Miner Overcome by Ammonia Fumes in Wyoming

SUMMARY

A 26 year old male trona miner died from asphyxia following the collapse of a section of a mine in which he was working. The cave-in was initially believed to have resulted from an earthquake in the area and the plant was immediately shut down while rescue operations were being conducted. By early afternoon, officials had determined that two miners remained trapped underground. One later walked to safety and the other had been located and was in audible communication with rescuers. EMTs were taken underground and were on the scene when rescuers removed the victim from his initial location nearly 48 hours after the cave-in occurred.

While bringing the victim from the section where he had been trapped, rescuers ran into a pocket of Ammonia gas and momentarily collapsed dropping the victim who was being carried on a backboard. When they regained rescue efforts, the victim had discontinued his breathing pattern and rescuers ventilated him in transit. EMT's began CPR immediately and continued while exiting from the mine and transferring the victim to the ambulance crew. He was transported to a local hospital where he was pronounced dead on arrival.

Employers may be able to minimize the potential for occurrence of this type of incident through the following precautions:

- **Maintain on-site emergency rescue and medical teams with underground rescue capabilities.**
- **Stabilize underground tunnel supports, particularly in geographical areas that are prone to earth movement.**
- **Provide emergency breathing apparatus in areas which are sensitive to pocketing of hazardous gases.**

INTRODUCTION

On a Friday morning, February 3, 1995, an underground shuttle car operator who had worked for a trona mine operation for a month was working underground when a 5.4 intensity earthquake occurred in the area, precipitating a roof cave-in and massive floor heaving in an area of the 1600' deep mine where 55 miners were trapped. The victim and three area co-workers were among those trapped. Two of those four workers in the area were able, along with the 51 other trapped miners, to exit the mine area within 2 hours of the earth movement, but the victim and one other worker remained trapped. The nearest co-worker was rescued the following morning and was hospitalized overnight. Within 48 hours of the incident, the victim was located by rescue teams and communication was begun to bring the victim safely to the surface.

The victim was located just under a mile from the bottom of a mine elevator shaft, but rescuers were limited in their ability to reach him due to the need to repair the ventilation system along the way to preclude a build-up of explosive methane gases. The plant had been shut down immediately after the earthquake struck and roadblocks had been set up to limit traffic to employees and emergency personnel.

When rescuers located the victim a medivac helicopter was called in. As he was brought to the area where EMT's waited underground, the rescue team advised EMTs that they had just lost the victim's pulse, and that they had earlier run into a pocket of Ammonia gas. The gas fumes had caused them to collapse, dropping the backboard on which the victim lay. As they recovered and came out of the area they noted that he was no longer breathing, and they attempted to ventilate him. By the time he had arrived at the point where the EMTs waited he had been in respiratory arrest for ten minutes. EMTs began CPR and continued it while bringing the victim to ground level and turning him over to an ambulance crew.

INVESTIGATION

Through a reciprocal notification agreement with the State Mine Inspector of the Department of Employment, the WY- Wyoming FACE Project was notified of the incident on February 6, 1995. Reports were requested and received from local law enforcement and coroner's offices and an investigation was begun.

One of the victim's co-workers had been approached by the victim shortly after the quake occurred, saying that another worker was trapped and the victim needed help in getting him free. By the time they arrived, the other trapped worker had been freed and had left the area. The victim was noted at that time to have blood on his head and to appear in shock or disoriented. The gas and dust in the area were reported by his co-worker as being so thick as to sound like running water. The two workers then attempted to move together by crawling along the floor which was covered with debris. Due to the exposure to gases, both workers were lying on the mine floor talking to each other with each passing out from time to time. As the victim's responses became more disoriented and hard to understand, the co-worker decided that he should go for help. His memory of events from that time to his rescue are limited as a result of his light-headedness from the exposure to gases there.

Rescuers entered the area of the mine where the victim was located on the second morning after the quake had occurred (around 45 hours). After several diversions due to cave-ins, they detected a light through a hole and began shouting for the victim. They did receive a verbal response and attempted to approach the area. They were stopped by high concentrations of ammonia and methane gas and finally were able to see the victim's neck and shoulders. They contacted the control center to let them know that the victim had been located but that they could not approach him until methane levels dropped to acceptable levels for rescue efforts.

When they reached the victim, he sat up and then fell onto his back. His eyes were fixed and he did not respond to physical or verbal stimuli. Rescuers administered oxygen and could see the victim's chest fill with air. Due to the limited space in the area where the victim lay, rescuers had to drag him out before they could place him on a backboard for transport. The victim's skin was yellowish and there was a yellow tint to his fixed pupils. His body temperature appeared cold and a white foamy substance was coming from his mouth.

Investigations by MSHA and the US Bureau of Mines were conducted to determine whether the earthquake had been triggered by a collapsing mine structure as a result of over-mining the area. There was some concern that excessive trona removal underground had left inadequate pillar support, causing a ground movement that would have enlarged the effect of the initial collapse. As of this writing, there is still no definitive answer to that aspect of the collapse.

The mine has been reopened and safety factors have been enhanced in the mining operation. Evacuation is now more readily available in the even of roof collapse. The company has reduced the amount of ore being mined and increased minimum pillar size. Barriers between panels have been increased to provide additional protection to workers if an adjoining section were to collapse. Evacuation plans have been updated since the event occurred.

CAUSE OF DEATH

The Medical Examiner listed the cause of death as inhalation of ammonia and carbon dioxide.

RECOMMENDATIONS/DISCUSSION

This incident could have been prevented by increasing the structural capabilities of the mine to its present levels. While the existing dimensions were within prescribed limits and attempts to rescue and revive the trapped miner appear to have been proper, the intensity of the collapse was greater than might reasonably have been anticipated.

Companies involved in similar operations are advised to maintain and enhance the readiness of on-site emergency rescue and medical personnel. In addition, there is a need for communications between responders and underground miners and a capability for those underground workers to access oxygen in the event of gases in the mine shafts.

Underground workers are aware of the hazards of mining and the potential for being trapped underground. Establishment of worker-oriented "My Brother's Keeper" programs would be advantageous both to employee safety and morale. Such efforts provide structured plans for organized evacuation and rescue efforts with workers taking personal responsibility for each other's safety in the event of a catastrophe below ground. In addition to the safety aspect of knowing that a fellow worker is there to help and that workers are individually responsible for another person, there is a recognition of the commitment of management to worker safety. In addition, the workers are encouraged to establish trust in their co-workers and a cohesiveness in the working environment.

Wherever there is a potential for mining operations to have reached a level of removal that minimizes the structural support of the earth's surface, additional supports and barricades provide an additional circle of safety that is of life-saving benefit to the miners and economic benefit to the company. The economic losses of a mine disaster are significant above and beyond the personal grief and morale loss that accompanies such disasters. Companies are encouraged to err on the side of safety in the interest of averting disaster in mining operations.

FATAL ACCIDENT CIRCUMSTANCES AND EPIDEMIOLOGY (Wyoming FACE) PROJECT

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (Wyoming FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

States participating in this study include: Kentucky, Maryland, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia.

NIOSH Funded/State-based Wyoming FACE Projects providing surveillance and intervention capabilities to show a measurable reduction in workplace fatalities include: Alaska, California, Colorado, Indiana, Iowa, Kentucky, Massachusetts, Maryland, Minnesota, Missouri, Nebraska, New Jersey, Wisconsin and Wyoming.

Additional information regarding this report is available from:

Wyoming Occupational Fatality Analysis Program
522 Hathaway Building - 2300 Capitol Avenue
Cheyenne, WY 82002
(307) 777-5439

Please use information listed on the Contact Sheet on the NIOSH FACE web site to contact In-house FACE program personnel regarding In-house FACE reports and to gain assistance when State-FACE program personnel cannot be reached.