

THE MINE EMERGENCY CAPABILITIES OF THE MINE SAFETY AND HEALTH ADMINISTRATION

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ABSTRACT

It is mandatory for the Mine Safety and Health Administration (MSHA) managers to play a major role in the effective crisis management of mine emergencies. This paper summarizes the organizational structure, capabilities, and training methods used by MSHA for response to mine emergencies in the United States.

INTRODUCTION

The Mine Safety and Health Administration was established in the U.S. Department of Labor by the Federal Mine Safety and Health Act of 1977. The 1977 Act authorizes MSHA to perform numerous safety and health related activities. Some of the major activities are to develop and promulgate regulations, conduct inspections and investigations, and approve equipment for use in mines, and approve plans submitted by mine operators. Approximately 2200 MSHA employees administer the requirements of the Act from four main organizational units with responsibilities throughout the United States. The Mine Safety and Health Administration has established 11 coal districts, six metal and nonmetal districts, and three technical support centers. MSHA's administration functions are handled by the agency's headquarters in Arlington, Virginia.

When an accident occurs in a mine, the regulations require that the mine operator must immediately contact the nearest appropriate MSHA district office. If the accident is an emergency, such as an entrapment, inundation, explosion or fire, the district manager will collect all available information and then immediately dispatch personnel to the mine site. The district manager will then implement MSHA's notification plan, first notifying the appropriate administrator in the Arlington headquarters. The administrator will then notify the Assistant Secretary of Labor for MSHA, and provide regular updates of available information. The administrator will also notify the director of technical support. The administrator's office and the technical support director's office will, in turn, notify necessary MSHA personnel, other government agencies, State agencies, miners' representatives, and other interested persons.

At the mine site, the mine rescue teams are notified to report to the mine. By law, each underground mine in the United States is required to have access to a minimum of two certified mine rescue teams. Normally, other mines in the vicinity of the emergency site will supply additional teams as available.

MSHA MINE EMERGENCY RESPONSE UNITS

Two of the major MSHA organizational components which receive the notification are the respective Mine Emergency Unit (MEU) assigned to either Coal or Metal and Nonmetal. The Coal MEU consists of 19 mine inspectors, a trainer, and a supervisor who volunteer for this duty. The team is headed by the Coordinator, Small Mines/Mine Emergency Unit who is located at the National Mine Health and Safety Academy in Beckley, West Virginia. Specialized equipment that is maintained by this unit are: 1) emergency breathing apparatus, 2) hand-held gas detection equipment, 3) specialized communications equipment, 4) Mobile Command Centers 2) a rescue capsule, and 3) a MEU support vehicle.

The Metal and Nonmetal MEU consists of 12 volunteer mine inspectors, and a trainer. This unit is headed by the Coordinator, Mine Emergency Unit who is located in Dallas, Texas. Their emergency equipment is maintained at the National Mine Health and Safety Academy. This team shares the resources of the other MSHA emergency units.

MOBILE COMMAND CENTERS

The Coal MEU maintains two types of mobile command centers which can be utilized at any mine emergency site. The first type of command center is a bus-type vehicle (Figure 1) which is specially equipped to be used for a quick, temporary MSHA on-site headquarters. It is equipped with several types of communications equipment, a conference area and is normally manned and operated by MEU personnel at the emergency site.



Figure 1. MSHA Command Center

The other type of mobile command center is a customized 40 foot office trailer. This trailer is intended to be used for long duration recovery or investigation activities. It contains three separate offices and supplies to support any type of extended field operation. This trailer is located at the National Mine Health and Safety Academy.

RESCUE CAPSULE

The MEU rescue capsule (Figure 2) consists of three sections which can be deployed either in tandem or separately. The upper two sections can accommodate one person each, and the bottom section is used for equipment or supplies. Sliding doors on each personnel section allow easy entrance and exit, even in low entry situations. Several communication systems can be used in conjunction with the capsule to communicate with passengers.



Figure 2. MEU Rescue Capsule

THE METT

Another major organizational component that will receive the emergency notification is the Mine Emergency Technology Team (METT) within Technical Support. The METT is headed by the Chief, Special Projects who reports to the Chief, Pittsburgh Safety and Health Technology Center at Bruceton, Pennsylvania. This team includes personnel from the Center's Mine Emergency Operations (MEO), Ventilation Division, and Physical and Toxic Agents Division.

The METT provides technical assistance, equipment, and personnel to the senior MSHA official, usually the MSHA District Manager, at the emergency site. This technical assistance aids the senior MSHA official in decision-making, and the issuance of orders as he deems appropriate, to assure the safety of personnel in the mine and on the surface. This official will approve plans to rescue persons, or recover persons and any portion of the mine such that mining operations can resume safely whenever practicable. The orders issued and approvals are performed with the knowledge and

cooperation of the mine operator, representatives of the miners, state officials, and other members of the ad hoc emergency management team. Technical assistance provided to the senior MSHA official is supplementary to that which is available in the district office.

MEO EQUIPMENT AND CAPABILITIES

SEISMIC LOCATION SYSTEM

The seismic location system (Figure 3) is truck-mounted and is capable of detecting and locating the source of seismic vibrations produced by trapped miners. Miners may generate seismic signals by pounding on mine surfaces such as the roof, floor, or ribs. These signals are detected by sensors installed either on the surface or underground. The system is capable of detecting signals at a range of 1500 feet, and can monitor approximated 1 square mile over most mines (depending upon terrain). Helmet stickers (Figure 4) describing how to signal have been distributed to all miners in the United States. The system is highly mobile, and can be airlifted.



Figure 3. Seismic Location System

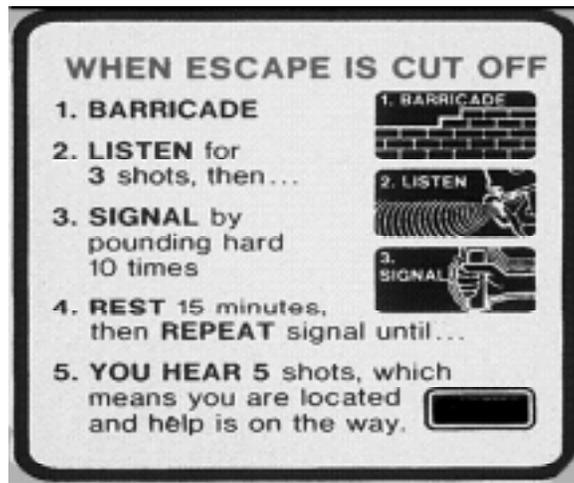


Figure 4. MEO Helmet Sticker

MINI-SEISMIC SYSTEM

The Mini-Seismic System (Figure 5) is a simplified version of the larger seismic location system. It has very limited capabilities; however, since it was designed to be very portable. It can be installed in difficult installations situations, such as in underground environments, and for use in building collapse rescue efforts. The Mini-Seismic System was used to help locate several survivors in rescue efforts after the Mexico City earthquakes in September, 1985.



Figure 5. Mini-Seismic System

TV PROBE SYSTEM

The MEO TV Probe System (Figure 6) is a self-contained system consisting of two complete permissible TV probes. Each probe has a remote focus, a zoom lens, and remote iris adjustments. The truck is equipped with winch system, electric generator, dual monitoring consoles, and a video-tape capability. The system is air transportable and capable of operating to depths of 1500 feet.



Figure 6. TV Probe System

VENTILATION DIVISION

The Ventilation Division provides expertise to the METT utilizing gas and airflow sampling techniques and in the interpretation of the results of gas sample analyses. The division maintains and operates instrumentation for continuous sampling and recording of mine gases, such as methane, ethane, carbon monoxide, carbon dioxide, and oxygen (Figure 7). The Chief of this Division is a mining engineer, and he directs mining engineers and technicians who are knowledgeable in entire-mine and face ventilation systems, mine gas sampling and monitoring equipment. The Ventilation Division maintains computer models developed by the division and researchers from the Department of Energy. Use of these models assists in the interpretation of gas sampling results in conjunction with mine ventilation conditions. The Division also assists in the testing of new sampling equipment jointly with the Department of Energy.

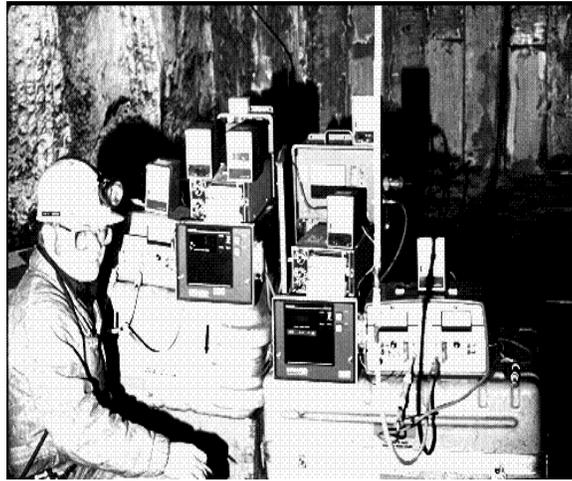


Figure 7. Ventilation Division Continuous Gas Monitoring Equipment

PHYSICAL AND TOXIC AGENTS DIVISION

The Physical and Toxic Agents Division provides the METT with analytical capabilities for determining concentrations of mine gases and products of combustion. The Division Chief directs chemical engineers and technicians who are proficient in operating gas chromatographs, mass spectrometers, and other sophisticated analysis equipment. The gas chromatographs are maintained in laboratories and used in daily Center activities. Upon notification of an emergency, the gas chromatographs are disconnected and installed in a gas analysis van for transportation to the emergency site. This Division also conducts basic research on the development of analytical equipment to improve the quality, quantity, and speed of gas analyses.

GAS ANALYSIS VAN

Gas samples taken directly from tubing or bottles, can be analyzed by MSHA personnel on-site using equipment installed in the mobile gas analysis van (Figure 8). This custom designed vehicle is housed at the Pittsburgh Safety and Health Technology Center. Equipment capability includes two portable gas chromatographs which can analyze samples for a variety of gas constituents including: methane, ethane, propane, acetylene, oxygen, nitrogen, hydrogen, carbon dioxide, carbon monoxide, and other low weight hydro-carbons. A robotic gas analyzer (Figure 9) is installed in the vehicle for analyzing gases on a continual basis. This system can process 4-6 samples per hour.



Figure 8. Gas Analysis Van

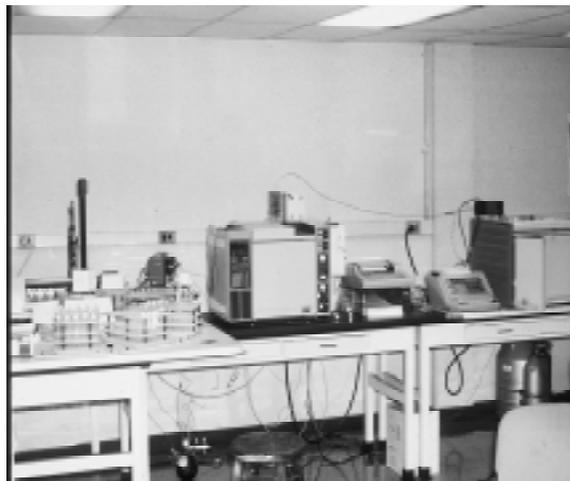


Figure 9. Robotic Gas Analyzer

TRAINING FOR MINE EMERGENCIES

Since it is mandatory for MSHA managers to play a major role in the effective crisis management of mine emergencies, a comprehensive program was initiated in 1980 to internally assess our organization's emergency response capabilities and the adequacy of managerial training for crisis situations. This objective was accomplished utilizing a combination of in-depth interviews and survey feedback methodologies. The results indicated a strong need to develop a crisis management training mechanism which would emphasize emergency problem solving, procedures and role clarification, and provide an exchange of knowledge which would be useful to managers participating in rescue and recovery activities.

Therefore, it was necessary to create a training program which would facilitate the development of crisis management skills and abilities for our managers. Specifically, the required considering training exercises that would incorporate use of group dynamics and group problem-solving techniques. It was also desire to reinforce knowledge and use of MSHA emergency procedures and to share appropriate technical knowledge and experiences among our managers.

The resulting seminar was named “MERD”, for Managerial Emergency Response Development. It is designed to be administered during a two-day time period and emphasizes emergency simulations and role-playing exercises. The simulations are the heart of the training program, allowing a dynamic combination of techniques to be utilized consecutively. The exercise is modeled after actual past or potential emergency situations with the objective of making the situation as authentic as possible. The development of such an exercise requires a team of experts who can provide state-of-the-art knowledge including: the mine emergency command system, mine ventilation, gas analysis, mine rescue and recovery, drilling, and particular mining conditions and layouts. At several stages throughout the development process, critiques of the technical content of the simulation is encourages. The ultimate critique of the exercise; however, occurs during a full dress rehearsal and prototype testing of the simulation utilizing members who are experienced in mine rescue and recovery. Often members from actual mine rescue teams are brought in for this purpose. During this stage, all final corrections and changes in content or procedures are incorporated into the exercise.

The role-playing training technique gives participants the opportunity to experience problems, explore solutions, and interact with other personalities which may actually exist during actual mine emergency operations. The success of this method is heavily dependent upon the participants’ willingness to actually adopt the various roles and behave as persons simulated in the real world. Success is also extremely dependent upon the control of the exercise and the quality of feedback which can be given to participants when the exercise is finished. This is accomplished in several ways. The primary control/feedback mechanism is through the use of trained persons called “controllers”. This group is composed of members of the simulation development committee and often those who have helped prototype test the simulations. Controllers and other trained observers utilize checklists which are developed simultaneously with the simulation exercise.

Behaviors and actions are noted as the simulation progresses and are consolidated in a meeting of the controller/observers after the simulation has been completed. Afterwards, a constructive critique is given to each group and feedback is solicited from participants. Detailed feedback is given during these sessions and a suggested solution is revealed to the group.

Simulations have been developed for a variety of underground and surface mining situations and for both coal and metal and nonmetal mines. Underground simulations are mainly focused on fires, explosions and inundations. Surface simulations have been developed for: 1) the rescue of victims of a truck going over a high wall into a strip mine, 2) an auger miner explosion, 3) a preparation plant fire, and 4) a stockpile emergency.

A typical two-day seminar for an underground simulation would start with a half day of presentations by experts regarding recent mine emergencies and other technically salient topics. During the second half of the first day, the group is briefed on the general information about the problem including: mining conditions, personnel, equipment, and the emergency organizational structure. Mine maps are reviewed and questions are addressed. Following this briefing, the first part of the MERD exercise is conducted. This is usually held in a main classroom with participants told to report to break-out rooms as they are needed in the problem. Two break-out rooms are utilized, one is designated as the Command Center, and the other as the Underground area. Time compression is utilized during Part I with 15 minutes of real time equivalent to 1 hour of simulation time.

On the second day, Part II is conducted. If this is performed at the Academy, actual mine rescue teams (Figure 10) located in our Mine Simulation Laboratory (MSL) interact with our managers who are stationed in the Command Center. If the problem involves a mine fire, a fresh-air base is established at the entrance to the MSL and theatrical smoke is used to simulate actual smoke conditions. The team may even be required to extinguish a fire in a specially designed area of the MSL. The exercise proceeds until the problem is solved and the rescue team has re-ventilated the mine.



Figure 10. Mine Rescue Team Simulating Rescue/Recovery

The day ends with the controller/observers conducting the group feedback sessions. Feedback is given to participants and comments and feedback is solicited from the group. If mine rescue teams are involved, they are also encouraged to give feedback. MERD training has been given the highest ratings by our managers, and now such training has also been extended to labor groups, mining companies, and other government agencies. The program has received accolades for being an effective tool for training managers and other emergency operations personnel in the skills required to respond to mine emergencies.

CONCLUSIONS

The Mine Safety and Health Administration has developed an emergency organizational structure, notification plan, and procedures to effectively respond to most types of mine emergencies. Specialized technical expertise and equipment have been developed to support mine emergency operations, and a highly effective training program has been developed and implemented to prepare managers and other emergency personnel for such operations.