PROCEDURES FOLLOWING MINE FIRES AND EXPLOSIONS

by

W. R. Park
Health & Safety Division
U. S. Bureau of Mines
Mt. Hope, West Virginia

Well organized, orderly recovery operations following mine fires and explosions do not occur just by chance. Such grganization has resulted from thoughtful preparation and effort by those in authority at a mine in developing procedures to be followed in the event of a fire or explosion. Although recovery operations following such occurrences may be different at each mine, there are many general rules and practices that should be followed.

Several years ago, an explosion occurred in a mine in southern West Virginia; 22 men died in that disaster. Recovery work was oderly, well organized, well handled, and presented a minimum calculated risk to those performing the operations. The good organization and effective handling of the job, particularly by company officials, doubtless resulted from the fact that they were experienced. This disaster was the third that had occurred in the company's mines in slightly less than 2 years. While we naturally deplore the circumstances that gave this company its experience, it is clear that something important was learned from each emergency. Hopefully, the day is not far off when we will have learned enough to prevent disasters altogether.

In contrast to the performance in connection with that disaster were the events surrounding an explosion that occurred the following day in a mine in central West Virginia near Summersville. Recovery operations at this mine were completely chaotic. The superintendent, assistant superintendent, and the acting mine foreman were underground when the explosion occurred. The superintendent and the assistant superintendent were killed, and the acting mine foreman exhausted himself underground attempting recovery operations. The general mine foreman, who was off duty and out of the State, did not learn of the explosion until the next day. Therefore, company officials with authority were not immediately available, and officials from other mines of the company did not arrive on the scene until late in the evening. Neighboring mine officials arrived at the mine shortly after learning of the disaster and these officials helped in every possible way; however, they had practically no experience with recovery work.

The mine is reached by one narrow mountainous road, and hundreds of people arrived at the mine during the first several hours after

the explosion. These people more than used all of the parking space available, blocked the road so that it was almost impossible to get to and away from the mine, and converged on the mine offices and other buildings until it was almost impossible to reach the mine openings, the buildings, or supplies. Furthermore, this crowd of people made it very difficult to converse with mine personnel, the recovery groups, and underground personnel. The crowd also hindered the collection of supplies and materials as well as the moving of such supplies and materials underground.

Underground recovery operations were slightly better organized, but overall direction of the underground work was not firm, and contact between the underground workers and surface people was extremely difficult. Although this explosion occurred during the morning of October 28, when Mr. Westfield and I arrived on the scene late in the evening, we found that overall recovery operations were in chaos, recovery work was poorly organized, and far too many people, including widows and children of the victims, were in the mine yard and buildings. Before going underground, we made some progress in having the surface activities controlled by having the mine yard roped off and patrolled by police officers, who after considerable difficulty were able to keep spectators out of the roped-off area. Company officials and State and Federal inspectors were assigned specific necessary duties on the surface, and underground many people were sent to the surface. Recovery operations were then planned and outlined and individuals were given specific duties and responsibilities.

Each of us here today likely believes and certainly hopes that neither a fire nor an explosion will occur in our mine; however, they do occur occasionally in even the best managed, well-maintained mines and when they do occur, particularly an explosion, the following steps must be taken promptly. If you are the highest man in authority at the mine when you learn that an explosion has occurred underground, you should immediately:

1. Have the main fan or fans checked to see that they are operating satisfactorily and keep whatever men are necessary at the fans to see that they stay in operation constantly. Repair any damage to the fan explosion doors or air duct.

2. Have the mine electrician or some other qualified person deenergize the mine electrical circuits and be certain that the disconnect switches are locked open or stay open until such time as those in authority deem it safe to reenergize the underground power lines.

3. Contact all underground working sections and other people underground, advise those you are able to contact to begin moving to the surface or to remain in the section and barricade themselves, or to take whatever actions is indicated by the circumstances and your conversation. Certainly, if the explosion is local or confined to one or two sections, you will not be able to contact these areas but will

be able to contact other working sections of the mine. Advise the underground personnel you are able to contact of all the details you know concerning the disaster and advise them on how they are to travel to the surface and on which escape routes they can most likely travel with the greatest degree of safety.

4. Notify higher local company officials of the occurrence, give them as many details as possible, and either notify all other high company officials or arrange to have some other person do so.

5. Notify or arrange to have notified local State and Federal inspectors as well as the main offices of the State and Federal inspectors. Notify or arrange to have law enforcement authorities advised of the disaster and request their assistance in keeping highways, parking areas, and the mine yard free of spectators and other people who are not essential to the recovery operations. Prepare or arrange to have prepared rooms for a first-aid station and a rescue station. Check or arrange to check first-aid supplies and stretchers. Arrange to obtain additional supplies if needed.

6. Arrange to alert mine rescue teams if they work on other shifts or rescue teams from neighboring mines of the company or other company mines in the area. Assemble or arrange to have assembled mine rescue apparatus and equipment. Establish immediately a preliminary plan of underground recovery operations, and if you are unable to lead this group, appoint the best qualified man available to be in charge of the recovery party. Outline the preliminary recovery operations as much as possible and arrange to have continuous contact between the recovery party and the surface by telephone or by whatever other means that are available. Alert or arrange to alert doctors and ambulances of the disaster and the possible need of service.

7. Establish some type of public relations and information service. Immediately after information of the disaster becomes available to the news media, newspaper, TV, and radio representatives will begin arriving on the scene.

a. A capable individual should be appointed to represent the company and give the news media information as it becomes available.

b. Telephone calls by the hundreds will begin coming to the mine from people requesting information concerning husbands, sons, brothers, and relatives; also, neighboring mine officials as well as mine officials from hundreds of miles away will call offering personal assistance as well as assistance in supplying materials and equipment.

8. Arrange to have employees needed for immediate underground work report to the mine as well as arrange to have personnel for succeeding shifts. Arrange to provide the necessary tools and equipment for re-

covery operations, such as saws, hammers, axes and brattice cloth. Where such tools and supplies are not immediately available at the mine, arrange to have them brought to the mine from other company mines, neighboring mines and warehouses. Arrange to have such supplies and materials stored and distributed by competent personnel. Arrange for food and perhaps housing for mine rescue teams and other members of the recovery parties when necessary. Arrange to furnish transportation for rescue teams and other members of the recovery party where necessary. Arrange with the engineering department to have prints of the sections of the mine affected by the disaster available in large numbers, particularly for the members of the recovery parties. Establish a positive check-in and check-out system and maintain the check-in and check-out system throughout the recovery operations.

9. If adjoining mines are interconnected with the disaster mine, the adjoining mine officials should be advised of the disaster so that employees in the adjoining mine may be withdrawn to the surface if necessary.

UNDERGROUND RECOVERY OPERATIONS

The company official leading the recovery party initially travels towards the explosion areas as carefully as possible looking particularly for the first evidence of explosion forces. Such evidence often is--a fine layer of mixed coal and rock dust that will settle on rock-dusted surfaces. Paper and other light materials are scattered by forces of the explosion and are carried and deposited on the haulage tracks and in other out-of-the-ordinary places. Recovery parties should not travel into a location showing positive evidence of explosion forces, unless the group is equipped with a carbon monoxide detector and a flame safety lamp.

Advancing into the affected area safely requires that the group be certain that they do not travel into oxygen-deficient or highly-explosive atmospheres. All mine explosions produce carbon monoxide and continuous testing with a carbon monoxide detector is an absolute necessity. The presence of carbon monoxide in an area shows clearly that protective equipment in the way of gas masks, Chemox, or oxygen breathing apparatus is necessary and must be used to examine inby areas. Many mine employees and officials have lost their lives by entering explosion areas without being able to check whether carbon monoxide was present in the area and without using protective equipment. You certainly can't help men trapped inby if you are overcome with carbon monoxide.

Whenever possible, recovery parties should enter underground mines and thereafter travel in intake air; when blown-out stoppings or overcasts or doors are first encountered, caution must be exercised, travel inby must be on foot and be slow, careful, and cautious. Continuous tests for oxygen deficiency, methane, and carbon dioxide should be made in the area with flame safety lamps and carbon monoxide detectors.

Where large areas have been affected and/or where methane or carbon monoxide is detected and stoppings and other ventilation facilities have been destroyed, mine rescue teams wearing protective equipment should examine as much inby area as possible before temporary ventilation is established by the erection of temporary stoppings and other ventilation facilities. Fairly effective temporary ventilation can be established by installing stoppings, checks, doors, and overcasts erected of canvas or plastics. Checks should be installed by the mine rescue teams. Mine rescue teams can usually examine inby in the explosion area for distances of about 500 feet. The explosion area should be examined and reventilated in this manner until the entire area has been recovered.

The recovery party should not pass side entries, rooms, abandoned areas, et cetera, until such areas have been examined or sealed. The foregoing methods of advance minimize the chances of forcing methane over an undetected fire in the explosion area which could result in a second or third explosion. While recovery parties are exploring and reventilating the explosion area, other men should be testing the air returning from the newly-ventilated area and in the main returns. Advancing recovery crews should be advised regarding such tests, and sudden or gradual increases in the methane and/or carbon monoxide percentages in these returns are danger signals that should be considered carefully by those in charge. Increased carbon monoxide generally indicates that there is a fire somewhere inby and an increase of methane indicates an explosive mixture of methane could be forced over the fire and cause an explosion. A substantial increase in carbon monoxide or methane content in air returning from an unexplored explosion area requires that recovery operations should be reevaluated and perhaps abandoned at least temporarily.

Recovery parties, of course, should attempt to reach and remove live persons from an explosion area as rapidly and safely as possible. However, care should be exercised in not disturbing evidence of the explosion in the affected area. Equipment, particularly controls of equipment, should not be disturbed, and exact records should be made of locations of equipment, line brattice, checks, stoppings, doors, clothing, bodies and flame safety lamps. Finally, and of major importance, underground recovery parties should follow plans and procedures of those in overall charge of the recovery operations. If the explosion area is large or if recovery operations are difficult and extend for more than 8 or 10 hours, recovery operations should be put on four 6-hour shifts with the crews relieving at the inby work locations.

When bodies are located by recovery crews, each body should be indentified by the lamp number or the indentification tag. The exact location of the body and number should be recorded in writing on a blueprint of the area when such print is available. Recovery crew members should not search the clothing on bodies, as there have been claims that money, watches, and other valuables have been taken from bodies by members of recovery parties.

3. Flooding fire area or entire mine - when considered, consider elevations - possibility of flooding area - effect of gas pressures.

4. Flushing with silt or other solid materials. Feasible on occasion, particularly if mine will not be reopened.

5. Use of inert gases - carbon dioxide. Effect of sealing or extinguishing fire is calculated from chemical analyses of air from sealed area. Fire in sealed area is considered extinquished when:

   a. Oxygen content of the sealed area will not support flame.

   b. Carbon monoxide has disappeared from the atmosphere in the sealed area.

   c. Area has been sealed for a sufficient length of time to preclude the likelihood of the fire rekindling.

Time for unsealing a fire area should be governed by:

1. Extent and intensity of fire at time of sealing

2. Type of burning material.

3. Tightness of seals and enclosed areas.

4. Influence of barometric pressure on enclosed area.

5. Position of fire area with respect to ventilation pressures.

6. Sampling and analyses.

7. Composition of fire gases in sealed area.

Preparation for unsealing:

1. Available apparatus and gas mask crews.

2. Ventilation changes when necessary - fire atmosphere directly to return airways.

3. Heavy rock-dusting outby seals.

4. Fan location and operation - with respect to fire location and seals.

5. Power circuits - deenergized.

MINE FIRES

Most mining men fear mine-fire hazards more than hazards encountered during recovery operations after an explosion because of possible explosion hazard, roof falls, fumes, heat and smoke.

Therefore, proper procedure in fighting, sealing, and unsealing mine fires is of the utmost importance. Incorrect procedure may result in one or more of the following:

1. Men working in the mine when a fire occurs may be needlessly exposed to or overcome by smoke and fumes from the fire.

2. An explosion with possible loss of life and property may occur during the fighting, sealing, or unsealing operations.

3. The lives of those engaged in fighting, sealing, or unsealing a mine fire may be jeopardized or sacrificed needlessly.

4. Property loss may be increased or curtailment of production prolonged.

Methods of Control and Extinguishment of Mine Fires

1. Fighting by direct attack.

   a. With water, rock dust, sand, foam generator, chemicals, fire truck, carbon dioxide.

   b. Fires can usually be extinguished by direct attack when in the incipient stage, but when underground fires burn freely for several hours, such fires often require sealing. Therefore, it is necessary to begin firefighting operations as rapidly and as orderly as possible. Water is still the best extinguishing agent for fires, but fire materials must be loaded and removed from the mine after the fire is extinguished and the materials cooled.

2. Sealing fire area - always necessary when there is danger of methane in the fire area.

   a. Simultaneous sealing of intake and return entries is necessary when dangers are presented by methane.

   b. Closure seals should be at least 1,000 feet from fire where possible.

   c. Sealing materials - lumber and wood fiber, concrete blocks, brick, brattice cloth.

6. Unsealing methods in writing for all people.

7. Air locking when necessary.

8. Unsealing by reventilating area and immediate exploration - most common method.

    a. Break intake air seal - examine fire area by apparatus crew first - then open return seals. Combustible gases should be kept below explosion limits - have men with detectors check returns at regulators.

In conclusion, don't ever expect that a fire or explosion recovery operation will be the same as one you were on previously - all are different in one respect or another.

COMMENTS

QUESTION: I have a question for Mr. O'Neal. In cases of mine disasters who has jurisdiction over this, the company, the Federal Bureau of Mines or the State Bureau of Mines?

ANSWER: I believe this is usually a joint venture but I believe that the state is overall the first option for the authority. I think the state and then the Bureau usually has a cooperative effort.

Mr. Richardson: I have just come from Washington and I heard this great argument going on between the pros and cons, those that think that the flame safety lamp is the only thing and others who think that this is not necessarily the instrument to use. I happen to be one who thinks it is but I would like your views upon this with respect to oxygen content and so forth.

ANSWER: This is a controversy that came up just recently in the last month or six weeks. The flame safety lamp has been long recognized--I guess for a 150 years or more--as an instrument for determining methane or an oxygen deficient atmosphere. As far as I know there has been no official policy adopted by our people in Mt. Hope. Myself, I like it. Although I understand that there is a possibility of going to differenct instrumentation. Here again this is all up in the air and I don't know what will be the final outcome. But I think the flame safety lamp is a good instrument for its purpose. That's just a personal opinion.

Mr. Gilliland: Jim, since you raised the issue that there were some people that didn't think that the flame safety lamp was so good, would you care to give some reasons that you may have heard as to why it isn't so good? I thought that you maybe had heard some specific comments that might be of value.

Reply: Well, I have no comments upon it at all. I have no knowledge of others that work so well. I don't know of anything else that does. They all depend upon batteries, but sometimes they're not working and this is the point that I question. It just goes back to the fact that some of the old things are still the best.

QUESTION: I'd like to ask a question of Mr. O'Neal. Due to the Farmington disaster, will there be any intensification of research work perhaps in degassification of coal seams, say something in the advance of the working face to get this gas out? Is the Bureau doing anything in this area?

ANSWER: I couldn't tell you for sure about their policies. I understand that there will be additional research on this.

QUESTION: On the Farmington disaster, has there been a decision reached as to the primary cause? Is there something that's particularly been hit upon?

ANSWER: No. No one is making a guess as to what particular incident actually transpired to set it in motion.

Dr. Scott: May I make one comment. It came to mind in Mr. O'Neal's talk about public news media in relation to these disasters. I don't know how many of us here saw CBS's program entitled "Mines-Danger" but I think there is a lot for us in the mineral industry to think about in the publicity area. I tried to do something about this in this conference. That is, I tried to get some coverage by the national medias of this conference. I talked with some vice presidents of NBC and of CBS on this by phone for some considerable period of time and felt I had made some progress. However, I don't see the television cameras in this room. I suggested to the news media that perhaps such a title as "Mines-Danger" was not just, considering what they covered. They didn't sa "Danger gaseous coal mines of West Virginia" - gaseous coal seams whether it's the state of West Virginia or any other state. They said "Mines-Danger." And that puts the little limestone producer, uranium miners, lead miners, and everyone else, even me as an educator, in the same basket. I don't know quite what to do about this. It's so hard for me to talk to a mother about her son coming here to school and for her to encourage him in a mineral oriented career when the only thing that she has seen, that relates to the industry, is some widow being asked a question at the time of the disaster, 'Well do you think we should have more mine inspection?' What a loaded question to put to some poor person who has just lost her husband. This is slanted news coverage. In the mineral industry these disasters are terrible but I think we have to stand up on our feet as professional people, as dedicated people to this industry in which we are involved, stand and be counted. We're not all bad. We're working on these problems and I get quite disturbed about this sometimes, I don't really know the answer to the problem.

COMMENT FROM FLOOR: Well you know this slanted news doesn't necessarily just apply to disasters. I'm going to use an example. Back in about 1961 when all the news media discovered all this poverty down in southern West Virginia and eastern Kentucky NBC came down to souther West Virginia and wanted to see a poverty stricken area. The people took him to see a town called Matoka which for all practical purposes was an abandoned mining town and the school was still there. This school was in pretty bad shape, windows were knocked out and there was maybe one or two rooms and one or two teachers. So cameramen were all over the place and used this on an evening news program. It so happened in the same county they had just finished about a 3 million dollar high school. So after the people got through showing the school in Matoka and all the pictures had been taken they asked them to come over and see their new school. Their reply was 'Oh, we're not interested in seeing new schools.'