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From: Linda Raisovich-Parsons [mailto:lparsons@umwa.org]
Sent: Monday, September 08, 2008 3:25 PM
To: zzMSHA-Standards - Comments to Fed Reg Group
Subject: RIN 1219-AB59

Attached are the comments of the United Mine Workers of America on the Proposed Rule for Safety Standards Regarding the Recommendations 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.

AB59-COMM-11

United Mine Workers of America

TELEPHONE
(703) 208-7200

UNITED MINE WORKERS' HEADQUARTERS
8315 LEE HIGHWAY
Fairfax, VA
22031-2215

September 8, 2008

Ms. Patricia Silvey
Office of Standards, Regulations, and Variances
Mine Safety and Health Administration
1100 Wilson Blvd., Room 2350
Arlington, VA 22209-3939

Dear Ms. Silvey,

Attached are the comments of the United Mine Workers of America on the Proposed Rule for Safety Standards Regarding the Recommendations 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. Also included are attachments for reports referenced in our comments.

The UMWA appreciates the opportunity to participate in this important rulemaking and asked that you forward our comments to the appropriate person(s) for consideration.

Sincerely,

Dennis B. O'Dell

Dennis O'Dell, Administrator
UMWA Department of Occupational
Health and Safety

Comments of the United Mine Workers of America on 30 CFR Parts 6, 14, 18 et al. Safety Standards Regarding the Recommendations 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; Conveyor Belt Combustion Toxicity and Smoke Density; Proposed Rules

Part 14-Approval of Conveyor Belts in Underground Coal mines

Introduction

The Union has historically maintained its opposition to the use of belt entries to ventilate the working section. The Union believes that legislative history of the Mine Act makes clear that these entries are the most susceptible to fires and should not be used to ventilate the working areas. However, MSHA has ignored this mandate and permitted the use of these entries for ventilation. In the past, the operators were permitted to use belt air through MSHA's approval of a rubber-stamped petition for modification which required an Atmospheric Monitoring System to "equal the protection of the standard." Then MSHA adopted a rule that allowed all operators to use belt air without even petitioning so long as certain conditions are met. The Union believes that no company should be permitted to use belt air unless there are extraordinary circumstances which create a "tradeoff" of safety if belt air is not used. Even in such situations, the operator must demonstrate that this both presents the safest option and includes other protections of miners before belt air use is authorized. These operations must be held to a "higher standard" with enhanced measures for detection and prevention as outlined in our comments on this proposal. Under any circumstance, outside of extraordinary mine conditions, belt air is inherently unsafe and should not be permitted, as was intended by Congress.

Mine fires such as the one at the BethEnergy Mines, Inc. Marianna Mine No. 58 in 1988 and the Aracoma Coal Company Alma No. 1 Mine in 2006 prove that the use of belt entry ventilation can be deadly. At Marianna, the belt atmospheric monitoring system provided two early alarms, both of which quickly cleared a little over one hour before the major fire erupted. Because the alarms cleared, they were ignored by everyone involved. The Union is convinced that the velocity of air current in the belt entry was responsible for these alarms clearing and subsequently being ignored. If someone had checked for the source of those early alarms, the mine fire likely would have been detected before becoming unmanageable and the mine might be working today. The Marianna fire is a prime example of how quickly a belt fire in an entry with belt air can get out of control. MSHA's report of this fire indicates that the fire began to propagate down the belt and to generate large volumes of smoke about 20 minutes after it was discovered burning. That was about the same time the persons located on the affected working sections were notified of the fire. The crews placed machinery in a safe place and de-energized the section before proceeding

out of the mine. In that short time period, the fire became so out of control the miners barely were able to escape. The smoke from the fire entered the intake track entry and then leaked into the intake escapeway. The intake escapeway entry was at a lower pressure and the return was located adjacent to the escapeway. Smoke quickly leaked through the stoppings into the intake escapeway as the air traveled toward the adjacent return entry. This resulted in the miners from three working sections having to escape through a smoke-filled escapeway only twenty minutes after the fire was discovered. It was lucky that everyone got out safely. The Union believes that the velocity of air in the belt entry did contribute to this near miss, even though MSHA did not acknowledge this fact. The volume of air passing over the belt drive cleared the smoke, causing the early alarms to be ignored and also propagating the fire quickly to an out of control stage. (Report attached).

The miners at Marianna were lucky to escape, however that was not the case at the Aracoma Coal Alma No. 1. Ventilation controls that should have been there were missing between the belt entry and the primary intake escapeway which permitted smoke to contaminate the escapeway entry. Two miners became separated from their crew as they tried to escape through thick black smoke in their primary intake escapeway. MSHA's report indicated that the air direction on the longwall belt was not traveling in the proper direction: air was traveling outby toward the discharge instead of inby toward the longwall working sections. It further indicated that the No. 2 section was utilizing air that ventilated the No. 2 section 48-inch belt conveyor as a supplement to face ventilation. No device was provided on the section to alert persons of rising carbon monoxide levels. In other words, they were using belt air to ventilate, but provided no atmospheric monitoring system or other protections. The Union questions how MSHA could have accepted that plan. It appears that this Aracoma mine was ventilating with belt air but was not required to have an atmospheric monitoring system. Further there were openings between the belt entry and the intake escapeway, which permitted thick black smoke to enter the miners' escape route. As recently as August 2008 another belt fire occurred in West Virginia at one of the A.T. Massey mines. The Union does not have many details on this incident except that it was a belt fire and miners had to once again escape through smoke. The time is now to promulgate regulations to protect miner from belt fires. How many more miners need lose their lives before adequate protections will be required?

The Union's comments on this proposal follows:

Proposed § 14.1 is derived from existing § 18.1. Part 14 would establish new flame resistance requirements for MSHA approval of conveyor belts for use in underground coal mines. It would also allow applicants for approval, approval holders and those seeking extensions a one-year phase-in period to continue to use the acceptance criteria in existing Part 18. During this period, approval holders could apply for a Part 18 acceptance or a Part 14 approval. The Agency specifically solicits comments on the impact of the one-year transition period on inventories and associated costs to approval holders.

The Union would insist that upon the effective date of this rule, any purchases made from that day forward would have to be approved and comply with new part 14. The operator should only be permitted to use existing belts in use that have been approved under existing Part 18 or already purchased and in stock, only until replacement is necessary.

Proposed 14.3, derived from 18.9(a) would limit the individuals who may be present during testing and evaluation to MSHA, representatives of the applicant, and other persons as agreed upon by MSHA and the applicant.

The Union would like to point out that it is the miners who have the most at risk since they will be exposed to these belts on a day-to-day basis. Historically, it has been the miners, not MSHA or representatives of the applicant who have died as a result of mine fires such as those that occur on beltlines. Because of this, the Union believes that miners (or representatives of the miners) should be allowed to observe and evaluate the testing of these belts. Proprietary protection can still be afforded regardless of who is present during such testing and evaluation. This would not only raise the confidence level of the miners in knowing that these conveyor belts meet or exceed the expectations of this rule, but also because of the miners work experience, they may be able to contribute helpful information during such testing that may further enhance the product.

Proposed § 14.4(b)(4) would require that an application for approval of a conveyor belt similar to a previously approved conveyor belt include an explanation of any changes from the existing approval, along with the approval number of the belt being changed. Documentation, which is listed in the prior approval, would not need to be resubmitted.
The example MSHA gave was if a manufacturer submits a 5-ply belt that is identical, except in number of plies that has been previously approved, to a family of belts with 3, 4, and 6, MSHA would likely grant an extension of approval without additional testing.

The Union opposes this proposal as drafted. It is confusing. If the Agency is saying that having tested a low number of ply belt and a high number of ply belt from the same manufacturer with everything being the same as the example given, and may approve a belt with a number of plies somewhere in between, it may make sense. MSHA should keep in mind that the number of plies bears a strong relationship to how that particular belt will function. For example, if a belt gets hung up in a belt drive with the drive rollers spinning, the belt will become hot, smoke, and may melt or burn. The thickness of the belt and the number of plies will determine how quickly a belt will melt, burn, or separate. Because of this, MSHA should take the safe approach and test <u>all</u> belt products, regardless of the number of plies to see how each one reacts under a controlled lab test, rather than find out later during a belt mine fire after it's too late.

Proposed 14.7(d) Maintain sales records for 5 years following the initial sale of any approved belt.

The Union urges that the sales records be kept as long as the belt is in use, whether it be at the operation it was originally purchased or other locations. A belt may sit at a mine operations shop, warehouse, or supply yard for a period longer than 5 years before installation. To keep the record straight, the Union seeks MSHA to mandate and enforce that all sales records follow the belt from the time of purchase to its grave. In the event that one operator would transfer or purchase used belts to another operator, which happens often between many small and large operators, the original purchase or sales records should be transferred with that belt and made a part of MSHA's record keeping provisions.

Proposed § 14.10, derived from existing §§ 6.10 and 7.8, would provide a mechanism for MSHA to periodically audit approved conveyor belts. Proposed § 14.10(a) would provide that approved conveyor belts be subject to periodic audits by MSHA to determine conformity with the technical requirements upon which the approval was based. MSHA would select representative conveyor belts to be audited. Upon request to MSHA, the approval holder may obtain any final audit report.

The Union would also like to add that these reports shall be provided to the representative of miners and the operator be required to post a copy on the mine bulletin board to be made available for all interested parties.

Proposed § 14.10(b) would require that approval holders make conveyor belts available to MSHA, at no cost, for audit upon request. Three samples sized according to § 14.5 would be required. Audits may be conducted no more than once a year, except for cause. The approval holder may observe any tests conducted during the audit.

The Union would insist that the representative of miners be given the same opportunity to be present during any testing or audit by the Agency.

Proposed § 14.10(c) would require manufacturers to allow MSHA to conduct an audit for cause at any time the Agency believes that an approved product is not in compliance with the technical requirements of the approval. Audits would allow MSHA to determine whether products are being manufactured as approved. MSHA would select the product, and may, if necessary, obtain products from sources other than the manufacturer such as
distributors or wholesalers.

The Union supports these audit procedures. Further, because of the fact that these defects could place miners lives at risk, the Union would insist that a prompt notice of the findings of such audits be made available to all interested parties, including the miner's representatives.

Proposed § 14.11(d) would provide for immediate suspension of the approval of the product without prior written notice to the approval holder if the product poses an imminent danger or hazard to the safety or health of miners. The suspension may continue until revocation proceedings are completed. Consistent with MSHA's practice, once an approval is suspended, MSHA would notify the public of this action through recall notices on its Web site at *http:// www.msha.gov*. All affected products must be removed immediately from underground coal mines, and MSHA would initiate enforcement action for failure to do so. MSHA believes that it must have the capability to order removal of noncompliant belt if an imminent hazard is created. Removal would protect miners from potential injury and life-threatening fire hazards.

The Union agrees with this section knowing that from time to time a tested product may eventually fail or need recalled. Because there are numerous members of the mining community that still do not use or have access to the web, the Union would insist that as well as the web, other means also be utilized for the purposes of providing meaningful notifications to the public.

Proposed 75.1108 allows for a period of one year, mine operators the option of using conveyor belts which have been accepted under existing part 18, or have been approved under new part 14. **We believe PVC belts and other plastic belts, that have been previously approved under this existing part 18, should be banned from use and removed as an acceptable conveyor belt when this rule takes effect. Too many miners have been taken to the hospital as a result of poisonous smoke fumes produced from these types of belts when these belts get over heated and smoke. Some operators have already discontinued using these belts and removed them from their properties. MSHA needs to re-evaluate belts that have been previously approved. The Union would further like to add comment and ask for further clarification on the one year option period. During this one year, there is nothing written to prohibit mine operators from purchasing and stockpiling enough belt from manufacturer's to last them for a number of years to follow, thereby not protecting miners <u>indefinitely</u> with the safer improved belt otherwise required by this rule. The Union would insist that upon the effective date of this rule, any purchases made from that day forward would have to be for approved belts that fully comply with new part 14. The operator should only be permitted to use existing belts already in use that have been approved under existing part 18 or already purchased and in stock, and only until replacement is necessary.**

Proposed 75.156(a) would require that to be qualified as an AMS operator, a person shall be provided with task training in accordance with the mine operators' approved part 48 training plan. **The Union insists that these training classes are not included in the already over crammed part 48 annual retraining classes. Part 48 training has had many additional requirements added without expanding the required time. This reduces the effectiveness of all the required training and should not be even further affected with the new training requirements of this rule. The Union believes that this training should be a separate and distinct training class for the purposes of the training of the AMS operator on his/her duties. The operator should be required to furnish to the representative of the miners a copy of the training plan fourteen (14) working days prior to its submission to the District Manager. Written comments from the miners' representative may be submitted directly to the District Manager for consideration prior to approving the plan. A copy of the approved plan should be required to posted on the mine bulletin board for access to all parties.**

75.156 states that training of AMS operators should be included in training under Part 48 which requires 40 hours training in mine health and safety at the start of employment and 8 hours annual refresher training. AMS operators should receive training under Part 48, just as any miner should but not for operating the AMS. Training on operating the AMS system is task training, not training in hazard recognition and avoidance. Making it part of Part 48 training would simply add to an already congested training agenda.

Section **75.323—Actions for Excessive Methane.** In Recommendation 18, the Panel stated that methane liberated from ribs along the belt, or from the broken coal on the belt, can present significant safety hazards. The Panel stated that if methane levels in the belt air course are too high to provide dilution of methane liberated at the working sections, then the use of the air from the belt entry to ventilate a working section should be discontinued. The proposed rule does not include specific requirements for this panel recommendation, but MSHA sought comment. **The Union agrees with the panel's recommendation that the District Manager must regularly evaluate any working section that has any methane reading in the belt entry at or above 0.5% measured 200 feet outby the dumping point tailpiece on the section. A physical check with a handheld methane detector should be required to be made on the same frequencies as the normal production examination fireboss runs or more often if necessary. An AMS sensor capable of recording levels of methane should also be installed at this point consistent with Panel recommendation 18. Corrective action shall be made whenever methane levels range between 0.5% and 1.0% at the key locations where these mandatory readings shall be made. The existing standard for the allowable limits for methane of 1% can remain in effect for the remaining portions of the belts <u>except</u> in areas where power is present, for example belt drives, transfer points, and pumps, at which point corrective action shall be made whenever methane levels range between 0.5% and 1.0% .**

Proposed 75.333 (c) (4)

Section 75.333(c)(4)—Ventilation Controls Proposed § 75.333(c)(4) is a new provision that addresses Panel Recommendation 14 dealing with airlock doors. High pressure differentials on doors can lead to serious injuries to miners opening and closing these doors. Providing an airlock between entries provides a safe means for miners to travel between two air courses. **The Union agrees with the panel's recommendation. The airlocks should not exceed 1000-foot distances between each one. These airlocks should be placed so that miners have access to them along their entire fresh air escape route to the outside.**

Section 75.350—Belt Air Course Ventilation

Proposed § 75.350(a)(2) would include a new requirement that the minimum air velocity in the belt entry be at least 50 feet per minute. MSHA has included this new requirement because of proposed § 75.1103–4 (fire detection systems) which, consistent with the Panel's recommendation, would prohibit point-type heat sensors for early-warning and detection of conveyor belt fires, and require the carbon monoxide fire sensor systems in all belt entries. Under this proposal, lower velocities could be requested by the mine operator in the ventilation plan in areas where the minimum velocity cannot be maintained. Where the District Manager approves such a plan, carbon monoxide sensor spacing would have to be reduced to no greater than 350 feet. NIOSH research and Agency experience show that the reduced spacing is necessary to assure carbon monoxide resulting from a fire is moved quickly from a fire to downwind sensors. Proposed § 75.350(b) addresses Panel Recommendation 7, which states that MSHA should evaluate, as part of the approval of the mine ventilation plan, the safety of the use of air in the belt entry to ventilate working sections. The Panel further stated that the District Manager must take special care to evaluate whether the air from the belt entry can be routed to the working face in a manner that is safe for all miners involved. Under the proposal, MSHA would revise existing § 75.350(b) to require that the use of air from a belt entry to ventilate a working section be permitted only when evaluated and approved by the District Manager in the ventilation plan. Under the proposal, the mine operator would have to provide information in the plan that the use of air from the belt entry affords at least the same measure of protection where belt haulage entries are not used to ventilate working places. This position of the rule relies on a significant misrepresentation of the Panel's findings. The Technical Study Panel did not generally endorse the use of belt air. Instead, it pointed out numerous problems with belt air. **In the past, MSHA simply rubber-stamped a boilerplate petition for modification for use of belt air so long as the operator installed an Atmospheric Monitoring System. The Union agrees with the Panel that operators must provide a valid "extraordinary" reason before the use of the belt entry for ventilation to the section is ever authorized. Then and only then should the Agency even consider approving such practices.**

Current Section 75.350 is derived without substantive change from Section 303(y) of the Federal Coal Mine Health and Safety Act of 1969 (Coal Act). Both the Senate and House versions of Section 303(y) included belt and trolley haulage entries within the coverage of the same section. Both the Senate and House versions of the bill required

physical separation of belt and trolley haulage entries from intake and return aircourses, required air velocities to be limited in belt and trolley haulages entries, and prohibited these entries from being used to provide ventilation to working places. Both versions of the bill also included the existing distinction between mines opened prior to the effective date of the provisions and those opened after. In reporting its version of the bill, the Senate stated: "The objective of the section is to reduce high air velocities in trolley and belt haulageways where the coal is transported because such velocities fan and propagate mine fires, many of which originate along the haulageways. Rapid intake air currents also carry products of the fire to the working places quickly before the men know of the fire and lessen their time for escape. If they use the return aircourses to escape, the air coursed through may contain these products and quickly overtake them. Also, the objective is to reduce the amount of float coal dust along belt and trolley haulageways. In some mines, it is not possible to isolate the intake and return airways from the haulageways. The latter is particularly true in a two or three entry system where the haulageway, of necessity, must be used to ventilate the face. Even in a multiple entry system of more than three entries, in some cases the haulageway runs for miles and some parallel entries may be blocked or partially blocked from roof falls, particularly in low coal, and, in such cases, it is not practical to open such entries. While it is necessary to reduce the velocity of air in the haulageway, complete elimination of air in the haulageway is not desirable, because it would create a new hazard. Some air is essential. The air velocity however, must be limited to an amount sufficient to insure an adequate supply of oxygen in the haulageway, to protect the health of miners, and to provide that the air not contain accumulations of methane." (Legislative History (Leg. Hist.) of the Federal Coal Mine Health and Safety Act of 1969, (1969 Coal Act) S. Rept. No. 91-411, 9lSt Cong., lst Sess., pp. 64-65) The managers on the part of the House of the 1969 Coal Act, stated: "The Senate bill provided for the separation of intake and return aircourses from belt and trolley haulages entries in the case of all mines, except where the entry system does not permit such separation, for the purpose of limiting the velocity of air coursed through these haulage entries to minimize hazards associated with fires and dust explosions originating in these haulageways. The House amendment required such separation from belt haulage entries and, in the case of new mines and in new working sections of existing mines, the Secretary, where there are trolley haulage systems, shall require a sufficient number of entries or rooms as intake aircourses in order to limit the velocity for the purposes mentioned above. The conference agreement adopts the House provision, but the intention of the managers that the Secretary carefully review this problem with a view to devising improved requirements for minimizing these hazards to the miners at the working faces from high velocities along belt and trolley haulageways on intake air. (Emphasis added) (Leg. Hist. 1969 Coal Act, House Rept., No. 91-563, 9lSt Cong., lst Sess., p. 1525) In discussing the summary of the 1977 Mine Act, the Senate Report stated: "The Secretary can promulgate new standards, if needed, but new standards in areas covered by existing standards cannot reduce existing levels of protection." (Leg. Hist. 1977 Mine Act, Sen. Rept., No. 95-181, 95th Cong., lst Sess., p. 599) The Senate Report further stated: "As is the case under the Coal Act, S. 7 7 requires that all new or revise standards promulgated by the Secretary must afford the same level of

protection which is provided by current standards." (Leg. Hist. 1977 Mine Act, Sen. Rept., No. 95-181, 95* Cong., lst Sess., p. 61 1) The UMWA is convinced the use of the belt entry to ventilate active workings will inevitably increase the dust levels reaching such areas. This will result in increased exposure of miners to respirable coal mine dust that will be carried in the air current to the active work areas after being coursed through the belt entry. The use of belt air ventilation may be another reason why we see the increased number of cases of black lung that NIOSH has uncovered in the last year. Section 303(b) states in pertinent part, "the Secretary shall prescribe the minimum velocity and quantity of air reaching each working face of each coal mine in order to render harmless and carry away methane and other explosive gases and to reduce the level of respirable dust to the lowest attainable level." The Union is concerned as we have always been in our past testimonies before MSHA and Congress, that the allowing belt air to be coursed to the section will continue to have a significant and detrimental impact on miners.

In studies conducted by NIOSH - Analysis of Mine Fires for All U.S. Underground and Surface Coal Mining Categories, statistics indicated that the most frequent fire location was the belt entry. For fires occurring between 1990-1999, a total of 24 fires were located in the belt entry. In another NIOSH Analysis of Mine Fires for the years 1978 -1992, once again the belt entry was the location of the most mine fires. (See reports attached) Consequently it is an undisputed fact that the belt entry is the most likely location for an underground mine fire. If these entries are to be used for ventilation to the working section, the mines doing so must be held to a higher standard. Historically, MSHA has permitted the use of belt entry ventilation if the operator installed an Atmospheric Monitoring System to detect the fire. The Union believes that any mine using belt air must be held to a higher standard by not only using detection measures, but also requiring additional fire prevention measures. The operator further must be required to provide additional measures to protect the miners' escapeway from the possibility of smoke from a belt fire contaminating the miners' escape.

MSHA solicits comments "related to circumstances in which the District Manager does not approve the continued use of belt air to ventilate active workings." The Agency should be focused on the intent of the Mine Act which mandated that belt air passages not be used to ventilate the active workings. The Agency rather asks the public to justify why they should not continue this practice and under what circumstances they should not approve the continuation of this practice. The Agency instead should be asking what reasons the operator has for using belt air and then should only be approved for "extraordinary" circumstances. They should not be questioning under what circumstances should they not continue this practice, but rather how those who wish to use belt air can justify why they need to do so as is the intent of the Mine Act.

Proposed § 75.350(a)(2) would include a new requirement that the minimum air velocity in the belt entry be at least 50 feet per minute. MSHA has included this new requirement because of proposed § 75.1103–4 (fire detection systems) which, consistent with the Panel's recommendation, would prohibit point-type heat sensors for early-warning and detection of conveyor belt fires, and require the carbon monoxide fire sensor systems in all belt entries. **The Union agrees with this proposal with exception.**

Under the proposal, lower velocities could be requested by the mine operator in the ventilation plan in areas where the minimum velocity cannot be maintained. Where the District Manager approves such a plan, carbon monoxide sensor spacing would have to be reduced to no greater than 350 feet. NIOSH research and Agency experience show that the reduced spacing is necessary to assure carbon monoxide resulting from a fire is moved quickly from a fire to downwind sensors. The Union would insist that prior to an approval being granted for such a request, an underground investigation is to be conducted to validate the need. MSHA will need to insure that there will be full participation during the investigation by all interested parties, including the representative of miners. The information should then be sent to the Assistant Secretary for review before approval is granted. The UMWA has often argued that the safest method of controlling the hazards associated with the belt entry is to have it isolated from all other entries. Our position has not changed, however, the Agency has approved mining plans that allow for multiple entries in common with the conveyor belt entry. Because of that, the Union believes carbon monoxide monitors and smoke detectors should be required in each these entries at intervals no greater than those in the conveyor belt entry. Entries in common with the conveyor belt entry should be deemed part of the coal haulage system and protections should be applied as if they were. In a previous hearing in belt air, Miner, Floyd Campbell expressed his concerns regarding MSHA decision in the proposed rule to change the frequency of calibration inspections. "Also, they were changing the inspections of calibrations from 7 to 10 days, that would be a decrease in the percent in number over the length of a year, from 52 to 36. I don't think that's a good idea to decrease the number of inspections for anything." The UMWA contends that increasing the time between, and reducing the number of calibration inspections, effects a reduction to miners' safety.

Proposed 75.350 (b) Again, the Union has always gone on record saying that the use of belt air to ventilate the working sections should be banned. Since it is apparent that this is not going to happen, the Union offers comment to the approval process. These plans should require approval from MSHA's headquarters in Arlington, Virginia by the Assistant Secretary. Upon implementation, all existing plans currently in use should be immediately reevaluated by the Assistant Secretary to determine if it is necessary to continue the use of belt air as prescribed under the new criteria. The Union questions MSHA's comment on "revocation would not be effective until completion of current mining." The Union believes the revocation process should be immediate. If the operator still refuses to comply, the Agency should pull the operators mining permits and place the mine under a closure order. The Union would like for the agency to explain the section under the proposal, where MSHA would allow a 3-month delayed compliance date for mine operators to submit a revision of the ventilation plan to the District Manager. How did the agency come up with

this time period and why do they feel it necessary to give one quarter of a year to comply? The Union would also like to again go on record by saying that MSHA should never approve two entry systems.

Proposed § 75.350(b)(3) would additionally require that where miners on the working section are on a reduced respirable coal mine dust standard that is below 1.0 mg/m3, the average concentration of respirable dust in the belt entry must be at or below the lowest applicable respirable dust standard on that section. In Recommendation 17, the Panel stated that respirable coal mine 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 existing regulated concentration of 1.0 mg/m3. The Panel also stated that District Managers should have the authority to require improvements in dust control in the belt entry if the dust concentration exceeds an 8-hour TWA of 1.0 mg/m3 or raises the concentration in that section above the exposure limit If a mine operator is unable to effectively reduce the respirable dust levels in the belt entry to meet this proposed requirement, the District Manager would have the authority to revoke the ventilation plan which had allowed the use of air from the belt entry to ventilate the working section. **The Union agrees with the panels recommendation made on the reduced levels of the coal mine dust standard to be put in place of current exposures on beltlines and working sections where belt air is to be utilized. The Union would also encourage and insist that MSHA be aggressive in using their authority to revoke operators plans where compliance is not met. The Union further goes on record to put MSHA on notice that this tool must be applied to all mines large and small. Too often in the past, MSHA has only gone after the larger operations and turned a blind eye to the smaller operations. This must be applied fair and equal across the board. Before the District Manager approves any plans, the Assistant Secretary in Arlington, Virginia, and the miners representative should have ample time (14 days minimum) to review and make comments or changes before approved. Miners work different shifts and often need additional time to confer, gather information and formulate a reply. The Employers plan this in advance and miners should have time to consider and weigh in too. If operators provide early information to the miners, there should be no significant delays to the whole process.**

Proposed 75.350 (b) (7) and (b) (8) the Union for the most part agrees with the panels recommendation.

The Union would discourage MSHA from allowing the District Managers the discretion to approve exceptions to the minimum and maximum velocities without first having an in depth review by MSHA's Headquarters in Arlington, Virginia. Because of the inconsistencies of the manner in which policies have been applied by MSHA District Managers in the past, these plans should require final approval from MSHA's headquarters in Arlington, Virginia by the Assistant Secretary. This is the only way that all plans would have the same level of protection and be consistent in all MSHA Districts.

Miners representatives should be included in this process and all information made available prior to final approval allowing miners input.

Proposed 75.350 (d) (1) and (d) (7)address Recommendation 16. The Panel recommended that for mines using air from the belt entry to ventilate working sections and areas where mechanized mining equipment is being installed or removed, where possible, a second carbon monoxide sensor be installed in the primary escapeway 1,000 feet upwind of the sensor required by the existing standard. The Panel also recommended that, when these sensors detect alert or alarm levels of carbon monoxide and the mine has designated the belt as the alternate escapeway, the AMS operator should have the ability and authority to remotely close or open the point-feed regulator after consulting with the responsible person designated by the mine operator to take charge during mine emergencies. **The Union has historically opposed the use of point feeding air and continues to take the position that this practice should not be allowed. Any opening between the belt entry and the escapeway provides an avenue for contamination of the escapeway. The miners' escapeway should be the most important entry into the section and must be protected to assure a clear escape route out of the mine. MSHA acknowledges these concerns in their comments on this section, "MSHA is aware that point-feeding air from the primary escapeway to the belt entry designated as the alternate escapeway can present significant problems for miners who must evacuate the mine." The Union would like further clarification on MSHA's suggestion to allow a requirement that would allow a means to remotely open the regulator from a designated surface location and closing and re-opening of a regulator during a fire in the primary escapeway. Closure of a regulator can reduce the intake air quality on a working section, and may cause sudden and rapid increases in methane concentrations and could lead to an ignition, explosion, or spread the fire and smoke into the areas where miners may not have been fully evacuated. Sadly, we witnessed this at the recent Sago mine disaster that eventually led to the deaths of the miners trapped on the section. This type of air change should only be left up to qualified mine rescue personal and their representatives, only after full evacuation of the mine has taken place and under close evaluation and approval by the agency.**

Section 75.351(b)—Designated Surface Location and AMS Operator) Proposed § 75.351(b)(2) addresses Panel Recommendation 12. This proposal would assure that the AMS operator's other duties would not adversely affect his/her primary responsibility of responding to AMS signals. In that recommendation, the Panel indicated that the highest priority of the AMS operator should be monitoring and responding to system signals. Consistent with the Panel's recommendation, the proposal would require that AMS operators have as a primary duty of the responsibility to monitor the malfunction, alert, and alarm signals of the AMS and to notify appropriate personnel of these signals. Under the proposal, the AMS operator would not be prohibited from performing additional duties as long as the alert, alarm and malfunction signals can be seen or heard, and a timely response can be initiated. This proposal is supposed to assure that the AMS operator's other duties would not adversely affect his/her primary responsibility of responding to AMS signals. **However, the Union strongly disagrees with any provision that allows the AMS operator to perform any other duty during the time that an actual emergency situation may be taking place. During the Jim Walters Resource Mine No. 5 accident investigation that took place in 2001, we witnessed a catastrophic chain of events of mishaps and failures that took place when the communication person was also assigned to monitor the AMS system. During the period of time when this individual was required to make or receive phone calls from underground and outside personal, he became distracted to the point that he silenced the system warnings of the AMS system. We would agree that during the normal day to day operations, an individual such as a dispatcher/communication person might be able to monitor the AMS unit while performing his/her regularly assigned duties, but once an actual situation occurs that would cause this individual to perform the tasks associated with a mine disaster, there should be another responsible person assigned and immediately available who can step in to help share the work load necessary to safely evacuate the miners, notify help, and secure the mine.**

75.351(b)(2) states that the "primary duty of the AMS operator is to monitor . . . the AMS system." **We agree. What this rule does not say is that the AMS operator should be only concerned with the AMS system or that he or she should not take or be assigned duties that are not directly related to miners' safety. The TSP encountered anecdotes which described AMS operators performing duties wholly unrelated not only to the AMS system but also to health and safety in general. One incident was described in which the AMS operator was calling out for pizza delivery.**

Proposed § 75.351(e)(1)(iii), renumbered from existing §75.351(e)(3),conforms the existing standard for sensor spacing to the minimum velocity of 100 feet per minute addressed in Panel Recommendation 13. At mines using air from the belt entry to ventilate the working sections, proposed § 75.351(e)(1)(iii) would require 1,000- foot sensor spacing where the minimum air velocity of 100 feet per minute (fpm) is maintained. If the mine operator requests approval to use velocities less than 100 fpm, but at least 50 fpm, maximum sensor spacing must be reduced to 500 feet. The proposal retains the existing requirement to reduce sensor spacing to 350 feet when the minimum velocity is less than 50 fpm. **The Union would support this but only if this can be proven at the mine site with miners' representatives present. If evidence does not support this, then the request should be denied. This would be to show that the data MSHA supplied is accurate and works consistently with the mine's ventilation. A ventilation survey should be conducted with the miners' representative present to assure that this will offer the added protection suggested under this proposal.**

Proposed § 75.351(e)(1)(iv) has been revised to add the requirement that if the distance between the belt drive unit, tailpiece transfer point, and belt take-up unit is more than 100 feet, an additional sensor would be required to monitor each of these belt conveyor components. **The Union supports this proposal. These sensors should also be included in**

the preshift exam as a requirement of a visual examination that they are in place as required by the plan. Normal functional exams as currently required by the regulations shall continue to apply.

Proposed § 75.351(e)(2) is a new provision which addresses Panel Recommendation 9. The Panel recommended that MSHA require the use of smoke sensors in addition to carbon monoxide sensors in mines using air from a belt entry to ventilate working sections at three specific locations. Under this proposal, smoke sensors would be required to be installed in areas where air from the belt entry is used to ventilate working sections and areas where mechanized mining equipment is being installed or removed. **The Union supports this proposal. It has been our experience that CO sensors do not detect smoke, and that the added protection of smoke sensors would help detect a fire in the earlier stages, thus allow a quicker response to extinguish.**

Proposed § 75.351(e)(2)(i) would require a smoke sensor to be installed at or near the working section belt tailpiece in the air stream ventilating the belt entry. In longwall mining systems, the sensor would 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 entry air at or near the tailpiece. **The Union supports this proposal because miners generally are working in this area and would hear or see the alarm.**

Proposed § 75.351(e)(2)(ii) would require a smoke sensor to be installed not more than 100 feet downwind of each belt drive unit, each tailpiece transfer point, and each belt take-up. Under the proposal, if the belt drive, tailpiece, and 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 of the belt drive. However, if the distance between the belt drive unit, tailpiece transfer point, and belt take-up units is more than 100 feet, an additional sensor would be required to monitor each of these belt conveyor components. These components are potential fire sources. The additional sensors will assure earlier detection of a fire. **The Union supports this proposal because we believe this will give added protection to miners.**

Proposed § 75.351(e)(2)(iii) would require smoke sensors to be installed at intervals not to exceed 3,000 feet along each belt entry. The Agency is not proposing to require a smoke sensor to be installed near the mid-point of the belt line as recommended by the Panel. **The Union would suggest to overcome the problem that MSHA has pointed out of additional splices in the system, MSHA should require that smoke sensors be placed at intervals of not to exceed 1500 feet and to have smoke sensors placed at every transfer point along each belt line. The Panel suggested a delayed effective date for the smoke sensor requirement, to permit in-mine evaluation of the sensors. The Panel noted reliability and maintenance issues with the use of smoke sensors in underground coal mines, especially along conveyor belt**

entries. NIOSH is currently testing smoke sensors used in other harsh industrial environments for their potential use in underground mines. The union has been aware of the industry looking at and testing smoke detectors since the early 1990's. There may even be mines that have such detectors in place today.

Proposal § 75.351(e)(2)(iv) MSHA proposes that this provision be effective one year after the Secretary has determined that a smoke sensor is available to reliably detect fire in underground coal mines. The Secretary's determination would be made after a nationally recognized testing laboratory formally lists a smoke sensor specifically tested for use in underground coal mines. In making the determination regarding the availability of smoke sensors, the Secretary will also consider whether additional rulemaking is appropriate. **The Union believes that this is another attempt to further delay protections that could save miners lives. Testing of smoke detectors has been taking place in mines since the 1990's. It is hard to believe that we need to re-invent the wheel on somethng that has been taking place for a number of years prior to this rule. Rather than MSHA waiting a year to determine whether additional rulemaking is required, the Union would insist that smoke sensors be mandated and placed throughout in mines immediately effective upon approval of such systems.**

Section 75.351(q)—Training would require training subjects to include: Familiarity with underground mining systems; basic atmospheric monitoring system requirements; the mine emergency evacuation and firefighting program of instruction; the mine ventilation system including planned air directions; appropriate responses to alert, alarm and malfunction signals; use of mine communication systems including emergency notification procedures; and AMS recordkeeping requirements. MSHA expects the training to address the specific conditions and practices at the mine where the AMS operator is employed. Based on Agency experience, MSHA believes an understanding of these subjects is essential to properly perform the duties of an AMS operator. **The training needs to be separate of the already overburdened annual part 48 training. These training records should also be made available to all interested parties 75.351 (q) describes several aspects of operating the AMS system and interpreting results. All the topics listed are appropriate and necessary but they are incomplete. An AMS operator should also be familiar with system maintenance and calibration. The reason for this is they need to know that the AMS is not infallible and that it must be maintained and calibrated on a regular basis. The AMS operator should be able to identify aspects of system performance that signal the need for maintenance and for calibration. We do not suggest that the AMS operator should perform system maintenance or calibration but that they understand the need for it, what is involved, and how the need would be addressed in system performance.**

Proposed § 75.351(q)(2) is new and would require that, at least once every six months, all AMS operators must travel to all working sections to retain familiarity with underground mining systems including haulage, ventilation, communication, and escapeways. The Panel stated that some AMS operators do not travel underground, and recommended that they be required to spend at least a day underground on a semi-annual basis. MSHA believes that the requirement in this proposal would allow AMS operators to retain familiarity with the mine. **The Union supports this proposal. It has been our experience that when the responsible person who monitors the AMS is familiar with the underground workings, they have a greater sense of what needs to be done during times of an emergency.**

Proposed § 75.351(q)(3) is changed to require records of the training be maintained for at least two years. The existing requirement is one year. This will allow MSHA to verify the training in the previous year has been conducted. **The Union supports this proposal.**

Proposed § 75.352(g) is a new provision addressing Panel Recommendation 16. The Panel recommended that when both of the sensors installed in the primary escapeway monitoring the point feed reach the carbon monoxide alert level, or if one sensor reaches the alarm level, a warning signal be given at the regulator location. The Panel's recommendation addresses point-feed regulators where air is introduced to a belt entry and used to ventilate the working section. The Panel specifically limited this recommendation to point-feed regulators feeding the belt entries designated as alternate escapeways. Panel Recommendation 16, which relates to the installation of an additional sensor and remote closing of the point-feed regulator, is addressed by proposed § 75.351(d)(1) and (d)(7). **The Union has historically opposed the use of point feeding air and continues to take the position that this practice should not be allowed. Any opening between the belt entry and the escapeway provides an avenue for contamination of the escapeway. The miners' escapeway should be the most important entry into the section and must be protected to assure a clear escape route out of the mine. MSHA acknowledges these concerns in their comments, "MSHA is aware that point-feeding air from the primary escapeway to the belt entry designated as the alternate escapeway can present significant problems for miners who must evacuate the mine."**

The Union would like further clarification on MSHA's suggestion to allow a requirement that would allow a means to remotely open the regulator from a designated surface location and closing and re-opening of a regulator during a fire in the primary escapeway. Closure of a regulator can reduce the intake air quality on a working section, and may cause sudden and rapid increases in methane concentrations and could lead to an ignition, explosion, or spread the fire and smoke into the areas where miners may not have been fully evacuated. Sadly, we witnessed this at the recent Sago mine disaster that eventually led to the deaths of the miners trapped on the section. This type of air change should only be left up to qualified mine rescue personal and their representatives, only after full evacuation of the mine has taken place and under close evaluation and approval by the agency.

Section 75.371—Mine Ventilation Plan; Contents

Proposed § 75.371(jj) addresses Panel Recommendation 13 regarding the approval of air velocities in the belt entry. Although the Panel recommended minimum and maximum velocities in the belt entry, they recognized that in certain areas of underground coal mines it may be difficult to achieve these velocities. The Panel specifically noted that this may occur in the outby air split near a point-feed regulator, or where the air meets a partial obstruction like an airway constriction at an overcast or undercast. Where the recommended velocities cannot be achieved, the Panel recommended that the District Manager may approve exceptions in the mine ventilation plan, dependent upon specific mine conditions approval in the mine ventilation plan will allow the District Manager to fully evaluate the conditions in the mine including all aspects of the mine ventilation system. In making a determination on whether to approve requested velocities, the District Manager would evaluate the need for increasing fire detection sensitivity by adjusting alert and alarm levels for high velocities or reducing sensor spacing for low velocities. **Before any approval on these requests are granted, the miners' representative must be involved and allowed to make comments. The Representative of the miners' should be afforded the opportunity to travel with MSHA and Mine Management during the investigation to determine if there is an actual need for changes to velocities. Further, MSHA Arlington office should be consulted for approval before changes to velocities are granted in the belt entry.**

Proposed § 75.371(mm) addresses Recommendation 10. The Panel recommended that MSHA perform regular, periodic reviews of the AMS records at mines using air from a belt entry to ventilate working sections to evaluate the number of occurrences of false alarms due to diesel exhaust. In those instances where such false alarms are excessive, the Panel recommended MSHA should require the use of existing diesel-discriminating sensors. **The Union supports this recommendation with some exceptions. In reference to MSHA's statement in this section which states " MSHA does conduct periodic reviews of AMS records during regular inspections of the mine.", the Union believes that this should be more clearly defined. When left up to interpretation of what is considered "periodic", The Union believes that the operators and the inspectors that inspect these systems, have to have a clear definition as to how often this system and records need to be inspected. This step is important to insure that the system is functional and also so that miners will not become complacent and routinely ignore the signals as false alarms. The Union also believes that it is equally important that miners are educated and trained to identify what the signals mean as well as how to react when the alarms go off.**

Proposed § 75.371(nn) addresses Panel Recommendation 8. The Panel recommended discontinuing the use of point-type heat sensors, and using carbon monoxide sensors for all mines using belt haulage. Existing § 75.351(m) requires that the use and length of any time delays be approved by the District Manager in the mine ventilation plan for mines using air from the belt entry to ventilate the working section. Time delays may also be necessary in some mines that do not use air from the belt entry to ventilate working sections to aid in the reduction of false alarms. **The Union agrees that point type heat sensors should be removed and banned from further use. If this rule moves forward, it must be must mandated that all mine operators will be required to replace these outdated systems with a modern CO monitoring system.**

Proposed § 75.371(yy) addresses Panel Recommendation 14 regarding the location of airlock doors installed between air courses. The Panel recommended that personnel doors along escapeways be structured to form an airlock when the force required to open a door, due to the pressure differential, exceeds 125 pounds. **The Union supports this recommendation.**

Proposed § 75.333(c)(4) would require that an airlock be established where the air pressure differential between air courses creates a static force exceeding 125 pounds on closed personnel doors along escapeways. Proposed § 75.371(yy) would require the operator to submit the locations where airlock doors are installed between air courses in the ventilation plan for approval by the District Manager. This requirement would apply to all underground coal mines. **The Union supports this recommendation.**

Proposed § 75.371(zz) addresses Panel Recommendation 14 regarding ventilating pressure within the primary escapeway. The Panel recommended that primary escapeways be ventilated with intake air preferably, and to the extent possible, the primary escapeway should have a higher pressure than the belt entry. The proposal would require that locations where the mine operator cannot maintain the pressure differential from the primary escapeway to the belt entry be included in the mine ventilation plan. This would allow the District Manager to evaluate specific mine conditions and require additional actions or precautions to be taken to protect the integrity of the primary escapeway, as appropriate. **The Union is appalled that MSHA would even consider approving a ventilation plan that would not require the primary escapeway to be ventilated with intake air. Miners have always demanded that they be provided with a safe, smoke free means of escape from the mine in the event of an emergency, and the only way that this can be insured is to protect and isolate a fresh air escapeway from the deepest point of penetration of the mine to the surface. If a mine operator cannot provide this to miners, then MSHA needs to hold these operators to a higher standard when considering the alternative.**

Section 75.380—Escapeways Bituminous and Lignite Mines, and 75.381—Escapeways; Anthracite Mines

This proposal would amend paragraphs (d)(7)(v), and (vi) and (f)(1) and add paragraphs (d)(7)(vii), (viii) and (ix) to § 75.380. It also would amend similar language in paragraphs (c)(5)(v) and (vi), and (e) and add paragraphs (vii), (viii) and (ix) to § 75.381. Proposed §§ 75.380(d)(7) and 75.381(c)(5) address Panel Recommendation 15. Proposed § 75.380 applies to escapeway requirements for bituminous and lignite mines, and § 75.381 applies to escapeway requirements for anthracite mines.

When reading this section the Union and miners across this country are furious because the Agency has already approved plans that force us to be placed in smoke filled areas of the mine for escape purposes. With all of the dangers that miners face on a day to day basis it's hard to understand how such a proposal is before us today when it was clearly the intent of Congress with the Federal Mine Safety and Health Act of 1977 not to do so. Since we are forced to comment on this section, keep in mind we do it with greater hopes that one day the agency that was put in charge of protecting this nation's miners, will wake up and put in place a rule that requires miners to be provided with several means of fully protected isolated fresh air escapeways in the mine without fear of having to be placed in areas that we know before we enter will be contaminated with smoke.

The Union would support the type of markings to be placed in the mine as suggested by this proposal as long as miners are given training so that they fully understand each marking. During a time of panic, such as would occur during a mine disaster, the Union cannot emphasize the importance of miners being familiar with the different markings without having to hesitate to guess or recall which is which. This is something that should come automatic to miners without having to think. A requirement needs to be written so that training is to be conducted with miners no less than every 90 days and more often if miners make the request because of the lack of confidence in distinguishing between the various meanings of each marking.

Proposed §§ 75.380(f) and 75.381(e) would require the primary escapeway to have a higher ventilation pressure than the belt entry. **The Union insist that this be enforced because a higher pressure in the primary escapeway would assure that air leakage would move from this escapeway to the belt entry. In case of a fire in the belt entry, the primary escapeway would not become contaminated. Unlike the Panel and MSHA, the Union believes that operators should be forced to maintain the pressure differential from the intake to the belt entry at all times. Had the agency have taken this type of enforcement approach at Aracoma, and paid more attention to the types of ventilation violations that occurred at this mine, Don Bragg and Ellery Hatfield would probably have survived. If the Agency continues to allow this lackadaisical attitude to overlook inefficient and damaged ventilation controls, it will be only a matter of time before more deaths occur in the coal fields.**

The Agency proposes that the primary escapeway be ventilated with intake air which has a higher ventilation pressure than the belt entry. The Union is glad to see that the Agency is proposing to maintain the escapeway at a higher ventilation pressure than the belt entry. This is something that could have saved a number of miner's lives. If the escapeway does not have the highest pressure, the smoke from a fire will always leak through the stopping line into the escapeway. Especially if a return is located adjacent to the escapeway.

Miners' have always been trained to go to the primary escapeway in the event of an emergency to find their way out of the mine. It is not ethical to continue a system that will almost guarantee that their escape route will be full of smoke. We would recommend that there be at least 50% higher pressure maintained in the escapeway than the other entries. The Union supports this proposal but would recommend enhancing its protection. The Union recommends that escapeways be provided an extra layer of protection from the possibility of fire and smoke leaking into the entry. The Union would suggest a doubled stopping line coated with fire retardant material or a similar added layer of protection to separate it from the belt entry. This would provide that extra protection to prevent or delay fire or smoke breaking through into the escapeway. That added time to escape through a clear escapeway could easily mean the difference between life and death. At Marianna and at the Alma Mine, the escapeway became contaminated within minutes after the fire erupted and miners were forced to evacuate through smoke. Two of those miners lost their lives. A continuation of the same policies that fail to provide adequate protection to the escapeway is totally unacceptable to the Union.

Another concern the Union raises is that the Agency did not specify how much higher the ventilation pressure in the escapeway would be. The Agency did not specify any ventilation quantity to maintain the higher pressure. The Union believes it is necessary to specify a minimum amount of ventilation needed above the quantity in the belt entry ventilation to guarantee a sufficient ventilation pressure differential. If the escapeway has a higher pressure that is minimal, the pressures could easily change in a fire situation. Fires change mine pressures. If the escapeway pressure is not sufficiently higher than the belt entry, the pressure changes created by the fire could easily overcome that pressure difference. This would create the same situation as was present at Marianna with the escapeway being contaminated with smoke. If the rule does not specify a minimum pressure difference, the requirement is left open to interpretation. The new rule should require a specific ventilation pressure difference to achieve the "higher pressure" needed to adequately protect the escapeway. **The Union would recommend at least 50% higher pressure.**

The Union also objects to the "easy out" that provided in these proposals. The rule proposes that the primary escapeway have a higher ventilation pressure than the belt entry "unless the mine operator submits an alternative in the mine ventilation plan to protect the integrity of the primary escapeway, based on mine specific conditions which is approved by the District Manager." If an operator cannot comply with the standard, section 101c of the Mine Act provides the Secretary may modify the application of this standard if the Secretary determines that an alternative method of achieving the result of such standard exists "which will at all times guarantee no less than the same measure of protection afforded the miners of such mine by such standard." Incorporating such a provision in this standard leaves the door open to abuse at the MSHA District level, as was the case in MSHA District 9 with the Crandall Canyon situation. Nevertheless, Section 101c at least provides an avenue for the miners' input, which is the minimum that should be required before any change is made to their escapeway.

75.1103–4—Automatic Fire Sensor and Warning Device Systems; Installation; Minimum Requirements

Proposed § 75.1103–4 addresses Panel Recommendation 8. The Panel recommended that MSHA initiate rulemaking to discontinue the use of point-type heat sensors (PTHS) for early-warning and detection of conveyor belt fires in all underground coal mines. **The Union fully supports this recommendation for all mines regardless of their size of large or small. Even further, the Union would insist to further protect our nations miners, all coal mines should be required to install a carbon monoxide sensor monitoring system regardless if they use belt air to ventilate the working section.**

Proposed § 75.1103–4 would require the use of carbon monoxide sensors for fire detection along belt conveyors in all underground coal mines. In addition, the proposal includes installation, maintenance, operating and training requirements. **The Union supports this proposal**

Proposed § 75.1103–4(a) would require the use of an early-warning fire detection system in all underground coal mines to identify fires along the entire belt conveyor system. **The Union supports this proposal. We further believe that the spacing should be of shorter distances than the 1000 foot requirement. These sensors should be placed every 500 feet to give a more accurate location of where the trouble may be.**

Proposed § 75.1103–4(a)(1) would require the use of carbon monoxide sensors to be installed at specific locations along belt conveyors. These locations maximize the potential of early warning of a fire in the belt entry, and are based on Agency experience with the use of carbon monoxide sensors in underground coal mines. **Should this portion of the proposal move forward, the Union is asking the Agency to spell out and clarify where these locations will be so that there is uniformity in all mining ventilation plans to be approved.**

Proposed § 75.1103–4(a)(1)(i) would require a sensor to be placed not more than 100 feet downwind of each belt drive unit, each tailpiece transfer point, and each belt take-up. Under the proposal, if the belt drive, tailpiece, and/or take-up 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. However, if the distance between the belt drive unit, tailpiece transfer point, and belt take-up units is more than 100 feet, an additional sensor would be required to monitor each of these belt conveyor components. **The Union supports this proposal.**

Proposed § 75.1103–4(a)(1)(ii) would require a sensor to be installed in the belt entry not more than 100 feet downwind of each section loading point. Under the proposal, this sensor would monitor the section loading point, and provide miners on the section with warning of fire in the belt entry. **The Union supports this proposal.**

Proposed § 75.1103–4(a)(1)(iv) would require sensors to be located upwind, a distance of no greater than 50 feet from the point where the belt air course is combined with another air course or splits into multiple air courses. **The Union supports this proposal. This information should be marked and provided on the mine map that is to be posted and made available to the miners.**

Proposed § 75.1103–4(a)(2) would remove the reference to point-type heat sensors and replace it with carbon monoxide sensors. In proposed § 75.1103–4(a)(1), MSHA would no longer accept the use of PTHS for fire detection along belt conveyors. **The Union believes that all PTHS systems should be limited to use for activating fire suppression systems as proposed in 75.1103-6. The Union agrees that only a CO monitoring system should be accepted for fire detection.**

Proposed § 75.1103–4(a)(3) would remove the 125-foot spacing requirement for point-type heat sensors and replace it with conforming requirements for carbon monoxide sensor spacing. **The Union supports this proposal with exception to insist that our added comments on spacing that are applicable to this section be applied.**

Proposed § 75.1103–4(b) would require that sensors be installed near the center in the upper third of the entry, in a location that does not expose personnel working on the fire detection system to unsafe conditions. The proposal provides that sensors must not be located in abnormally high areas or in other locations where air flow patterns do not permit products of combustion to be carried to the sensors. **The Union supports this proposal.**

Proposed § 75.1103–5(a) requires that when the carbon monoxide level reaches 10 parts per million above the ambient level at any sensor location, an effective warning signal must be provided at specific locations. Consistent with MSHA's existing standards for a warning signal to be effective, it must be seen or heard. **Unless otherwise shown that this level proves to be ineffective, the Union supports this proposal.**

Proposed § 75.1103–5(a) would require warning signals to be provided at both underground work locations and on the surface. **The Union supports this proposal.**

Proposed § 75.1103–5(a)(1) would require effective warning signals to be provided to working sections and other work locations where miners may be endangered from a fire in the belt entry. Locations where miners may be endangered would include working sections, areas where mechanized mining equipment is being installed or removed, permanent work locations, and other locations specified in the Mine Emergency Evacuation and Firefighting Program of Instruction required by § 75.1502. **The Union supports this proposal.**

Proposed § 75.1103–5(a)(2) retains the existing requirement that the warning signal be provided to a manned location. The proposal would require that the manned location be on the surface. **The Union supports this proposal.**

Proposed § 75.1103–5(a)(2)(i) retains the requirement for having a telephone or equivalent communication with all miners who may be endangered. **The Union supports this proposal**

Proposed § 75.1103–5(a)(2)(ii) is new, and requires a mine map or schematic that shows the location of sensors and the intended air flow direction at these locations to be posted at the manned surface location. **Because we believe that this information is necessary for miners to know the location of sensors and direction of air flow, we believe that this information should also be posted on the mine bulletin board and made available to all interested parties.**

Proposed §§ 75.1103–5(d) through (h) are new provisions which would specify responses required to signals from the automatic fire warning devices. This proposal is consistent with requirements for responses to AMS signals in existing § 75.352. **The Union believes that these provisions should apply to all mines.**

Proposed §§ 75.1103–5(d) and (e) specifies requirements for responses to malfunction and warning signals when a malfunction or warning signal is received at the surface location. **The Union supports this proposal but would insist that MSHA add the miners' representative as part of the appropriate personnel to be immediately notified.**

Proposed § 75.1103–5(f) would require specific procedures be followed in case of a warning signal. **The Union believes that these procedures should be a part of the training that is to be provided to all miners. A copy of the plan should also be posted on the mine bulletin board and a copy provided to the miners' representative.**

Proposed § 75.1103–5(g) would require that, if the warning signal will be activated during calibration of sensors, personnel manning the surface location must be notified prior to and upon completion of calibration. The notification is also required for miners underground in affected areas. **The Union supports this proposal.**

Proposed § 75.1103–5(h) would require that if any fire detection component becomes inoperative, immediate action must be taken to repair the component. While repairs are being made, the belt may continue to operate if the requirements in proposed §§ 75.1103– 5(h)(1) through (h)(6) are met. Otherwise, the belt must be taken out of service until necessary repairs are made. **The Union supports this proposal in part. If the entire fire detection system becomes inoperative, the belt should be shut down and miners removed from the affected area until the system is repaired. Otherwise, miners are put at risk of fire without adequate protection; the consequences could put their life in jeopardy.**

Proposed § 75.1103–6 would provide that point-type heat sensors may be used to activate fire suppression systems. **The Union recognizes a benefit in allowing them to be used for activating fire suppression systems. Consistent with the Panel's recommendation, under the proposal point-type heat sensors the Union supports continued use to actuate deluge-type water systems, foam generator systems, multipurpose dry powder systems, or other equivalent automatic fire suppression systems.**

Section 75.1103–8—Automatic Fire Sensor and Warning Device Systems; Inspection and Test Requirements. **The Union supports MSHA recommendations on the changes suggested that are necessary for the accuracy and upkeep of a CO monitoring system.**

Proposed § 75.1731 would require: (a) Damaged rollers and other malfunctioning belt conveyor components to be immediately repaired or replaced; and (b) conveyor belts to be properly aligned to prevent the moving belt from rubbing against the support structure or other components. In both instances, improper belt examinations could lead to uncorrected hazards. **The Union would like to point out that this could result in frictional heating of combustibles in the belt entry which could cause a fire as history has shown in the past. The proposed provisions would require mine operators to assure that belt examiners identify and correct hazardous conditions in the conveyor belt entry to improve safety of miners. It is common knowledge that beltlines are one of the most vulnerable areas for a fire to occur. Beltlines cover miles and miles of distance in the mine and are for the most part neglected when it comes to maintenance and housekeeping. A large part of the problem is that operators run coal 24/7 and these beltlines only get attention for maintenance when they break or are written up by the Agency during an inspection. MSHA has countless violations on record that have been written to validate this statement. In 2007 alone, MSHA's #1 top number of violations were written on accumulation of combustible materials-30 CFR 75.400, many of which were**

identified on beltlines. The #9th most written violation was maintenance of incombustible content of rock dust-30 CFR 75.403 many of which was identified on beltlines. The #12th most written violation was mechanical equipment guards- 30 CFR 75.1722 many of which were identified on beltlines. The #18th most written violations was Accumulations of combustible materials-30 CFR 77.1104, many of which were identified on beltlines. When searching MSHA's data from the previous years, consistently the top violations that are issued by the Agency are found to exist in beltlines. The Union has attached some of MSHA's own "Best Practice Pocket Cards" that have identified belt fires on conveyor belts. This also shows that MSHA is and has been aware of the existing problems for a number of years and has tried to address these problems in manners other than enforcement. The Union believes that in order to move forward so that more miners will not have to die as a result of neglected beltlines, MSHA must insist and enforce that operators do all of the following:

1) Damaged rollers and other malfunctioning belt conveyor components must be immediately repaired or replaced. These rollers can easily be identified during each preshift examination and called out to the oncoming shift. Each mine operator should assign miners to replace or repair these damaged components at the beginning of the following oncoming shift. In the event that replacement rollers or other components are not readily available, the repairs should be made immediately upon delivery of the components, even if it requires shut down during the normal production hours' cycle.

2) Conveyor belts must be properly aligned to prevent the moving belt from rubbing against the structure or components. In many instances, this can be corrected immediately by notifying the belt crew of the problem. It is better to train a belt while it is running loaded with coal. In the event the belt is running unaligned because of a need to replace rollers or other components, the repairs should be made immediately upon delivery of the components, even if it requires shut down during the normal production hours' cycle. If the belt is allowed to continue to run without being corrected, the beltline will be damaged and possibly allow an unnecessary amount of coal spillage and accumulation to occur along the beltline, causing a fire.

3) Noncombustible materials shall not be allowed to accumulate in the belt conveyor entry. This can be identified during each preshift examination and called out to the oncoming shift. If there is no immediate danger of a fire, the mine operator should assign miners at the beginning of the following oncoming shift to correct the hazard. If these conditions go uncorrected the conditions can lead to the creation of a mine fire that will put miners lives at risk.

4) Splicing of any approved conveyor belt must maintain flame-resistant properties of the belt. If the belt is allowed to continue to run without being corrected, the beltline will be damaged and possibly allow an unnecessary amount of coal spillage and accumulation to occur along the beltline causing a fire. In the event that the splice is worn and presents no immediate hazard, then it should be repaired at the beginning of the following oncoming shift to correct the hazard.

Overview

History of this rule-making.

In its section-by-section analysis of this proposed rule, MSHA omitted certain aspects of the history of this rulemaking. Specifically, and as discussed in the TSP report, the shortcomings of the Bureau of Mines procedure for accepting belts, the 2G test, were recognized as early as 1967. (p 46-47, TSP Report). MSHA was not the first to note problems nor were they first noticed in 1980.

Second, the purpose of the "large scale test" was to create an experimental environment that resembled in-mine conditions, something the 2G test lacked altogether. (p 47, TSP Report)

Third, MSHA conducted a regulatory flexibility analysis to determine the economic impact on mining operations from implementing the BELT test procedure. This was first published in 1992 when the rule was first proposed and updated in 1999. Both are referenced in the TSP report.)

Miners should be full participants in the enforcement of this rule.

The provision in this proposed rule that would exclude any but the belt manufacturer and MSHA officials from viewing a test of a belt for its flammability is not warranted. (Sec. 14.3 at p 35029 and 35051) Miners and representatives of miners have a material interest in the outcomes of these tests and should not be excluded. The explanation that the purpose of this exclusion is to protect manufacturers' proprietary information . This is not convincing. Manufacturers' proprietary information can be protected in many ways other than completely excluding miners from witnessing these tests. Miners material interests in their own health and safety should outweigh manufacturers' concern about proprietary information in any case.

Similarly, MSHA proposes to conduct periodic post-approval audit of approved belts. (14.10 (a) at p 35052) We support this practice. However, we feel that miners and their representatives should be able to obtain final reports of such an audit. As the proposed rule is written, only the approval holder may receive the final report. Distribution of similar reports for example, by NIOSH, concerning shortcomings of respirators are not merely made available to whoever is interested, they are published and distributed to the mining industry as a whole. We see no reason why results of a post-approval audit should

not be distributed or at least made available to the entire industry. Miners have a material interest in the results of such audits.

And, along the same line, if MSHA considers revoking approval for belt approved under this rule, it provides the holder of the approval to have a hearing with MSHA concerning such an action, among other matters. (14.11 (b) at p 35052) Miners and their representatives should be able to participate in that hearing. Not only do miners have a material interest in the outcome of such a hearing, they may have important testimony to offer at the hearing concerning the performance of the belt whose approval may be revoked.

Miners and their representatives – indeed anybody except belt manufacturers and mine operators are excluded from at least two aspects of this rule.

Mines that use Belt Air should be held to a higher standard.

Use of the belt entry to ventilate a working face is inherently less safe than directing belt air to the return air course or treating it as a neutral entry. Using a belt entry for face ventilation creates the following hazards:

- **it allows smoke and other products of combustion to contaminate the face area,**
- **it reduces the number of escapeways that miners have in the event of an emergency, and**
- **it compromises efforts to reduce miners' exposure to respirable dust because the concentration of respirable dust in the belt entry is higher than it is in other entries.**

The standard that the belt air rule replaced ([old] 30 CFR 75.350) which prohibited using the belt entry for face ventilation has none of these problems. If there is fire in the belt entry that does not provide face ventilation, smoke *cannot* go to the face because it is either a neutral entry or a return. Intake entries remain viable escapeways unhindered either by the belt or smoke from a belt fire. And since the concentration of respirable dust in intake entries without a belt is less than it is with the belt, air from an unbelted entry is more effective at controlling respirable dust at the face. For these reasons, the use of belt air for face ventilation is *inherently* less safe than the practice that it replaced.

The use of atmospheric monitoring systems to monitor the entry for carbon monoxide alleviates some of the hazards of using the belt entry for face ventilation but it does not

eliminate them. Use of an AMS is assumed to result in prompt fire suppression. (As we have learned from the fire at the Aracoma mine, this is not a valid assumption.) However, the AMS *only* detects fire, it does not prevent products of combustion from entering a working face and it does not prevent fires from occurring.

It is because use of belt air for face ventilation is inherently less safe, even with the AMS, that the TSP concluded that mine operators that use belt air for face ventilation had to be "*held to a higher standard.*" This is the language used in the report as recommendation number 6. What the report failed to do is to describe in practical terms what this means. Regardless, MSHA overlooked this recommendation and merely repeated language that is already in the Mine Act, as follows, at proposed 30 CFR 75.350 (b) (p 35053 of the proposed rule):

> **"The use of air from a belt air course to ventilate a working section .. shall be permitted only when evaluated and approved by the District Manager in the mine ventilation plan. The mine operator must provide justification in the plan that the use of air from a belt entry must afford at least the same measure of protection where belt haulage entries are not used to ventilate working places."**

The proposed rule then goes on to discuss requirements for controlling the concentration of respirable dust, minimum and maximum air velocities, and requirements for point feeds. That is, the operator's proposal is evaluated entirely in relation to its effects on mine ventilation. As we have said above, we consider use of belt air for face ventilation inherently less safe than not doing so and consequently, is inherently incapable of affording ".. at least the same measure of protection where belt haulage entries are not used to ventilate working places," regardless of its effects on the concentration of respirable dust, air velocity, and point feeds and regardless of the use of AMS.

The TSP recommended that the operator that proposed using a belt entry for face ventilation be "held to a higher standard." That is, the benefit of using belt air had to be found elsewhere. This is an appropriate – and required – standard for evaluating any change in mining regulations – but by limiting its attention to mine ventilation (any change in ventilation cannot make other ventilation worse), it falls short of what the TSP recommended. The TSP illustrated the meaning of a "higher standard" with examples. In one, the use of belt air for face ventilation was to improve a principal aim of ventilation, i.e., for diluting and removing methane. This tradeoff recognized a well-known feature of underground coal mining – that the mine consists of *integrated systems* concerned generally with safety and productivity, not *separate and isolated* systems, for ventilation, fire prevention and control, ground control, transportation, production, electrical power, communications, etc. A change in one system – for example using a belt entry for face ventilation – can and often does affect and require changes in others. When the TSP

suggested that mine operators that use belt entries for face ventilation be "held to a higher standard," it was based on these two fundamental principles:

- **Using a belt entry for face ventilation was inherently less safe than not doing so, for reasons described above, AND**
- **An underground coal mine consists of integrated systems such that a change in one system affects the performance of others.**

The reason the proposed MSHA criteria for evaluating changes in mine ventilation falls short of the TSP recommendation is that it would evaluate mine ventilation in isolation from its effects on the rest of the mine. It treats it as an independent system, as if any changes in ventilation are to be evaluated only in terms of how it changes ventilation without considering effects in other systems.

The Technical Study Panel concluded 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."* It should be clear from this excerpt that in evaluating an operator's proposal to use belt air, there is more that the District Manager should consider than the AMS, the concentration of respirable dust, air velocity, and point feeds. The District Manager needs to look at the operator's plan *in its entirety* to determine whether there are safety *advantages* in using belt air that can outweigh the inherent risk in using belt air.

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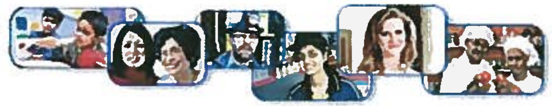
Protecting Miners' Safety and Health Since 1978



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Most Frequently Cited Standards for 2007

Safety is a Value

Underground - Coal
01/01/2007 - 12/31/2007

Total Violations for this type of operation: 66,575

Rank	# of Viols.	Percent *	Standard
1	8,179	12.29%	75.400
2	3,852	5.79%	75.503
3	3,189	4.79%	75.370(a)(1)
4	2,653	3.99%	75.202(a)
5	1,998	3.00%	75.220(a)(1)
6	1,580	2.37%	75.1725(a)
7	1,452	2.18%	75.517
8	1,445	2.17%	75.512
9	1,138	1.71%	75.403
10	1,001	1.50%	75.333(h)
11	911	1.37%	75.604(b)
12	908	1.36%	75.1722(a)
13	898	1.35%	75.1100-3
14	863	1.30%	75.1403
15	596	0.90%	75.515
16	563	0.85%	75.1100-2(b)
17	528	0.79%	75.807
18	521	0.78%	77.1104
19	450	0.68%	75.904
20	441	0.66%	75.342(a)(4)

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Mine Safety and Health Administration (MSHA)
1100 Wilson Boulevard, 21st Floor
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AB59-COMM-11-1

It Happened...

On March 9, 1992, a fire occurred on a coal feeder and caused extensive damage to the equipment. A contributing factor to the extensive damage were the excessive amounts of loose coal, coal dust and oil which were permitted to accumulate on and around the electrical and mechanical components of the coal feeder.

On March 22, 1992, an equipment fire occurred, caused by a frictional heating due to a mechanical failure in the power train. The fire spread across the entire piece of equipment and was enhanced by combustible materials around the work area such as coal dust, loose coal, hydraulic oil and resin cartridges.

On March 2, 1995, smoke was observed coming from a belt conveyor portal. The underground power was de-energized and the miner's exited via the intake aircourse. The fire originated when a metal bearing became hot enough to ignite accumulations of grease around the roller.

Example of a storage area for combustible materials.

Best Practices
Fire Protection
Card No. BPFP-13

COMBUSTIBLE MATERIALS

COMBUSTIBLE MATERIALS, including coal dust, loose coal, scrap paper, wood, plastic, spilled oil or diesel fuel, and oily rags are all examples of easily ignitable materials in a mine. Such materials can typically be ignited by small ignition sources and can rapidly grow into a dangerous and uncontrollable fire. Adequate control of these materials are necessary to reduce a mine's potential for fire. Good housekeeping and rock dusting are effective techniques in reducing these hazards.

- **ALWAYS** remove accumulations of loose coal and coal dust in belt entries, especially around moving equipment.
- **ALWAYS** remove combustible waste materials.
- **ALWAYS** store lubricating oil and grease used underground in fire resistant, closed containers.
- **ALWAYS** construct designated storage locations for oils and grease of fire resistant materials.
- **ALWAYS** apply sufficient rock dust in order to reach the desired concentration of inert material.

REMEMBER:

- Materials saturated with combustible liquids ignite easier.
- The ignition potential of combustible materials increases in the presence of explosive gases.

U.S. Department of Labor
Mine Safety and Health Administration

AB59-COMM-11-2

It Happened...

On June 18, 1990, a fire occurred along a belt entry. A wedge shaped rock lodged between the belt and take-up roller caused the belt to slip. The friction caused a fire at the head pulley and the second drive roller. The fire was extinguished using two extinguishers and water.

On March 18, 1998, smoke was detected near a unit belt drive. Mandoors were opened to divert the smoke. The belt slippage switch was not operating properly.

On November 1, 1991, smoke was detected in a conveyor belt entry. Elevated concentrations of carbon monoxide were not detected by the sensors 100 feet inby. Smoke and flames were observed near the drive pulley. The fire was extinguished with water.

Example of a typical belt conveyor

Best Practices
Fire Protection

Card No. BPFP-15

BELT CONVEYORS

BELT CONVEYORS require constant maintenance and monitoring. Belt slippage tests could be designed with a handle or small hydraulic jack that permits the examiner to physically raise the belt off of a roller in order to simulate belt slippage and test for conveyor sequencing.

- **ALWAYS** replace worn or damaged idlers on a conveyor line as soon as possible.
- **ALWAYS** investigate the smell of burning rubber coming from a conveyor line.
- **ALWAYS** remove accumulations of float dust from conveyor lines and make certain of adequate rock dusting.
- **ALWAYS** plainly mark locations of fire taps along conveyor lines.
- **ALWAYS** make certain that threads on fire taps along conveyor lines are covered and clean.
- **ALWAYS** make certain that fire hose provided along conveyor lines is properly stored in containers.
- **NEVER** take fire hose from conveyor lines to use for purposes other than fire fighting.

U.S. Department of Labor
Mine Safety and Health Administration

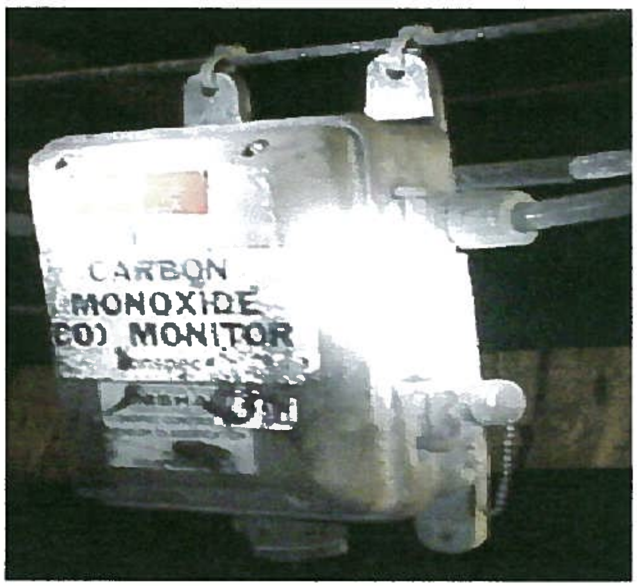
- **NEVER** rely only on your of smell to warn you of a fire.
- **NEVER** make field repairs to faulty sensors, replace them with approved new ones.

It Happened...

On December 12, 1994, an electrical fault in the transformer windings caused a fire in a 1500 KVA load center. A CO sensor three crosscuts outby the fire went into alarm and was subsequently investigated. The fire was contained within the load center and put out with fire extinguishers.

On May 5, 1995, a belt fire occurred due to friction against the belt structure. Brattice cloth and material under the belt caught fire. The fire was detected by a CO monitoring system and prompt response by mine personnel prevented the fire from burning out of control.

On January 3, 1998, following two ten hour production shifts, a belt fire occurred when the belt was stopped. An idler roller failed causing frictional heating from metal to metal contact. The fire was discovered after activation of the audible alarm on the surface by the CO monitoring system.



Example carbon monoxide sensor installation

Best Practices Fire Protection

Card No. BPFP-5

FIRE DETECTION

FIRE DETECTION SYSTEMS vary in their design and application. Different types of detectors look for different products generated by the fire. Some detectors look for heat, some look for specific gases such as carbon monoxide (CO), some look for smoke, and some look for light produced by a flame. With advances in technology, its is possible to have different combinations of detection to monitor a wider spectrum of fire conditions.

LOCATIONS

Belt drives	Unattended electrical equipment
Bleeder entries	Beginning and end of belt flights
Idle areas	

- **ALWAYS** investigate fire alarms immediately. Treat an alarm as if a fire exists until proven otherwise.
- **ALWAYS** determine the causes of nuisance alarms and correct the problem.
- **ALWAYS** keep sensors clean and dry and maintain them in working order.
- **ALWAYS** report fire detection system problems to mine management.
- **ALWAYS** test the sensors in a fire area as soon as possible after the fire is extinguished.
- **ALWAYS** replace sensors that show signs of fire damage.
- **ALWAYS** connect sensors together using MSHA approved flame-resistant cable that also meets the specifications of the detection system manufacturer.
- **ALWAYS** monitor your detection systems from one central location.
- **ALWAYS** consider the use of infrared or thermal imaging systems for detecting hot spots.

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TIPS FOR FIRE SUPRESSION DESIGN:

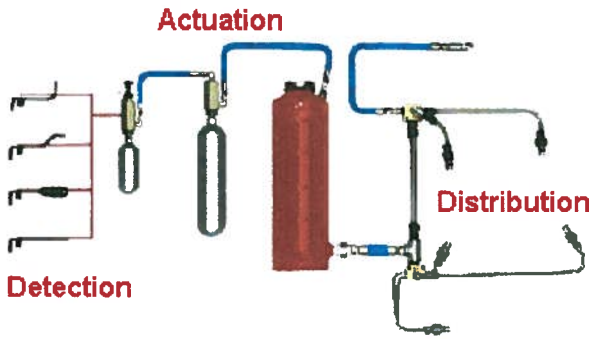
- Design water spray systems to deliver 0.75 gpm of water per square foot of belt with a residual pressure of at least 10 psig to the most remote nozzle. Wet pipe sprinklers should be designed to provide at least 10 psig residual pressure to the most remote four flowing heads.
- Use accepted design practices established by MSHA when designing fire suppression systems. This should include considerations for testing and maintenance.
- Locate spray nozzles or sprinkler heads for maximum effectiveness.
- Flexible hoses, such as hydraulic hoses, used to feed sprinklers or spray nozzles should be of an MSHA-approved flame resistant construction.

It Happened...

On January 10, 1990, a fire occurred on the face behind the headgate drum of the shearer as it was cutting drawrock. The shearer had been stopped previously to check the oil in the gearcase due to potential overheating. Flames were extinguished in 1-2 minutes with the fire suppression sprays and a wash down hose.

On June 18, 1990, belt slippage occurred when a rock lodged between the belt and the take-up roller. Friction at the head pulley caused a fire. The water spray system did not activate due to a malfunctioning solenoid. Two fire extinguishers and a fire hose were used to fight the fire.

On November 24, 1994, a fire occurred at a belt drive. Smoke was diverted to a return air course. A fire fighting crew used fire extinguishers and water to extinguish the blaze. The fire suppression system had been activated and controlled the fire.



Example of a basic fire suppression system

Best Practices Fire Protection

Card No. BPFP-4

FIRE SUPPRESSION

FIRE SUPPRESSION SYSTEMS vary in their design and application. All systems except automatic sprinklers should be provided with an emergency manual release that can be operated from a safe, smoke-free location during a fire.

LOCATIONS

Belt Drives	Diesel Fuel Storage Locations
Oil Storage Locations	Mobile Equipment
Battery Charging Stations	Working Sections

- **ALWAYS** report fire suppression system problems to mine management.
- **ALWAYS** keep fire suppression detectors in working order.
- **ALWAYS** check to ensure that your actuation system is operable.
- **ALWAYS** protect hose and valve fittings from damage.
- **ALWAYS** provide regulators for high pressure water applications.
- **ALWAYS** use automatic sprinklers whenever possible.
- **ALWAYS** keep manual actuators unobstructed.
- **ALWAYS** check for signs of physical damage or conditions that would prevent system operation.

- **NEVER** keep valves to your suppression system turned off, unless maintenance is being performed and the area is manned.
- **NEVER** allow nozzles and sprinkler heads to become obstructed.
- **NEVER** allow untrained employees to maintain your fire suppression system

U.S. Department of Labor
Mine Safety and Health Administration

IC 9426

UNITED STATES BUREAU OF MINES
INFORMATION CIRCULAR/1995

Analysis of Underground Coal Mine Fire Incidents in the United States From 1978 Through 1992

UNITED STATES DEPARTMENT OF THE INTERIOR

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally-owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

Information Circular 9426

Analysis of Underground Coal Mine Fire Incidents in the United States From 1978 Through 1992

By William H. Pomroy and Annie M. Carigiet

UNITED STATES DEPARTMENT OF THE INTERIOR
Bruce Babbitt, Secretary

BUREAU OF MINES
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TABLES—Continued

UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

in	inch	pct	percent
min	minute		

Quantities in this report are expressed in U.S. customary units of measure rather than the standard USBM practice of expressing quantities in metric units. U.S. customary units are used because the Federal agencies that compile coal mine production data used in this report (Energy Information Administration, U.S. Department of Energy; and Mine Safety and Health Administration, U.S. Department of Labor) provide this data only in U.S. customary units, and because the previous USBM report summarizing coal mine fire incidents in the United States from 1950 to 1977 (Information Circular 8830) also uses U.S. customary units. Users of this report are expected to compare, analyze, and evaluate data from this report and the other sources. Use of metric units in this report would therefore have required such users to perform extensive unit conversions.

ANALYSIS OF UNDERGROUND COAL MINE FIRE INCIDENTS IN THE UNITED STATES FROM 1978 THROUGH 1992

By William H. Pomroy[1] and Annie M. Carigiet[2]

ABSTRACT

This U.S. Bureau of Mines publication is an analysis of underground coal mine fire incidents occurring in the United States during the 15 years from 1978 through 1992. The fire data used in this analysis were obtained from U.S. Mine Safety and Health Administration mine fire investigation reports. Fires were analyzed by year, State, coalbed thickness, mine size, mining method, ignition source, burning substance, location, equipment involved, detection method, time of day, time of year, number of injuries and fatalities, method of extinguishment, and evacuation measures taken. In all, 164 fires are included in this report, or an average of 10.8 fires per year. The most fires occurred in West Virginia, Kentucky, and Pennsylvania, respectively. However, the fire incidence rates for these States, expressed as the number of fires per million tons of coal mined, were the lowest, second lowest, and fourth lowest of all underground coal producing States. The most common ignition source was electricity; the most common burning substance was coal; the most frequent fire location was the belt entry; the most common equipment involved in fires was the conveyor belt; and the most common extinguishing agent was water.

[1]Supervisory mining engineer.
[2]Computer assistant.
Twin Cities Research Center, U.S. Bureau of Mines, Minneapolis, MN.

INTRODUCTION

Underground fires represent a serious and constant threat to the safety of mine workers. Miners in the immediate vicinity of a fire must contend with intense heat, blinding smoke, toxic fumes, roof falls, and the other direct effects of a fire. However, the vast majority of victims never actually see the fire, succumbing instead to deadly fume-laden air or asphyxiation. The mine's ventilation system, which normally supplies fresh air to the workings, can transport smoke and fire gasses with equal efficiency. Additionally, the heat produced by a fire can significantly alter normal airflows and directions. Miners remote from a fire may be forced to evacuate through smoke and fumes. Sometimes a fire may block the escape route. Miners can become confused by unfamiliar ventilation system behavior and usually do not have knowledge of the fire's location. No peril is more feared by miners than a raging fire in the mine.

Efforts to improve mine fire safety have been a priority for mine operators, regulatory authorities, equipment manufacturers, research organizations, and others for many years, and significant progress toward reducing fire hazards has been achieved. Underground fires are now rare events, and injuries and fatalities caused by mine fires are at an alltime low. However, the threat of fire has not been eliminated entirely, and as long as combustible materials and ignition sources are present underground, the potential for disastrous fires will remain. Despite the recognized seriousness of the mine fire hazard and the industry's best efforts toward fire prevention, it is somewhat alarming to note that the number of fires per million worker-hours is higher in underground mines than in above-ground industrial occupancies (*1*).[3]

The U.S. Bureau of Mines (USBM), mining and mining-affiliated companies, academic institutions, and others have directed considerable research attention to reducing fire hazards in mining. A critical prerequisite to the development of a sound research strategy is up-to-date and accurate data describing and quantifying the industry's mine fire experience. Such data would also be useful for regulatory decision making, fire safety product marketing, development of fire safety training programs, and similar purposes.

In support of the above objectives, the USBM and other agencies have completed various analyses of coal mine fires (*2-4*). A comprehensive and detailed statistical analysis covering the period from 1950 through 1977 was summarized in USBM Information Circular (IC) 8830, "A Statistical Analysis of Coal Mine Fire Incidents in the United States From 1950 to 1977," which was published in 1980 (*5*). The most recent data contained in that report are now over 15 years old, and significant changes have occurred in the U.S. underground coal mining industry since then. As a result, the data in IC 8830 are of limited usefulness for assessing current mine fire problems. This current report was prepared as an update of IC 8830 to cover the subsequent 15-year period from 1978 through 1992.

The fire data used in the preparation of this report were obtained from the files of U.S. Mine Safety and Health Administration (MSHA) mine fire Reports of Investigation maintained at MSHA's Pittsburgh Safety Technology Center. These Reports of Investigation are prepared by MSHA Coal Mine Safety and Health staff for every fire reported to MSHA authorities. Reporting of fires to MSHA is in accordance with mandatory Federal regulations requiring coal mine operators to immediately notify MSHA in the event of a fire causing an injury or any noninjury fire lasting longer than 30 min (*6*). For each such fire (defined as "reportable"), MSHA produces a Report of Investigation describing the mine, circumstances leading to the fire, cause and detection of the fire, mine emergency and fire-fighting operations, post-fire mine recovery, and conclusions and recommendations.

This report differs from IC 8830 (*5*) in several important respects. The scope of the earlier report included both surface and underground mine fires, whereas this report covers only underground fires. This report utilized only one source of fire data, the aforementioned MSHA Reports of Investigation on file at the Pittsburgh Safety Technology Center. In contrast, IC 8830 summarized data from three independent sources. In addition to MSHA Reports of Investigation, IC 8830 reported data on nonreportable fires and included a section analyzing the expert opinions of several mine safety directors. The data on nonreportable fires were obtained from cooperating mining companies in an effort to establish similarities and differences between the causes and characteristics of reportable and nonreportable fires and to estimate the percentage of fires that were extinguished before they became reportable.

Another difference between this report (*5*) and the earlier report is the source of the MSHA Reports of Investigation. For the earlier report, MSHA's Health and Safety Analysis Center and all MSHA Coal Mine Safety and Health district and subdistrict offices were visited. Project personnel personally searched the files at these offices for fire reports. It was noted at the time that the files at the district and subdistrict offices contained informal, internal memoranda concerning short-duration fires that were legally nonreportable, but were reported as a courtesy. All fire reports, whether reportable or not, were included in the analysis for IC 8830.

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[3]Italic numbers in parentheses refer to items in the list of references at the end of this report.

Most of the fire incidents included in this report meet MSHA's definition of a reportable fire, with only a very few being nonreportable. It is likely that more "courtesy reports" of short-duration, nonreportable fires would have been found had all MSHA district and subdistrict offices been visited for this report, as had been the case for the earlier report (*5*). As a result, the reader should be aware that when comparing the two reports, the data contained in the earlier report may be slightly skewed toward shorter duration fires.

The data tables included in this report present data in three 5-year subgroupings covering the 1978-82, 1983-87, and 1988-92 periods, as well as for the entire 15-year period from 1978 through 1992. Data are presented in this fashion to highlight the changes that occur slowly over time.

A small discrepancy in the dates of coverage for IC 8830 (*5*) and this report should be noted. Although the title of IC 8830 refers to the period from 1950 to 1977, its period of coverage did not actually extend to the end of calendar year 1977. Rather, it extended only to the end of September 1977. However, three additional fires occurred during the fourth quarter of 1977. In order for both IC 8830 and this report to provide continuous coverage of all reported underground coal mine fires from 1950 through 1992, the three late 1977 fires that are not contained in IC 8830 are included in this report. Where data are grouped by time period in this report, the late 1977 fires are included in the 1978-82 grouping.

Discussion of the data usually covers the entire 15-year period from 1978 through 1992. However, certain discussions focus on the most recent period, 1988-92, as these data are most relevant to current mining practices. To reveal changes that have occurred over a longer time period, data from this study are compared to data from IC 8830 (*5*). Normally, these discussions include the entire 1950 through 1977 period covered by IC 8830. However, certain discussions focus on other time periods, such as 1953 through 1977, corresponding to the beginning of Federal mine safety legislation standardizing fire reporting requirements, or 1970 through 1977, corresponding to the effective date of the 1969 Mine Safety and Health Act. Column summation totals may vary slightly because of rounding.

DATA ANALYSIS

Data were assembled in two forms: actual numbers of fires and fire incidence rates. Fire incidence rates, for purposes of this report, are defined as the number of fires per million tons[4] of coal mined. Fire incidence rates are included to enable the reader to more meaningfully compare data from industry sectors having differing levels of coal production and therefore differing exposure to fire risks. The coal production data required for calculating incidence rates was obtained from the U.S. Department of Energy (DOE), Energy Information Administration (*7*), and the U.S. Department of Labor, MSHA (*8-22*). Production data vary slightly because of differing reporting requirements from these sources.

Data are presented in two formats: tables and figures. Tables are provided that include the exact number of fires, mine production data, incidence rates, etc. Figures are included to enable the reader to better discern patterns in the data, such as trends over time. The data were not statistically analyzed because of the often small number of fires occurring in a given category and time period.

The mine fire Reports of Investigation obtained from the MSHA Pittsburgh Safety Technology Center and used in this report were entered into a computer database using Paradox database software for data reduction and analysis. Those wishing to obtain a copy of this database are invited to contact the authors.

[4]In this report, "tons" refer to "short tons."

STATE AND TIME TRENDS

A total of 164 fires were reported to MSHA from 1978 through 1992. Table 1 shows fires by State for each year from 1978 through 1992, fires by State for the three major time periods, and total number of fires by State. Overall, the average number of fires per year was 10.8, compared to 32.4 fires per year for the preceding 15-year period from 1963 through 1977 (*5*). The three States having the greatest number of fire incidents during the 15 years from 1963 through 1977 were West Virginia, Pennsylvania, and Kentucky (*23*). These same three States recorded the greatest number of fires during the 1978 through 1992 period as well (with Pennsylvania and Kentucky in reversed order).

Table 2 shows underground coal mine production for the 1978 through 1992 period. Table 3 shows fire incidence rates for the same time period. The fire incidence rate for all States over the entire 15-year period from 1978 through 1992 was 0.031. From IC 8830 (*5*), the fire incidence rate for the 1950 through 1977 period was 0.115, almost four times higher. Figure 1 shows underground coal mine fires, underground coal mine production, and fire incidence rates for the 1978 through 1992 period. An upward trend is evident in coal production, and an overall downward trend is evident in both fires and fire incidence rates.

Table 1.—Number of fires by State and year

State	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1978-82	1983-87	1988-92	Total
Alabama	1	0	0	2	1	1	0	2	3	0	0	0	0	0	1	4	6	1	11
Colorado	0	0	1	1	0	1	1	0	2	2	1	0	1	0	0	2	6	2	10
Illinois	4	4	0	2	0	3	2	1	1	0	1	0	0	1	0	12	7	2	21
Indiana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iowa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kentucky	1	1	1	2	2	0	3	2	3	4	4	2	1	0	1	7	12	8	27
Maryland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
Ohio	1	0	1	1	3	0	0	0	1	1	0	0	1	0	0	6	2	1	9
Pennsylvania	1	0	1	1	3	1	2	0	2	3	3	2	3	1	1	6	8	10	24
Tennessee	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utah	0	0	1	1	1	1	1	0	1	1	1	1	0	0	0	3	4	2	9
Virginia	1	0	1	1	3	2	4	1	1	0	2	1	2	0	1	6	8	6	20
West Virginia	1	5	5	2	2	2	1	1	3	4	1	1	0	0	3	15	11	5	31
Wyoming	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Total	10	10	14	13	15	11	14	7	17	15	13	7	8	2	8	62	54	38	164

Table 2.—Underground coal mine production by State and year, 10^6 tons

State	1978[1]	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1978-82	1983-87	1988-92	Total
Alabama	7.8	8.4	9.5	8.6	11.3	10.9	13.2	14.4	13.2	14.3	14.8	16.3	17.5	17.1	15.9	45.6	66.0	81.6	193.2
Colorado	5.6	6.1	6.2	6.6	6.6	5.6	6.4	6.3	5.5	5.6	6.9	8.5	10.6	9.6	10.2	31.1	29.4	45.8	106.3
Illinois	32.2	32.7	35.0	29.2	34.7	31.8	38.5	37.3	39.7	37.5	38.5	39.3	41.7	43.1	47.0	163.8	184.8	209.6	558.2
Indiana	0.7	0.8	0.7	0.6	1.6	1.8	2.2	2.1	1.9	2.4	2.4	2.5	3.1	2.8	2.6	4.4	10.4	13.4	28.2
Iowa	0.2	0.1	0.2	0	0	0	0.2	0.2	0.1	0	0	0	0	0	0	0.5	0.5	0	1.0
Kentucky	74.9	73.4	75.0	77.2	74.8	64.8	78.2	80.3	87.2	92.1	94.1	98.6	105.3	97.3	95.7	375.3	402.6	491.0	1,268.9
Maryland	0.5	0.9	1.6	1.7	1.9	1.6	2.2	1.8	2.5	2.4	2.1	1.8	2.1	2.6	2.4	6.6	10.5	11.0	28.1
New Mexico	0.8	0.8	0.9	0.8	0.7	0.1	0.6	0.8	0.8	0.6	0.2	0	0	0	0.1	4.0	2.9	2.9	7.2
Ohio	15.5	14.5	12.9	10.7	12.2	10.8	14.1	13.6	14.4	12.6	11.3	10.8	12.9	12.2	12	65.8	65.5	59.2	190.5
Pennsylvania	42.5	43.3	41.5	34.2	35.5	34.5	36.9	35.5	36.8	37.8	38.8	39.1	40.1	40.6	44.7	197.0	181.5	203.3	581.8
Tennessee	5.2	4.3	4.7	5.1	4.5	4.4	5.2	5.1	5.2	4.8	4.6	4.6	4.5	3.1	2	23.8	24.7	18.8	67.3
Utah	11.3	12.0	13.3	13.8	17.0	11.8	12.3	12.8	14.3	16.5	18.2	20.1	22.1	21.9	21.3	67.4	67.7	103.6	238.7
Virginia	27.3	27.4	31.4	32.3	31.0	26.8	32.6	33.3	33.8	36.7	37.6	35.9	39.1	34.1	34.6	149.4	163.2	181.3	493.9
West Virginia	83.6	91.3	95.8	89.1	103.5	91.9	105.8	103.5	103.1	107.2	109.8	113.1	123.3	119.8	115.1	463.3	511.5	581.1	1,555.0
Wyoming	0.9	0.7	0.9	1.3	1.3	1.3	1.3	1.1	0.2	0.1	1.1	1.6	1.7	2.4	2.5	5.1	4.0	9.3	18.4
Total	309.0	316.7	329.6	311.2	336.6	298.1	349.7	348.1	358.7	370.6	380.4	392.2	424.0	406.6	406.1	1,603.1	1,725.2	2,009.3	5,337.6

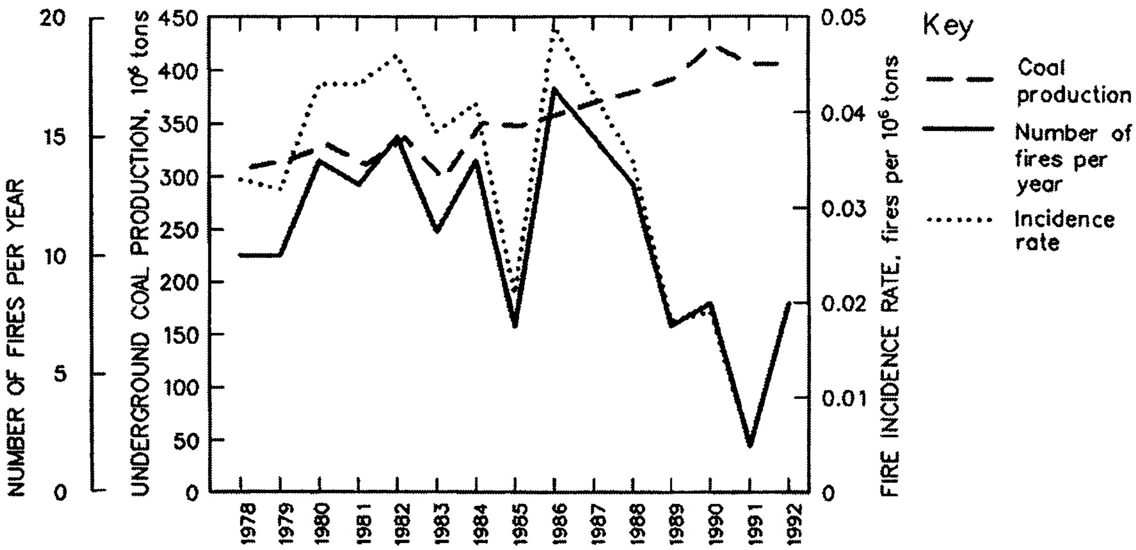
[1]Includes fourth quarter 1977.

Source: MSHA (4).

Table 3.—Fire incidence rate by State and year

State	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1978-82	1983-87	1988-92	Total
Alabama	0.128	0	0	0.233	0.088	0.092	0	0.139	0.227	0	0	0	0	0	0.063	0.088	0.091	0.012	0.057
Colorado	0	0	0.161	0.152	0	0.179	0.156	0	0.364	0.357	0.145	0	0.094	0	0	0.064	0.204	0.044	0.094
Illinois	0.124	0.122	0.057	0.068	0	0.094	0.052	0.027	0.025	0	0.026	0	0	0.023	0	0.073	0.038	0.010	0.038
Indiana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iowa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kentucky	0.013	0.014	0.013	0.026	0.027	0	0.038	0.025	0.034	0.043	0.043	0.020	0.009	0	0.010	0.019	0.030	0.016	0.021
Maryland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.000	0	0	3.300	0.139
Ohio	0.065	0	0.078	0.093	0.246	0	0	0	0.069	0.079	0	0	0.078	0	0	0.091	0.031	0.017	0.047
Pennsylvania	0.024	0	0.024	0.029	0.085	0.029	0.054	0	0.064	0.079	0.077	0.051	0.075	0.025	0.022	0.030	0.044	0.049	0.041
Tennessee	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utah	0	0	0.075	0.072	0.059	0.085	0.081	0	0.070	0.061	0.055	0.050	0	0	0	0.045	0.059	0.019	0.038
Virginia	0.037	0	0.032	0.031	0.097	0.075	0.123	0.030	0.030	0	0.053	0.028	0.051	0	0.029	0.040	0.049	0.033	0.040
West Virginia	0.012	0.055	0.052	0.022	0.019	0.022	0.009	0.010	0.029	0.037	0.009	0.008	0	0	0.026	0.032	0.022	0.009	0.020
Wyoming	0	0	1.111	0	0	0	0	0	0	0	0	0	0	0	0	0.196	0	0	0.054
Total	0.033	0.032	0.043	0.043	0.046	0.038	0.041	0.021	0.049	0.042	0.035	0.018	0.019	0.005	0.020	0.040	0.038	0.019	0.031

Figure 1



Number of underground coal mine fires per year, underground coal mine production, and fire incidence rate, 1978-92.

COALBED THICKNESS

Table 4 shows the number of fires that occurred during the three major time periods and the total number of fires by various ranges of coalbed thickness. Table 5 shows underground coal mine production by year for the same coalbed thickness ranges. Table 6 shows the number of self-reported fires, number of fires per million tons of production, and expected number of fires if fires occurred in linear proportion to production. Over three-quarters of all fires for which coalbed thickness was reported occurred in mines having coalbed thicknesses from 49 to 96 in. The range from 73 to 96 in had the highest number of fires per million tons of production. Figure 2 shows reported fires, expected fires, fire incidence rates, and underground coal mine production by coalbed thickness. An upward trend is evident in the fire incidence rate from thinner to thicker coalbeds.

Table 4.—Number of fires by coalbed thickness and time period

Coalbed thickness, in	1978-82	1983-87	1988-92	Total
36 or less	3	2	4	9
37 to 48	5	2	4	11
49 to 60	14	20	8	42
61 to 72	7	11	8	26
73 to 96	18	15	8	41
More than 96	3	7	2	12
Not reported	12	7	4	23
Total	62	64	38	164

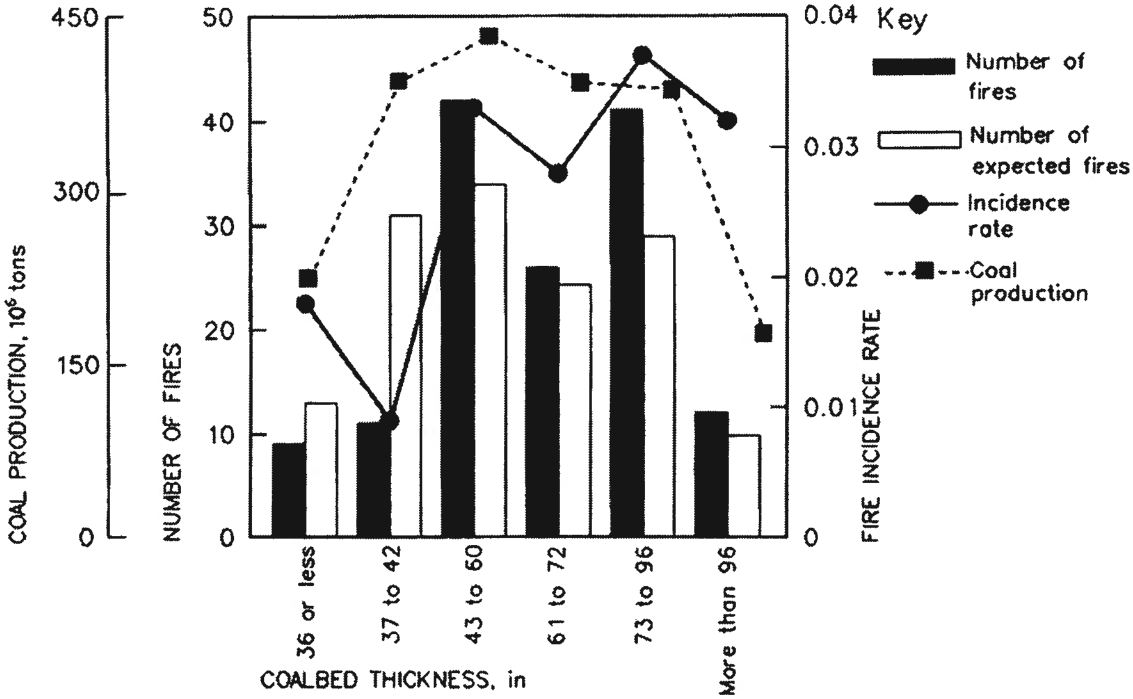
MINE SIZE

Fire data were analyzed with respect to mine size using two independent measures of mine size: mine production tonnage and number of underground employees. However, the reader is cautioned that previous research by the USBM and others has caused the reliability of self-reported accident data by small mines to be questioned (*24*). For a variety of reasons, small mines have been shown to underreport accidents that do not result in a serious injury or fatality. Since most fires do not cause an injury or fatality, it is probable that small mines are underrepresented in the fire data. The analysis in this section (and throughout the report) is based almost entirely on fires that were self-reported by mining companies without attempting to correct for the probable reporting bias.

Table 7 shows fires by mine size as defined by daily production tonnage. The most fires occurred at mines having production greater than 2,000 tons per day. However, as shown in table 8, mines producing more than 2,000 tons per day account for the greatest percentage of overall production. Therefore, it is logical that these mines should also account for the most fires.

A more meaningful representation of the data requires the number of fires within each mine size category to be compared to that category's proportion of total production. Table 9 shows the number of reported fires by daily production tonnage, incidence rates, and expected number of fires if fires were in linear proportion to production

Figure 2



Number of fires, number of expected fires, fire incidence rate, and underground coal mine production by coalbed thickness, 1978-92.

Table 5.—Underground coal mine production by coalbed thickness and year, 10^6 tons

Coalbed thickness, in	1978[1]	1979	1980	1981	1982	1983	1984	1985	1986	1987
36 or less	20.9	25.0	25.5	26.7	27.0	23.0	29.7	26.5	31.0	28.0
37 to 48	82.6	79.2	79.5	78.8	78.2	65.1	75.9	78.1	77.9	83.0
49 to 60	78.0	84.0	87.3	78.7	85.2	71.4	82.9	97.5	90.7	94.5
61 to 72	46.6	44.4	52.5	47.8	51.6	54.3	63.3	47.4	53.9	65.6
73 to 96	56.3	65.5	64.8	59.8	72.7	67.0	78.4	83.3	85.6	78.1
More than 96	19.8	18.3	19.7	19.4	21.9	17.6	19.8	16.1	19.4	22.0
Total	304.2	316.4	329.3	311.2	336.6	298.4	350.0	348.9	359.0	371.2

Coalbed thickness, in	1988	1989	1990	1991	1992	1978-82	1983-87	1988-92	Total
36 or less	33.2	31.1	57.9	48.2	54.2	125.1	138.2	224.6	487.9
37 to 48	80.5	87.8	77.6	77.2	71.9	398.3	380.0	395.0	1,173.0
49 to 60	93.2	93.7	85.8	81.5	78.8	413.2	437.0	433.0	1,283.0
61 to 72	68.5	72.4	81.0	85.0	86.3	242.9	284.5	393.2	920.6
73 to 96	76.0	72.8	83.6	78.4	75.9	319.1	392.4	386.7	1,098.0
More than 96	29.0	34.8	37.8	36.0	39.2	99.1	95.4	176.8	371.3
Total	380.4	392.6	423.7	406.3	406.3	1.597.0	1,727.0	2,009.3	5,333.3

[1]Includes fourth quarter 1977.

Source: MSHA (*4*).

Mines producing 401 to 800 tons per day experienced the fewest fires relative to production; mines producing greater than 2,000 tons per day experienced the greatest number of fires relative to production.

The other independent measure of mine size is the number of underground employees. Table 10 shows the number of reported fires by mine size as defined by number of underground employees. The greatest number of fires was reported at mines having more than 250 underground employees. However, as shown in table 11, mines employing more than 250 underground workers also account for the greatest percentage of overall production; therefore, the higher number of fires does not necessarily indicate a greater hazard. Just as was true in the earlier analysis, it is logical that these larger mines should also account for the most fires.

Table 6.—Number of fires, fire incidence rate, and number of expected fires by coalbed thickness

Coalbed thickness, in	Number of fires	Fire incidence rate	Number of expected fires
36 or less	9	0.018	12.9
37 to 42	11	0.009	31.0
43 to 60	42	0.033	33.9
61 to 72	26	0.028	24.3
73 to 96	41	0.037	29.0
More than 96	12	0.032	9.8
Total known	141	NA	NA
Not reported	23	NA	141.0
Total	164	NA	NA

NA Not available.

Table 12 shows the number of reported fires by number of underground employees, incidence rates, and expected number of fires if fires were in linear proportion to production. Mines employing 35 to 99 underground workers experienced the fewest fires relative to production, whereas mines employing 250 or more underground workers experienced the greatest number of fires relative to production.

Figures 3 and 4 show reported fires, expected fires, fire incidence rates, and underground coal mine production by mine size, defined by daily production tonnage and number of underground employees, respectively. Increasing trends in both number of fires and fire incidence rates are evident for both measures of mine size. However, as noted above, these results are valid only if reporting of fires is consistent between all size groups.

MINING METHOD

Underground coal mines in the United States are categorized as either longwall or room and pillar, depending on the extraction system used. The layout of longwall mine workings is considerably different than the room-and-pillar arrangements employed in continuous and conventional mining. In turn, these differences profoundly affect ventilation, haulage, emergency escape routes, and other mine characteristics that impact fire safety. Therefore, an analysis of reported fires and fire incidence rates by mining method (longwall or room and pillar) is of considerable interest.

The MSHA Accident Investigation Reports used as the primary source of fire incident data for this report provided mining method information in about 50 pct of cases. For the cases where the mining method was omitted from these reports, information on the mining method was obtained from the "Longwall Census" reports

Table 7.—Number of fires by daily underground coal mine production tonnage range and year

Production, tons per day	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
0 to 200	0	0	0	1	1	0	0	0	0	0
201 to 400	0	1	1	0	1	0	1	1	1	0
401 to 800	0	0	0	1	1	1	0	0	0	4
801 to 2,000	0	0	1	1	2	6	3	0	0	2
More than 2,000	8	5	6	8	8	0	10	6	13	6
Not reported	2	4	6	2	2	1	0	0	3	3
Not producing	0	0	0	0	0	3	0	0	0	0
Total	10	10	14	13	15	11	14	7	17	15

Production, tons per day	1988	1989	1990	1991	1992	1978-82	1983-87	1988-92	Total
0 to 200	2	0	1	0	0	2	0	3	5
201 to 400	0	2	0	0	0	3	3	2	8
401 to 800	0	0	0	0	0	2	5	0	7
801 to 2,000	2	0	0	0	2	4	11	4	19
More than 2,000	8	5	6	2	4	35	35	25	95
Not reported	1	0	1	0	2	16	7	4	27
Not producing	0	0	0	0	0	0	3	0	3
Total	13	7	8	2	8	62	64	38	164

Table 8.—Underground coal mine production by daily production tonnage range and year

Production, tons per day	1978[1]	1979	1980	1981	1982	1983	1984	1985	1986	1987
0 to 200	38.6	22.6	20.5	22.8	23.5	19.0	18.0	16.7	17.4	15.7
201 to 400	31.8	29.5	32.0	34.3	33.2	27.9	29.3	28.0	25.3	24.5
401 to 800	39.9	35.7	39.2	40.9	41.1	36.0	43.0	38.7	37.6	36.8
801 to 2,000	69.5	62.8	70.4	71.0	65.0	48.6	59.0	61.5	62.9	61.2
More than 2,000	128.9	165.7	167.3	142.4	174.2	166.9	200.7	203.8	215.7	232.9
Total	308.7	316.3	329.4	311.4	337.0	298.4	350.0	348.7	358.9	371.1
	1988	1989	1990	1991	1992	1978-82	1983-87	1988-92	Total	
0 to 200	14.0	12.2	11.8	9.6	8.1	128.0	86.8	55.7	270.5	
201 to 400	21.3	21.9	21.1	19.3	16.5	160.8	135.0	100.1	396.0	
401 to 800	39.8	38.4	40.0	32.1	30.3	196.8	192.1	180.6	569.5	
801 to 2,000	64.0	64.7	75.4	73.3	72.1	338.7	293.2	349.5	981.4	
More than 2,000	241.5	255.4	275.3	272.1	279.3	778.5	1,020.0	1,323.0	3,122.0	
Total	380.6	392.6	423.6	406.4	406.3	1,602.0	1,727.1	2,009.0	5,338.1	

[1]Includes fourth quarter 1977.

Source: MSHA (*4*).

Table 9.—Number of fires, fire incidence rate, and number of expected fires by daily underground coal mine production tonnage range

Production, tons per day	Number of fires	Fire incidence rate	Number of expected fires
0 to 200	5	0.018	6.8
201 to 400	8	0.020	9.9
401 to 800	7	0.012	14.3
801 to 2,000	19	0.019	24.6
More than 2,000	95	0.030	78.4
Total known	134	NAp	134.0
Unknown or not reported	30	NAp	NAp
Total	164	NAp	NAp

NAp Not applicable.

conducted by "Coal Mining & Processing" magazine (name changed to "Coal Mining" in 1984 and then changed to "Coal" in 1988) for the years 1982 and 1984 through 1992 (*25-35*). A summary of fire incidents in longwall and room-and-pillar mines from 1982 through 1992 is shown in table 13. The reader is cautioned that these data are classified by mine type and not by location within a mine. Fires in a longwall mine could have occurred at a longwall face or somewhere else in a longwall mining section. However, they might also have occurred in another part of the mine and involve equipment and procedures that are common to both longwall and room-and-pillar mines.

Table 10.—Number of fires by number of underground employees and year

Number of employees	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1 to 34	0	0	1	2	3	1	1	1	1	2
35 to 99	0	1	0	1	0	0	3	0	1	2
100 to 249	0	0	2	2	1	3	6	1	5	4
250 or more	8	5	5	7	9	3	4	5	7	3
Not reported	2	4	6	1	2	[1]4	0	0	3	4
Total	10	10	14	13	15	11	14	7	17	15
	1988	1989	1990	1991	1992	1978-82	1983-87	1988-92	Total	
1 to 34	2	2	1	0	0	6	6	5	17	
35 to 99	2	0	1	0	1	2	6	4	12	
100 to 249	4	1	1	0	2	5	19	8	32	
250 or more	5	4	4	2	3	34	22	18	74	
Not reported	0	0	1	0	2	15	11	3	29	
Total	13	7	8	2	8	62	64	38	164	

[1]Includes three fires that ocurred in temporarily inactive mines.

Table 11.—Underground coal mine production by number of underground employees and year, 10^6 tons

Number of employees	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1 to 34	35.9	46.0	53.4	55.5	61.2	57.4	69.6	67.7	71.0	72.1
35 to 99	34.7	40.4	45.0	48.3	50.0	43.0	53.1	52.9	57.6	58.6
100 to 249	56.8	69.3	78.3	75.6	75.5	69.6	79.0	83.6	91.1	100.2
250 or more	101.3	144.2	143.8	120.0	141.6	121.7	140.3	137.8	132.6	133.1
Total	228.7	299.9	320.5	299.4	328.3	291.7	342.0	342.0	352.3	364.0

Number of employees	1988	1989	1990	1991	1992	1978-82	1983-87	1988-92	Total
1 to 34	75.1	77.7	83.4	74.0	78.6	252.0	337.8	388.8	978.6
35 to 99	68.6	73.6	80.6	82.0	81.1	218.4	265.2	385.9	869.5
100 to 249	90.1	95.3	102.4	101.2	99.9	355.5	423.5	488.9	1,267.9
250 or more	142.7	139.9	152.7	146.3	143.8	650.9	665.5	725.4	2,041.8
Total	376.5	386.5	419.1	403.5	403.4	1,476.8	1,692.0	1,989.0	5,157.8

Source: MSHA (8-22).

Table 12.—Number of fires, fire incidence rate, and number of expected fires by number of underground employees

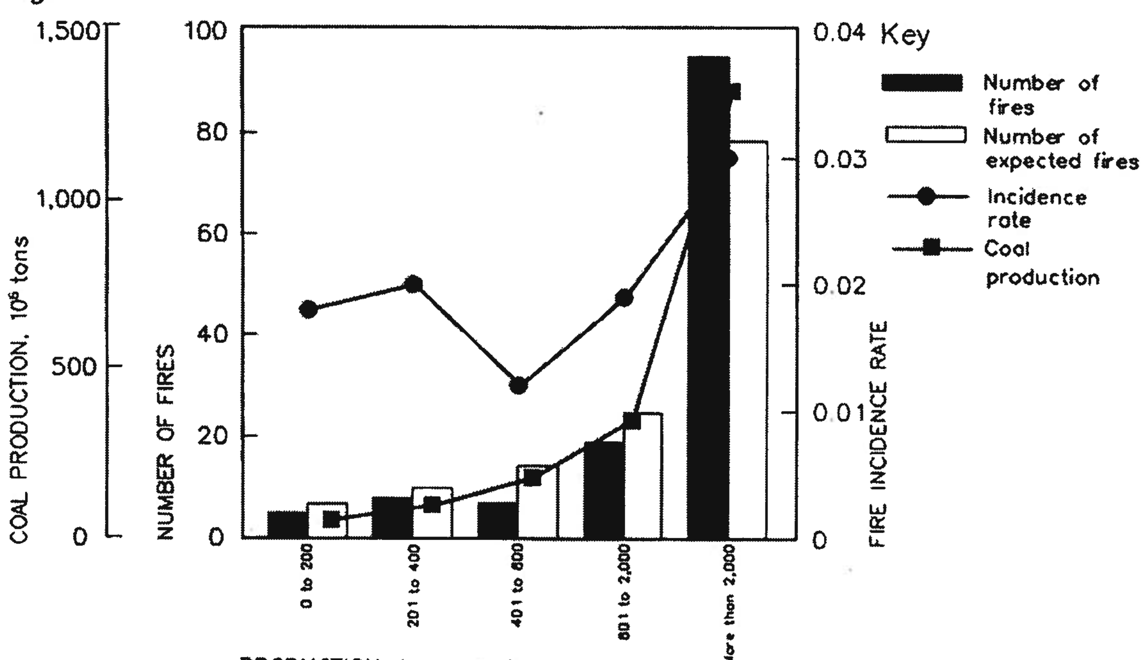
Number of employees	Number of fires	Fire incidence rate	Number of expected fires
1 to 34	17	0.017	25.6
35 to 99	12	0.014	22.8
100 to 249	32	0.025	33.2
250 or more	74	0.036	53.5
Total (known)	135	NAp	135.1
Unknown or not reported	29	NAp	NAp
Total	164	NAp	NAp

NAp Not applicable.

Table 13.—Number of fires by year and mining method

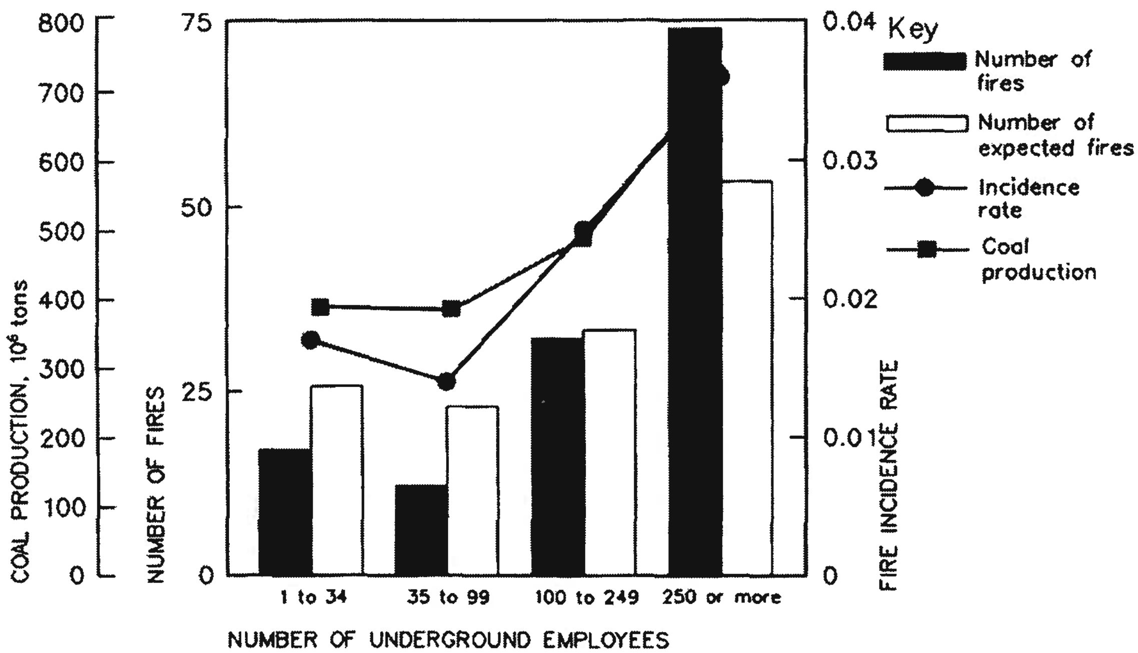
Year	Longwall	Room and pillar
1982	5	10
1983	4	7
1984	6	8
1985	2	5
1986	10	7
1987	7	8
1988	4	9
1989	3	4
1990	2	6
1991	1	1
1992	5	3
Total	49	68

Figure 3



Number of fires, number of expected fires, fire incidence rate, and underground coal mine production by daily tonnage range, 1978-92.

Figure 4



Number of fires, number of expected fires, fire incidence rate, and underground coal mine production by underground employees, 1978-92.

For fire incidence rate calculations, coal production data from longwall operations are required. However, until quite recently, such industry-wide data were not routinely collected and published. DOE's Energy Information Administration collects coal mine production data from mining companies on its EIA-7A form. This form was modified to include questions on production method (longwall or room and pillar) in 1989, and production method data were first published in 1990.

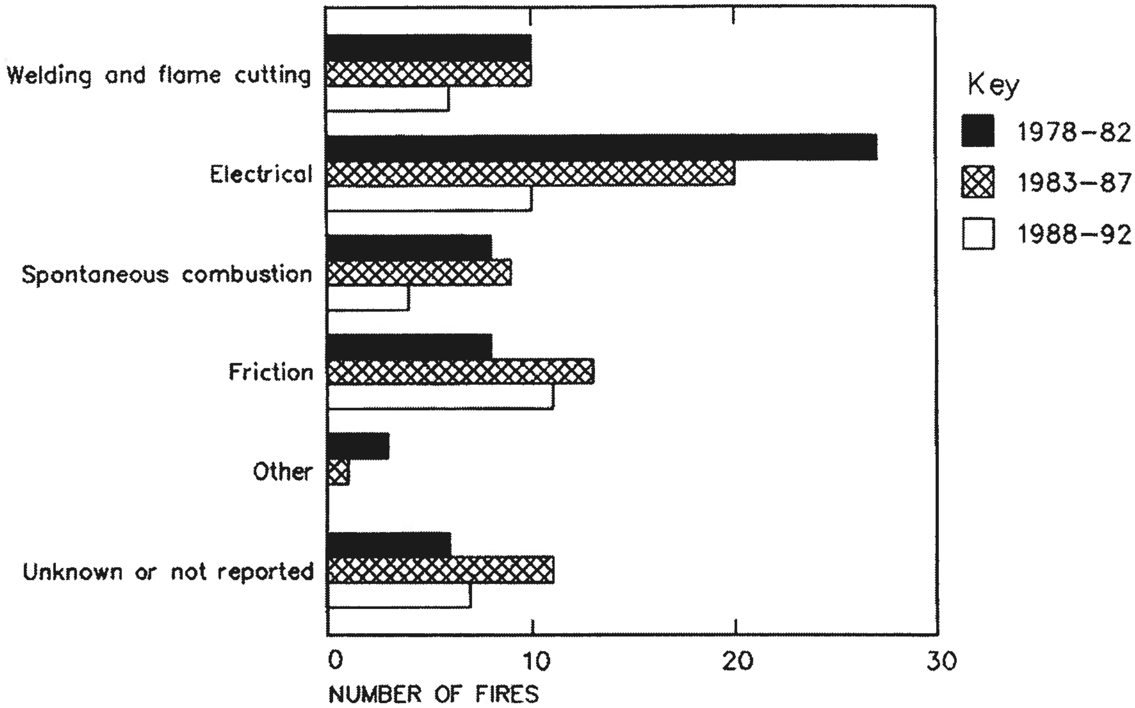
For the years 1990 through 1992, DOE reports that longwall mining accounted for 29, 29, and 31 pct, respectively, of total underground coal production. Even these figures are suspect, however. In 1991, mining equipment manufacturers and suppliers estimated longwall faces accounted for 37 pct of production from U.S. underground coal mines (*36*). Using the DOE longwall production data for the 1990-1992 period, the incidence rate for fires in longwall operations was 0.022. The incidence rate for fires in room-and-pillar operations during the same time period was 0.012. Based on the equipment manufacturers' and suppliers' estimate of longwall production, the incidence rates would be 0.017 and 0.013, respectively. These results suggest a somewhat higher hazard may exist in longwall mines.

IGNITION SOURCE

Reported fires by ignition source for the three major time periods are listed in table 14 and illustrated in figure 5. Of the 164 fires reported to MSHA, the ignition source was known and reported in 140 cases. The leading underground coal mine fire ignition source for the 1978 through 1992 period is electrical, accounting for over 41 pct of all fires for which the ignition source was known and 35 pct of all fires. Electrical fires include fires that resulted directly from an electrical fault or failure, such as a short circuit or insulation failure. Not all fires on electrically powered equipment were necessarily classified as electrical fires. Such fires were classified as electrical only if the fire originated from an electrical fault or failure.

The second leading cause of fires was friction, accounting for about one-quarter of all fires for which the ignition source was reported. Frictional fires include conveyor belts rubbing on pulleys or stationary objects, overheated brakes, overheated compressors, etc. The frequency of electrical fires declined over time, whereas fires caused by frictional sources increased. For the most recent time period, friction was the leading cause of fires.

Figure 5



Number of fires by ignition source, 1978-92.

Table 14.—Number of fires by ignition source and time period

Ignition source	1978-82	1983-87	1988-92	Total
Welding and flame cutting ...	10	10	6	26
Electrical	27	20	10	57
Spontaneous combustion	8	9	4	21
Friction	8	13	11	32
Other	[1]3	[2]1	0	4
Unknown or not reported	6	11	7	24
Total	62	64	38	164

[1]Overheated brakes, two roof falls.
[2]Roof fall.

Referring to IC 8830 (*5*), the leading ignition sources during the 1970 through 1977 period were (in descending order) electrical, spontaneous combustion, welding and cutting, and friction. These same four ignition sources accounted for the greatest number of fires in the 1978 through 1992 period, however in different rank order.

BURNING SUBSTANCE

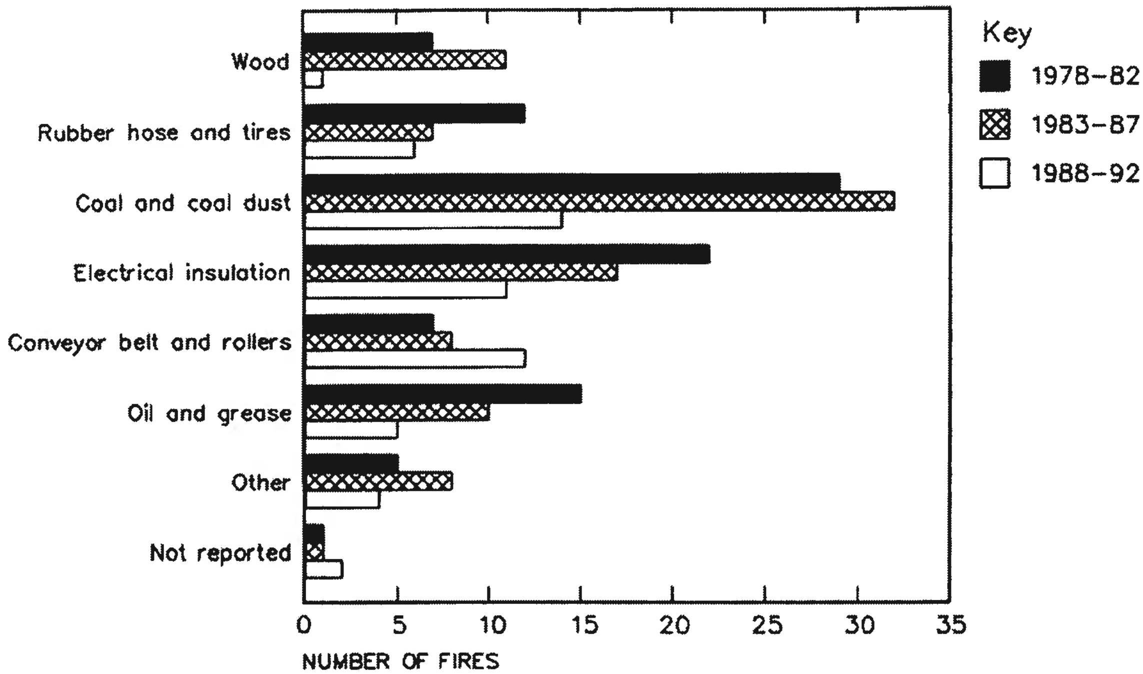
Table 15 identifies the substances that were involved in the fires. These data are illustrated in figure 6. More than one substance was involved in most fires, so the column totals add to considerably more than the total of 164 fires that occurred during the period. Coal-coal dust was the most common burning substance, followed by electrical insulation, oil-grease, conveyor belt-rollers, and rubber hose-tires. Data from IC 8830 (*5*) for the 1953-77 period show the same five leading burning substances. As shown in figure 6, all burning substances experienced a drop in the number of fires over time, except for conveyor belt and rollers, which showed an increase for each time period.

Table 15.—Number of fires by burning substance and time period

Substance	1978-82	1983-87	1988-92	Total
Wood	7	11	1	19
Rubber hose and tires	12	7	6	25
Coal and coal dust	29	32	14	75
Electrical insulation	22	17	11	50
Conveyor belt and rollers	7	8	12	27
Oil and grease	15	10	5	30
Other[1]	5	8	4	17
Not reported	1	1	2	4
Total (known)	92	85	49	226

[1]Acetylene, methane, brattice, clothing, polyurethane foam, and resin.

Figure 6



Number of fires by burning substance, 1978-92.

UNDERGROUND LOCATION

The underground locations where coal mine fires originated are listed in table 16 and illustrated in figure 7. In most cases, mine personnel were able to determine precisely where the fire originated. In a few cases, mine personnel inferred the point of origin from their knowledge of the location of specific fire hazards and the behavior of the fire.

Table 16.—Number of fires by underground location and time period

Location	1978-82	1983-87	1988-92	Total
Shaft, slope, bottom, or station	5	2	2	9
Track haulage	15	4	4	23
Belt entry	10	16	11	37
Working face	12	11	8	31
Intake entry	8	15	2	25
Power center or electrical equipment	2	5	4	11
Mined out, caved, or gob	7	7	2	16
Unknown or not reported	1	2	2	5
Other[1]	2	2	3	7
Total	62	64	38	164

[1]Return entry, shop, and stockpile recovery tunnel.

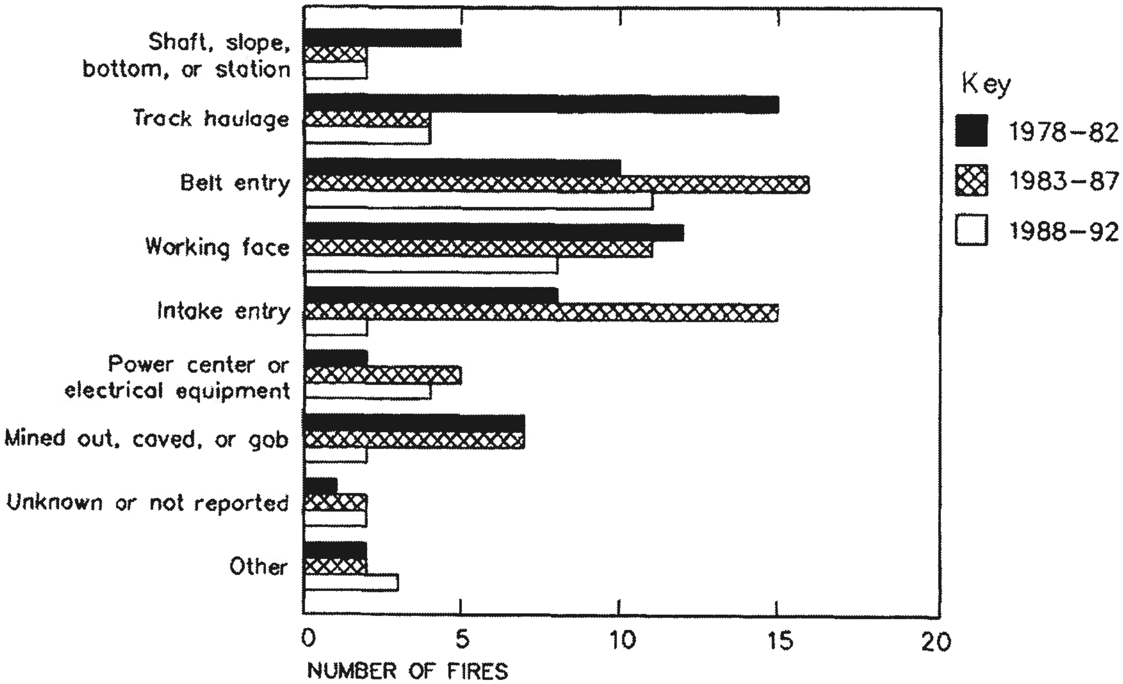
The most frequent fire locations before 1982 were the track-haulage entry and working face areas. This finding is consistent with the 1950-77 data from IC 8830 (5), but in reverse rank order. Beginning with the 1983-87 period and continuing through the 1988-92 period, the belt entry becomes the leading fire location, whereas fires occurring in the track-haulage entry drop dramatically. The increase in the number of fires in belt entries is probably related to the increased utilization of belt haulage over the past decade rather than an increased level of fire hazard in belt entries.

An increasing trend is also evident for power centers or electrical equipment. However, the actual number of fires in this category is relatively low for all three time periods (1978-82, 1983-87, and 1988-92).

EQUIPMENT INVOLVED

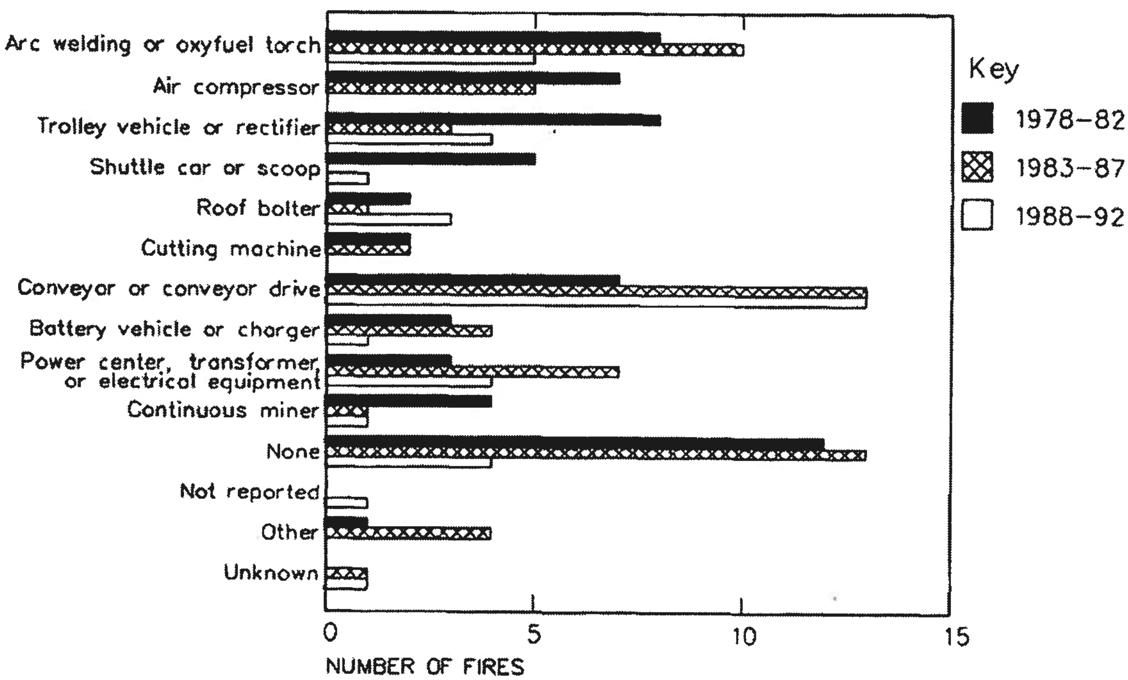
The equipment involved in underground coal mine fires is listed in table 17 and illustrated in figure 8. The equipment category accounting for the greatest number of fires during the 1978 through 1992 period was conveyor-conveyor drive, followed by arc welding-oxyfuel cutting equipment, trolley vehicle-rectifier, and power center-transformer-electrical equipment. Increasing trends are observed for roof bolters, power centers-transformers-electrical equipment, and conveyor-conveyor drives. However, the high number of fires associated with conveyors and conveyor drives makes that increasing trend the most important.

Figure 7



Number of fires by underground location, 1978-92.

Figure 8



Number of fires by equipment involved, 1978-92.

Table 17.—Number of fires by equipment involved and time period

Equipment	1968-72	1973-77	1978-82	1983-87	1988-92	1978-92
Arc welding or oxyfuel torch	4	2	8	10	5	23
Air compressor	3	4	7	5	0	12
Trolley vehicle or rectifier	11	6	8	3	4	15
Shuttle car or scoop	17	2	5	0	1	6
Roof bolter	6	4	2	1	3	6
Cutting machine	27	4	2	2	0	4
Conveyor or conveyor drive	24	9	7	13	13	33
Battery vehicle or charger	NA	NA	3	4	1	8
Power center, transformer or electrical equipment	4	9	3	7	4	14
Continuous miner	8	1	4	1	1	6
None	49	21	12	13	4	29
Not reported	0	0	0	0	1	1
Other	12	0	1	4	0	[1]5
Unknown	2	0	0	1	1	2
Total	167	62	62	64	38	164

NA Not available.
[1]Car spotter, two diesel trucks, and two water pumps.

Although all other equipment types show downward trends, two categories are particularly noteworthy. The number of fires on cutting machines showed a marked downward trend, especially for the 1968 to 1972 period versus the post-1972 period. This finding is consistent with the downward trend in conventional mining, which is the only mining method to utilize the cutting machine. The other noteworthy downward trend was in the "none" category, which also dropped dramatically, meaning that more and more fires in recent years have involved mining equipment.

One of the more significant trends in underground coal mining equipment utilization in recent years is the increasing application of diesel-powered mobile equipment. This trend has been accompanied by increasing safety concerns related to the storage, handling, and use of large quantities of diesel fuel underground, and the potential fire risks associated with the mobile equipment itself. However, these data do not indicate a serious problem. Only, two diesel equipment fires are included in table 17, and referring to table 15, reported fires involving rubber hose and tires and oil and grease are declining.

DETECTION METHOD

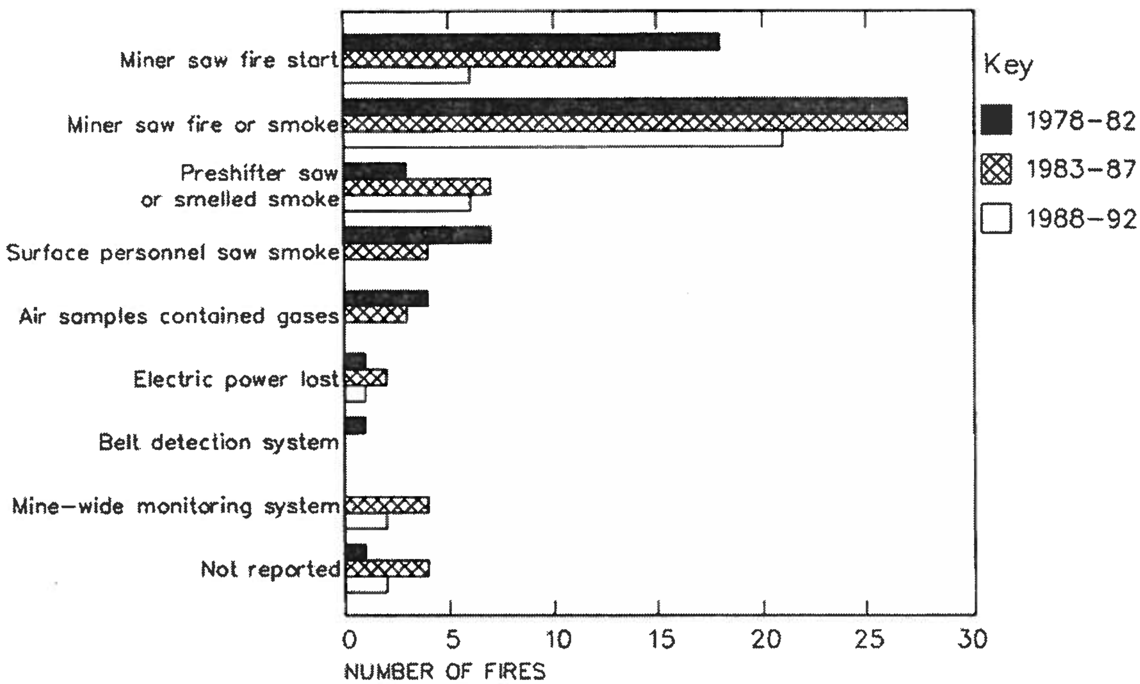
The methods by which underground coal mine fires were detected are listed in table 18 and illustrated in figure 9. The leading methods were miners who were present when the fire started, and miners who saw or smelled smoke at some time after the fire started. These two methods accounted for 112 of the 164 fires, or 68 pct during the 1978 through 1992 period. This compares to 693 out of 987 fires, or 70 pct for the 1953 through 1977 period. Two other findings from the detection data are noteworthy. Despite the high number of fires occurring on conveyors (the most frequent equipment involved in fires), and MSHA regulations which, until recently, required thermal detection systems on belt lines and at belt drives (carbon monoxide gas or smoke detection systems may now be used in place of thermal detection systems), only two fires, or 1.2 pct, were detected by belt fire detection systems. In several instances where belts were involved in fires, the belt fire detection system did alarm; however, it was after the fire had been detected by other means. This finding is consistent with a large body of conveyor belt entry fire detection research, which indicates the relative insensitivity of spot-thermal belt fire detection systems.

Table 18.—Number of fires by method of detection and time period

Method of detection	1978-82	1983-87	1988-92	1978-92
Miner saw fire start	18	13	6	37
Miner saw fire or smoke	27	27	21	75
Preshifter saw or smelled smoke	3	7	6	16
Surface personnel saw smoke	7	4	0	11
Air samples contained gases	4	3	0	7
Electric power lost	1	2	1	4
Belt detection system	1	0	0	1
Mine-wide monitoring system	0	4	2	6
Not reported	1	4	2	7
Total	62	64	38	164

Finally, it is noteworthy that mine atmosphere analysis accounted for 13 fires or 7.9 pct. Six of these fires were detected by a mine-wide monitoring system. With increased usage of mine-wide monitoring systems, mine atmosphere analysis can be expected to become a more common means of fire detection in the future. However, even more importantly, the reader is reminded that the source of data for this analysis consisted almost entirely of reportable fires, meaning that they caused an injury or

Figure 9



Number of fires by method of detection, 1978-92.

were noninjury fires lasting longer that 30 min. Since mine-wide monitoring systems are capable of detecting fires in their early stages, it is quite possible, and indeed probable, that a much larger number of fires were actually detected by mine-wide monitoring systems than the data in table 17 indicate. However, the fires would likely have been discovered while they were still very small and easily extinguished, hence not causing injury or lasting longer than 30 min and, therefore, not having to be reported to MSHA. Although the low number of fires detected by conveyor belt thermal fire detection systems might be attributed to this same reasoning, such an explanation is unlikely because of the well-documented slow response time of these systems.

TIME OF DAY

The time of day (expressed as an interval corresponding to day, evening, or night shift) when underground coal mine fires were first discovered is listed in table 19 and illustrated in figure 10. These times are not intended to represent the time when the fires actually started. However, in many cases, personnel were present at the time, or very close to the time when the fires started. In a few cases, particularly for spontaneous combustion fires, discovery lagged initiation by a considerable amount, and a definitive determination of the time when initiation occurred was impossible. For consistency in data reporting, the times indicated in table 19 are the time of day when the fires were first discovered and reported.

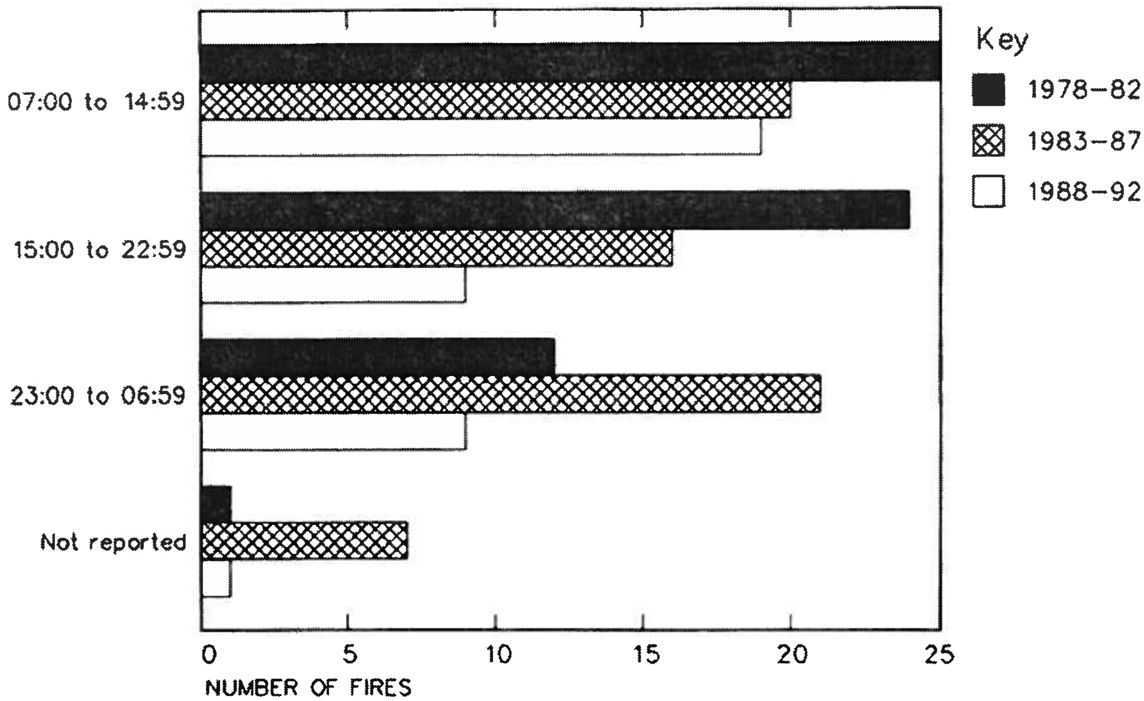
Table 19.—Number of fires by time of day and time period

Time of day	1978-82	1983-87	1988-92	1978-92
07:00 to 14:59	25	20	19	64
15:00 to 22:59	24	16	9	49
23:00 to 06:59	12	21	9	42
Not reported	1	7	1	9
Total	62	64	38	164

The greatest number of fires was discovered on the day shift, followed by the evening shift and night shift. However, these findings are not particularly useful. Since the mining activity that correlates with both the occurrence and discovery of fires is generally greater during the day shift, one would expect more fires to occur and be discovered during the day shift. A more meaningful and revealing insight would be provided by determining whether the discovery of fires during a particular shift was in proportion, or not in proportion to the level of mining activity occurring during that shift.

It was not possible to precisely determine whether the discovery of fires was in proportion to the level of mining activity on a given shift because data quantifying the level of underground coal mining activity occurring during each shift were not available. However, an indication of the

Figure 10



Number of fires by time of day, 1978-92.

level of mining activity was obtained from a U.S. Bureau of Labor Statistics (BLS) survey of shiftwork practices in various U.S. industries (*37*). These data show that about 81.7 pct of the mining work force is employed on the day shift, 7.5 pct on the evening shift, and 10.8 pct on the night shift.

These data are not necessarily representative of shiftwork practices specific to the underground coal mining industry ("mining" as defined in the BLS survey includes all sectors of the mining industry, including surface and underground metal, nonmetal, and coal mining, as well as oil and gas production). However, using the BLS factors to estimate the expected number of fires discovered on each shift, the discovery of fires on the day shift was considerably lower than expected, and the discovery of fires on the evening and night shifts was considerably higher than expected.

TIME OF YEAR

Reported fires by time of year are listed in table 20 and illustrated in figure 11. Data are shown grouped by season, with fall including September through November, winter including December through February, spring including March through May, and summer including June through August. No dramatic trends are evident in the data; however, a slight decrease was noted for the winter months during the most recent time period.

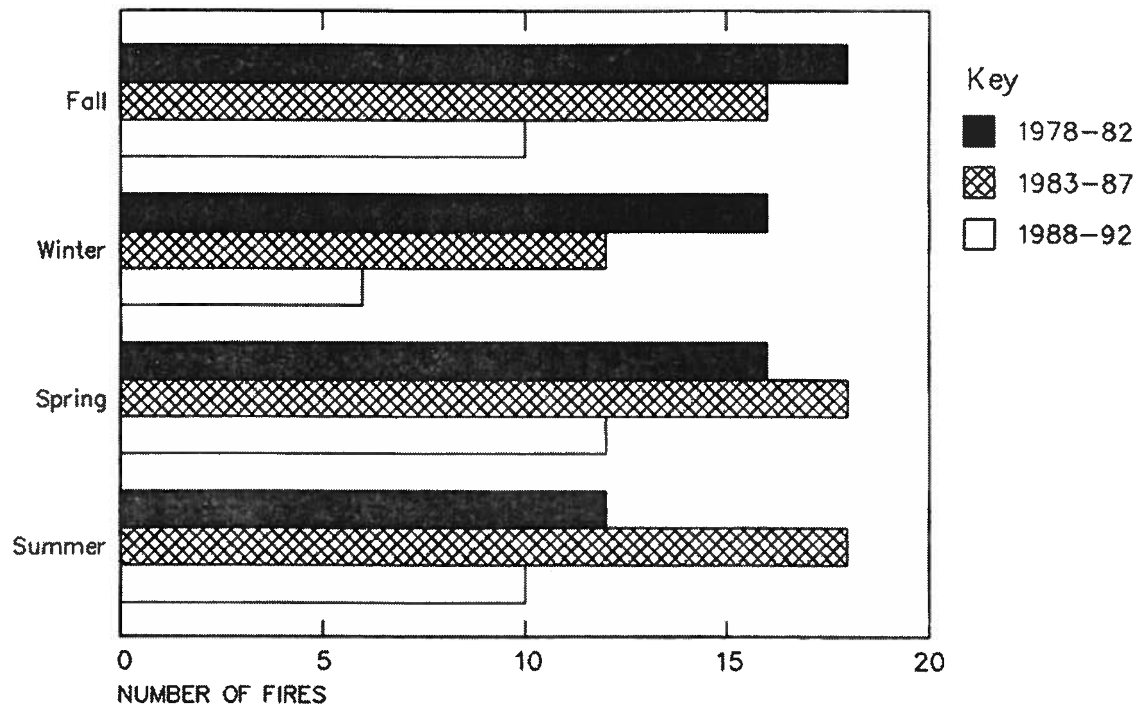
Table 20.—Number of fires by time of year and time period

Time of year	1978-82	1983-87	1988-92	1978-92
Fall	18	16	10	44
Winter	16	12	6	34
Spring	16	18	12	46
Summer	12	18	10	40
Total	62	64	38	164

INJURIES AND FATALITIES

Table 21 shows injuries and fatalities caused by underground coal mine fires from 1978 through 1992, and the location, equipment involved, and ignition source for each fire that caused an injury or fatality. Over this 15-year period, a total of 17 fires caused 43 injuries and 30 fatalities. The injury incidence rate (injuries per 100 million tons of coal mined) over this period was 0.82, and the fatality incidence rate (fatalities per 100 million tons of coal mined) was 0.57. The injury incidence rate during the 1950 through 1977 period was 2.35, or 2.86 times the 1978 through 1992 rate. The fatal incidence rate over the 1950 through 1977 period was 0.79, or 1.38 times the 1978 through 1992 rate.

Figure 11



Number of fires by time of year, 1978-92.

Table 21.—Injuries and fatal fires by year, number of injuries and/or fatalities, location, equipment involved, and ignition source

Year	Number of injuries	Number of fatalities	Location	Equipment involved	Ignition source
1978	0	1	Shaft bottom	Oxyacetylene torch	Flame cutting.
	6	0	Track entry	Trolley line	Electrical.
1979	1	0	..do.	..do.	Electrical.
1980	2	0	Working face	Shuttle car	Electrical.
1981	1	0	Track entry	Trolley line	Electrical.
1982	1	0	Not reported	Oxyacetylene torch	Flame cutting.
	2	0	Track entry	Air compressor	Friction.
1984	10	0	Longwall headgate	Power cable	Electrical.
	0	27	Main intake	Air compressor	Friction.
1986	3	0	Longwall face	Oxyacetylene torch	Flame cutting.
	2	1	Belt entry	Conveyor belt	Friction.
1987	0	1	Working face	Continuous miner	Friction.
	3	0	Longwall headgate	Air compressor	Friction.
	1	0	Belt entry	Conveyor belt	Unknown.
1988	5	0	..do.	..do.	Friction.
1992	1	0	Working face	Power center	Electrical.
	5	0	..do.	Not reported	Not reported.
Total	43	30	NAp	NAp	NAp.

NAp Not applicable.

The most frequent locations for injury fires were the track entry (4 fires, 10 injuries), working face (3 fires, 8 injuries), and belt entry (3 fires, 8 injuries). The four track entry fires all occurred before 1983, while the three belt entry fires all occurred after 1985. For fatal fires, no single location accounted for more than one fire, with fires occurring at the shaft bottom, main intake, belt entry, and working face. From IC 8830 (5), the most frequent location for injury fires during the 1970 through 1977 period was the working face (five fires) and haulageway (two fires). For fatal fires, two were located at the face and three were outby during the 1970-77 period.

The equipment most frequently involved in injury fires was the trolley line (three fires, eight injuries) and conveyor belt (three fires, eight injuries). Oxyacetylene cutting torches and air compressors were each involved in two injury fires. No single type of equipment was involved in more than one fatal fire, with fires involving an oxyacetylene torch, air compressor, conveyor belt, and continuous miner. From IC 8830 (5), the equipment most frequently involved in injury fires during the 1970 through 1977 period was oxyacetylene cutting torches, with three fires. For fatal fires, no type of equipment was involved in more than one fire during the 1970-77 period.

The most common ignition sources for injury fires were electrical (6 fires, 20 injuries), friction (4 fires, 10 injuries), and flame cutting (2 fires, 4 injuries). The ignition source for three of the four fatal fires was friction; however, the source of the friction was different in all three cases (overheated air compressor, stuck idlers on conveyor belt, frictional ignition of methane at a working face). From IC 8830 (5), the most common ignition source for injury fires during the 1970 through 1977 period was electrical (six fires), with no other ignition source accounting for more than one fire. During that time period, all five fatal fires were electrical in origin.

METHOD OF EXTINGUISHMENT

The attempted and successful extinguishing agents for underground coal mine fires from 1978 through 1992 are listed in table 22. Figure 12 shows successful extinguishing agents only. For all three time periods, water was the most common attempted and successful extinguishing agent, followed by dry chemicals. Use of rock dust was more common than sealing (including both sealing with and without carbon dioxide or nitrogen injection). However, sealing was successful in extinguishing more fires than rock dust. Fire-fighting usually involved the use of more than one extinguishing agent, and, often, more than one extinguishing agent was required for successful extinguishment. Thus, the totals in both attempted extinguishment and successful extinguishment add to more than the total number of fires that occurred during the period.

The success rate for the various extinguishing agents is also shown in table 22 for all time periods. The success rate is the ratio of the number of fires that were successfully extinguished with a given agent to the number of fires in which an attempt was made to extinguish the fire with that agent.

This analysis is not intended to suggest that one agent is inherently more effective in fighting coal mine fires than another agent based solely on the difference in the number of successful attempts or success rate. Other factors were often significant, such as the quantity of agent immediately available to fire fighters and the size of the fire.

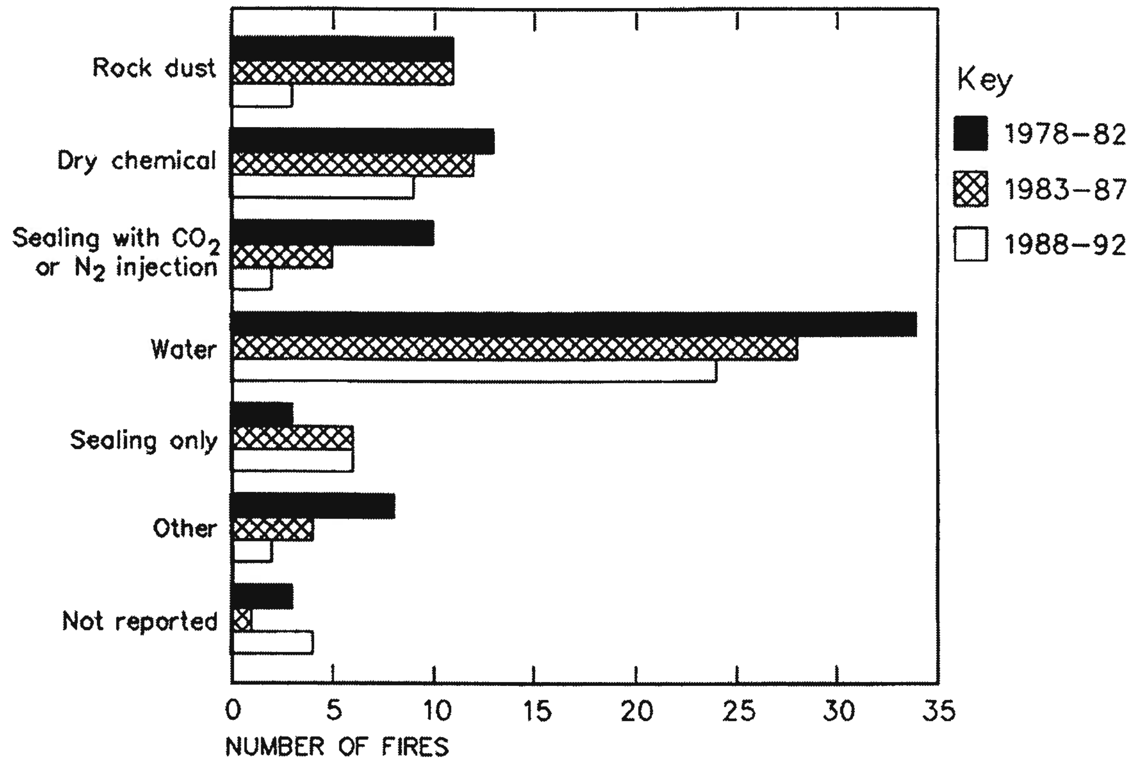
In the case of water versus rock dust or dry chemical extinguishers, for example, fire fighters might use rock dust or dry chemicals to suppress a fire while a hose line is connected and extended to the fire area. Total extinguishment could be achieved with water, and table 22 indicates water as the successful extinguishing agent. However, successful extinguishment might not have been possible without the temporary control of the fire using rock dust or dry chemical extinguishers.

Table 22.—Number of fires by method of extinguishment, time period, and number of attempts, number of successful attempts, and success rate of extinguishment

Method of extinguishment	1978-82			1983-87		
	Number of attempts	Number of successful attempts	Success rate	Number of attempts	Number of successful attempts	Success rate
Rock dust	21	11	0.52	13	11	0.85
Dry chemicals	32	13	0.41	17	12	0.71
Sealing with CO_2 or N_2 injection	10	10	1.00	7	5	0.71
Water	39	34	0.87	35	28	0.80
Sealing only	3	3	1.00	9	6	0.67
Other	6	8	NA	7	4	NA
Not reported	3	3	NA	1	1	NA
	1988-92			**1978-92**		
	Number of attempts	Number of successful attempts	Success rate	Number of attempts	Number of successful attempts	Success rate
Rock dust	10	3	0.30	44	25	0.57
Dry chemicals	25	9	0.36	74	34	0.46
Sealing with CO_2 or N_2 injection	2	2	1.00	19	17	0.89
Water	40	24	0.60	114	86	0.75
Sealing only	7	6	0.86	19	15	0.79
Other	9	2	NA	22	14	NA
Not reported	4	4	NA	8	8	NA

NA Not available.

Figure 12



Number of fires by successful method of extinguishment, 1978-92.

More importantly, it must be remembered that the data utilized in this analysis are limited, almost entirely, to reportable fires. However, it is believed that most fires are successfully extinguished before they become reportable (less than 30 min and without injury). For example, in IC 8830 (*5*), it is estimated that three times more fires are extinguished at the nonreportable stage than those that cause an injury or last longer than 30 min, thus becoming reportable. In order for a fire to be extinguished while still nonreportable, firefighting would almost certainly have to be initiated immediately, or within a very few minutes after those fires start. Dry chemicals, rock dust, and manually operated or automatic fire suppression systems would be the most likely methods to be used immediately on a fire, thereby achieving extinguishment while the fire is still nonreportable. The relatively small number of cases of successful extinguishment for dry chemical, rock dust, and manually operated or automatic fire suppression systems is believed to relate more to their effectiveness in extinguishing fires than to their lack of use or lack of effectiveness.

If it were possible to determine the success rate for extinguishing agents based on the total number of fires occurring rather than the number of reportable fires, the results would almost certainly be quite different than those shown in table 22. Again, referring to IC 8830 (*5*) where such data are included, the most common successful extinguishing agent for reportable fires from 1953 through 1977 was water, but the most common successful extinguishing agent for nonreportable fires during that period was dry chemicals.

Sealing a mine or portion of a mine is the fire extinguishing method of last resort and is implemented only when all other methods have been tried and failed, or eliminated from consideration. Sealing a mine or portion of a mine is laborious and dangerous work, extremely costly, risks the loss of considerable coal resources, and often prevents mine production activities for months or years. Carbon dioxide or nitrogen injection can add considerable expense to the already high costs of sealing a mine. Every attempt is made to extinguish a mine fire by means other than sealing. Thus, the number of fires where extinguishment was attempted by sealing is a measure of the failure of other fire-fighting methods. During the 1978 through 1992 period, 23 pct of mine fires required all or part of the mine to be sealed. The proportion of mine fires that were required to be sealed during the 1953 through 1977 period was exactly the same: 23 pct.

MINE EVACUATIONS

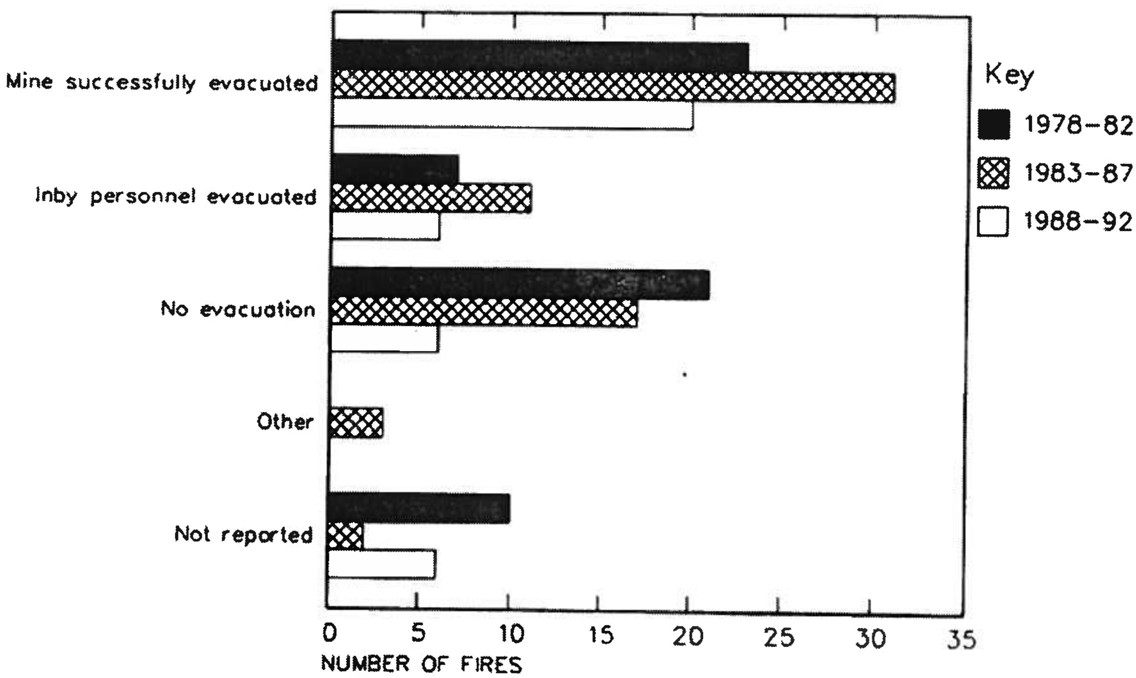
The number and extent of mine evacuations implemented at mines experiencing reportable fires during the 1978 through 1992 period are listed in table 23 and illustrated in figure 13. During this period, total mine evacuations were implemented in 74 out of 164 fires, or 45 pct. During the 1978 through 1982 period, total mine evacuations were implemented in 23 out of 62 fires, or 37 pct. During the 1988 through 1992 period, this proportion had increased to 20 out of 38 fires, or 53 pct. When considering both total evacuations and partial evacuations (evacuating inby personnel only), the proportion increased from 48 pct in the earlier time period to 68 pct in the later time period. The downward trend in the "no evacuation" category is clearly evident in figure 13.

The fire report data do not support a definitive explanation for this increase in the percentage of fires resulting in total or partial evacuations. It may result from a generally increased level of knowledge of, and caution by, management regarding the risks to underground personnel from fire.

Table 23.—Number of fires by degree of mine evacuation and time period

Degree of evacuation	1978-82	1983-87	1988-92	1978-92
Mine successfully evacuated	23	31	20	74
Inby personnel evacuated	7	11	6	24
No evacuation	21	17	6	44
Other	0	3	0	3
Not reported	11	2	6	19
Total	62	64	38	164

Figure 13



Number of fires by degree of mine evacuation, 1978-92.

CONCLUSIONS

The major findings of this statistical analysis of underground coal mine fires are shown in table 24. For comparison purposes, table 25 contains the major findings from IC 8830 (5).

During the 1978 through 1992 period, the overall fire incidence rate (fires per million tons of coal mined) was 0.031. The fire incidence rate for the 1950 through 1977 period was 0.115, over three times higher than the rate for the 1978 through 1992 period. The injury incidence rate (injuries caused by underground coal mine fires per 100 million tons of coal mined) for the 1978 through 1992 period was 0.82. The injury incidence rate for the 1950 through 1977 period was 2.35, over 2½ times higher than the rate for the 1978 through 1992 period. The fatality incidence rate (fatalities caused by underground coal mine fires per 100 million tons of coal mined) for the 1978 through 1992 period was 0.57. The fatality incidence rate for the 1950 through 1977 period was 0.79, about one-third higher than the rate for the 1978 through 1992 period.

In comparing the 1950 through 1977 period to the 1978 through 1992 period, significant reductions in the incidence rates for total fires, injuries, and fatalities are clearly evident. However, since 1968, no downward trend is evident in incidence rates for total fires, injuries, or fatalities.

Table 24.—Major findings of statistical analysis of underground coal mine fires, 1978-92

Category	All fires	Injury fires	Fatal fires
Ignition source	Electrical, friction, welding or cutting.	Electrical, friction, welding or cutting.	Friction, welding or cutting.
Detection	Miner saw or smelled smoke, miner saw fire start, examiner saw or smelled smoke.	Miner saw fire start, miner saw or smelled smoke.	Miner saw fire start, miner saw or smelled smoke.
Burning substance	Coal, electrical insulation, conveyor belt or rollers.	Coal, electrical insulation, conveyor belt or rollers.	Coal, conveyor belt or rollers, electrical insulation.
Equipment involved	Conveyor belt, welding or cutting, trolley line, electrical equipment.	Trolley line, conveyor belt, welding or cutting, air compressor.	Conveyor belt, air compressor, welding or cutting, continuous miner.
Location	Belt entry, working face, intake aircourse, track entry.	Track entry, working face, belt entry, longwall.	Shaft bottom, intake aircourse, belt entry, working face.
Successful extinguishing agent	Water, dry chemicals, rock dust	Water, dry chemicals, rock dust.	Water, dry chemicals.

Table 25.—Major findings of statistical analysis of underground coal mines fires, 1950-77

Category	All fires	Injury fires	Fatal fires
Ignition source	Electrical, spontaneous combustion, friction.	Electrical, welding or cutting	Electrical.
Detection	Miner saw fire start, miner saw or smelled smoke.	Miner saw fire start, miner saw or smelled smoke.	Miner saw fire start, miner saw or smelled smoke.
Burning substance	Electrical insulation, coal, conveyor belt or rollers.	Electrical insulation, coal, conveyor belt or rollers.	Electrical insulation, coal, conveyor belt or rollers.
Equipment involved	Conveyor belt, cutting machine, track locomotive.	Welding or cutting	Conveyor belt, cutting machine, track locomotive.
Location	Outby working face, working face, haulageway.	Outby face, haulageway	Outby face, working face.
Successful extinguishing agent	Water, dry chemicals, rock dust	Water, dry chemicals, rock dust.	Water, dry chemicals, rock dust.

Following the pattern established during the 1950 through 1977 period, electricity was the most frequent ignition source for underground coal mine fires during 1978 through 1992, followed by friction and welding-cutting. However, for the most recent time period, friction became the leading ignition source. The most frequent ignition sources for injury fires were also electricity, friction, and welding-cutting. For fatal fires, friction was the most frequent ignition source. The most notable differences between the 1950-77 and the 1978-92 ignition source data are the decline in the incidence of electrical fires and the emergence of friction as an ignition source of increasing significance. Electricity is still the most frequent source of fires, but during the 1950-77 period, 62 pct of all fires were electrical in origin, compared to 35 pct during the 1978-92 period. In contrast, friction was the ignition source in 21 pct of all fires during the 1978-92 period, but only 9.6 pct during the 1950-77 period. It is likely that the increased usage of conveyor belts for both section haulage and main haulage underground and the increased use of mobile equipment and air compressors have all contributed to the increase in fires caused by friction.

The most frequent method of fire detection during the 1978-92 period was nearby miners who saw or smelled smoke and investigated until they discovered a fire. The next most frequent fire detection methods were miners who were present when the fire actually started and pre-shift examiners or supervisors who saw or smelled smoke as they fire bossed the mine. For injury and fatal fires, the most frequent method of fire detection was miners who saw the fire start, followed by nearby miners who saw or smelled smoke. During the 1950-77 period, the most frequent method of fire detection for all fires, injury fires, and fatal fires were miners who saw the fire start, followed by nearby miners who saw or smelled smoke.

Coal, electrical insulation, and rubber were the most frequent burning substances involved in underground coal mine fires during both the 1950-77 and 1978-92 periods. These three materials were also the most frequent burning substances for injury fires and fatal fires during both time periods. Coal was involved in about 45 pct of all fires. Electrical insulation was involved in 43 pct of fires prior to 1978, but only 30 pct after 1978. Rubber was involved in about 30 pct of fires during both time periods. During the 1978 through 1992 period, fires involving rubber were equally divided between rubber hoses-tires and conveyor belts.

During the 1978-92 period, conveyor belts, welding and cutting equipment, and trolley lines were the equipment most frequently involved in underground coal mine fires. The equipment most frequently involved in injury fires during that period was the trolley line, followed by conveyor belts, welding and cutting equipment, and air compressors. Only four fatal fires occurred during the period, with one each involving a conveyor belt, air compressor, welding and cutting equipment, and continuous miner. During the 1950-77 period, conveyor belts were the equipment most frequently involved in fires, followed by cutting machines and trolley locomotives. During that time period, the equipment most frequently involved in injury fires was welding and cutting equipment. For fatal fires, it was conveyor belts, cutting machines, and trolley locomotives. Conveyor belts, trolley-powered equipment, and welding and cutting equipment have been the leading equipment involved in underground coal mine fires for over 40 years, from 1950 through 1992. The only new equipment type to become an important factor in recent years is the air compressor.

During the 1978-92 period, the most fires occurred in the belt entry, followed by the working face area, the intake entry, and the track entry. The most injury fires occurred in the track entry, followed by the working face area and the belt entry. Fatal fires occurred in the shaft bottom area, belt entry, intake entry, and working face area. During the 1950-77 period, most fires occurred immediately outby the working face. This area was also the frequent location for injury fires and fatal fires during that time period. Other frequent fire locations included the working face and haulageway (both track and belt).

The agent that was most frequently successful in extinguishing underground coal mine fires was water, followed by dry chemicals and rock dust. This was true for all fires from 1950 through 1992, as well as for injury fires over that period and for fatal fires during the 1950-77 period.

Two significant conclusions can be drawn from this analysis. First and most important, the fire incidence rate, injury incidence rate, and fatality incidence rate have all declined between the 1950 through 1977 period and the 1978 through 1992 period. Likely causes of this decline are safer mining equipment and practices and stricter enforcement of mine fire safety regulations.

The other significant conclusion is the similarity between the 1950 through 1977 and the 1978 through 1992 data sets regarding ignition sources, fire detection, burning substances, equipment involved, location, and successful extinguishing agent. These sets were almost identical for both time periods (though sometimes in differing rank order), which together span over 40 years. This observation is in apparent conflict with the obvious and fundamental changes in mining technology, methods, and equipment that have occurred over the past four decades.

One possible explanation for the decline in fire incidence rates but lack of change in fire characteristics is that the newer technology and equipment may, in relative terms, present less fire risk, while the older technology and methods may present an inherently greater fire risk, even when improved fire protection technology and stricter regulations are applied. As older, more fire-prone equipment is mothballed or scrapped, or "old technology" mines are shut down, the fire risks they represent are mothballed, scrapped, and shut down along with them, resulting in a lower overall fire incidence rate. For example, in the earlier time periods, a large number of fires were reported on trolley equipment and cutting machines. These represent older mining technologies. However, for the most recent time period, very few fires were reported on longwall faces, which represent a newer technology. As new and safer materials, fire protection technologies, electrical systems, hydraulic systems, etc. are developed and made available, they may be more readily incorporated into new equipment designs and newer mines than retrofitted to older equipment or installed in older mines. Fires involving the newer generation of equipment may be occurring, but might be of shorter duration and therefore not reportable.

Future implications of these findings are not obvious. Although a continuation of the decline in the number or fires and fire incidence rates might be expected, such a decline would not be automatic. The observed decline in reported fires and incidence rates is probably the result of a combination of many factors, though improvements in mining and safety technology coupled with stricter regulations and enforcement activities must certainly be the predominate factors responsible. It must therefore be concluded that further reductions in the number of fires and the fire incidence rate will be possible only through continued efforts in all of these areas.

It must also be recognized that although newer mining technology may be inherently less fire prone than older technology, it is not without risk. Conveyor belt haulage, for example, may be an improvement over track haulage in terms of fire risk, but conveyors are, nonetheless, a significant source of fires in underground coal mines. As new technologies are introduced, their effect on mine fire protection must continually be assessed and deficiencies corrected on an ongoing basis.

Clearly, improvements in mine fire protection technology are necessary and achievable, and use of data such as that contained in this report can assist in these efforts.

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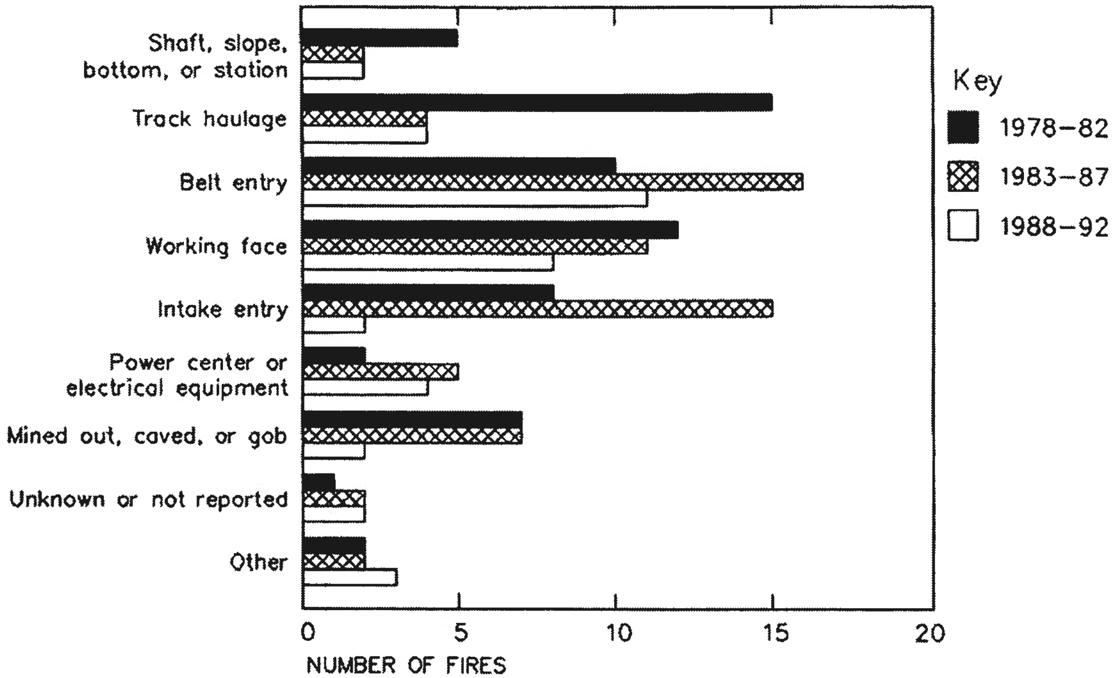
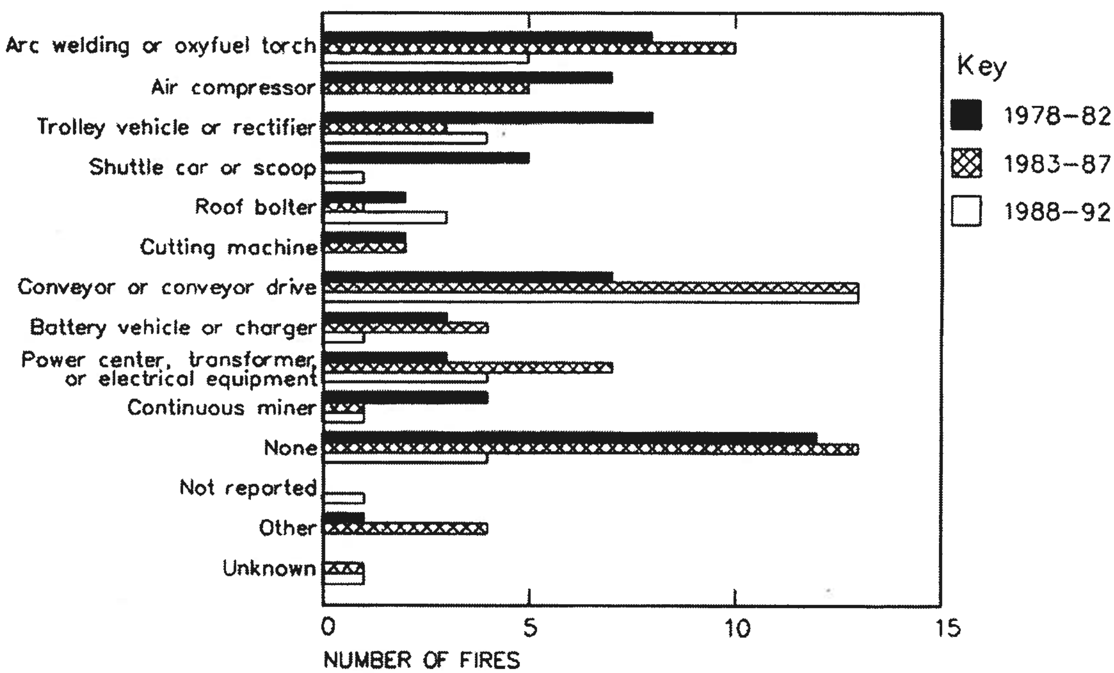
Figure 7



Number of fires by underground location, 1978-92.

Figure 8



Number of fires by equipment involved, 1978-92.

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Analysis of Mine Fires for All U.S. Underground and Surface Coal Mining Categories: 1990–1999

Department of Health and Human Services
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

NIOSH

Information Circular 9470

Analysis of Mine Fires for All U.S. Underground and Surface Coal Mining Categories: 1990–1999

By Maria I. De Rosa

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
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UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

hr	hour(s)	st	short ton
min	minute(s)		

ANALYSIS OF MINE FIRES FOR ALL U.S. UNDERGROUND AND SURFACE COAL MINING CATEGORIES: 1990–1999

By Maria I. De Rosa[1]

ABSTRACT

This report analyzes mine fires for all U.S. underground and surface coal mining categories by state and 2-year time periods during 1990–1999. Risk rate values are derived, and ignition source, methods of fire detection and suppression, and other variables are examined. The data were derived from Mine Safety and Health Administration (MSHA) mine fire accident publications and verbal communications with mine personnel. The analysis will provide the National Institute for Occupational Safety and Health, MSHA, and the mining industry with a better understanding of the causes and hazards associated with mine fires and will form a basis for future fire research programs.

[1]Industrial hygienist, Pittsburgh Research Laboratory, National Institute for Occupational Safety and Health, Pittsburgh, PA.

INTRODUCTION

Coal mine fires pose a constant danger to the safety of miners and to their livelihood. Underground mine fires pose an added hazard because of the confined environment with remote exits. Enactment of safety regulations [30 CFR[2] 75 and 77] for underground coal mines and surface coal operations has greatly improved the safety of miners. However, mine fires and fire injuries remain serious hazards for all coal mining operations.

This report analyzes mine fires and fire injuries for all U.S. coal mining categories (underground coal mines, surface of underground coal mines, surface coal mines, and coal preparation plants) during 1990–1999. Fires involving contractors are also included in the analysis. Similar analyses (for underground coal mines only) by the former U.S. Bureau of Mines (USBM) were reported by McDonald and Pomroy [1980] and Pomroy and Carigiet [1995] for 1950–1977 and 1978–1992, respectively. For comparison purposes, data for 1978–1992 are mentioned in the "Underground Coal Mine Fires" section of this report. Detailed analyses of mobile equipment fires for all underground and surface coal and metal/nonmetal mining categories during 1990–1999 have recently been reported by NIOSH [De Rosa 2004].

Risk rate values (fire and injury risk rates) for the 10-year period (1990–1999) and for five successive 2-year periods within the 10-year period are derived. Risk rate values for individual states for the 10-year period are also derived. Other variables by state and time period include employees' working hours, lost workdays, and coal production (underground and surface coal mines only). The number of fire fatalities is reported by time period. Variables such as ignition source, method of detection and suppression, equipment involved, location, and burning material are reported by five 2-year periods only. Furthermore, the number of fire injuries per number of fires causing injuries and total fires has been analyzed by year, ignition source, equipment involved, and location. For comparison purposes, the major fire and fire injury findings for all coal mining categories have been reported.

The data in this report were derived from "Injury Experience in Coal Mining" [MSHA 1991a, 1992, 1993, 1994a, 1995a, 1996, 1997, 1998b, 1999c, 2000], "Fire Accident Reports" [MSHA 1991b,c; 1994b; 1995b,c; 1998a,c,d,e,f; 1999a,b,d,e], MSHA "Fire Accident Abstracts" internal publications, and verbal communications with mine personnel. Mining companies are required by 30 CFR 50 to report to MSHA all fires that result in injuries and fires that are not extinguished within 30 min of discovery. A small number of fires lasting <30 min without injuries reported in the "Fire Accident Abstracts" have been included in this report.

The analysis in this report will provide the National Institute for Occupational Safety and Health (NIOSH), the Mine Safety and Health Administration (MSHA), and the mining industry with a better understanding of the causes and hazards of mine fires and fire injuries. It will also form a basis for developing future fire research programs.

METHODOLOGIES

For all coal mining categories, data on coal mine fires during 1990–1999 have been reported as actual numbers and calculated values.

1. For each mining category, actual numbers include the total number of fires, fire injuries, employees' working hours, lost workdays, and coal production (for underground and surface mines only) for a 10-year period (1990–1999) and for five successive 2-year periods within the 10-year period. These numbers have also been reported by state (10-year period). The actual number of fire fatalities has been reported by time period. Furthermore, actual numbers of fires for the five 2-year periods have been reported by ignition source, method of detection and suppression, equipment involved, location, and burning material. Actual numbers of fire injuries per number of fires causing injuries and total fires have been reported by year, ignition source, equipment involved, and location.

2. For each mining category, the calculated values include the fire and injury risk rates during the 10-year period and the five 2-year periods. The fire risk rate (Frr) values were calculated according to the USBM formula [Pomroy and Carigiet 1995]. The injury risk rate (Irr) values were calculated according to the MSHA formula [MSHA 1991a, 1992, 1993, 1994a, 1995a, 1996, 1997, 1998b, 1999c, 2000]. Also, risk rate values for individual states (10-year period) were calculated according to the above-mentioned formulas.

Of note is that only the risk rate values for the 10-year and five 2-year periods and risk rate values for individual states with the highest number of fires and fire injuries were considered for comparison purposes. The fatality risk rate values were not calculated because of the extremely small number of fire fatalities during the 10-year period.

3. Calculations of risk rate values are as follows:

a. Fire risk rate (Frr) value: Number of fires per million tons of coal produced [Pomroy and Carigiet 1995].
b. Injury risk rate (Irr) value: Number of fire injuries multiplied by 200,000 working hours per total employees' working hours [MSHA 1991a, 1992, 1993, 1994a, 1995a, 1996, 1997, 1998b, 1999c, 2000]. The Irr value is the average risk rate value for the number of fire injuries per 200,000 working hours for a given time period.

[2]*Code of Federal Regulations*. See CFR in references.

c. Total employees' working hours (Ewhr) value during 1990–1999: Sum of 10 yearly Ewhr values for all of the states involved in fires. This value also includes the Ewhr value reported for all other states not involved in fires. The Ewhr value for each state (10-year time period) is the sum of 10 yearly Ewhr values for that state.
d. Total employees' working hours (Ewhr) value for five 2-year time periods: Sum of two yearly Ewhr values for all of the states, involved and not involved in fires, within the 2-year period.
e. The coal production (CP) values in short tons were calculated similarly.
f. The lost workday (LWD) values were reported by state and time period.
g. An LWD value of 6,000, assigned by MSHA to each fatality, was reported.

FIRE DATA ANALYSIS FOR ALL COAL MINING CATEGORIES

UNDERGROUND COAL MINE FIRES

Table 1 and figure 1 show the number of fires and fire injuries that occurred in underground coal mines by state during 1990–1999. Table 1 also shows by state the risk rates, employees' working hours, lost workdays, and coal production. Overall, 87 fires occurred in 12 states. Twenty-seven of those fires caused 34 injuries (the yearly average was 8.7 fires and 3.4 injuries). One fire and one injury involved a contractor. The underground mine fires required 25 mine rescue team interventions and 30 mine/section evacuations followed by 13 mine/section sealing/flooding/CO_2/N_2 gas injections. The Ewhr value was 1,003 × 10^6 hr (Irr = 0.007), the CP value was 4,008 × 10^6 st (Frr = 0.022), and the LWD value was 208.

Virginia had the most fires (15 fires and 7 injuries). Pennsylvania had the most fire injuries (12 fires and 9 injuries), followed by Kentucky (12 fires and 6 injuries), and Alabama (12 fires and 4 injuries). Among these states, Alabama had the highest fire risk rate value (Frr = 0.073), whereas Pennsylvania had the highest injury risk rate value (Irr = 0.016).

Table 2, partly illustrated in figure 2, shows by time period the number of fires, fire injuries, risk rates, employees' working hours, lost workdays, and coal production. The number of fires and fire injuries show a decrease followed by an increase during the five time periods (see table 2 and figure 2). This was accompanied by a decline in employees' working hours throughout the periods and an overall small decrease in coal production. The Irr and Frr values follow patterns similar to those shown by the fire and injury values.

By comparison, data from Pomroy and Carigiet [1995] show that during 1978–1992 a total of 11 states were involved in 164 underground coal mine fires (yearly average, 10.8) with 43 injuries (yearly average, 2.9) and 27 fatalities (yearly average, 2; however, the 27 deaths occurred during a single fire caused by an overheated air compressor [MSHA 1984]). The CP value was 5,340 × 10^6 st (yearly average, 356 × 10^6 st) (Frr = 0.031). Data on employees' working hours and injury risk rates were not available.

Tables 3–8 show the number of fires by ignition source, method of detection and suppression, equipment involved, location, and burning material by time period. Figure 3 shows the major variables during 1990–1999. Table 9 shows the number of fire injuries per number of fires causing injuries and total fires by year, ignition source, equipment involved, and location.

Table 1.—Number of fires, fire injuries, and risk rates for underground coal mines by state, employees' working hours, lost workdays, and coal production, 1990–1999

State[1]	No. fires[1]	No. injuries[1]	LWD[2]	Ewhr,[2] 10^6 hr	CP,[2] 10^6 st	Frr[3]	Irr[3]
Alabama	12	4	6	67	165	0.073	0.012
Colorado	7	1	4	20	148	0.047	0.01
Illinois	12	1	6	96	403	0.03	0.002
Indiana	1	1	—	5	24	0.042	0.04
Kentucky	12	6	1	245	948	0.013	0.005
Ohio	1	—	—	32	133	0.0075	—
Pennsylvania	12	9	14	116	456	0.026	0.016
Tennessee	2	—	—	9	21	0.095	—
Utah	1	—	—	34	252	0.004	—
Virginia	15	7	140	96	291	0.052	0.015
West Virginia	9	5	37	271	1,131	0.008	0.004
Wyoming	3	—	—	3	23	0.13	—
All other states	—	—	—	9	13	—	—
Total	87	34	208	1,003	4,008	[3]0.022	[3]0.007

[1]Derived from MSHA "Fire Accident Abstract" and "Fire Accident Report" publications.
[2]Derived from MSHA "Injury Experience in Coal Mining" publications.
[3]Calculated according to USBM and MSHA formulas reported in the "Methodologies" section.

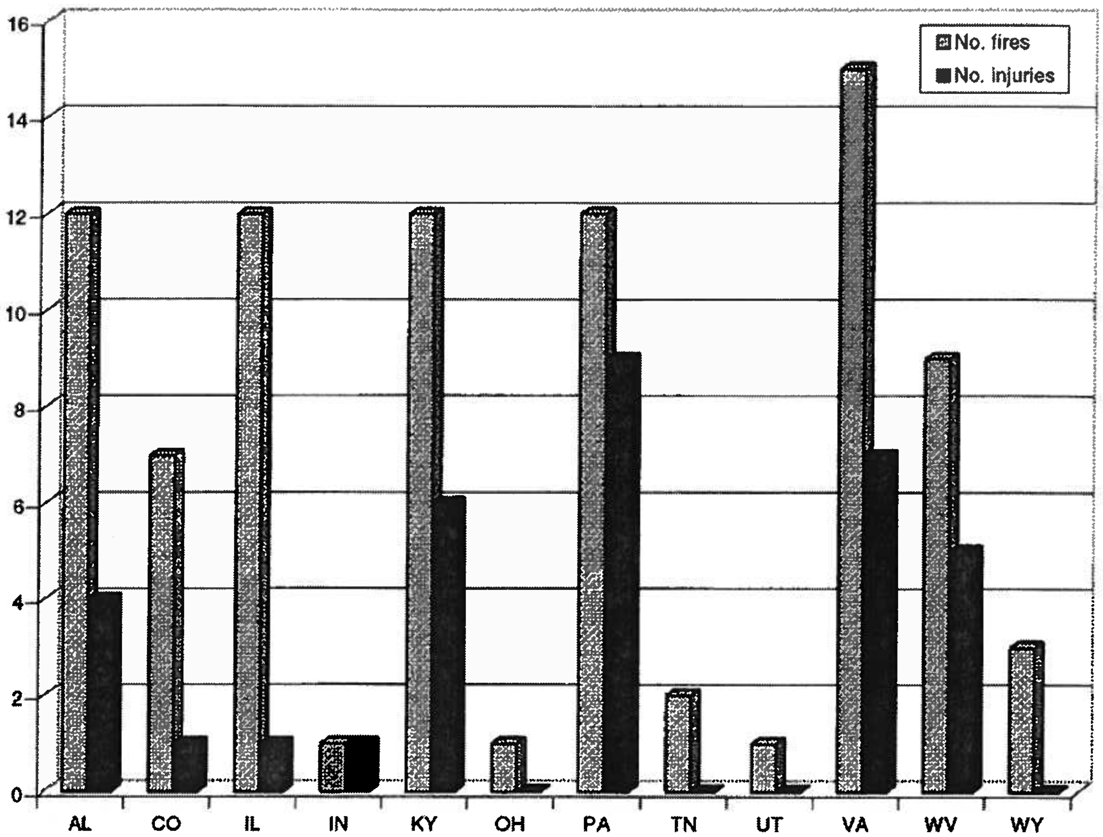

Figure 1.—Number of fires and fire injuries for underground coal mines by state, 1990–1999.

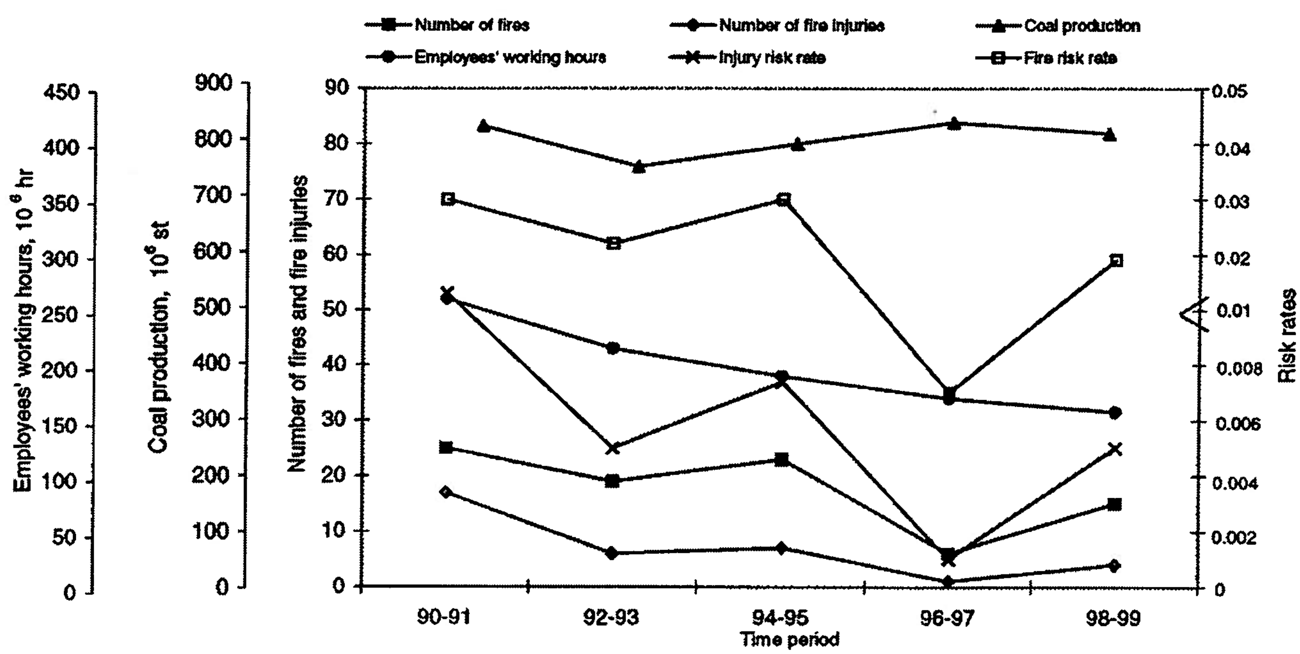

Figure 2.—Number of fires, fire injuries, risk rates, and coal production for underground coal mines by time period and employees' working hours, 1990–1999.

Table 2.—Number of fires, fire injuries, and risk rates for underground coal mines by time period, employees' working hours, lost workdays, and coal production. 1990–1999

	Time period					
	90-91	92-93	94-95	96-97	98-99	90-99
Number of fires[1]	25	18	23	6	15	87
Number of fire injuries[1]	17	5	7	1	4	34
LWD[2]	121	45	12	8	22	208
Ewhr,[2] 10^6 hr	257	209	196	179	162	1,003
CP,[2] 10^6 st	824	752	792	830	810	4,008
Frr[3]	0.03	0.024	0.03	0.007	0.019	[3]0.022
Irr[3]	0.013	0.005	0.007	0.001	0.005	[3]0.007

[1]Derived from MSHA "Fire Accident Abstract" and "Fire Accident Report" publications.
[2]Derived from MSHA "Injury Experience in Coal Mining" publications.
[3]Calculated according to USBM and MSHA formulas reported in the "Methodologies" section.

Table 3.—Number of fires for underground coal mines by ignition source and time period, 1990–1999

Ignition source	Time period 90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Flame cutting/welding spark/slag/flame[1]	8	2	3	2	2	17
Spontaneous combustion[2]	4	2	4	3	2	15
Electrical short/arcing/explosion[3]	5	7	9	1	6	28
Conveyor belt friction	1	5	5	—	4	15
Heat source	—	—	1	—	—	1
Overheated oil/grease	2	—	—	—	—	2
Mechanical malfunction/friction	3	1	1	—	—	5
Flammable liquid/refueling fuel on hot surfaces	1	—	—	—	—	1
Hydraulic fluid/fuel on equipment hot surfaces	—	1	—	—	—	1
Other	1	—	—	—	1	2
Total	25	18	23	6	15	87

[1]This source usually caused fires involving welders' clothing or oxyfuel/grease. However, in one instance sparks/hot slag/flames caused a methane ignition followed by a large fire requiring firefighting intervention and mine/section evacuation and sealing. In another instance, undetected hot slag caused a large fire requiring firefighting intervention and mine evacuation and sealing, followed by a methane explosion.
[2]This source at least twice was accompanied by methane explosions.
[3]This source caused 12 mobile equipment fires.

Table 4.—Number of fires for underground coal mines by method of detection and time period, 1990–1999

Method of detection	Time period 90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Visual method:						
Flames/flash fires	2	1	3	—	—	6
Sparks	7	2	3	1	2	15
Smoke	3	4	2	—	1	10
Late smoke detection	7	9	12	2	6	36
CO/H_2 gas sampling	1	1	2	2	1	7
Touched hot spots	1	—	—	—	1	2
CO/smoke belt detection system	—	—	1	—	—	1
Mine-wide monitoring system	—	—	—	—	1	1
Undetected	1	—	—	—	1	2
Explosion[1]	3	1	—	1	1	6
Power loss	—	—	—	—	1	1
Total	25	18	23	6	15	87

[1]Includes methane ignition, electrical cable, and starter box explosions.

Table 5.—Number of fires for underground coal mines by suppression method and time period, 1990–1999

Suppression method	Time period 90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Mine/section sealing/flooding/CO_2/N_2 gas injections	3	2	3	2	3	13
Portable fire extinguisher	4	6	5	1	1	17
Water	6	2	8	1	3	20
Manual/FE[1]	7	1	1	—	2	11
FE-dry chemical powder/rock dust/water[2]	2	6	5	1	3	17
Machine water spray	2	—	—	—	—	2
FSS-dry chemical powder-water	—	1	1	—	1	3
Destroyed/heavily damaged[3]	1	—	—	1	2	4
Total	25	18	23	6	15	87

FE Portable fire extinguisher.
FSS Machine fire suppression system.
[1]Methods used by welders to extinguish clothing or oxyfuel/grease fires.
[2]In two instances, foam was also used.
[3]Due to failure of other firefighting methods, late fire detection, or undetected fires.

Table 6.—Number of fires for underground coal mines by equipment involved and time period, 1990–1999

Equipment	Time period 90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Oxyfuel torch	8	2	4	2	2	18
Beltline/drive/pulley/feeder	3	4	5	—	4	16
Electrical system/cable/starter/breaker/ transformer/rectifier/voltage box	4	4	2	—	3	13
Generator/pump/fan	1	1	1	—	—	3
Mobile equipment[1]	4	5	7	1	4	21
Other[2]	5	2	4	3	2	16
Total	25	18	23	6	15	87

[1]Includes scoops, bolters, continuous miners, shearers, ore cart, shuttle cars, 3-wheelers, jeeps, railrunners, trolleys, locomotives, and power scalers.
[2]Includes nonequipment (mostly coal piles).

Table 7.—Number of fires for underground coal mines by location and time period, 1990–1999

Location	Time period 90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Flame cutting/welding areas[1]	6	2	3	2	2	15
Gobline/sealed/abandoned/coal pit areas	3	2	3	1	1	10
Belt entry/feeder/slope/portal branch areas	6	5	7	—	6	24
Longwall panel/headgate/main return	2	—	1	3	1	7
Haulage/track rails	2	1	—	—	—	3
Power station/rectifier areas	—	1	—	—	1	2
Generator/transformer/fan/breaker/pump areas	1	2	2	—	1	6
Charging station	—	—	3	—	—	3
Mining face/intersection/crosscut areas	4	—	3	—	—	7
Maintenance areas	1	1	1	—	—	3
Mobile equipment working areas[2]	—	4	—	—	3	7
Total	25	18	23	6	15	87

[1]Includes belt entry, feeder, drive and pulley areas, shops, elevator shafts, overcasts, longwall face/headgate, and mobile equipment maintenance areas.
[2]Includes haulage, bolting, and transportation areas.

Table 8.—Number of fires for underground coal mines by burning material and time period, 1990–1999

Burning material	Time period					
	90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Coal/coal dust	4	2	6	3	1	16
Electrical cables/wires/starter/voltage box/rectifier/ electrical insulation/breaker/transformer/batteries	5	7	7	1	6	26
Belt/feeder/drive/pulley	3	2	4	—	4	13
Oxyfuel/grease/clothing	7	2	2	1	1	13
Elevator shaft/motor	1	3	2	—	—	6
Flammable liquids/refueling fuel/methane	1	1	1	1	2	6
Hydraulic fluid	—	1	1	—	—	2
Gearbox	1	—	—	—	1	2
Oil/resin	3	—	—	—	—	3
Total	25	18	23	6	15	87

Table 9.—Number of fire injuries per number of fires causing injuries and total fires in underground coal mines by year, ignition source, equipment involved, and location, 1990–1999

Year	No. fires causing injuries	No. total fires	No. fire injuries	Ignition source	Equipment	Location
1990	2	16	8	Electrical short/arcing/battery explosion	Electrical cables/starter/ voltage box/battery.	Loading track/charging station.
	2	—	2	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
1991	1	9	1	Refueling fuel on hot surfaces	Mobile equipment[2]	Maintenance areas.
	4	—	4	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
	1	—	1	Electrical short/arcing	Pump unit	Pump station.
	1	—	1	Conveyor belt friction	Beltline/pulley	Belt entry.
1992	2	14	3	Electrical short/arcing	Power cables/mobile equipment[2]	Trolley track rails/ transportation areas.
1993	2	4	2	Electrical short/arcing	Power breaker/mobile equipment[2]	Pump station/bolting areas.
1994	1	11	1	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
	2	—	2	Electrical short/arcing	Power cable/mobile equipment[2]	Charging station/ mining areas.
	1	—	1	Conveyor belt friction	Beltline/drive/pulley	Belt entry.
1995	1	12	1	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
	1	—	1	Heat source	Heater	Mining intersection.
	1	—	1	Conveyor belt friction	Coal feeder/motor	Belt entry.
1996	—	3	—	—	—	—
1997	1	3	1	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
1998	—	5	—			—
1999	1	10	1	Conveyor belt friction	Beltline/drive pulley	Belt entry.
	1	—	1	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
	1	—	1	Hot surface	Mobile equipment[2]	Maintenance areas.
	1	—	1	Electrical short/arcing	Electrical power cables	Power station.
Total	27	87	34			

[1]Includes beltlines, longwall mining face, and mobile equipment maintenance areas.
[2]Includes bolters, scoops, jeeps, trolley, railrunners, and shuttle cars.

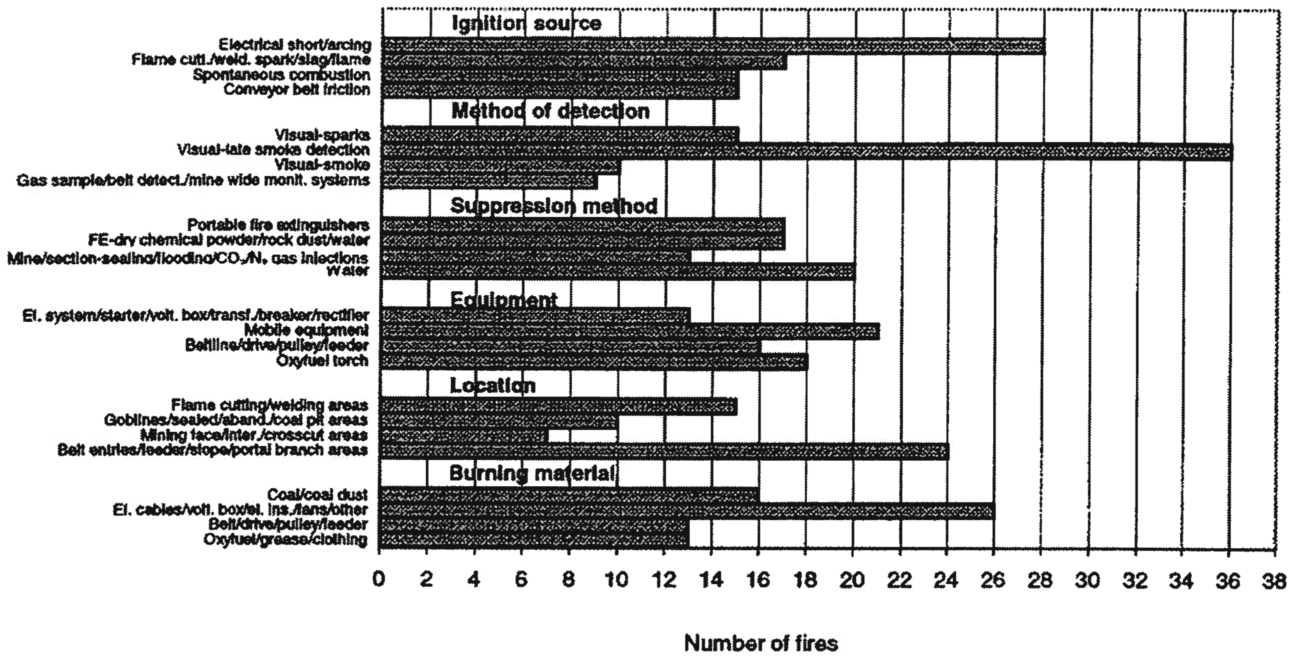

Figure 3.—Major variables for underground coal mine fires, 1990–1999. (FE = portable fire extinguisher)

Ignition Source

The number of fires and fire injuries by ignition source and time period is shown in tables 3 and 9. Electrical short/arcing caused the most fires (28 fires or 32% with 17 injuries). These occurred in electrical power and cable systems, power circuits and breakers, belt transformers, grounded cables and wires, batteries, high-voltage boxes, power generators, and rectifiers. The fires involved beltlines, drives, and pulleys; power centers and power units; and mobile equipment. Twelve mobile equipment electrical fires became large fires (at times involving the hydraulic lines) that required firefighting interventions and mine/section evacuations.

Another ignition source was flame cutting/welding spark/slag/flames (18 fires or 21% with 10 injuries). This source caused fires usually involving welders' clothing or oxyfuel/grease (grease embedded in the equipment's mechanical components). However, in at least one instance sparks/hot slag/flames caused a methane ignition followed by a large fire, which required firefighting intervention and mine/section evacuation and sealing. In another instance, undetected hot slag caused a large fire, which required firefighting intervention and mine evacuation and sealing followed by a methane explosion.

Friction of conveyor belts against pulleys, drives, rollers, idlers, and bearings resulted in 16 fires (18%) with 4 injuries. This source, usually detected long after the fire had started, caused extensive damage to beltlines, drives, and pulleys and disruption of mining operations.

Spontaneous combustion of coal resulted in 15 fires (17%). This source, usually detected long after the fire had started, caused fires involving goblines and sealed and abandoned areas, which severely disrupted mining operations. In at least two instances the spontaneous combustion fires were accompanied by methane explosions and required mine rescue team interventions and mine/section evacuations.

Other ignition sources were flammable liquid/refueling fuel on hot surfaces (four fires), mechanical malfunction/friction (two fires), overheated oil/grease (two fires), heat source (one fire), and hydraulic fluid sprayed onto mobile equipment hot surfaces (one fire). The latter fire grew out of control and required mine rescue team intervention.

During the first period (1990–1991), the largest number of fires were caused by the flame cutting welding spark/slag/flame source. During the second, third, and fifth periods, the largest number of fires were caused by the electrical short/arcing/explosion source. During the fourth period, the largest number of fires were caused by spontaneous combustion (see table 3). By comparison, data from Pomroy and Carigiet [1995] for 1978–1992 show that the leading ignition sources in underground coal mine fires were electrical short/arcing, belt friction, flame cutting/welding spark/slag, and spontaneous combustion.

Method of Detection

Table 4 shows the number of fires by method of detection and time period. The most frequent methods were miners who saw smoke long after the fire had started, followed by welders who saw sparks and miners who saw smoke shortly after the fires had started. Other methods of detection were operators who saw the fires when they started as flames/flash fires, miners who heard an explosion or touched hot spots, and operators who experienced power loss. Nine fires were detected by CO/H_2 gas sampling, CO/smoke belt fire detection systems, or mine-wide monitoring systems. Two fires were undetected.

During the first period, the largest number of fires were detected by sparks and detected late by smoke. During the second, third, and fifth periods, the largest number of fires were detected late by smoke. During the fourth period, the largest number of fires were detected late by smoke and by CO/H_2 gas sampling (see table 4). By comparison, data from Pomroy and Carigiet [1995] for 1978–1992 show that the most frequent methods of detection for underground coal mine fires were miners who saw the fires when they started or saw smoke shortly after they had started.

Suppression Method

Table 5 shows the number of fires by suppression method and time period. Usually more than one agent was used to fight a fire. The most common methods were water or portable fire extinguishers alone and portable fire extinguishers with dry chemical powder, rock dust, and water. In two instances, foam was also used. In 13 instances, mine/section sealing/flooding/ CO_2/N_2 gas injections were required. Other methods included manual techniques with or without portable fire extinguishers (welders' methods to extinguish clothing or oxyfuel/grease fires) and machine water sprays.

Of note is that portable fire extinguishers alone, although used upon discovery of the fires, were successful in extinguishing only small fires involving grease, flammable liquids, power units, engine/mechanical malfunctions, oxyfuel/grease, and overheated oil. Three pieces of mobile equipment involved in fires had machine fire suppression systems. Dual activation (two activations) of machine fire suppression and motor deenergization systems was successful in temporarily abating the fires. However, the flames reignited, fueled by the flow of pressurized fluids entrapped in the lines (not affected by the motor deenergization operation).

Twelve of the mobile equipment electrical fires (which in at least one instance affected the hydraulic lines) and one hydraulic fluid fire became large fires because of unavailability of effective machine fire suppression systems, lack of an emergency line drainage system, or lack of effective and rapid local firefighting response capabilities. Mine rescue teams (required for 25 of the fires), upon mine/section evacuation (required 30 times), fought the mobile equipment fires (5 times) and other large fires with dry chemical powder, rock dust, and water. In all, five fires destroyed or heavily damaged equipment (including two pieces of mobile equipment) because of failure of other firefighting methods, late fire detection, undetected fires, or fire size.

Other factors that determined the success of fire-suppressing agents were the time that elapsed between detection and application of agents and effective and rapid local firefighting response capabilities.

During the first period, the largest number of fires were suppressed manually with or without portable fire extinguishers or by water alone. During the second period, the largest number of fires were suppressed with portable fire extinguishers, dry chemical powder, rock dust and water or with portable fire extinguishers alone. During the third period, the largest number of fires were suppressed with water alone. During the fourth period, the largest number of fires were extinguished by mine/section sealing/flooding/CO_2/N_2 gas injections. During the fifth period, the largest number of fires were extinguished by mine/section sealing/flooding/CO_2/N_2 gas injections; by dry chemical, rock dust, and water; or by water alone (see table 5). By comparison, data from Pomroy and Carigiet [1995] for 1978–1992 show that the most common suppression methods used in underground coal mine fires were water, dry chemical powder, rock dust, and sealing with CO_2/N_2 gas injections.

Equipment Involved

Table 6 shows the number of fires by equipment involved and time period. The equipment most often involved was mobile equipment (e.g., scoops, shuttle cars, bolters, railrunners, continuous miners, trolleys, ore carts, jeeps, locomotives, shearers, three-wheelers, and power scalers). This was followed by oxyfuel torches; beltlines, pulleys, drives, and feeders; and electrical systems, cables, breakers, starters, rectifiers, voltage boxes, and transformers. Other equipment included pumps, generators, and ventilation fans. Sixteen fires did not involve equipment (mostly coal piles).

During the first and fourth periods, the largest number of fires involved oxyfuel torches. During the second and third periods, the largest number of fires involved mobile equipment. During the fifth period, the largest number of fires involved mobile equipment and beltlines, drives, pulleys, and feeders (see table 6). By comparison, data from Pomroy and Carigiet [1995] for 1978–1992 show that the equipment most often involved in underground coal mine fires were beltlines and drives, followed by flame cutting/welding equipment.

Location

Table 7 shows the number of fires by location and time period. Figure 3 shows the major fire locations during 1990–1999. The most common locations were belt entry, feeder, slope and portal branch areas, flame cutting/welding areas (at the longwall face and headgate, belt entries, feeders, shops, elevator shafts, overcasts, and mobile equipment maintenance areas), and goblines, sealed, abandoned, and coal pit areas. Other fire locations were the mining face, intersection, and crosscut areas; the longwall panel/headgate and main return areas; and mobile equipment working areas (haulage, bolting, and transportation areas). Generator and pump housing, belt transformer, fan and breaker areas, haulage and track rail areas, rectifier, charging and power stations, and maintenance areas were other locations affected by fires.

During the first period, the largest number of fires occurred at flame cutting/welding areas and at belt entry, feeder, portal branch, and slope areas. During the second, third, and fifth periods, the largest number of fires occurred at belt entry, slope, feeder, and portal branch areas. During the fourth period, the largest number of fires occurred at longwall panel, headgate, and main return areas (see table 7). By comparison, data from Pomroy and Carigiet [1995] for 1978–1992 show that the most common fire locations in underground coal mines were belt entry, working face, intake entry, and track haulage areas.

Burning Materials

Table 8 shows the number of fires by burning material and time period. The materials most often involved were electrical cables, starters, voltage boxes, rectifiers, electrical insulation, breakers, transformers, and batteries. These were followed by coal and coal dust; belts, feeders, drives, and pulleys; and oxyfuel, grease, and clothing. Other burning materials were flammable liquids, methane, elevator shafts and motors, oil and resin, hydraulic fluids, and gearboxes.

During the first period, the largest number of fires involved oxyfuel, grease, and clothing materials. During the second, third, and fifth periods, the largest number of fires involved electrical cables, wires, starters, voltage boxes, transformers, starters, and batteries. During the fourth period, the largest number of fires involved coal and coal dust (see table 8). By comparison, data from Pomroy and Carigiet [1995] for 1978–1992 show that the most frequent burning materials in underground coal mines were coal and coal dust, electrical insulation, oil and grease, conveyor belts and rollers, wood, rubber hoses, and tires.

Fire Injuries

Table 9 shows the number of fire injuries per number of fires causing injuries and total fires by year, ignition source, equipment involved, and location during 1990–1999. Overall, there were 34 injuries caused by 27 fires. The greatest number of fire injuries occurred in 1990 (10 injuries caused by 4 fires) and 1991 (7 injuries caused by 7 fires). The ignition sources that caused most of the fire injuries were electrical short/arcing, battery explosion, and flame cutting/welding spark/slag/flames. Other ignition sources were conveyor belt friction, heat source, and refueling fuel on hot surfaces. The equipment most often involved in fire injuries were electrical power cables, voltage boxes, oxyfuel torches, beltlines, drives, pulleys and feeders, and mobile equipment. The most common locations for fire injuries were pump, power and charging stations, mobile equipment working areas, flame cutting/welding areas, trolley track rails and transportation areas, and belt entries.

By comparison, data from Pomroy and Carigiet [1995] for 1978–1992 show that the ignition sources causing the most of the fire injuries were electrical short/arcing, belt friction, and flame cutting/welding sources. The equipment most often involved in fire injuries and fire fatalities included air compressors (which caused 27 fatalities during one fire), trolley power cables, and oxyfuel torches. The most common locations for fire injuries were main intakes, belt entries, longwall headgate, working faces, and track entries.

SURFACE OF UNDERGROUND COAL MINE FIRES

Table 10 and figure 4 show the number of fires and fire injuries occurring at the surface of underground coal mines by state during 1990–1999. Table 10 also shows by state the risk rate, employees' working hours, and lost workdays.

A total of 65 fires occurred in 10 states. Thirteen of those fires caused 12 injuries and 1 fatality (the yearly average was 6.5 fires and 1.2 injuries). Four fires and one fire injury involved contractors. The Ewhr value was 97×10^6 hr (Irr = 0.025); the LWD value was 6,206. Pennsylvania had the most fires (20 fires and 5 injuries), followed by West Virginia (16 fires and 1 fatality) and Kentucky (15 fires and 3 injuries). Among these states, Pennsylvania had the highest injury risk rate value (Irr = 0.095).

Table 11, partly illustrated in figure 5, shows by time period the number of fires, fire injuries, and fire fatalities; risk rates; employees' working hours; and lost workdays. The number of fires and fire injuries show a decrease followed by an increase during the five time periods, accompanied by a decline in employees' working hours throughout the periods (see table 11 and figure 5). The Irr values follow patterns similar to those shown by the injury values.

Tables 12–17 show the number of fires by ignition source, method of detection and suppression, equipment involved, location, and burning material by time period. Figure 6 shows the major variables during 1990–1999. Table 18 shows the number of fire injuries per number of fires causing injuries and total fires by year, ignition source, equipment involved, and location.

Ignition Source

The number of fires and fire injuries by ignition source and time period is shown in tables 12 and 18. The leading sources were hydraulic fluid/fuel sprayed onto equipment hot surfaces (11 fires or 17% with 1 injury), spontaneous combustion/hot coal (11 fires or 17%), and flame cutting/welding spark/slag/flames (11 fires or 17% with 7 injuries). Three of the mobile equipment hydraulic fluid/fuel fires became large fires, which at times required fire department interventions. In at least two instances flames erupted in the cab, probably because of the ignition of flammable vapors and mists that penetrated the cab. Of note is that most of the hydraulic fluid/fuel fires were caused when hydraulic fluids sprayed onto equipment hot surfaces; subsequently, these fires involved the fuel lines. The flame cutting/welding spark/slag/flame source caused fires usually involving welders' clothing or oxyfuel/grease (grease embedded in the equipment's mechanical components). However, in one instance sparks/hot slag/flames caused a methane ignition followed by a large fire, and twice undetected hot slag caused coal belt fires. Other ignition sources were heat source (four fires), electrical short/arcing (four fires), conveyor belt friction (three fires), and overheated oil (one fire). Twenty ignition sources (mostly affecting facilities) were unknown.

During the first period, the largest number of fires were caused by hydraulic fluid/fuel sprayed onto equipment hot surfaces. During the second period, the largest number of fires were caused by spontaneous combustion/hot coal. During the third and fourth periods, the largest number of fires were caused by the flame cutting/welding spark/slag/flame source. During the fifth period, the largest number of fires were caused by flame cutting/welding spark/slag/flames, spontaneous combustion/hot coal, and hydraulic fluid/fuel sprayed onto equipment hot surfaces (see table 12).

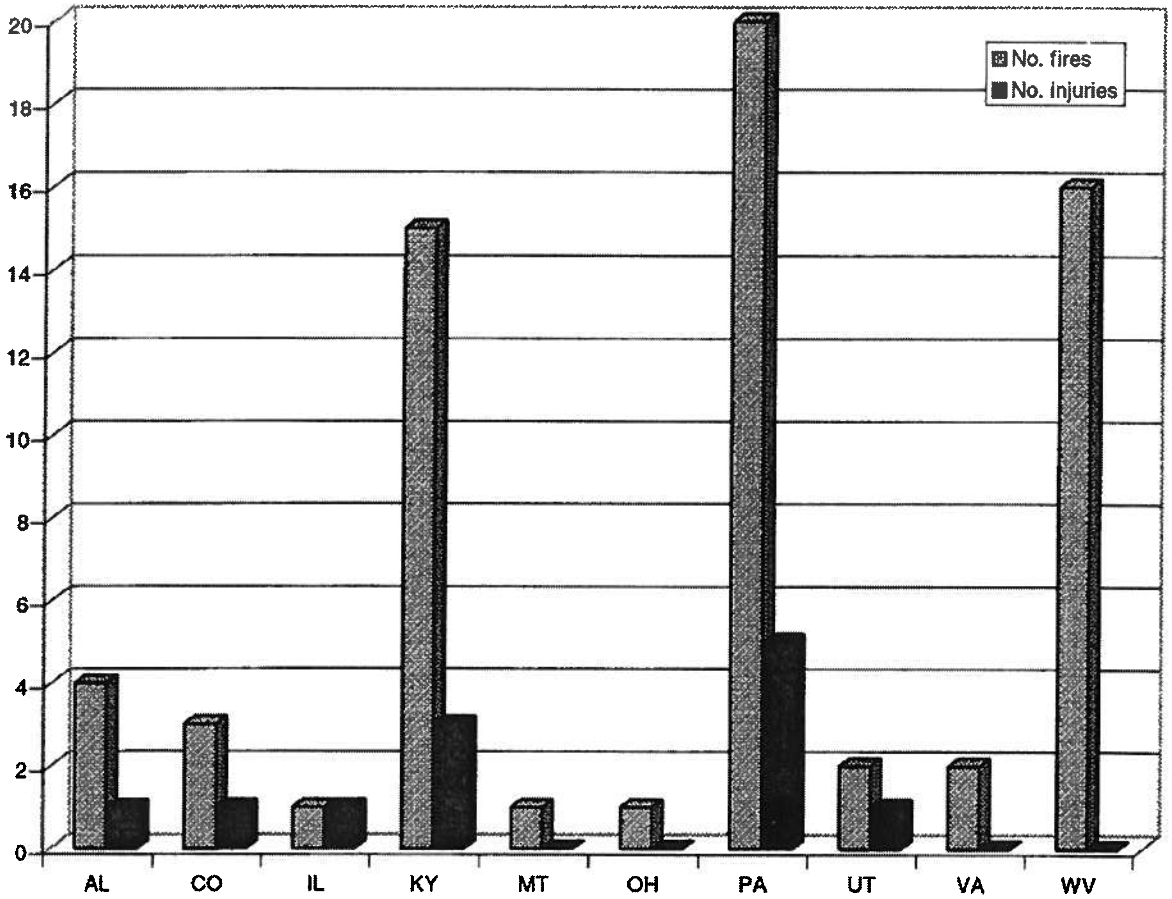

Figure 4.—Number of fires and fire injuries for surface of underground coal mines by state, 1990–1999.

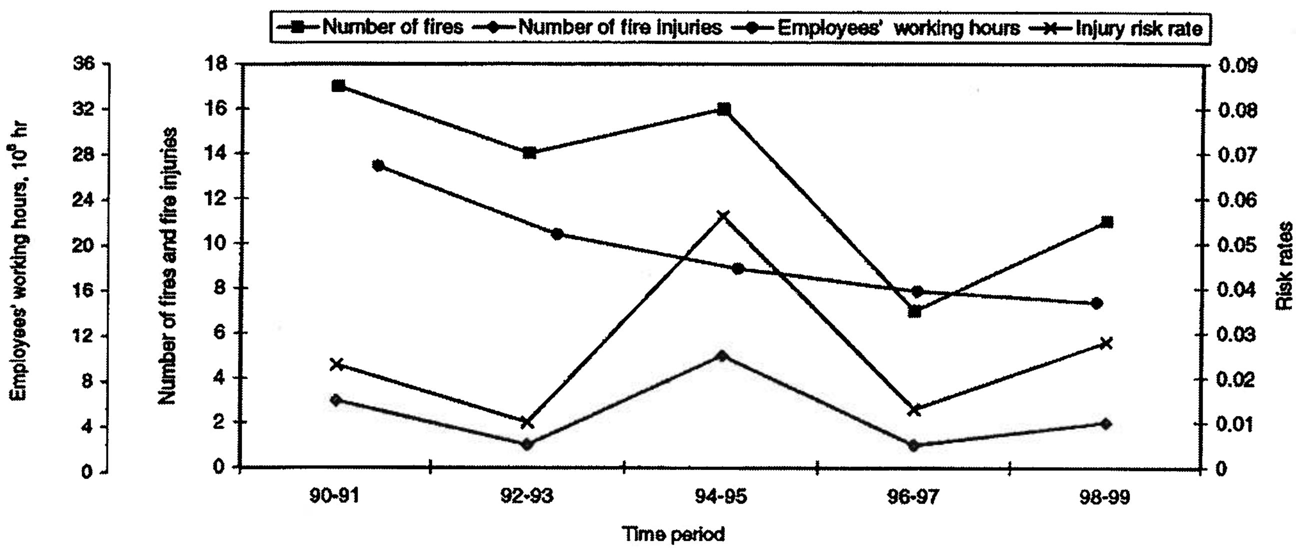

Figure 5.—Number of fires, fire injuries, and risk rates for surface of underground coal mines by time period and employee' working hours, 1990–1999.

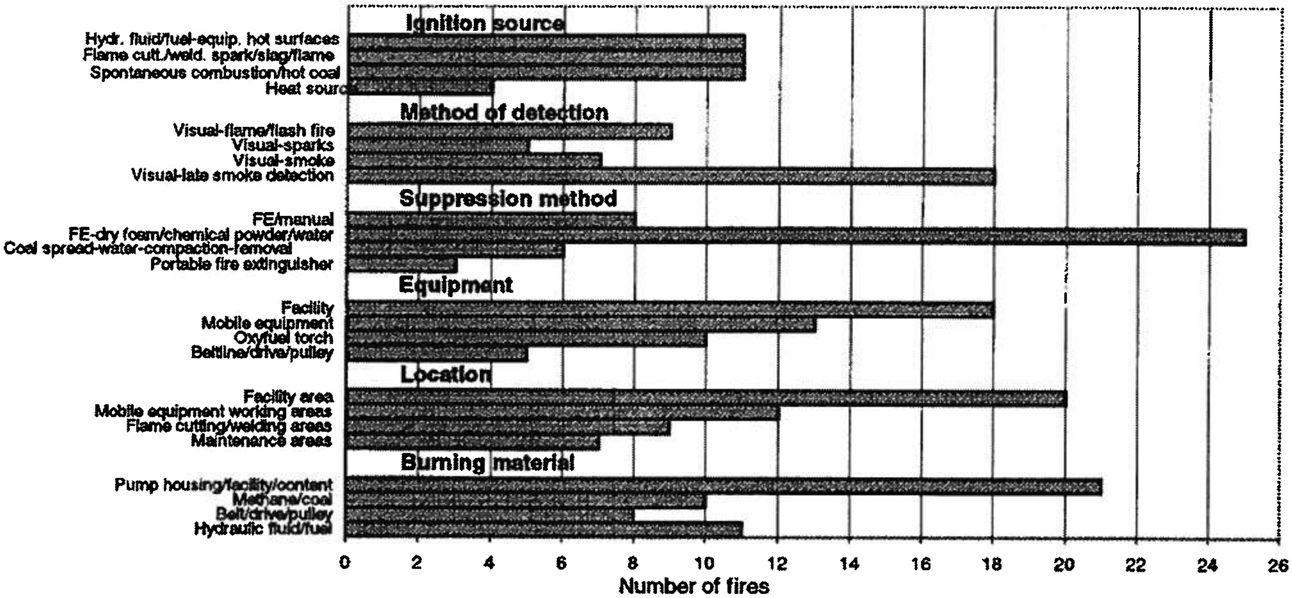

Figure 6.—Major variables for surface of underground coal mine fires, 1990–1999. (FE = portable fire extinguisher)

Table 10.—Number of fires, fire injuries, and risk rates for surface of underground coal mines by state, employees' working hours, and lost workdays, 1990–1999

State[1]	No. fires[1]	No. injuries[1]	LWD[2]	Ewhr,[2] 10^6 hr	Irr[3]
Alabama	4	1	4	5.8	0.035
Colorado	3	1	—	3.6	0.056
Illinois	1	1	42	6	0.033
Kentucky	15	3	88	23	0.026
Montana	1	—	—	0.12	—
Ohio	1	—	—	3.7	—
Pennsylvania	20	5	24	10.5	0.095
Utah	2	1	6	4	0.05
Virginia	2	—	42	11	—
West Virginia[4]	16	—	6000	20.4	—
Other states	—	—	—	8.8	—
Total	65	12	6206	97	30.025

[1]Derived from MSHA "Fire Accident Abstract" and "Fire Accident Report" publications.
[2]Derived from MSHA "Injury Experience in Coal Mining" publications.
[3]Calculated according to MSHA formula reported in the "Methodologies" section.
[4]West Virginia had 1 fire fatality.

Table 11.—Number of fires, fire injuries, fire fatalities, and risk rates for surface of underground coal mines by time period, employees' working hours, and lost workdays, 1990–1999

	Time period					
	90-91	92-93	94-95	96-97	98-99	90-99
Number of fires[1]	17	14	16	7	11	65
Number of fire injuries[1]	3	1	5	1	2	12
Number of fire fatalities	1	—	—	—	—	1
LWD[2]	6000	24	88	10	84	6206
Ewhr,[2] 10^6 hr	27	21	18	16	15	97
Irr[3]	0.023	0.01	0.056	0.0125	0.028	30.025

[1]Derived from MSHA "Fire Accident Abstract" and "Fire Accident Report" publications.
[2]Derived from MSHA "Injury Experience in Coal Mining" publications.
[3]Calculated according to MSHA formula reported in the "Methodologies" section.

Table 12.—Number of fires for surface of underground coal mines by ignition source and time period, 1990–1999

Ignition source	Time period 90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Heat source	1	1	2	—	—	4
Flame cutting/welding spark/slag/flame[1]	2	1	4	2	2	11
Electrical short/arcing	3	—	—	—	1	4
Spontaneous combustion/hot coal	2	3	3	1	2	11
Conveyor belt friction	1	1	—	1	—	3
Hydraulic fluid/fuel on equipment hot surfaces	4	2	3	—	2	11
Overheated oil	1	—	—	—	—	1
Unknown/other	3	6	4	3	4	20
Total	17	14	16	7	11	65

[1]This source caused fires usually involving welders' clothing or oxyfuel/grease. However, in one instance undetected hot slag caused a methane ignition followed by a large fire, and twice undetected hot slag caused coal belt fires.

Table 13.—Number of fires for surface of underground coal mines by method of detection and time period, 1990–1999

Method of detection	Time period 90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Visual method:						
Flames/flash fires	2	2	3	—	2	9
Sparks	2	—	—	1	2	5
Late smoke detection	6	3	4	2	3	18
Smoke	2	1	3	1	—	7
Smoldering	1	1	—	—	—	2
Smelled smoke	—	1	—	—	—	1
Explosion	1	—	2	—	—	3
Undetected	3	6	4	3	4	20
Total	17	14	16	7	11	65

Table 14.—Number of fires for surface of underground coal mines by suppression method and time period, 1990–1999

Suppression method	Time period 90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Manual/FE[1]	3	—	3	—	2	8
FE-foam/dry chemical powder/water	6	6	7	3	3	25
Coal spread-water-compaction-removal[2]	2	—	1	1	2	6
Destroyed/heavily damaged[3]	3	6	4	3	4	20
Portable fire extinguisher	3	—	—	—	—	3
FE-FSS-dry chemical powder	—	1	1	—	—	2
Other	—	1	—	—	—	1
Total	17	14	16	7	11	65

FE Portable fire extinguisher.
FSS Machine fire suppression system.
[1]Methods used by welders to extinguish clothing or oxyfuel/grease fires.
[2]Methods used to extinguish spontaneous combustion/hot coal fires.
[3]Due to failure of other firefighting methods, late fire detection, or undetected fires.

Table 15.—Number of fires for surface of underground coal mines by equipment involved and time period, 1990–1999

Equipment	Time period 90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Oxyfuel torch	2	1	3	2	2	10
Beltline/drive/pulley	2	1	1	1	—	5
Heater/maintenance equipment	2	1	2	—	—	5
Electrical power unit/system	1	—	—	—	1	2
Pump	1	—	—	—	—	1
Facilities	2	5	4	3	4	18
Mobile equipment[1]	6	2	3	—	2	13
Other[2]	1	4	3	1	2	11
Total	17	14	16	7	11	65

[1]Includes hoists, loaders, dozers, scrapers, trucks, highlifts, excavators, and tractors.
[2]Includes nonequipment (mostly coal piles).

Table 16.—Number of fires for surface of underground coal mines by location and time period, 1990–1999

Location	90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
	Time period					
Flame cutting/welding areas[1]	2	—	4	1	2	9
Coal silo/stock/refuse pile	1	2	1	—	2	6
Beltline/drawoff tunnel areas	1	2	2	1	—	6
Power station	2	—	—	—	1	3
Maintenance areas	3	1	3	—	—	7
Facility areas	2	6	4	4	4	20
Mobile equipment working areas[2]	5	3	2	—	2	12
Charging station	1	—	—	1	—	2
Total	17	14	16	7	11	65

[1]Includes beltline areas, storage silos, and mobile equipment maintenance areas.
[2]Includes loading, hoisting, and haulage areas.

Table 17.—Number of fires for surface of underground coal mines by burning material and time period, 1990–1999

Burning material	90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
	Time period					
Flammable liquids	1	1	2	—	2	6
Electrical wires/systems/batteries	2	—	—	—	1	3
Facility/content/pump housing	4	6	4	3	4	21
Belt/drive/pulley	3	2	2	1	—	8
Coal/methane	1	3	3	1	2	10
Wood ties/refuse pile/electrical insulation	1	—	1	1	—	3
Oxyfuel/grease/clothing	1	—	1	1	—	3
Hydraulic fluid/fuel	4	2	3	—	2	11
Total	17	14	16	7	11	65

Table 18.—Number of fire injuries per number of fires causing injuries and total fires at surface of underground coal mines by year, ignition source, equipment involved, and location, 1990–1999

Year	No. fires causing injuries	No. total fires	No. fire injuries	Ignition source	Equipment	Location
1990	1	7	1	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
	1	—	1	Battery explosion	Mobile equipment[2]	Charging station.
1991[3]	2	10	1	Hydraulic fluid/fuel on equipment hot surfaces	Mobile equipment[2]	Loadout area.
1992	—	6	—	—	—	—
1993	1	8	1	Training fire	Turnout gear	Fire training area.
1994	2	6	2	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
1995	2	10	2	Heat source	Heater	Refuse/maintenance areas.
	1	—	1	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
1996	—	2	—	—	—	—
1997	1	5	1	Flame cutting/welding spark/slag/flame	Oxyfuel torch/mobile equipment.[2]	Maintenance areas.
1998	2	5	2	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
1999	—	6	—	—	—	—
Total	13	65	12			

[1]Includes beltline, drive, and pulley areas; storage silos; shops; and mobile equipment maintenance areas.
[2]Includes highlifts, loaders, and trucks.
[3]During 1991, there was 1 fire fatality.

Method of Detection

Table 13 shows the number of fires by method of detection and time period. The most frequent method of detection was miners who saw smoke long after the fires had started, followed by operators who saw the fires when they had started as flames/flash fires. Other methods of detection were miners who saw smoke shortly after the fires had started; welders who saw sparks; and miners who heard an explosion, saw smoldering of coal, or smelled smoke. Twenty fires were undetected. The largest number of fires were detected late by smoke throughout the periods (table 13).

Suppression Method

Table 14 shows the number of fires by suppression method and time period. The most common methods were dry chemical powder and water, followed by manual techniques with or without portable fire extinguishers (welders' methods to extinguish clothing or oxyfuel/grease fires) and coal spread, water, compaction, and removal (method used to extinguish spontaneous combustion/hot coal fires). Other fire suppression methods were portable fire extinguishers alone and foam and water.

Two pieces of mobile equipment involved in fires had machine fire suppression systems. Dual activation (one activation) of machine fire suppression and engine shutoff systems failed to temporarily abate the flames because of the flow of pressurized fluids entrapped in the lines (not affected by the engine shutoff operation). Most of the hydraulic fluid/fuel fires became large fires. In at least three instances these fires required fire department interventions because of the continuous flow of fluid/fuel from the pumps due to engine shutoff failure, lack of an emergency hydraulic line drainage system, difficulty in activating available emergency systems at ground level, or lack of effective and rapid local firefighting response capabilities. (Fire-resistant hydraulic fluid is not required for equipment use at surface coal operations.)

Fire brigades and fire departments (required in six instances) fought three mobile equipment fires and other large fires with foam, dry chemical powder, and water. However, 20 fires destroyed or heavily damaged equipment (including two pieces of mobile equipment) because of failure of other firefighting methods, late fire detection, undetected fires, or fire size.

The largest number of fires were suppressed with portable fire extinguishers, foam, dry chemical powder, and water throughout the periods (table 14).

Equipment Involved

Table 15 shows the number of fires by equipment involved and time period. The equipment most often involved included mobile equipment (hoists, dozers, loaders, scrapers, trucks, highlifts, excavators, and tractors) and oxyfuel torches. Other equipment included heaters and maintenance equipment, beltlines, drives and pulleys, maintenance equipment, electrical systems, power units, and pumps.

During the first period, the largest number of fires involved mobile equipment. During subsequent periods, the largest number of fires involved facilities (see table 15).

Location

Table 16 shows the number of fires by location and time period. The most common locations were facilities and mobile equipment working areas (e.g., loading, hoisting, and haulage areas). These were followed by flame cutting/welding areas (at beltline areas, storage silos, and mobile equipment maintenance areas) and maintenance areas. Other fire locations were coal silos, stock and refuse pile areas, beltline and drawoff tunnel areas, and power and charging stations.

During the first period, the largest number of fires occurred at mobile equipment working areas. During subsequent periods, the largest number of fires occurred at facility areas (see table 16).

Burning Materials

Table 17 shows the number of fires by burning material and time period. The materials most often involved were pump housing and facilities/content, followed by hydraulic fluid/fuel, coal and methane, and belts, drives, and pulleys. Other burning materials were flammable liquids, electrical systems, wires and batteries, wood ties, refuse piles, electrical insulation, and oxyfuel/grease/clothing. During the first period, the largest number of fires involved hydraulic fluid/fuel and facility/content materials. During subsequent periods, the largest number of fires involved facility/content materials (see table 17).

Fire Injuries

Table 18 shows the number of fire injuries per number of fires causing injuries and total fires by year, ignition source, equipment involved, and location during 1990–1999. Overall, 13 fires caused 12 injuries and 1 fatality.

The greatest number of fire injuries occurred in 1995 (three injuries caused by three fires). The sources that caused most of the fire injuries were flame cutting/welding spark/slag/flames, heat sources and pressurized can explosions, and hydraulic fluid/fuel sprayed onto equipment hot surfaces. Other ignition sources were an electrical short/arcing/battery explosion and a source used to light a training fire. The equipment most often involved included oxyfuel torches, heaters, mobile equipment, batteries, and turnout gear. The locations where most of the fire injuries occurred were flame cutting/welding, maintenance, and mobile equipment working areas. Other fire locations were charging stations and fire training areas.

The fire fatality in West Virginia in 1991 may actually have been caused by cardiac failure, although the victim's body was found among the burnt office rubble [MSHA 1991c].

SURFACE COAL MINE FIRES

Table 19 and figure 7 show the number of fires and fire injuries for surface coal mines by state during 1990–1999. Table 19 also shows by state the risk rates, employees' working hours, lost workdays, and coal production.

For surface coal mines, 215 fires occurred in 21 states during 1990–1999. Ninety-four of those fires caused 93 injuries and 1 fatality (the yearly average was 21.5 fires and 9.3 fire injuries). Fourteen fires and seven injuries involved contractors. The Ewhr value was 729×10^6 hr (Irr = 0.026), the CP value was $6{,}355 \times 10^6$ st (Frr = 0.034), and the LWD value was 8,141.

Kentucky had the most fires and fire injuries (45 fires and 23 injuries), followed by Pennsylvania (33 fires and 14 injuries), West Virginia (25 fires and 14 injuries), and Indiana (20 fires and 8 injuries). Among these states, Pennsylvania had the highest fire risk rate value (Frr = 0.145), while Kentucky had the highest injury risk rate value (Irr = 0.041).

Table 20, partly illustrated in figure 8, shows by time period the number of fires, fire injuries, fire fatalities, risk rates, employees' working hours, lost workdays, and coal production. There was a decrease in fires and fire injuries during most of the periods (an increase is seen only during 1994–1995), accompanied by a decline in employees' working hours throughout the periods and an increase in coal production during most of the periods. The Irr and Frr values follow patterns similar to those shown by the injury and fire values (see table 20 and figure 8).

Tables 21–26 show the number of fires by ignition source, method of detection and suppression, equipment involved, location, and burning material by time period. Figure 9 shows the major variables during 1990–1999. Table 27 shows the number of fire injuries per number of fires causing injuries and total fires by year, ignition source, equipment involved, and location.

Table 19.—Number of fires, fire injuries, and risk rates for surface coal mines by state, employees' working hours, lost workdays, and coal production, 1990–1999

State[1]	No. fires[1]	No. injuries[1]	LWD[2]	Ewhr,[2] 10^6 hr	CP,[2] 10^6 st	Frr[3]	Irr[3]
Alabama	5	4	176	24.8	80	0.063	0.032
Arizona	3	1	17	16.1	120.7	0.025	0.012
Colorado	2	—	—	11.6	91	0.022	—
Illinois	6	4	44	24.2	94	0.064	0.033
Indiana	20	8	430	53.7	280	0.071	0.03
Kansas	1	—	—	1.3	3.5	0.286	—
Kentucky	45	23	527	112.1	602.5	0.075	0.041
Louisiana	3	2	—	2.5	31.8	0.094	0.16
Missouri	3	2	41	4.8	11.4	0.263	0.083
Montana[4]	4	—	6,000	16	392.8	0.01	—
New Mexico	6	1	37	30	246.5	0.034	0.007
Ohio	11	6	8	40.3	168.1	0.065	0.03
Oklahoma	1	1	11	6.2	15.6	0.064	0.032
Pennsylvania	33	14	501	72.5	228.3	0.145	0.039
Tennessee	1	1	17	4.6	15	0.067	0.044
Texas	13	6	17	60.1	529.6	0.025	0.02
Utah	1	—	—	0.2	2.6	0.39	—
Virginia	6	3	79	22.7	88.4	0.068	0.026
Washington	1	—	—	10.4	47	0.021	—
West Virginia	25	14	182	92.7	536.6	0.047	0.03
Wyoming	25	3	54	62.7	2,454.1	0.01	0.01
Other states	—	—	—	60	394.5	—	—
Total	215	93	8,141	729	6,355	[3]0.034	[3]0.026

[1]Derived from MSHA "Fire Accident Abstract" and "Fire Accident Report" publications.
[2]Derived from MSHA "Injury Experience in Coal Mining" publications.
[3]Calculated according to USBM and MSHA formulas reported in the "Methodologies" section.
[4]Montana had one fire fatality.

Table 20.—Number of fires, fire injuries, fire fatalities, and risk rates for surface coal mines by time period, employees' working hours, lost workdays, and coal production, 1990–1999

	Time period					
	90-91	92-93	94-95	96-97	98-99	90-99
Number of fires[1]	67	37	47	40	24	215
Number of fire injuries[1]	32	17	19	16	9	93
Number of fire fatalities	1	—	—	—	—	1
LWD[2]	6,610	646	284	327	274	8,141
Ewhr,[2] 10^6 hr	177	154	143	131	124	729
CP,[2] 10^6 st	1,180	1,176	1,267	1,325	1,408	6,355
Frr[3]	0.057	0.032	0.037	0.03	0.017	[3]0.034
Irr[3]	0.036	0.022	0.026	0.024	0.015	[3]0.026

[1]Derived from MSHA "Fire Accident Abstract" and "Fire Accident Report" publications.
[2]Derived from MSHA "Injury Experience in Coal Mining" publications.
[3]Calculated according to USBM and MSHA formulas reported in the "Methodologies" section.

Table 21.—Number of fires for surface coal mines by ignition source and time period, 1990–1999

Ignition source	Time period 90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Heat source	5	—	2	1	2	10
Flammable liquid/refueling fuel on hot surfaces	5	3	2	6	2	18
Flame cutting/welding spark/slag/flame[1]	20	12	14	7	6	59
Spontaneous combustion/hot coal	4	1	7	6	3	21
Conveyor belt friction	—	—	2	1	—	3
Hydraulic fluid/fuel on equipment hot surfaces	24	15	18	13	6	76
Engine/mechanical malfunction/friction/explosion	5	4	—	1	1	11
Overheated oil	1	—	1	1	1	4
Electrical short/arcing	1	2	—	3	2	8
Natural gas explosion	1	—	—	—	1	2
Unknown	1	—	1	1	—	3
Total	67	37	47	40	24	215

[1]This source caused fires usually involving welders' clothing or oxyfuel/grease. However, on four occasions undetected hot slag caused coal and belt fires. In another instance, undetected hot slag caused a coal chute smoldering fire, which, upon water application, produced a flashback accompanied by a gas explosion, resulting in one fatality.

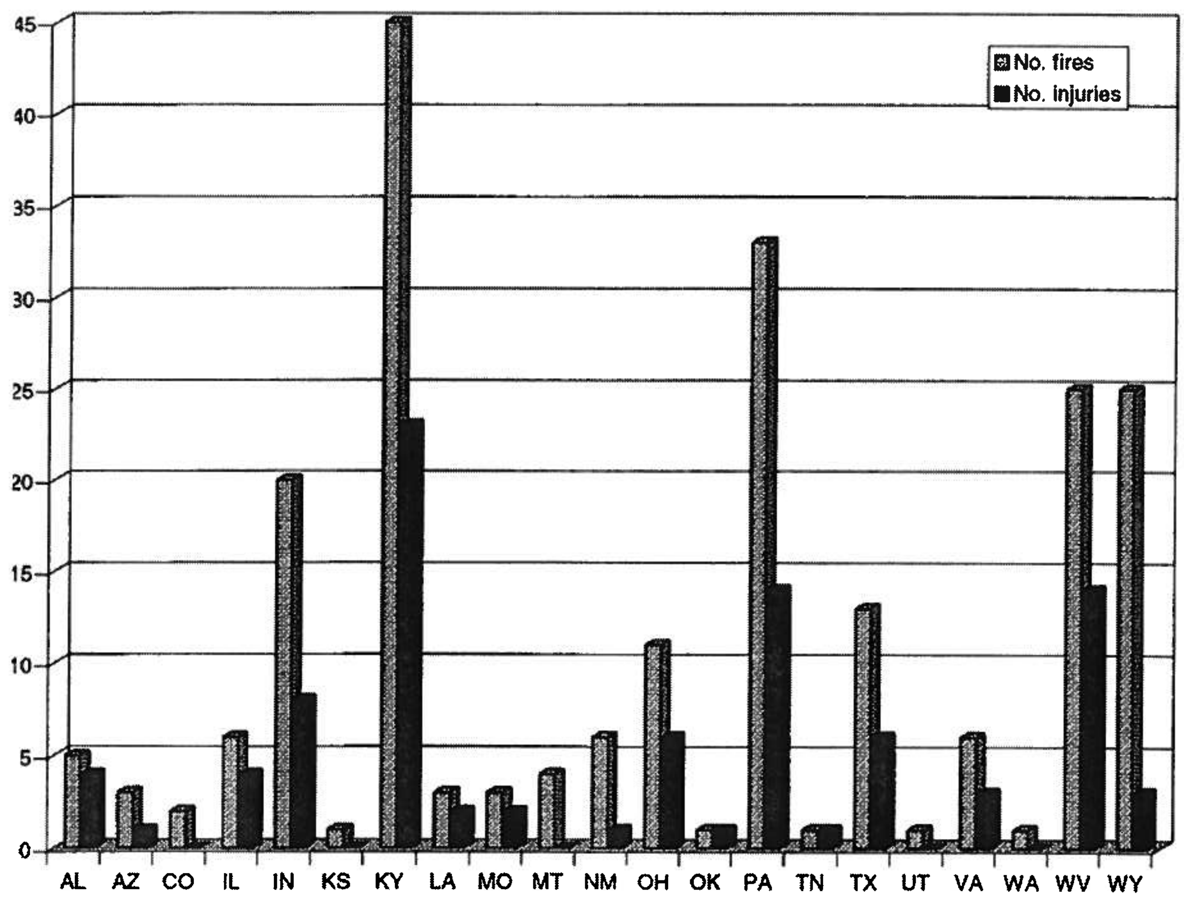

Figure 7.—Number of fires and fire injuries for surface coal mines by state, 1990–1999.

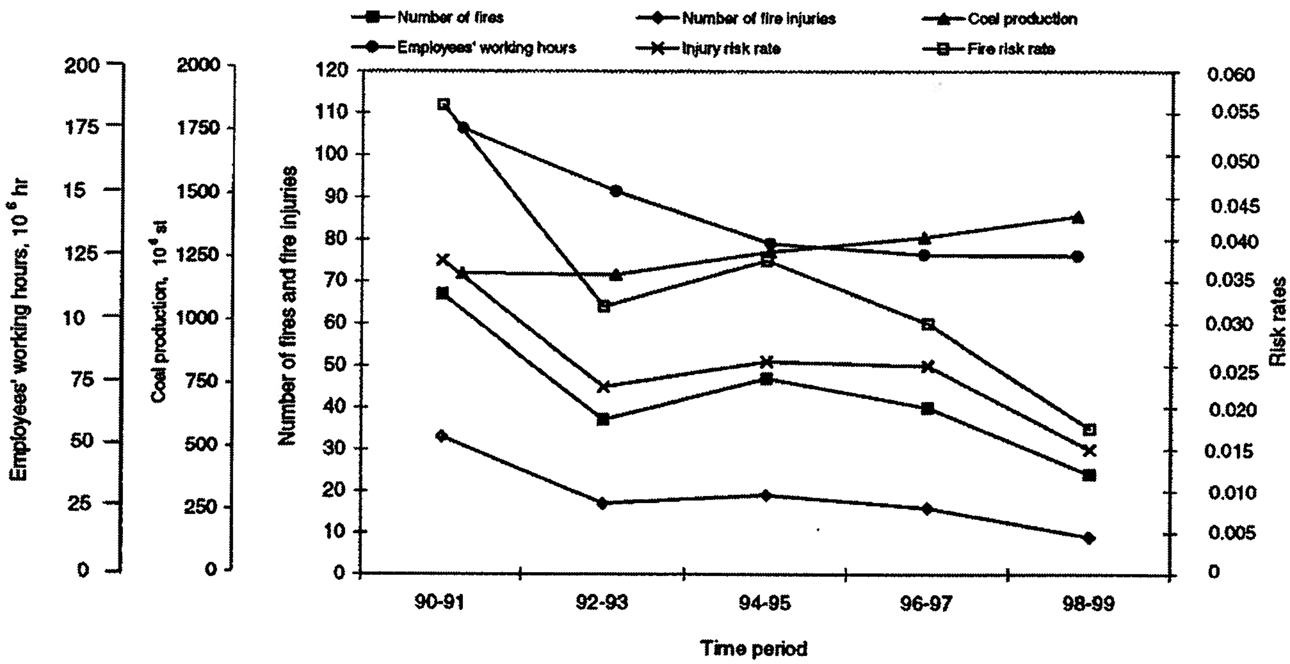

Figure 8.—Number of fires, fire injuries, risk rates, and coal production for surface coal mines by time period and employees' working hours, 1990–1999.

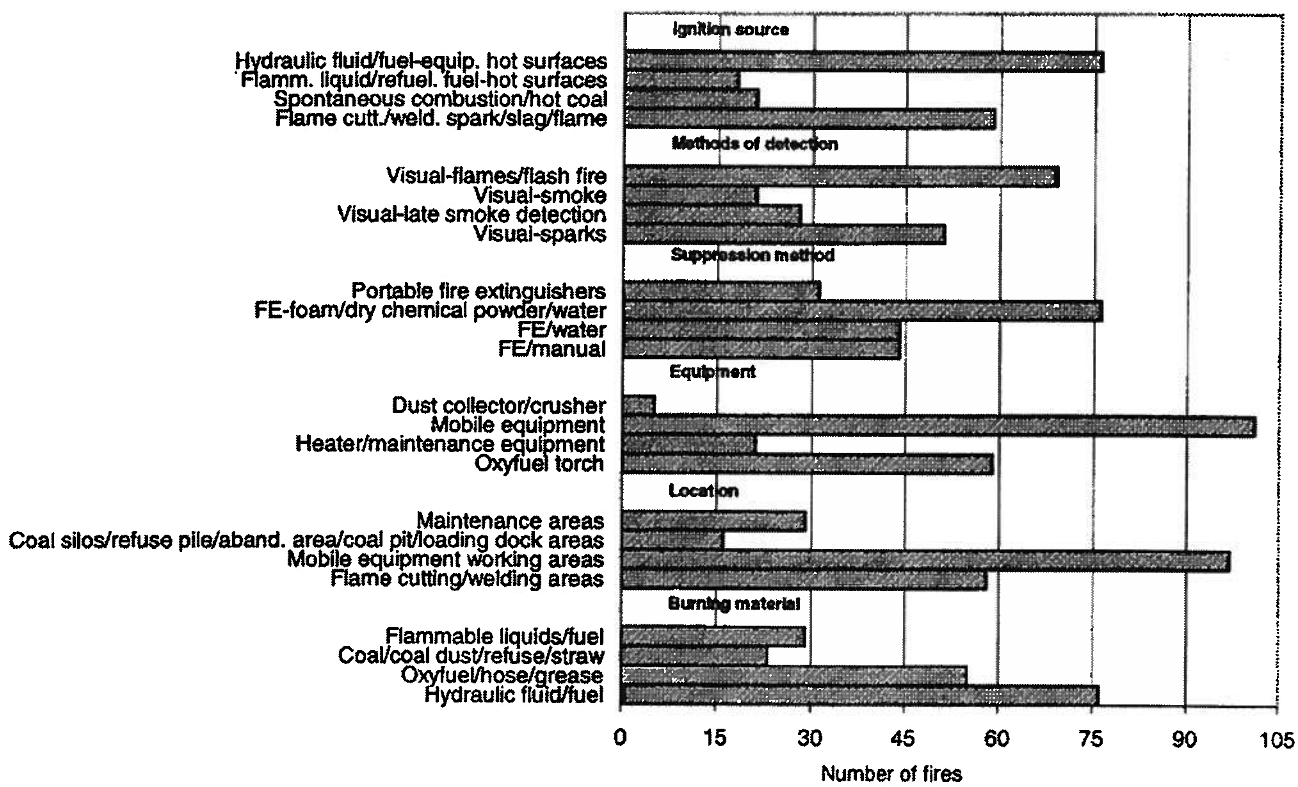

Figure 9.—Major variables for surface coal mine fires, 1990–1999. (FE = portable fire extinguisher)

Table 22.—Number of fires for surface coal mines by method of detection and time period, 1990–1999

Method of detection	Time period 90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Visual method:						
Flames/flash fires	22	9	17	14	7	69
Smoke	4	8	—	5	4	21
Smoldering	1	—	—	—	—	1
Late smoke detection	6	2	7	9	4	28
Glow	—	—	1	—	—	1
Sparks	20	8	11	7	5	51
Electrical/mechanical sparks	1	5	—	—	1	7
Radiator smoke/oil mist spray	1	—	—	1	—	2
Undetected	4	2	4	2	1	13
Fire alarm/electrical trip warning	1	—	—	1	—	2
Smelled smoke	—	1	2	—	—	3
Explosion	5	—	2	—	1	8
Power loss	—	1	—	—	1	2
Popping sound	2	1	3	1	—	7
Total	67	37	47	40	24	215

Table 23.—Number of fires for surface coal mines by suppression method and time period, 1990–1999

Suppression method	Time period 90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Manual/FE[1]	16	7	10	7	4	44
Portable fire extinguisher	8	8	1	10	4	31
FE-water	15	3	15	5	6	44
FE-water/foam/dry chemical power	23	15	18	15	5	76
Coal spread-water-compaction-removal[2]	—	—	—	2	—	2
FSS-dry chemical powder-water	2	—	—	1	2	5
Destroyed/heavily damaged[3]	3	4	3	—	3	13
Total	67	37	47	40	24	215

FE Portable fire extinguisher
FSS Machine fire suppression system
[1]Methods used by welders to extinguish clothing or oxyfuel/grease fires.
[2]Methods used to extinguish spontaneous combustion/hot coal fires.
[3]Due to failure of other firefighting methods, late fire detection, or undetected fires.

Table 24.—Number of fires for surface coal mines by equipment involved and time period, 1990–1999

Equipment	Time period 90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Air compressor	2	—	—	—	—	2
Oxyfuel torch	20	12	14	7	6	59
Heater/maintenance equipment	8	1	5	3	4	21
Beltline/drive/pulley	—	—	2	1	—	3
Crusher/dust collector	1	—	2	2	—	5
Facility	1	—	1	1	—	3
Other/unknown	4	2	5	6	4	21
Mobile equipment[1]	31	22	18	20	10	101
Total	67	37	47	40	24	215

[1]Includes haulage/utility trucks, loaders, dozers, drills, shovels, backhoes, buckets, excavators, scrapers, auger/miners, and excavators.

Table 25.—Number of fires for surface coal mines by location and time period, 1990–1999

Location	Time period 90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Flame cutting/welding areas[1]	21	12	13	7	5	58
Coal silos/loading dock/refuse pile/abandoned coal pit areas	1	2	6	4	3	16
Beltline area	1	—	2	2	—	5
Dust collector/baghouse/crusher areas	2	—	2	2	—	6
Facility	1	—	1	1	1	4
Maintenance areas	11	3	5	6	4	29
Mobile equipment working areas[2]	30	20	18	18	11	97
Total	67	37	47	40	24	215

[1]Includes coal chute, beltline, bucket/transfer house, shaft, dust collector and coal chute areas, and mobile equipment maintenance areas.
[2]Includes mining, haulage, loading, and drilling areas.

Table 26.—Number of fires for surface coal mines by burning material and time period, 1990–1999

Burning material	90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Oxyfuel/hose/grease/clothing	20	9	13	8	5	55
Coal/coal dust/straw/refuse	5	2	7	4	5	23
Crusher/dust collector/furnace/baghouse	3	—	1	2	—	6
Belt/idler/pulleys	1	—	2	2	—	5
Facility/content	1	—	1	1	—	3
Flammable liquid/refuel fuel	9	4	4	7	5	29
Hydraulic fluid/fuel	23	16	19	12	6	76
Electrical system/batteries/collector ring/breaker	2	5	—	4	1	12
Air compressor/transmission oil	2	1	—	—	1	4
Natural gas/chemicals	1	—	—	—	1	2
Total	67	37	47	40	24	215

Table 27.—Number of fire injuries per number of fires causing injuries and total fires at surface coal mines by year, ignition source, equipment involved, and location, 1990–1999

Year	No. fires causing injuries	No. total fires	No. fire injuries	Ignition source	Equipment	Location
1990	11	38	11	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
	3		3	Heat source-flammable liquid	Heater/air compressor	Refuse/maintenance areas.
	1		1	Mechanical friction	Mobile equipment[2]	Drilling area.
	3		3	Hydraulic fluid/fuel on equipment hot surfaces	Mobile equipment[2]	Haulage area.
	1		1	Flammable liquid on hot surfaces	Mobile equipment[2]	Maintenance area.
1991[3]	4	29	4	Heat source-flammable liquid	Heater/furnace	Furnace room/maintenance area.
	6		5	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas/ coal chute areas.[1]
	4		4	Hydraulic fluid/fuel on equipment hot surfaces	Mobile equipment[2]	Loading/haulage/ drilling/ mining areas.
1992	5	20	5	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
	3		3	Hydraulic fluid/fuel on equipment hot surfaces	Mobile equipment[2]	Drilling/mining areas.
	1		1	Flammable liquid on hot surfaces	Mobile equipment[2]	Maintenance area.
1993	4	17	4	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
	1		1	Heat source-flammable liquid	Heater	Maintenance area.
	1		1	Engine malfunction	Mobile equipment[2]	Maintenance area.
	2		2	Hydraulic fluid/fuel on equipment hot surfaces	Mobile equipment[2]	Haulage area.
1994	4	27	4	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
	2		2	Heat source-flammable liquid	Heater/maintenance equipment.	Maintenance area.
	1		1	Conveyor belt friction	Beltline	Beltline area.
	2		2	Hydraulic fluid/fuel on equipment hot surfaces	Mobile equipment[2]	Mining area.
1995	2	20	2	Heat source-flammable liquid	Heater	Refuse area.
	4		4	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
	4		4	Hydraulic fluid/fuel on equipment hot surfaces	Mobile equipment[2]	Drilling/haulage/mining areas.
1996	3	20	3	Hydraulic fluid/fuel on equipment hot surfaces	Mobile equipment[2]	Loading/hopper areas.
	1		1	Engine malfunction	Mobile equipment[2]	Haulage areas.
	3		3	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
	2		2	Heat source-refueling fuel	Heater	Maintenance area.
1997	1	20	1	Heat source-flammable liquid	Heater	Maintenance area.
	2		2	Flammable liquid on hot surfaces	Mobile equipment[2]	Maintenance area.
	4		4	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
1998	3	13	3	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
	1		1	Flammable liquid on hot surfaces	Heater	Maintenance area.
	1		1	Hydraulic fluid/fuel on equipment hot surfaces	Mobile equipment[2]	Haulage area.
	1		1	Gas explosion	Mobile equipment[2]	Mining area.
1999	2	11	2	Flammable liquid on hot surfaces	Heater	Maintenance area.
	1		1	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
Total	94	215	94			

[1]Includes beltline area, bucket and transfer houses, coal chute and dust collector areas, and mobile equipment maintenance areas.
[2]Includes trucks, dozers, loaders, drills, shovels, and buckets.
[3]During 1991, there was 1 fire fatality.

Ignition Source

The number of fires and fire injuries by ignition source and time period is shown in tables 21 and 27. The leading sources were hydraulic fluid/fuel sprayed onto equipment hot surfaces (76 fires or 35% with 22 injuries), followed by flame cutting/welding spark/slag/flames (59 fires or 27% with 44 injuries), spontaneous combustion/hot coal (21 fires or 10%), and flammable liquid/refueling fuel on hot surfaces (18 fires or 8% with 7 injuries). Other ignition sources were engine/mechanical malfunctions/friction/explosions (11 fires), heat sources (10 fires), electrical short/arcing (8 fires), overheated oil (4 fires), conveyor belt friction (3 fires), and natural gas explosions (2 fires). Three ignition sources were unknown. The flame cutting/welding spark/slag/flame ignition source caused fires usually involving welders' clothing or oxyfuel/grease (grease embedded in the equipment's mechanical components). However, in four instances undetected hot slag caused coal belt ignitions. In another instance, undetected hot slag caused a coal chute smoldering fire, which, upon application of water, produced a flashback accompanied by a gas explosion (causing one fatality).

Forty-two of the mobile equipment hydraulic fluid/fuel fires became large fires, which at times required fire brigades and fire department interventions. On at least five occasions, the cab was suddenly engulfed in flames, forcing the operators to exit under hazardous conditions, probably due to the ignition of flammable vapors and mists that penetrated the cab. Of note is that most of the hydraulic fluid/fuel fires were caused when hydraulic fluids sprayed onto equipment hot surfaces; subsequently, these fires involved the fuel lines.

During the first through fourth periods, the largest number of fires were caused by hydraulic fluid/fuel sprayed onto equipment hot surfaces. During the fifth period, the largest number of fires were caused by hydraulic fluid/fuel sprayed onto equipment hot surfaces and flame cutting/welding spark/slag/flame sources (see table 21).

Method of Detection

Table 22 shows the number of fires by method of detection and time period. The most frequent methods were operators who saw the fires when they started as flames/flash fires, welders who saw sparks, miners who saw smoke long after the fires had started, and miners who saw smoke shortly after the fires had started. Thirteen fires were undetected. Other methods of detection were miners who heard an explosion, operators who heard a popping sound, miners who saw electrical/mechanical sparks or smelled smoke, operators who saw radiator white smoke/oil mist spray or experienced power loss, and miners who heard an electrical trip warning or fire alarm. The largest number of fires were detected by flames/flash fires throughout the periods (table 22).

Suppression Method

Table 23 shows the number of fires by suppression method and time period. The most common methods were portable fire extinguishers, foam, dry chemical powder, and water. These were followed by manual methods with or without portable fire extinguishers and water or portable fire extinguishers alone. Five pieces of mobile equipment involved in fires had machine fire suppression systems. Dual activation (three activations) of machine fire suppression and engine shutoff systems succeeded in temporarily abating the fires. However, the flames reignited, fueled by the flow of pressurized fluids entrapped in the lines (not affected by the engine shutoff operation), which hindered the operators' safe escape. Most of the mobile equipment hydraulic fluid/fuel fires became large fires, which required at least 15 fire brigade and fire department interventions because of the continuous flow of fluid/fuel from the pumps due to engine shutoff failure, lack of an emergency hydraulic line drainage system, difficulty in activating available emergency systems at ground level, or lack of effective and rapid local firefighting capabilities. (Fire-resistant hydraulic fluid is not required for equipment use at surface coal operations.) Other methods included coal spread, water, compaction, and removal. Fire brigades and fire departments, which were required in at least 26 instances, fought the mobile equipment fires and other large fires with foam, dry chemical powder, and water. However, 13 fires destroyed or heavily damaged equipment (including six pieces of mobile equipment) because of failure of other firefighting methods, late fire detection, undetected fires, or fire size.

During the first through fourth periods, the largest number of fires were suppressed with portable fire extinguishers, foam, dry chemical powder, and water. During the fifth period, the largest number of fires were suppressed with portable fire extinguishers and water (see table 23).

Equipment Involved

Table 24 shows the number of fires by equipment involved and time period. The equipment most often involved was mobile equipment (trucks, dozers, loaders, drills, shovels, backhoes, buckets, scrapers, excavators, and augers). This was followed by oxyfuel torches, heaters, and maintenance equipment. Other equipment included crushers and dust collectors; beltlines, drives, and pulleys; facilities; and air compressors. The largest number of fires involved mobile equipment throughout the periods (table 24).

Location

Table 25 shows the number of fires by location and time period. The most common locations were mobile equipment working areas (mining, haulage, loading, and drilling areas). These were followed by flame cutting/welding areas (at beltline areas, shaft, coal chute and dust collector areas, bucket and transfer houses, and mobile equipment maintenance areas) and maintenance areas. Other fire locations included coal silos, loading docks, refuse piles, abandoned and coal pit areas, dust collectors, baghouses, crushers and beltline areas, and facilities. The largest number of fires throughout the periods occurred at mobile equipment working areas (table 25).

Burning Materials

Table 26 shows the number of fires by burning material and time period. The material most often involved was hydraulic fluid/fuel, followed by oxyfuel/grease/clothing, flammable liquids, coal and coal dust, and straw and refuse. Other burning materials included electrical systems, batteries, collector rings and breakers, dust collectors, baghouses, and furnaces. Belts, idlers and pulleys, air compressors, transmission oil, facilities and contents, and natural gas and chemicals also burned during fires. The largest number of fires involved hydraulic fluid/fuel throughout the periods (table 26).

Fire Injuries

Table 27 shows the number of fire injuries per number of fires causing injuries and total fires by year, ignition source, equipment involved, and location during 1990–1999. Overall, there were 93 injuries and 1 fatality caused by 94 fires.

The greatest number of fire injuries occurred in 1990 (19 injuries caused by 19 fires) and 1991 (13 injuries and 1 fatality caused by 14 fires). The ignition sources that caused most of the fire injuries were flame cutting/welding spark/slag/flames and hydraulic fluid/fuel sprayed onto equipment hot surfaces. These were followed by flammable liquid on hot surfaces and by heat sources and pressurized can explosions. Other ignition sources were engine/mechanical malfunctions/friction and conveyor belt friction. The equipment most often involved included oxyfuel torches, mobile equipment, heaters, maintenance equipment, dust collectors and samplers, and beltlines. The locations where most of the fire injuries occurred were flame cutting/welding and mobile equipment working areas. Other fire locations were maintenance, dust collector, and beltline areas.

The fire fatality in Montana in 1991 was caused by a flashback accompanied by a gas explosion that engulfed the mechanic who was hosing down a coal chute smoldering fire. The smoldering of coal was due to undetected hot slag produced during flame cutting/welding operations [MSHA 1991b].

COAL PREPARATION PLANT FIRES

Table 28 and figure 10 show the number of fires and fire injuries for coal preparation plants by state during 1990–1999. Table 28 also shows the risk rates, employees' working hours, and lost workdays by state. For coal preparation plants, 91 fires occurred in 11 states during 1990–1999. Twenty-three of those fires caused 25 injuries (the yearly average was 9.1 fires and 2.5 injuries). Ten fires and eight injuries involved contractors. The Ewhr value was 241 × 10^6 hr (Irr = 0.021), and the LWD value was 198.

Pennsylvania had the most fires (24 fires and 4 injuries), whereas West Virginia (22 fires and 7 injuries) and Kentucky (22 fires and 7 injuries) had the most fire injuries. Among these states, Kentucky had the highest injury risk rate value (Irr = 0.025).

Table 29, partly illustrated in figure 11, shows the number of fires, fire injuries, risk rates, employees' working hours, and lost workdays by time period. The number of fires decreased during most of the periods (an increase is seen only during the last period). The number of fire injuries show a decrease followed by an increase during the periods, accompanied by a decline in employees' working hours throughout the periods. The Irr values follow patterns similar to those shown by the injury values (see table 29 and figure 11).

Tables 30–35 show the number of fires by ignition source, method of detection and suppression, equipment involved, location, and burning material by time period. Figure 12 shows the major variables during 1990–1999. Table 36 shows the fire injuries per number of fires causing injuries and total fires by year, ignition source, equipment involved, and location.

Ignition Source

The number of fires and fire injuries by ignition source and time period is show in tables 30 and 36. The leading source was spontaneous combustion/hot coal (24 fires or 26%). This was followed by flame cutting/welding spark/slag/flames (15 fires or 17% with 8 injuries), hydraulic fluid/fuel sprayed onto equipment hot surfaces (10 fires or 11% with 6 injuries), and conveyor belt friction (9 fires or 10% with 1 injury). The flame cutting/welding spark/slag/flame ignition source caused fires usually involving welders' clothing or oxyfuel/grease (grease embedded in the equipment's mechanical components). However, in one instance undetected hot slag caused a storage facility fire. Other ignition sources were electrical short/arcing (nine fires), flammable liquid/refueling fuel on hot surfaces (six fires), engine/mechanical malfunctions/friction (three fires), overheated oil (two fires), and a chemical explosion (one fire). Eight ignition sources were unknown. The spontaneous combustion/hot coal fires were detected long after the fires had started due to lack of continuous and early combustion gas/smoke detection systems. Two of the mobile equipment hydraulic fluid/fuel fires became large fires, which at times required fire brigade and fire department interventions. In two instances the cab was suddenly engulfed in flames, forcing the operators to exit under hazardous conditions, probably due to the ignition of flammable vapors and mists that penetrated the cab. Of note is that most of the hydraulic fluid/fuel fires were caused when hydraulic fluids sprayed onto equipment hot surfaces; subsequently, these fires involved the fuel lines.

During the first, third, fourth, and fifth periods, the largest number of fires were caused by spontaneous combustion/hot coal. During the second period, the largest number of fires were caused by spontaneous combustion/hot coal and by flame cutting/welding spark/slag/flames (see table 30).

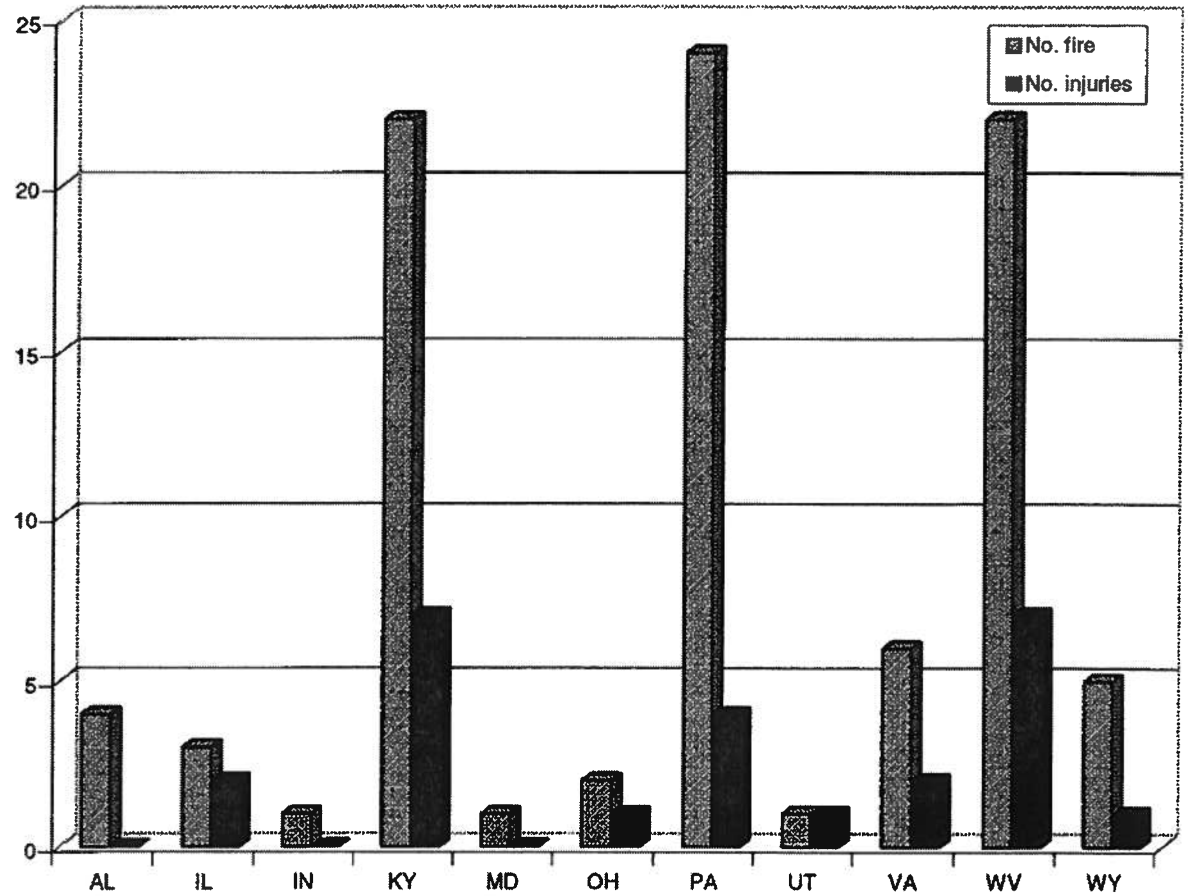

Figure 10.—Number of fires and fire injuries for coal preparation plants by state, 1990–1999.

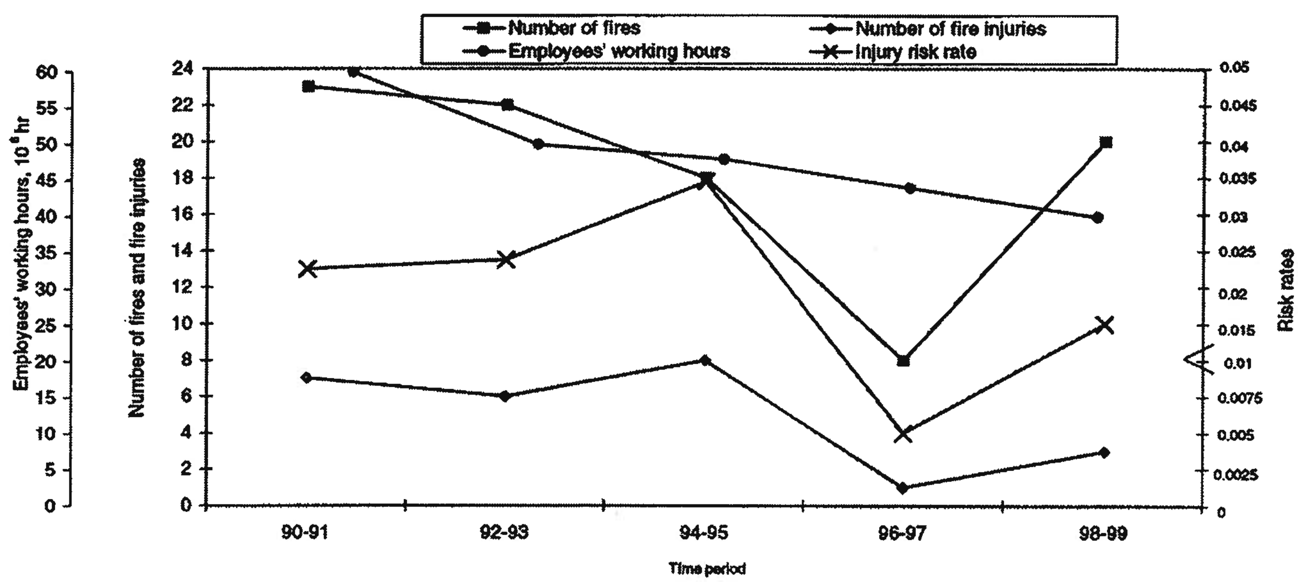

Figure 11.—Number of fires, fire injuries, and risk rates for coal preparation plants by time period and employees' working hours, 1990–1999.

Table 28.—Number of fires, fire injuries, and risk rates for coal preparation plants by state, employees' working hours, and lost workdays, 1990–1999

State[1]	No. fires[1]	No. injuries[1]	LWD[2]	Ewhr,[2] 10^6 hr	Irr[3]
Alabama	4	—	—	11	—
Illinois	3	2	14	15	0.027
Indiana	1	—	—	8.4	—
Kentucky	22	7	83	56	0.025
Maryland	1	—	—	1	—
Ohio	2	1	7	12.5	0.016
Pennsylvania	24	4	60	34.4	0.023
Utah	1	1	—	2.1	0.095
Virginia	6	2	—	21.5	0.019
West Virginia	22	7	34	59.5	0.024
Wyoming	5	1	—	4.1	0.049
Other states	—	—	—	15.3	—
Total	91	25	198	241	[3]0.021

[1]Derived from MSHA "Fire Accident Abstract" and "Fire Accident Report" publications.
[2]Derived from MSHA "Injury Experience in Coal Mining" publications.
[3]Calculated according to MSHA formula reported in the "Methodologies" section.

Table 29.—Number of fires, fire injuries, and risk rates for coal preparation plants by time period, employees' working hours, and lost workdays, 1990–1999

	Time period					
	90-91	92-93	94-95	96-97	98-99	90-99
Number of fires[1]	23	22	18	8	20	91
Number of fire injuries[1]	7	6	8	1	3	25
LWD[2]	116	19	37	—	26	198
Ewhr,[2] 10^6 hr	60	50	48	44	39	241
Irr[3]	0.023	0.024	0.033	0.005	0.016	[3]0.021

[1]Derived from MSHA "Fire Accident Abstract" and "Fire Accident Report" publications.
[2]Derived from MSHA "Injury Experience in Coal Mining" publications.
[3]Calculated according to MSHA formula reported in the "Methodologies" section.

Table 30.—Number of fires for coal preparation plants by ignition source and time period, 1990–1999

Ignition source	Time period					
	90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Heat source	1	—	2	—	1	4
Conveyor belt friction	1	2	2	—	4	9
Flame cutting/welding spark/slag/flame[1]	4	6	2	1	2	15
Chemical explosion	—	—	—	1	—	1
Spontaneous combustion/hot coal	5	6	4	4	5	24
Flammable liquid/refueling fuel on hot surfaces/ explosion	3	1	1	—	1	6
Electrical short/arcing[2]	2	4	1	—	2	9
Overheated oil	—	1	—	—	1	2
Engine/mechanical malfunctions/friction	1	—	1	1	—	3
Hydraulic fluid/fuel on equipment hot surfaces	3	2	2	1	2	10
Unknown	3	—	3	—	2	8
Total	23	22	18	8	20	91

[1]This source caused fires usually involving welders' clothing or oxyfuel/grease. However, in at least one instance undetected hot slag caused a storage facility fire.
[2]On one occasion this source caused a coal dust explosion in a dust collector.

Table 31.—Number of fires for coal preparation plants by method of detection and time period, 1990–1999

Method of detection	Time period 90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Visual:						
Flames/flash fires	8	3	3	2	4	20
Smoke	2	4	4	1	3	14
Sparks	1	5	1	1	1	9
Smoldering	—	—	—	—	1	1
Late smoke detection	6	9	6	3	8	32
Dim lights	—	—	—	—	1	1
Explosion	1	—	—	1	—	2
Popping sound	1	—	—	—	—	1
Undetected	2	1	3	—	1	7
Touched hot spots	1	—	1	—	—	2
Other	—	—	—	—	1	1
Total	23	22	18	8	20	91

Table 32.—Number of fires for coal preparation plants by suppression method and time period, 1990–1999

Suppression method	Time period 90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Manual/FE[1]	3	5	4	1	1	14
FE-foam/water/dry chemical powder	8	7	2	1	8	26
Water	7	3	4	1	5	20
Coal spread-water-compaction removal[2]	2	5	4	3	4	18
Destroyed/heavily damaged[3]	3	2	4	2	2	13
Total	23	22	18	8	20	91

FE Portable fire extinguisher.
[1]Methods used by welders to extinguish clothing or oxyfuel/grease fires.
[2]Methods used to extinguish spontaneous combustion/hot coal fires. In one case, a CO_2 permanent fire extinguishment system was used.
[3]Due to failure of other firefighting methods, late fire detection, or undetected fires.

Table 33.—Number of fires for coal preparation plants by equipment involved and time period, 1990–1999

Equipment	Time period 90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Electrical control/power system	2	3	1	—	1	7
Oxyfuel torch	4	6	2	1	2	15
Heater/maintenance equipment	2	—	3	—	—	5
Airlock gate	1	—	—	—	—	1
Dust sampler/collector/dryer/washer	4	—	—	1	1	6
Beltline/drive/pulley	1	3	2	—	5	11
Facility	1	—	3	—	1	5
Chemical tank	—	—	—	1	—	1
Hopper	—	—	—	—	2	2
Mobile equipment[1]	5	4	3	2	3	17
Air compressor	—	1	—	—	—	1
Other[2]	3	5	4	3	5	20
Total	23	22	18	8	20	91

[1]Includes loader, dozer, and haulage/utility trucks.
[2]Includes nonequipment (mostly coal piles).

Table 34.—Number of fires for coal preparation plants by location and time period, 1990–1999

Location	90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Flame cutting/welding areas[1]	4	6	2	1	2	15
Beltline/rail dump areas	3	2	3	—	4	12
Coal silos/stock pile/coal feeder	4	5	5	4	5	23
Power station	—	1	—	—	1	2
Maintenance areas	3	1	2	—	1	7
Thermal dryer/dust collector/washer/hopper areas	3	2	—	—	2	7
Airlock gates	1	1	—	—	—	2
Charging station	—	—	—	1	—	1
Mobile equipment working areas[2]	3	3	3	2	3	14
Facility area	2	1	3	—	2	8
Total	23	22	18	8	20	91

Time period columns: 90-91 through 98-99.

[1]Includes packing material building, plastic material storage, coal bypasses, loadout facilities, raw coal silos, drawoff tunnels, coal feeders, shops, coal hoppers, and mobile equipment maintenance areas.
[2]Includes loading and haulage areas.

Table 35.—Number of fires for coal preparation plants by burning material and time period, 1990–1999

Burning material	90-91 No. fires	92-93 No. fires	94-95 No. fires	96-97 No. fires	98-99 No. fires	90-99 No. fires
Oxyfuel/grease/clothing	2	4	1	1	1	9
Alcohol/chemicals	1	—	—	1	—	2
Flammable liquids/oil/grease	2	2	3	—	1	8
Belt/drive/pulley	3	3	3	—	4	13
Facility/content	1	—	3	—	1	5
Coal/coal dust/wood/insulation/rubber tires/ packing materials	8	7	7	4	7	33
Electrical systems/wires/cables	1	4	—	—	2	7
Hydraulic fluid/fuel	3	2	1	1	3	10
Equipment mechanical components	2	—	—	1	1	4
Total	23	22	18	8	20	91

Table 36.—Number of fire injuries per number of fires causing injuries and total fires at coal preparation plants by year, ignition source, equipment involved, and location, 1990–1999

Year	No. fires causing injuries	No. total fires	No. fire injuries	Ignition source	Equipment	Location
1990	2	11	3	Refueling fuel on hot surfaces	Pump/heater	Pump housing/maintenance areas.
	1	—	1	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
1991	1	12	1	Electrical short/arcing-coal dust explosion	Dust sampler	Dust collector area.
	1		1	Heat source	Heater	Maintenance area.
	1	—	1	Hydraulic fluid/fuel on equipment hot surfaces	Mobile equipment[2]	Loading area.
1992	3	11	3	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
	1	—	1	Electrical short-flammable liquid	Thermal dryer	Dryer area.
1993	1	11	1	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
	1	—	1	Hydraulic fluid/fuel on equipment hot surfaces	Mobile equipment[2]	Loading area.
1994	1	10	1	Heat source-flammable liquid	Heater	Maintenance area.
	1	—	1	Refueling fuel on hot surfaces	Maintenance equipment	Maintenance area.
	1	—	1	Conveyor belt friction	Beltline	Beltline area.
1995	1	8	1	Flame cutting welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
	2	—	3	Hydraulic fluid/fuel on equipment hot surfaces	Mobile equipment[2]	Loading/haulage areas.
	1	—	1	Mechanical malfunction	Mobile equipment[2]	Haulage area.
1996	1	5	1	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
1997	—	3	—	—	—	—
1998	1	10	1	Flame cutting/welding spark/slag/flame	Oxyfuel torch	Flame cutting/welding areas.[1]
1999	1	10	1	Hydraulic fluid/fuel on equipment hot surfaces	Mobile equipment[2]	Loading area.
	1		1	Heat source-flammable liquid	Thermal dryer	Dryer area.
Total	23	91	25			

[1]Includes loadout facilities, sump and coal feeder areas, shops, packing material building, and plastic material storage.
[2]Includes loaders and trucks.

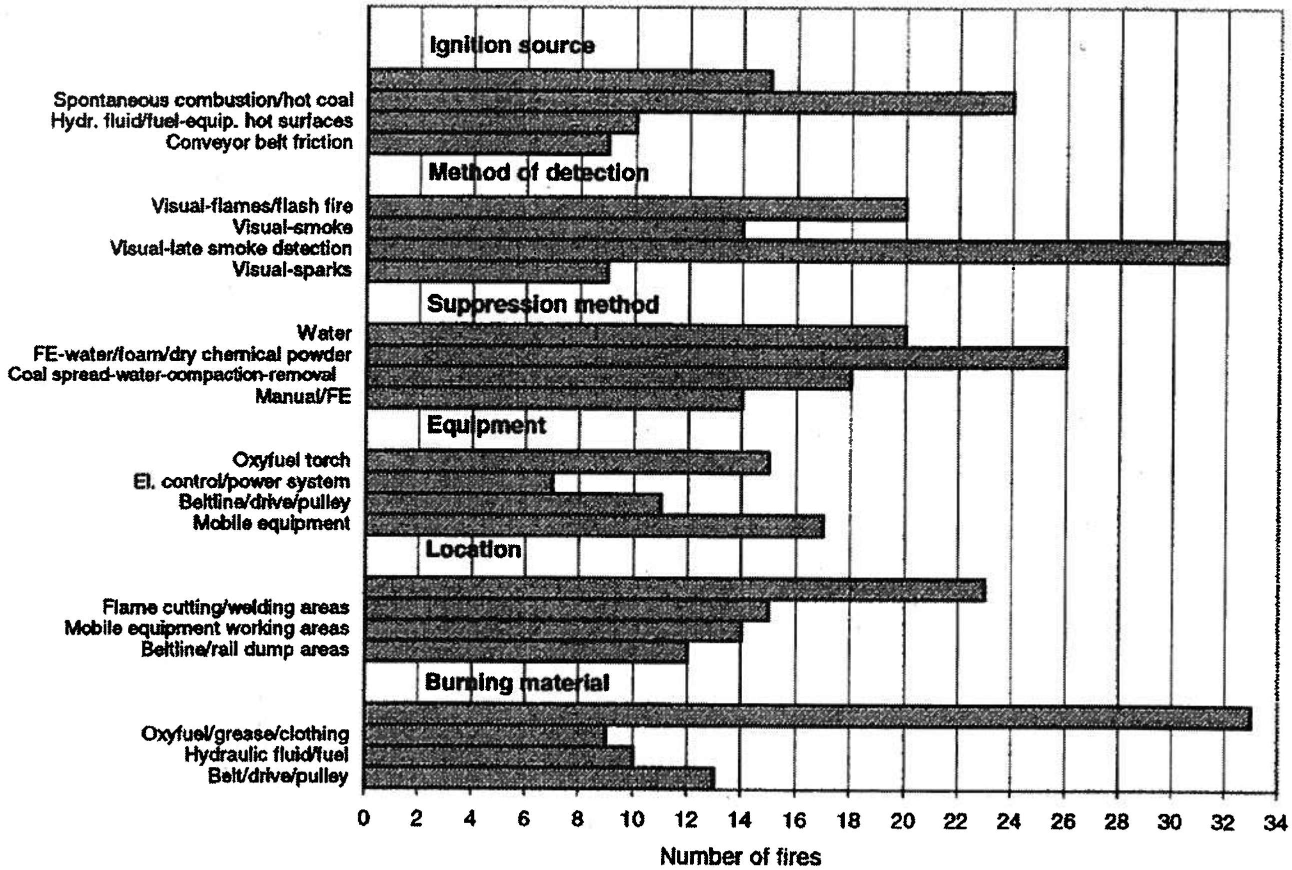

Figure 12.—Major variables for coal preparation plant fires, 1990–1999. (FE = portable fire extinguisher)

Method of Detection

Table 31 shows the number of fires by method of detection and time period. The most frequent method was miners who saw smoke long after the fires had started, followed by operators who saw the fires when they started as flames/flash fires, miners who saw smoke shortly after the fire had started, and welders who saw sparks. Other methods of detection were miners who touched hot spots, miners who saw smoldering of coal or heard an explosion, and operators who heard a popping sound or saw dimming of equipment lights. In one instance, a coal sampler detected a coal silo smoldering fire. Seven fires were undetected.

During the first period, the largest number of fires were detected when they started as flames/flash fires. During subsequent periods, the largest number of fires were detected late by smoke (see table 31).

Suppression Method

Table 32 shows the number of fires by suppression method and time period. The most common methods were water alone and coal spread, water, compaction, and removal. These were followed by portable fire extinguishers, foam, dry chemical powder and water, manual techniques with or without portable fire extinguishers, and dry chemical and water alone. In one instance, a permanent CO_2 fire-extinguishing system was used to put out a coal silo smoldering fire. None of the mobile equipment involved in fires had machine fire suppression systems. Most of the hydraulic fluid/fuel fires became large fires, which in one instance required a fire brigade and fire department intervention because of the continuous flow of fluid/fuel from the pumps due to engine shutoff failure, lack of an emergency hydraulic line drainage system (the flow of pressurized fluids entrapped in the lines was not affected by the engine shutoff operation), difficulty in activating available emergency systems at ground level, or lack of effective and rapid local firefighting response capabilities. (Fire-resistant hydraulic fluid is not required for equipment use at surface coal operations.)

Fire brigades and fire departments (required on at least nine occasions) fought the mobile equipment fires and other large fires with foam, dry chemical powder, and water. However, 13 fires destroyed or heavily damaged equipment (including four pieces of mobile equipment) because of failure of other firefighting methods, late fire detection, undetected fires, or fire size.

During the first, second, and fifth periods, the largest number of fires were suppressed with portable fire extinguishers, foam, dry chemical powder, and water. During the third period, the largest number of fires were extinguished by coal spread, water, compaction, and removal; manually with or without portable fire extinguishers; and water alone. During the fourth period, the largest number of fires were extinguished by coal spread, water, compaction, and removal (see table 32).

Equipment Involved

Table 33 shows the number of fires by equipment involved and time period. The equipment most often involved included mobile equipment (loaders, dozers, and trucks); oxyfuel torches; and beltlines, drives, and pulleys. Other equipment included electrical control and power systems, dust collectors and samplers, dryers and washers, heaters and maintenance equipment, hoppers, airlock gates, chemical tanks, and air compressors.

During the first period, the largest number of fires involved mobile equipment. During the second period, the largest number of fires involved oxyfuel torches. During the third period, the largest number of fires involved heaters, maintenance equipment, facilities, and mobile equipment. During the fourth and fifth periods, the largest number of fires involved mobile equipment (see table 33).

Location

Table 34 shows the number of fires by location and time period. The most common locations were coal silos, stockpile, and coal feeder areas and flame cutting/welding areas (at packing material buildings, plastic material storage, coal bypasses, loadout facilities, raw coal silos, drawoff tunnels, coal feeders, shops, coal hoppers, and mobile equipment maintenance areas). Other fire locations were mobile equipment working areas (loading and haulage areas), beltline and rail dump areas, facilities, and maintenance areas. Also affected by fires were thermal dryer, dust collector, washer, and hopper areas; power stations; airlock gates; and charging stations.

During the first and second periods, the largest number of fires occurred at flame cutting/welding areas. During the third, fourth, and fifth periods, the largest number of fires occurred at coal silo, feeder, and stockpile areas (see table 34).

Burning Materials

Table 35 shows the number of fires by burning material and time period. The materials most often involved were coal and coal dust, insulation material, rubber tires, wood, and packing materials, followed by belts, drives, and pulleys and hydraulic fluid/fuel. Other burning materials were flammable liquids, oil/grease, oxyfuel/grease/clothing, electrical systems, wires and cables, facilities and contents, equipment mechanical components, and alcohol and chemicals. Throughout the periods the largest number of fires involved coal, coal dust, wood, insulation, rubber tires, and packing materials (table 35).

Fire Injuries

Table 36 shows the number of fire injuries, number of fires causing injuries, and total fires by year, ignition source, equipment involved, and location during 1990–1999. Overall, there were 25 injuries caused by 23 fires.

The greatest number of fire injuries occurred in 1995 (five injuries caused by four fires) and 1992 (four injuries caused by four fires). The ignition sources that caused most of the fire injuries were flame cutting/welding spark/slag/flames, hydraulic fluid/fuel sprayed onto equipment hot surfaces, and flammable liquid/refueling fuel on hot surfaces. Other ignition sources were heat sources, mechanical malfunctions, electrical short/arcing and coal dust explosion, and conveyor belt friction. The equipment most often involved included oxyfuel torches, mobile equipment, heaters, maintenance equipment, dust collectors and samplers, pumps, and beltlines. The fire locations where most of the fire injuries occurred were flame cutting/welding areas and mobile equipment working areas. Other fire locations were maintenance areas, dust collector areas, thermal dryer and beltline areas, and pump housings.

SUMMARY OF MAJOR FIRE AND FIRE INJURY FINDINGS FOR ALL COAL MINING CATEGORIES

The major fire and fire injury findings for all coal mining categories for 1990–1999 are reported in tables 37–38. Table 39 and figure 13 show the number of fires, fire injuries, risk rates, employees' working hours, and coal production (underground and surface coal mines only) by time period for all coal mining categories. Table 40 shows major findings (for underground coal mines only) for 1978–1992.

For all coal mining categories, 458 fires occurred during 1990–1999; 157 of those fires caused 164 injuries and 2 fatalities (Ewhr = 2,070 × 10^6 hr, Irr = 0.016; CP (for underground and surface coal mines only) = 10,363 × 10^6 st, Frr = 0.044, LWD = 14,753). Twenty-nine fires and 17 injuries involved contractors.

Sixty-six fires required firefighting interventions by mine rescue teams (25 times in underground mines) and fire brigades and fire departments (at least 41 times at surface coal operations). In all, 51 fires destroyed or heavily damaged equipment (including 16 pieces of mobile equipment) because of failure of other firefighting methods, late fire detection, undetected fires, or fire size. A total of 114 fires were detected late, and 42 fires were undetected. The greatest number of fires and fire injuries occurred at surface coal mines; the highest risk rate values were also calculated for this category.

For all coal operations, the ignition sources that caused the greatest number of fires were flame cutting/welding spark/slag/flames (103 fires or 23% with 69 injuries), hydraulic fluid/fuel sprayed onto equipment hot surfaces (98 fires or 21% with 29 injuries), spontaneous combustion/hot coal (62 fires or 14%), electrical short/arcing (49 fires or 11% with 18 injuries), and conveyor belt friction (31 fires or 7% with 6 injuries).

Table 37.—Major fire findings for all coal mining categories, 1990–1999

Variables	Underground coal mines	Surface of underground coal mines	Surface coal mines	Coal preparation plants
GT: No. fires: 458 CP, 10^6 st: 10,363 Frr: 0.044 No. fires causing injuries: 157	No. fires: 87 CP, 10^6 st: 4,008 Frr: 0.022 No. fires causing injuries: 27	No. fires: 65 No. fires causing injuries: 13	No. fires: 215 CP, 10^6 st: 6,355 Frr: 0.034 No. fires causing injuries: 94	No. fires: 91 No. fires causing injuries: 23
Ignition source	Electrical short/arcing/explosion Flame cutting/welding/spark/slag/flame Conveyor belt friction Spontaneous combustion	Hydraulic fluid/fuel on equipment hot surfaces Flame cutting/welding spark/slag/ flame Spontaneous combustion/hot coal Heat source	Hydraulic fluid/fuel on equipment hot surfaces Flame cutting/welding spark/slag/flame Spontaneous combustion/hot coal Flammable liquid-refueling fuel on hot surfaces	Spontaneous combustion/hot coal Flame cutting/welding spark/slag/ flame Hydraulic fluid/fuel on equipment hot surfaces Conveyor belt friction
Method of detection	Late smoke detection Visual-sparks Visual-smoke CO/H_2 gas sample	Late smoke detection Visual-flames/flash fires Visual-smoke Visual-sparks	Visual-flames/flash fires Visual-sparks Late smoke detection Visual-smoke	Late smoke detection Visual-flames/flash fires Visual-smoke Visual-sparks
Suppression method	FE/water FE-DCP-rock dust/water Portable fire extinguisher Sealing/flooding/CO_2/N_2 gas injections	FE-foam/water/DCP Manual/FE Coal spread-water-compaction-removal Portable fire extinguisher	FE-foam/DCP/water Manual/FE FE/water Portable fire extinguisher	FE-foam/DCP/water Water Coal spread-water-compaction-removal Manual/FE
Equipment involved	Mobile equipment[1] Oxyfuel torch Beltline/drive/pulley/feeder Electrical system/units/other	Facility Mobile equipment[1] Oxyfuel torch Beltline/drive/pulley	Mobile equipment[1] Oxyfuel torch Heater/maintenance equipment Dust collector/crusher	Mobile equipment[1] Oxyfuel torch Beltline/drive/pulley Electrical control/power system
Location	Belt entries/feeder/slope/portal branch areas Flame cutting/welding areas[2] Gobline/sealed/abandoned coal pit areas Mining face/crosscut/intersection areas	Facility areas Mobile equipment working areas Flame cutting/welding areas[2] Beltline/drawoff tunnel areas	Mobile equipment working areas Flame cutting/welding areas[2] Maintenance area Coal silo/pit areas/other	Coal silos/feeder/stockpile Flame cutting/welding areas[2] Mobile equipment working areas Beltline/rail dump areas
Burning material	Electrical wires/cables/units/other Coal/coal dust Belt/drive/pulley/feeder Oxyfuel/grease/clothing	Facility/content/other Hydraulic fluid/fuel Coal/methane Belt/drive/pulley	Hydraulic fluid/fuel Oxyfuel/grease Flammable liquid/refueling fuel Coal/coal dust	Coal/wood/insulation material/other Belt/drive/pulley Hydraulic fluid/fuel Oxyfuel/grease/clothing

DCP Dry chemical powder.
FE Portable fire extinguisher.

[1]Includes scoops, bolters, shuttle cars, ore carts, 3-wheelers, trolleys, locomotives, rail runners, shearers, continuous miners, loaders, dozers, shovels, scrapers, drills, highlifts, excavators, backhoes, buckets, trucks, auger/miners, hoists, and power scalers.

[2]Includes longwall face and headgate; belt entries; beltline areas; drive, pulley, and feeder areas; overcasts; shops; storage silos; plastic/packing material buildings; shafts; coal chutes; dust collectors; elevator shafts; bucket/transfer housing; coal bypasses; drawoff tunnels; raw coal hoppers; and mobile equipment maintenance areas.

NOTE.—Variables are listed in descending order of occurrence.

Table 38.—Major fire injury findings for all coal mining categories, 1990–1999

Variables	Underground coal mines	Surface of underground coal mines	Surface coal mines	Coal preparation plants
Grand total: No. fire injuries: 164 No. fire fatalities: 2 Ewhr, 10^6 hr: 2,070 Irr: 0.016 LWD: 14,753	No. fire injuries: 34 Ewhr, 10^6 hr: 1,003 Irr: 0.0068 LWD: 208	No. fire injuries: 12 No. fire fatalities: 1 Ewhr, 10^6 hr: 97 Irr: 0.025 LWD: 6,206	No. fire injuries: 93 No. fire fatalities: 1 Ewhr, 10^6 hr: 729 Irr: 0.026 LWD: 8,141	No. fire injuries: 25 Ewhr, 10^6 hr: 241 Irr: 0.021 LWD: 198
Ignition source	Electrical short/arcing Flame cutting/welding spark/slag/flame Conveyor belt friction Heat source	Flame cutting/welding spark/slag/flame Heat source Battery explosion Hydraulic fluid/fuel on equipment hot surfaces	Flame cutting/welding spark/slag/flame Hydraulic fluid/fuel on equipment hot surfaces Flammable liquid on hot surfaces Heat source	Flame cutting/welding spark/slag/flame Hydraulic fluid/fuel on equipment hot surfaces Refueling fuel on hot surfaces Electrical short/arcing-coal dust explosion
Method of detection	Visual-smoke Visual-sparks Late smoke detection	Visual-sparks Visual-flames Explosion Visual-flames/flash fire	Visual-sparks Visual-flames/flash fires Visual-smoke/explosion	Visual-sparks Visual-flames/flash fires Explosion
Suppression method	FE-rock dust/DCP/water Manual/FE Portable fire extinguisher	FE/manual Portable fire extinguisher FE-foam/DCP/water	FE-manual FE-foam/DCP/water Portable fire extinguisher	FE-manual FE-foam/water/DCP Portable fire extinguisher
Equipment involved	Electrical power cables/systems/starter/voltage box/mobile equipment Oxyfuel torch Beltline/drive/pulley Heater	Oxyfuel torch Heater Mobile equipment[1]	Oxyfuel torch Mobile equipment[1] Heater	Oxyfuel torch Mobile equipment[1] Heater/maintenance equipment Dust collector/sampler
Location	Pump/power/charging stations/mobile equipment working areas Flame cutting/welding areas[2] Trolley track rails/transportation areas Belt entries	Flame cutting/welding areas[2] Maintenance area Mobile equipment working areas Charging station	Flame cutting/welding areas[2] Mobile equipment working areas Maintenance areas	Flame cutting/welding areas[2] Mobile equipment working areas Maintenance area Dust collector area
Burning material	Electrical units/wires/cables Oxyfuel/grease/clothing Belt material Mobile equipment mechanical components	Oxyfuel/grease/clothing Hydraulic fluid/fuel Batteries	Oxyfuel/grease/clothing Hydraulic fluid/fuel Flammable liquids Pressurized can	Oxyfuel/grease/clothing Hydraulic fluid/fuel Flammable liquids/refueling fuels Dust collector liners

DCP Dry chemical powder.
FE Portable fire extinguisher.
[1]Includes scoops, shuttle cars, bolters, rail runners, jeeps, trucks, loaders, dozers, scrapers, shovels, highlifts, excavators, buckets, backhoes, drills, and tractors.
[2]Includes conveyor belt entries, beltline areas, longwall mining face, shops, loadout facilities, bucket/transfer houses, coal chutes, dust collectors, storage silos, sump areas, and mobile equipment working and maintenance areas.
NOTE.—Variables are listed in descending order of occurrence.

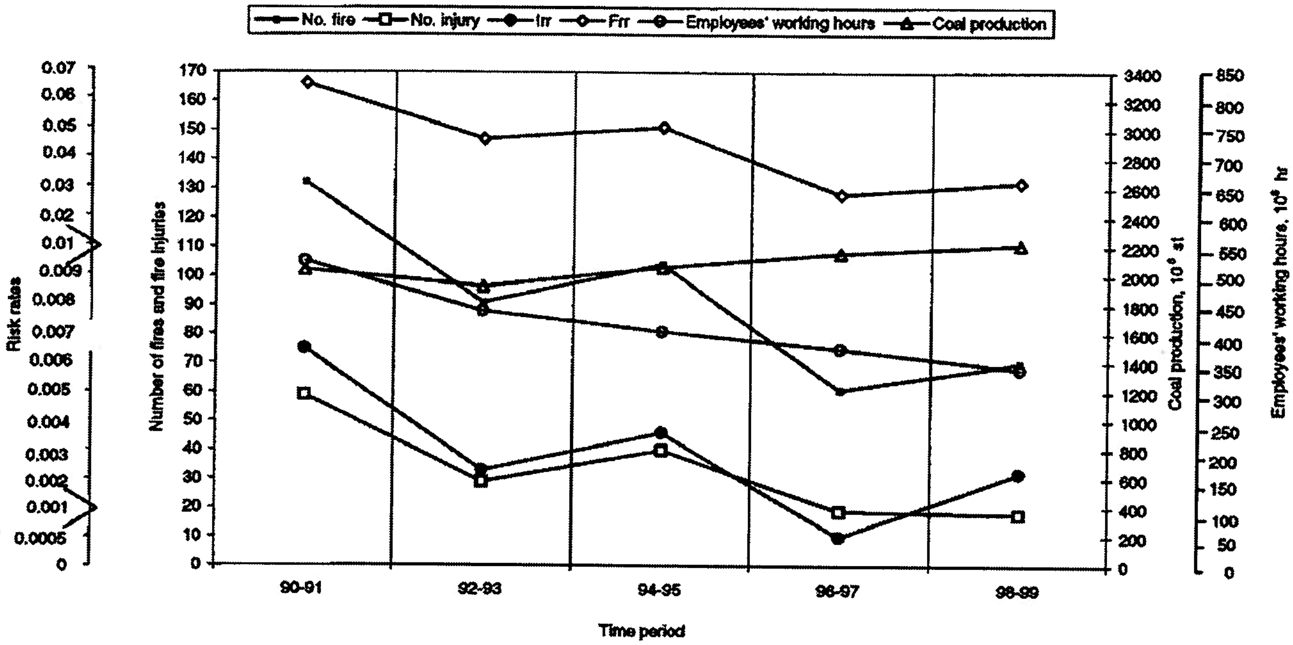

Figure 13.—Number of fires, fire injuries, risk rates, and coal production (underground and surface coal mines only) for all coal mining categories by time period and employees' working hours, 1990–1999.

Table 39.—Number of fires, fire injuries, fire fatalities, and risk rates for all coal mining categories by time period, employees' working hours, lost workdays, and coal production, 1990–1999

	Time period					
	90-91	92-93	94-95	96-97	98-99	90-99
Number of fires[1]	132	91	104	61	70	458
Number of fire injuries[1]	59	29	39	19	18	164
Number of fire fatalities[1]	2	—	—	—	—	2
LWD[2]	12,847	734	421	345	406	14,753
Ewhr,[2] 10⁶ hr	521	434	405	370	340	2,070
CP,[2] 10⁶ st	2,004	1,928	2,059	2,155	2,218	10,363
Frr[3]	0.066	0.047	0.051	0.028	0.032	[3]0.944
Irr[3]	0.023	0.013	0.019	0.01	0.011	[3]0.016

[1]Derived from MSHA "Fire Accident Abstract" and "Fire Accident Report" publications.
[2]Derived from MSHA "Injury Experience in Coal Mining" publications.
[3]Calculated according to USBM and MSHA formulas reported in the "Methodologies" section.

Table 40.—Major findings for underground coal mine fires, 1978–1992

Category	All fires	Injury fires	Fatal fires
Ignition source	Electrical, friction, welding or cutting.	Electrical, friction, welding or cutting.	Friction, welding or cutting.
Detection	Miner saw or smelled smoke, miner saw fire start, examiner saw or smelled smoke.	Miner saw fire start, miner saw or smelled smoke.	Miner saw fire start, miner saw or smelled smoke.
Burning substance	Coal, electrical insulation, conveyor belt or rollers.	Coal, electrical insulation, conveyor belt or rollers.	Coal, conveyor belt or rollers, electrical insulation.
Equipment involved	Conveyor belt, welding or cutting, trolley line, electrical equipment.	Trolley line, conveyor belt, welding or cutting, air compressor.	Conveyor belt, air compressor, welding or cutting, continuous miner.
Location	Belt entry, working face, intake air course, track entry.	Track entry, working face, belt entry, longwall.	Shaft bottom, intake air course, belt entry, working face.
Successful extinguishing agent	Water, dry chemicals, rock dust.	Water, dry chemicals, rock dust.	Water, dry chemicals.

Source: Pomroy and Carigiet [1995].

The flame cutting/welding spark/slag/flame source caused fires usually involving welders' clothing or oxyfuel/grease (grease embedded in the equipment's mechanical components). However, in at least two instances sparks/hot slag/flames caused methane ignitions followed by large fires (which on one occasion required firefighting interventions and mine/section evacuation and sealing), in six cases undetected hot slag caused coal belt fires, in one instance undetected hot slag caused a storage facility fire, in another instance undetected hot slag caused a large fire that required firefighting intervention and mine evacuation and sealing followed by a methane explosion, and in another instance undetected hot slag caused a coal chute smoldering fire, which, upon water application, produced a flashback accompanied by a gas explosion (causing one fatality). The spontaneous combustion/hot coal fires, accompanied in two instances by methane explosions, usually were detected late (by gas sampling, smoke, or coal removal) due to lack of continuous and early combustion gas/smoke detection systems. This source caused fires involving goblines, sealed and abandoned areas, coal silos, coal chutes, dust collectors, and beltlines. Forty-eight of the mobile equipment hydraulic fluid/fuel fires and 12 equipment electrical fires (the latter occurred mostly in underground coal mines) became large fires, which required 24 firefighting interventions (5 interventions by mine rescue teams in underground coal mines and 19 interventions by fire brigades and fire departments at surface coal operations) because of continuous flow of fluid/fuel from the pumps due to engine shutoff failure, lack of an emergency line drainage system (the flow of pressurized fluids entrapped in the lines was not affected by the engine shutoff operation), difficulty in activating available emergency systems at ground level, or lack of effective and rapid local firefighting response capabilities. (Fire-resistant hydraulic fluid is not required for equipment use at surface coal operations.) During these fires,on at least seven occasions the cab was suddenly engulfed in flames, probably due to the ignition of flammable vapors and mists that penetrated the cab. Of note is that most of the hydraulic fluid/fuel fires were caused when hydraulic fluids sprayed onto equipment hot surfaces; subsequently, these fires involved the fuel lines. In all, 10 pieces of equipment involved in fires had machine fire suppression systems. Dual activation (six activations) of machine fire suppression and engine shutoff systems temporarily succeeded in abating the fires, which reignited due to the flow of fluids embedded in the lines.

The number of fires show decreases followed by increases during the five time periods. The number of fire injuries decreased during most of the periods (an increase is seen only during 1994–1995), accompanied by a decline in employees' working hours throughout the periods and an increase in coal production during most of the periods. The Irr and Frr values follow patterns similar to those shown by the injury and fire values (see table 39 and figure 13).

The major findings for each coal mining category are discussed below.

1. In underground coal mines, 87 fires occurred; 27 of the fires caused 34 injuries (Ewhr = $1{,}003 \times 10^6$ hr, Irr = 0.007, CP = $4{,}008 \times 10^6$ st, Frr = 0.022, LWD = 208). The leading ignition source (table 1) was electrical short/arcing (28 fires or 32% with 17 injuries) involving electrical power and cable systems, power circuits, breakers, belt transformers, grounded wires and cables, batteries, high-voltage boxes, generators, rectifiers, and mobile equipment electrical cable systems. This was followed by the flame cutting/welding spark/slag/flame source (18 fires or 21% with 10 injuries); conveyor belt friction involving pulleys, drives, rollers, idlers, and bearings (16 fires or 18% with 4 injuries); and spontaneous combustion (15 fires or 17%). The flame cutting/welding spark/slag/flame ignition source caused fires usually involving welders' clothing or oxyfuel/grease (grease embedded in the equipment's mechanical components). However, in one instance sparks/hot slag/flames caused a methane ignition followed by a large fire, which required firefighting intervention and mine/section evacuation and sealing. In another instance, undetected hot slag caused a large coal fire, which required firefighting intervention and mine evacuation and sealing followed by a methane explosion. The spontaneous combustion ignition source caused fires involving goblines and sealed and abandoned areas, which were accompanied in two instances by methane explosions. In all, five fires destroyed or heavily damaged equipment (including two pieces of mobile equipment) because of failure of other firefighting methods, late fire detection, undetected fires, or fire size. Thirty-six fires were detected late by smoke, and two fires were undetected.

Of note is that a large number of fires caused by electric short/arcing, belt friction, and spontaneous combustion sources were detected long after the fire had started due to lack of continuous and early combustion gas/smoke detection systems. By contrast, 12 of the mobile equipment electrical fires (which in at least one instance affected the hydraulic lines) and 1 hydraulic fluid fire became large fires shortly after they started. Five of these fires required mine rescue team interventions because of unavailability of effective machine fire suppression systems, lack of an emergency hydraulic line drainage system (the flow of pressurized fluids entrapped in the lines was not affected by the motor deenergization operation), or lack of effective and rapid local firefighting response capabilities. Three pieces of mobile equipment involved in fires had machine fire suppression systems. Dual activation (two activations) of machine fire suppression and motor deenergization systems succeeded in temporarily abating the fires. However the flames reignited, fueled by the fluids entrapped in the lines.

Upon mine/section evacuation (required 30 times), mine rescue teams (required 25 times), which were greatly hindered by intense smoke in reaching the fire location, fought the mobile equipment fires and other fires with dry chemical, rock dust, and water. In two instances, foam was also used. However, five fires destroyed or heavily damaged equipment. Thirteen times mine/section sealing/flooding/CO_2/N_2 gas injections were required.

The equipment most often involved in fire injuries included electrical cable systems, voltage boxes, mobile equipment, oxyfuel torches, beltlines, drives, and pulleys. The most common locations where fire injuries occurred were electrical power, pump, and charging stations, mobile equipment working areas, flame cutting/welding areas, trolley track and transportation areas, and belt entries.

A comparison of underground coal mine fire data for 1978–1992 [Pomroy and Carigiet 1995] and 1990–1999 shows that during the latter period fire fatalities declined dramatically from a yearly average of 2 to 0. However, 27 of the 1978–1992 fire fatalities occurred during a single fire caused by an overheated air compressor. There was also a decline in the number of fires (from a yearly average of 10.8 to 8.7) and a small increase in fire injuries (from a yearly average of 2.9 to 3.4), accompanied by a slight increase in coal production (from a yearly average of 356×10^6 to 401×10^6 st). Other comparisons show that during both periods similar methods of detection and suppression were used. Very few fires were detected by gas sampling, CO/smoke belt fire detection systems, or mine-wide monitoring systems.

Fires and fire injuries show decreases followed by increases during the five time periods. This was accompanied by a decline in employees' working hours throughout the periods and an increase in coal production during some of the periods. The Irr and Frr values follow patterns similar to those shown by the injury and fire values (see table 2 and figure 1).

2. At surface of underground coal mines, 65 fires occurred; 13 of the fires caused 12 injuries and 1 fatality (Ewhr = 97×10^6 hr, Irr = 0.025, LWD = 6,206). The leading ignition sources (table 1) were hydraulic fluid/fuel sprayed onto equipment hot surfaces (11 fires or 17%), flame cutting/welding spark/slag/flames (11 fires or 17% with 1 injury), spontaneous combustion/hot coal (11 fires or 17%), and electrical short/arcing (4 fires or 6%). Twenty ignition sources were unknown. In all, 20 fires destroyed or heavily damaged equipment (including two pieces of mobile equipment) because of failure of other firefighting methods, late fire detection, undetected fires, or fire size. Eighteen fires were detected late, and 20 were undetected. The flame cutting/welding spark/slag/flame source caused fires usually involving welders' clothing or oxyfuel/grease (grease embedded in the equipment's mechanical components). However, in one instance sparks/hot slag caused a methane ignition followed by a large fire, and in two other instances undetected hot slag caused coal belt fires. The spontaneous combustion/hot coal fires were usually detected long after the fire had started due to lack of continuous and early combustion gas/smoke detection systems. Three mobile equipment hydraulic fluid/fuel fires became large fires, which required fire department interventions because of the continuous flow of fluid/fuel from the pumps due to engine shutoff failure, lack of an emergency hydraulic line drainage system (the flow of pressurized fluids entrapped in the lines was not affected by the engine shutoff operation), difficulty in activating available emergency systems at ground level, or lack of effective and rapid local firefighting response capabilities. In at least two instances flames erupted in the cab, probably because of the ignition of flammable vapors and mists that penetrated the cab. Two pieces of mobile equipment involved in fires had machine fire suppression systems. Dual activation (one activation) of machine fire suppression and engine shutoff systems failed to temporarily abate the fires because of the flow of fluids entrapped in the lines. Fire departments (required in at least six instances) fought the mobile equipment fires and other large fires with foam, dry chemical powder, and water.

The equipment most often involved in fire injuries included oxyfuel torches, heaters, and mobile equipment. The most common locations where fire injuries occurred were flame cutting/welding, maintenance, and mobile equipment working areas and charging stations.

The number of fires and fire injuries show decreases followed by increases during the five time periods, accompanied by a decline in employees' working hours throughout the periods. The Irr values follow patterns similar to those shown by the injury values (see table 11 and figure 5).

3. At surface coal mines, 215 fires occurred; 94 of the fires caused 93 injuries and 1 fatality (Ewhr = 729×10^6 hr, Irr = 0.026, CP = $6,355 \times 10^6$ st, Frr = 0.034, LWD = 8,141). The leading ignition sources (table 2) were hydraulic fluid/fuel sprayed onto equipment hot surfaces (76 fires or 35% with 22 injuries), flame cutting/welding spark/slag/flames (59 fires or 27% with 44 injuries), spontaneous combustion/hot coal (21 fires or 10%), and flammable liquid/refueling fuel on hot surfaces (18 fires or 8% with 7 injuries). Three ignition sources were unknown. In all, 13 fires destroyed or heavily damaged equipment (including six pieces of mobile equipment) because of failure of other firefighting methods, late fire detection, undetected fires, or fire size. Twenty-eight fires were detected late, and 13 were undetected. The flame cutting/welding spark/slag/flame source caused fires usually involving welders' clothing or oxyfuel/grease (grease embedded in the equipment's mechanical components). However, on four occasions undetected hot slag caused a coal belt ignition, and in one instance undetected hot slag caused a coal chute smoldering fire, which, upon application of water, produced a flashback accompanied by a gas explosion (causing one fatality). The spontaneous combustion/hot coal fires were usually detected long after the fires had started (by smoke or coal removal) due to lack of continuous and early combustion gas/smoke detection systems. Forty-two of the mobile equipment hydraulic fluid/fuel fires became large fires, which required at least 15 fire brigade and fire department interventions because of the continuous flow of fluid/fuel from the pumps due to engine shutoff failure, lack of an emergency hydraulic line drainage system (the flow of pressurized fluids entrapped in the lines was not affected by the engine shutoff operation), difficulty in activating available emergency systems at ground level, or lack of effective and rapid local firefighting response capabilities. On at least five occasions the cab was suddenly engulfed in flames, forcing the operators to exit under hazardous conditions, probably due to the ignition of flammable vapors and mists that penetrated the cab. Five pieces of equipment involved in fires had machine fire suppression systems. Dual activation (three activations) of machine fire suppression and engine shutoff systems succeeded in temporarily abating the fires; however, the flames reignited, fueled by the flow of fluids entrapped in the lines. Fire brigades and fire departments, which were required in at least

26 instances, fought the 15 equipment fires and other large fires with foam, dry chemical powder, and water.

The ignition sources causing most of the fire injuries were flame cutting/welding spark/slag/flames (44 injuries), hydraulic fluid/fuel sprayed onto equipment hot surfaces (22 injuries), flammable liquids on hot surfaces (7 injuries), and heat sources (7 injuries). The equipment most often involved included oxyfuel torches, mobile equipment, and heaters. The most common locations where fire injuries occurred were flame cutting/welding areas, mobile equipment working areas, and maintenance areas.

Fires and fire injuries decreased during most of the periods (an increase is seen during 1994–1995). This was accompanied by a decline in employees' working hours throughout the periods and an increase in coal production during most of the periods. The Irr and Frr values follow patterns similar to those shown by the injury and fire values (see table 20 and figure 8).

4. At coal preparation plants, 91 fires occurred; 23 of the fires caused 25 injuries (Ewhr = 241 × 10^6 hr, Irr = 0.021, LWD = 198). The leading ignition sources (table 2) were spontaneous combustion/hot coal (15 fires or 17%), flame cutting/welding spark/slag/flames (15 fires or 17% with 8 injuries), hydraulic fluid/fuel sprayed on equipment hot surfaces (10 fires or 11% with 6 injuries), and conveyor belt friction (9 fires or 11% with 1 injury). In all, 13 fires destroyed or heavily damaged equipment (including four pieces of mobile equipment) because of failure of other firefighting methods, late fire detection, or undetected fires. Thirty-two fires were detected late by smoke, and seven fires were undetected. The flame cutting/welding spark/slag/flame source caused fires usually involving welders' clothing or oxyfuel/grease (grease embedded in the equipment's mechanical components). However, in one instance undetected hot slag caused a storage facility fire. The spontaneous combustion/hot coal fires were detected long after they had started (usually by coal removal, gas sampling, or smoke) due to lack of continuous and early combustion gas/smoke detection systems. Two of the hydraulic fluid/fuel fires became large fires because of the continuous flow of fluid/fuel from the pumps due to engine shutoff failure, lack of an emergency hydraulic line drainage system (the flow of pressurized fluids entrapped in the lines was not affected by the engine shutoff operation), difficulty in activating available emergency systems at ground level, or lack of effective and rapid local fire response capabilities (none of the equipment involved in fires had a machine fire suppression system). In at least two instances, the cab was suddenly engulfed in flames, forcing the operators to exit under hazardous conditions, probably due to the ignition of flammable vapors and mists that penetrated the cab. Fire brigades and fire departments (required in at least nine instances) fought the equipment fires and other large fires with foam, dry chemical powder, and water.

The equipment most often involved in fire injuries included oxyfuel torches, mobile equipment, heaters and maintenance equipment, and dust collectors and samplers. The most common locations where fire injuries occurred were flame cutting/welding areas, mobile equipment working areas, maintenance areas, and dust collector areas.

Fires decreased during most of the periods (an increase is seen during 1998–1999). The data on fire injuries show decreases followed by increases during the periods, accompanied by a decline in employees' working hours throughout the periods. The Irr values follow patterns similar to those shown by the injury values (see table 24 and figure 11).

CONCLUSIONS

During 1990–1999, a total of 458 fires occurred in all coal mining categories; 157 of those fires caused 164 injuries and 2 fatalities. The greatest number of fires and fire injuries occurred at surface mines, which also had the highest risk rate values. A total of 66 firefighting interventions were required. Of these, there were 25 mine rescue team interventions in underground mines, including 5 mobile equipment firefighting interventions, and 41 fire brigade and fire department interventions at all surface operations, including 19 mobile equipment interventions. In all, 50 fires destroyed or heavily damaged equipment (including 16 pieces of mobile equipment) because of failure of other firefighting methods, late fire detection, undetected fires, or fire size. A total of 114 fires were detected late by smoke, and 42 fires were not detected.

In the future, coal mine fires might be prevented or detected and extinguished at their earliest stage by adopting existing/improved technologies and/or by developing new technologies. Several strategies for reducing the number of fires and fire injuries follow.

1. *Adopt existing/improved safety procedures and develop new technologies for flame cutting/welding operations. Require safety training for welders (including contractors) working in gaseous environments.*

At all coal operations during 1990–1999, flame cutting/welding operations caused 102 fires (22% of total fires with 69 injuries). These fires usually involved welders' clothing or oxyfuel/grease (grease embedded in the equipment's mechanical components). However, in two instances sparks/hot slag/flames caused methane ignitions followed by large fires (one of these fires required firefighting interventions and mine/section/facility evacuation and sealing), in six cases undetected hot slag caused coal belt fires, in one instance undetected hot slag caused a storage facility fire, in another instance undetected hot slag caused a large coal fire that required firefighting intervention and mine evacuation and sealing followed by a methane explosion, and in another instance undetected hot slag caused a coal chute smoldering fire, which, upon water application, produced a flashback accompanied by a gas explosion (causing one fatality), which required firefighting interventions and mine/section evacuations. By adopting existing/improved safety procedures, the flame cutting/welding fires due to the ignition of oxyfuel/grease might be prevented. By developing new technologies to contain sparks/slag, the flame cutting/welding fires due to sparks and hot slag might also be prevented.

2. *Adopt existing/improved inspection programs for mobile equipment hydraulic, electrical, and fuel systems. Adopt an optimal ground level location for the activation of emergency systems. Develop new emergency technologies for engine/pump shutoff, hydraulic line drainage, line safeguards, and fire barriers. Develop rapid equipment/cab fire detection and effective fire prevention/suppression systems. Develop effective and rapid local firefighting capabilities. Schedule more frequent fire emergency preparedness training for equipment operators.*

At all coal operations during 1990–1999, there were 98 (21% of total fires with 29 injuries) mobile equipment hydraulic fluid/fuel fires (mostly at surface operations) and 12 equipment electrical fires in underground mines, which in at least one instance affected the hydraulic lines. Most of the hydraulic fluid/fuel fires became large fires because of the continuous flow of fluid/fuel from the pumps due to engine shutoff failure, flow of pressurized fluids entrapped in the hydraulic lines (not affected by the engine shutoff operation), difficulty in activating emergency systems at ground level, or lack of effective and rapid local firefighting capabilities. Of note is that most of the hydraulic fluid/fuel fires were caused when hydraulic fluids sprayed onto equipment hot surfaces; subsequently, these fires involved the fuel lines. In at least seven instances the cab was suddenly engulfed in flames, probably due to the ignition of flammable vapors and mists that penetrate the cab during the spraying of pressurized hydraulic fluid onto equipment hot surfaces. Also, most of the mobile equipment electrical fires became large fires because of unavailability of effective machine fire suppression systems, lack of an emergency hydraulic line drainage system, or lack of effective and rapid local firefighting capabilities. In all, 10 pieces of mobile equipment involved in fires had machine fire suppression systems. Dual activation (six activations) of machine fire suppression and engine shutoff systems succeeded in abating the fires, but the flames reignited, fueled by the flow of fluids entrapped in the lines (not affected by the engine, or motor, shutoff operation).

By adopting existing/improved mobile equipment inspection programs, hydraulic line and electrical cable wear and tear might be detected early, thereby preventing hydraulic fluid/fuel and electrical cable fires. By adopting an optimal location for ground level activation of machine fire suppression and engine shutoff systems, these emergency operations might be performed safely and in a timely manner, thus stopping the continuous flow of fluid/fuel from the pumps. By developing new technologies for the emergency draining of pressurized fluids entrapped in lines, the hydraulic fluid fires might not reignite, thus allowing the operators to exit the cab safely. By developing/adopting cab fire detection and cab fire inerting/suppression systems, the cab fires might not occur. By preparing local miners to fight mobile equipment fires, when detected, with large, contained quantities of suppressant agents on vehicles for ease of deployment to the fire site, these fires might be extinguished in their early stage.

3. *Adopt existing/improved continuous and early combustion gas/smoke detection systems.*

At all coal operations during 1990–1999, there were 71 (16% of total fires) spontaneous combustion/hot coal fires involving goblines, sealed and abandoned areas, coal silos, coal chutes, dust collectors, and beltlines. The spontaneous combustion/hot coal fires were usually detected late due to lack of continuous and early combustion gas/smoke detection systems; however, twice they were accompanied by methane explosions. By adopting existing continuous and early combustion gas/smoke detection systems, the spontaneous combustion/hot coal fires might be detected and suppressed at their earliest stage.

4. *Adopt existing/improved technologies to monitor equipment operations.*

At all coal mining operations during 1990–1999, there were 30 fires (7% of total fires with 6 injuries) caused by the operational failure of beltlines, drives, and pulleys. By adopting existing/improved technologies to monitor equipment operations, failures might be detected early, thereby preventing these types of equipment fires.

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DHHS (NIOSH) Publication No. 2004–167

Aracoma Coal Company

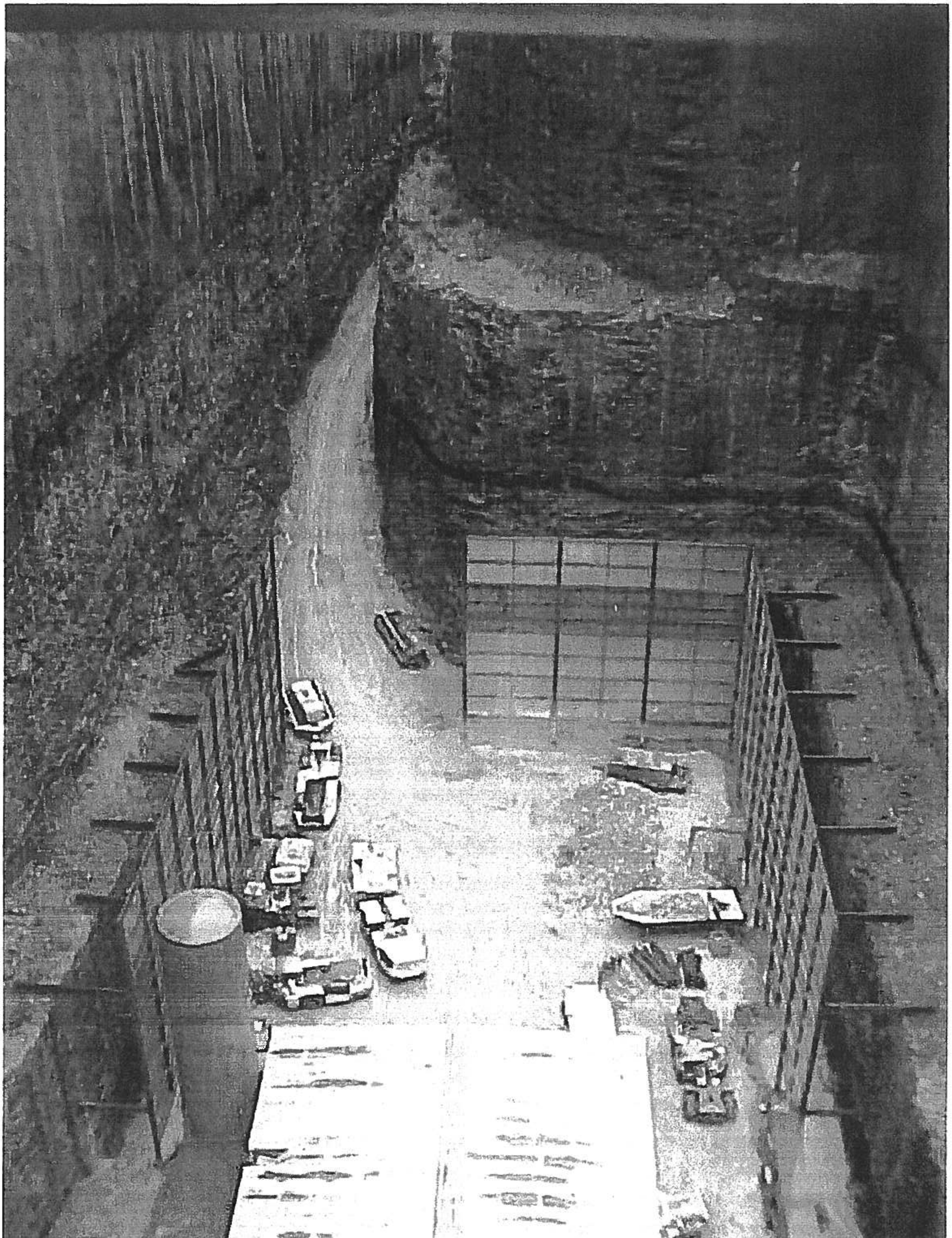
Alma No. 1 Mine

Fatal Investigation

January 19, 2006

Permit No.: U-5006-99

AB59-COMM-11-5



West Virginia Office of Miners' Health, Safety and Training

January 19, 2006

Conveyor Belt Fire/Double Fatality
Aracoma Coal Company, Inc.
Aracoma Alma No. 1
Permit No. U-5006-99

Region Three – Danville Office
137 Peach Court, Suite 2
Danville, West Virginia 25053
Harry Linville, Inspector-at-Large

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Alma No.1 Mine
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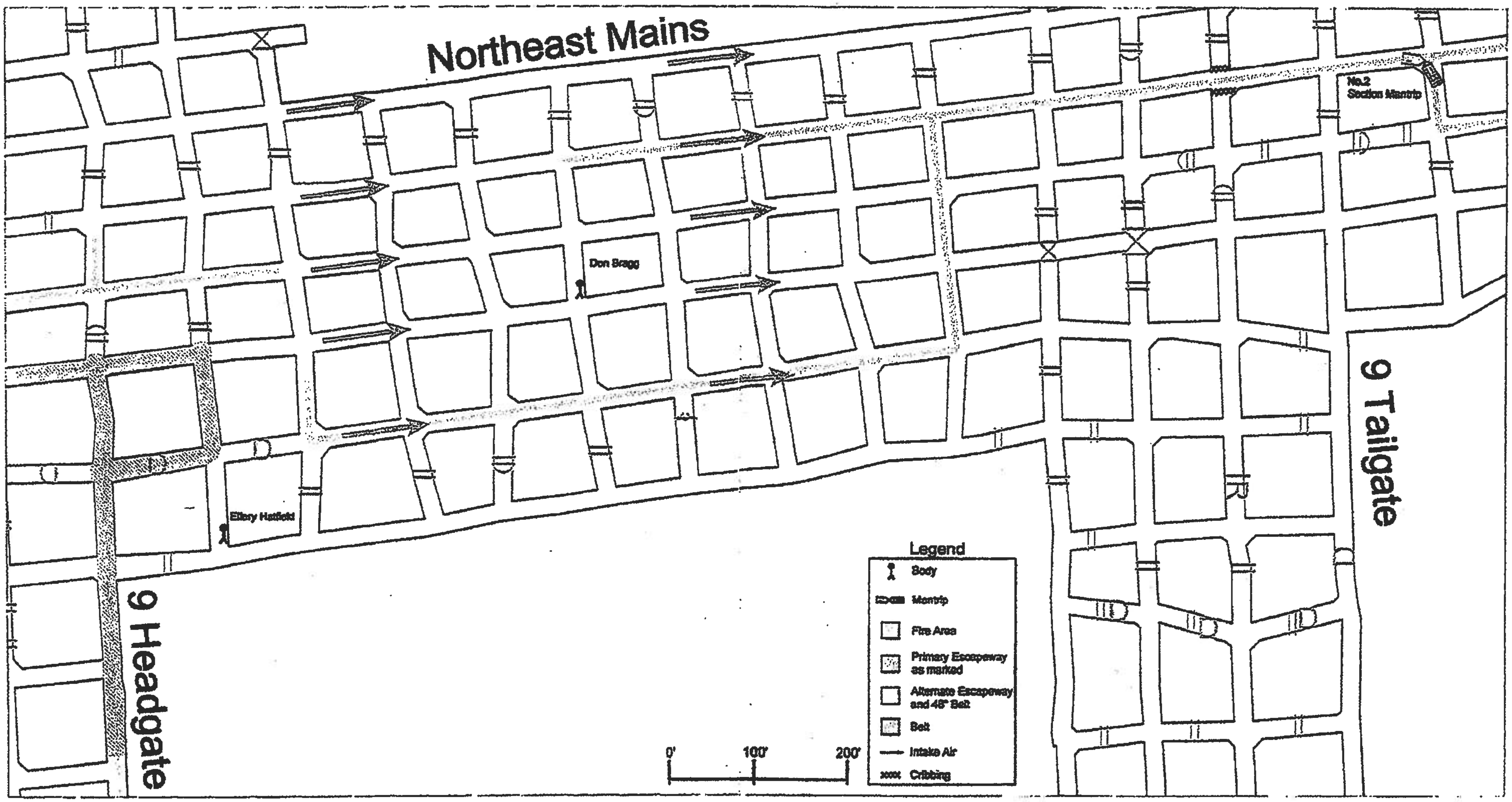


Conveyor Belt Fire/Double Fatality
Aracoma Coal Company, Inc.
Aracoma Alma No. 1
Permit No. U-5006-99

GENERAL INFORMATION

Aracoma Coal Company, Inc. was permitted to operate the Aracoma Alma No. 1 mine (Permit No. U-5006-99) on January 25, 2000. The mine employs 182 people on three shifts and utilizes Apollo Mine Services, Inc. (Permit No. C-3920) contractor employees to assist in manpower needs at the Aracoma Alma No. 1 mine (hereafter referred to as Alma No. 1). The mine utilizes swing shift rotation on two-week intervals for all production employees. Two underground continuous mining units, one longwall mining unit and one construction section are currently in operation. Coal is being mined in the Alma seam. Transportation of supplies and personnel to the continuous miner sections, longwall section and the construction section is by rubber-tired diesel-powered equipment. Track is utilized along the Rum Creek belts.

An underground conveyor belt fire occurred on January 19, 2006 at the Alma No. 1 mine located near Stollings in Logan County, West Virginia.

Mr. Don Israel Bragg and Mr. Ellery Elvis Hatfield, roof bolter operators on the active No. 2 section, were fatally injured when they became separated from their crew while attempting to evacuate from the No. 2 section. Both victims expired as a result of asphyxiation due to, or as a consequence of, an underground mine fire with suffocation and carbon monoxide intoxication. The men were recovered from the mine on January 21, 2006.

Mr. Don Israel Bragg, age 33, had been employed at the Alma No. 1 mine since January 5, 2004 and had approximately 9½ years total mining experience. Mr. Don Israel Bragg resided at Accoville, Logan County, West Virginia and is survived by his wife, Delorice.

Mr. Ellery Elvis Hatfield, age 46, had been employed at the Alma No. 1 mine since August 31, 2001 and had approximately 11½ years total mining experience. Mr. Ellery Elvis Hatfield resided near Simon, Wyoming County, West Virginia and is survived by his wife, Freda.

Mr. Don Israel Bragg and Mr. Ellery Elvis Hatfield received annual refresher training on January 14, 2006.

Mr. Eddie Lester, Vice President of Operations for Alma No. 1 mine, notified Mr. Richard Boggess, District Inspector for the Office of Miners' Health, Safety and Training, at approximately 7:33 p.m. on January 19, 2006 of the conveyor belt fire and that two miners were unaccounted for. A mine rescue/fire fighting operation was started immediately.

DESCRIPTION

The No. 2 Northeast Mains evening shift crew entered the Alma No. 1 mine on January 19, 2006 at their normal starting time of 2:30 p.m. under the direction of Section Foreman Mr. Michael Plumley. The No. 2 section crew included the following persons – Mr. Steve Hensley, Continuous Miner Operator; Mr. Billy Mayhorn, Continuous Miner Operator; Mr. Elmer Mayhorn, Roof Bolter Operator; Mr. Ellery Elvis Hatfield, Roof Bolter Operator; Mr. Don Israel


No. 2 Section Diesel Mantrip

Bragg, Roof Bolter Operator; Mr. Randall Crouse, Roof Bolter Operator; Mr. Michael Shull, Electrician; Mr. Joe Hunt, Shuttle Car Operator; Mr. Pat Kinser, Shuttle Car Operator; Mr. Gary Baisden, Shuttle Car Operator; Mr. Duane Vanover, Scoop Operator; and Mr. Michael Plumley, Section Foreman.

The crew entered the mine from the box cut portal on a Brookville 14-man, rubber-tired diesel mantrip (Serial No. 9059). They proceeded along their normal travel route to the No. 1 four-way through the airlock doors into the North Mains intake escapeway travelway, turning right along the North East Mains to the airlock doors at the No. 9 longwall headgate conveyor belt. The crew traveled through the outby set of doors under the No. 9 longwall conveyor belt to the inby set of doors where Mr. Carl White, Dayshift Belt Examiner, opened and shut the airlock doors, allowing the mantrip to enter the Northeast Mains intake escapeway travel way.

The No. 2 section crew proceeded from spad 3333 in the No. 8 entry of North East, traveling seven crosscuts then turning left traveling three crosscuts to the No. 5 entry, then turning right, traveling five crosscuts to spad 3546, turning right traveling one crosscut to spad 3547 in the No. 4 entry, then turning left traveling approximately twenty-three crosscuts (approx. 2325 ft.) to the mouth of the No. 2 section. This is the normal daily travel route from the box cut to the No. 2 section.

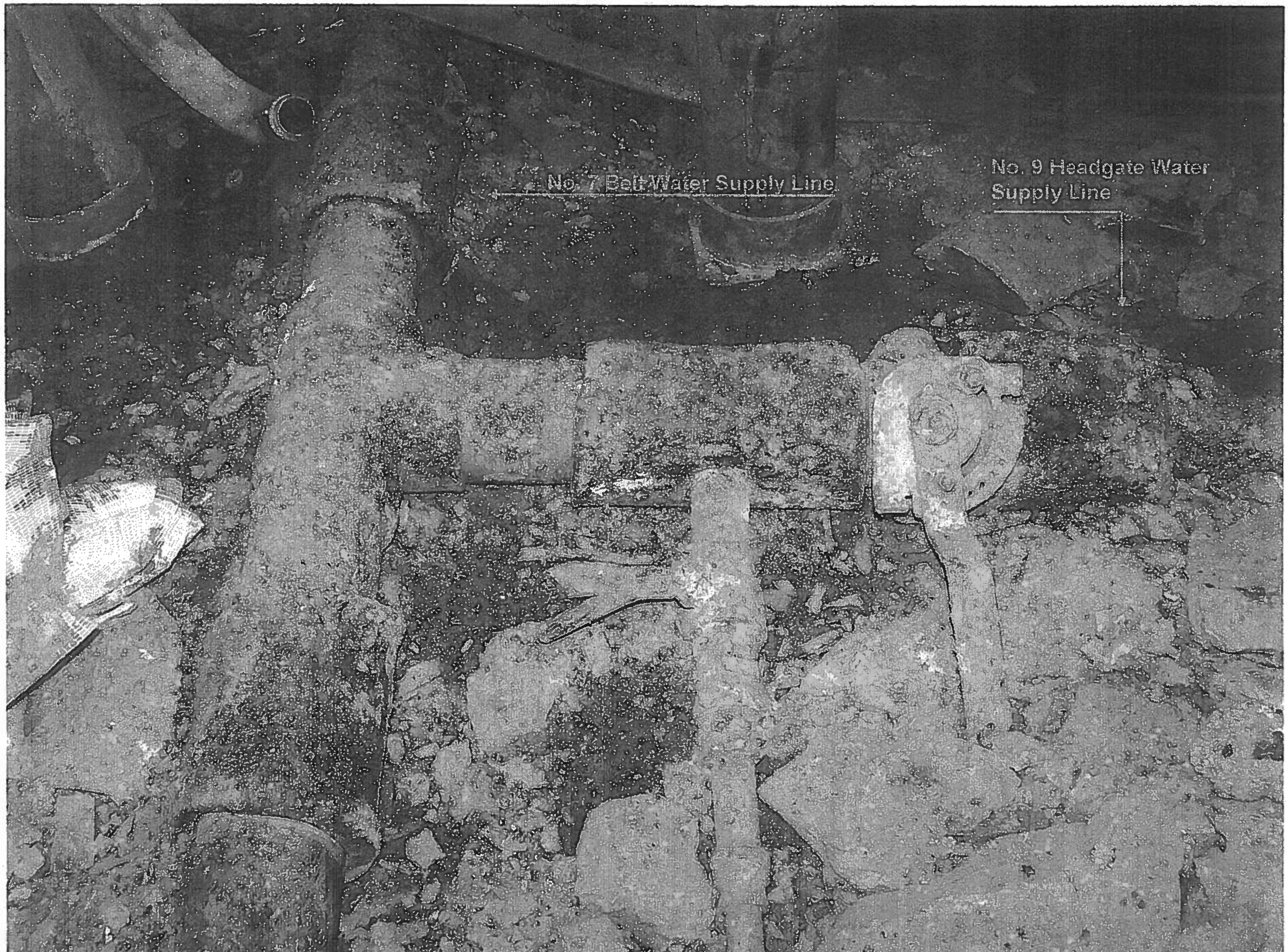
Upon arrival on the No. 2 section the evening shift crew met the dayshift crew along with Mr. Terry Shadd (No. 2 Section Mine Foreman/Superintendent) at the mantrip staging area. The dayshift crew had just finished rock dusting the section. While waiting for the rock dust to clear the face areas, a brief meeting was held with both crews concerning a new proposed work schedule. The discussion of the proposed work schedule lasted approximately ten to fifteen minutes.

At the conclusion of the meeting, the dayshift coal crew exited the mine without delay and did not notice anything unusual during their travel out of the mine. The evening shift coal crew proceeded to their assigned duties.

The No. 2 section utilizes split ventilation with four working faces. The No. 3 entry is intake. Two remote control continuous miners, three shuttle cars, two roof bolting machines and two battery-operated scoops are utilized on this section.

Mr. Steve Hensley, Continuous Miner Operator, completed a partial scrap cut in the No. 1 face. Mr. Steve Hensley then trammed the continuous miner to the No. 2 entry and mined 2 break right through into the No. 3 entry. Upon completing 2 break right, Mr. Steve Hensley trammed the continuous miner down the No. 2 entry and was waiting on the roof bolt crew. Section Foreman Mr. Michael Plumley mined 3 break right. Continuous Miner Operator Mr. Billy Mayhorn and Shuttle Car Operator Mr. Gary Baisden at the start of the shift had been instructed to get a scoop and a load of crib blocks and set some cribs at an area at the mouth of the No. 2 section.

Mr. Carl White, Dayshift Belt Examiner, was stationed at the No. 9 headgate longwall mother drive on January 19, 2006 to watch over the No. 9 headgate longwall belt. The No. 9 longwall belt shut down several times during his shift. Mr. Carl White said he could see a hazy mist around the mother drive and storage unit but could not find any problems. He checked drive motors and bearing temperatures with a heat temperature gun and found no problems. Mr. Dustin Dotson, Mine Foreman, arrived at the No. 9 headgate and briefly talked with Mr. Carl White. Mr. Dustin Dotson then proceeded to the belt starter box, opened a door on the box and


No. 7 Belt Water Supply Line
No. 9 Headgate Water Supply Line


valve for
Drive

shortly thereafter left the area. The belt continued to run uninterrupted the remainder of the day shift.

At the end of Mr. Carl White's shift, he was still concerned with the condition at the longwall belt. Therefore, he contacted Mr. Bryan Cabell, Evening Shift Belt Examiner/Fireboss, who was located at the No. 7 belt head and asked him to report to the No. 9 headgate longwall belt as soon as possible. Mr. Carl White then traveled outby, down the No. 9 headgate longwall belt and met with the longwall dayshift crew and proceeded to the surface. They arrived on the surface at approximately 4:00 p.m.

Mr. Bryan Cabell, Belt Examiner/Fireboss, stated that a carriage was wrecked in the mother drive storage unit causing a misalignment of the beltline and allowing the belt to rub a bearing. Mr. Bryan Cabell unsuccessfully tried to train the beltline and align the carriage unit. Mr. Bryan Cabell called Mr. Fred Horton, Evening Shift Mine Foreman, to inform him of the belt condition and to request chain ratchets. Mr. Bryan Cabell was at the No. 9 headgate mother drive unit when the fire started.

The evening shift longwall crew, under the direction of Mr. David R. Runyon, arrived at the No. 9 longwall section at approximately 3:50 p.m. When the crew arrived the No. 9 longwall belt was off. The evening shift crew started the No. 9 longwall belt to clear the face chain so slack could be removed from the chain. Also at this time two setups of belt structure were removed.

According to Mr. Gary Richardson, Longwall Headgate Operator, the second shift started producing coal at 4:25 p.m. The conveyor belt ran uninterrupted until 5:05 p.m. Mr. Gary Richardson, when calling about the belt conveyor, was told by Mr. Bryan Cabell that he had shut the belt conveyor down due to smoke and would get it running again as soon as possible.

At this time, Mr. Pat Calloway and Mr. Jonah Rose arrived on the scene on the No. 714 Wallace 5-man diesel powered, rubber-tired vehicle, parking it in the main travel way that crosses under the mother drive beltline. An attempt was made by Mr. Pat Calloway to move the No. 714 diesel mantrip. The mantrip would not start and was completely destroyed in the fire. Mr. Bryan Cabell received a fire extinguisher from Mr. Pat Calloway and proceeded to fight the fire, Mr. Jonah Rose gathered additional fire extinguishers. At least three fire extinguishers were discharged on the fire with no success. Mr. Bryan Cabell stated that he attempted to attach a fire hose to the fire valve at the storage unit but was unsuccessful because the fire hose and fire valve fittings were incompatible.

Mr. Bryan Cabell then attempted to open the fire valve and direct water onto the fire area but no water was present in the water supply line. Mr. Bryan Cabell instructed Mr. Pat Calloway to check the water supply line to determine why no water was being supplied and to correct the problem. Mr. Bryan Cabell then tried to locate the cutoff valve for the yellow two-inch water supply line by traveling along the No. 7 belt toward the No. 9 longwall belthead. He was unable to get within 75 feet of the discharge roller where the cut off valve is located due to heavy black smoke. The fire was burning out of control and no means was available to fight the fire.

Mr. Jonah Rose was left at the outby set of double airlock doors to look and listen for miners retreating from the No. 2 section.

Mr. Gary Richardson, Longwall Headgate Operator, was listening on the mine phone and heard someone tell the dispatcher, Mr. Gary (Mike) Brown, to contact the No. 2 section and have them come off the section and tell the longwall crew if they encountered smoke to get into the

intake and come off the section. He also heard conversation between Mr. Bryan Cabell and Mr. Fred Horton concerning the fire at the mother drive.

At approximately 5:55 p.m. Mr. Gary Richardson attempted to call out his two-hour report when he discovered that the mine phone was inoperative. After he updated the longwall crew, the Section Foreman Mr. David R. Runyon and Chief Electrician Mr. Jamie Adkins, decided to go see what was going on. Approximately ten minutes after they left, the longwall section lost power. It was at this time that the longwall crew took it upon themselves to evacuate. They traveled off the No. 9 headgate longwall section through the cut through into the North Mains primary intake escapeway.

After several unsuccessful attempts to contact the section by mine phone, Mr. Gary (Mike) Brown, Dispatcher, who is located on the surface, shut down the No. 2 section conveyor belts at approximately 5:39 p.m. to get the attention of someone on the crew. Shortly thereafter, Section Foreman Mr. Michael Plumley called outside to see why his belt was not running when Dispatcher Mr. Gary (Mike) Brown and Shift Foreman Mr. Fred Horton notified Mr. Michael Plumley of a fire and for him to assemble his crew and leave the section.

Section Foreman Mr. Michael Plumley then instructed the crew to meet at the mantrip. A headcount of the crew was conducted and the crew proceeded to exit the mine, not knowing the extent or seriousness of the fire.

Mr. Steve Hensley, Mantrip Operator, stopped the mantrip and picked up Mr. Billy Mayhorn and Mr. Gary Baisden at spad 4177. The No. 2 section coal crew proceeded out their normal travel route down the No. 5 entry to spad 3547, turning right and traveling through the crosscut to the No. 4 entry at spad 3546.

The No. 2 section coal crew encountered a burning smell during their travel in the No. 5 entry at the mouth of the No. 10 headgate construction work site and shortly thereafter could actually see light smoke. As the crew proceeded along the No. 5 entry roadway, some crew members pulled their shirts up over their mouths and noses to help with breathing.

When Mr. Steve Hensley, Mantrip Operator, turned left into the No. 4 entry at spad 3546, the crew encountered a wall of thick black smoke that traveled up the primary intake escapeway toward the No. 2 section as a result of a missing ventilation control at the No. 7 conveyor belt tailpiece. Mr. Steve Hensley immediately stopped the mantrip and informed the crew he could not see to go any farther.

At this point, a panic situation occurred. A decision was made to go through the mandoor located three crosscuts outby spad 3546, which was installed by members of the No. 2 section coal crew approximately three weeks prior to the fire. The No. 2 section crew was familiar with this area and stopped at this location to allow Section Foreman Mr. Michael Plumley to fireboss the seal. Physical evidence (self-rescuer tops and bottoms) indicated that the No. 2 section coal crew traveled outby the manbus approximately one or two crosscuts before donning their self-rescuer devices.

The coal crew felt their way along the coal ribs for approximately three crosscuts in heavy, dense black smoke with zero visibility.

When the crew entered through the mandoor into the 48-inch belt secondary escapeway, the air was clear. Once the crew entered into the belt entry, Section Foreman Mr. Michael Plumley conducted a headcount and, at this time, the crew realized that Mr. Don Israel Bragg and Mr. Ellery Elvis Hatfield were missing.

Section Foreman Mr. Michael Plumley, Mr. Steve Hensley and Mr. Billy Mayhorn traveled back through the mandoor and into the smoke filled No. 4 entry roadway, trying to locate Mr. Don Israel Bragg and Mr. Ellery Elvis Hatfield. They traveled outby and inby for a short distance, shouting for the missing miners. They soon retreated due to thick heavy smoke and after receiving no response from the missing miners.

The No.2 section crew regrouped and proceeded down the 48-inch belt secondary escapeway toward the mouth of Northeast Mains outby the No. 9 headgate mother drive belt. The No. 2 section crew stated that the air was clear on the 48-inch belt and that some of the crew had removed their mouthpieces but kept their rescuers on. The No. 2 section crew exited the secondary escapeway into North Mains primary intake escapeway through mandoors at spads 2859 and 2866 where they were met by Mr. Bryan Cabell, Evening Shift Belt Examiner, and Mr. Pat Calloway, Foreman

A headcount was taken and Mr. Pat Calloway instructed the crew to stay together. Mr. Bryan Cabell and Mr. Pat Calloway were informed by the No. 2 section crew at this time that two of the crew members were unaccounted for. The No. 2 section crew and longwall crew met at the mouth of the cut through in the North Mains primary intake escapeway.

Section Foreman Mr. Michael Plumley, Mr. Steve Hensley and Mr. Joe Hunt attempted to travel back up the 48-inch belt secondary escapeway to try and locate Mr. Don Israel Bragg and Mr. Ellery Elvis Hatfield but were stopped due to smoke entering the belt escapeway at the area of No. 9 headgate mother drive.

Mr. Fred Horton, Evening Shift Mine Foreman, and Mr. Billy Hall, Evening Shift Maintenance Chief, arrived and instructed Mr. Pat Calloway to stay with the No. 2 section crew and to keep everybody together. Mr. Raymond Grimmett, Grader Operator, arrived at the top of the hill and was instructed by Mr. Pat Calloway to park the grader in a crosscut and stay with the No. 2 section crew.

Mr. Fred Horton and Mr. Billy Hall traveled through the cut through and up the No. 9 headgate longwall belt to determine if the fire could be accessed from this location, but because of heavy smoke roll back they had to retreat.

Mr. Dustin Dotson, Mr. Terry Shadd, Mr. Bob Massey and other company officials arrived and were informed of the two missing crew members and the severity of the fire.

A decision was made to travel back to the longwall face to retrieve extra rescuers and line curtain. They cut the No. 9 longwall belt inby the cut through and removed the belt structure. Ventilation controls were installed in an attempt to remove air from the fire. Members of the No. 2 section crew and the longwall crew assisted with this work.

After ventilation controls were installed, Mr. Fred Horton, Evening Shift Mine Foreman, directed Mr. Pat Calloway and Mr. Michael Plumley to take all of the hourly employees to the surface. A headcount was taken and they proceeded to the surface on two diesel rubber-tired mantrips, arriving on the surface at approximately 8:00 p.m.

The following persons remained in the mine and attempted unsuccessfully to locate the missing miners: Mr. Dwayne Francisco, Mr. Fred Horton, Mr. Chris Adkins, Mr. Peppy Lester, Mr. Terry Shadd, Mr. Bob Massey, Mr. Edward Ellis, Mr. Dustin Dotson, Mr. Rodney Morrison, Mr. Billy Hall, Mr. David R. Runyon, and Mr. Gary Goff.

Mine rescue teams had arrived at the mine therefore, a decision was made to bring all persons to the surface. At approximately 10:30 p.m., all non-mine rescue personnel had been removed from the mine.

FINDINGS OF FACT

1. The Aracoma Coal Company's Alma No. 1 Mine is ventilated by three main fans, one blowing and two exhaust.
2. On January 19, 2006 one hundred fifty-seven (157) persons reported for work at the Alma No. 1 Mine, one hundred twenty-five (125) employees and thirty-two (32) contractor employees.
3. This mine utilizes one longwall mining section and two continuous miner sections for coal production.
4. Mine transportation recently switched from a battery operated track system to rubber-tired diesel equipment.
5. CSE SR-100 self-rescuer devices are utilized at this mine.
6. The No. 9 headgate longwall section was utilizing the tailgate blockage plan on January 19, 2006 as a result of a roof fall.
7. The No. 3 continuous miner section was idle on the evening shift on January 19, 2006.
8. An accurate map of the mine was not provided on January 19, 2006.
9. The fire hose outlets provided at the mother drive storage unit area for the No. 9 longwall belt could not be utilized because the shut-off valve for the water supply for the fire hose outlets was found in the closed position.
10. The water sprinkler fire suppression system installed on the No. 9 headgate longwall belt conveyor drive area could not activate in the event of a fire or a rise in temperature because the water supply valve was found in the closed position.
11. The air direction on the longwall belt was not traveling in the proper direction in that air was traveling outby toward the discharge instead of inby toward the longwall working sections.
12. The No. 2 section was utilizing air that ventilated the No. 2 section 48-inch belt conveyor as a supplement to face ventilation. No device was provided on the section to alert persons of rising carbon monoxide levels.
13. The No. 9 headgate mother belt storage unit was not properly maintained thus allowing the belt to run out of alignment.
14. Ventilation controls were missing, allowing smoke to enter the primary intake escape-way for the No. 2 section.
15. Nine subpoenas were issued during this investigation.
16. Eighty-three (83) interviews were conducted.

CONCLUSION

Mr. Don Israel Bragg, age 33, and Mr. Ellery Elvis Hatfield, age 46, were fatally injured when they became separated from their crew after encountering thick black smoke in their primary intake escapeway while attempting to evacuate from the No. 2 section during a conveyor belt fire at the No. 9 headgate mother drive. Both expired as a result of asphyxiation due to or as a consequence of an underground mine fire with suffocation and carbon monoxide intoxication.

ENFORCEMENT ACTION

During the course of this extended investigation, several inspections were conducted. A total of one hundred and sixty-eight (168) notices of violations were issued. Seven (7) of the violations were determined to have contributed to the occurrence of this accident. Sixteen (16) individual personal assessments were also issued. Seven (7) recommendations for withdrawal or suspension of certifications were issued.

The Office of Miners' Health, Safety & Training issued a control order under Chapter 22A, Article 2, Section 68. The order was issued at 8:45 p.m. on January 19, 2006 to preserve the accident scene and was terminated at 12:50 p.m. on July 17, 2006.

The following is a list of the contributing violations:

(V-1) Title 36, Series 6, Section 4 4.1(j): Based on testimony and evidence received during an investigation following a fatal mine fire, the approved longwall mining plan was not being complied with on the No. 9 longwall headgate section in that the mother drive beltline ventilating air current that is normally used to supplement the intake air current to the longwall face was traveling in the opposite direction. The ventilating air current that is required to travel toward the longwall face along the beltline was reversed, resulting in the air current traveling toward the mother drive head.

(V-2) Chapter 22A, Article 2, Section 58 (d)(1): Based upon testimony received and evidence obtained during an investigation of a fatal mine fire that occurred on January 19, 2006, it has been determined that no water was available at the fire hose outlets on the mother drive belt for the No. 9 headgate longwall section. The fire hose outlet valve on the two-inch supply waterline at the fire location was opened and no water was available. The main cutoff valve for the two-inch water supply line for the longwall belt was found in the closed position. The cutoff valve is located near the longwall belt discharge roller.

(V-3) Chapter 22A, Article 2, Section 58 (f): Based on testimony and evidence obtained during a fatal mine fire investigation, it was determined that a fire hose with fittings suitable for connection with each belt conveyor waterline system was not provided at or near the No. 9 headgate longwall belt drive and take-up area. The connector on the fire hose provided was too large in diameter for the fire hose outlet and could not be attached to allow water to be used to fight a mine fire. Additionally, the same problem existed on the No. 9 headgate longwall belt on December 23, 2005 according to testimony provided by Brandon Conley, a smoldering fire occurred December 23, 2005 and he could not get the fire hose to connect to the water hose outlet. He stated this condition was reported to management at that time.

(V-4) Chapter 22A, Article 2, Section 60(b): Based on testimony and evidence obtained during a fatal mine fire investigation, a separate and distinct intake air escapeway is not provided from the active North East Mains No. 2 Section to the surface. Required ventilation controls were not provided at the No. 7 belt tailpiece area. This condition allowed heavy black smoke to enter the primary intake escapeway following a belt fire that occurred on January 19, 2006.

(V-5) Chapter 22A, Article 2, Section 37(o): According to testimony and evidence received during a mine fire/fatal investigation, the No. 9 headgate mother drive conveyor belt was not maintained in a safe operating condition. The storage unit drop-off carriage system contained damaged, missing or improperly installed components, which caused the drop-off carriages to improperly unlatch. This condition contributed to the belt running out of alignment causing a fire at the storage unit area.

(V-6) Chapter 22A, Article 2, Section 39(j): Based on evidence obtained and testimony received during a fatal mine fire investigation, it was determined that the water sprinkler system designed to be automatically activated in the event of a fire or rise in temperature failed to activate on the No. 9 headgate longwall belt drive on January 19, 2006. The water supply valve for the fire suppression system was found in the off position.

(V-7) Chapter 22A, Article 2, Section 17: Based upon testimony and evidence obtained through a fatal mine fire investigation, it has been determined that a belt fire occurred at the mother drive area of the No 9 headgate longwall belt on January 19, 2006 at approximately 5:00 p.m. and all persons whose safety was endangered were not promptly notified to remain clear of the area where the dangerous condition existed. The No. 2 section crew was not notified until approximately 5:40 p.m. The crew traveled down their intake escapeway and travel way leading straight to the fire where they encountered heavy black smoke. Two of the crew members became separated from the crew and eventually succumbed while trying to escape.

RECOMMENDATIONS OF

ARACOMA COAL COMPANY, INC.
P.O. BOX 1120
HOLDEN, WV 25625
304-752-6194

Aracoma Coal Company, Inc. is committed to the safety of its employees and everyone on its property. Notwithstanding this commitment to safety, on January 19, 2006, the Alma Mine, MSHA Id. No. 46-08801 and State Id. U-5006-99, suffered a fatal accident when two members died as a result of a fire at the mine.

Aracoma continues to investigate this matter and while its investigation is not concluded, the Company can, with its preliminary findings, make the following proposals. To prevent a re-occurrence of this accident, Aracoma has undertaken the following remedial measures, some of which are beyond state and federal mine safety requirements:

1. The mine has checked and repaired all stoppings along beltlines in the Alma Mine. Further, all belt examiners and other examiners have been re-instructed to check stoppings during their exams, and to further work with the mine foreman to make any changes necessary to make the 75.1200 map reflect the situation of all ventilation controls.

2. The mine has checked all fire fighting nozzles, lines, and hoses and ensured they are in proper working order.

3. The mine has installed a new custom designed sprinkler system on the belt head and belt storage unit for the longwall mother belt.

4. The mine has conducted a thorough inspection of the belt system to ensure it is in proper working order. Further, belt examiners and electricians have been re-instructed on belt maintenance.

5. The mine has re-instructed all members on the requirements of the Emergency Evacuation and Fire Fighting Plan and taken steps to ensure that the immediate withdrawal of all inby personnel takes place when a fire occurs. Specifically, the contents of the Emergency Evacuation and Fire Fighting Plan have been discussed with members and it has been the subject of weekly safety talks. Further, the mine has conducted emergency evacuation drills for all members, including the walking of escapeways. All new hires walk the escapeways for their work area when they are hired.

These items will be incorporated into the mine's West Virginia Comprehensive Safety Program. All members have been retrained on these provisions.

Sid Young
President, Aracoma Coal Company
July 14, 2006

Comprehensive Mine Safety Program

Modifications as required by WVOMHS&T

The following changes are required in the Comprehensive Mine Safety Program due to a fatal accident on January 19, 2006.

1. Management shall provide training, at a minimum of eight hours, for all persons who are required to conduct mandatory fireboss examinations as required by law. This training shall include all persons conducting the required examinations, as well as others who may by used in that capacity even if on an infrequent basis. The content of this training will be approved by the WVOMHS&T prior to the training being conducted. A representative of the WVOMHS&T will be present during this training.
2. Deluge type water sprays, water sprinklers, dry chemical sprinkler systems or foam generators (designed to be automatically activated in the event of a fire or rise in the temperature) shall be installed at each main and secondary belt drive, take-up and storage unit system installed underground. This mine shall also

comply with all provision of 30 CFR from the Federal Register, pertaining to fire protection along beltlines.

3. The mine's emergency response plan shall include a means to assure that adequate water is available for fire fighting purposes at all times, particularly during times of power outages.
4. On all sprinkler-type fire suppression systems, a water pressure gauge will be installed at or near the end of the water line and in a position that the gauge can be readily seen. The belt examiner shall note and record the pressure reading when making his examination.
5. Mine management will designate a competent individual at the mine to be responsible for reviewing and counter signing the electrical examination books to assure that all required equipment is being properly examined.
6. Mine management will train all mine personnel in the response requirements of the Co monitoring system. Also, all new employees, contractors, vendors, etc., will be trained on this same system prior to entering the mine.
7. The Emergency Evacuation and Fire Fighting Plan as required by 30 CFR 75.1502 from the Federal Register shall be incorporated into the Comprehensive Mine Safety Program.
8. All belt storage units for the longwall belts will be examined by a representative of the manufacturing company for proper installation prior to the belts being placed in operation.
9. A checklist will be developed to determine exactly what items are to be checked to satisfy the monthly examination of fire suppression equipment on belt lines.
10. A functional examination of all belt fire-fighting equipment will be conducted every 6 months. This examination will require opening fire valves, assuring fire hose will couple to fire hose, fire hose and fire outlets are compatible, fire nozzles are compatible with fire hose and visually check fire extinguishers. A written record of this examination will be maintained at the mine.
11. Main water lines used to deliver water for fire fighting purposes shall not be located in the same entry at conveyor belt drives, take-ups and storage units.

APPENDIX

- Mine Information Sheet
- Victim Information Sheets
- Persons Present During Investigation
- Attachments A, B, C, D, E & F

MINE INFORMATION

COMPANY Aracoma Coal Company, Inc.

MINE NAME Aracoma Alma No. 1

WV PERMIT U-5006-99 MSHA PERMIT NO. 46-08801

ADDRESS P. O. Box 1120 Holden, WV 25625

COUNTY Logan PHONE NO. 304-752-6195

DATE PERMIT ISSUED January 25, 2000

WORKING STATUS Active

LOCATION Rt. 17 and Airport Road at Stollings, WV

UNION ______ NON-UNION X

DAILY PRODUCTION 1569 tons ANNUAL PRODUCTION TO DATE 25,112 tons

TOTAL EMPLOYEES 180

NUMBER OF SHIFTS 3

COAL SEAM NAME AND THICKNESS Alma – 42 inches to 68 inches

ACCIDENT INCIDENT RATE 10.44 LOST TIME ACCIDENTS 2

TYPE OF HAULAGE Belt

WVOMHST INSPECTOR Richard Boggess

DATE OF LAST INSPECTION January 19, 2006

NOTIFIED BY Eddie Lester

NOTIFICATION TIME 7:33 p.m. January 19, 2006

CMSP – ANNIVERSARY DATE February 7, 2006

CMSP – CONTACT PERSON Charles Conn

INVESTIGATION

The following persons were present for the initial onsite investigation conducted on January 31, 2006.

ARACOMA COAL COMPANY, INC.

Drexel Short	Senior Vice President, Group Operations
Frank Foster	Corporate Safety Coordinator
Keith Hainer	Manager of Maintenance
Robert Ellis	Chief of Maintenance (Aracoma Alma No. 1)
Bill Stapleton	Mine Engineer
Chad Evans	Diesel Tractor Operator

MINE SAFETY AND HEALTH ADMINISTRATION

Bill Corroco	Accident Investigation Program Manager
Kenny Murray	Accident Investigator - Leader
Anthony Webb	Investigator
Dennis A. Beiter	Technical Support

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Willie Barker	Safety Instructor

INTERVIEWS
(* Denotes those interviewed)

The following persons were present during interviews conducted on February 8, 2006.

ARACOMA COAL COMPANY, INC.

Randall Crouse *	Roof Bolter Operator
Steve Hensley *	Continuous Miner Operator
Patrick W. Kinser *	Shuttle Car Operator
H. Michael Shull *	Electrician
Mark E. Heath	Attorney

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader

Michael Finnie	Investigator
Ronald W. Stahlhut	Investigator
Charles W. Pogue	Investigator
Arlie A. Webb	Investigator
Anthony J. Burke	Investigator
Dennis A. Beiter	Technical Support
William J. Francart	Technical Support
Derrick Tjernlund	Technical Support
Rodney Brown	Inspector
Daniel M. Barish	Solicitor – U. S. Dept. of Labor
Keith A. Bell	Solicitor – U. S. Dept. of Labor
Marne Mitskog	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
Terry Farley	Health and Safety Administrator
William Tucker	Investigator
Eugene White	Investigator
Steve Cox	Investigator
Timothy Bradford	Attorney

The following persons were present during the interviews conducted on February 9, 2006.

ARACOMA COAL COMPANY, INC.

Joseph F. Hunt *	Shuttle Car Operator
Thomas D. Vanover *	Scoop Operator
Brandon U. Conley *	Beltman
Candice Conley	B. Conley's Representative
Mark E. Heath	Attorney

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader
Michael Finnie	Investigator
Ronald W. Stahlhut	Investigator
Charles W. Pogue	Investigator
Arlie A. Webb	Investigator
Anthony J. Burke	Investigator
Dennis A. Beiter	Technical Support
William J. Francart	Technical Support
Derrick Tjernlund	Technical Support
Jeffrey Waggett	Technical Support
Rodney Brown	Inspector

Daniel M. Barish	Solicitor – U. S. Dept. of Labor
Keith A. Bell	Solicitor – U. S. Dept. of Labor
Marne Mitskog	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
Terry Farley	Health and Safety Administrator
William Tucker	Investigator
Eugene White	Investigator
Steve Cox	Investigator
Timothy Bradford	Attorney

The following persons were present during the interviews conducted on February 10, 2006.

ARACOMA COAL COMPANY, INC.

Elmer "Blue" Mayhorn *	Roof Bolter Operator
Billy Mayhorn*	Continuous Miner Operator
Brian Cabell *	Belt Examiner
David J. Hardy	Attorney

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader
Anthony J. Burke	Investigator
Charles W. Pogue	Investigator
Ron Stahlhut	Investigator
Arlie A. Webb	Investigator
Dennis A. Beiter	Technical Support
William Francart	Technical Support
Derrick Tjernlund	Technical Support
Daniel M. Barish	Solicitor – U. S. Dept. Labor
Keith A. Bell	Solicitor – U. S. Dept. Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
Terry Farley	Health and Safety Administrator
William Tucker	Investigator
Eugene White	Investigator
Steve Cox	Investigator
Danny Cook	Investigator

The following persons were present during the interviews conducted on February 16, 2006.

ARACOMA COAL COMPANY, INC.

Patrick Calloway *	Section Foreman
David J. Hardy	Attorney

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader
Anthony Burke	Investigator
Arlie A. Webb	Investigator
Dennis A. Beiter	Technical Support
William J. Francart	Technical Support
Jeffrey Waggett	Technical Support
Daniel M. Barish	Solicitor – U. S. Dept. of Labor
Keith Bell	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Steve Cox	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on February 23, 2006.

ARACOMA COAL COMPANY, INC.

Gary Richardson *	Longwall Head Gate Operator
Kirby Puett *	Day Shift Dispatcher
Gary D. Baisden *	Shuttle Car Operator
David J. Hardy	Attorney
Mark E. Heath	Attorney

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader
Anthony Burke	Investigator
Ronald Stahlhut	Investigator
Charles Pogue	Investigator
Arlie A. Webb	Investigator
Michael Finnie	Technical Support
Dennis A. Beiter	Technical Support

William Francart	Technical Support
Derrick Tjernlund	Technical Support
Daniel M. Barish	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Steve Cox	Investigator
J. Davitt McAteer	Representative – Governor's Office
Beth Spence	Representative – Governor's Office

The following persons were present during interviews conducted on February 24, 2006.

ARACOMA COAL COMPANY, INC.

Jonah Rose *	Roof bolter Operator
Gary (Mike) Brown *	Dispatcher, Second Shift
Mike Plumley *	Section Foreman, Second Shift
Michael M. Fisher	Attorney
Mark Heath	Attorney

MINE SAFETY AND HEALTH ADMINISTRAION

Kenny Murray	Accident Investigator – Leader
Arlie A. Webb	Investigator
Ronald W. Stahlhut	Investigator
Charles W. Pogue	Investigator
Anthony Burke	Investigator
Michael Finnie	Investigator
William J. Francart	Technical Support
Dennis A. Beiter	Technical Support
Derrick Tjernlund	Technical Support
Jeffrey Waggett	Technical Support
Daniel M. Barish	Solicitor – U. S. Dept of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Steve Cox	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on February 28, 2006.

ARACOMA COAL COMPANY, INC.

Jesse J. Jude II *	Electrician
Timothy Dingess *	Electrician
James L. B. Shelton *	Dispatcher
David J. Hardy	Attorney
Jennifer Shelton	J. Shelton's Representative

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader
Arlie A. Webb	Investigator
Anthony Burke	Investigator
Michael Finnie	Investigator
Ronald W. Stahlhut	Investigator
William J. Francart	Technical Support
Dennis A. Beiter	Technical Support
Daniel M. Barish	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Danny Cook	Investigator
Steve Cox	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on March 2, 2006.

ARACOMA COAL COMPANY, INC.

Darrick Vannatter *	Longwall Move Crew
Larry Browning *	Longwall Head Gate Operator
Wyatt Robinson, Jr. *	Beltman
David J. Hardy	Attorney
Rebecca Robinson	W. Robinson, Jr.'s Representative

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader
Ronald W. Stahlhut	Investigator
Michael Finnie	Investigator

Charles Pogue	Investigator
Anthony Burke	Investigator
Arlie A. Webb	Investigator
William J. Francart	Technical Support
Dennis A. Beiter	Technical Support
Derrick Tjernlund	Technical Support
Jeffrey Waggett	Technical Support
Daniel M. Barish	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Danny Cook	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on March 3, 2006.

ARACOMA COAL COMPANY, INC.

Shane Stanley *	Dispatcher
Bucky D. Harvey *	Longwall Headgate Operator
David J. Hardy	Attorney

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader
Anthony Burke	Investigator
Ronald W. Stahlhut	Investigator
Charles Pogue	Investigator
Michael Finnie	Investigator
Arlie A. Webb	Investigator
Derrick Tjernlund	Technical Support
Daniel M. Barish	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Danny Cook	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on March 6, 2006.

ARACOMA COAL COMPANY, INC.

Carl White *	Beltman
David J. Hardy	Attorney

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader
Ronald W. Stahlhut	Investigator
Michael Finnie	Investigator
Charles Pogue	Investigator
Anthony Burke	Investigator
Arlie A. Webb	Investigator
William J. Francart	Technical Support
Dennie A. Beiter	Technical Support
Derrick Tjernlund	Technical Support
Keith Bell	Solicitor – U. S. Dept of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Steve Cox	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on March 7, 2006.

ARACOMA COAL COMPANY, INC.

Nicholas D. Baisden *	Construction Crew
Joshua W. F. Noe *	Roof bolter Operator
Steve A. Marcum *	Electrician
David J. Hardy	Attorney

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader
Ronald W. Stahlhut	Investigator
Michael Finnie	Investigator
Anthony Burke	Investigator
Arlie A. Webb	Investigator
William J. Francart	Technical Support

Dennis A. Beiter	Technical Support
Derrick Tjernlund	Technical Support
Keith Bell	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
John Kinder	Investigator
Steve Cox	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on March 8, 2006.

MSHA MINE EMERGENCY TEAM

Ronald Hixson *	Team Member
Jan Lyall *	Team Member

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader
Anthony Burke	Investigator
Ronald Stahlhut	Investigator
Charles Pogue	Investigator
Michael Finnie	Investigator
William J. Francart	Technical Support
Dennis A. Beiter	Technical Support
Keith Bell	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Steve Cox	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on March 9, 2006.

ARACOMA COAL COMPANY, INC.

Donald R. Hagy, Jr. *	Construction Crew Foreman

David J. Hardy	Attorney

PYOTT-BOONE ELECTRONICS, INC.

Joey A. Davis *	Computer Technician
Doug Kuhn	Sales/Engineering Director

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader
Michael Finnie	Investigator
Ronald W. Stahlhut	Investigator
Charles Pogue	Investigator
Arlie A. Webb	Investigator
Anthony Burke	Investigator
William J. Francart	Technical Support
Dennis A. Beiter	Technical Support
Keith Bell	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Danny Cook	Investigator
Eugene White	Investigator
Steve Cox	Investigator
Beth Spence	Representative – Governor's office

The following persons were present for the interviews conducted on March 14, 2006.

ARACOMA COAL COMPANY, INC.

Gary M. Brown *	Dispatcher
Brian Cabell *	Belt Examiner
Rod Morrison *	Longwall Superintendent
David J. Hardy	Attorney

LOGAN COUNTY MINE SERVICES

Roy S. Stepp *	Engineer

MINE SAFETY AND HEALTH ADMINISTRATION

Ron Stahlhut	Investigator
Michael Finnie	Investigator

Arlie A. Webb	Investigator
Anthony Burke	Investigator
Charles W. Pogue	Investigator
William J. Francart	Technical Support
Dennis A. Beiter	Technical Support
Keith Bell	Solicitor – U. S. Dept of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Steve Cox	Investigator
Monte Hieb	Chief Engineer
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on March 15, 2006.

ARACOMA COAL COMPANY, INC.

Jesse J. Jude II *	Electrician
Patrick Callaway *	Production Foreman
John McNeely *	Airway Walker
David J. Hardy	Attorney
Mark E. Heath	Attorney

SOUTHERN COALFIELD MINE RESCUE TEAM

C. Bradley Justice *	Team Member

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader
Arlie A. Webb	Investigator
Ronald W. Stahlhut	Investigator
Charles W. Pogue	Investigator
Anthony Burke	Investigator
Michael Finnie	Investigator
William J. Francart	Technical Support
Dennis A. Beiter	Technical Support
Keith Bell	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Danny Cook	Investigator
Steve Cox	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on March 16, 2006.

ARACOMA COAL COMPANY, INC.

Edward R. Ellis *	Assistant Longwall Coordinator
Raymond L. Grimmett *	Road Grader Operator
Gary L. Richardson *	Headgate Operator
Renee Grimmett	R. Grimmett's Representative

MINE SAFETY AND HEALTH ADMINISTRATION

Arlie A. Webb	Investigator
Anthony Burke	Investigator
Ronald Stahlhut	Investigator
Charlie Pogue	Investigator
Michael Finnie	Investigator
William J. Francart	Technical Support
Dennis A. Beiter	Technical Support
Derrick Tjernlund	Technical Support
Keith Bell	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Steve Cox	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on March 17, 2006.

PINNACLE MINING COMPANY

Richard Crockett *	Mine Rescue Team Member

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader
Arlie A. Webb	Investigator
Anthony Burke	Investigator
Charles Pogue	Investigator
Ronald Stahlhut	Investigator
Michael Finnie	Investigator
William J. Francart	Technical Support
Dennis A. Beiter	Technical Support
Keith Bell	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING MINE EMERGENCY TEAM

Clarence Dishman *	Mine Emergency Team Member

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Steve Cox	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on March 20, 2006.

MINE SAFETY AND HEALTH ADMINISTRATION MINE EMERGENCY TEAM

Franklin D. Thomas *	Mine Emergency Team Member

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader
Charlie Pogue	Investigator
Michael Finnie	Investigator
Ronald Stahlhut	Investigator
William J. Francart	Technical Support
Daniel M. Barish	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

Richard Boggess *	District Inspector
C. A. Phillips	Deputy Director

William Tucker	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on March 21, 2006.

ARACOMA COAL COMPANY, INC.

Charles E. Conn *	Massey Energy East Ky. Mine Rescue Captain
Mark E. Heath	Attorney

ELK RUN COAL COMPANY

Robert Asbury *	Mine Rescue Team Captain
Mark E. Heath	Attorney

MINE SAFETY AND HEALTH ADMINISTRATION MINE EMERGENCY TEAM

Mack Wright *	Mine Emergency Team Member

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator –Leader
Ronald L. Stahlhut	Investigator
Charles Pogue	Investigator
Anthony Burke	Investigator
William J. Francart	Technical Support
Derrick Tjernlund	Technical Support
Dennis A. Beiter	Technical Support
Daniel M. Barish	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on March 22, 2006.

ARACOMA COAL COMPANY, INC.

Brandon Lusk *	Roof Bolter Operator

CONSOLIDATION COAL COMPANY

James Kelly *	Consol of Kentucky Mine Rescue Captain
C. E. "Spike" Bane	Safety Director

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader
Charles Pogue	Investigator
Ronald Stahlhut	Investigator
William J. Francart	Technical Support
Dennis A. Beiter	Technical Support
Derrick Tjernlund	Technical Support
Daniel M. Barish	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING MINE EMERGENCY TEAM

John Scott *	Mine Emergency Team Member

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINNG

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Beth Spence	Representative – Governor's office
J. Davitt McAteer	Representative – Governor's office

The following persons were present during the interviews conducted on March23, 2006.

WHITE COUNTY COAL COMPANY

Michael Emery *	Alliance Coal Mine Rescue Team Captain
Phillip Kettinger	M. Emery's Representative

MINE SAFETY AND HEALTH ADMINISTRATION

Richard J. Kline *	Assistant District Manager
Vicki L. Mullins *	MSHA Specialist
Kenny Murray	Accident Investigator –Leader
Ronald W. Stahlhut	Investigator
Michael Finnie	Investigator
Jeffrey Waggett	Investigator
Charles Pogue	Investigator
William J. Francart	Technical Support
Dennis A. Beiter	Technical Support
Daniel M. Barish	Solicitor – U. S. Dept. of Labor

Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on March 24, 2006.

LOGAN COUNTY OFFICE OF EMERGENCY MANAGEMENT

Roger Bryant *	Director

LOGAN COUNTY 911

Marilyn Crosby *	Director

MINE SAFETY AND HEALTH ADMINISTRATION MINE EMERGENCY TEAM

James W. Langley *	Mine Emergency Team Member

MINE SAFETY AND HEALTH ADMINISTRATION

Luther Marrs *	Assistant District Manager
Kenny Murray	Accident Investigator –Leader
Arlie A. Webb	Investigator
Ronald W. Stahlhut	Investigator
Michael Finnie	Investigator
Charles Pogue	Investigator
William J. Francart	Technical Support
Dennis A. Beiter	Technical Support
Daniel M. Barish	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Steve Cox	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on March 27, 2006.

ARACOMA COAL COMPANY, INC.

Jerry Workman *	Longwall Set up/Tear down
Elbert J. Clay *	Headgate Operator
Mark E. Heath	Attorney

CONTINENTAL CONVEYOR AND EQUIPMENT

Michael R. Williams *	Service Representative
Philip J. Carroll III	Attorney

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator –Leader
Arlie A. Webb	Investigator
Michael Finnie	Investigator
Ronald W. Stahlhut	Investigator
Charles Pogue	Investigator
Anthony Burke	Investigator
Dennis A. Beiter	Technical Support
Derrick Tjernlund	Technical Support
Daniel M. Barish	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Danny Cook	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on March 29, 2006.

ARACOMA COAL COMPANY, INC.

Charles W. Acord *	Move Crew
Roger Ooten *	Beltman
Kevin S. Ferguson *	Mechanic/Beltman
Mark E. Heath	Attorney

MINGO LOGAN COAL COMPANY

Eddie Lawson *	Mine Rescue Captain
Joe Estep	Safety Manager

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader
Anthony Burke	Investigator
Arlie A. Webb	Investigator
Ronald W. Stahlhut	Investigator
Charles Pogue	Investigator
Michael Finnie	Investigator
Jeffrey Waggett	Investigator
Dennis A. Beiter	Technical Support
Derrick Tjernlund	Technical Support
Daniel M. Barish	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on March 30, 2006.

ARACOMA COAL COMPANY, INC.

Brian R. Caserta *	Shield Operator
Brad Maynard *	Utility Man

MINE SAFETY AND HEALTH ADMINISTRATION

Minness C. Justice, Jr. *	Coal Mine Inspector
Kenny Murray	Accident Investigator – Leader
Arlie A. Webb	Investigator
Anthony Burke	Investigator
Charles Pogue	Investigator
Dennis A. Beiter	Technical Support
Jeffrey Waggett	Technical Support
Derrick Tjernlund	Technical Support
Daniel M. Barish	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Steve Cox	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on March 31, 2006.

ARACOMA COAL COMPANY, INC.

Billy Brown, Jr. *	Longwall Setup
Mark E. Heath	Attorney

LAUREL CREEK COMPANY

Ronnie Ooten *	Riverton Mine Rescue Captain

MINE SAFETY AND HEALTH ADMINISTRATION

Bill J. Gillenwater *	Supervisor
Timothy L. Justice *	Coal Mine Inspector
Kenny Murray	Accident Investigator – Leader
Arlie A. Webb	Investigator
Charles Pogue	Investigator
Dennis A. Beiter	Technical Support
Derrick Tjernlund	Technical Support
Daniel M. Barish	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

William Tucker	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on April 11, 2006.

ARACOMA COAL COMPANY, INC.

Gary C. Neil *	Longwall Electrician
Chadwick Evans *	Supply Tractor Operator
David J. Hardy	Attorney

MINE SAFETY AND HEALTH ADMINSTRATION

Arlie A. Webb	Investigator
Anthony Burke	Investigator
Ronald Stahlhut	Investigator
Charles Pogue	Investigator
Michael Finnie	Investigator
William J. Francart	Technical Support
Derrick Tjernlund	Technical Support
Keith Bell	Solicitor – U. S. Dept. of Labor

Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on April 12, 2006.

ARACOMA COAL COMPANY, INC.

Billy J. Maynard *	Continuous Miner Operator
Kevin R. Evans *	Longwall Move Crew
Shawn J. Sturgell *	Roof bolter Operator
Mark E. Heath	Attorney

CONSOLIDATION COAL COMPANY

Dennis C. Perry *	V. P. Eight Mine Rescue Team Captain
Michael Canada	D. Perry's Representative

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator - Leader
Charles Pogue	Investigator
Ronald Stahlhut	Investigator
Michael Finnie	Investigator
Anthony Burke	Investigator
William J. Francart	Technical Support
Derrick Tjernlund	Technical Support
Dennis A. Beiter	Technical Support
Keith Bell	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Beth Spence	Representative – Governor's office

The following persons were present during the interviews conducted on April 13, 2006.

ARACOMA COAL COMPANY, INC.

Jason T. Adkins *	Continuous Miner Operator
David M. Runyon *	Outby Beltman

MINE SAFETY AND HEALTH ADMINISTRATION

Kenny Murray	Accident Investigator – Leader
Ronald Stahlhut	Investigator
Charles Pogue	Investigator
Arlie A. Webb	Investigator
William J. Francart	Technical Support
Dennis A. Beiter	Technical Support
Derrick Tjernlund	Technical Support
Keith Bell	Solicitor – U. S. Dept. of Labor
Autumn D. Furby-Pritt	Court Reporter

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

C. A. Phillips	Deputy Director
William Tucker	Investigator
Eugene White	Investigator
Beth Spence	Representative – Governor's office

Attachment A

MINE RESCUE EFFORTS

When mine officials determined that the fire was beyond their ability to control, calls were made for mine rescue assistance. The mine has primary mine rescue coverage by A. T. Massey's Southern West Virginia team and the East Kentucky team. These were the first two teams notified and the first two teams to report to the mine site. Additional teams were requested and they reported to the mine over the next forty-two hours. This report will identify the mine rescue teams and their work in recovering the two victims and in fighting the mine fire.

At approximately 11:37 p.m. on Thursday, January 19, 2006, the first mine rescue teams, Southern West Virginia and East Kentucky, entered the mine. The two teams traveled from the box-cut on the surface into the North Mains area and the mouth of the old 4 Right Panel by diesel mantrip. One team was to remain at the mouth of the 4 Right Panel while the other team explored inby in the 4 Right Panel. There was a belief by many Aracoma management personnel that the two men may have attempted to come outside by way of the 10 Headgate entries. The team had to stop exploring due to heavy smoke and impassable water. Additional information was obtained from the No. 2 section crew by mine management, and mine rescue efforts were then directed toward the fire area. The teams re-assembled at the mouth of the 4 Right Panel and were told to wait there until joined by the Mingo Logan and Riverton Mine Rescue Teams.

Once all four teams were assembled at the mouth of the 4 Right Panel, the four teams were told to advance toward the fire area. Once they had arrived near the fire location, they were instructed to assess the fire's condition. When a determination had been made on the extent and level of the fire, it was decided to proceed with exploration inby in search of the two missing miners. Plans were then made for the Southern West Virginia team to prepare to fight the fire while being backed up by the Riverton team. The East Kentucky team was to prepare to explore the North East Mains inby the fire area to a point near where the section mantrip was abandoned by the No. 2 Section crew on their retreat from the mine; the Mingo Logan team was to serve as their backup. The Southern West Virginia team was preparing to fight the fire but did not have any water to do so. The East Kentucky team attempted to locate the abandoned No. 2 Section mantrip but they were unable to locate it due to the dense smoke and extreme heat in the area.

To aid in the fire-fighting efforts, it was determined that the fresh water pumps located near the mouth of the 4 Right Panel would need to be energized and started. However, the power source for the pumps would actually take power to other areas of the mine because of the power configuration. A decision was made to send Aracoma electricians into the mine and have them separate the power supply at the pumps so no power went farther into the mine. To assist the electricians in this project, the Pinnacle Mine Rescue team was sent underground with them.

Over the course of the next few hours, additional teams were sent underground to assist in the fire fighting and exploration activities. Water was delivered by pressure pumps to the fire area around 10:45 a.m. on January 20, 2006. Water and foam were being applied to the fire by 11:00 a.m. by the Pinnacle team. For approximately the next twenty-eight hours, various teams were involved in fighting the fire at the longwall belt drive and storage unit. In addition, teams were exploring areas of the mine in an attempt to locate the missing miners. Initial efforts for the exploration occurred in the area where the section crew left the mantrip; the next area checked was the No. 2 Section and associated face areas. From here attempts were made to locate the individuals in the 10 Headgate areas. The area immediately inby the fire was one of the last areas checked due to heavy smoke concentrations and extreme heat.

The Southern Coalfields team found the first victim at 2:40 p.m. on January 21, 2006 approximately four crosscuts inby the fire area. This victim was identified as Donald Bragg. The second victim, Ellery Hatfield, was found forty minutes later at approximately 3:20 p.m. by the Consol of Kentucky Mine Rescue team. Mr. Hatfield was found one break inby spad number 3267 between the No. 8 and No. 9 entries of Northeast Mains. Once both bodies were located, the mine rescue teams were told to stop exploration and return to the fresh air bases.

Arrangements were made to transport the victims to the surface of the mine. All rescue teams were brought to the surface with exception of the Lone Mountain and VP-8 Mine Rescue teams. These two teams were left to monitor the fire area. Efforts to monitor the fire continued until sometime during the early hours of January 24, 2006. The fire was extinguished on January 21, 2006 but rescue teams continued to monitor and cool the fire area to prevent restarting through the early hours of January 24, 2006. Additional activities continued by the mine rescue teams of exploring and recovering all areas of the mine.

Mine rescue teams involved in this rescue and recovery are listed below.

The following mine rescue teams responded to the Aracoma Coal Company, Alma No. 1 mine fire.

MASSEY ENERGY
Massey Energy Southern West Virginia Team
Massey Energy East Kentucky Team

FOUNDATION COAL
Riverton Mine Rescue Team
Emerald Mine Rescue Team
Cumberland Mine Rescue Team

ARCH COAL COMPANY
Mingo Logan Mountaineer Team
Lone Mountain Mine Rescue Team

JEWELL SMOKELESS COAL CORPORATION
Jewell Smokeless No. 1
Jewell Smokeless No. 2

CONSOLIDATION COAL COMPANY
Buchanan Mine Rescue
VP-8 Mine Rescue
Consol of Kentucky

EASTERN ASSOCIATED COAL CORPORATION
Harris Southern Appalachian Team
Federal No. 2 Team

EXCEL MINING COMPANY
Excel Kentucky
Excel Illinois

PINNACLE MINING COMPANY
Pinnacle Blue Team
Pinnacle Gray Team

PARAMOUNT COAL COMPANY
Paramount Mine Rescue

DICKENSON-RUSSELL COAL COMPANY
Dickenson-Russell Mine Rescue

MOUNTAINEER NO. 1 MINE RESCUE ASSOCIATION, INC.

MOUNTAINEER NO. 2 MINE RESCUE ASSOCIATION, INC.

SOUTHERN COALFIELD MINE RESCUE ASSOCIATION

POCAHONTAS MINE RESCUE ASSOCIATION, INC.

MINE SAFETY AND HEALTH ADMINISTRATION MINE EMERGENCY TEAM

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING MINE EMERGENCY TEAM

Attachment B

CO MONITORING SYSTEM

The carbon monoxide or CO monitoring system used at the Aracoma Alma No. 1 mine is a Pyott-Boone system. Since belt air is used in the face ventilation at this mine the CO system must meet the MSHA requirements for using belt air in the face regions. Upon observation of the system master station on January 25, 2006 the computer clock was found to be improperly set. By comparing several wristwatches at the scene it was agreed upon by WVOMHST and MSHA officials that the computer clock was twenty-three (23) minutes fast. This condition must be considered for all times stated in the CO system event log. All times listed are +23 minutes of the actual times. On March 2, 2006 an effort was made to retrieve additional information and it was found that the computer clock had been updated and the event log erased.

EVENT LOG HIGHLIGHTS 1/19/06

TIME	SENSOR	SIGNAL	LOCATION
17:36:34	82	WARNING	STORAGE UNIT
17:36:55	82	ALARM	STORAGE UNIT
17:38:44	81	WARNING	INBY 7 BELT TAIL
17:39:05	81	ALARM	INBY 7 BELT TAIL
18:02:22	Belt Boss –STOP-Remote (from master station)		No. 1 – 2 SECTION BELT
18:02:26	Belt Boss –STOP- Sequence		No. 2 – 2 SECTION BELT
18:02:34	Belt Boss –STOP- Sequence		No. 3 – 2 SECTION BELT
18:33:50	71	WARNING	1200 ft. No. 1 – 2 SECTION BELT
18:34:05	71	ALARM	
18:39:19	73	WARNING	2600 ft. No. 1 – 2 SECTION BELT
18:39:50	73	ALARM	
18:53:19	74	WARNING	3800 ft. No. 1 – 2 SECTION BELT
18:54:35	74	ALARM	
19:03:21	72	WARNING	4500 ft. No. 1 – 2 SECTION BELT
19:31:22	77	WARNING	No. 3 – 2 SECTION BELT
19:31:35	76	WARNING	No. 2 – 2 SECTION BELT
19:32:40	76	ALARM	
19:33:23	77	ALARM	
19:36:33	79	WARNING	No. 3 – 2 SECTION BELT
19:38:18	79	ALARM	

With the time corrected and simplified, events happened as follows:

1. 5:13 p.m. – sensor 82 at storage unit gives warning and alarm
2. 5:16 p.m. – sensor 81 at 7 belt tail gives warning and alarm
3. 5:39 p.m. – 2 section belts were shut down remotely from outside
4. 6:11 p.m. – sensor 71 on no. 1 – 2 section belt gives warning and alarm
5. 6:16 p.m. – sensor 73 on no. 1 – 2 section belt gives warning and alarm
6. 6:30 p.m. – sensor 74 on no. 1 – 2 section belt gives warning and alarm
7. 6:40 p.m. – sensor 72 on no. 1 – 2 section belt gives warning

8. 7:08 p.m. – sensor 76 and 77 at 2 tail and 3 head give warning and alarm
9. 7:13 p.m. – sensor 79 at 2 section tailpiece gives warning and alarm

Warning at (5 ppm) CO Alarm at (10 ppm) CO
Warning and Alarms are given at the surface location.

The use of belt air in the face regions requires a CO sensor to be located at or near the working section tailpiece. An audible and visual alarm of sufficient magnitude to be seen and heard by miners working at the location is also required on the section. This alarm should be activated when any sensor reaches the alarm level (10 ppm), or when any two consecutive sensors reach the warning level (5 ppm).

The No. 2 working section was not provided with the audible/visual alarm.

The 9 Headgate longwall section was provided with an 805C audible/visual alarm and a CO sensor. According to the event log this alarm did not function at the January 19 fire. The sensor and alarm was removed from the mine and tests were conducted by MSHA at the Approval and Certification Center in Triadelphia, WV. It was determined that the battery in the 805C alarm was not connected. Results showed that with the battery disconnected the alarm would give an audible/visual signal but at a much reduced rate. A light meter was used to check the brightness of one of the LEDs used to provide the visual alarm. At the 24-volt level with the battery disconnected and the audible and visual test buttons engaged, 1.12 LUX was measured. At the 24-volt level with the battery connected and the audible and visual test buttons engaged, 69.51 LUX was measured. All LEDs on the alarm appeared to have the same level of intensity.

As noted earlier the CO system did give a warning and alarm for the sensors listed above. However, several problems were found with the system and the requirements to use the system as used at this mine.

1. Miners at this mine were inadequately trained as to the basic operating principle of the AMS or Atmospheric Monitoring System.
2. AMS operators (dispatchers) were inadequately trained as to the proper operation of the AMS.
3. The written record of alerts and alarms does not give all information required. Numerous alarms were not recorded in the log event book
4. Calibrations of CO sensors were inadequate in that the event log does not reflect the proper amount of CO used to calibrate the sensors.
5. Working sections ventilated from a belt air course did not have CO monitors in the primary escapeway.
6. The No. 2 section was not provided with an audible/visual alarm on the CO monitoring system.
7. The 9 Headgate longwall section audible/visual alarm on the CO monitoring system did not activate.
8. The battery was disconnected in the 9 Headgate longwall section audible/visual CO alarm.
9. Miners were not removed from affected areas of the mine during CO alarm conditions that occurred prior to January 19, 2006.

10. The Approved Roof Control Plan for this mine required that a CO sensor be located at the mouth of the panel in each intake entry if the longwall tailgate becomes impassible. The longwall was impassible at this time and no CO sensor was provided in this position.

Currently West Virginia Code does not include provisions that require the CO monitoring system and thus the only violation issued was pertaining to item No. 10 as required in the Approved Roof Control Plan.

Attachment C

LONGWALL BELT AND STORAGE UNIT

The 9 Headgate longwall mother belt is a 60-inch Continental Conveyor system with a Continental Conveyor belt storage unit. Due to adverse roof conditions and a roof fall that covered a large portion of the storage unit, a thorough inspection of the storage unit was not possible. A pinch roller unit is attached to the outby end of the storage unit to assist in removing belt from the storage unit. The 150-horsepower vector motor is connected to a winch at the outby end of the storage unit.

The storage unit is approximately 150-175 feet in length and has a guide on the top rails for the main carriage and drop-off carriages to ride. All carriages are provided with V-groove wheels to ride on this guide. Carriage keeper brackets are bolted to the carriages and extend to the bottom of the rail to prevent the carriages from lifting off the rail. Two of the four carriage keeper brackets for the main carriage are missing. The main carriage is connected to the winch by a 1½ inch wire rope. With the storage unit empty and fully collapsed, the outby drop-off carriage is connected to the main carriage by a latching system and each drop-off carriage is connected to the adjoining drop-off carriage by the same type of latching mechanism. These latches differ in height and must be in the proper order and have the proper trip lever posts in place to unlatch the drop-off carriages in the proper location. A preliminary inspection of the storage unit before the roof collapse revealed that five trip lever posts are missing and one is bent and broken.

The winch maintains a constant tension on the wire rope, the main carriage and the drop-off carriages. As the longwall advances, belt is taken into the unit and the carriages move on the guide rails until the belt is tight or the storage unit is full. At approximately 25-foot intervals, trip lever posts are placed on each side of the storage unit. These posts must correspond to the height of the trip levers on the latching mechanism for the intended drop-off carriage. As the trip levers on the drop-off carriage come in contact with the trip lever posts, the trip levers are raised and unlatched from the adjoining carriage. This should take place at approximately 25-foot intervals until the unit is full and all drop-off carriages are dropped off in their proper location. These drop-off carriages have rollers, which when properly spaced, are intended to keep the belt being stored in the storage unit in alignment and separated.

The 9 headgate storage unit was installed on a 9.32 percent grade that sloped downward toward the face. Upon installation the inby end of the storage unit was raised and metal legs installed to try to compensate for the grade. This sloping condition caused a problem with drifting on the drop-off carriages from their intended location. Continental Conveyor provided a bolt to act as a braking system for the drop-off carriages, but according to testimony, drifting remained a problem with some carriages. Also, according to testimony, the drop-off carriages would have to be chained in place to prevent drifting.

Testimony revealed that the drop-off carriage system was not in working order and that the carriages routinely had to be manually set in the proper location and many times chained in place. Also, according to testimony, the drop-off carriages would unlatch on one side and not on the other side causing the carriage to become cocked in the storage unit and forcing the belt to run out of alignment. According to testimony, at the time of the fire at the storage unit, a drop-off carriage became misaligned when it was unlatched on one side and remained latched on the other side.

As mentioned earlier, during a preliminary inspection of the storage unit before the roof collapse, five trip lever posts were observed missing and one broken and bent. According to testimony, at least three of these trip lever posts were destroyed when the unit was first placed in service in October 2005 and these post were never replaced.

Testimony and evidence indicate that the belt had run out of alignment prior to the January 19 fire. Deep grooves cut into the frame of the drive and storage unit, frayed belt edges, a large pile of belt trimming, bottom belt hangers that had been cut into by belt rubbing, all point to prior alignment problems. Also, testimony revealed and the CO event log confirmed a similar event occurred on December 23, 2005 at the 9 Headgate mother drive location.

Attachment D

WATER SYSTEM

The water system servicing the Aracoma Alma No. 1 mine is supplied from a holding tank located above the Melville box cut portals by a 12-inch steel line from the tank to the portal.

An 8-inch supply line extends underground to the No. 4 seventy-two inch conveyor that follows the belt conveyor for a distance of 4800 feet to the Rum Creek portal. The 8-inch supply line extends along the no. 5 seventy-two inch conveyor belt for a distance of 4800 feet; at that point the supply line branches off to the No. 3 section into a 4-inch line that extends onto the 48-inch No. 1, No.2, and No. 3 conveyor belts for a total length of 5340 feet. The elevation where the supply line enters the mouth of the No. 3 section is a drop of 12 feet outby to the box cut portal. The 8-inch water supply line continues on to the No. 5 seventy-two inch belt conveyor for a distance of 4800 feet. At a location at the mouth of the No. 5 tailgate two 60 horsepower pumps are in line to boost the water pressure inby due to the extreme elevations in the mine terrain.

At this pump location the water supply is directed into a 4-inch line and an 8-inch line that continues inby to the No. 6 seventy-two inch belt conveyor that is approximately 2000 feet in length. The water supply is also branched into a 6-inch line at the No. 1 four-way that supplies the longwall section.

The 8-inch supply line continues along the No. 7 seventy-two inch belt conveyor that extends a distance of 969 feet and is maintained with an 8-inch water supply line up to the point where the tailpiece is located inby spad no. 3249. The No. 7 tailpiece is a 271.24 foot elevation increase from the box cut portal.

The water supply for the fire hose outlets that extends along the No. 9 mother drive belt conveyor is maintained with a 2-inch water supply line that is branched off from the No. 7 belt conveyor 8-inch supply line at the No. 9 mother drive discharge. The 2-inch water supply line that extends inby to the longwall monorail system provides water only for the fire hose outlets along the longwall conveyor and is capped off with a shut-off valve inby the monorail system.

Each conveyor belt drive at this mine is provided with a water sprinkler type fire suppression system that is designed to activate in the event of a fire or rise in temperature.

The water supply lines that extend from the surface along each belt conveyor and to each working section are provided with 1½-inch standard thread fire hose outlets.

Attachment E

ELECTRICAL

The electrical equipment used at the 9 Headgate mother belt area included:
One AEEI 12,470 volt dual line splitter
One AEEI 12,470 to 480 volt power center
One Continental Conveyor belt starter with two 750 horsepower DC motors
One Continental Conveyor single 150 horsepower constant
Tension winch controller with a 150 horsepower vector motor and a 1½ horsepower vector blower motor (cooling motor)
One hydraulic power pack used to operate the pinch roller

The substation at the Melville portal is provided with two high voltage breakers. One breaker supplies the continuous miner sections and the other supplies the 9 Headgate longwall section and 10 Headgate longwall setup. 12,470 volts is supplied to the dual splitter and the power center is supplied by the feed-through connection at the input end of the splitter.

Circuit No. 1 of the splitter supplies the 9 Headgate longwall section and circuit No. 2 supplies the 10 Headgate longwall setup. The power center supplies 480 volts to the belt controller and the constant tension winch controller. Two 500 MCM cables are provided for each of the 750 horsepower belt drive motors as per the electrical print requirements. The vector controller provides power to the 150 horsepower vector motor and the 1½ horsepower vector blower.

The splitter, power center, belt starter, and winch controller were not burned but did receive extensive heat and smoke damage. Little could be done to test the circuitry of these controls but a visual examination was conducted. The ground monitor for the 1½ horsepower vector blower was bridged out with a wire across the relay contacts. Also, the ground monitor for the No. 2 belt drive motor had a short wire installed on one side of the relay contacts that appeared to have at one time been connected to the other side of the relay contacts but was not connected at the time of inspection.

A Pyott-Boone Old Faithful 235 deluge control box was mounted to the side of the belt starter and provided the control and the alarm for the sprinkler system installed at the belt drive.

Attachment F

The accident investigation teams along with mine management personnel conducted several onsite investigations between February 1 and February 8, 2006.

OMHS&T ACCIDENT INVESTIGATION TEAM

C. A. Phillips	Deputy Director
Terry Farley	Health and Safety Administrator
Monte Hieb	Chief Engineer
Dennie Ballard	Assistant Inspector-at-Large, Reg. 3
William Tucker	Assistant Inspector-at-Large, Reg. 4
Richard Boggess	District Inspector
Eugene White	District Inspector
John Kinder	District Inspector
Danny Cook	Electrical Inspector
Steve Cox	Safety Instructor
Willie Barker	Safety Instructor
Timothy Bradford	Attorney

MSHA ACCIDENT INVESTIGATION TEAM

Kenneth Murray	District 6 Manager
Arlie A. Webb	Staff Assistant, District 6
Anthony Burke	Coal Mine Inspector, District 6
Charles Pogue	Roof Control Specialist, District 2
Ronald Stahlhut	Electrical Supervisor, District 8
Michael Finnie	Supervisor, Special Investigations, District 10
Dennis A. Beiter	Supervisory Mining Engineer, Technical Support
William J. Francart	Mining Engineer, Ventilation Div., Tech. Support
Derrick Tjernlund	Senior Fire Protection Engineer, Technical Support
Jeffrey Waggot	Technical Support
Keith Bell	Senior Trial Attorney, U. S. Dept. of Labor
Daniel M. Barish	Senior Trial Attorney, U. S. Dept. of Labor

United States
Department of Labor
Mine Safety and Health Administration
Office of the Administrator
Coal Mine Safety and Health

Report of Investigation
(Underground Coal Mine)

Mine Fire

Marianna Mine No. 58 (I.D. No. 36-00957)
BethEnergy Mines, Inc.
Marianna Borough, Washington County, Pennsylvania

March 7, 1988

by

Raymond A. Strahin
Coal Mine Safety and Health Inspector

David N. Wolfe
Coal Mine Safety and Health Inspector

and

Charles W. Pogue
Coal Mine Safety and Health Inspector

Originating Office
Mine Safety and Health Administration
4015 Wilson Boulevard
Arlington, Virginia 22203
Jerry L. Spicer, Administrator
for Coal Mine Safety and Health

United States
Department of Labor
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Report of Investigation
(Underground Coal Mine)

Mine Fire

Marianna Mine No. 58 (I.D. No. 36-00957)
BethEnergy Mines, Inc.
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March 7, 1988

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Report of Investigation
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Mine Fire

Marianna Mine No. 58 (I.D. No. 36-00957)
BethEnergy Mines,Inc.
Marianna Borough, Washington County, Pennsylvania

March 7, 1988

Abstract of Investigation

U.S. Department of Labor
Mine Safety and Health Administration

Authority—This report is based on an investigation made pursuant to the Federal Mine Safety and Health Act of 1977, Public Law 91-173, as amended by Public Law 95-164.

Section A—Identification Data

1. Title of investigation: Noninjury Underground Mine Fire	2. Date MSHA investigation started: March 8, 1988
3. Report release date: March 14, 1990	4. Mine: Marianna Mine No. 58
5. Mine ID number: 36-00957	6. Company: Beth Energy Mines, Inc.
7. Town, County, State: Marianna Borough, Washington County, Pennsylvania	8. Author(s): Raymond A. Strahin, Charles W. Pogue and David N. Wolfe

Section B—Mine Information

9. Daily production: 4,159	10. Surface employment: 49
11. Underground employment: 278	12. Name of coalbed: Pittsburgh
13. Thickness of coalbed: 72 inches	

Section C—Last Quarter Injury Frequency Rate (HSAC) for:

14. Industry: 12.95	15. This operation: 18.05
16. Training program approved: March 27, 1979	17. Mine Profile Rating: N/A

Section D—Originating Office

18. Mine Safety and Health Administration Coal Mine Health and Safety District No.: 2	Address: 4800 Forbes Avenue, Pittsburgh, Pennsylvania 15213

Section E—Abstract

On Monday, March 7, 1988, at about 10:20 p.m., a fire occurred at the 3 Northwest belt drive located in No. 6 entry, No. 1 crosscut of the Marianna Mine No. 58, Beth Energy Mines, Inc. Three of the 30 miners who were working inby at the time of the fire observed smoke and quickly escaped. Twenty-seven miners were exposed to heat and smoke and escaped with the aid of self-contained self-rescuers. Five of the 27 miners were transported to the hospital and treated for smoke inhalation and then released. An exact cause of the fire could not be determined due to the entire mine being sealed and not expected to be reopened; however, it is suspected that the fire occurred when frictional heating of the belt conveyor ignited coal dust. The friction was likely caused by a large coal accumulation in the drive rollers.

Section F—Mine Organization

Company officials:	Name	Address
19. President:	R. J. Fisher	701 East Third Street Bethlehem, Pennsylvania 18016
20. Superintendent:	Larry R. Mayton	P. O. Box 143 Eighty Four, Pennsylvania 15330
21. Safety Director:	John M. Gallick	P. O. Box 143 Eighty Four, Pennsylvania 15330
22. Principle officer—H&S:	Larry R. Mayton	P. O. Box 143 Eighty Four, Pennsylvania 15330
23. Labor Organization:	United Mine Workers of America	900 Fifteenth Street, N.W. Washington, D.C. 20005
24. Chairman—H&S Committee:	Carol J. Davis	P. O. Box 463 Ellsworth, Pennsylvania 15331

MSHA Form 2000-57, Apr 82 (revised)

TABLE OF CONTENTS

APPENDICES

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[1] Appendix N was prepared and added to this report at the request of the Administrator for Coal Mine Safety and Health. This Appendix describes important action by MSHA since the Marianna Mine Fire. It is intended to assist in the dissemination of information to the mining community which is relevant to reducing the likelihood of such an occurrence in the future.

General Information

The Marianna Mine No. 58 located on Pennsylvania Route 2020, in the Borough of Marianna, was opened in 1903. It was operated by BethEnergy Mines Inc. Northern Division, which is a subsidiary of Bethlehem Steel Corporation, Bethlehem, Pennsylvania.

The principal officials of the Northern Division at the time of the accident were:

Northern Division

Ted Brisky	General Manager
John Gallick	Director of Safety and Environmental Health
Thomas J. Schell	Electrical Engineer

Marianna Mine No. 58

Larry Mayton	Mine Superintendent
Thomas Duvall	Mine Foreman
Francis Cooley	Special Engineer
Robert Rasel	Maintenance Foreman
James Vincent Bucenell, Jr.	Daylight Shift Foreman
Larry Stowinsky	Afternoon Shift Foreman
Wayne Perkins	Safety Inspector

The Marianna Mine No. 58 was opened by 6 air shafts into the Pittsburgh coalbed, which averages 72 inches in thickness. A total of 327 persons were employed at this mine, 278 underground and 49 on the surface. Production at the mine averaged 4,159 tons daily on 2 coal-producing shifts, 5 days a week.

Coal was mined on 5 producing sections, 3 on development utilizing continuous-mining machines, and 2 on retreat utilizing continuous-mining machines.

The coal was transported from the 3 working sections in 3 Northwest by 36-inch and 42-inch belt conveyors to the 3 Northwest Butterley bunker coal storage facility. Coal was loaded from the bunker storage facility by a 42-inch belt conveyor into 10-ton mine cars to be transported to the Marianna skip hoist bottom. Coal from 1 Southeast and 21 Butt was loaded into mine cars and transported by track haulage to the hoist bottom. The material was hoisted to the surface by a 10-ton skip hoist, and deposited into a 7,000-ton raw coal silo. The coal was then processed in the preparation plant, located near the skip-hoist facility, at the Marianna Mine and transported by rail to the consumer.

Supplies and equipment were lowered into the mine utilizing an equipment hoist. Trolley-operated locomotives were used as the primary means of hauling coal, supplies, and equipment throughout the mine. Galis self-propelled personnel carriers were used to transport workers to and from the working sections.

The 3 Northwest Submains, where the fire occurred, was developed by a block system of mining. Multiple entries and connecting crosscuts were developed from the Southwest Mains Right off 46 Mains. Mining commenced in February 1981, and initially consisted of seven entries. After developing the entries and connecting the first line of crosscuts, an additional entry was added. As development of the submain progressed, panels consisting of seven to nine entries were driven to the left off the submain and connected at the back end with the bleeder entries. At the time of the accident, there were three active working sections in the 3 Northwest Submains. Mining in each of the sections was being done with two sets of production equipment consisting of Joy Model 12/11 continuous-mining machines, Joy shuttle cars, Fletcher roof-bolting machines, and S & S scoop cars. Each section was provided with two separate return aircourses and was ventilated with a separate split of intake air. The entries near the beginning of 3 Northwest, identified by the numbers 1 through 8 (from left to right, facing inby), were being used as follows:

The Nos. 1, 2, 3, and 8 entries were return aircourses with the Nos. 3 and 8 entries designated as escapeways. The Nos. 4, 5, 6, and 7 entries were intake aircourses with the No. 7 entry designated as an escapeway. The trolley haulage system was located in No. 4 entry and the belt conveyor was located in No. 6 entry. Permanent stoppings, constructed of dry-stacked, masonry blocks with the joints plastered or masonry blocks set in mortar, were used to provide the required separation between the various aircourses.

Due to the limited number of intake aircourses at the beginning of 3 Northwest, and the working sections being advanced to greater distances from the main ventilating fan, the operator requested and was granted permission to allow the air used to ventilate the belt conveyor entry to also be used to ventilate the active working places. The request to use belt air was made to the District Manager for Coal Mine Safety and Health of the Mine Safety and Health Administration (MSHA). Approval was granted and the requirements contained in the request were made a part of the current approved ventilation system and methane and dust control plan for the mine. Since the mine was in operation prior to 1970, the District Manager has the authority under 30 CFR 75.326 to approve such a request. Some of the requirements contained in the approved plan were that a carbon monoxide (CO) monitoring system capable of detecting CO at a level of one part per million would be used, sensors for the system would be installed in belt entries at spacings between 1,000 and 2,000 feet, according to the air velocity, and that audible and visual alarms would be activated automatically at the dispatcher's office in the lamphouse and underground dumper's shanty when one or more monitors indicated a CO concentration of 10 parts per million (ppm) or more above ambient. (An ambient level had not been established; therefore, the monitors indicated the actual level of CO.) Also, approval of the plan included the elimination of the requirement for the separation of the belt and trolley haulage entries with stoppings. Separation of the belt entry and trolley haulage entries was discontinued in the 5 Left section; however, separation of the entries continued in the 8 Left and 3 Northwest sections.

A Joy Model 8H-96 exhausting mine fan located on the surface at Sabol air shaft, which provided the total intake and return air for ventilating the 3 Northwest area of the mine, was replaced with a Joy Model 120-65 fan on December 26, 1987. Following the replacement of the fan, two additional air splits were established in 3 Northwest and, reportedly, the quantity of air for the working sections was increased.

The results of the air measurements taken in cubic feet per minute (cfm) on each of the section splits following the air change and submitted to MSHA in a letter dated January 4, 1988, were as follows:

8 Left	No. 11 Split	22,400 cfm
	No. 12 Split	22,500 cfm
5 Left	No. 29 Split	15,000 cfm
	No. 30 Split	23,000 cfm
3 Northwest	No. 23 Split	16,100 cfm
	No. 24 Split	15,700 cfm

An air measurement taken by Larry Mayton, Superintendent, at a regulator that was located in the 3 Northwest belt entry outby the belt drive after the ventilation change on December 26, 1987, indicated that 60,000 cfm of air was present in the belt entry. A large portion of the regulator was removed to reduce the restriction and velocity of air which was blowing the coal dust from the belt conveyor and resulted in float coal dust accumulating in the area of the belt drive.

Three-phase electric power for the 3 Northwest section belt drive was purchased from West Penn Power Company at 25 KV and transformed to 7.2 KV at the Moore Portal surface substation for underground distribution. The electrical configuration of the surface transformer was delta/delta. Power entered the mine at Moore borehole through No. 4/0 AWG, 3 conductor, type SHD-GC, 10 KV cable and was protected against overload, short circuit, grounded phase, and undervoltage conditions by an oil circuit breaker located in a Sil-Pak switchhouse manufactured by Pemco Corporation. A zigzag grounding transformer, used to derive a system neutral, was grounded through a 180 ohm resistor limiting the fault current to 25 amperes. Westinghouse CO9 relays were connected to the phase conductors by current transformers with a ratio of 300:5. The CO9 relays were set on 4 amp tap for overcurrent protection and the instantaneous trip unit was adjusted to trip at 40 amps. Grounded phase protection was obtained by CO9 relay set on the 2 amp tap and connected to grounding circuit by a current transformer with a ratio of 25:5. The 3-phase 7,200-volt circuit from the bottom of Moore borehole supplied power to the 5 Left, 8 Left, and 3 Northwest coal-producing sections, as well as 3 Northwest Main No. 1 belt drive, the origin of the fire. A No. 4/0 AWG, 3 conductor, type SHD-GC cable conducted power to the 3 Northwest Mains switchhouse located at the mouth of the submains. The feed-through circuit in the switchhouse extended power to the coal-producing sections and the branch circuit feed in the switchhouse supplied power to the 3 Northwest main belt conveyor power center and No. 1 belt starter. Overload and short-circuit protection for the branch circuit feed was provided by an oil-filled circuit breaker with overcurrent adjustment set to trip at 60 amperes and short circuit set to trip at 1440 amperes.

The branch circuit feed in the switchhouse fed 7,200 volts to a 300 KVA Line Power Company power center where the voltage was reduced to 575 volts alternating current for operation of the belt conveyor starter and drive motors. The power center was equipped with molded case circuit breakers complete with devices that would provide short-circuit, grounded phase, undervoltage protection and ground check circuit to monitor continuity of the grounding circuit to the belt starter. The dual 125-horsepower, 575 volts, 3-phase wound rotor belt starter was manufactured by Ensign Electric and was equipped with all the devices to provide overload, short circuit, and grounded phase protection. The starter was equipped with 2-molded case circuit breakers with magnetic trip ranges of 800 to 1600 amps and 2 size 5 contactors with overload heaters sized to open at 119 amps. The full-load current rating of each of the 125-horsepower belt conveyor drive motors was 125 amps. The 10-horsepower hydraulic belt takeup motor was protected by a 100-amp molded case circuit breaker with a size 1 overload relay with 20.1 amp thermal overloads. Ensign pilot wire ground check system (MSHA BTS Acceptance No. 111576EE(3)) was installed to monitor continuity of grounding circuits for the belt conveyor drive motor and the hydraulic takeup motor. MSA permissible thermotect mini-mine belt fire detection system and Mefcor Model CSP1000-E belt slip switch were wired into the control circuit to deenergize the belt starter if a fire sensor activated or belt slip switch slowed or stopped.

Since the mine was sealed shortly after the fire occurred, the information gathered for the investigation was provided primarily by employees at the Marianna No. 58 Mine. In addition, a continuous tape recorder, manufactured by Reproduction Technologies Incorporated, Model No. 7800 8-channel log, was in place to record conversations between the dispatcher and persons underground. Times, conversations, and events before and during the mine fire were accurately recorded and available for the investigation.

Accident

On March 7, 1988, during the 4:00 p.m. to 12:00 midnight shift, 89 workers entered the mine for the purpose of producing coal on the 21 Butt, 1 Southeast, 3 Northwest, 5 Left, and 8 Left working sections. Mining in the working sections continued until approximately 7:00 p.m., when the 3 Northwest belt conveyor system was reported as being down.

Richard Brumley, Belt Dumper, was assigned to the 3 Northwest coal dump. When the belt system was reported down, Brumley called the underground maintenance shop and requested that a mechanic be dispatched to troubleshoot the reason the belt conveyor system was not operating. Brumley began walking in the belt entry between 7:00 p.m. and 7:30 p.m. and found a Jabco switchbox in the off position. Brumley adjusted the pullcord and reset the Jabco switch, and the belt system immediately started operating.

Production continued for almost 3 hours without further incident, except that at 9:08 p.m., the CO sensor at 3 Northwest belt tailpiece (4-9) indicated a high warning. The warning lasted for 2 seconds, cleared, then was indicated again 2 seconds later for 27 seconds. This warning automatically cleared and was not investigated.

At approximately 10:20 p.m., John Stowinsky, Mine Examiner, arrived at the 3 Left belt transfer and recorded the time, date, and his initials on the date board. At approximately 10:25 p.m., at a location between 2 Left and 1 Left, he smelled smoke. A short time later, light smoke was observed and quickly changed to heavy black smoke, making it necessary for him to exit the belt through a door located in the No. 15 stopping. He walked up the track haulage entry to the equipment doors at the 3 Northwest belt drive. He opened the equipment doors and observed fire coiled around the belt drive rollers. He stated that the fire had not reached the roof at this time. At 10:32 p.m., the CO monitor system alerted John Robinson, Dispatcher, of a low alarm of 11 ppm at the No. 23 stopping in the belt entry approximately 2,000 feet inby the 3 Northwest belt drive unit. This station went into high alarm of 15 ppm at 10:34 p.m. Joseph Sciascia, Mechanic, was sent to investigate the reason for the alarm. While enroute, Sciascia was further advised by trolley phone to stop by the 3 Northwest belt drive because the sensor at that location had also alarmed. Records indicated that this alarm occurred at 10:37 p.m. The records also show that the sensor at the belt drive went into low alarm of 11 ppm at 10:29:54 p.m. and cleared itself at 10:30:50 p.m.

Sciascia picked up Richard Brumley, Dumper, and they arrived at the drive as Stowinsky was exiting through the equipment doors to get a fire extinguisher. Apparently, they had arrived at the belt drive about the same time. Firefighting attempts with extinguishers were unsuccessful. Water was not readily available, and the belt drive deluge system had been turned off. Testimony did not establish the reason for the deluge system being turned off. Robinson instructed Gary Lowery, Dumper, to call 5 Left. Lowery was able to contact 5 Left at 10:50 p.m. Robinson alerted 3 Northwest at 10:51 p.m., and 8 Left at 10:55 p.m. The workers from the three inby sections were evacuated and arrived on the surface at approximately 12:15 a.m. In an attempt to accurately describe their activities and events that occurred during their evacuation, each working section will be addressed separately. Miners in 21 Butt, 19 Butt, and 1 Southeast sections were notified of the fire and instructed to evacuate the mine. In summary, the 3 Northwest sections were notified to evacuate 16, 17 and 21 minutes after the CO monitoring system indicated a high alarm of 15 ppm at 10:34 p.m.

<u>8 Left Section off 3 Northwest</u>

John Brottish, Section Foreman, and nine miners were assigned to the 8 Left working section. The section consisted of 9 working places, 5 intakes, and 4 returns. The track haulage was located in No. 3 entry, the intake escapeway was in No. 6 entry, and the alternate (return) escapeway was in No. 9 entry.

After arriving on the section and being assigned to their job duties, normal production activities continued until approximately 7:00 p.m., when the 3 Northwest main belt conveyor stopped operating, causing the belt conveyors in 8 Left to also stop. The belts were down for about 40 minutes before the problem was discovered and corrected. Normal production activities resumed until about 10:20 p.m., when the belts stopped operating for the second time. When the shuttle cars did not return to the face area to be loaded, Brottish walked to the feeder and observed both shuttle cars parked and the belt conveyor idle. He then called the underground dumper's shanty and talked with Lowery. Lowery informed Brottish that the fire alarms were going off in the dumper's shanty, and that someone was sent to the 3 Northwest belt drive to investigate the cause. Brottish then returned to the face area. While cleaning the feeder, Steve Vargo and George Sakel, Shuttle Car Operators, heard the dispatcher paging 8 Left, but thought he was saying 5 Left. When he continued paging, they went to the pager and Vargo answered the phone and was informed by Robinson to evacuate the mine because of a belt fire. Vargo sent David McVay, Brattice Man, to the left side, Sakel to the right side, and he took the middle entries to alert everyone on the section of the fire.

All miners reported to the section power center to discuss the fire and deenergize the power for the face equipment. Brottish called the dispatcher and told him they were leaving the section in the mantrip. At crosscut No. 10 of 8 Left, they encountered heavy smoke and, because of poor visibility, stopped the mantrip. Self-contained self-rescuers (SCSR) were given to all persons and the extra SCSR's were taken with them in the event one failed to operate. Leaving the mantrip car, all entries were contaminated with heavy black smoke. The crew decided the only option available was the left side return airway. A door was found, but had to be pried open in order to enter the return. Before Brottish entered the return, he called the dispatcher and gave him information of their intentions. Light smoke was encountered in the return and at this time, the crew decided to put the SCSR's on. As they were traveling the return, visibility became difficult when the light smoke turned to heavy black smoke in the area of the overcast located at 5 Left junction. They crossed the overcast and continued traveling the return until they came to a door in No. 10 stopping of 3 Northwest submain. At the door, they exited the return into the track entry which had clear air. At this time, they discovered Sakel was not with them. A comment was made that Sakel had turned around when he saw smoke barreling from the top of 5 Left overcast. Ross, Nichols, and McVay volunteered to return and search for Sakel. Ross asked Brottish for his light so he could tie it to the waterline and find his way back. A waterline was laying on the mine floor in the left return. Nichols stayed on the waterline while Ross and McVay traveled to the overcast where Sakel separated from the crew. Ross stated that when he and McVay started across the overcast, he had one hand on the waterline and was just about to climb on the overcast when it blew out. Ross turned around and grabbed McVay and started crawling along the waterline to retreat from the return. Visibility became so difficult that they crawled into and overtop of Nichols while he sat on the waterline. They continued crawling until they saw the light that they had left tied to the waterline. They then exited the return.

Sakel, knowing another way out of the mine, had decided not to cross the overcast at 5 Left and at this point entered and traveled the 5 Left intake escapeway to a location safely outby the fire. There he was joined by the 8 Left crew at approximately 11:50 p.m. The crew was transported to Moore Shaft bottom and then to the surface, arriving at 10 minutes after 12 midnight.

There were four miners sent to the Canonsburg General Hospital for treatment for possible smoke inhalation.

3 Northwest Section

Mark Ladisic, Section Foreman, and seven miners were assigned to the 3 Northwest section. The 3 Northwest section consisted of 10 working places, 6 intakes and 4 returns. The track haulage was located in the No. 3 entry, the intake escapeway in No. 7 entry, and the alternate escapeway was in No. 10 entry. After arriving on the section and being assigned to their job duties, normal production activities continued until about 7:00 p.m., when the shuttle car caught the side guard on the feeder, causing the feeder to shift and pull the on/off control switch, stopping the belt. The belt conveyor was down for approximately 40 minutes before the condition was found and corrected. At approximately

10:20 p.m., the conveyor belt went down for the second time. Ladisic, who was on the left side of the section, heard the belt stop. He went to the mine phone and called Lowery, the dumper. Lowery said he was not sure why the belt was down, to check with the on/off control switches. Apparently, this was just prior to the CO alarms. Ladisic sent Floyd Lippencott, Shuttle Car Operator, to check the switches. Lippencott checked the switches and found nothing wrong, so he went back and moved his shuttle car off the feeder. He and John Quskas, Utility Man, cleaned both sides of the feeder and while standing there, they smelled burning rubber and saw smoke in the belt entry. Lippencott immediately informed Ladisic, who called the dispatcher and was informed at 10:51 p.m. that they had a fire on the belt somewhere in the 5 Left area and to evacuate the mine. Ladisic sent one shuttle car operator to the face to have everyone report to the dinner hole shanty and the other shuttle car operator was sent to deenergize the power. Two miners came to the mantrip carrying fire extinguishers. Everyone proceeded out in the mantrip to about one crosscut outby 8 Left where they encountered heavy smoke. Ladisic stopped the mantrip and had everyone get out and take a SCSR. Because of the heavy smoke in the track and belt entries, they decided to go back toward the face and get into the intake escapeway. They walked about two crosscuts and donned their SCSR's. Floyd Lippencott, a member of the crew and an experienced mine rescue person, assisted the miners with their SCSR's. The crew picked up additional SCSR's that were stored at the entrance to the intake escapeway. With Ladisic in front and Lippencott in back, they proceeded out the intake escapeway. After traveling about 5 or 6 crosscuts, they encountered heavy smoke. Ladisic then decided to go through a door into the right return, which was also designated as an escapeway. Because he did not know the exact location of the fire, Ladisic would feel and open each door in the stoppings as they walked out the return. When he opened the door in No. 3 stopping which was located outby the fire, the air was clear. Ladisic and his crew crossed the intake escapeway at this point and entered the belt entry where they saw the shift foreman and other miners. Ladisic notified the shift foreman that everyone from the 3 Northwest section was out. The crew was then given instructions to proceed to the surface.

5 Left Section off 3 Northwest

Frank Dankovich, Section Foreman, and nine crew members were assigned to the 5 Left retreat section. The 5 Left section consisted of 9 working places, 7 intakes and 2 returns. The track haulage was in No. 7 entry, the intake escapeway No. 8 entry, and the alternate escapeway No. 9 entry. After arriving on the section and being assigned to their job duties, production activities started. When the conveyor belt stopped at approximately 7:00 p.m., Dankovich did not know which belt was not operating. He checked the belt feeder and walked down the No. 3 belt to the Nos. 3 and 2 belt transfer point. Before he arrived at the transfer point, the belt conveyor started.

Dankovich saw Joe Gomutza, Belt Man, at the belt transfer and, after conversing with him for about 15 minutes, he walked back up to the section. Normal production activities continued until approximately 10:20 p.m., when the belt stopped. Dankovich, on the assumption that only his section's belt had ceased operating made his preshift examination. After he signed his books, he went back to the face area where the miners were waiting for the belt to start. Hearing the phone ring, Dankovich walked to the phone. When he picked it up to answer, there was no response. He called the dumper who said there was a fire on the belt. He then called the dispatcher. When the dispatcher answered, Dankovich could hear the sound of CO alarms. The dispatcher said there was a fire on the belt and to bring the miners out. Dankovich instructed the miners to back the continuous-mining machine from the working face and deenergize the power from all face equipment. All of the crew members assembled and boarded the mantrip. After traveling about 8 or 10 crosscuts, they encountered smoke. Everyone got out of the mantrip with an SCSR and walked about two crosscuts back toward the section. They entered the intake escapeway through a door and traveled down the escapeway for about 5 or 6 crosscuts. There they ran into smoke again and decided to go into the return escapeway. After traveling about two crosscuts they again encountered smoke. At this point, the SCSR's were donned. When they came to the overcast located at 5 Left junction, some of the crew members said they could not travel over the overcast because of too much smoke. Dankovich decided to get back into the intake escapeway through a door in the overcast. As they proceeded in the intake escapeway, Dankovich noticed that material from the sump construction was on his right side. Dankovich knew he was going the wrong way, so he took the crew back into the escapeway. After discussing how to travel out of the mine, Dankovich and the crew walked back to the overcast. He opened the door into the intake escapeway and looked to the right and then to the left. When he looked to the left, he could feel the air current on his face, so he then knew which direction to travel out of the section. They crossed over the overcast and proceeded out the intake escapeway. About three crosscuts from clear air, they saw fire around a stopping on the right side toward the belt. At this point, they saw Larry Stowinsky, Shift Foreman, who was coming up the intake escapeway looking for them. Harry Cogar, who was having problems, was assisted by Barbara Rickard, Larry Stowinsky, and Gary Kuklish, who shouldered him and helped him out. The 5 Left crew assembled outby the fire and were taken to Moore Shaft. They arrived on the surface at approximately 12:10 a.m.

One workman from the 5 Left crew was sent to the hospital to be treated for possible smoke inhalation.

Activities of MSHA Personnel

At approximately 12:10 a.m., on March 8, 1988, Orlando J. Abbadini, Supervisory Coal Mine Safety and Health Inspector, was informed by John Gallick, Safety Director of BethEnergy, of an underground fire at the Marianna No. 58 Mine. All the miners inby the fire had been evacuated and were fighting the fire with water. Abbadini notified Joseph Garcia, Subdistrict Manager, Monroeville, Pennsylvania. Garcia called Donald Huntley, District Manager for District 2 who, in turn, notified MSHA Headquarters in Arlington, Virginia. Robert Newhouse, Supervisory Coal Mine Safety and Health Inspector, and Charles Pogue, Coal Mine Inspector, from the Waynesburg Field Office, were dispatched to the mine site as were inspection personnel from the Washington, Pennsylvania, field office. A 103(k) Order and a 107(a) Order of Withdrawal were issued requiring all persons to be withdrawn from the mine except those persons necessary for the underground firefighting operations. As the situation continued to develop, members of MSHA's mine rescue team were alerted, as well as personnel from the Ventilation Division of the Pittsburgh Health Technology Center. MSHA's Mine Emergency Operations (MEO) Unit, located at Hopewell, Pennsylvania, was alerted in addition to personnel of the Physical and Toxic Agents Division, who provide gas analysis capabilities utilizing a mobile gas chromatograph. Those personnel, who had been placed on alert, were later dispatched to the mine as the firefighting activities intensified.

Underground Firefighting Activities

When the fire was discovered, it was described as being within the belt drive installation in the vicinity of the drive rollers. Visibility was good at that time, and the fire had not reached the roof, which was about two feet above the top belt. The shift foreman stated in his interview that "I could see some flames around the belt drive, and I knew right then it was a fire, but at that time I didn't think it was something that couldn't be put out. The flames there, they looked like something you hit with a fire extinguisher and that was it." Miners initially tried to extinguish the fire using all available fire extinguishers from underground areas, including the two fire stations.

After assigning miners to various positions, Larry Stowinsky, Shift Foreman, observed a firehose and nozzle attached to the fire tap at the belt drive. He began pulling on the firehose and found it to be wedged under the belt drive unit. He tried every means possible to remove the hose, but had to eventually cut the hose. This left a short piece of hose, without a nozzle, for use in firefighting. He sent miners to the 2 Left fire station to get additional hose to extend up the belt entry. Frank Knizner, Shop Mechanic, observed that water was not being discharged from the water deluge spray nozzle. The control valve handle was missing so Knizner used a wrench to turn the valve stem to the on position. Water began to flow from the spray nozzles, but by this time, the fire had spread inby the takeup, and to leave the water from the spray nozzles running would serve no purpose. Testimony did not establish the reasons this valve was turned off. In the meantime, Stowinsky was preparing to have the fire cars from 2 Left and Marianna 58 bottom sent to the 3 Northwest belt fire. Prior to cutting the firehose, he had determined that progress was being made in extinguishing the belt fire. Stowinsky reentered the belt entry and assisted miners in moving a 150-pound fire extinguisher through the equipment doors to alongside the belt drive, but it did not work. Upon this entrance to the belt entry, he found that the fire had spread inby to the belt takeup, and was burning out of control. He observed the fire was spreading too rapidly and realized the safety of the miners inby was in jeopardy. He walked to the intake escapeway and found it to be smoke free. He walked to the dumper shanty and called for Robinson to evacuate the mine; however, by this time, evacuation procedures had been started.

Stowinsky walked four blocks inby the fire in the intake escapeway and found Frank Dankovich and his crew from 5 Left. Harry Cogar, Roof Bolter, was having difficulty in breathing while walking the escapeway from 5 Left. Gary Kuklish and Barbara Rickard, Crew Members, gave assistance to Cogar. After assuring that miners from 5 Left were out, Stowinsky went back to find the 8 Left and 3 Northwest crews. Several minutes passed, and Stowinsky saw Mark Ladisic and the 3 Northwest crew again. They had already escaped safely. While Stowinsky was talking with Ladisic, George Sakel from 8 Left was seen walking behind the 3 Northwest crew. Stowinsky questioned Sakel about the 8 Left crew. Sakel stated the 8 Left crew continued to walk the left return to a location outby the fire. Stowinsky decided to don an SCSR and attempted to find the 8 Left crew in the left return. Heavy black smoke and poor visibility forced him to exit the return. Back on the track entry, Stowinsky talked with miners who had seen John Brottish and the 8 Left crew walking the track haulage. Hearing this and knowing all miners were safely outby the fire, he returned to the belt entry to continue fighting the fire. After the miners were removed from inby the fire, miners reduced the airflow over the fire by redirecting the air currents to the right return by opening mandoors and installing check curtains in the belt and intake escapeway entries.

A small hand-carried foam generator from the 2 Left fire station was positioned in the belt entry inby the belt drive and connected to the fire tap at the belt drive with a 1-1/2 inch firehose. A second foam generator was delivered from Marianna No. 58 bottom fire station and positioned approximately six crosscuts inby the belt drive in the parallel entry between the track and belt entry. Concrete blocks were removed from the belt stopping and the foam generator was placed in the opening. A 1-1/2 inch firehose was connected to the generator from the 2-inch metal water supply line in the No. 5 entry. The supply of foam was available in 5-gallon containers at the underground fire stations. At approximately 12:30 a.m., on March 8, Wayne Perkins, Company Safety Inspector, arrived underground to assist in fighting the fire. Perkins transported 700 feet of firehose and several fire taps to 3 Northwest. He instructed miners to install a 1-1/2 inch firehose to provide water to the intake escapeway, and a 1-1/2 inch firehose to the belt entry. The supply of foam was depleted and additional foam, which had been ordered, had not yet arrived. The water supply to the foam generator in the belt entry was turned to the off position. A fire nozzle was attached to the hose. While changing the firehose from the generator to the spray nozzle, the fire spread outby and totally engulfed the foam generator. Perkins and his crew retreated and applied water to the fire with two 1-1/2 inch firehoses. At approximately 1:37 a.m., Perkins and Stowinsky were informed that the fire had spread to the intake escapeway. Miners were instructed to install a check curtain between Nos. 3 and 4 crosscuts in the intake escapeway to restrict the airflow over the fire. Perkins had miners connect a firehose to a water fire tap near the fire station at 2 Left. The firehose was positioned to create a water spray barrier across the belt entry. Reduced water pressure at the fire resulted in the fire tap being turned to the off position. In an effort to prevent the fire from spreading inby, 10 tons of rock dust was discharged into the belt at No. 8 stopping. Perkins attempted to make a complete evaluation of the fire. He traveled approximately 15 crosscuts in the parallel No. 5 entry, checking stoppings for heat and opening doors to check the extent of the fire. He returned to the phone and informed the dispatcher of his findings. Persons at the fire site estimated the fire to be confined to the intake escapeway and belt entry. At approximately 2:00 a.m., Perkins was informed by Ron Bizick, Mine Inspector, that Marianna No. 60 and BethEnergy's Mine Rescue Teams were underground and being transported to the 3 Northwest belt fire. At approximately 2:30 a.m., BethEnergy Mine Rescue Teams and Charles W. Pogue, Coal Mine Safety and Health Inspector, Waynesburg Field Office, arrived at 3 Northwest.

An underground command center was established in the No. 1 crosscut between the track and belt entry. Communication was established by using a MSA three digital dial phone system to the surface command center at the Moore Portal.

Team members were assigned to relieve miners in the belt entry and intake escapeway. The fire in the intake escapeway had traveled to within 20 feet of the check curtain across the intake escapeway. The curtain was pulled from the right coal rib and water immediately applied to the flames. Miners were sent to attend the firehose in the belt entry. Foam was delivered in 5- and 50-gallon containers.

The surface command center requested that air readings be taken to determine the amount of air ventilating the belt, intake escapeway, and track entries. Measurements were taken and revealed that 22,300 cfm of air was present in the belt entry, 21,230 cfm of air was in the intake escapeway, and 153,000 cfm of air was in the track entry.

Ron Bizick and three mine rescue team members traveled the right return and reported heavy black smoke, but no fire. Wayne Perkins traveled the track and parallel entry and reported heavy smoke, but free of fire. At 5:45 a.m., Robert Newhouse reported that the belt fire was spreading to the parallel intake entry at No. 9 crosscut and requested that an additional mine rescue team be sent underground. At approximately 6:05 a.m., MSHA's Mine Emergency Response Team arrived at the fresh-air base to establish a monitoring station to remotely take air samples of the mine atmosphere in the left and right return entries. At 6:14 a.m., samples from the right return indicated 2.5 percent methane, 600 + ppm CO and 18 percent oxygen, in the left return, 1.3 percent methane and 19.3 percent oxygen. At approximately 7:15 a.m., Larry Mayton, Mine Superintendent, reported to the fresh-air base and assumed command of the firefighting activities. Mine Rescue Teams from Consolidation Coal Company's Bailey and Dilworth Mines arrived at the fresh-air base. Bailey's Rescue Team began constructing a bulkhead at the No. 9 crosscut for the placement of a Jamiason foam generator. The generator was placed in operation, but deenergized because of the lack of water pressure. Then they disconnected the firehose from the generator and began applying water through the belt stopping at No. 8 crosscut. A 4-inch plastic waterline and fire tap at each crosscut was being installed in the track entry. The Dilworth Rescue Team controlled the foam generator and firehose in the belt entry and intake escapeway. At approximately 10:00 a.m., the Emerald Mine Rescue Team arrived at the fresh-air base. They were given a briefing and requested to make a methane test in the Right return. They used a Riken detector and found 2.0 percent methane. After conducting the methane test, the team then relieved persons who were fighting the fire in the belt and intake escapeway. At approximately 11:00 a.m., Roger Uhazie, Supervisory Coal Mine Safety and Health Inspector; Barry Mylan, United Mine Workers of America (UMWA) Safety Inspector; and Bill Schlaupitz, Safety Inspector for Consolidation Coal Company, who had arrived at the fresh-air base earlier, opened a door in the No. 11 crosscut stopping. They determined that flames had totally engulfed the belt entry at this location. They returned to the fresh-air base and briefed Larry Mayton on the conditions found. Uhazie and Mylan walked to the intake escapeway and observed Mine No. 33 Rescue Team attending the foam generator at No. 7 crosscut. Miners were observed using a firehose at No. 6 crosscut in the belt entry. An evaluation of the roof inby the 3 Northwest belt drive resulted in additional roof supports (posts) being installed from the drive to No. 6 crosscut. At approximately 12:20 p.m., fire was reported burning over the top of the stopping at No. 12 crosscut to the track entry. Guard boards, cribs, and roof coal were burning. Miners began moving haulage equipment. A track jeep, locomotive, and supply car were abandoned because of the flames on the haulageway. Approval was given from the surface command center to remove the foam generator from No. 9 crosscut to a location between No. 10 and No. 11 crosscuts. Miners had constructed a bulkhead for that purpose. It was not until approximately 4:30 p.m., that miners had completely installed the 4-inch waterline. At approximately 1:00 p.m., four rescue teams from Maple Creek, Cumberland, Mathies, and Warwick Mine No. 3 were sent underground to the fresh-air base. The outby end of the fire in the belt entry was between No. 4 and No. 5 crosscuts, and the fire in the intake escapeway was at No. 5 crosscut. The monitor station had reported the following readings:

Left Return	CO 100 PPM	O_2 20.9%	CH_4 0.0%
Right Return	CO 600 PPM	O_2 14.5%	CH_4 2.6%

At approximately 4:30 p.m., while the rescue teams were fighting the fire in the belt and intake escapeway entries, the Cumberland Mine Rescue Team was sent to explore the No. 8 entry (right side) return air course. Heavy smoke and heat limited the exploration to a distance of about 300 feet. The Mathies Mine Rescue Team entered the left side return air course at No. 12 crosscut, at about 5:30 p.m., and reported clear air. The Cumberland Mine Rescue Team entered the left side return air course at No. 12 crosscut at about 8:30 p.m., and discovered the fire had spread into the return. They observed foam about 5 feet in depth, heavy smoke and detected 3.8 percent of methane, and returned to the fresh-air base. They were instructed to enter the left side return air course at the No. 4 crosscut and extend the monitoring station sampling hose from No. 2 entry to No. 1 entry. While the team was extending the sampling hose, Tony Bertovich, Captain, Mathies Mine Rescue Team, who had also entered the left return air course, detected 10 percent of combustible gas. After extending the sampling hose to the No. 1 entry, the monitor station reported to the surface command center that the combustible gas in No. 1 entry was in excess of 4 percent. At 9:00 p.m., on March 8, the surface command center ordered all persons to be withdrawn from the underground portion of the mine.

Surface Firefighting Activities

On March 8, 1988, at 9:00 p.m., all personnel were withdrawn from the underground area of the mine, and at 10:35 p.m., all power was removed from the underground portion of the mine. On March 9, at 12:45 a.m., all persons were removed from the surface area of the mine at Moore Portal.

The Company proposed a plan to flood the 3 Northwest fire area from the surface. Water borehole Nos. 1 and 2 were drilled to facilitate pumping the water. Borehole W was completed on March 25; however, it was never used for that purpose. No. 1 borehole was used to take air samples of the mine atmosphere and No. 2 water borehole was used to pump water into the mine. Water pumping started on March 13, 1988, and continued until March 15. Approximately 8 million gallons of water were pumped into No. 2 borehole.

To retain the water being pumped into the mine, additional boreholes were drilled to facilitate pumping stow material (limestone and cement). Boreholes A through S were drilled for the purpose of sealing. Polyurethane (23,000 pounds) was pumped into borehole S. The stow material was pumped into the remaining boreholes.

On March 17, 1988, the Company requested the MEO borehole camera to be lowered into the mine via borehole K, which was located in the left return of 3 Northwest. The only condition observed by the camera was heavy smoke.

A second plan was formulated to convert the water-retaining dams to air seals by using the existing boreholes and stone materials pumped into the mine. In addition to boreholes A through S, boreholes T, U, and V were drilled. Boreholes T and U were drilled for sealing 3 Northwest and V borehole was drilled for the purpose of monitoring the mine atmosphere behind the air seals. Results of a ventilation survey, air quantities and qualities, while Sabol fan was operating, indicated the air seals were ineffective.

Leakage at boreholes N through S was confirmed when nitrogen was pumped into borehole R and immediately detected at borehole S.

Nitrogen was injected into borehole R and, during the reentry of the mine on April 4, continued until the mine was evacuated on April 5.

The location of the boreholes and proposed flooding area are shown on the mine map in Appendix L.

Re-entry

At 10:00 a.m. on April 4, 1988, BethEnergy, Inc., officials presented a plan for re-entering the No. 58 Mine to determine the condition of the seals at 3 Northwest. The plan provided for an examination of the elevator at Moore Portal and then for two rescue teams, accompanied by a minimum number of persons necessary for support, to proceed underground and walk to 2 Northwest and establish a fresh-air base. Upon the completion of an examination at the 2 Northwest area, the teams would then proceed to 3 Northwest. Initially, the plan was not approved by MSHA since the V borehole had only been out of the explosive range of methane for about 3 hours. By 2:00 p.m., and after the V borehole was out of the explosive range for about 7 hours, the plan was approved. Jerry Davis, MSHA, and John Funka, Pennsylvania Department of Environmental Resources (DER), completed the inspection of the elevator at 4:15 p.m., and by 4:47 p.m., the Marianna No. 58 rescue teams, accompanied by Charles Pogue and Robert Swarrow, MSHA, had entered the mine. The teams traveled and explored the area up to 2 Northwest where they started encountering roof falls, roof and rib sloughage, water and smoke. At 10:25 p.m., the Cambria Mine Rescue Team entered the mine to relieve the Marianna Team and try to evaluate accessibility around the roof falls. After encountering 230 ppm

CO in the track entry and determining that all routes to the 3 Northwest seals were inaccessible, Ted Brisky, BethEnergy, Inc., ordered everyone to evacuate the mine. At 2:50 a.m., on April 5, all persons were out of the mine.

Sealing of the Mine

On April 5, a plan was submitted to stop the main fans and seal the mine. The seals were constructed of wood, plywood, brattice material and foam (Rigipak). The steel doors on Nos. 1 and 2 hoists were used as part of the seal. Sabol fan was stopped at approximately 8:40 p.m., Tuesday, April 5, and the shaft was sealed at approximately 11:00 p.m., Tuesday, April 5. Sealing operations continued on the remaining openings. Seals at these openings were completed at 2:00 a.m. on April 6. Samples of the mine atmosphere are being collected routinely at each main shaft and borehole.

Discussion

The area of the fire and equipment involved were not available for the investigation since the mine had been sealed. This investigation was limited to statements of witnesses, mine maps, the communication recordings, and other above-ground information.

1. The fire occurred at the main belt drive in 3 Northwest submains. These entries in 3 Northwest were started in February 1981, and had been mined about 5,400 feet. They provided production sources for three sections; the 3 Northwest section in the submains, 8 Left, and 5 Left sections. The shuttle cars on the 3 Northwest section dumped coal through a feeder directly onto the 3 Northwest 42-inch belt line. The 8 Left and 5 Left section shuttle cars dumped on feeders discharging on panel belts which, in turn, discharged upon the 42-inch belt in 3 Northwest. The 3 Northwest belt discharged into a bunker system which, in turn, was used to load mine cars.

2. The 3 Northwest submains was started with seven entries and, after one crosscut, an eighth entry was mined. In the vicinity of the fire and for some distance inby, the Nos. 1, 2, and 3 entries were returns, No. 4 was the track, No. 5 was a parallel intake, No. 6 was the belt, No. 7 was the intake escapeway, and No. 8 was a return. The belt drive was set in the first crosscut where the No. 5 intake entry was started, and, for four crosscuts inby, the belt and track entries contained most of the intake air for the 3 Northwest area.

3. The actual ventilation quantities are not known because air readings and mine map information was incomplete. Using all available information, the ventilation in the vicinity and for a few thousand feet inby the fire was

estimated. The intake escapeway only carried about 30,000 cfm at this point, but the track and belt combined carried at least 180,000 cfm. Information from an MSHA inspection on February 17 was as follows: the track entry contained a velocity of 1,700 fpm in the area of the fire; the belt entry contained 1,024 fpm five crosscuts inby the fire; 733 fpm at crosscut No. 12; and 375 fpm at crosscut No. 16. All of these readings were taken under overcasts and the last three readings were taken by the inspector and obtained from a UMWA safety committee person's notes. During the fire, CO sensors alarmed at crosscuts 23 and 54. Using the times and distances between these alarms, a velocity of 78 fpm was determined. These measurements and calculations indicate that the belt entry was such a high resistance entry that it shed its air rapidly to the Nos. 4 (track) and 5 entries, and that the belt entry did not deliver much air to the working sections. This is also supported by the fact that crews inby found smoke from the belt entry fire in all intakes.

4. A Mine Safety Appliance Company (MSA) automatic fire sensor and warning device system with point-type heat sensors was installed in the belt haulageways in the 3 Northwest area of the mine. Testimony indicated that alarms were heard in the dumper's shanty, but it could not be determined whether they were CO monitor alarms, heat sensor alarms, or both.

5. The Company had permission in the ventilation plan to use air in the belt entry to provide additional ventilation to working places and an MSA Data Acquisition Network (DAN) 6200 Monitoring Control System was installed to monitor for CO in belt entries. Sensors for the system were installed at the 3 Northwest belt drive unit and at intervals of 2,000 feet along the belts ~~(See Appendix J)~~. The computer components of the system were installed in the dispatcher's office located on the surface at Moore Portal. The system was installed to provide an audible and visual warning alarm to the dispatcher's office, which activated automatically when one or more sensors indicated a CO concentration of 10 and 15 ppm, respectively. In addition to an on-screen monitor of the CO concentration values received from the sensors, a printer was installed to automatically record data when the concentration was 10 ppm or higher. The separation between the belt and track entries had not been maintained completely, as permitted by the approved ventilation plan. Some stoppings between the belt and track in the submains had been completely or partially removed prior to the fire.

6. The intake escapeway was a single entry from Sabol shaft to 3 Northwest, a distance of about 2,800 feet. It then crossed five overcasts before entering 3 Northwest. Therefore, due to this intake entry resistance, it effectively was a regulated air split prior to reaching 3 Northwest and contained, at best, 30,000 cfm. It is believed the intake escapeway provided little ventilation to the working sections and probably some of the air it delivered to the sections was leakage from the belt entry. The high resistance of the intake escapeway and the proximity of the adjacent return promoted the belt air leakage through the stoppings separating the escapeway and the belt entry.

7. The cause of the fire can only be subject to speculation, as the investigation at the scene was prevented by the fire, and the mine has been sealed. It is believed that the conveyor was operating with peak loading at or above carrying capacity because: the three sections could have delivered up to 21 tons per minute at times; the Company had increased the angle of the troughing idlers outby the No. 5 Left to increase carrying capacity; spillage was observed during firefighting activities between the belt drive and the discharge area, a distance of about 300 feet; and, this spillage was several feet deep in places, up to and sometimes on the bottom belt. The spillage could have totaled 300 to 400 tons. Belt conditions immediately inby the drive are not known.

   The size of this accumulation of coal indicates that the conveyor belt drive and take-up may have operated with coal spillage and packed coal for some time; however, testimony indicated this accumulation did not exist at 7:00 p.m. Heat, generated by friction under these conditions, could have ignited the coal spillage around the drive. This early stage of the fire apparently did not produce a sufficient amount of CO to initiate a warning from the CO monitoring system, which was set to warn and alarm at 10 and 15 ppm, respectively. Therefore, the fire was not yet detected by the CO monitoring system. One CO sensor did alarm at 9:08 p.m. for about 30 seconds. At 9:08:30 p.m., this sensor (4-9), located at the end of 3 Northwest belt, indicated a high warning of 10.5 ppm. This warning automatically cleared at 9.5 ppm two seconds later. At 9:08:34 p.m., this sensor again indicated high warning of 11.5 ppm which was cleared at 9:08:59 p.m. when 10 ppm was indicated. There was no known activity in that area that would generate CO, and most alarms caused by electrical interference either indicate negative or higher positive readings. However, three sensors were upstream from sensor 4-9. Calibration differences of sensors could have played a role, but the information is inconclusive. This alarm was not investigated.

Momentary slipping of the belt in the drive, caused by the spillage, probably began to occur. As the slippage increased, it caused the belt to stop. Shortly after it stopped, probably 5 to 10 minutes, the belt was observed burning in the drive. Heat, generated by the slipping and suspected coal fire was believed sufficient to ignite the belt. It has been learned in recent belt fire tests by the Bureau of Mines that the point of belt ignition is a critical time in that much smoke occurs with a rapid increase in CO at that time. The CO monitoring system began to alarm at about the time the belt was discovered burning. This is also consistent with the recent Bureau of Mines belt fire tests. Until the point of belt ignition, the fire was apparently not large enough to produce sufficient CO to generate a warning from the CO monitoring system. However, between 10:30 p.m. and 10:45 p.m., four sensors of the CO monitoring system alarmed. Testimony indicates that during this period, the fire was small enough so that it could be fought directly, and the opinion of persons fighting the fire was that the fire could have been extinguished. However, adequate firefighting equipment was not readily available.

8. Firefighting facilities available for the 3 Northwest area of the mine included a 4-inch aluminum waterline installed along the belt conveyors to the belt tailpieces on the working sections. A 6-inch aluminum waterline was installed in the left side return air course. A 2-inch steel waterline was installed in the entry located between the belt conveyor haulage entry and the trolley haulage entry. Water was supplied from the Borough of Marianna's water system and by two 50,000-gallon capacity tanks located on the surface at Moore Portal. A "fire car" containing portable fire extinguishers, brattice material, and a portable foam generator was located in a track spur at 2 Left off 3 Northwest. Deluge-type water spray systems were attached to the water supply and installed at each belt drive unit.

9. The fire apparently began to propagate down the belt and to generate large volumes of smoke about 20 minutes after it was discovered burning. This is approximately the same time that persons located on the affected working sections were notified of the fire.

Interviews of the section crews indicated that the order to evacuate did not result in immediate evacuation of the 8 left and 5 left sections. The crews placed machinery in what were considered safe places, proceeded to the dinner hole, then in an orderly manner, proceeded to the mantrips. On the 3

Northwest section, the crew smelled smoke before they received notification to evacuate. Two miners obtained fire extinguishers, and this crew ran into heavy smoke shortly after evacuation started.

The Bureau of Mines has conducted detailed studies of the evacuation and the miners' use of SCSR's while leaving the mine. The Bureau of Mines report had not been published at the time this report was completed. Also, at the request of MSHA, the Bureau of Mines evaluated SCSR's used at the Marianna Mine for both escape and firefighting to determine whether complaints by the users of the SCSR's could be attributed to defects in the SCSR's (See Appendix E). It could not be determined which of the SCSR's evaluated by the Bureau of Mines were used in evacuating the mine.

10. The heavy smoke from the belt fire entered the intake track entry with the belt air as it rapidly left the belt entry (noted in the previous discussions). Leakage to the intake escapeway also caused that entry to be filled with smoke. Although examination of the stoppings separating the belt and intake escapeways was not possible following the fire, it is believed that since rapid smoke contamination of the intake escapeway occurred, there was substantial leakage through the stoppings. Also, the mine design contributed to the loss of a clear intake escapeway for the three crews. The escapeway was at a lower pressure caused by restrictions at the outby end, and it was in the leakage path of the belt air seeking a route to the return entry.

    The velocity of air in the belt entry did not cause the fire to burn out of control. The Bureau of Mines belt fire tests have shown that the type conveyor belt used burns faster at lower velocities than were present during the initial stage of the fire (See Appendix F). The lack of adequate fire protection and firefighting equipment allowed the fire to grow beyond control. In the early stages of the fire, miners were able to get close enough to the fire to use fire extinguishers. Belt fire tests conducted at the Bureau of Mines' Lake Lynn Laboratory demonstrated that, with air velocities of 800 ppm, miners would be able to get close enough to the fire. However, with the air velocity at 300 fpm smoke roll-back occurred, preventing close approach to the fire.

11. Information obtained from interviews during the investigation indicated that airflow was reduced in the belt entry at about 11:30 p.m., one hour after the fire was discovered. Mandoors were opened in stoppings outby between the belt to intake escapeway and intake escapeway to return to reduce the airflow. Air

readings taken by Federal inspectors at 2:30 a.m. were: 22,300 cfm in the belt entry; 21,230 cfm in the intake escapeway; and 153,000 cfm in the track entry.

At 12:30 a.m., the fire had been extinguished from the belt drive inby to the take-up, about one crosscut, but it had spread inby. At this time, it was confined to the belt entry. At about 1:37 a.m., the fire had spread to the intake escapeway at the third crosscut inby the drive, and a check curtain was installed in this entry to reduce air velocities. Between 2:30 and 3:00 a.m., a rescue team tried to cut the belt at a location 12 to 15 crosscuts inby the drive, but the heat in the belt entry was too intense, and this effort was not successful.

At 5:45 a.m., the fire had spread to the No. 5 entry, seven crosscuts inby the belt drive. The fire continued to spread and by 12:10 p.m. on March 8, had reached the track entry ten crosscuts inby the drive. At 8:30 p.m., the fire had spread to the left side return about ten crosscuts inby the drive, and at this time, the mine was evacuated. Progress on the inby edge of the fire was not established.

Conclusion

The sealing of the entire mine prevented any physical examinations of the fire area, or of equipment which could have determined the exact cause of the fire. Based on the information obtained during the investigation, it was the opinion of the MSHA investigators that the most plausible cause of the fire was a large amount of coal accumulated between the belt drive and figure eight, causing coal to be carried back into the drive rollers, resulting in friction which ignited the coal dust. Although other causes of the fire could be possible, evidence is not available to support other causes. The lack of adequate fire protection and firefighting equipment contributed to the severity of the accident.

Raymond A. Strahin
Coal Mine Safety and Health
Inspector

David N. Wolfe
Coal Mine Safety and Health
Inspector

Charles W. Pogue
Coal Mine Safety and Health
Inspector

Approved by:

Jerry L. Spicer
Administrator
for Coal Mine Safety and Health

Data Sheet

U.S. Department of Labor
Mine Safety and Health Administration

APPENDIX A

Section A—Victim Data

1. Name: Steve C. Vargo
2. Sex: ☒ Male ☐ Female
3. Social Security Number: -6181
4. Age: 59
5. Job Classification: Shuttle Car Operator
6. Experience at this Classification: 5 years
7. Total Mining Experience: 36 years
8. What activity was being performed at time of accident?: Operating shuttle car;
9. Victim's Experience at this Activity:
10. Was victim trained in this task?:

Section B—Victim Data for Health and Safety Courses/Training Received *(related to accident)*

	Date Received
11. Annual Refresher	03/07/87
12. SCSR	09/28/82
13.	
14.	

Section C—Supervisor Data *(supervisor of victim)*

15. Name: John Brottish, Jr.
16. Certified: ☒ Yes ☐ No
17. Experience as Supervisor: 10 years
18. Total Mining Experience: 18 years

Section D—Supervisor Data for Health and Safety Courses/Training Received *(related to accident)*

	Date Received
19. W65-SCSR	12/11/85
20. Mine Rescue	10/03/84
21. Methane & Oxygen Deficiency	10/04/84
22. SCSR	

23. When was the supervisor last present at accident scene prior to the accident?: N/A
24. What did he do when he was there?: Supervised the evacuation of 8 Left section.
25. When was he last in contact with the victim?: N/A
26. Did he issue instructions relative to the accident?: Yes
27. Was he aware of or did he express an awareness of any unsafe practice or condition?

No

Section I (Coal Only)

APPENDIX A **Steve Vargo**

MSHA and/or State Certification and/or Qualification

Mine ID 36-00957

Date Training Plan Approved 03/27/79

		Date Training Received			Date Training Received
* [ ]	Certified Person (Underground)		[ ]	Dust	
* [ ]	Certified Person (Surface)		[ ]	Dust (Calibration)	
* [ ]	Methane & Oxygen Deficiency Testing		[ ]	Noise	
* [ ]	Electrical		* [ ]	Impoundments	
* [ ]	Energized Surface High Voltage		* [ ]	Hoisting Engineer	

*Annual Retraining Required

Section II (Metal/Non-Metal and Coal)
MSHA Training Programs Completed

Date of Hire 12/17/46 Date Training Plan Approved 03/27/79

	Required Training (Victim)	Date Training Received		Required Training (Victim)	Date Training Received
[ ]	New Miner (U.G.)		[ ]	Hazard Training (U.G.)	
[ ]	New Miner (Sur.)		[ ]	Hazard Training (Sur.)	
[ ]	Newly Employed Experienced (U.G)				
[ ]	Newly Employed Experienced (Sur.)			Task Training Specify Type:	
[X]	Annual Refresher (U.G.)	03/07/87			
[ ]	Annual Refresher (Sur.)				

Section III

Company Training Program Completed:

Training	OJT/Formal	Instructor	Date Completed
Annual Refresher	Formal	R. A. Narshus	03/07/87

Section IV

APPENDIX A STEVE VARGO

DID VICTIM HAVE TRAINING SPECIFICALLY RELATED TO THE TASK BEING PERFORMED AT THE TIME OF THE ACCIDENT?

N/A

/ / YES / / NO WHEN? ____________

BY WHOM? ____________ HOW WAS TRAINING GIVEN? ____________

Section V

RECOMMEND TRAINING PLAN EVALUATION BY EDUCATION & TRAINING OFFICE

/ / YES /X/ NO

Data Sheet

APPENDIX A

U.S. Department of Labor

Mine Safety and Health Administration

Section A—Victim Data

1. Name: George Sakel
2. Sex: ☒ Male ☐ Female
3. Social Security Number: -8576
4. Age: 34
5. Job Classification: Shuttle Car Operator
6. Experience at this Classification: 8 years
7. Total Mining Experience: 13 years
8. What activity was being performed at time of accident?
9. Victim's Experience at this Activity
10. Was victim trained in this task?

Section B—Victim Data for Health and Safety Courses/Training Received ***(related to accident)***

	Date Received
11. Annual Refresher	04/04/87
12. SCSR	07/21/82
13.	
14.	

Section C—Supervisor Data ***(supervisor of victim)***

15. Name: John Brottish
16. Certified: ☒ Yes ☐ No
17. Experience as Supervisor: 10 years
18. Total Mining Experience: 18 years

Section D—Supervisor Data for Health and Safety Courses/Training Received ***(related to accident)***

	Date Received
19. W65- SCSR Training	12/11/85
20. Mine Rescue	10/03/84
21. Methane and Oxygen Deficiency	10/04/84
22.	

23. When was the supervisor last present at accident scene prior to the accident?

N/A

24. What did he do when he was there?

Supervised the evacuation of 8 Left section.

25. When was he last in contact with the victim?

N/A

26. Did he issue instructions relative to the accident?

Yes

27. Was he aware of or did he express an awareness of any unsafe practice or condition?

No

MSHA Form 2000-58, June 83 (Revised)

Section I (Coal Only)

APPENDIX A George Sakel

MSHA and/or State Certification and/or Qualification Mine ID 36-00957

Date Training Plan Approved 03/27/79

		Date Training Received			Date Training Received
*[ ]	Certified Person (Underground)		[ ]	Dust	
*[ ]	Certified Person (Surface)		[ ]	Dust (Calibration)	
*[ ]	Methane & Oxygen Deficiency Testing		[ ]	Noise	
*[ ]	Electrical		*[ ]	Impoundments	
*[ ]	Energized Surface High Voltage		*[ ]	Hoisting Engineer	

*Annual Retraining Required

Section II (Metal/Non-Metal and Coal)
MSHA Training Programs Completed

Date of Hire 08/03/74 Date Training Plan Approved 03/27/79

	Required Training (Victim)	Date Training Received		Required Training (Victim)	Date Training Received
[ ]	New Miner (U.G.)		[ ]	Hazard Training (U.G.)	
[ ]	New Miner (Sur.)		[ ]	Hazard Training (Sur.)	
[ ]	Newly Employed Experienced (U.G)				
[ ]	Newly Employed Experienced (Sur.)			Task Training Specify Type:	
[X]	Annual Refresher (U.G.)	04/04/87			
[ ]	Annual Refresher (Sur.)				

Section III

Company Training Program Completed:

Training	OJT/Formal	Instructor	Date Completed
Annual Refresher	Formal	R. A. Narchus	04/04/87

DID VICTIM HAVE TRAINING SPECIFICALLY RELATED TO THE TASK BEING PERFORMED AT THE TIME OF THE ACCIDENT?

N/A

/__/ YES /__/ NO WHEN?__________

BY WHOM?__________ HOW WAS TRAINING GIVEN?__________

Section V

RECOMMEND TRAINING PLAN EVALUATION BY EDUCATION & TRAINING OFFICE

/__/ YES /X/ NO

Data Sheet

APPENDIX A

U.S. Department of Labor
Mine Safety and Health Administration

Section A—Victim Data

1. Name: Joseph J. Ross

2. Sex: ☒ Male ☐ Female

3. Social Security Number: -1170

4. Age: 38

5. Job Classification: Section Utility Man

6. Experience at this Classification: 3 years

7. Total Mining Experience: 16 years

8. What activity was being performed at time of accident? Operating the continuous-mining machine

9. Victim's Experience at this Activity:

10. Was victim trained in this task? Yes

Section B—Victim Data for Health and Safety Courses/Training Received *(related to accident)*

		Date Received
11.	Annual Refresher	01/16/88
12.	SCSR	
13.		
14.		

Section C—Supervisor Data *(supervisor of victim)*

15. Name: John Brottish

16. Certified: ☒ Yes ☐ No

17. Experience as Supervisor: 10 years

18. Total Mining Experience: 18 years

Section D—Supervisor Data for Health and Safety Courses/Training Received *(related to accident)*

		Date Received
19.	W65 - SCSR Training	12/11/85
20.	Mine Rescue	10/03/84
21.	Methane and Oxygen Deficiency	10/04/84
22.	SCSR	

23. When was the supervisor last present at accident scene prior to the accident? N/A

24. What did he do when he was there? Supervised the evacuation of the 8 Left section.

25. When was he last in contact with the victim? N/A

26. Did he issue instructions relative to the accident? Yes

27. Was he aware of or did he express an awareness of any unsafe practice or condition?

No

APPENDIX A Joseph Ross

MSHA and/or State Certification and/or Qualification

Mine ID 36-00957

Date Training Plan Approved 03/27/79

	Certification	Date Training Received		Certification	Date Training Received
*☐	Certified Person (Underground)		☐	Dust	
*☐	Certified Person (Surface)		☐	Dust (Calibration)	
*☐	Methane & Oxygen Deficiency Testing		☐	Noise	
*☐	Electrical		*☐	Impoundments	
*☐	Energized Surface High Voltage		*☐	Hoisting Engineer	

*Annual Retraining Required

Section II (Metal/Non-Metal and Coal)
MSHA Training Programs Completed

Date of Hire 07/21/71 Date Training Plan Approved 03/27/79

	Required Training (Victim)	Date Training Received		Required Training (Victim)	Date Training Received
☐	New Miner (U.G.)		☐	Hazard Training (U.G.)	
☐	New Miner (Sur.)		☐	Hazard Training (Sur.)	
☐	Newly Employed Experienced (U.G)				
☐	Newly Employed Experienced (Sur.)			Task Training Specify Type:	
X	Annual Refresher (U.G.)	01/16/88			
☐	Annual Refresher (Sur.)				

Section III

Company Training Program Completed:

Training	OJT/Formal	Instructor	Date Completed
Annual Refresher	Formal	R. A. Narchus	01/16/88

DID VICTIM HAVE TRAINING SPECIFICALLY RELATED TO THE TASK BEING PERFORMED AT THE TIME OF THE ACCIDENT? N/A

/ / YES / / NO WHEN? ____________

BY WHOM? ____________________ HOW WAS TRAINING GIVEN? ____________

Section V

RECOMMEND TRAINING PLAN EVALUATION BY EDUCATION & TRAINING OFFICE

/ / YES / X / NO

Data Sheet

APPENDIX A

U.S. Department of Labor
Mine Safety and Health Administration

Section A—Victim Data

1. Name: David Knizner
2. Sex: [X] Male [ ] Female
3. Social Security Number: -4852
4. Age: 38
5. Job Classification: Continuous-Mining Machine Operator
6. Experience at this Classification: 3 years
7. Total Mining Experience: 12 years
8. What activity was being performed at time of accident? Operating the continuous-mining machine
9. Victim's Experience at this Activity: 12 years
10. Was victim trained in this task? Yes

Section B—Victim Data for Health and Safety Courses/Training Received *(related to accident)*

	Course	Date Received
11.	Methane Detection	
12.	Annual Refresher	06/13/87
13.	SCSR	
14.		

Section C—Supervisor Data *(supervisor of victim)*

15. Name: John Brottish, Jr.
16. Certified: [ ] Yes [ ] No
17. Experience as Supervisor: 10 years
18. Total Mining Experience: 18 years

Section D—Supervisor Data for Health and Safety Courses/Training Received *(related to accident)*

	Course	Date Received
19.	W65-SCSR Training	12/11/85
20.	Mine Rescue	10/03/84
21.	Methane and Oxygen Deficiency	10/04/84
22.	SCSR	

23. When was the supervisor last present at accident scene prior to the accident? N/A
24. What did he do when he was there? Supervised the evacuation of 8 Left section.
25. When was he last in contact with the victim? N/A
26. Did he issue instructions relative to the accident? Yes
27. Was he aware of or did he express an awareness of any unsafe practice or condition?

No

Section I (Coal Only)

APPENDIX A **David Knizner**

MSHA and/or State Certification and/or Qualification

Mine ID 36-00957

Date Training Plan Approved 03/27/79

		Date Training Received			Date Training Received
* [ ]	Certified Person (Underground)		[ ]	Dust	
* [ ]	Certified Person (Surface)		[ ]	Dust (Calibration)	
* [ ]	Methane & Oxygen Deficiency Testing		[ ]	Noise	
* [ ]	Electrical		* [ ]	Impoundments	
* [ ]	Energized Surface High Voltage		* [ ]	Hoisting Engineer	

*Annual Retraining Required

Section II (Metal/Non-Metal and Coal)
MSHA Training Programs Completed

Date of Hire 06/02/75 Date Training Plan Approved 03/27/79

	Required Training (Victim)	Date Training Received		Required Training (Victim)	Date Training Received
[ ]	New Miner (U.G.)		[ ]	Hazard Training (U.G.)	
[ ]	New Miner (Sur.)		[ ]	Hazard Training (Sur.)	
[ ]	Newly Employed Experienced (U.G)				
[ ]	Newly Employed Experienced (Sur.)				
[x]	Annual Refresher (U.G.)	06/13/87			
[ ]	Annual Refresher (Sur.)				

Task Training
Specify Type:

CMO	Brattice Man
CMOA	Motorman
Scoop	Jeep
Mantrip	
Shuttle Car	

Section III

Company Training Program Completed:

Training	OJT/Formal	Instructor	Date Completed
Annual Refresher	Formal	R. A. Narchus	01/15/88

DID VICTIM HAVE TRAINING SPECIFICALLY RELATED TO THE TASK BEING PERFORMED AT THE TIME OF THE ACCIDENT?

N/A

/ / YES / / NO WHEN?__________

BY WHOM?____________________ HOW WAS TRAINING GIVEN?____________

Section V

RECOMMEND TRAINING PLAN EVALUATION BY EDUCATION & TRAINING OFFICE

/ / YES /X/ NO

Data Sheet

APPENDIX A

U.S. Department of Labor
Mine Safety and Health Administration

Section A—Victim Data

1. Name: Harry D. Cogar
2. Sex: ☒ Male ☐ Female
3. Social Security Number: -5725
4. Age: 50
5. Job Classification: Roof Bolter
6. Experience at this Classification: 5 years
7. Total Mining Experience: 15 years
8. What activity was being performed at time of accident? Operating the roof drill;
9. Victim's Experience at this Activity:
10. Was victim trained in this task?

Section B—Victim Data for Health and Safety Courses/Training Received *(related to accident)*

	Course	Date Received
11.	Annual Refresher	07/11/87
12.	SCSR	07/12/82
13.		
14.		

Section C—Supervisor Data *(supervisor of victim)*

15. Name: Frank Dankovich
16. Certified: ☒ Yes ☐ No
17. Experience as Supervisor: 7 years
18. Total Mining Experience: 13 years

Section D—Supervisor Data for Health and Safety Courses/Training Received *(related to accident)*

	Course	Date Received
19.	Annual Refresher	12/06/87
20.	Mine Rescue	11/10/84
21.	Methane and Oxygen Deficiency	02/18/84
22.	SCSR	

23. When was the supervisor last present at accident scene prior to the accident? N/A
24. What did he do when he was there? Supervised the evacuation of 5 Left section.
25. When was he last in contact with the victim? N/A
26. Did he issue instructions relative to the accident? Yes
27. Was he aware of or did he express an awareness of any unsafe practice or condition? No

Section I (Coal Only)

APPENDIX A **Harry D. Cogar**

MSHA and/or State Certification and/or Qualification Mine ID 36-00957

Date Training Plan Approved 03/27/79

		Date Training Received			Date Training Received
*[ ]	Certified Person (Underground)		[ ]	Dust	
*[ ]	Certified Person (Surface)		[ ]	Dust (Calibration)	
*[ ]	Methane & Oxygen Deficiency Testing		[ ]	Noise	
*[ ]	Electrical		*[ ]	Impoundments	
*[ ]	Energized Surface High Voltage		*[ ]	Hoisting Engineer	

*Annual Retraining Required

Section II (Metal/Non-Metal and Coal)
MSHA Training Programs Completed

Date of Hire 11/15/72 Date Training Plan Approved 03/27/79

	Required Training (Victim)	Date Training Received		Required Training (Victim)	Date Training Received
[ ]	New Miner (U.G.)		[ ]	Hazard Training (U.G.)	
[ ]	New Miner (Sur.)		[ ]	Hazard Training (Sur.)	
[ ]	Newly Employed Experienced (U.G)				
[ ]	Newly Employed Experienced (Sur.)			Task Training Specify Type:	
[X]	Annual Refresher (U.G.)	07/11/87-			
[ ]	Annual Refresher (Sur.)				

Section III

Company Training Program Completed:

Training	OJT/Formal	Instructor	Date Completed
Annual Refresher	Formal	R. A. Narchus	07/11/87

DID VICTIM HAVE TRAINING SPECIFICALLY RELATED TO THE TASK BEING PERFORMED AT THE TIME OF THE ACCIDENT?

N/A

/ / YES / / NO WHEN?__________

BY WHOM?__________ HOW WAS TRAINING GIVEN?__________

Section V

RECOMMEND TRAINING PLAN EVALUATION BY EDUCATION & TRAINING OFFICE

/ / YES /X/ NO

APPENDIX B

Persons who participated in the investigation:

Beth Energy Mines, Inc., Northern Division

John Gallick	Division of Safety and Environmental Health
Roger Heard	Division of Safety and Environmental Health

Marianna Mine No. 58

Wayne Perkins	Safety Inspector

United Mine Workers of America

Leonard Fleming	International Health and Safety Representative
Thomas Shumaker	International Health and Safety Representative
Carol Davis	Chairman, Local No. 2874, Safety Committee
Denise Hutchison	Member, Local 2874, Safety Committee
Harry S. Gilpin	Member, Local 2874, Safety Committee

Pennsylvania Department of Environmental Resources

Jesse Bolen	Deep Mine Inspector
Gene Letzo	Deep Mine Inspector
John Funka	Deep Mine Inspector - Electrical

Mine Safety and Health Administration

Raymond A. Strahin	Coal Mine Safety and Health Inspector
David N. Wolfe	Coal Mine Safety and Health Inspector
Charles W. Pogue	Coal Mine Safety and Health Inspector
Jerry Davis	Supervisory Coal Mine Safety and Health Inspector

Pittsburgh Safety and Health Technology Center - Ventilation Division

John Urosek	Supervisory Mining Engineer
Kevin Stricklin	Mining Engineer

APPENDIX C

Persons who provided recorded statements.

Beth Energy Mines, Inc.

Thomas J. Shell	Electrical Engineer

Marianna Mine No. 58

Larry Mayton	Mine Superintendent
Francis Cooley	Special Engineer
Thomas Duvall	Mine Foreman
Robert Rasel	Chief, Maintenance Foreman
Wayne Perkins, Sr.	Mine Inspector
Lawrence Stowinsky	Afternoon Shift Foreman
James Bucenell, Jr.	Daylight Shift Foreman
John Stowinsky	Afternoon Mine Examiner
John Chisra	Daylight Mine Examiner
John Brottish, Jr.	8 Left Section Foreman
Frank Dankovich	5 Left Section Foreman
Mark Ladisic	3 Northwest Section Foreman
Charles Greyhosky	Daylight Construction Foreman
James Mihal	Maintenance Foreman
Forrest Salva	Shop Mechanic
John Moore	Shop Mechanic
Joseph Sciascia	Shop Mechanic
Frank Knizner	Shop Mechanic
Lawrence Washington	Daylight Dispatcher
John Robinson, Jr.	Afternoon Dispatcher
David Teagarten	Daylight Belt Dumper
Gary Lowery	Afternoon Belt Dumper
Richard Brumley	Afternoon Belt Dumper
Frank Bozith	5 Left Miner Operator
Joseph Machnik	5 Left Roof Bolter Operator
Barbara Rickard	5 Left Shuttle Car Operator
Larry Nopwasky	5 Left Shuttle Car Operator
Don Rasel	5 Left Utility Man
David Pinkney	5 Left Utility Man
Joseph Rudman	5 Left Section Mechanic
Gary Kuklish	5 Left Roof Bolter Operator
Chester Kuczykowski	5 Left Brattice Man
John Stepp	5 Left Miner Operator Helper

Harry Cogar	5 Left Roof Bolter
David Knizner	8 Left Miner Operator
Joseph Ross	8 Left Utility Man
Dennis Loey	8 Left Utility Man
Steve Vargo	8 Left Shuttle Car Operator
George Sakel	8 Left Shuttle Car Operator
Charles Miller, Jr.	8 Left Section Mechanic
David McVay	8 Left Brattice Man
Greg Petronka	3 Northwest Miner Operator
John Puska	3 Northwest Utility Man
Robert McMurray	3 Northwest Miner Operator Helper
Frank Skariot	3 Northwest Roof Bolter Helper
Floyd Lippencott	3 Northwest Shuttle Car Operator
Joseph Gilpin	3 Northwest Brattice Man
Gregory Amos	3 Northwest Roof Bolter Operator
Joseph Gmutza	5 Left Joy Man (belt cleaner)
Jack O'Neal	Midnight Belt Man

Mine Safety Appliance Company

Lawrence Peters	Sales Representative
Sam Tarsick	Service Representative

APPENDIX D

Mine Rescue Team Members who participated in the firefighting and recovery operations.

BETH ENERGY MINES, INC.

Mine No. 58 - Mine Rescue Team

R. Bizick
D. Raab
F. Fenia
W. Reese
B. DeBusk
B. Carson
T. Olinger
K. Wiley
B. Carroll

Mine No. 33 - Mine Rescue Team

F. Patterson
J. Williamson
F. Hoover
J. Johnson
R. Tronzo
R. Mervine
R. Bernazzoli
J. Gorcik
B. Hoover
W. Noll
J. Toth
E. Stock
R. McEvoy

Mine No. 108 - Mine Rescue Team

H. Allan
C. Tenney
D. Riegel
C. Wolfe
R. Bodkins
C. Taylor
T. Rader

Mine No. 131 - Mine Rescue Team

C. Aleshire
D. Signow
J. Smoot
D. Scott
B. Warner
R. Casto
J. Nichols
D. Dingess

UNITED STATES STEEL MINING COMPANY

Cumberland - Mine Rescue Team

Kenneth Murray
Gary Klinefelter
Robert Bohach
Frederick Waine
Thurman Titus
John Chambers
Patrick Maher
Charles Zabrosky

CONSOLIDATION COAL COMPANY

Bailey - Mine Rescue Team

Bill Schlaupitz
Lawrence F. Cuddy, Jr.
Larry C. Deemer
Thomas C. Rigotti
Bruce M. Beeles
Christopher T. McCauley
Tom Blaskovich
D. J. Waters
G. S. Kee
Peter D. Vicinelly
Jerry L. Rife
Eugene A. Menozzi

MATHIES COAL COMPANY

Mathies - Mine Rescue Team

Anthony Bertovich
Raymond Kocik
Don Krek
Harry Davis
Mike Matus
Terry Bennett
Malcolm Dunbar

DUQUESNE LIGHT

Warwick - Mine Rescue Team

David Adams
Ralph E. Burwell
Franklin Lawrence
Joseph E. Spiker
William F. Vanata
Robert E. Lawrence
Eugene McManis

UNITED STATES STEEL MINING COMPANY

Maple Creek - Mine Rescue Team

Wiliam Wilson
Larry Hunchuck
Jack Andrews
Vic Pagac
William Homistek
Edward Sullivan
Gerald Kosco
Vince Potoko
Lloyd Birt

EMERALD MINES COMPANY

Emerald Mine Rescue Team

Dennis Dobosh
Tom Bochna
Gary Bochna
Ed McIntyre
Allan Vazel
J. L. Kechner
J. D. Pekar
John Garcia
Brad Miller

CONSOLIDATION COAL COMPANY

Dilworth - Mine Rescue Team

James E. Hunyady
J. L. Weiss
John J. Gearing
John J. Connelly
Andrew M. Berdar
Michael L. Miller
Joseph T. Oziemblowsky
Edward Plisko

THE NACCO MINING COMPANY

Powhatan No. 6 - Mine Rescue Team

John Forrelli
Steve Hill
Mike Voleck
John Voleck
Don Foster
Gary Garczyk
Dick Rice
Jerry Taylor
John Palfy
Jerry Edgar
Claude Luke
Gary Jones

United States Department of the Interior

BUREAU OF MINES

PITTSBURGH RESEARCH CENTER
COCHRANS MILL ROAD
POST OFFICE BOX 18070
PITTSBURGH, PENNSYLVANIA 15236-0070

APPENDIX E

MINE SAFETY AND HEALTH ADMINISTRATION
MORGANTOWN, W. VA.
AUG 3 1988
RECEIVED

May 23, 1988

Mr. Jeffrey Kravitz, Chief
Mine Emergency Operations
Mine Safety and Health Administration
1200 Airport Road
Aliquippa, Pennsylvania 15001

Dear Jeff:

Attached is a report describing our inspection and evaluation of the CSE SCSR's recovered from the Marianna Mine fire. The apparatus were used both for escape and firefighting. The testimonies included some complaints from the users, some stating that they couldn't get enough air, with one person twice losing consciousness while wearing the apparatus. We attempted to determine if the complaints were attributable to defects in the SCSR's.

We found holes in the breathing bags of several of the SCSR's. We could not determine, however, if the holes existed prior to use or occurred during handling and storage after use. There was no other damage found in the apparatus. From the testimonies of the users, however, it was learned that they all exhaled into the apparatus during the donning process. This filling of the breathing bag with mostly nitrogen could easily have caused an hypoxic situation resulting in loss of consciousness. The other complaints might be attributed to the miners' first actual use of the apparatus.

Please call if you have any questions.

Sincerely yours,

Nicholas Kyriazi
Biomedical Engineer
MSHE

Attachment

cc: NKyriazi
JGKovac
MSHE Files

MSHE:NKyriazi:lmw:05-13-88:723-6478

Marianna Mine Fire CSE SCSR's

SN	Exp Date	Cyl Pres	O2 Flow	Condition	Leak Test	Duration MIN	Avg Inh CO2 %	Min Inh CO2 %	Avg Inh O2 %	WB Temp °C	DB Temp °C	Exh Pres mm H_2O	Inh Pres mm H_2O
11503	10/89	2800	1.74		Pass	62	3.9	1.9	68	46	50	32	55
11508	9/89	0			Pass								
11544	7/89	0		Hole in bag	Fail								
11612	7/89	0			Pass								
11675	5/89	2200	1.68		Pass	42	2.9	1.3	75	48	52	34	56
11719	9/89	0			Pass								
11748	7/89	0			Pass								
11770	10/89	0			Pass								
11911	7/89	0			Fail								
11942	10/89	0			Pass								
11943	11/87	0			Pass								
11985	7/89	2300	1.7		Pass	47	3.4	1.6	76	47	51	32	5
12000	7/89	0			Fail								
12174	9/89	0			Pass								
12185	11/88	3500	2.45	Half opened. Flow later 1.73	Fail	72	3.6	1.7	78	47	51	34	5
12231	7/89	2100	1.68		Fail	46	2.2	0.7	72	46	50	32	5
12258	7/89	0			Pass								
12319	10/89	2200	1.72		Fail	43	2.5	0.9	71	43	50	32	5
12329	7/89	0		Holes in bag; bad dents in case.	Fail								
12412	7/89	1900	1.68		Fail	44	3.5	1.8	70	46	51	32	[illegible]
12417	7/89	0			Pass								
12460	7/89	1700	1.68		Pass	32	2.5	1	77	48	53	39	[illegible]
12480	7/89	0			Pass								
12481	11/87	0		Leak test marginal	Pass								
16606	10/87	0			Pass								
16607	7/89	0		Leak test marginal	Pass								
16737	11/88	0			Fail								
19069	11/88	3500	1.73	Dent in case.	Pass	76	4.3	2	66	47	51	35	
19149	9/89	2700	1.73		Pass	53	2.6	1.1	66	44	50	37	
20904	7/89	2300	1.7		Fail	47	3.7	1.9	66	46	50	33	
21245	5/89	1500	1.68	Hole in bag.	Fail	15	2.1	0.5	71	45	49	31	
21265	7/89	1800	1.72	Hole in bag.	Fail	34	2.5	0.8	66	46	50	31	

United States Department of the Interior

BUREAU OF MINES

PITTSBURGH RESEARCH CENTER
COCHRANS MILL ROAD
POST OFFICE BOX 18070
PITTSBURGH, PENNSYLVANIA 15236-0070

APPENDIX - F

December 20, 1988

Mr. Robert W. Dalzell
Chief, Approval and Certification Center
Mine Safety and Health Administration
Industrial Park Road
RR1, Box 251
Triadelphia, WV 26059

Dear Mr. Dalzell:

At the request of the Mine Safety and Health Administration (MSHA), two large-scale conveyor belt fire tests were conducted in the Bureau of Mines surface gallery at Lake Lynn Laboratory. The objective of the tests was to evaluate the flammability behavior of the belting, loaded with run-of-mine coal, at gallery airflows of 800 ft/min and 300 ft/min. The test conditions were selected to simulate those along the belt line at the time of the Marianna No. 58 mine fire, March 7, 1988. The belting and coal for the tests were provided by BethEnergy Mines, Inc. Representatives of MSHA, the Pennsylvania Office of Deep Mine Safety, United Mine Workers of America, and BethEnergy Mines observed one or both of the tests.

The surface gallery consists of a 90 ft long fire tunnel and a 20 ft long tapered transition section that connects the tunnel to a 6 ft diameter fan. The fan blows air through the tunnel at the desired rate. A schematic of the gallery is shown in the attached figure. The conveyor structure consists of 5 in diameter troughed idler rollers spaced 4 ft apart. The ignition source is a 3 ft by 2 ft liquid fuel tray fire positioned below and just downstream of the tail pulley. The tray fire is shielded from the direct airflow by the tail pulley and a steel plate. Thermocouples are located in the tunnel to measure gas temperatures and a gas sampling probe is positioned at the 80 ft location, 1.5 ft from the roof. An array of twelve thermocouples, uniformly distributed over the gallery cross section (81 sq ft), measures the average temperature of the hot gases exiting the tunnel; this temperature is used to calculate the fire intensity. Two video cameras are located in the transition section to observe and record the tests.

For these tests a 35 ft length (42 1/2 in width) of belt was placed on the top rollers with the top cover up and a 20 ft length of belt was placed on the bottom rollers with the top cover down. The distance between the top and bottom belts was about 16 in. The upstream ends of both belts were bent downward into the ignition tray, so that flames from the tray fire would envelop about 5 ft of the top belt and 3 ft of the bottom belt. Thermocouples were embedded at known distances along the edges and centerline of the top

Marianna Mine Fire SCSR Evaluation

The Bureau was asked to inspect and evaluate the condition of 32 CSE SCSR's that were recovered from the Marianna Mine after their use in a mine fire there on 7 March 1988. Some users complained that they couldn't get enough air and one person lost consciousness twice. We attempted to determine if these complaints were attributable to defects in the SCSR's.

Nineteen of the apparatus that we received had empty O_2 cylinders, eleven had partially-filled cylinders, and two were unused with full cylinders. All of the apparatus were visually inspected for damage or defects. The ones with O_2 remaining in the cylinders were tested on our breathing and metabolic simulator (BMS). The attached chart shows the results of the inspection and the BMS testing.

The inspection turned up holes in the breathing bags of several apparatus. Such holes can permit toxic gases in the ambient atmosphere to enter the breathing circuit, either by diffusion if the user is at a low work rate, or by entrainment while drawing the bag flat at a high work rate. It cannot be determined if the holes in the bags occurred before or after their use. We were told that the apparatus were deposited in a pile after their use; this handling may have damaged the breathing bags. One apparatus (12329) had a severely dented case in the vicinity of the several holes in its bag increasing the likelihood that this damage existed before use. This cannot be positively determined; however, this type of damage has been seen before in our long-term field evaluation of SCSR's.

Tightness of the breathing circuit was tested in all the apparatus according to the normal recommended manufacturer's procedure; twenty passed the leak test. Of the twelve that failed the leak test, four had visible holes in their breathing bags. As stated before, the failing of the breathing circuit tightness test may be a result of the handling and storage after use.

We found three apparatus (11943, 12481, and 16606) that were past their expiration dates and had not had their pressure regulators refurbished in the recall by CSE Corporation. They evidenced no defects or damage during their inspection, however.

All of the apparatus exhibited typical performance in the BMS tests. The values of the monitored variables at the ends of their durations (rather than entire test averages) were used for comparison since durations varied depending on cylinder pressure. The values of these variables for all of the apparatus were typical for the AU-9A1 and very close to each other except for CO_2, which was generally higher with longer duration.

The apparatus with no O_2 left were connected to a full O_2 cylinder in order to test the funtioning of their demand valves. Inhaling from each of these apparatus was easy and normal; no obstructions or 'stiff' demand valves were apparent.

In conclusion, we found no evidence that there were any mechanical problems with the AU-9A1 SCSR's that could have been the source of the complaints voiced by the users. The holes in the breathing bags of some of the apparatus may or may not have existed before their emergency use. If the holes did exist prior to use, the in-leakage of toxic gases, if present in the ambient air, could have caused the loss of consciousness, depending upon the nature and concentration of the pollutant. In addition, the testimonies revealed that all of the users exhaled into the apparatus upon donning. This filling of the breathing circuit with exhaled air, composed mostly of nitrogen, can lead to an hypoxic situation also causing loss of consciousness. Either inleakage of toxic gases or hypoxia could have caused the loss of consciousness. The complaints of not getting enough air must be attributed to the first-time use of closed-circuit breathing apparatus which are more restrictive than normal breathing.

belt and along the centerline of the bottom belt to measure flame spread rates. The coal was placed on the top belt starting at 8 ft from the upstream end. The coal bed was 8 in high along the centerline of the belt and 18 in wide, leaving about 12 in of exposed belting on each side. Additional thermocouples were placed within the coalbed. The coal loading was about 36 lbs per linear foot of belt (975 lbs of coal on 27 ft of top belt). The gallery airflow was set at 800 ±50 ft/min (65,000 CFM) or 300 ±20 ft/min (24,000 CFM) as measured at several locations above the top belt and near the exit of the tunnel. The airflow between the belts, measured 15 ft from their upstream ends, was about 200 ft/min at the 800 ft/min gallery flow and 80 ft/min at the 300 ft/min gallery flow.

For the test at the 800 ft/min airflow, two pieces of slightly worn 3-ply rubber belting were received: a 35 ft length of Goodyear Glide 500, MSHA Acceptance No. 28-3/24, and a 55 ft length of Goodyear Glide 500, MSHA Acceptance No. 28-3/42. Both belts were 42 1/2 in wide and 3/8 in thick, with an 1/8 in top cover and a 1/16 in bottom cover. A 35 ft length (300 lbs) of belt 3/42 was used for the top belt and a 20 ft length (182 lbs) of belt 3/24 was used for the bottom belt. For the test at the 300 ft/min airflow, a 70 ft piece of new 3-ply rubber belting was received: Goodyear Glide 600, MSHA Acceptance No. 28-3/40, 48 in wide, 7/16 in thick, with a 3/16 in top cover and a 1/16 in bottom cover. This belt had a composition similar to the Goodyear Glide 500, MSHA Acceptance No. 28-3/42. The belt was cut to a width of 42 1/2 in. The 35 ft top belt and 20 ft bottom belt weighed 375 lbs and 218 lbs, respectively. The coal was run-of-mine Pittsburgh seam coal, 3 in x 0; a coal analysis report is attached.

For both tests, two gallons of a fuel mixture (0.5 gal gasoline, 1.5 gal of kerosene) were floated on top of water in the tray and ignited. This quantity of fuel alone burns for 5 to 6 min with a peak intensity of 0.6 to 0.8 megawatts.

At the 800 ft/min gallery airflow, the belting in the ignition area ignited and a propagating fire ensued. The time-temperature traces obtained from the belt and coal thermocouples indicated that the flames spread along the exposed surfaces of the top belt and bottom belt at a rate of 2 ft/min. Flames reached the end of the exposed surfaces of the top belt about 18 min after ignition of the tray fire. As the fire propagated along the top belt, the belting and coal fell from the rollers to the floor and continued to burn. The average flame spread rate along the centerline of the top belt and along the coalbed is estimated to be 0.8 ft/min. This is only an estimate since the flame spread rate was influenced by the top belt and coal falling from the rollers. The maximum temperatures recorded by the belt thermocouples ranged from 800 to 900° C. The fire that consumed the belting lasted about 40 minutes and generated large quantities of black smoke. The residue collected from the floor after the test weighed 1055 lbs and consisted of black ashes containing small portions of charred belting, partially burnt coal and unburnt coal; about 400 lbs was lost as a result of the fire.

The peak fire intensity of 6 megawatts occurred about 14 min after the start of the test. The maximum downstream CO and CO_2 concentrations were 0.12% and 1.9%, respectively, and the O_2 concentration fell to 18.1%. The maximum gas temperature above the belting was 730° C and that near the roof at the tunnel exit was 198° C. There was no significant rollback of smoke and hot gas against the ventilation flow. The maximum gas temperature near the roof and 15 ft upstream of the ignition area was 9° C.

At the 300 ft/min gallery airflow, flames propagated from the ignition area 2 to 3 min after the start of the tray fire and reached the end of the top belt about 6 min later. The time-temperature traces indicated that the flames spread along the exposed surfaces and centerline of the top belt, and the coalbed, at a rate of 6 ft/min. The flames spread rate along the bottom belt is estimated to be 4 ft/min. The belt temperatures reached 900° C. As the fire progressed, large quantities of smoke were produced and the belting and coal fell to the floor and continued to burn. The fire that consumed the belting lasted for about 37 min from the start of the test. The collected residue weighed 955 lbs and consisted of black ashes containing some partially burnt and unburnt coal; about 600 lbs was lost due to the fire.

The maximum downstream CO and CO_2 concentrations of >1% and 12.4%, respectively, were measured about 10 min after the start of the tray fire; the minimum O_2 concentration was 4.1%. The peak fire intensity of 5.6 megawatts occurred at about 14 min. The maximum gas temperature above the belting was 1200° C and that near the roof at the tunnel exit was 430° C. A substantial rollback of smoke and hot gas, against the ventilation flow, filled the top half of the tapered transition section during most of the test. The smoke and gas exited the gallery via openings near the roof of the transition section. The maximum gas temperature near the roof and 15 ft upstream of the ignition area was 410° C. The pertinent data for both tests are shown in the table.

In conclusion, both strands of rubber belting and most of the coal on the top belt were consumed by fires of about 40 min duration at gallery airflows of 800 and 300 ft/min. The peak fire intensities were similar, about 6 megawatts. However, the flames propagated more rapidly along the belting and coalbed at the lower airflow, and downstream temperatures were greater. The downstream CO and CO_2 concentrations and the O_2 depletion were also significantly higher at the 300 ft/min airflow. Smoke and hot gas rolled back against the ventilation at the lower flow, but not at the higher airflow. Thus the results from these two conveyor belt/coal fire tests indicate that the fire hazards, in terms of flame spread rates, downstream temperatures and toxic product loading were greater at the 300 ft/min airflow than at 800 ft/min.

An edited version of the videotapes of both tests is available. If there are any question concerning the tests, please call (412) 892-6628.

Sincerely yours,

Richard W. Watson for

Charles P. Lazzara
Supervisory Research Chemist
Fires and Explosions

Enclosures

Table. - Conveyor Belt/Coal Fire Test Data
35 ft top belt (TB); 20 ft bottom belt (BB)

Test No. (date)	Ambient temp., C (F)	Airflow, ft/min	Flame spread rate, ft/min	Max. gas temp., C (F) Tunnel position			Max. fire intensity, megawatts	Max. CO, ppm	Max. CO_2, %	Min. O_2, %
				0 ft	35 ft	90 ft				
71 (10/27/88)	4 (39)	800	2 (TB) 2 (BB)	9 (48)	730 (1,346)	198 (388)	6	1,230	1.9	18.1
72 (12/8/88)	2 (36)	300	6 (TB) 4 (BB)	410 (770)	1,200 (2,192)	430 (806)	5.6	>10,000	12.4	4.1

Notes: 1. Flame spread rates were along surfaces of belt not covered with coal.
2. Gas sampling probes (CO, CO_2, O_2) located 80 ft into tunnel, 18 inches from roof.

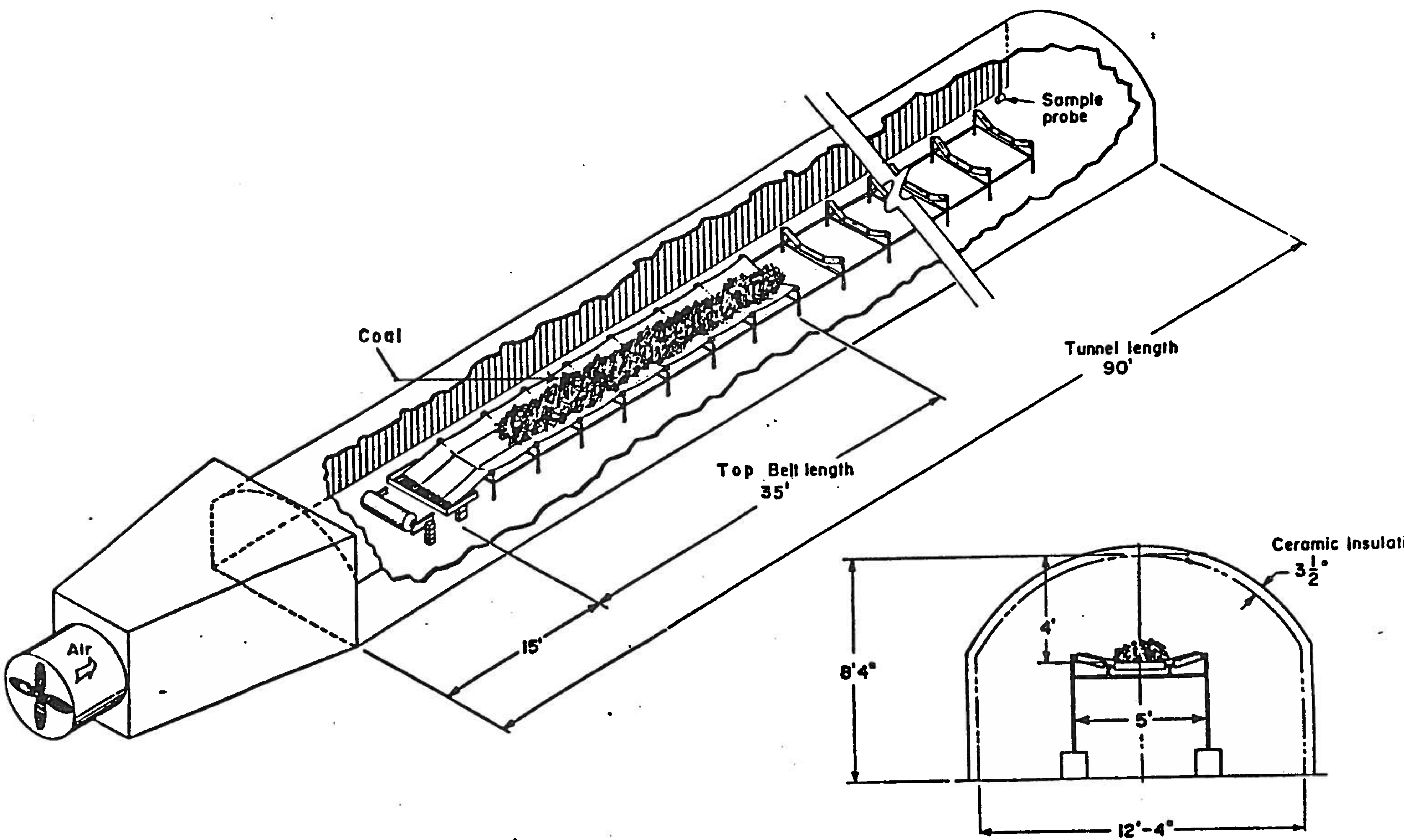


Figure. - Schematic of surface fire gallery.

GEOCHEMICAL TESTING
COAL, WATER AND MATERIALS ANALYSIS

R.D. 2, BOX 124
Somerset, Pennsylvania 15501
Phone: (814) 445-6666 or 443-1671

COAL ANALYSIS REPORT

Client: U.S. Bureau of Mines

Sampled by: Leon Miller

Sampling date: Rec 11/17/88

Analyzed on: 11/19/88

Description: P.O. #L0395171
Beth Energy Mines PGH Seam Coal

LAB NO. 58392	AS RECEIVED	DRY	DAF
MOISTURE	2.76		
ASH	32.95	33.89	
VOLATILE	27.22	27.99	42.34
FIXED CARBON	37.07	38.12	57.66
	------	------	------
	100.00	100.00	100.00
SULFUR	1.15	1.18	
BTU	9334	9599	14520

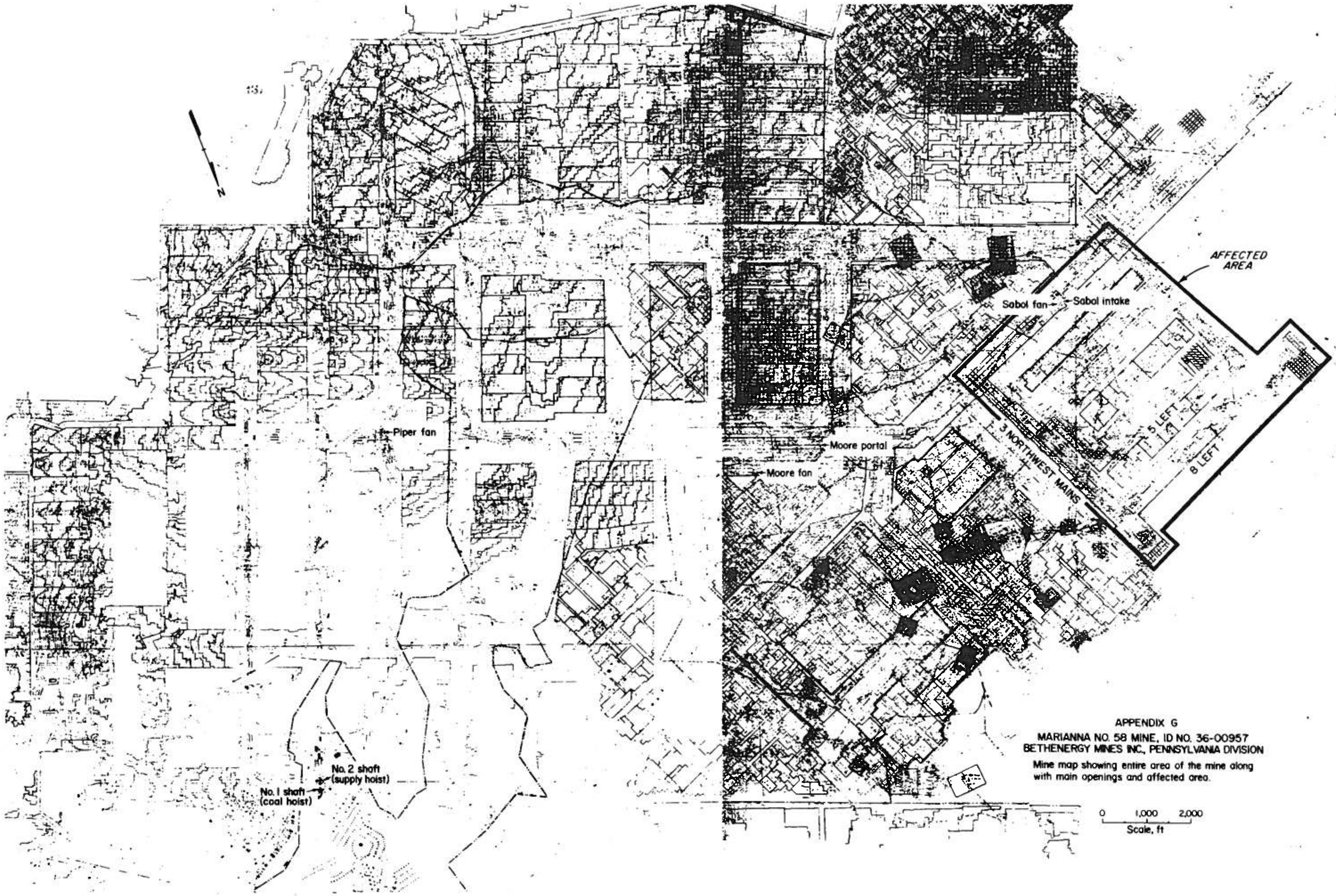
FSI 4.5

Forrest E. Walker
Director of Technical Services

APPENDIX G - MINE MAP (ENTIRE MINE)

Showing Mine Openings, Portal, Air Shafts, and the Affected Area.

1000' to the inch



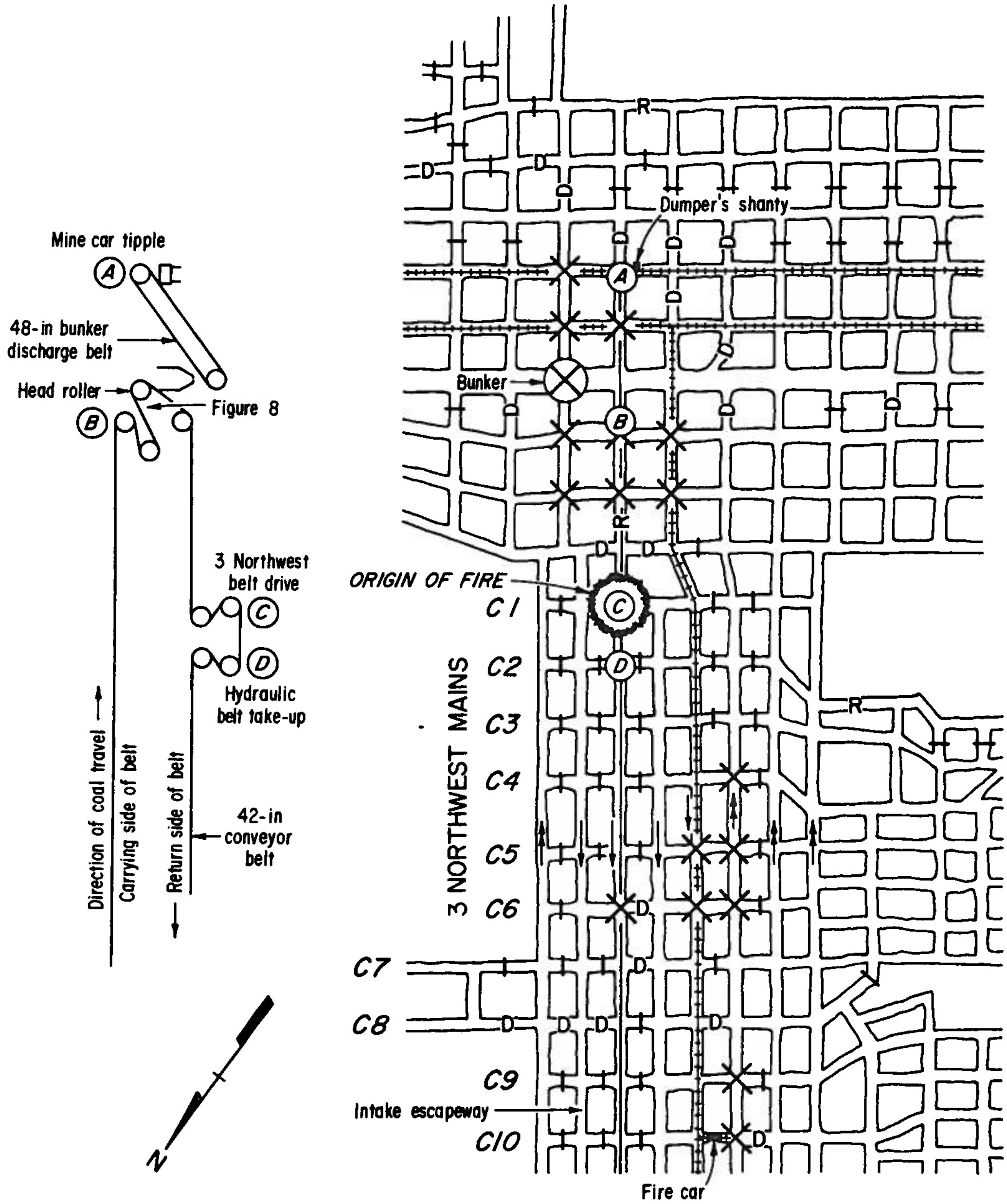
APPENDIX G
MARIANNA NO. 58 MINE, ID NO. 36-00957
BETHENERGY MINES INC., PENNSYLVANIA DIVISION

Mine map showing entire area of the mine along with main openings and affected area.

APPENDIX H - MINE MAP (AFFECTED AREA)

Location of Fire Car, Belt Drive, Takeup, Figure 8,

Bunker Area, Dumper's Shanty, Origin of Fire, etc.



LEGEND

=R= Regulator
⫫ Permanent stopping
=D= Permanent stopping with door
← Intake air
X Overcast
← Return air
++++ Track
— Belt
C9 Crosscut

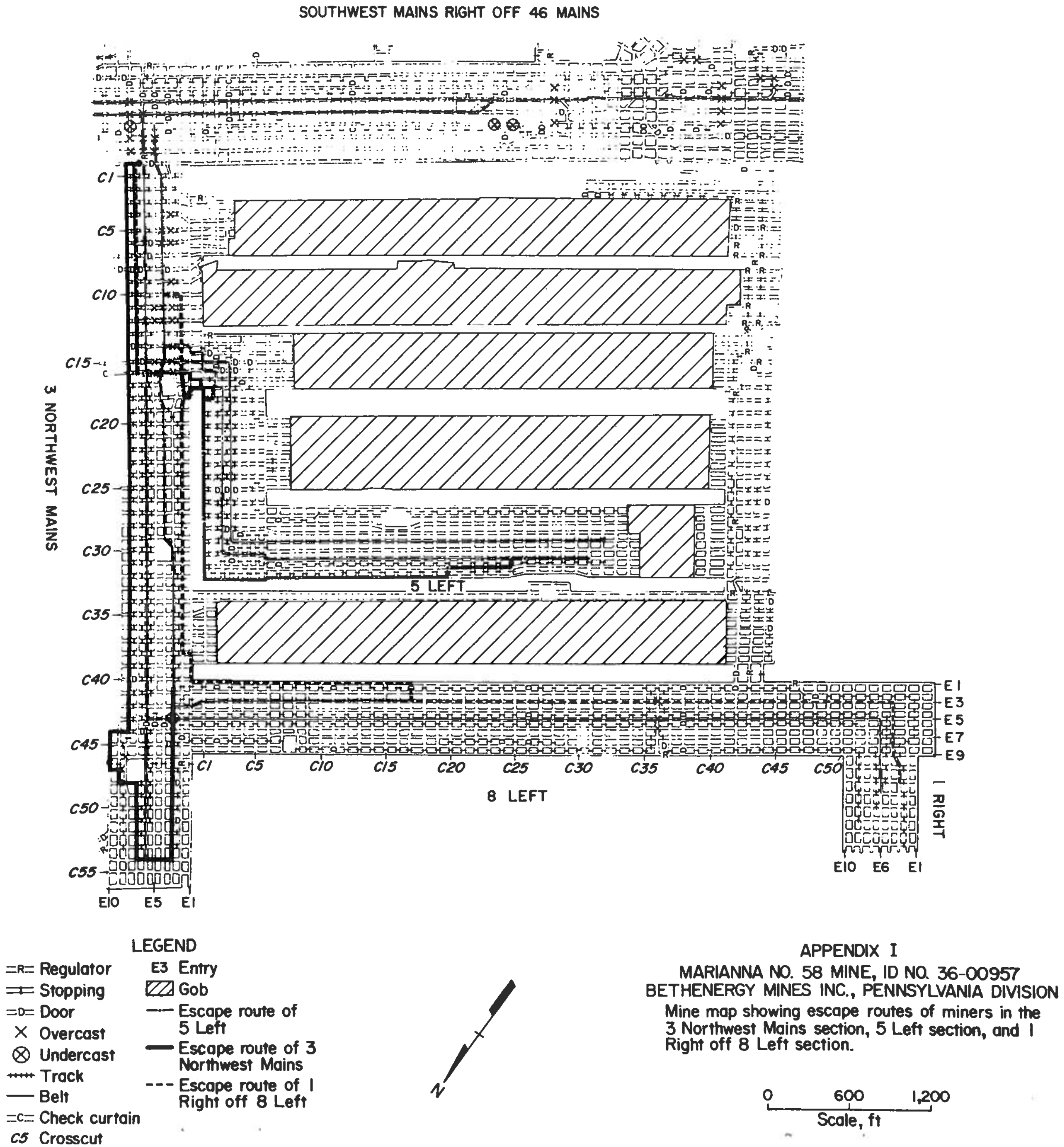
APPENDIX H

MARIANNA NO. 58 MINE, ID NO. 36-00957
BETHENERGY MINES INC., PENNSYLVANIA DIVISION

Mine map showing location of belt drive, take-up, figure 8, bunker area, dumper's shanty, fire car, and origin of fire.

0 300 600
Scale, ft

APPENDIX I - MINE MAP (ESCAPE ROUTES)

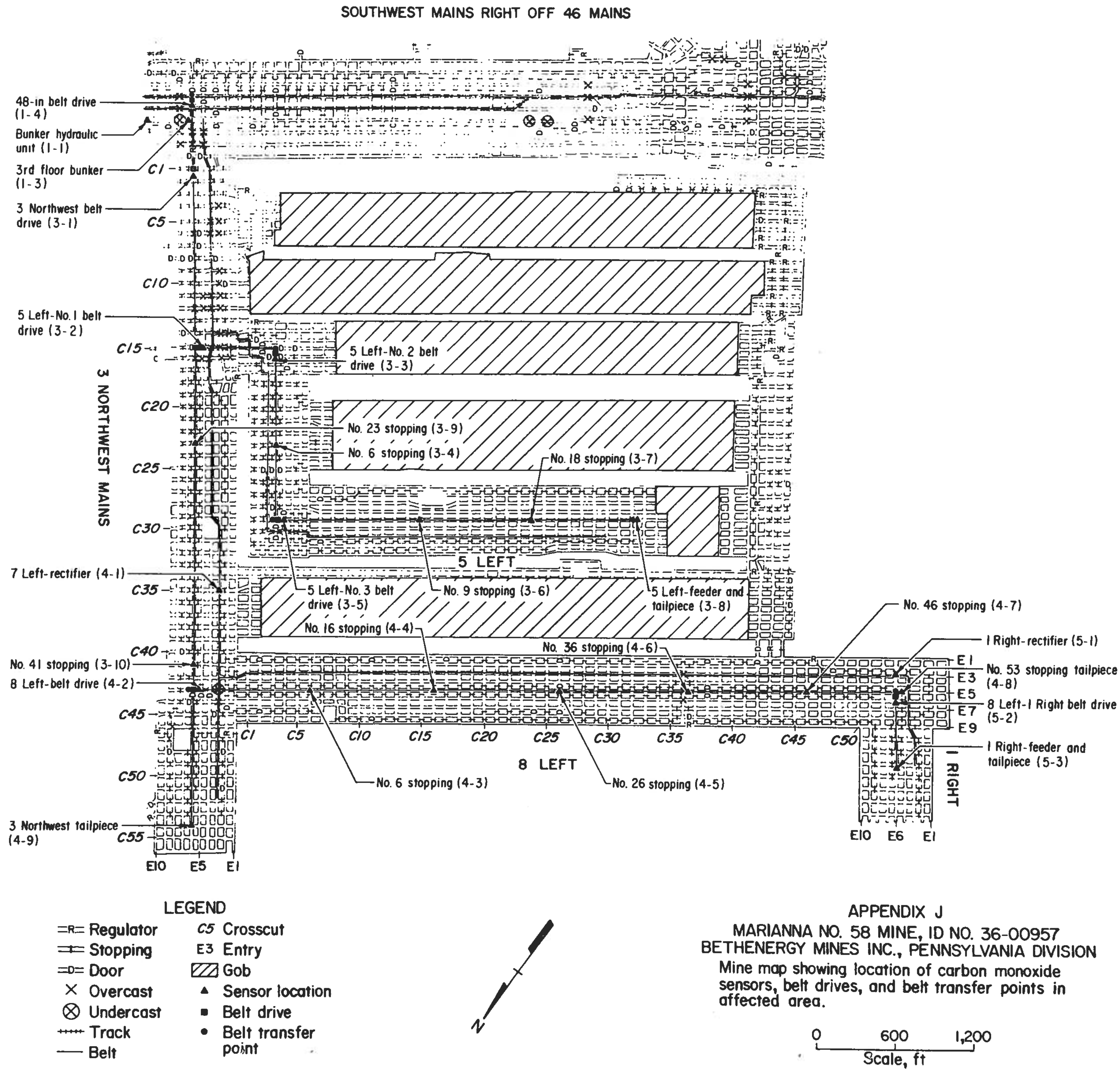


APPENDIX I

MARIANNA NO. 58 MINE, ID NO. 36-00957
BETHENERGY MINES INC., PENNSYLVANIA DIVISION

Mine map showing escape routes of miners in the 3 Northwest Mains section, 5 Left section, and 1 Right off 8 Left section.

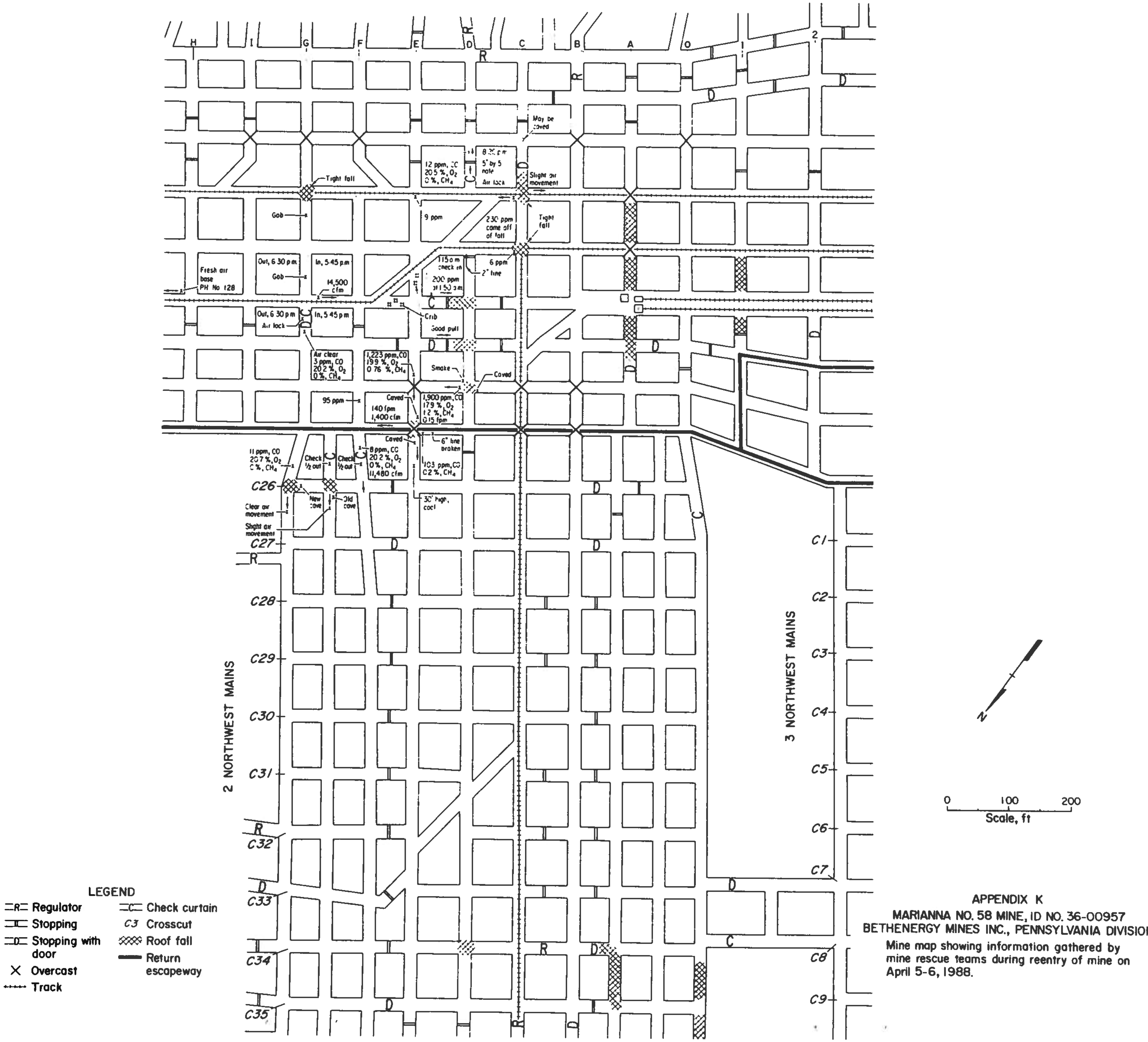
APPENDIX J - MINE MAP CO SENSOR LOCATIONS



APPENDIX J

MARIANNA NO. 58 MINE, ID NO. 36-00957
BETHENERGY MINES INC., PENNSYLVANIA DIVISION
Mine map showing location of carbon monoxide sensors, belt drives, and belt transfer points in affected area.

APPENDIX K - MINE MAP (RE-ENTRY)

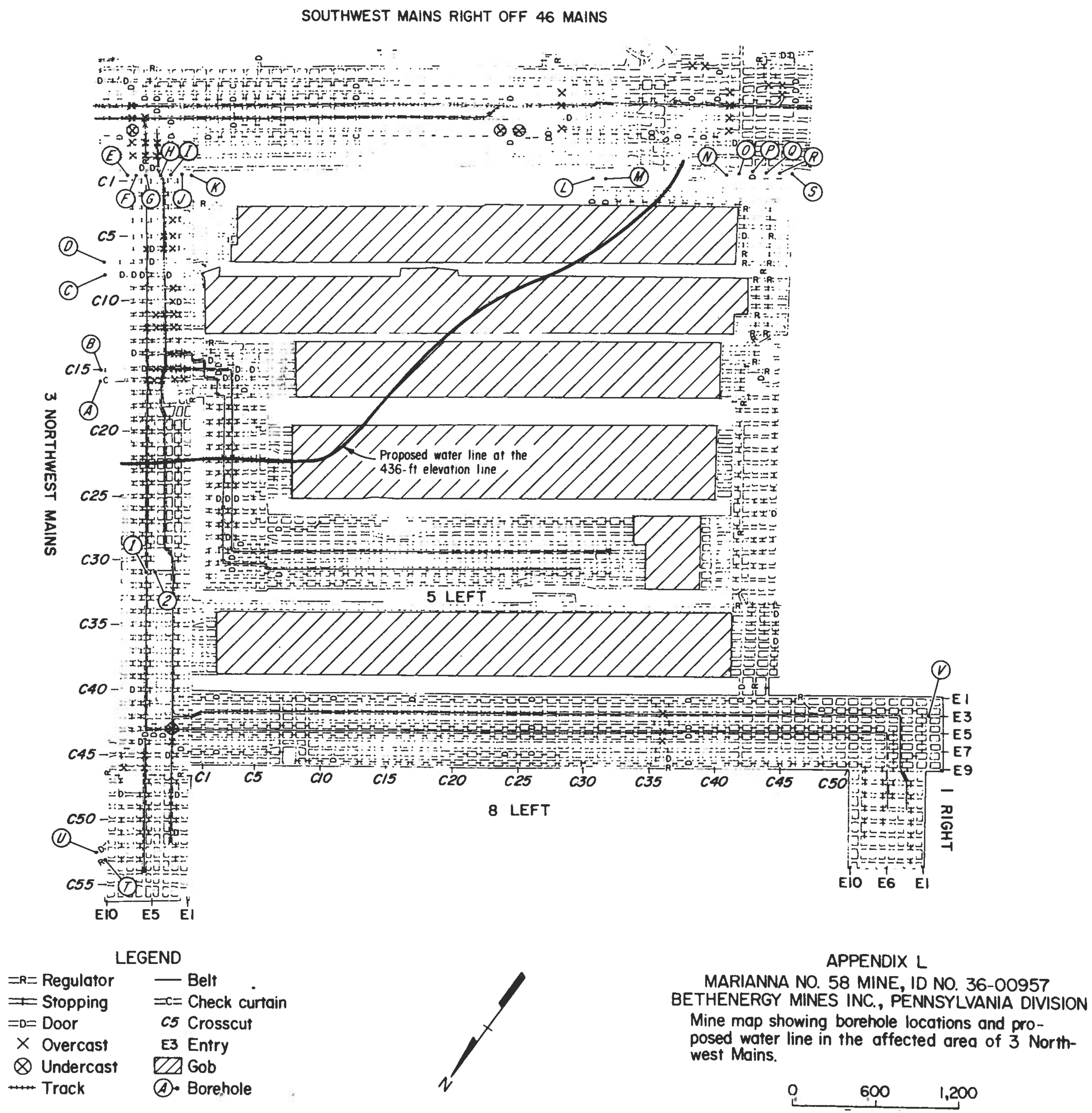


APPENDIX K

MARIANNA NO. 58 MINE, ID NO. 36-00957
BETHENERGY MINES INC., PENNSYLVANIA DIVISION

Mine map showing information gathered by mine rescue teams during reentry of mine on April 5-6, 1988.

APPENDIX L - MINE MAP BOREHOLE LOCATIONS



APPENDIX L

MARIANNA NO. 58 MINE, ID NO. 36-00957
BETHENERGY MINES INC., PENNSYLVANIA DIVISION

Mine map showing borehole locations and proposed water line in the affected area of 3 Northwest Mains.

ACTIONS BY MSHA SINCE THE FIRE

Abstract

This Appendix summarizes the actions taken by the Mine Safety and Health Administration since the March 7, 1988, Marianna Mine fire. The purpose of the summary is to show where, in the Agency's view, improvements are being made to reduce the likelihood of a similar occurrence in the future.

Discussion

(1) MSHA is preparing a proposed rule to introduce the use of belt materials with improved flame-resistant characteristics. Publication of the proposed rule is expected in the spring of 1990. The use of improved belt material in mines will reduce the likelihood of conveyor belt fires.

(2) MSHA's Belt Entry Ventilation Review Report, issued on August 25, 1989, included a preliminary discussion of the Marianna Mine fire. One conclusion of the Report was that the fire illustrates the importance of protecting the intake escapeway from air leakage from the belt entry or any entry containing fire sources. The Report also recognizes that the fire demonstrates the importance of training miners in mine evacuation during fire conditions. Based on the Report, the following actions have been taken:

(a) An MSHA informational bulletin was issued on November 2, 1989, to the mining industry. The bulletin addresses construction, maintenance, and inspection of stoppings, and reemphasizes that the belt entry should be separated from the intake escapeway with substantially constructed and well-maintained permanent stoppings.

(b) MSHA has undertaken a review of mine firefighting and evacuation plans to ensure that such plans address prompt warning of belt entry fires and immediate response to the alarms provided. Mine training plans are also being reviewed by the Agency for proper miner training in the use of SCSR's, including the preparedness of miners to travel through smoke during evacuation.

(c) Through the review and approval of mine ventilation plans, MSHA is applying the concept of designing mine ventilation systems to protect the intake escapeway from air leakage from adjacent intake airways.

(3) Ventilation plans for mines opened prior to 1970 in which "belt air" is used are being reviewed for possible revision. Such revisions would include any necessary provisions derived from petitions for modification which permit the use of belt air.

(4) To improve monitoring system technology, the Department of the Interior's Bureau of Mines and MSHA are jointly investigating the use of smoke detectors in underground coal mines. MSHA intends to use data obtained by the Bureau of Mines to develop performance standards for smoke detectors.

(5) Performance standards for CO monitoring systems are being developed by MSHA. These standards would address design and approval requirements for such systems.

(6) MSHA has asked the Bureau of Mines to conduct further research to evaluate the effect of air velocities on underground firefighting where coal and wood are involved. These tests would provide insight into firefighting activities in all areas of a mine. Conventional practice for fighting fires in mines is to reduce the flow of air over the fire. Tests by the Bureau of Mines focusing on flame propagation along conveyor belts have shown that such fires generally propagate less rapidly at higher air velocities. Future tests involving coal and wood, which are prevalent in all entries in a mine, would help to determine whether there is any advantage to restricting airflows to fight mine fires.

(7) MSHA issued an information bulletin to the mining community on December 5, 1989, which includes a description of the elements of a sound belt maintenance and clean-up program. MSHA inspection staff have also been instructed to re-emphasize the importance of belt entry maintenance during MSHA inspection activities.

Mine Citation/Order

U.S. Department of Labor
Mine Safety and Health Administration

Section I—Violation Data

1. Date (Mo Da Yr)	01 17 90
2. Time (24 Hr. Clock)	1100
3. Citation/Order Number	3128932
4. Served To	John M. Gallick
5. Operator	Beth Energy Mines, Inc.
6. Mine	Marianna Mine No. 58
7. Mine ID	36-00957 (Contractor)

8. Condition or Practice — 8a. Written Notice (103g) ☐

The approved books entitled "Examination of Electrical Equipment" containing the results of examinations of electrical equipment required to be conducted under the provisions of Sections 75.313-1, 75.512, 75.512-2, 75.703-3(d)(11), 75.812, 75.812-2, 75.900, 75.900-3, and 75.900-4, were not stored in a fireproof repository on the surface of the mine. The books were located in the underground shop area of the mine at Moore Portal and were not made available to interested persons due to the mine being sealed following a mine fire.

See Continuation Form (MSHA Form 7000-3a) ☐

9. Violation — A. Health ☐ Safety ☒ Other ☐ — B. Section of Act: — C. Part/Section of Title 30 CFR: 75.1808

Section II—Inspector's Evaluation

10. Gravity:

A. Injury or Illness (has) (is): No Likelihood ☒ Unlikely ☐ Reasonably Likely ☐ Highly Likely ☐ Occurred ☐

B. Injury or Illness could reasonably be expected to be: No Lost Workdays ☒ Lost Workdays or Restricted Duty ☐ Permanently Disabling ☐ Fatal ☐

C. Significant and Substantial (See Reverse): Yes ☐ No ☒ — D. Number of Persons Affected: 000

11. Negligence (check one): A. None ☐ B. Low ☐ C. Moderate ☒ D. High ☐ E. Reckless Disregard ☐

12. Type of Action: 104-a

13. Type of Issuance (check one): Citation ☒ Order ☐ Safeguard ☐

14. Initial Action: A. Citation ☐ B. Order ☐ C. Safeguard ☐ D. Written Notice ☐ E. Citation/Order Number: F. Dated: Mo Da Yr

15. Area or Equipment

16. Termination Due — A. Date: 04 17 90 — B. Time (24 Hr. Clock): 0800

Section III—Termination Action

17. Action to Terminate

18. Terminated — A. Date: Mo Da Yr — B. Time (24 Hr. Clock)

Section IV—Automated System Data

19. Type of Inspection (activity code): AFC — 20. Event Number: 5539561 — 21. Primary or Mill

22. Signature: David N. Wolfe — 23 AR Number: 20463

MSHA Form 7000-3, Mar 85 (Revised)

Mine Citation/Order

U.S. Department of Labor
Mine Safety and Health Administration

Section I—Violation Data

1. Date: Mo 01 Da 17 Yr 90
2. Time (24 Hr. Clock): 1100
3. Citation/Order Number: 3128933
4. Served To: John M. Gallick
5. Operator: BethEnergy Mines, Inc.
6. Mine: Marianna Mine No. 58
7. Mine ID: 36–00957 (Contractor)
8. Condition or Practice
8a. Written Notice (103g) ☐

The mine map approved on December 1, 1987, did not include the volume of air entering and leaving the intake and return splits of the 3 Northwest Submain and an overcast located at the mouth of 3 Left off 3 Northwest Submains used to allow return air to pass over the intake escapeway.

See Continuation Form (MSHA Form 7000-3a) ☐

9. Violation: A. Health ☐ Safety ☒ Other ☐ B. Section of Act: — C. Part/Section of Title 30 CFR: 75.316

Section II—Inspector's Evaluation

10. Gravity:
A. Injury or Illness (has) (is): No Likelihood ☒ Unlikely ☐ Reasonably Likely ☐ Highly Likely ☐ Occurred ☐
B. Injury or Illness could reasonably be expected to be: No Lost Workdays ☒ Lost Workdays or Restricted Duty ☐ Permanently Disabling ☐ Fatal ☐
C. Significant and Substantial (See Reverse): Yes ☐ No ☒
D. Number of Persons Affected: 000

11. Negligence (check one): A. None ☐ B. Low ☐ C. Moderate ☒ D. High ☐ E. Reckless Disregard ☐

12. Type of Action: 104–a–,
13. Type of Issuance (check one): Citation ☒ Order ☐ Safeguard ☐

14. Initial Action: A. Citation ☐ B. Order ☐ C. Safeguard ☐ D. Written Notice ☐ E. Citation/Order Number: F. Dated: Mo Da Yr

15. Area or Equipment

16. Termination Due: A. Date: Mo 04 Da 17 Yr 90 B. Time (24 Hr. Clock): 0800

Section III—Termination Action

17. Action to Terminate

18. Terminated: A. Date: Mo Da Yr B. Time (24 Hr. Clock):

Section IV—Automated System Data

19. Type of Inspection (activity code): AFC
20. Event Number: 5539561
21. Primary or Mill:
22. Signature: Charles A. Pogue
23. AR Number: 20380

Mine Citation/Order

U.S. Department of Labor
Mine Safety and Health Administration

Section I—Violation Data

1. Date: Mo 01 Da 17 Yr 90
2. Time (24 Hr. Clock): 1100
3. Citation/Order Number: 3128930
4. Served To: John M. Gallick
5. Operator: Beth Energy Mines, Inc.
6. Mine: Marianna Mine No. 58
7. Mine ID: 36-00957 (Contractor)
8a. Written Notice (103g) ☐

8. Condition or Practice

Loose coal and coal dust was permitted to accumulate on the mine floor to a depth of up to 5 feet on both sides of the belt conveyor at the figure eight belt structure and accumulations were present to a depth of up to 18 inches on both sides of the belt from the figure 8 to the 3 Northwest belt drive unit.

See Continuation Form (MSHA Form 7000-3a) ☐

9. Violation: A. Health ☐ Safety ☒ Other ☐ B. Section of Act: — C. Part/Section of Title 30 CFR: 75.400

Section II—Inspector's Evaluation

10. Gravity:
A. Injury or Illness (has) (is): No Likelihood ☐ Unlikely ☐ Reasonably Likely ☒ Highly Likely ☐ Occurred ☐
B. Injury or Illness could reasonably be expected to be: No Lost Workdays ☐ Lost Workdays or Restricted Duty ☒ Permanently Disabling ☐ Fatal ☐
C. Significant and Substantial (See Reverse): Yes ☒ No ☐
D. Number of Persons Affected: 030

11. Negligence (check one): A. None ☐ B. Low ☐ C. Moderate ☒ D. High ☐ E. Reckless Disregard ☐

12. Type of Action: 104—a—,
13. Type of Issuance (check one): Citation ☒ Order ☐ Safeguard ☐

14. Initial Action: A. Citation ☐ B. Order ☐ C. Safeguard ☐ D. Written Notice ☐ E. Citation/Order Number: F. Dated: Mo Da Yr

15. Area or Equipment

16. Termination Due: A. Date: Mo 04 Da 17 Yr 90 B. Time (24 Hr. Clock): 0800

Section III—Termination Action

17. Action to Terminate

18. Terminated: A. Date: Mo Da Yr B. Time (24 Hr. Clock):

Section IV—Automated System Data

19. Type of Inspection (activity code): AFC
20. Event Number: 5539561
21. Primary or Mill
23. AR Number: 20380
22. Signature: Charles H. Pogue

MSHA Form 7000-3, Mar 85 (Revised)

Mine Citation/Order

U.S. Department of Labor
Mine Safety and Health Administration

Section I—Violation Data

1. Date: Mo 01 Da 17 Yr 90
2. Time (24 Hr. Clock): 1100
3. Citation/Order Number: 3128931
4. Served To: John M. Gallick
5. Operator: Beth Energy Mines, Inc.
6. Mine: Marianna Mine No. 58
7. Mine ID: 36-00957 (Contractor)
8. Condition or Practice — 8a. Written Notice (103g) ☐

A sufficient amount of water was not supplied at all times to the water branch lines and spray nozzles for the fire suppression device (water deluge system) installed at the 3 Northwest belt drive unit. The manual shutoff control valve for the deluge system was in the off position and the handle for the valve was missing.

See Continuation Form (MSHA Form 7000-3a) ☐

9. Violation: A. Health ☐ Safety ☒ Other ☐ — B. Section of Act: — — C. Part/Section of Title 30 CFR: 75.1101-3

Section II—Inspector's Evaluation

10. Gravity:
A. Injury or Illness (has) (is): No Likelihood ☐ Unlikely ☐ Reasonably Likely ☒ Highly Likely ☐ Occurred ☐
B. Injury or Illness could reasonably be expected to be: No Lost Workdays ☐ Lost Workdays or Restricted Duty ☒ Permanently Disabling ☐ Fatal ☐
C. Significant and Substantial (See Reverse): Yes ☒ No ☐ — D. Number of Persons Affected: 030

11. Negligence (check one): A. None ☐ B. Low ☐ C. Moderate ☒ D. High ☐ E. Reckless Disregard ☐

12. Type of Action: 104-a
13. Type of Issuance (check one): Citation ☒ Order ☐ Safeguard ☐

14. Initial Action: A. Citation ☐ B. Order ☐ C. Safeguard ☐ D. Written Notice ☐ E. Citation/Order Number: F. Dated: Mo Da Yr

15. Area or Equipment:

16. Termination Due: A. Date: Mo 04 Da 17 Yr 90 — B. Time (24 Hr. Clock): 0800

Section III—Termination Action

17. Action to Terminate:

18. Terminated: A. Date: Mo Da Yr — B. Time (24 Hr. Clock):

Section IV—Automated System Data

19. Type of Inspection (activity code): AFC
20. Event Number: 5539561
21. Primary or Mill:
22. Signature: Raymond A. Strahin
23. AR Number: 20538

MSHA Form 7000-3, Mar 85 (Revised)