AN EXAMINATION OF MAJOR MINE DISASTERS IN THE UNITED STATES AND A HISTORICAL SUMMARY OF MSHA'S MINE EMERGENCY OPERATIONS PROGRAM

by

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ABSTRACT

The purpose of this paper is to briefly review some major mine disasters occurring within the United States and to investigate factors which precipitated development of a MSHA surface mine rescue system. This report discusses utilization of this system within the Mine Emergency Operations program of the Mine Safety and Health Administration (MSHA), U.S. Department of Labor. In addition, the research being performed to refine surface mine rescue techniques and procedures, update equipment, and take advantage of an ever advancing technology, is delineated.

INTRODUCTION

Records show that the first significant use of coal in the United States began in 1702 with coal obtained from outcrop deposits along the James River in Virginia. This coal was used in blacksmith forges. As time passed, mines went deeper, and by 1810 three vertical shafts approximately 300 feet deep were in operation. During that year (1810), the first coal mine explosion occurred. As mine depths increased, methane was more frequently encountered, increasing the probability of formation of explosive mixtures in poorly ventilated workings and mine explosions became recognized as one of coal mining's major occupational hazards.

In states where coal mine production began prior to 1820, there was about a 75-year interval between the beginning of mining and the first reported explosion. Where mining began between 1820 and 1850, the interval was almost 60 years, and where mining became a local industry after 1850, the average explosion free period was 20 years.[1]

On the morning of December 6, 1907, at the Monogah Nos. 6 and 8 Mines in Monogah, West Virginia, 367 men entered the mines to work. At 10:28 a.m., an explosion occurred killing nearly all persons underground, wrecking the ventilating system, smashing locomotives, motors, and cars, and destroying the surface boiler house and fan. Of those underground, 4 men escaped through an outcrop opening, and 1 man was rescued.

Thirteen days later, on December 19, 1907, at the Darr Mine, Jacobs Creek, Pennsylvania, at 11:30 a.m., an awful rumbling was followed by a loud report and a concussion shook the nearby buildings.

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[1]Figures in parentheses refer to items in bibliography at the end of this report.

The underground mine explosion was felt within a radius of several miles. Two hundred-thirty-nine men met their fate that day; no one escaped.

The increasing frequency of mine explosions and the tremendous loss of human lives aroused public attention and brought about action through federal agencies to find a way to control the threatening menace. Congress authorized an investigation into the causes of mine explosions with a safety factor viewpoint. Immediately after the passage of the Health and Safety Act in May 22, 1908, the Mine Accidents Division of the Technologic Branch of the Geological Survey was organized.

In an endeavor to reduce loss of life in rescue operations after mine disasters, an investigation was undertaken of various types of mine rescue apparatus and of mine rescue work in general. In addition to the main station at Pittsburgh, branch stations with rescue apparatus were established in various coal fields. The first was in cooperation with the State Geological Survey at Urbana, Illinois, in 1908; the second was at Knoxville, Tennessee; and the third was at Seattle Washington, in 1909.

On July 1, 1910, an Act of Congress (36 Stat. 369) established the Bureau of Mines. At the time of the passage of the Act, the factors that were most effective in calling attention to the advisability of action by the Government were the continuing disasters in coal mines and a growing realization of the waste of both life and resources in the various mining and metallurgical industries in the country.

During the ensuing years, there occurred a sharp reduction in mine disasters and fatalities. This was certainly due to the combined efforts of the Bureau of Mines, state inspectors, and mine officials that helped eliminate the causes that existed. As the years passed, unpredictable black powder explosives were replaced by permissible explosives; open light lamps were replaced by permissible electric cap lamps; permissible electrical equipment was required; increased use of training was stressed; and job specialities were introduced. Safety programs were instituted, better ventilation practices were initiated, and regular tests were made for methane. Rock dusting was performed on a regular basis, and federal inspections required by the Federal Mine Safety Act of 1952 helped locate and control potential problems.

By 1968, the frequency of mine disasters was significantly reduced and most major causes responsible for mine explosions had been identified.

Than at about 5:15 a.m., on November 20, 1968, an explosion ripped through the Consolidation Coal Company No. 9 Mine in Farmington, West Virginia. At the time of the explosion, 99 men were underground on the midnight to 8:00 a.m. shift. During the following days, 21 men managed to escape; but on November 30, 1968, after repeated explosions and uncontrolled fires, rescuers were forced to seal the mine entombing 78 miners.

Once again, public attention was aroused and with the issues of mine health and safety the topic of debate, the 91st Congress enacted the Federal Coal Mine Health and Safety Act of 1969.

Sensing the urgent need for action to develop more sophisticated and effective mine survival and rescue techniques, the then Director of the Bureau of Mines, John F. O'Leary, sent a letter to the President of the National Academy of Engineering on December 3, 1968, inviting the academy to participate in a study to determine how miners' prospects of survival might be improved in the event of any circumstance that precluded their normal withdrawal from a mine.

At this point, a very significant event in the development of surface mine rescue techniques will be discussed. The date is August 13, 1963, and the place is Oneida No. 2 Slope Coal Mine, Felling Mining Company, Oneida, Pennsylvania. At about 8:50 a.m. on Tuesday, the supporting pillar on the east side of the slope collapsed without warning. Loose coal, rock, and timbers tumbled down and blocked the slope area entombing three workmen.[2]

The following is a sequential outline of events effectively leading to the rescue of two of the three trapped miners. Historically, this procedure is the first recorded event of a miner being located and rescued through a borehole in the United States.

8:50 a.m. - Tuesday Aug. 13	-	Collapse of slope pillar and entombment of three men.
2:00 - 5:00 p.m. - Tuesday	-	Blower fans and tubing installed in slope.
7:30 a.m. - Wednesday Aug. 14	-	Exploratory observations conducted into slope.
10:15 a.m. - Wednesday	-	Gunboat lowered on trial run and continued collapse of pillars.

At this point it was determined that the men were inaccessible through the slope and other methods were necessarily required.

Wednesday afternoon	-	Plan to drill 6-feet diameter borehole to bottom of slope discarded due to unavailability of equipment and engineering problems.
7:00 p.m. - Saturday Aug. 17	-	6-inch diameter borehole (#1) started.
12:40 a.m. - Sunday Aug. 18	-	6-inch diameter borehole (#2) started.
9:25 a.m. - Sunday	-	#1 hole breakthrough at 331 feet. #2 hole stopped.
11:10 p.m. - Sunday	-	Drill pipe out of hole. Indistinct voice communications heard. Telephone lowered, not effective. Microphone lowered, connected to amplifier at surface. Sound amplifier lowered; two-way communications established. Lights and food lowered to (2) men. U.S. Navy physician sets up tent on-site. Medication lowered. Swollen hands and feet successfully treated.

1:30 p.m. - Sunday	-	#2 hole resumed in search of third man.
7:00 p.m. - Sunday	-	#2 hole reached 335 feet and did not breakthrough; hole had drifted north. Hole abandoned.
8:30 p.m. - Monday Aug. 19	-	#3 hole (6-inch) started.
3:40 p.m. - Tuesday Aug. 20	-	Rescue drill rig moved onto site and started drilling a 12-inch. hole (#4)
5:00 p.m. - Tuesday	-	Supply container lodges in supply hole. Attempts to free container, breaks food and communications lines. Situation rectified.
10:00 p.m. - Tuesday	-	#3 hole breaks through at 327 feet. One of the two miners already found sees bit. Oral communications established between third victim and second victim. Communications equipment lowered to try to communicate to third victim. No response.
10:15 p.m. - Tuesday	-	#4 hole stopped. Affecting roof, rescuers informed by trapped men that the drilling was being done in the wrong place. Drill moved 26 feet West and 5 feet south of 6-inch supply hole (#1).
7:30 a.m. - Wednesday Aug. 21	-	(#5) 12-inch hole started.
7:50 a.m. Thursday Aug. 22	-	(#5) hole penetrates coal seam at 323.5 feet, wrong location.
5:55 p.m. - Thursday	-	(#6) 12-inch hole started 4 feet East and 6 feet North of #5.
7:45 - 9:20 p.m. - Friday Aug. 23	-	Radioactive source lowered into #4 (abandoned) hole and detection head lowered into supply hole. One of the trapped miners operates detection head. Ineffective due to insufficient radioactive material.
3:30 p.m. - Saturday Aug. 24	-	#6 hole breakthrough at 308.5 feet.
7:20 p.m. Saturday	-	Drill pipe pulled out, more supplies lowered.
7:30 a.m. Sunday Aug. 25	-	#6 hole plugged at bottom so reaming could be done.

6:20 p.m. Tuesday Aug. 27	-	18-inch reamed hole completed, drill pipe pulled out. Harnesses, grease, communications gear lowered to the two trapped men via a 5/8-inch rope into the 18-inch hole.
1:55 a.m. Wednesday Aug. 28	-	First miner enters bottom of hole.
2:10 a.m. Wednesday	-	First miner reaches surface; pulled out by man power.
2:34 a.m. Wednesday	-	Second miner enters bottom of hole.
2:42 a.m. Wednesday	-	Second miner reaches surface. Both rescued men flown to nearest hospital by helicopter.

During the remaining hours, various attempts were made to locate the third victim through use of probe holes, highly sensitive communications equipment, and a closed circuit TV survey made at the bottom of the escape hole. The search officially ended at 10:30 p.m., Friday, August 29.

This marked the first recorded event of a man being rescued by use of a borehole drilled into a mine in the United States. First contact with two of the three trapped men occurred five days after entrapment. For nine days, the men were sustained through a 6-inch diameter supply hole and 14 days after entrapment, two of the three men were saved. Although this operation was crude at times and often unorganized, the procedure proved effective, and its significance was not forgotten in the years to come.

On February 25, 1969, the President of the National Academy of Engineering accepted the challenge from the Director of the Bureau of Mines and submitted a proposal for a study directed toward an assessment of the technological capabilities that may be applied to survival techniques in mining disasters. This met with a favorable response from the Bureau of Mines, and on March 5, 1969, Contract No. S0190606 was approved by both parties. The final report of the Academy, which was released in March, 1970, recommended that the Bureau move immediately to:

1. Develop a self-contained escape breathing apparatus which provides oxygen for one hour and is as portable as present technology permits.

2. Investigate the feasibility of installing portable and central shelters within mines by developing and testing prototype portable shelters able to withstand secondary explosions and containing life support for 15 men for 15 days.

3. Develop and acquire an electromagnetic communications system capable of voice transmission to the mine and coded message transmission to the surface.

4. Develop and acquire a seismic location system capable of locating a trapped miner who has no means of communication except by pounding on the mine roof, rib, or on the floor.

5. Acquire two drilling rigs capable of high penetration rates to depths of 2,500 feet; one rig to probe for trapped miners with 6- to 8-inch diameter holes and the other to cut 28-inch holes for rescue.

These recommendations served as a starting point for a continuing and concentrated effort by the Department of the Interior to improve its mine search and rescue capability following entrapment of miners.

Following recommendations of the National Academy of Engineering, the Deputy Director, Health and Safety, Bureau of Mines, was given the major responsibility for developing a comprehensive mine search and rescue plan with resources and capabilities to locate miners trapped in a mine disaster, establish communications, and effect their survival and eventual rescue through boreholes drilled from the surface. In 1971, a Mine Emergency Operations Group (MEO) was set up in Pittsburgh, Pennsylvania, at the Pittsburgh Technical Support Center to operate the mine search and rescue plan which included acquiring, manning, and maintaining the necessary equipment and facilities.[3]

On May 7, 1973, when the Mining Enforcement and Safety Administration was established by Secretarial Order, the MEO Group became part of this new organization, and the overall administration of the Mine Emergency Plan then became the responsibility of the Assistant Administrator--Technical Support, now MSHA.

The authority to expend federal funds for conducting mine emergency operations in all mines is found in the Organic Act of the Bureau of Mines, as amended, and in Sections 103, 501, and 502 of the Federal Coal Mine Health and Safety Act of 1969, with the specific provisions being as follows:

> Section 103(e) "...in the event of any accident occurring in a coal mine where rescue and recovery work is necessary, the Secretary or an authorized representative of the Secretary shall take whatever action he deems appropriate to protect the life of any person, and he may, if he deems it appropriate, supervise and direct the rescue and recovery activity in such mine."
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> Section 501(a) "The Secretary...shall conduct such studies, research, experiments, and demonstrations as may be appropriate (2) to develop new or improved methods of recovering persons in a coal mine after an accident; (3) to develop new or improved means and methods of communication from the surface to the underground area of a coal mine; and (11) for such other purposes as...necessary to carry out the purpose of this Act."
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> Section 501(c) "In carrying out the provisions for research, demonstrations, experiments, studies, training, and education under this section...the Secretary...may enter into contracts with and make grants to, public and private agencies and organizations and individuals..."
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> Section 502(b) "The Secretary shall, to the greatest extent possible, provide technical assistance to operators in meeting the requirements of this Act and in further improving the health and safety conditions and practices in coal mines."

Inasmuch as suitable personnel, equipment, and facilities required by the plan were not all available in the Bureau of Mines, those needed were obtained through contract with private industry.

In June, 1970, contract [(No. B) 101260] was awarded to Westinghouse Electric Corporation's Space and Defense Center, Baltimore, Maryland, to undertake the five tasks as delineated by the National Academy of Engineering.

On January 16, 1971, a demonstration was performed at the U.S. Steel No. 14 Mine at Munson near Gary, West Virginia. This demonstration was held under simulated disaster conditions in extreme cold weather and on the most rugged terrain West Virginia had to offer. Over 800 feet of overburden stood between the area of simulated mine entrapment and the rescue drill rig.

Communications were immediately set up between the surface rescue crew and men underground with electromagnetic, through-the-earth, high quality voice reception, maintaining 100 percent intelligibility continuously through-out the demonstration.[4]

Coded message signals were received from the men underground; thus, an effective two-way electromagnetic through-the-earth communication path was established.

The seismic location system was deployed and soon seismic signals were received from the men underground. A location was determined, and the probe drill rig was set up at the designated site and started drilling a 8-1/2-inch hole. After the probe drill had penetrated the mine, supplies and a hard wire communication line was lowered to the simulated trapped men. Next the rescue drill moved onto the site, and eight days later, a 28-1/2-inch hole was completed into the mine. A rescue capsule was lowered and it was shown that men could be hoisted out in this manner.

After this very successful demonstration on February 5, 1971, all the MEO equipment was returned to the newly established staging facility at Charleston, West Virginia, for refurbishment. The Charleston facility was part of a large industrial complex known as the Charleston Ordinance Center owned by the Park Corporation. The building contained approximately 46,000 sq. feet of hard surface storage area and was equipped with an overhead crane capable of handling any component of the MEO rescue equipment.

Even while crews labored to refurbish the equipment and restore an emergency response capability, an event was developing which would further stress the importance of having such equipment readily available.

March 26, 1971, Nemacolin Mine, Buckeye Coal Company, Nemacolin, Pennsylvania, at approximately 10:20 a.m., a fire occurred in 118 straight mains section. There were 125 persons underground, 11 of whom were working in 118 straight mains.[5] Of the 11, nine persons escaped leaving 2 men trapped somewhere in the workings. The MEO seismic system and drilling equipment were immediately called upon.

The seismic system was deployed and detected no response from underground. In other attempts, boreholes were drilled from the surface into the face area of 118 straight mains in an attempt to contact and rescue the trapped men. The first borehole was drilled into the face area at about 3:45 p.m. on March 27. Additional holes were also being drilled in the face area, and as these holes penetrated the mine workings, efforts were made to contact the entrapped men by lowering phone communications. Throughout the entire recovery operations, approximately 90 boreholes had been drilled into the mine workings in and around the fire area. Various materials were induced into the mine through these boreholes in an effort to control the fire.

On March 31, it was decided that the entrapped men could not have survived the gases produced by the fire, and it was agreed by all parties to flood the mine.

Since 1971, the operation and maintenance function as well as the emergency response capability has been contracted annually both with Westinghouse Electric Corporation and Rowan Drilling Company (a subcontractor to Westinghouse on the initial contract). Additionally, original equipment has been modified and upgraded, new equipment has been obtained and/or developed, and all equipment is field tested when funds permit.

In 1972, a second staging facility was established in Salt Lake City, Utah. This facility is part of the Otto Buehner Corporation complex. It has 16,000 sq. feet of inside storage area and is readily accessible to trunk highways, the Salt Lake City Airport, and the major rail terminal in the city.

One year after the Nemacolin Mine fire, 2,500 miles away, fire developed in another mine, once again requiring the MEO rescue capabilities. The date was May 2, 1972, and the mine, Sunshine Mine, Sunshine Mining Company, Kellogg, Idaho. A fire probably originating in an abandoned stope raged through abandoned workings of the mine and then moved onto the working levels. Two hundred and one men were underground when the fire was discovered. One hundred-eight men managed to exit safety; but 93 others, whose escape routes were cut off by fire, remained trapped underground in depths up to 5,200 feet.[6]

MEO crews then testing the seismic equipment at the Bureau of Mines Experimental Mine at Bruceton, Pennsylvania were alerted, and within 24 hours, both crew and equipment were airlifted via two U.S. Air Force C-130 aircraft to Spokane, Washington. The seismic and auxiliary trucks were then driven to the emergency site.

During the next two weeks, MEO provided technical and logistics support to rescue operations. Due to the great depth at which the men were trapped, seismic and drilling techniques were not feasible and could not be employed. Access to levels below 3,700 feet was prohibited due to the extent of the fire. While crews battled smoke and fire, MEO personnel, in conjunction with Bureau of Mines personnel, conducted a closed circuit TV exploration of a new vent raise from the 3,700-foot level to the 4,800-foot level. The resulting video tape recordings were reviewed, and it was shown feasible to lower a rescue capsule from the 3,700-foot level. MEO logisticians located several rescue capsules and had these flown to the emergency site. Meanwhile, other MEO crews rigged the hoist and communications for the capsule. Two weeks from the start of rescue operations, two men were rescued from the 4,800-foot level by means of the escape capsule and the courage of volunteer federal mine inspectors.

During the course of rescue operations, MEO supplied inflatable air bags which were used for emergency stoppings, gas chromatograph equipment for gas analysis to follow the course of the fire, air compressors, portable hoists, electric carts, rescue capsules, various communications equipment, breathing apparatus, and air and highway transportation for men and equipment. This logistics effort made a substantial contribution to the rescue operations and established a very important capability to be included among the services offered by MSHA Mine Emergency Operations.

The year 1972 proved to be a very busy one for MEO. At about 7:30 p.m., Saturday, July 22, 1972, a fire broke out at the Blacksville No. 1 Mine, Consolidation Coal Company, Blacksville, West Virginia. At the time of the fire, 43 men were working in the mine, 9 of whom were trapped inby the fire.[7] A 5-5/8 inch borehole was started above the A-3 section, 400 feet outby the face area, at about 7:00 p.m. Seismic operations circumscribed the A-3 panel. There were no indications of survivors detected.

At about 2:40 p.m., Monday, July 24, 1972, a minor explosion occurred in the vicinity of the fire, and all men engaged in fighting the fire had to be withdrawn from the mine. All rescue efforts now relied on the borehole ad seismic system operations. At 3:45 p.m., the drill penetrated the mine at a depth of 733 feet. Due to excessive water in the hole, casing operations were begun. To prevent further explosions, the mine was sealed at 10:30 p.m.

At 1:00 a.m., Tuesday, July 25, 1972, a communications probe was lowered into the mine. Attempts at communicating with the trapped men proved fruitless. A sample of the mine atmosphere was collected and analyzed. Results determined that the mine atmosphere could not support life. The seismic system remained in continuous operation until 8:00 a.m., Friday, July 28. No significant seismic events were recorded during this period.

MEO services were not called upon again until one year later on August 17, 1973, when at 6:30 p.m., MEO was notified that two miners had been trapped underground at the Hecla Mining Company, Lakeshore Mine near Casa Grande, Arizona. The MEO notification plan was implemented and personnel were put on alert. On August 19, a request was made to locate inflatable air bags for possible use in ventilation control. On August 20, MEO was requested to locate probe drill rigs in the area capable of drilling a borehole into the entrapment area, in excess of 1,200 feet in depth.

Several probe drill rigs were located by the Baltimore logistics team while the MEO crews were en route to the emergency site. The probe truck developed by the Bureau of Mines was flown to the site via C-130 aircraft and drilling of a 6-1/2-inch borehole into the mine commenced at 9:00 p.m. on August 20.

Several delays in drilling were encountered due to problems with drill hammers and drill bits. On August 24, the drill broke through into the mine at 7:00 a.m. A communications probe was lowered and monitoring was performed for several hours. No contact was made.

It was only one month later that MEO was called into action again. At 1:30 p.m., on September 30, MEO was notified that a miner was trapped underground by a mine fire at the Pyro Mining Company's No. 2 Mine near Sullivan, Kentucky. MEO arranged air transportation for Coal Mine

Health and Safety personnel from Washington, D.C. and MEO personnel from Baltimore, Maryland, and Pittsburgh, Pennsylvania. The seismic system, logistics trailer and MEO personnel from Charleston, West Virginia were deployed to the emergency site. A drill rig for drilling probe holes was located and ordered to the site. MEO personnel supervised the drilling of two probe holes and conducted seismic signaling and listening functions. Logistics support was provided for all phases of activities. As analysis of samples from each of the probe holes showed high carbon monoxide and low oxygen content of the mine atmosphere, an environment which cannot support life. The seismic operation showed no response indicative of life below. Rescue operations were terminated at 2:00 p.m. on October 3.

On June 6, 1974, MESA entered into a Memorandum of Understanding with the National Park Service pledging its rescue capabilities to emergencies involving "groups or individuals engaged in scientific studies, mapping, or exploration within the caves of the Parks (who) may sustain injuries that would preclude their removal from the caves by little evacuation through the cave passages."[8]

During June 1975, the MEO office at Pittsburgh was disbanded and responsibility for the program supervision was transferred to members of the Assistant Administrator, Technical Support, staff in Arlington, Virginia.

Approximately six months later, several plans were initiated to reduce program costs and improve response capability. These plans included:

1. De-escalation of maintenance at the Salt Lake City Staging Facility from a daily to quarterly maintenance cycle.

2. Transfer of responsibility for the maintenance and deployment of the Western Command/Communications vehicle from contractor to the Denver Technical Support Center.

3. Relocation of the Eastern Staging Facility from Charleston, West Virginia, to Aliquippa, Pennsylvania. This move would provide easy access to a major airport to assure emergency airlift response while concurrently providing nearly three times the warehousing space at a much lower leasing cost.

While relocation plans were being arranged, the MEO team was again called into action. On March 9, 1976, an explosion ripped through the Scotia Mining Company's Scotia Mine, near Ovenfork, Kentucky, killing 15 men. MEO arranged for Air Force airlift of MSHA's mine rescue teams. Only three days later, while recovery efforts and investigations were being conducted, a second explosion occurred in the same section of the Scotia Mine. This time killing 11 men, including 3 federal inspectors. Again, MEO arranged for Air Force airlift of MSHA's mine rescue teams. Only three days later, while recovery efforts and investigations were being conducted, a second explosion occurred in the same section of the Scotia Mine. This time killing 11 men, including 3 federal inspectors. Again, MEO arranged for emergency Air Force airlift of MSHA's mine rescue team and other mine rescue equipment. The Command/Communications vehicle was deployed and set up as a command base providing invaluable radio and telephone communications. Rowan Drilling supervisory contract personnel were brought to the site to provide consultation expertise for probe hole drilling. MEO personnel installed over 10,000 feet of gas sampling tube bundles which were connected to continuous gas analysis equipment. Also a downhole television survey was successfully conducted at the face area of the 2 Southeast Main heading, the possible area of the explosion. In Baltimore, MEO logisticians arranged for the purchase and delivery of many items which were necessary for the recovery operations. The Command/Communications vehicle was retained on site control until March 15, 1977.

The MEO crews relocated the Eastern Staging Facility at Aliquippa, Pennsylvania, during May and June, 1976. The MEO Chief established office space at this facility and the MEO function subsequently became a Branch of the Division of Health Technology, Pittsburgh Technical Support Center.

In July, 1976, the MEO seismic system was deployed again; not in response to an emergency, but to test the MSHA seismic system side-by-side with a system modified by the Bureau of Mines. These tests were designed to determine how MSHA could improve its seismic system through modifications which would increase the system signal-to-noise ratios. Three major areas were investigated: (1) A new geophone subarray configuration; (2) reduction of thermal noise at the field preamplifiers; and (3) noise introduced by the system is 21.5KW diesel generator.

Results from these tests showed that at times a new 24 geophone subarray used in lieu of the standard 7-geophone subarray configuration may increase detect ability. Further research in this area is necessary.

The presently used field preamplifiers were found to have a sufficiently low thermal noise level, but modifications to incorporate capability to use the 24-geophone subarray and reduce the size and weight of existing units are required.

The unwanted seismic and acoustic noise produced by the system’s 21.5KW generator can be filtered out with the use of appropriate electronic filters.

While plans were being outlined for an intensive field test program and to incorporate the various modifications discussed above, on February 7, 1977, a fire broke out in the Bethlehem No. 32 Mine near Ebensburg, Pennsylvania. During the next 3 weeks, MEO crews set up a communications net so that immediate results of gas monitoring could be called in to a command center, assisted in installing gas sampling tube bundles through boreholes drilled into the mine so that the fire’s progress could be monitored, and located various hard-to-find materials for the mining company. The rescue drill rig from the Eastern Staging Facility was deployed to Bethlehem so that a large diameter borehole could be drilled for the purpose of installing a high capacity emergency water pump. Although MEO involvement in this area was completed in March following completion of the large diameter borehole other Technical Support emergency response functions continued onsite until March of 1978.

Ironically, while working in support of the mine fire fighting operations at the Bethlehem Mine, MEO was notified on March 1, 1977 of another emergency requiring their help. On this date a sudden in-rush of water occurred in the west Skidmore conveyor gangway of the Porter Tunnel Mine near Tower City, Pennsylvania. The seismic system was deployed and MEO arranged for a mobile office trailer to be set up as a command headquarters.

The first victim was found by underground crews on March 1. On March 2, a second victim was discovered and underground exploratory crews heard tapping from a miner, (Ronald Adley), who was trapped. A rescue hole about 50 feet long was driven through solid rocky by hand by underground rescuers, resulting in the rescue of Mr. Adley on March 6.

Recovery crews trying to reach other victims encountered a solid wall of debris several feet in length. Fourteen holes were drilled from the surface into the underground passageways by volunteer drilling companies under MEO supervision in attempts to locate the trapped miners. Television and voice probes were employed and various seismic detection attempts were performed.

This disaster marked the first time underground geophone subarrays were employed so that ultimate sensitivity could be utilized.

Unfortunately, all efforts showed no indication of the missing miners and the bodies of the last victims were recovered on March 30.

The seismic system was then returned to the Eastern Staging Facility and the rescue drill rig was returned to the Bethlehem Mine to complete the emergency pump hole.

Less than 1 month later, on April 10, 1977, MEO was called into action again. A fire broke out at the J & L Steel Company's Vesta No. 5 Mine at Vestaburg, Pennsylvania. MEO crews set up communications from a command base to the key gas monitoring locations. Also, gas sampling tube bundles were installed through boreholes drilled ahead of the fire area so that the fire's progress could be monitored. Fortunately, the fire was extinguished by underground crews later that month without injury or loss of life.

Presently, the MEO crews have embarked on an extensive field test program in three regions throughout the United States: The Alabama coal fields, Western coal and metal/nonmetallic mines, and North Eastern coal and metal/nonmetallic mines. Results from these tests will define when it is advantageous to use the 24-geophone subarray configurations and give the MEO crews experience in working in various different geological environments to which they have not been previously exposed. The data acquired during these tests will be invaluable when MEO crews attempt the next proposed modification to the system in FY-78, a completely automated computer-controlled signal processing system so that real-time seismic locations may be performed.

Other future proposed additions to MEO capabilities include: a satellite communications link so that instant two-way private line video or audio communications can be established whenever the MEO crews arrive on-site anywhere in the United States; a probe truck complete with borehole television probes, two-way communications probes, infrared television probes, and various gas and temperature sensing devices; and by FY-82, electromagnetic location devices to work in conjunction with portable underground transceivers.

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