocities in these two areas and other specific areas if the mine conditions warrant the exceptions and if the exceptions each apply to a limited region of the mine.

Conclusion

All members of the Panel affirmed the recommendation.

References

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RECOMMENDATION NUMBER 14 – ESCAPEWAYS AND LEAKAGE

Primary escapeways should be designed, constructed, and maintained in accordance with the provisions of 30 CFR § 75.333 (b)-(d) to minimize the air leakage.

Primary escapeways should be ventilated with intake air preferably and, to the extent possible, the primary escapeway should have a higher pressure than the belt entry.

Discussion

Primary and alternate escapeways should be designed and constructed to protect the integrity of the mine atmosphere in these airways. They should be located to follow the most direct safe route from a working section or panel to the surface. These escapeways should be effectively separated from each other and from other entries by permanent stoppings, doors and overcasts. Although these are physically separated from each other by means of stoppings and doors, the committee felt that the two escapeways may be side-by-side if the stoppings are adequately designed and maintained.

Both primary and alternate escapeways should be maintained in travelable and safe conditions at all times. They should be kept free of potential sources of fire in accordance with the provisions of 30 CFR§ 75.380(f). The operator should develop a program for coal dust clean-up and equipment maintenance in both escapeways.

Stoppings and doors (including personnel doors) along the escapeways should be clearly marked so that they can easily be identified. Consideration should be given to requiring that personnel doors along escapeways be structured to form an air lock when exceeding a certain force to open due to a pressure differential. For example when the pressure force on 3 ft x 4 ft personnel doors is greater than 125 lb, for safety reasons, these doors should be installed in pairs to form an airlock door (30 CFR § 75.333(d)(3)). Further, these should be clearly marked and posted on the ventilation maps.

To protect the integrity of the mine atmosphere underground, both escapeways should preferably be ventilated with intake air. This allows positive pressure differentials across the stoppings to be maintained, thus causing the leakage flow to move in the right direction from the escapeways to the adjacent entries. However, the Panel recognizes that with multiple fans in complex ventilation systems there will be cases of cross leakage flows of air from one entry to another. The negative effects of such cases should be minimized by improving the quality of the stoppings and doors, i.e., by developing improved stopping and door designs, and utilizing state of the art construction techniques.

When the belt entry is ventilated with intake air and a fire occurs in the belt entry, the fresh air is at the back of the fire fighters and the flame and smoke flowing away from them. This situation protects the workers from toxic gases and allows keeping the fire fighting units in good and safe operating conditions (Bookshar, 2007). This increases the probability of success of the fire fighters to control the fire.

Some air leakage through ventilation structures (stoppings, doors and/or overcasts) is unfortunately unavoidable, and is often characterized by a significant loss of fresh air to the return. In coal mines it often represents approximately 50 percent of the total quantity of air circulated by the main fan(s). When belt air is used for working section ventilation and is at a higher pressure than the escapeway, there is a risk of contaminating the escapeway with smoke and hazardous fumes from the belt entry. The risk is even greater when the stoppings are subject to deformations caused by external forces (geologic, pneumatic or due to concussion) inducing higher leakage rates. To reduce leakage from the belt entry to the escapeway, the stoppings and personnel doors in them should be constructed of non-combustible materials of sufficient strength, installed adequately, and maintained regularly. Additionally, re-application of sealants to the stoppings and immediate surrounding strata may be considered.

Main entry stoppings, especially those near the surface fans, should be constructed of solid concrete blocks or reinforced yielding stoppings. These structures should be lined with sealants applied to the entire face from the high pressure side. Because of their location in relation to the main fans, these stoppings are subject to higher pressure differentials, thus increasing the air leakage. To ameliorate these effects, these stoppings should be inspected regularly and repaired promptly.

Studies have shown that by using these types of stoppings leakage rates as low as 140 cfm/ 100 ft^2/ in. water gauge can be achieved (Timko and Thimons, 1982; Dupree et al., 1993).

For longwall panel entries, often located several miles away from main fans, thus having less pressure differentials across the stopping line, hollow cinder blocks or metal panel or yielding stoppings may be used. However, they still should be sealed from the high-pressure side. Ventilation surveys have shown that for yielding stoppings the leakage flow rate is in the order of 300 cfm/100 ft^2/ in. water gauge (Kennedy, 1996).

In underground mines, the continuous change in airway characteristics (increased mine resistance due to airways closing in as a result of convergence and increased air traveling distance due to mine development) creates imbalances in the airflow distribution. In coal mines, these imbalances are corrected by adjusting regulators or point feeds at the expense of higher overall mine resistance. As the resistance is increased more fan pressure is required to ventilate a section or panel. More pressure induces more leakage.

Conclusion

All members of the Panel affirmed the recommendation.

References

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RECOMMENDATION NUMBER 15 – LIFELINES

The Technical Study Panel endorses the lifeline regulations promulgated by MSHA (*Federal Register*, 2006) but is recommending two additional methods of strengthening the rules. First, the Panel recommends that all coal mine lifelines be standardized across the country with regard to the tactile signals attached to the lifeline. Second, the Panel recommends that three standardized tactile signals be designed to indicate (1) impediment to travel ahead (door, regulator, overcast, pool of water, etc.), (2) SCSR cache in the adjacent crosscut, and (3) to the doors located in the crosscut.

<u>Discussion</u>

The lifeline regulations published in the *Federal Register* (MSHA, 2006) are clearly logical additions to the safety measures now being implemented in U.S. coal mines. In particular, the directional nature of the cones, the reflective markers utilized, the flame-resistant nature of the lifelines, and the ability of the lifelines to lead escaping miners to the SCSR caches are all important positive attributes of the lifeline system. However, only a portion of the capability and potential of a lifeline system is being utilized, and the Technical Study Panel recommends that more of the possibilities be implemented in the lifeline regulations.

The possibility that additional tactile signals to miners would be quite useful has been suggested in a NIOSH publication IC 9481 (Conti et al., 2005). In that publication, the authors mention that "we recommend that two directional indicators be mounted together on the lifeline approximately 6 to 10 feet from a door, regulator, etc." This signal to escaping miners would clearly warn them of potential hazards ahead in their travel path. In addition to the hazards mentioned in the NIOSH publication, the tactile signal could also be used for water sumps, overcasts, and tripping hazards like haulage tracks. This suggestion by the NIOSH authors is quite logical and indicates the potential of using the lifeline for a variety of tactile signals.

In considering the potential to add additional signals to the lifeline, the signals must provide clear tactile indications of the three important items suggested above. The signals may simply be cones placed back-to-back as suggested in IC 9481 or the regulations may call for the signals to be transmitted by touch to the miner using items attached to the line of a different shape (for example, 2-inch-diameter spheres). It would not be difficult to implement these additional signals on the line. One possible scheme would use the following attachments:

(1) two back-to-back directional cones to indicate an impediment in the travel path,

(2) four back-to-back directional cones to indicate a door into an adjacent escapeway (plus an attached line leading to the door), and

(3) six back-to-back directional cones to indicate a SCSR cache (plus an attached line leading to the cache).

These signals should be researched for practicality and easy detection by both gloved and ungloved miners before they are implemented.

With the attachment of additional signals to the lifeline, it becomes essential that the lifelines and the signals attached be standardized across the coal industry. Miners may work at several mines within their company and many change companies several times during their career. Standardization reduces the possibility of confusion in an emergency. In addition, the signals when standardized can be printed on reflective hat stickers to be placed inside the hard hats of working miners so that they will always have a readily available reference that can be read even in a smoky mine opening.

In assessing the cost of implementing these recommendations, it appears that most of the costs are in the lifeline itself and that the added lifeline signals would result in only modest additional costs. The primary manufacturer of lifelines (Cambria Association for the Blind, Ebensburg, PA) has said that they have split cones that can be added after the lifelines are in place (Fuller, 2007). This should make the standardization quite achievable in mines that already have an alternate lifeline tactile system in place. In addition, standardizing the lifelines and the signals would allow more manufacturers to enter the market and may result in less expensive lifelines. Standardizing may thus reduce the costs of lifelines even if added features are being required in the regulations.

Conclusion

All members of the Panel affirmed the recommendation.

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RECOMMENDATION NUMBER 16 – POINT-FEEDING

The Technical Study Panel recommends that when point-feeding from adjacent entries into the belt entry is performed to supplement air flow through the belt entry, as provided by 30 CFR § 75.350(d), those mines have an additional requirement to more quickly provide two separate escapeways in an emergency situation. Specifically, the Panel recommends that two CO sensors be placed in the primary escapeway outby every point-feed regulator with 1,000 feet of space between the two (if possible). We propose that if both of these monitors reach the CO alert level of the mine, or if one sensor reaches the alarm level, a warning signal be given at the regulator location. The AMS operator shall then have the ability and authority to remotely close or open the point-feed regulator after consulting with the responsible person. The section foreman in the affected section must also be notified so that checking on the cause of the problem and evacuation can be initiated in a quick and orderly manner.

Discussion

The field visits to mines, the testimony of rescue experts, and the study of mine ventilation systems have led the Technical Study Panel to conclude that the point-feed procedure when using belt entry air in the working section can present significant problems for face workers if a fire were to occur in the primary intake outby the point-feed regulator. In some mines, the face area of a longwall may be up to 15,000 feet from the point-feed regulator (Fiscor, 2007). In a two-entry longwall section and in some other section layouts, this may result in both the primary and secondary escapeways being contaminated with CO and smoke before anyone can manually close the regulator.

The testimony given by Dr. Fred Kissell at the Pittsburgh meeting of the Technical Study Panel supports an improvement over the current regulations in the closing of the point-feed regulator. In his presentation, Dr. Kissell stated that there were four common features that were often associated with fatal events involving mine fires. These features are:

(1) delayed evacuation,

(2) lack of lifelines,

(3) confusion in locating escapeways, and

(4) malfunction of SCSRs.

These conclusions are based on a variety of research efforts outlined in publications by Goodman and Kissell (1990), Kissell and Litton (1992), and Kissell, Timko, and Litton (1993).

Items (2) and (4) in Dr. Kissell's list are being better addressed by recent standards and, to a great extent, these problems should be less troublesome in future years. Features (1) and (3) can be better addressed by improved speed in initiating an escape and a better knowledge of which escapeway will be required in an escape. However, the seriousness of a delay in initiating an escape would be greatly reduced if the point-feed regulator were closed remotely and quickly in case of evidence of a fire in the intake because the closure would more adequately separate the two section escapeways without waiting for the section foremen to travel to the point-feed regulator to determine the cause. In addition, the closing of the point-feed regulator is an indication that the primary intake is contaminated and that escape is required through the belt entry. This should provide valuable information so that the atmospheric monitoring system (AMS) operator and the section foreman can better choose the proper escape path. Thus, delays and confusion would both be lessened, though some negative effects of these elements may still exist.

One positive aspect of this recommendation is that this problem can be adequately addressed by harnessing the technology already available in mines using belt air at the face, i.e., the AMS. The AMS can provide a means of detecting a fire or other CO-producing event in the primary escapeway and should produce very few nuisance events. AMS manufacturers have reported at the Birmingham meeting of the Technical Study Panel that oversight and control functions can be readily programmed as part of the normal functions of atmospheric monitoring. It appears to be technically feasible.

The Technical Study Panel recommendation on the 1000-foot spacing of the two CO sensors to be located outby the point-feed regulator was made to eliminate some of the possible false alarms that may occur if a non-threatening source such as a piece of diesel equipment is responsible for the elevated CO readings. The recommended spacing may be impractical or impossible if the point-feed regulator is located near a shaft bottom or in certain other mine locations. The spacing should be adjustable to meet the layout of the individual mine layouts.

It should be noted that in mine layouts where the secondary escapeway is located in a return entry beside the primary escapeway, such as in many three-entry longwall sections, the closing of the point-feed regulator does not provide the same improvement in safety for the section workers. In these mines, this recommended management of the point-feed regulator is not necessary. The usefulness of this recommendation will thus apply to a portion but not all mines.

It is necessary when considering the institution of a remotely activated system to evaluate any negative effects that may be produced by the remote activation. MSHA personnel have advised that the remote closure of the point-feed regulator may reduce air flow to the working section and raise the chance of methane buildup. For this reason, the remote closure should be affected only after checking with the section foreman so that he may remove his section personnel from the working face and deactivate the section power. Other possible secondary effects should also be evaluated before the remote closure plan is utilized. The Technical Study Panel recognizes the need for a thorough review of possible effects before instituting such a plan.

Conclusion

All members of the Panel affirmed the recommendation.

References

Goodman, G. & Kissell, F. (1990). Evaluating those factors that influence escape from coal mine fires. *SME Transactions, 286:* 1801-1805.

Fiscor, S. (2007). U.S. Longwall Census. *Coal Age*, *112(2)*: 30-38.

Kissell, F. & Litton, C. (1992). How smoke hinders escape from coal mine fires. *Mining Engineering*, *44(1)*: 79-83.

Kissell, F., Timko. R., & Litton, C. (1993). Ranking factors impacting survival during coal mine fires. *Mining Engineering, 45(8):* 1077-1083.

RECOMMENDATION NUMBER 17 – RESPIRABLE DUST

Respirable dust concentrations in the air coursed through a belt conveyor entry and used to ventilate working sections should be as low as feasible and must not exceed the current regulated concentration of 1.0 mg/m³. District managers shall have the authority to force improvements in dust control in the belt entry if the dust concentration exceeds an 8-hour TWA of 1.0 mg/m³ or is shown to be raising the concentration in the working section above the exposure limit. If the improvements are not effective, the District Manager shall have the authority to revoke the authorization to use belt air in the working section.

Discussion

The potential for a high concentration of dust in the belt airway contributing to an increased dust concentration in the downstream working sections exists in any system where belt air is coursed through a working section. The respirable dust concentrations normally found in belt entries using both operator and inspector samples averages 0.5 mg/m³ (Schultz, 2007). This average concentration of dust would suggest that the dust concentrations in the belt air coursed to the face would not normally be much of a problem.

However, the variation in the average dust concentrations in Schultz's data was quite high with operator samples taken in the belt entry showing a maximum of about 7.8 mg/m³ of respirable dust concentration and inspector samples showing dust concentrations as high as 2.0 mg/m³. This maximum concentration data, which may be a result of poor ventilation or poor dust controls in that particular area, shows a more problematic situation and the potential for the belt air to increase the average dust concentration in the working section. Considering that the primary intake entries must contribute at least 50% of the total air to the section (30 CFR 73.350(b)), dust concentration calculations indicate that the belt air will not increase the average dust concentration at the face unless the belt air dust concentration is higher than that measured at the working face.

To perform an analysis of the contribution of dust in the belt air used in the section, it is possible to derive a formula using basic principles of air flow (Haney, 1996). In Haney's paper, the dust concentration of the intake air to the section, C_e, is calculated as follows:

$$C_e = \frac{(C_i \times Q_i) + (C_b \times Q_b)}{Q_i + Q_b} \qquad (1)$$

where:

C_i = dust concentration in the main intake, mg/m³
C_b = dust concentration in the belt entry, mg/m³

Q_i = intake air quantity, m³/s
Q_b = belt entry air quantity, m³/s

This establishes the dust concentration at the intake to the section, but to determine whether the belt air is raising or lowering the dust concentration in the working section, it is necessary to determine the mass of dust that passes through that area and the contribution of the face equipment. The mass of dust that passes through the face (assuming that belt air is used at the face) is:

$$M_f = C_f(Q_i+Q_b) \qquad (2)$$

where:
M_f = mass of dust passing through the face, mg/s
C_f = dust concentration at the face when using belt entry air at the face, mg/m^3

The contribution of the face equipment to the total dust (in mg/s) can then be calculated as:

$$M_s = M_f - (C_i \times Q_i) - (C_b \times Q_b) \qquad (3)$$

The dust concentration in the face area if the belt air is not used at the face can then be calculated as:

$$C_f' = \frac{M_s + (C_i \times (Q_i - Q_b))}{Q_i - Q_b} \qquad (4)$$

This last calculated value of C_f' (for belt air not used at the face) can then be compared to the previous determined value of C_f (for belt air used at the face) to determine whether or not the dust concentration is increased or decreased by using belt air at the face.

While the calculations are somewhat complicated and are only an approximation, it is often possible to come to conclusions based on a comparison of the belt entry air concentration and the dust concentration at the face when belt entry air is used at the face. If the belt entry air concentration is lower that that at the face (when using belt entry air at the face), then the belt entry air will not cause an increase in the dust concentration at the face. If the dust concentration of the belt entry air is higher than in the working section (when using belt entry air at the working face), it is then necessary to use equations (3) and (4) above to determine whether the belt air will increase or decrease the dust concentration at the working face.

If the belt air dust concentration is higher than that at the working face, it would be a clear indication that the dust controls on the belt may be in need of improvement. Because the principal source of dust in belt entries appears to be at transfer points, simple improvements such as better sprays and shrouds at the transfer points may bring down the dust concentrations. In addition, it may be possible to reduce the velocity of air in the belt airway and the amount of dust re-entrainment as a means of reducing the dust concentrations. Whatever improvements are possible through the use of engineering controls, the operator must be encouraged to implement them or to use air from a cleaner air source.

Where the controls fail to bring the belt air dust concentrations to or below the average dust concentrations measured at the working face, it would be best for the health of the workers if the District Manager were to decide to divert the dust away from the face, i.e., terminate the use of belt air at the working face. This would be in accordance with the Federal Mine Safety & Health Act of 1977 where it states in Section 303(b) that "the Secretary or his authorized representative shall prescribe the maximum respirable dust level in the intake air courses in each coal mine in order to reduce such level to the lowest attainable level."

The words quoted from the 1977 Act may not have been directed toward the use of belt air at the face. However, they apply very well to the use of belt air at the face in terms of the general rule stated, i.e., that a mine should always strive to achieve the lowest attainable dust level. In a mine where use of belt air at the face is a possibility, the lowest attainable dust level may be associated with the use of belt air or it may be a result of not using the belt air at the face. The District Manager should have the freedom to reject the use of belt air at the face if it is an appropriate method of dust reduction.

Conclusion

All members of the Panel affirmed the recommendation.

Reference

Haney. R. [after 1993]. Effect of belt air on dust levels in underground coal mines. Department of Labor, Mine Safety and Health Administration. Pittsburgh, Pennsylvania. 10 pages.

Schultz, M. (2007). Response to Panel Questions in an E-mail of Feb. 2.

RECOMMENDATION NUMBER 18 – MINE METHANE

The methane gas released from broken coal on the conveyor belt and from the belt entry presents a problem in some mines that can affect the ability to keep the methane gas below 1% at the working place. It is therefore recommended that the MSHA District Manager shall require adjustments to the ventilation system if the belt air is being utilized on the working section and is causing difficulty in keeping the methane below 1% in the working place. In addition, it is recommended that the District Manager regularly scrutinize any working section that has methane readings at or above 0.5% methane (measured 200 feet outby the tailpiece of the belt) to prevent the gas liberated on a conveyor belt or from the belt entry from increasing the methane content at the working place above 1.0%.

<u>**Discussion**</u>

Members of the Technical Study Panel inquired of MSHA staff members as to the number of continuous miner and longwall working faces that have problems with the methane being liberated on conveyor belts and then raising the methane content of the air on the working face. Data on that topic was rather sparse, but some of the MSHA personnel did have knowledge of specific mines where such problems existed. Mark Eslinger, Supervisory Mining Engineer at MSHA Coal Mine Safety and Health District 8, had general knowledge of one mine where the rib liberation caused the belt air to be quite high (Eslinger, 2007). At this mine, the air on the belt was reversed to ease the methane problems at the working face. Eslinger also made mention of a mine where methane contents of up to 5% were measured by inspectors in the belt entry. However, this mine did not use belt air at the face.

Bill Knepp, Assistant District Manager, Technical Services, MSHA Coal Mine Safety and Health District 9, mentioned high methane contents in the belt entries at the mines of the Mid-Continent Coal and Coke Company near Carbondale, Colorado (Knepp, 2007). In those mines, the huge amounts of methane emitted and the amounts of ventilation air required in the longwall faces required monitoring of the methane on the belt entry to ensure better control of the methane at the working face.

Additional information on the potential for gas liberated in the belt entry is found in the publication by Krog et al. (2006). It that study, the methane emitted by the four major sources on a longwall working section in Southwestern Pennsylvania was measured over a three-day period. The measurements showed that the methane in the belt entry from the broken coal and the rib contributed about 20% of the total methane that was generated on the working section. Because this mine had slowdown periods due to the methane content at the shearer, it was a candidate for having the belt air put on an outby ventilation flow. This type of a mine using belt air at the face would likely have two choices for reducing the methane at the working face: reverse the air in the belt entry or institute a degasification system to reduce the methane. In some cases, particularly where the gas cannot be easily marketed, reversing the belt air may be both the safest and the most economical method of handling the methane.

While the number of mines for which gas emissions in the belt entry are a significant problem may be small, the problem of gas emitted in the belt entry cannot be easily dismissed. Accordingly, the gas contents at the end of the belt entry should be carefully scrutinized in all mines using belt air at the working face to ensure that the methane contents at the face are kept at safe levels.

Conclusion

All members of the Panel affirmed the recommendation.

Reference

Eslinger, M. (2007). E-Mail to W. Francart Dated July 19.

Knepp, W. (2007). Phone Conversation of July 2 with Jan Mutmansky.

Krog, R., Schatzel, S., Garcia, F., & Marshall, J. (2006). Predicting methane emissions from longer longwall faces by analysis of emission contributors," Proceedings, 11th U.S./North American Mine Ventilation Symposium, (Pp. 383-392). Taylor & Francis, London, United Kingdom.

RECOMMENDATION NUMBER 19 - INSPECTIONS

The Technical Study Panel considers the inspection of mines utilizing belt air in the working section as a priority that must be addressed. Accordingly, the Panel recommends that a more structured procedure be instituted to help mine inspectors complete their inspection duties with greater ease and efficiency and reduce chances of overlooking safety hazards. This recommendation is aimed at the mines using belt air in the working section, but can be applied to any underground coal mine.

Discussion

The impetus for this recommendation comes from a study of the Report of Investigation of the Aracoma Alma Mine #1 mine fire of January 19, 2006 (MSHA, 2007). In that report, there is a large compilation of significant and substantial violations of federal mining regulations. Many of these violations should have been identified in the inspections that occurred prior to January 19 of 2006. With the potential for serious repercussions when using belt air at the face, the inspection of a mine in this category should have a list of required checks that must be made and measurements that must be accomplished to ensure that the belt air ventilation system is being safely used and the mine emergency evacuation and fire protection standards are strictly followed.

Data gathering for the purpose of identifying the need for this recommendation was almost entirely performed by talking to MSHA personnel about inspection practices and procedures. The first contact on this topic was with Bill Knepp on July 2, 2007, and covered a number of topics including inspection procedures (Knepp, 2007). That conversation answered some questions, but left others unanswered. The topic was again taken up on August 9, 2007.

The Aracoma Alma Mine Report of Investigation and discussion with MSHA personnel seem to indicate that more structured reporting procedures for MSHA inspectors may be in order for mines using belt air at the face (and perhaps for all underground coal mines). In 2006, MSHA attempted to adopt a computerized inspection tracking system as a means of better analyzing mine performances in keeping within the safety regulations. One MSHA manager (Dupree, 2007) reported that the tracking system ran into trouble because it was not user-friendly and inspectors were simply required to rewrite their underground notes taken during inspections. As a result, the computerized system was dropped and MSHA now uses the hand-written notes of the inspectors as the record of inspections.

The Internal Review of MSHA's Actions at the Aracoma Alma Mine #1 (MSHA, 2007a) indicates that the current system of inspections does not have internal checks to ensure that the inspection reports have covered all the essential facts needed to keep the belt air and many other important safety standards enforced. It is therefore recommended that MSHA develop and perfect a set of procedural requirements for inspectors of underground coal mines that requires the team of inspectors to respond to every inspection requirement. A research effort should be initiated to decide whether computerization can be implemented to ease the inspector's job, particularly with regard to knowing exactly what is required in an inspection and entering his/her reports after each mine visit. The job of the inspector may become more complicated if this recommendation is adopted. Computerization may be one way of easing the burden as well as making the inspection process more effective in detecting problems and for easy system-wide data tracking.

While computerization of the inspection procedure may take a considerable amount of time and effort to accomplish at the beginning, the regimentation of inspections requirements may be accomplished by computer-aided methods regardless or whether or not the reporting is computerized. MSHA personnel are clearly capable of outlining the inspection requirements for each type of coal mine (longwall vs. room-and-pillar, single-split versus double-split, belt-air mine vs. non-belt-air mine, etc.). Both the Aracoma Report of Investigation (MSHA, 2007) and the Internal Review (MSHA, 2007a) support the need for a strong effort to upgrade the inspection procedures utilized by MSHA.

While the Technical Study Panel recognizes that the primary goal in our charge was to investigate the use of belt air in working sections, our suggestion that MSHA inspections be more structured can be applied to any underground coal mining system. It is our firm belief that more structured inspection procedures will help MSHA inspectors do their job and perform it in a more efficient manner. The Technical Study Panel therefore suggests that Congress may wish to implement more structured inspection procedures for all underground coal mining systems and that this process be initiated immediately.

Conclusion

All members of the Panel affirmed the recommendation.

References

Dupree, A. (2007). Assistant District Manager, MSHA Coal Mine Safety and Health District 5, Phone Conversation of August 10.

Knepp, W. (2007). Assistant District Manager, MSHA Coal Mine Safety and Health District 9, Phone Conversation of July 2.

Mine Safety and Health Administration. (2007). Report of Investigation, Fatal Underground Coal Mine Fire, January 19, 2006, Aracoma Alma Mine #1, Aracoma Coal Company, Inc., Stollings, Logan County, West Virginia, I.D. No. 46-08801. Coal Mine Safety and Health, Arlington, Virginia. 164 pages.

Mine Safety and Health Administration. (2007a). Internal Review of MSHA's Actions at the Aracoma Alma Mine #1, Aracoma Coal Company, Inc., Stollings, Logan County, West Virginia, 181 pages.

RECOMMENDATION NUMBER 20 - RESEARCH

The Technical Study Panel recommends that research utilizing ventilation modeling, engineering design and risk analysis be performed to investigate the following areas:

(1) development of guidelines for improved escapeway design in various ventilation situations,

(2) ways to reduce air leakage through ventilation controls, and

(3) use of booster fans in underground coal mining operations.

<u>**Discussion**</u>

The use of point-feed regulators presents an inherent problem that may be addressed by changing the ventilation systems to eliminate the point-feeding concept. A number of systems are possible. Some alternatives are as follows:

(1) using two intake air streams totally separated from the air intake points to the working sections,

(2) implementing secondary escapeways in return entries when belt air is used at the face,

(3) using belt conveyors in return entries of longwalls with both escapeways in intake air splits, and

(4) using tertiary escapeways in certain mining systems.

In alternative (1) above, the totally separated belt intake has a number of advantages with some dust and gas disadvantages also being possible. But the totally separated belt has a major escape advantage if a fire occurs on the belt. However, it is more difficult to fight a fire on the belt when the ventilation is in the outby direction.

For alternative (2), the use of a return entry for escape has been utilized in coal mines at times. In a longwall system, the return may be a good escape route if the headgate entries are filled with smoke or other problems are causing the primary escapeway to be a poor avenue for egress. In such a situation, a return airway may be a wise choice for escape. One major disadvantage would be the difficulty of keeping the return escapeway clear of any falls or other impediments to escape and the difficulty of keeping ahead of the smoke in an escape attempt.

The use of belt conveyors in the return is a practice that has been used in other parts of the world, but is used less frequently in the United States. One major appeal of this system is that the dust and/or methane generated on the belt conveyor system is not carried to the face. In addition, the combustion products of a belt fire are carried away from the face, making a belt fire much less of a hazard. However, use of the belt in the return may require more maintenance to keep the entry free of roof problems and will normally result in more difficulties when attempting to fight a belt fire.

The use of a tertiary escapeway may be the most prudent manner of improving escape probabilities in some mining systems. If both the primary and secondary escapeways are intakes and a major fire or explosion occurs in the intake, then a tertiary escapeway in the return air may be the safest escape path possible.

The Technical Study Panel acknowledges that there may be some impractical suggestions in the list of topics above. However, it is important to realize that not many of the overall possibilities have been thoroughly evaluated. We have provided some alternatives that have departed from the norm in the hopes that we can improve underground safety in the future. Researching all the alternatives appears to be appropriate at this time.

In addition to developing guidelines for improved escapeway designs, the Panel identified two other research topics: methods to reduce air leakage utilizing improved ventilation controls and use of booster fans in underground coal mines.

In underground mines, the continuous change in airway characteristics due to airways closing in as a result of convergence and increased air traveling distance due to mine development creates imbalances in the airflow distribution. In coal mines, these imbalances are corrected by isolating mined out areas using permanent stoppings or installing regulators resulting in higher overall mine resistance. As the resistance is increased more fan pressure is required to ventilate a section or panel. More pressure induces more leakage. The leakage quantities can be reduced by improving the quality of these ventilation controls: stoppings, doors and regulators (Kennedy, 1996). Research is needed on durable stopping construction materials, improved designs and construction techniques for these controls, and most importantly, the development of environmentally friendly and cost effective sealant materials.

Another alternative to reduce leakage is to utilize booster fans. A booster fan, when sized and located properly, can not only be used to assist main surface fans but also reduce leakage and make more air available to ventilate the working areas. The main problem with booster fans is the possibility of uncontrolled recirculation in an inadequately designed system (Crocco, 2007). However, with the advent of reliable atmospheric monitoring systems and through their early detection capabilities that enables immediate system adjustments, booster fans can be effectively used to enhance the health and safety conditions in underground coal mines. Based on these arguments, the Technical Study Panel recommends that MSHA start exploring the conditions under which booster fans can be used safely in underground coal mines, especially in deep mines with difficult conditions. This exploratory work should be completed in three years. In the future, deeper mines are inevitable and better technology should be explored and utilized.

<u>Conclusion</u>

All members of the Panel affirmed the recommendation.

<u>References</u>

Crocco, W. (2007). Comments to the Panel at the Salt Lake City Meeting, Transcript of May 16, Pp. 82-85.

Kennedy, W. (1996). *Practical mine ventilation.* Intertec Publishing, (Pp. 37-55). Chicago, Illinois.

APPENDICES

A. Charter

B. *Federal Register* Notice Establishing the Panel

C. Background of Panel Members

D. List of Materials Provided to Panel Members

A. Charter

1. The Committee's official designation.

Technical Study Panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining.

2. The Committee's objectives and the scope of its activity.

The Committee is established in accordance with the requirements of Section 11 of the Mine Improvement and New Emergency Response Act of 2006 (MINER Act) and the Federal Advisory Committee Act. The purpose of the Committee is to ''provide independent scientific and engineering review and recommendations with respect to the utilization of belt air and the composition and fire retardant properties of belt materials in underground coal mining.'' (MINER Act, Sec. 11)

3. The period of time necessary for the Committee to carry out its purposes.

Not later than one year after the date on which all Committee members are appointed, the Committee must ''prepare and submit … a report concerning the utilization of belt air and the composition and fire retardant properties of belt materials in underground coal mining.'' (MINER Act, Sec. 11)

4. The agencies or officials to whom the Committee reports.

The Committee submits a report to the Secretary of Labor, the Secretary of Health and Human Services, the Committee on Health, Education, Labor, and Pensions of the Senate, and the Committee on Education and Workforce of the House of Representatives.

5. The agency responsible for providing necessary support for the Committee.

The Mine Safety and Health Administration, U.S. Department of Labor, is primarily responsible for providing support for the Committee, including financial, organizational, and administrative. The National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services, may assist with compiling research and other scientific information.

6. A description of the duties for which the Committee is responsible.

As required by Section 11 of the MINER Act, the Committee will provide independent scientific and engineering review and make recommendations in the form of a report with respect to the utilization of belt air and the composition and fire retardant properties of belt materials in underground coal mining.

7. Membership.

As required by Section 11 of the MINER Act, the Committee will be composed of the following:

• Two individuals appointed by the Secretary of Health and Human Services, in consultation with the Director of the National Institute for Occupational Safety and Health and the Associate Director of the Office of Mine Safety;

• Two individuals appointed by the Secretary of Labor, in consultation with the Assistant Secretary for Mine Safety and Health; and

• Two individuals, one appointed jointly by the majority leaders of the Senate and House of Representatives and one appointed jointly by the minority leaders of the Senate and House of Representatives. Four of the six individuals listed above must possess a masters or doctoral level degree in mining engineering or another scientific field demonstrably related to the subject of the report. No individual appointed shall be an employee of any coal or other mine, or of any labor organization, or of any State or Federal agency primarily responsible for regulating the mining industry.

8. Compensation.

While carrying out the duties of the Committee, its members shall be entitled to receive compensation as a consultant, at an hourly rate equivalent of GS–15, step 10. Employment is not expected to exceed 130 days per year. Committee members will also receive per diem in lieu of subsistence and travel expenses.

9. The estimated annual costs to operate the Committee in dollars and person years.

• Estimated annual operating cost: $600,000.

• Estimated staff years: 4.

10. The estimated number and frequency of Committee meetings.

The Committee will meet at least three times before its termination date. The Agency estimates that each meeting will last approximately two to three days.

11. The Committee's termination date.

This Committee will terminate upon the submission of its report that must be finalized no later than one year after the date on which all members of the Panel are appointed, as required by Section 11 of the MINER Act.

12. The date the charter is filed.

The charter is filed on the date indicated below.

E. L. Chao

Elaine L. Chao
Secretary of Labor

DEC 2 0 2006

Date

B. *Federal Register* Notice of Establishment of the Panel

parties for joint development of policies and procedures affecting the custody, release, and supervision of individuals targeted for this transition initiative.

Scope of Work and Specific Requirements: Goals of the TJC include (1) Improved public safety by reducing the threat of harm to persons and property by released offenders in communities to which they return and (2) increased success rates of offenders who transition from jails into the community by fostering (a) Effective treatment programming that reduces offender's risk of violating laws upon release, (b) accountability for both offender and system officials, and (c) community and victim involvement. Appropriate use of dynamic assessment of risk and needs must be a critical component of the model, as well as a commitment to ongoing use of evidence based principles for behavior change.

It is expected that the primary Transition from Jail to the Community (TJC) components will include:

1. *Build the TJC Model:* The cooperative agreement provider will offer expertise, facilitation, documentation and staff/consultant support activities to develop the TJC model, identifying likely differences in approaching the various categories of jailed individuals and implications for developing a model approach. A primary initial task must include use of practitioners and experts in the development of the model. The types of individuals and process for selecting them must be included in the application.

2. *Implement the TJC Model:* The scope of work will include testing the model in two selected sites before adding four more jurisdictions.

3. *Conduct Evaluation:* A key component will be evaluation to determine the impact of TJC activities on impacted jails/communities.

4. *Develop Products to Share Learnings:* Recognizing that NIC can only provide direct assistance to a very small portion of all the jails/communities, the applicant must develop outreach tools like a TJC Implementation Manual for Jails and Local Communities, a NIC Learning Center TJP module, monographs and articles.

Depending on proposed work plans, it is likely that at least part of the above items 2–4 will be products of future awards, funding permitted. However, the application should discuss and propose a general strategy for addressing all four components and propose a specific work plan for this initial 18-month award. Key TJC challenges and issues for this initiative include:

- Assessment tools
- Evidence based practices
- Individualized case management planning
- Jail based programs and strategies
- Community based programs and strategies
- Coordination and cooperation between jails and public/private human services agencies/groups
- TJC challenges:
  - From jail administrator's perspective
  - From perspectives of other governmental human services agencies
  - From not for profit, NGO's and other community agency perspectives
- Local political implications for TJC
- Local/State implications for TJC
- Information system processes and needs

Additional jail/community transition issues may be identified by the applicant. The applicant must prioritize and address at minimum five challenges/issues. Explain the criteria used for prioritizing your challenges/issues. Also, the applicant must describe why each challenge/issue is important, propose strategies for successfully addressing each challenge/issue and propose how the impact of each challenge/issue will be measured.

Application Requirements: Applications must be submitted using OMB Standard Form 424, Federal Assistance and attachments. (Copies can be downloaded from the NIC Web page at *http://www.nicic.org*. The applications should be concisely written, typed double spaced and referenced to the project by the "NIC Application Number" and Title referenced in this announcement.

Submit an original and five copies. The original should have the applicant's signature in blue ink. A cover letter must identify the responsible audit agency for the applicant's financial accounts.

Authority: Public Law 93–415.

Funds Available: The award will be limited to a maximum of $425,000 (direct and indirect costs). Funds may only be used for the activities that are linked to the desired outcome of the project. No funds are transferred to State or local governments. Supplemental awards are a possibility based upon satisfactory performance of the awardee and based upon the availability of funding in future years.

This project will be a collaborative venture with the NIC Administration Division.

Eligibility of Applicants: An eligible applicant is any State or general unit of local government, private agency, educational institution, organization, individual or team with expertise in the described areas.

Review Considerations: Applications received under this announcement will be subjected to a 3 to 5 person NIC Peer Review Process.

Number of Awards: One.

NIC Application Number: 07TI01. This number should appear as a reference line in the cover letter, in box 11 of Standard Form 424, and outside of the envelope in which the application is sent.

Catalog of Federal Domestic Assistance Number 16.603.

Executive Order 12372: This program is subject to the provisions of Executive Order 12372. E.O. 12372 allows states the option of setting up a system for reviewing applications from within their States for assistance under certain Federal programs. Applicants (other than Federally-recognized Indian tribal governments) should contact their State Single Point of Contact (SPOC), a list of which can be found at *http://www.whitehouse.gov/omb/grants/spoc.html*.

NIC expects this award to be signed by March 15, 2007.

Larry B. Solomon,
Deputy Director, National Institute of Corrections.

[FR Doc. E6–21978 Filed 12–21–06; 8:45 am]

BILLING CODE 4410–36–P

DEPARTMENT OF LABOR

Mine Safety and Health Administration

Technical Study Panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining

AGENCY: Mine Safety and Health Administration (MSHA), Labor.

ACTION: Notice of meeting.

SUMMARY: This notice informs interested persons of the first meeting of the Technical Study Panel (Panel) on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. The public is invited to attend.

DATES: The meeting will start at 1 p.m. on Tuesday, January 9, 2007 and will conclude no later than 5 p.m. on Wednesday, January 10, 2007.

ADDRESSES: The meeting location is the Ronald Reagan Building and International Trade Center, Polaris

Suite, 1300 Pennsylvania Avenue, NW., Washington, DC 20004.

FOR FURTHER INFORMATION CONTACT: Patricia W. Silvey, Director, Office of Standards, Regulations, and Variances, Mine Safety and Health Administration, 1100 Wilson Boulevard, Room 2330, Arlington, Virginia 22209; *silvey.patricia@dol.gov* (Internet e-mail), 202–693–9440 (voice), or 202–693–9441 (facsimile).

SUPPLEMENTARY INFORMATION: The Panel is created under Section 11 of the Mine Improvement and New Emergency Response Act of 2006 (MINER Act) (Public Law 109–236). A copy of the charter establishing this Panel is included as Appendix A of this notice. The purpose of the Panel is to prepare and submit a report concerning the utilization of belt air and the composition and fire retardant properties of belt materials in underground coal mining.

Consistent with the requirements of the MINER Act, the membership of the Panel is as follows:

Selected for Appointment by the Secretary of Health and Human Services.

Dr. Jurgen F. Brune, Chief, Disaster Prevention and Response Branch, Centers for Disease Control, National Institute for Occupational Safety and Health, Pittsburgh Research Laboratory, Pittsburgh, Pennsylvania.

Dr. Felipe Calizaya, Associate Professor, University of Utah, Mining Engineering, Salt Lake City, Utah.

Selected for Appointment by the Secretary of Labor.

Dr. Jan M. Mutmansky, Professor Emeritus of Mining Engineering, the Pennsylvania State University, University Park, Pennsylvania.

Dr. Jerry C. Tien, Associate Professor, Department of Mining Engineering, University of Missouri-Rolla, Rolla, Missouri.

Selected for Appointment Jointly by the Majority Leaders of the Senate and House of Representatives.

Mr. Thomas P. Mucho, Thomas P. Mucho & Associates, Inc., Mining Consultancy, Washington, Pennsylvania.

Selected for Appointment Jointly by the Minority Leaders of the Senate and House of Representatives.

Dr. James L. Weeks, Director, Evergreen Consulting, LLC, Silver Spring, Maryland.

This first meeting will focus on preparatory and administrative issues before the Panel, including:

1. Opening remarks.
2. Procedural issues.
3. Other preparatory and administrative issues.
4. Development of plan or timeline to address Panel objectives.
5. Discussion of future meetings.

Subsequent meetings of the Panel will allow an opportunity for all interested parties to address the Panel and submit written comment on the topics under consideration of the Panel.

Official records of the meeting will be available for public inspection at the above MSHA address.

Dated: December 20, 2006.

Richard E. Stickler,

Assistant Secretary for Mine Safety and Health.

Appendix A—Advisory Committee Charter

1. The Committee's official designation.

Technical Study Panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining.

2. The Committee's objectives and the scope of its activity.

The Committee is established in accordance with the requirements of Section 11 of the Mine Improvement and New Emergency Response Act of 2006 (MINER Act) and the Federal Advisory Committee Act. The purpose of the Committee is to "provide independent scientific and engineering review and recommendations with respect to the utilization of belt air and the composition and fire retardant properties of belt materials in underground coal mining." (MINER Act, Sec. 11)

3. The period of time necessary for the Committee to carry out its purposes.

Not later than one year after the date on which all Committee members are appointed, the Committee must "prepare and submit * * * a report concerning the utilization of belt air and the composition and fire retardant properties of belt materials in underground coal mining." (MINER Act, Sec. 11)

4. The agencies or officials to whom the Committee reports.

The Committee submits a report to the Secretary of Labor, the Secretary of Health and Human Services, the Committee on Health, Education, Labor, and Pensions of the Senate, and the Committee on Education and Workforce of the House of Representatives.

5. The agency responsible for providing necessary support for the Committee.

The Mine Safety and Health Administration, U.S. Department of Labor, is primarily responsible for providing support for the Committee, including financial, organizational, and administrative. The National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services, may assist with compiling research and other scientific information.

6. A description of the duties for which the Committee is responsible.

As required by Section 11 of the MINER Act, the Committee will provide independent scientific and engineering review and make recommendations in the form of a report with respect to the utilization of belt air and the composition and fire retardant properties of belt materials in underground coal mining.

7. Membership.

As required by Section 11 of the MINER Act, the Committee will be composed of the following:

- Two individuals appointed by the Secretary of Health and Human Services, in consultation with the Director of the National Institute for Occupational Safety and Health and the Associate Director of the Office of Mine Safety;
- Two individuals appointed by the Secretary of Labor, in consultation with the Assistant Secretary for Mine Safety and Health; and
- Two individuals, one appointed jointly by the majority leaders of the Senate and House of Representatives and one appointed jointly by the minority leaders of the Senate and House of Representatives.

Four of the six individuals listed above must possess a masters or doctoral level degree in mining engineering or another scientific field demonstrably related to the subject of the report. No individual appointed shall be an employee of any coal or other mine, or of any labor organization, or of any State or Federal agency primarily responsible for regulating the mining industry.

8. Compensation.

While carrying out the duties of the Committee, its members shall be entitled to receive compensation as a consultant, at an hourly rate equivalent of GS–15, step 10. Employment is not expected to exceed 130 days per year. Committee members will also receive per diem in lieu of subsistence and travel expenses.

9. The estimated annual costs to operate the Committee in dollars and person years.

- Estimated annual operating cost: $600,000.
- Estimated staff years: 4.

10. The estimated number and frequency of Committee meetings.

The Committee will meet at least three times before its termination date. The Agency estimates that each meeting will last approximately two to three days.

11. The Committee's termination date.

This Committee will terminate upon the submission of its report that must be finalized no later than one year after the date on which all members of the Panel are appointed, as required by Section 11 of the MINER Act.

12. The date the charter is filed.

The charter is filed on the date indicated below.

Dated: December 20, 2006.

Elaine L. Chao,

Secretary of Labor.

[FR Doc. E6–22031 Filed 12–21–06; 8:45 am]

BILLING CODE 4510–43–P

NATIONAL SCIENCE FOUNDATION

National Science Board—Vannevar Bush Award Committee; Sunshine Act Meetings

The National Science Board's Vannevar Bush Award Committee, pursuant to NSF regulations (45 CFR Part 614), the National Science Foundation Act, as amended (42 U.S.C. 1862n–5), and the Government in the Sunshine Act (5 U.S.C. 552b), hereby gives notice in regard to the scheduling of meetings for the transaction of National Science Board business and other matters specified, as follows:

DATE AND TIME: Friday, January 12, 2007, at 2:30 p.m.

SUBJECT MATTER: Discussion of recommendations for recipient(s) of the 2007 Vannevar Bush Award

STATUS: Closed.

This meeting will be held by teleconference originating at the National Science Board Office, National Science Foundation, 4201 Wilson Blvd., Arlington, VA 22230.

Please refer to the National Science Board Web site (*http://www.nsf.gov/nsb*) for information or schedule updates, or contact: Ann Noonan, National Science Board Office, 4201 Wilson Blvd., Arlington, VA 22230. Telephone: (703) 292–7000.

Michael P. Crosby,

Executive Officer and NSB Office Director.

[FR Doc. E6–22015 Filed 12–21–06; 8:45 am]

BILLING CODE 7555–01–P

NUCLEAR REGULATORY COMMISSION

[Docket No. 52–011–ESP]

Establishment of Atomic Safety and Licensing Board; ASLBP No. 07–850–01–ESP–BD01

Pursuant to delegation by the Commission dated December 29, 1972, published in the **Federal Register**, 37 FR 28,710 (1972), and the Commission's regulations, *see* 10 CFR 2.104, 2.300, 2.303, 2.309, 2.311, 2.318, and 2.321, an Atomic Safety and Licensing Board is being established to preside over the following proceeding: Southern Nuclear Operating Company (Early Site Permit For Vogtle Esp Site).

This Board is being established pursuant to an October 5, 2006 Notice of Hearing and Opportunity to Petition for Leave to Intervene published in the **Federal Register** (71 FR 60,195 (Oct. 12, 2006)). The hearing will consider the August 14, 2006 application, as supplemented, of Southern Nuclear Operating Company (SNC) pursuant to 10 CFR Part 52 for an early site permit (ESP) for the Vogtle ESP site in eastern Georgia, as well as the December 11, 2006 petition to intervene submitted by the Petitioners Center for a Sustainable Coast, Savannah Riverkeeper, Southern Alliance for Clean Energy, Atlanta Women's Action for New Directions, and Blue Ridge Environmental Defense League challenging the ESP application.

The Board is comprised of the following administrative judges:

G. Paul Bollwerk, III, Chair, Atomic Safety and Licensing Board Panel, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001.

Dr. Nicholas G. Trikouros, Atomic Safety and Licensing Board Panel, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001.

Dr. James Jackson, Atomic Safety and Licensing Board Panel, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001.

All correspondence, documents, and other materials shall be filed with the administrative judges in accordance with 10 CFR 2.302.

This proceeding will serve as a pilot for extending the use of the Commission's existing high-level waste repository-related Electronic Submittal System to Commission licensing and enforcement cases generally. An order is being issued contemporaneously with this Licensing Board establishment notice establishing procedures in this proceeding for submitting documents using the Electronic Submittal System.

Issued at Rockville, Maryland, this 15th day of December 2006.

E. Roy Hawkens,

Chief Administrative Judge, Atomic Safety and Licensing Board Panel.

[FR Doc. E6–21936 Filed 12–21–06; 8:45 am]

BILLING CODE 7590–01–P

NUCLEAR REGULATORY COMMISSION

[Docket Nos. 50–369 And 50–370]

Environmental Assessment and Finding of No Significant Impact; Duke Power Company Llc; Mcguire Nuclear Station, Units 1 And 2

The U.S. Nuclear Regulatory Commission (NRC) is considering issuance of an amendment for Facility Operating Licenses Nos. NPF–9 and NPF–17, issued to Duke Power Company LLC (the licensee), for operation of the McGuire Nuclear Station, Units 1 and 2 (McGuire 1 and 2), located in Mecklenburg County, North Carolina. As required by Title 10 of the Code of Federal Regulations (10 CFR), Part 51, Section 51.21, the NRC is issuing this environmental assessment and finding of no significant impact.

Environmental Assessment

Identification of the Proposed Action

The proposed action would revise the McGuire 1 and 2 licensing basis to adopt a selective implementation of the alternative source term radiological analysis methodology in accordance with 10 CFR 50.67. The proposed action would also revise Technical Specification 3.9.4, "Containment Penetrations."

The proposed action is in accordance with the licensee's application dated December 20, 2005, as supplemented by letters dated May 4 and August 31, 2006.

The Need for the Proposed Action

The proposed action would provide the licensee more flexibility in scheduling outage tasks when moving fuel that has been afforded 72 hours of fission product decay time. The proposed action would also revise the applicability of the specification to apply only during movement of recently irradiated fuel. The licensee committed to developing administrative controls to adequately close containment penetrations during refueling operations, if necessary. If the application is not approved, the current Technical Specification would unnecessarily restrict movement of irradiated fuel.

C. Background of Members

Selected for Appointment by the Secretary of Health and Human Services.

Dr. Jürgen F. Brune, Director, Spokane Research Laboratory, National Institute for Occupational Safety and Health, Spokane, Washington.

Dr. Felipe Calizaya, Associate Professor, University of Utah, Mining Engineering, Salt Lake City, Utah.

Selected for Appointment by the Secretary of Labor.

Dr. Jan M. Mutmansky, Professor Emeritus of Mining Engineering, the Pennsylvania State University, University Park, Pennsylvania elected by his fellow Panel members to be Chairman.

Dr. Jerry C. Tien, Associate Professor, Department of Mining Engineering, University of Missouri-Rolla, Rolla, Missouri.

Selected for Appointment Jointly by the Majority Leaders of the Senate and House of Representatives.

Mr. Thomas P. Mucho, Thomas P. Mucho & Associates, Inc., Mining Consultancy, Washington, Pennsylvania.

Selected for Appointment Jointly by the Minority Leaders of the Senate and House of Representatives.

Dr. James L. Weeks, Director, Evergreen Consulting, LLC, Silver Spring, Maryland.

D. List of Materials Provided to Members of the Panel

MEETING 1 - January 9 and 10, 2006

Ronald Reagan Building and
International Trade Center,
Polaris Suite,
1300 Pennsylvania Avenue, NW.,
Washington, DC 20004

1. Mine Safety and Health Administration. (2006). Technical Study panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. Notice of Meeting. *Federal Register*. 71(December 22, 2006): 77069-77071.
2. Mine Safety and Health Administration. (2007). Technical Study panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. Transcript of Proceedings. Polaris Suite, Ronald Reagan Building and International Trade Center, 1300 Pennsylvania Avenue, N.W., Washington, D.C. January 9, 2007. 90 pages.
3. Presentation: William Francart, P.E., Mining Engineer. Using Belt Air to Ventilate Active Working Areas. DOL/MSHA Pittsburgh Safety and Health Technology Center, Ventilation Division. January 9, 2007. 15 slides.
4. Presentation: William Knepp, Assistant District Manager for Technical Services, District 9 Coal. Belt Air Federal Advisory Committee Briefing. Ronald Reagan Building, Washington, D.C. DOL/MSHA, Coal Mine Safety and Health, Denver, Colorado. January 9-10, 2007. 53 slides.
5. Presentation: Michael Kalich, Senior Mining Engineer, Belt Air Federal Advisory Committee Briefing, Ronald Reagan Building, Washington, D.C. January 9-10, 2007. DOL/MSHA, Coal Mine Safety and Health, Safety Division, Arlington, VA. Slide 1 – 26.
6. Mine Safety and Health Administration. (2007). Technical Study panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. Transcript of Proceedings. Polaris Suite, Ronald Reagan Building and International Trade Center, 1300 Pennsylvania Avenue, N.W., Washington., D.C., January 10, 2007. 118 pages.
7. Presentation: Michael Kalich, Senior Mining Engineer, Belt Air Federal Advisory Committee Briefing, Ronald Reagan Building, Washington, D.C. January 9-10, 2007. DOL/MSHA, Coal Mine Safety and Health, Safety Division, Arlington, VA. Slide 27 – 43.
8. Presentation: Mark Schultz, Supervisory Mining Engineer. Health Effects of Utilizing Belt Air in Underground Coal Mines. MSHA Technical Support, Pittsburgh Safety and Health Technology Center, Pittsburgh, PA. January 10, 2007. 32 slides.

9. Harry Verakis, Senior Projects Engineer. Conveyor Belt Flammability. MSHA Technical Support, Triadelphia, WV. January 10, 2007. 40 slides.
10. Federal Mine Safety and Health Act of 1977, Public Law 91-173, as amended by Public Law 95-164. (referred to as the 1977 Mine Act.)
11. Mine Safety and Health Administration. (1988). Safety Standards for Underground Coal Mine Ventilation, Proposed Rule. *Federal Register*, 53(January 27, 1988): 2382-2424.
12. Mine Safety and Health Administration. (1989). Belt Entry Ventilation Review: Report of Findings and Recommendations. 101 pages.
13. Mine Safety and Health Administration. (1992). Safety Standards for Underground Coal Mine Ventilation, Final Rule. *Federal Register*, 57(May 15, 1992): 20868-20928.
14. Department of Labor. (1992). Final Report of the Department of Labor's Advisory Committee on the Use of Air in the Belt Entry to Ventilate the Production (Face) Areas of Underground Coal Mines and Related Provisions (Belt Air Advisory Committee). November 1992. 111 pages.
15. Mine Safety and Health Administration. (1992). Requirements for Approval of Flame-Resistant Conveyor Belts, Proposed rule. *Federal Register*, 57(December 24, 1992): 61524-61535.
16. Mine Safety and Health Administration. (1994). Safety Standards for Underground Coal Mine Ventilation, Proposed Rule. *Federal Register*, 59 (May 19, 1994): 26356-26399.
17. Mine Safety and Health Administration. (1996). Safety Standards for Underground Coal Mine Ventilation, Final Rule. *Federal Register*, 61 (March 11, 1996): 9764-9846.
18. Mine Safety and Health Administration. (1999). Requirements for Approval of Flame-Resistant Conveyor Belts, Proposed rule; limited reopening of the record; request for public comments. *Federal Register*, 64(December 28, 1999): 72617-72619.
19. Mine Safety and Health Administration. (2003). Underground Coal Mine Ventilation-Safety Standards for the Use of a Belt Entry as an Intake Air Course To Ventilate Working Sections and Areas Where Mechanized Mining Equipment Is Being Installed or Removed, Proposed rule; notice of public hearings; notice of close of record. *Federal Register*, 68(January 27, 2003): 3936-3968.
20. Comments of the National Institute for Occupational Safety and Health to the DOL on The Mine Safety and Health Administration's Report "Belt Entry Ventilation Review: Report of Findings and Recommendations" 30 CFR Part 75. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH, 11/22/89, 6 pages.
21. Testimony to DOL 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. Presented at the MSHA Public Hearing

April 18, 1990, Reston, Virginia. J. Donald Miller, M.D., Assistant Surgeon General, Director, NIOSH. 22 pages.

22. Schulte, P. Education and Information Division, NIOSH Comments to the 2003 NPRM. National Institute for Occupational Safety and Health, Robert A. Taft Laboratories, Cincinnati, OH. March 27, 2003. 44 pages.
23. Mine Safety and Health Administration. (2004). Compliance Guide for MSHA's Safety Standards for the Use of Belt Entry as an Intake Air Course to Ventilate Working Sections and Areas Where Mechanized Mining Equipment is Being Installed or Removed, September 2004. 45 pages.
24. Mine Safety and Health Administration. 2004. Underground Coal Mine Ventilation-Safety Standards for the Use of a Belt Entry as an Intake Air Course To Ventilate Working Sections and Areas Where Mechanized Mining Equipment Is Being Installed or Removed, Final Rule. *Federal Register*, 69(April 2, 2004): 17480- 17530.
25. MINE IMPROVEMENT AND NEW EMERGENCY RESPONSE ACT OF 2006 (MINER ACT) PL 109-236 (S 2803), June 15, 2006.
26. Mine Safety and Health Administration. (2006). Technical Study Panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining, Notice of meeting. *Federal Register*, 71(December 22, 2006): 77069-77071.
27. Comments of the National Institute for Occupational Safety and Health to the DOL on The Mine Safety and Health Administration’s Report “Belt Entry Ventilation Review: Report of Findings and Recommendations” 30 CFR Part 75. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH. 11/22/89. 6 pages.
28. Testimony to DOL 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. Presented at the MSHA Public Hearing April 18, 1990, Reston, Virginia. J. Donald Miller, M.D., Assistant Surgeon General, Director, NIOSH. 22 pages.
29. Comments of the National Institute for Occupational Safety and Health on the Mine Safety and Health Administration Proposed Rule Underground Coal Mine Ventilation-Safety Standards for the Use of a Belt Entry as an Intake Air Course to Ventilate Working Sections and Areas Where Mechanized Mining Equipment is Being Installed or Removed. 30 CFR 75. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, NIOSH, March 28, 2003. 6 pages.
30. Belt Air eDocket- MSHA web site at the following internet address: http://www.msha.gov/regs/comments/03-1307/beltairedocket.htm
31. Comment from John C. Biechman of the National Fie Protection Association to MSHA concerning 68 FR 3939, Proposed rule, [belt air] dated on March 10, 2003.

32. Comment from Charles Burggraf of RAG American Coal Holding, Inc. to MSHA Re' Comments Concerning Use of Belt Entry as an Intake Air Course dated March 27, 2003.
33. Comment from the United Mine Workers of America on the Proposed rule: Underground Coal Mine Ventilation-Safety Standards for the Use of a Belt Entry as an Intake Air Course to Ventilate Working Sections and Areas Where Mechanized Mining Equipment is Being Installed or Removed dated April 10, 2003.
34. Hearing submission by Twentymile Coal Company on Belt Entry as an Intake Air Course dated April 3, 2003.
35. Hearing submission by Randy Bedilion, Safety Committeeman at RAG Cumberland Mine and a member of Local 2300 of the United Mine Workers of America dated April 10, 2003
36. Hearing submission of United Mine Workers that includes UMWA's report on the Jim Walter Resources #5 Coal Mine Disaster of September 23, 2001, UMWA JWR explosion Rep aa76-hear-4-birminghamal.
37. Hearing submission by Keith Pylar dated April 28, 2003.
38. Industry Comments: Comment on the Proposed Regulations on Belt Entry as an Intake Air Course received by MSHA on May 6, 2003 (JWR aa76-posthearingcomment-100); Comment received from A. Bill Olsen of Mountain Coal Company received by MSHA on May 16, 2003 (aa76-comm-101phc); Comment received from Kevin Tuttle of Deer Creek Mine dated June 20, 2003 (AA76_COMM_102BELTAIR.pdf); and Comments of Kenneth May of Canyon Fuel Company dated June 27, 2003 (aa76-comm-105Beltentry.pdf).
39. Union Comments: Comment on Belt Air from Joseph Main of the United Mine Workers of America dated June 23, 2003 (JWR UMWA Comments aa76-comm-104beltair); and Comments of Joseph Main of the United Mine Workers of America dated June 30, 2003 (UMWA Exhibit 1 aa76-comm-106.pdf)
40. NMA Comments: NMA-BCOA Joseph Lamonica & Bruce Watzman dated June 30, 2003 (aa76-comm-103phc.pdf).
41. Mine Safety and Health Administration. (2003). Underground Coal Mine Ventilation, Use of Belt Air, No. 30 CFR Part 75, Mount Garfield Room, 755 Horizon Drive, Grand Junction, Colorado. April 3, 2003. 32 pages.
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44. Mine Safety and Health Administration (2003). Proposed Belt Air Rule for Underground Coal Mines. Holiday Inn North, 5000 10th Avenue, No., Birmingham, Alabama. April 29, 2003. 109 pages.
45. Mine Safety and Health Administration. (2003). Proposed Belt Air Rule for Underground Coal Mines. Holiday Inn, 1950 Newton Pike, Lexington, Kentucky. May 1, 2003. 56 pages.
46. Mine Safety and Health Administration . Code of Federal Regulations - 30 CFR 75.350
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48. Mine Safety and Health Administration. (1989). Belt Entry Ventilation Review: Report of Findings and Recommendations. 101 pages.
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57. Kissell, P. and Litton, C. (1992). How Smoke Hinders Escape from Coal Mine Fires. Technical Papers. Mining Engineering. January 1992. Page 79-83.

58. Verakis, H. and Dalzell, R. (1988). Impact of Entry Air Velocity on the Fire Hazard of Conveyor Belts. Fourth International Mine Ventilation Congress, Brisbane, Queensland. July 1988, Page 375-381.
59. Stricklin, K. and Haney, R. [after 1999]. Longwall Dust Control Practices. Department of Labor, Mine Safety and Health Administration. 10 Pages.
60. Mine Safety and Health Administration. (2004). Compliance Guide for MSHA's Safety Standards for the Use of Belt Entry as an Intake Air Course to Ventilate Working Sections and Areas Where Mechanized Mining Equipment is Being Installed or Removed, September 2004. 45 pages.
61. Mine Safety and Health Administration. (2003). Underground Coal Mine Ventilation-Safety Standards for the Use of a Belt Entry as an Intake Air Course To Ventilate Working Sections and Areas Where Mechanized Mining Equipment Is Being Installed or Removed, Proposed rule; notice of public hearings; notice of close of record. *Federal Register*, 68(January 27, 2003): 3936-3968.
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64. Colinet, et al. (1997). Status *of Dust Control Technology on U.S. Longwalls*. Chapter 55; Proceedings of the 6th International Mine Ventilation Congress. Page 345-351.
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66. Pomroy, W. and Carigiet. A. (1995). Underground Coal Mine Fire Incidents From 1978 Through 1992. Information Circular 9426. Department of the Interior, Bureau of Mines. 31 Pages.
67. Department of Labor. (1992). Final Report of the Department of Labor's Advisory Committee on the Use of Air in the Belt Entry to Ventilate the Production (Face) Areas of Underground Coal Mines and Related Provisions (Belt Air Advisory Committee). November 1992. 111 pages.
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75. US Bureau of Mines. (1989). Laboratory-Scale Fire Tunnel Test for Conveyor Test Equipment and Procedure in Fire Testing Procedures and Construction Drawings For the Belt Evaluation Laboratory Test. Department of Interior, Bureau of Mines. March 1989. 7 pages.
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Mine Ventilation Symposium (June 8-12, 2002, Kingston, Ontario, Canada). A. A. Balkema Publishers, Lisse, Netherlands. Pages. 527-532.
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96. Edwards et al. (1999). Mine Fire Detection in the Presence of Diesel Emissions Proc Eighth U.S. Mine Ventilation Symposium. Rolla, MO: University of Missouri-Rolla, Press. Pages 295-301.
97. Edwards et al. (1997). Mine Fire Detection Under Zero Air Flow Conditions. Proceedings of the 6th International Mine Ventilation Congress, Chapter 52, Ramani RV, ed., Littleton, CO: Society for Mining, Metallurgy, and Exploration, Inc. February 1997. Pages 331-336.
98. DeRosa, M. (2004). Analysis of Mine Fires for All U.S. Underground and Surface Coal Mining Categories: 1990-1999. Information Circular 9470. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Pittsburgh Research Laboratory, Pittsburgh, PA. September 2004. 43 pages.
99. Lazzara et al. (1990). New Initiatives in the Prevention of Fires and Explosions in the USA Minesafe International, 1990 (Perth, Western Australia, September 10-14, 1990). Perth: Chamber of Mines and Energy of Western Australia. Pages 389-402.
100. Krog et al. (2006). Predicting Methane Emissions by Analysis of Emission Contributors. Proceedings of the 11th U.S./North American Mine Ventilation Symposium, University Park, Pennsylvania, June 5-7, 2006. Mutmansky JM, Ramani RV. eds., London, U.K.: Taylor & Francis Group. June 2006. Pages 383-392.
101. Edwards et al. (2004). Real-Time Neural Network Application to Mine Fire – Nuisance Emissions Discrimination. Mine Ventilation: Proc 10th U.S./North American Mine Ventilation Symposium (May 16-19, 2004, Anchorage, AK), Ganguli-R and Bandopadhyay-S, eds. A. A. Balkema Publishers, Lisse, Netherlands. May 2004. Page 425-431.
102. Francart, W. (2006). Reducing Belt Entry Fires in Underground Coal Mines. 11th U.S./North American Mine Ventilation Symposium 2006 –Mutmansky & Ramani (eds.). 6 pages.
103. Smith et al. (1995). The Performance of Automatic Sprinkler Systems in the Extinguishment of incipient Conveyor Belt Fires under Ventilated Conditions. Chapter 34. Proceedings of the 7th U.S. Mine Ventilation Symposium, June 57, 1995. Lexington, Kentucky. Underground Ventilation Committee of SME, a joint committee of the Coal Division and the Mining & Exploration Division, and the University of Kentucky. Society for Mining, Metallurgy, and Exploration, Inc. Littleton, Colorado. Pages 220-223.
104. Two day meeting attendance sheets
105. Agenda for the 2 day meeting

MEETING 2 – March 28 – 30, 2007

Holiday Inn Pittsburgh Airport
8256 University Blvd.
Coraopolis, PA 15108-2591

106. Mine Safety and Health Administration. (2007). Technical Study panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. Notice of Meeting. *Federal Register*. Vol. 72. No 48. March 13, 2007. Page 11379-11380.
107. TSP Belt Air Survey 2-07 - Coal Mine Safety and Health, 2003 AMS survey updated for 2006: 2003 AMS Survey/2006 AMS/belt air survey.
108. TSP Belt Violations 4th quarter 2006 - Coal Mine Safety and Health, 4th quarter 2006 violations of 75.400 and 75.1725(a).
109. Conveyor belt questions – list of potential questions for conveyor belt manufacturers.
110. Belt combustion toxicity – BCOA/UMWA Belt Q&A from 1995.
111. Answer to panel dust questions – Schultz, M. Current dust concentrations in belt air intake and return samples for calendar year 2006.
112. Francart 2006 Belt Fires Paper – Francart, W. (2006). Reducing belt entry fires in underground coal mines. Chapter 5 - 11th U.S. North American Mine Ventilation Symposium 2006 – Mutmansky & Ramani (eds). Pages 303-308.
113. TSP Major Conveyor Belt Companies – MSHA/Tech Support, January 30, 2006 – Listing of major conveyor belt companies with respect to underground coal mines.
114. TSP2003 AMS Survey with 2006 update 59 Mines.
115. Francart, W. (2005). MSHA Survey – Atmospheric Monitoring Systems in U.S. Underground Coal Mines. SME Annual Meeting, Feb. 28-Mar.2, 2005, Salt Lake City, Utah.
116. Mine Safety and Health Administration. (1992). District 2, Accident Investigation Report (Underground Coal Mine), Non-Injury Mine Fire – Belt Conveyor, Dilworth Mine (I.D. No. 36 04281, Consolidation Coal Company, Rices Landing, Greene County, Pennsylvania. January 22, 1992. 19 pages.
117. Mine Safety and Health Administration. (2003). Coal Mine Safety and Health, Report of Investigation, Underground Coal Mine Fire January 6, 2003, Mine 84, Eighty Four Mining Company, Eighty Four, Washington County, Pennsylvania, I.D. No. 36-00958, District 2, 319 Paintersville Road, Hunker Pennsylvania. April 9, 2003. 28 pages.
118. Mine Safety and Health Administration. (2003). Coal Mine Safety and Health, Report of Investigation, Underground Coal Mine Fire, Non-Injury Mine Fire Accident, April 9 & 10, 2003, VP8, I.D. 44-03795, Island Creek Coal Company,

Mavisdale, Buchanan County, Virginia, District 5, P.O. Box 560, Wise County Plaza, Norton, Virginia. July 15, 2003. 31 pages.

119. Mine Safety and Health Administration. (1988). Coal Mine Safety and Health, Report of Investigation, Underground Coal Mine Fire Marianna Mine No. 58 (I.D. No. 36-00957) BethEnergy Mines, Inc., Marianna Borough, Washington County, Pennsylvania. March 7, 1988. 80 pages.
120. Mine Safety and Health Administration. (1995). Transcript Proposed Requirement for Approval of Flame Resistant Conveyor Belts, Part 14. 340 Race Track Road, Washington, PA. May 2, 1995. 162 pages.
121. Mine Safety and Health Administration. (1992). Belt Air Advisory Committee, Second Meeting, Volume I, Crown Sterling Suites, 2300 Woodcrest Place, Birmingham, Alabama. Wednesday, April 22, 1992. 176 pages.
122. Mine Safety and Health Administration. (1992). Belt Air Advisory Committee, Second Meeting, Volume II, Crown Sterling Suites, 2300 Woodcrest Place, Birmingham, Alabama. Thursday, April 23, 1992. 218 pages.
123. Mine Safety and Health Administration. (1992). Belt Air Advisory Committee, Third Meeting, Volume I, David L. Lawrence Convention Center, Room 9 North, Pittsburgh, Pennsylvania. Thursday, May 21, 1992. 217 pages.
124. Mine Safety and Health Administration. (1992). Belt Air Advisory Committee, Third Meeting, Volume II, David L. Lawrence Convention Center, Room 9 North, Pittsburgh, Pennsylvania. Friday, May 22, 1992. 243 pages.
125. Mine Safety and Health Administration. (1992). Belt Air Advisory Committee, Fourth Meeting, Volume I, University of Kentucky, Mining and Mineral Resources Building, Room 102, Lexington, Kentucky. Monday, June 1, 1992. 244 pages.
126. Mine Safety and Health Administration. (1992). Belt Air Advisory Committee, Fourth Meeting, Volume II, University of Kentucky, Mining and Mineral Resources Building, Room 102, Lexington, Kentucky. Tuesday, June 2, 1992. 198 pages.
127. Mine Safety and Health Administration. (1992). Belt Air Advisory Committee, Fifth Meeting, Volume I, Denver Ballroom, Suite 3, Marriott City Center, Denver, Colorado. Monday, August 3, 1992. 210 pages.
128. Mine Safety and Health Administration. (1992). Belt Air Advisory Committee, Fifth Meeting, Volume II, Denver Ballroom, Suite 3, Marriott City Center, Denver, Colorado. Tuesday, August 4, 1992. 267 pages.
129. Mine Safety and Health Administration. (1992). Belt Air Advisory Committee, Fifth Meeting, Volume III, Denver Ballroom, Suite 3, Marriott City Center, Denver, Colorado. Wednesday, August 5, 1992. 162 pages.
130. Intake Belt DA Query Inspector 800-0 series (Inspector) – ADJUSTED.xls – data file.

131. Intake Belt DA Query Inspector 800-0 series (Inspector).xls – data file.
132. Intake Belt DA Query Inspector 800-0 series – Adjusted. xls – data file.
133. Intake Belt DA Query Operator 800-0 series1.xls. – data file.
134. Return Belt DA Query Inspector 200-0 series – ADJUSTED.xls – data file.
135. Return Belt DA Query Inspector 200-0 series.xls – data file.
136. Return Belt DA Query Operator 200-0 series-Adjusted.xls – data file.
137. Return Belt DA Query Operator 200-0 series.xls – data file.
138. Mine Safety and Health Administration. (2007). Coal Mine Safety and Health, Report of Investigation, Fatal Underground Coal Mine Fire, January 19, 2006, Aracoma Alma Mine #1, Aracoma Coal Company, Inc., Stollings, Logan County, West Virginia, I.D. No. 46-08801. Arlington, Virginia. 164 pages.
139. Mine Safety and Health Administration. (2007). Technical Study panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. Transcript of Proceedings. Glenwood Room, Holiday Inn Pittsburgh Airport, 8256 University Blvd, Coraopolis, Pennsylvania. March 28, 2007. 187 pages.
140. Presentation: Overview from NIOSH – Robert Timko, NIOSH, Manager of the Dust and Diesel Monitoring Team, Pittsburgh, PA .
141. Presentation: Belt flammability research/ NIOSH large and laboratory scale studies – Chuck Lazzara, NIOSH, (Retired), includes a DVD with a short movie. 70 slides.
142. Presentation: Belt toxicity issues - C. David Litton, NIOSH, Research Physicist, Pittsburgh PA. 24 slides.
143. Presentation: Goodyear – David J. Maguire, Director, Global Technology Engineered Products, The Goodyear Tire and Rubber Company.
144. Presentation: Fenner-Dunlop – Geoff Normanton, Vice President, Technology, Fenner-Dunlop, Conveyor Belting, Americas, Scottdale, Georgia (Slide 1-25).
145. Presentation: Fenner-Dunlop –BRIAN Rothery, C.Chem M.R.S.C., Head of Development and Quality Assurance, Fenner-Dunlop, Conveyor Belting, Europe, United Kingdom (Slide 26 – 49).
146. Presentation: Phoenix – Bernd Küsel, Executive Vice President, Phoenix Conveyor Belt Systems, GMBH, Hamburg, Germany.
147. Mine Safety and Health Administration. (2007). Technical Study panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. Transcript of Proceedings. Glenwood Room, Holiday Inn Pittsburgh Airport, 8256 University Blvd, Coraopolis, Pennsylvania. March 29, 2007. 190 pages.
148. Presentation on laboratory-scale flammability testing – Harry Verakis, MSHA, Senior Projects Engineer, MSHA Technical Support, Triadelphia, WV.
148.1 Maas, W. 1949. Fire Hazards Due to Slipping Rubber Belt Conveyors. Geologie En Mijnbouw, November. 11:309-312.

148.2 Canadian Standards Association/Standards Council of Canada. 1987. Fire-Performance and Antistatic Requirements for Conveyor Belting. CAN/CSA-M422-M87. May. Canadian Standards Association, Ontario, Canada. 24 pages.

149. Presentation on belt fire historical data – Terry Bentley, MSHA, Acting Special Assistant to the Administrator, Coal Mine Safety and Health, Chief of Safety, Safety Division, Arlington, VA.

150. Presentation: Using belt air at the face/ belt velocity limits – Robert Krog, NIOSH, Associate Service Fellow, Pittsburgh PA 15236.

151. Presentation: Factors that affect escape – Fred Kissell, NIOSH, (Retired).

152. Presentation: Thomas McNider, James Walters Resources, On behalf of the National Mining Association, Birmingham, Alabama.

153. Mine Safety and Health Administration. (2007). Technical Study panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. Transcript of Proceedings. Glenwood Room, Holiday Inn Pittsburgh Airport, 8256 University Blvd, Coraopolis, Pennsylvania. March 30, 2007. 102 pages.

154. Presentation: 1992 Belt Air Advisory Committee report – Raja V. Ramani, Ph.D., P.E.; Emeritus Professor of Mining Engineering, Penn State University.

155. Carroll et al. (1988). Kinetic Modeling of Generation and Decay of HCl From Burning PVC. Journal of Vinyl Technology. Vol. 10, No. 3. September 1988. Page 106-110.

156. De Rosa, M. (1994). Correlations of Hydrogen Chloride and Hydrogen Cyanide Concentrations Evolved During Combustion of Chlorine-and Nitrogen-Containing Materials. Report of Investigations 9521. United States Department of the Interior, Bureau of Mines. 19 pages.

157. De Rosa, M. and Litton, C. (1991). Embedded Hydrogen Chloride and Smoke Particle Characteristics During Combustion of Polyvinyl Chloride and Chlorinated Mine Materials. Report of Investigations 9368. United States Department of the Interior, Bureau of Mines. 18 pages.

158. Goodman, G. and Kissell, F. (1990). Evaluating those factors that influence escape from coal mine fires. Society for Mining, Metallurgy, and Exploration, Inc. Transactions Vol. 286, pages 1801-1805.

159. Kissell, F. and Litton, C. (1992). How smoke hinders escape from coal mine fires. Mining Engineering. January. Pg 79-83.

160. Kissell, F. and Timko, R. (1991). Pressurization of Intake Escapeways with Parachute Stoppings to Reduce Infiltration of Smoke. Chapter 4. In Proceedings of the 5th U.S. Mine Ventilation Symposium, June 3-5, 1991. Y.J. Wang, ed. Society for Mining, Metallurgy, and Exploration, Inc., Littleton, Colorado. Pages 28-34.

161. Kissell et al. (1993). Ranking factors impacting survival during coal mine fires. Mining Engineering. August. Pg 1077-1083.

162. Küsel, B. (2006). Comparing fire standards on conveyor belts. Conveyors. March. American Longwall. Page 36, 38.
163. Presentation: Lazzara, C. Conveyor Belt Flammability Tests. Unpublished. Presented during the March 2007 Technical Study Panel Meeting in Coraopolis, PA. 7 pages. 2007.
164. Three day meeting attendance sheets
165. Agenda for the 3 day meeting.
166. Meeting submission by Dr. Ramani (copies of his slides) on 3/30/07.

MEETING 3 – May 16 and 17, 2007

Salt Lake Plaza Hotel at Temple Square
122 West South Temple
Salt Lake City, UT 84101

167. Mine Safety and Health Administration. (2007). Technical Study panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. Notice of Meeting. *Federal Register*. 72 (May 2, 2007): 24338-24339.
168. Memo dated July 25, 1973 to Alex O'Rourke, John J. Somers, Frank C. Mann, and John W. Stevenson from R. W. Dalzell, Chief, Ventilation Group Concerning Ventilation belt entries. United States Department of the Interior, Mining Enforcement and Safety Administration, Pittsburgh Technical Support Center, Pittsburgh, PA. 9 pages.
169. TSPBeltAirHits. April 5, 2007. Webtrends Default Report Special on the number of "hits" on the MSHA website concerning TSP-related materials.
170. Smith et al. (1995). Performance of Automatic Sprinkler Systems for Extinguishing Incipient and Propagating Conveyor Belt Fires Under Ventilated Conditions. Report of Investigations 9538. United States Department of the Interior, Bureau of Mines, Pittsburgh Research Center, Pittsburgh, PA. 25 pages.
171. Ryan et al. (1993). Effect of Pressure on Leakage of Automatic Sprinklers. Report of Investigations 9451. United States Department of the Interior, Bureau of Mines, Pittsburgh Research Center, Pittsburgh, PA. 18 pages
172. Sapko et al. (1989). Water Barrier Performance in a Wide Mine Entry. *Third International Colloquium on Dust Explosions, Oct. 23-28, 1988, Szczyrk, Poland*. Archivum Combustionis. Vol. 9: No. 1/4, Page 389-403.
173. Smith et al. (1994). The Effect of Underground Mining Conditions on the Activation of Automatic Sprinklers. Report of Investigations 9492. United States Department of the Interior, Bureau of Mines, Pittsburgh Research Center, Pittsburgh, PA. 17 pages.

174. Smith et al. (1993). The Effect of Ventilation on the Water Spray Pattern of Automatic Sprinkler Heads. Report of Investigations 9459. United States Department of the Interior, Bureau of Mines, Pittsburgh Research Center, Pittsburgh, PA. 16 pages.
175. du Plesis et al. (2001). Evaluation of the Bagged Stone Dust Barrier Effectiveness in a Board and Pillar Mine. Chapter 81, *Proceedings of the 7th International Mine Ventilation Congress*, Ed. Stanislaw Wasilewski, June 17-22, 2001, Cracow, Poland. 8 pages.
176. 2007-03-28: Response-Mutmansky, NIOSH communiqué
177. 2007-03-28: Response – Tien, NIOSH communiqué
178. 2007-03-28: Response-Weeks, NIOSH communiqué
179. Egan, M. (1994). Combustion Products from Thermal Decomposition of Electrical Cable Jackets and Splicing Materials draft submitted for publication on April 29, 1994. 34 pages.
180. The Nose vs Atmospheric Monitoring Systems, communiqué from Dave Litton
181. James F. Kohler, Branch Chief, Solid Minerals. Comments for the – Technical Study Panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. United States Department of the Interior, Bureau of Land Management, Utah State Office, P.O Box 45155, Salt Lake City, UT 84145. Submitted May 11, 2007.
182. Resume of Hamid Maleki, Ph.D., roof control expert
183. Presentation: Laine Adair, Tuesday, May 15 at the Aberdeen Mine. same May 2, 2007 as the presentation on Thursday, May 17.
184. Presentation: Pete Wyckoff, Arch Western Resources, LLC, Tuesday May 15, 2007, West Elk Mine given at the Skyline Mine visit.
185. Presentation: Gene DiClaudio, Arch Western Bituminous Group, Tuesday, May 15, 2007.
186. Presentation: Wes Sorensen, Skyline Mine, Tuesday, May 15, 2007.
187. Tjernlund, D. (2006). B.E.L.T. Method Evaluation of Aracoma Alma No. 1 Conveyor Belt Samples Recovered After the January 19, 2006 Fatal Belt Conveyor Fire. PAR 0093903, U.S.DOL/MSHA. MSHA Technical Support Approval and Certification Center, Triadelphia, WV. May 9, 2006. 8 pages.
188. MSHA Questions May 2007. Possible Questions for MSHA Panel.
189. Mine Safety and Health Administration. (2007). Technical Study panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. Transcript of Proceedings. Salt Lake Plaza Hotel, 122 West South Temple, Salt Lake City, Utah. May 16, 2007. 185 pages.
190. Presentation: William, Francart (MSHA), ARACOMA BAC OVERVIEW 2.ppt
191. Presentation: Jeff McKenzie, Bureau of Land Management – Utah State Office.
192. Presentation: Link Derick, Colorado Mining Association.

193. Mine Safety and Health Administration. (2007). Technical Study panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. Transcript of Proceedings. Salt Lake Plaza Hotel, 122 West South Temple, Salt Lake City, Utah. May 17, 2007. 198 pages.
194. Presentation: Gary L. Skaggs, Agapito Associates, Inc., 626-01 MSHA Two Entry Presentation May-17-07.ppt; 70 slides.
195. Agapito, J. and Goodrich, R. Five Stress Factors Conducive to Bumps in Utah, USA, Coal Mines. Ninth International Congress on Rock Mechanics, Paris, France, 25–28 August 1999. Also was to be presented at the 19th Conference on Ground Control in Mining, Morgantown, West Virginia, August 8-10, 2000. 8 pages.
196. DeMarco et al. (1988). Characterization of Chain Pillar Stability in a Deep Western Coal Mine – Case Study. Society of Mining Engineers Prepring 88-76. For presentation at the SME annual Meeting, Phoenix, Arizona, January 25-28, 1988. 14 pages.
197. Gilbride, L. and Hardy, M. (2004). Interpanel Barriers for Deep Western U.S. Longwall Mining. 23rd International Conference on Ground Control in Mining, Morgantown, West Virginia, August 3–5, 2004. 8 pages.
198. Haramy, K. and Kneisley, R. (1990). Yield pillars for stress control in longwall mines – case study. International Journal of Mining and Geological Engineering. 8:287-304.
199. Harvey, J. and Palacios, J. (1987). Two-Entry Development for Longwall Mining. December 10, 1987. Submitted by Gary Skaggs. 11 pages.
200. Presentation: Utah Mining Association 1 – Hamid Maleki, President, Maleki Technologies, Inc.
201. Presentation: Utah Mining Association 2 – David Litvin, President
202. Presentation: Utah Mining Association 3 - Laine Adair – written statement
203. Presentation: Utah Mining Association 4 – Laine Adair – incomplete presentation slides
204. Presentation: Utah Mining Association 5 - George Kenzy
205. Presentation: Utah Mining Association 6 - Kevin Tuttle
206. Presentation: Utah Mining Association 7 - Charles Reynolds – no written statement
207. Presentation: Utah Mining Association 8 - Wendell Christensen
208. Presentation: Utah Mining Association 9 - James Poulson
209. Presentation: Utah Mining Association 10 - Gary Leaming
210. Presentation: Utah Mining Association 11 - Carl Pollastro – no written statement
211. Presentation: Utah Mining Association 12 - Doug Johnson
212. Two day meeting sign-in sheets
213. Agenda for the 2 day meeting.

MEETING 4 – June 20 through 21

Best Western Birmingham Airport Hotel,
5216 Messer Airport Highway,
Birmingham, AL 35212

214. Mine Safety and Health Administration. (2007). Technical Study panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. Notice of Meeting. *Federal Register*. 72(May 2, 2007): 31347-31348.
215. Mine Safety and Health Administration. (1985). Two Entry Longwall Mining Systems. – A Technical Evaluation, Prepared for David Zegeer, Assistant Secretary for Mine Safety and Health, by the MSHA Task Force on Longwall Mining, R. L. Ferriter, Chairman. Arlington, Virginia. June 12, 1985. 112 pages.
216. Submission: Standard comparison (2007). Compilation of worldwide belt testing standards compiled by Tong Wang and Geoff Normanton of Fenner Dunlap, April 2007. 7 pages.
217. Conti, R. and Litton, C. (1993). Effects of Stratification on CO levels from Mine Fires. 6th U.S. Mine Ventilation Symposium. Chapter 73, Pages 489-494.
218. Edwards, J. and Friel, G. (1996). Comparative In-Mine Evaluation of CO and Smoke Detection. USBM Report of Investigation 9622. 13 pages.
219. Edwards et al. (2006). CO Dispersion from a Coal Fire in a Mine Entry. 11th U.S. Mine Ventilation Symposium. 7 pages.
220. Warner, B. (1974). Suppression of Fires on Underground Coal Mine Conveyor Belts. Walter Kidde & Company, Inc. Belleville, N.J. USBM Contract Final Report (Contract No. H0122086). Department of the Interior, Bureau of Mines, Washington, D.C. September 13, 1974. 109 pages.
221. Mitchell et al. (1967). Fire Hazard of Conveyor Belts. Report of Investigations RI-7053. U.S. Department of the Interior, Bureau of Mines. December 1967. 19 pages.
222. Mine Safety and Health Administration. (2007). Technical Study panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. Transcript of Proceedings. Best Western Airport Hotel, 5216 Messer Airport Highway in Birmingham, Alabama. June 20, 2007. 373 pages.
223. Presentation: American Mine Research (David Graf, Bob Saxton, and Jim Gunnoe)
224. Presentation: Pyott-Boone (Doug Coon)
225. Presentation: Rel-Tek Corporation (Al Ketler)
226. Presentation: Conspec Controls (Rob Albinger)
227. Presentation: Mine Tour, No. 4 Mine belt air issues (T. McNider)

227(a) – Booklet of JWR presentations (incomplete)
228. Presentation: JWR No. 7 Mine belt air issues (Keith Pylar)
229. Presentation: AMS at JWR (Randy Watts/Tommy McNider)
230. NMA- (Bruce Watzman) – only oral presentation
231. CONSOL Energy- (Dr. Pramod Thakur) – only oral presentation
232. Presentation: Alpha Natural Resources- (David Decker)
232(a) – copy of oral statement
233. Presentation: Arch Coal- (Patrick Leedy, Greg Dotson, and Bill Olsen)
234. Presentation: Utah American Energy, Incorporated (Jim Poulson)
235. Presentation: Alpha Engineering Services-(Gary Hartsog)
236. Presentation: Goodyear- (David McGuire)
237. Mine Safety and Health Administration. (2007). Technical Study panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. Transcript of Proceedings. Best Western Airport Hotel, 5216 Messer Airport Highway in Birmingham, Alabama. June 21, 2007. 226 pages.
238. Presentation: C. David Litton; NIOSH on belt fire detection sensors and state-of-the-art smoke sensors.
239. Morrow, G. and Litton, C. (1992). In-Mine Evaluation of Smoke Detectors. Information Circular 9311. U.S. Department of the Interior. Bureau of Mines, Pittsburgh, PA. 18 pages.
240. Presentation: Launa Mallett; NIOSH , Effective training techniques for emergency response preparedness (for AMS operators and in general for underground miners)
241. Vaught et al. (2000). Behavioral and Organizational Dimensions of Underground Mine Fires. Information Circular IC-9450. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Pittsburgh Research Laboratory, Pittsburgh, PA. May 2000. 240 pages.
242. Peters, R. (2002). Strategies for Improving Miners' Training. Information Circular IC-9463. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Pittsburgh Research Laboratory, Pittsburgh, PA. September 2002. 57 pages.
243. Vaught et al. (2004). An Oral History Analysis of Mine Emergency Response. Information Circular IC-9471. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Pittsburgh Research Laboratory, Pittsburgh, PA. April 2004. 77 pages.
244. Mallett et al. (1999). The Emergency Communication Triangle. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational

Safety and Health, Pittsburgh Research Laboratory, Pittsburgh, PA.DHHS (NIOSH) Publication Number 99-157. October 1999. 17 pages.
245. United Mine Workers of America – Joe Weldon, Dwight Cagle, Larry Turner, Glen Loggins, and Tome Wilson) – No written Comment]
245(a) - Mine Citation/Order 7688586 JWR #4 Mine, dated 9/6/2006. 1 page.
246. Presentation: Center for Regulatory Effectiveness- (Bruce Levinson)
247. Presentation: Jim Walter Resources- (Dale Byram) – No written statement
248. Two day meeting sign-in sheets
249. Agenda for the 2 day meeting.
250. Comment from William B. Bookshar, P.E., Received by MSHA via email on July 1, 2007. 3 pages.
251. Polack, S. (1956). Research to develop a schedule for testing conveyor belts for fire resistance. U.S. Department of the Interior, Bureau of Mines, Pittsburgh, Pennsylvania. Presented at 9th International Conference of Directors of Safety in Mines Research, Heerlen, Netherlands and Brussels, Belgium. June 28 – July 4, 1956. 29 pages.
252. Verakis, H. (2007). Conveyor Belt Fire Test Methods—A Review and Analysis. MSHA Technical Support, Approval and Certification Center, Triadelphia, West Virginia. August 2007. 32 pages.
253. Comment received by MSHA on 8/14/07 from Joseph A. Sbaffoni, Director of the Bureau of Mine Safety. Pennsylvania Department of Environmental Protection, Uniontown, PA, dated August 9, 2007. 3 pages.

MEETING 5 – September 17 through 19

Sheraton Reston Hotel
11810 Sunrise Valley Drive,
Reston, Virginia 20191

254. Mine Safety and Health Administration. (2007). Technical Study panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. Notice of Meeting. *Federal Register*. 72(August 1, 2007): 42132.
255. Proposed Recommendations, Technical Study Panel.
256. Mine Safety and Health Administration. (2007). Technical Study panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. Transcript of Proceedings. Conference Room 5. Sheraton Reston, 11810 Sunrise Valley Drive, Reston, Virginia, 237 pages. September 17, 2007.
257. Mine Safety and Health Administration. (2007). Technical Study panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. Transcript of Proceedings.

Conference Room 5. Sheraton Reston, 11810 Sunrise Valley Drive, Reston, Virginia, September 18, 2007. 191 pages.
258. Presentation: Dr. Felipe Calizaya' - Draft recommendations 14, 15, and 16.
259. Mine Safety and Health Administration. (2007). Technical Study panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining. Transcript of Proceedings. Conference Room 5. Sheraton Reston, 11810 Sunrise Valley Drive, Reston, Virginia, September 19, 2007. 164 pages.
260. Final Recommendations, Technical Study Panel.
261. Three day meeting sign-in sheets
262. Conti et al. (2005). Fire Response Preparedness for Underground Mines. Information Circular IC-9481. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Pittsburgh Research Laboratory, Pittsburgh, PA. December 2005. 25 pages.
263. Mine Safety and Health Administration. (1992). Belt Air Advisory Committee, Sixth Meeting, Volume I, Ramada Renaissance Hotel, Gallery II Ballroom, 950 North Stafford Street, Arlington, Virginia. Wednesday, September 9, 1992. 265 pages.
264. Mine Safety and Health Administration. (1992). Belt Air Advisory Committee, Sixth Meeting, Volume II, Ramada Renaissance Hotel, Gallery II Ballroom, 950 North Stafford Street, Arlington, Virginia. Thursday, September 10, 1992. 228 pages.
265. Mine Safety and Health Administration. (1992). Belt Air Advisory Committee, Sixth Meeting, Volume III, Ramada Renaissance Hotel, Gallery II Ballroom, 950 North Stafford Street, Arlington, Virginia. Friday, September 11, 1992. 157 pages.
266. Krog et al. (2006). Predicting methane emissions from longwall faces by analysis of emission contributors. Proceedings, 11th U.S./North American Mine Ventilation Symposium, Taylor & Francis, London, pp. 383-392.
267. Mine Safety and Health Administration. (1999). Updated Preliminary Regulatory Impact Analysis And Regulatory Flexibility Analysis, Proposed Rule on 30 CFR Part 14 and 30 CFR §§ 75.1108 and 75.1108-1, RIN 1219-AA92, Proposed Requirements for the Approval of Flame-Resistant Conveyor Belt Rule. December 1999. 95 pages.
268. Mine Safety and Health Administration. (2007). Internal Review of MSHA's Actions at the Aracoma Alma Mine #1, Aracoma Coal Company, Inc., Stollings, Logan County, West Virginia, June 28, 2007. 233 pages.
269. Timko, R. and Thimons, E. (1982). Sulfur Hexafluoride as a Mine Ventilation Research Tool- Recent Field Applications. Research Investigation RI-8735, U.S. Bureau of Mines, Washington, DC, 19 pp.
270. Fiscor, S. (2007). U.S. Longwall Census. *Coal Age*, Vol. 112, No. 2, pp. 30-38.

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