

**UNITED STATES  
DEPARTMENT OF LABOR  
MINE SAFETY AND HEALTH ADMINISTRATION  
Metal and Nonmetal Mine Safety and Health**

**Report of Investigation**

**Fatal Other Accident**

**October 17, 2002**

**Storm Exploration Decline  
Barrick Goldstrike Mine Inc.  
Elko, Eureka County, Nevada  
I.D. 26-02300**

**Investigators**

**Michael S. Okuniewicz  
Supervisory Mine Safety and Health Inspector**

**Richard M. Wilson  
Mine Safety and Health Inspector**

**Joseph A. Olivier  
Mine Safety and Health Specialist**

**Jeffery H. Kravitz  
Chief Mine Emergency Operations**

**Virgil F. Brown  
Mine Emergency Unit Specialist**

**Charles D. Campbell  
Senior Mining Engineer**

**Jerry W. Antel  
Engineering Technician**

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**OVERVIEW**

On October 17, 2002, Dale R. Spring, miner, age 49, was fatally injured and Theodore C. Milligan, mine rescue team trainer, age 38, was critically injured when they collapsed while evaluating conditions in an inactive underground gold mine. Milligan passed away on October 23, 2002.

The victims were part of a mine rescue team that had been directed to explore a gold mine that had been inactive for more than two years. Two weeks prior to the accident, Barrick's management requested that the next scheduled underground mine rescue training be conducted at the Storm Exploration Decline to evaluate the mine for the possibility of reactivating it.

Mine management was aware that the mine had not been ventilated since April 2000 and expected the temperature in the mine to be near 100 degrees Fahrenheit with very high humidity. The slope of this decline was reported to average 15 percent to the surface. On June 23, 2002 two Barrick supervisors entered the Storm Decline for a distance of about 600 feet before low oxygen readings forced their retreat.

On the day of the accident, a three-man team entered the mine and advanced 800 feet before the effects of high heat, high humidity, and foggy conditions forced their return to the surface. Underestimating the hazards presented by this environment, the second team entered the mine and advanced about 2,000 feet before deciding to return to the surface.

The accident resulted from a failure to accurately assess the risks from environmental exposure to excessive heat and humidity. Contributing to the severity of the accident was the failure to maintain the Biopak 240S apparatus properly by ensuring that all units were equipped with a frozen Gel-Pak/Gel-Tube.

Spring had a total of 26 years mining experience, 6 years and 12 weeks with this company. Milligan had a total of 10 years mining experience, 2 years with this company.

## **GENERAL INFORMATION**

The Storm Exploration Decline (Storm Decline), an inactive underground gold exploration mine, was a joint venture between Dee Gold Mining Company and Barrick Gold Exploration, Inc. (Barrick), with Barrick having sole managing authority over the mine. The operation was located near Elko, Eureka County, Nevada. The principal operating official for Barrick was Chantel Lavoie, Manager, Barrick Goldstrike Underground Division.

Barrick developed the Storm Decline from the lowest level of the Dee Gold Mining Company open pit in March 1999. The decline was developed to explore ore bodies to identify potential gold-bearing ore reserves. Conventional mining methods utilizing drilling, blasting, and trackless haulage were used to advance the decline. The mine was closed during April 2000 and access to it was controlled by locked gates.

On June 23, 2002 Lauren Roberts, superintendent of continuous improvement, and Lonnie Foutch, underground supervisor, unlocked the gate and entered the mine for a distance of about 600 feet before low oxygen readings forced their retreat.

Two weeks prior to the accident, Barrick's engineering department contacted the mine rescue team training coordinator to ask if the next scheduled underground mine rescue training could be conducted at the Storm Decline to map underground conditions, and to evaluate the mine for the possibility of reactivating it.

The last regular inspection of this mine was completed on April 19, 2000, and the mine was closed shortly thereafter. Barrick had not notified the Mine Safety and Health Administration (MSHA) of plans to re-enter this inactive mine prior to the accident.

## **DESCRIPTION OF THE ACCIDENT**

On the day of the accident, Dale Spring and Theodore Milligan (victims) and seven other mine rescue team members reported for work at the Meikle Mine rescue station between 6:20 and 7 a.m., their normal starting time. Loren Roberts had arranged to have Lonnie Foutch accompany the team during this activity since he had

worked at this mine when it was developed. Before the team members left the mine rescue station, Foutch reviewed the map of the Storm Decline with them. Milligan explained to the team that their assignment would involve mapping conditions of the Storm Decline for possible reactivation of the mine.

Each team member worked with a partner to bench test their self-contained breathing apparatus. Spring and Milligan assisted other team members in testing their apparatus. None of the other team members could recall if Milligan or Spring tested their own apparatus during this time. The team loaded their apparatus into the back of a pickup truck and drove 6 miles to the Storm Decline, arriving at the portal at about 9 a.m.

Milligan again briefed the team at the portal on the conditions they could encounter in the decline. The team was told to anticipate low levels of oxygen and high heat, and not to exceed their limits. They were instructed to check the ground conditions, utilities, and atmospheric conditions, monitor mine gases, take pictures of the exploration, and verify the conditions accurately on the mine map. The nine team members were divided into three three-man teams. The teams were to carry the following equipment: a pager phone, 500-foot rolls of blasting line for communications, a TMX 412 multi-gas monitor, a digital camera, and scaling bar.

After examining and testing the mine opening at about 9:55 a.m., team one, consisting of Bart Freteig, Dan Marque, and Kurt Tomton, miners, entered the mine wearing their apparatus but not under oxygen. They proceeded about 500 feet down the decline. At that point, the multi-gas monitor alarm indicated a low oxygen level reading of 19.5 percent. After reporting the oxygen level to the surface, they donned their facemasks, went under oxygen, and advanced.

As the team advanced and stopped at unspecified intervals, they cut the wire and hooked up the phone to call outside. After calling, they spliced the wire with the remaining wire on the spool and continued to advance. As one spool ran out, they spliced another one on. The teams left the phone at their farthest point of advance for the next team's use.

At 10:25 a.m., team one reached the 800-foot level and phoned the surface. They reported the following conditions to the surface: oxygen readings of 18.5 to 19.0 percent, heat readings of 103 degrees Fahrenheit (F), and fog that prevented taking photographs and limited their visibility. They reported that they were going to retreat to the surface. At 10:32 a.m., the team arrived at the surface.

After being debriefed by team one, team three, consisting of Milligan, Spring, and Brett Campbell, mechanic, decided they would continue the exploration and entered the decline at 10:45 a.m. Team two, consisting of Lenny Wilcox, miner, Gary Pitt, Part 48 Trainer, and Lee McCombs, miner, functioned as the backup team with McCombs assigned to monitor the mine phone and record the information called outside. Spring was spooling out wire for the mine pager phone. Milligan monitored gas readings, and Campbell assisted both. Team three proceeded down the decline to the 500-foot level where they donned their apparatus. At 11 a.m., after advancing to the 800-foot level, Spring called the surface. He reported oxygen readings of 10.2 to 10.3 percent, high heat, and stated they were continuing down the decline.

At 11:17 a.m., the team stopped at about 1000 feet and Spring reported 17.3 percent oxygen and a temperature of 103 degrees F. The team continued to advance and at 11:25 a.m. they reached the 2,000-foot level. Spring called McCombs to report that they could not read the multi-gas monitor because the indicator was fogged. He reported 104 degrees F and high humidity, and said they were going to retreat back to the surface.

The team left the mine phone and started walking up the 15-percent decline with Spring in the lead. Milligan was having difficulty coping with the heat and stopped to rest every 20 to 30 feet. When Milligan told Campbell he was not sure he could make it to the surface, Campbell stayed with him as they walked up the decline. They eventually caught up with Spring, who was also exhausted from climbing the steep slope. Campbell then decided to continue alone at a slow pace to get help. Campbell tried to signal team two by shorting the phone line as he made his way up the slope.

At 11:40 a.m., as Campbell neared the surface, McCombs heard Campbell's yell for help. Wilcox, Pitt, and

McCombs went down the decline about 100 feet, where they met Campbell. Campbell was completely exhausted and informed them that Spring and Milligan were down, and that their units might be out of oxygen.

At 11:45 a.m., Fouch activated the company's emergency response plan, and emergency medical personnel were requested. After team two retrieved the three oxygen cylinders from the apparatus used by team one, they entered the mine with the spare cylinders and located Spring about 700 feet from the mine opening, unconscious, lying face down with his mask on. Spring's oxygen bottle was checked and found to contain about 1,500 pounds per square inch gauge (PSIG) of oxygen. The bypass on Spring's apparatus was used during the effort to revive him. After these efforts were unsuccessful, Spring's mask was removed and his vital signs were checked. His pulse was quick and weak and no respiration activity was detected. CPR was started and continued for several minutes, with no signs of response. The team then decided to look for Milligan.

Milligan was found about 70 feet farther down the decline from Spring's location. He was lying on his side with his mask off, unconscious, gasping for breath. Milligan's apparatus was checked and it indicated the oxygen cylinder was empty. The team proceeded to give Milligan oxygen using their own masks and he became semi-conscious. They tried to carry Milligan up the 15-percent grade to the surface, but the steep slope made their attempts unsuccessful. They continued to care for Milligan until they were relieved by emergency medical personnel, who arrived at the mine at 12:52 p.m. At about 1:30 p.m., Milligan was placed on a stretcher, transported to the surface, and life-flighted to Elko General Hospital. He was transferred the next day to the LDS Hospital in Salt Lake City, Utah, where he died on October 23, 2002. The cause of death was attributed to lack of oxygen to the brain from environmental exposure.

Spring's body was transported to the surface where he was pronounced dead. The cause of death was attributed to multiple organ failure from environmental exposure.

## INVESTIGATION OF ACCIDENT

On the day of the accident, the Mine Safety and Health Administration (MSHA) was notified at 12:45 p.m., by a telephone call from Craig Ross to Tyrone Goodspeed, supervisory mine safety and health inspector. An investigation began the same day. A 103(k) order was issued pursuant to Section 103(k) of the Mine Act to ensure the safety of the miners. The accident investigation was conducted with the assistance of the State of Nevada Mine Safety and Training Section, mine management, and the miners.

## DISCUSSION

### Accident Location

The accident occurred inside the inactive Storm Decline. The mine was driven on a 15-percent downgrade for approximately 3,400 feet. Drift height was about 15 feet with an average width of 15 feet. Rockbolts were installed on 4-foot centers for ground support.

The Storm Decline had not been worked since April 2000 and mechanical ventilation was not provided to clear the mine air prior to the rescue personnel entering. The map provided to the team was last updated in April 2000.

### Equipment

The nine rescue team members were equipped with the Biopak 240S self-contained breathing apparatus manufactured by Biomarine Incorporated (Biomarine) and were owned by Barrick.

The equipment provided for the team's use at the Storm Decline site included the following: a digital camera, a scaling bar, a TMX 412 multi-gas monitor, two Femco mine pager phones, several 500-foot spools of two-strand blasting wire, and a Bacharach sling psychrometer for measurements of temperature and humidity.

The TMX multi-gas monitor, manufactured by Industrial Scientific Corporation, was equipped with sensors installed to measure oxygen, carbon monoxide, sulfur dioxide, and lower explosive limits of combustible gases. The monitor did not contain a hygiene board. The last calibration record for this monitor was October 9, 2002.

First-aid supplies, spare self-contained breathing apparatus, spare compressed oxygen cylinders and a stretcher were not provided at the Storm Decline.

### **Gas and Temperature Readings**

The gas readings taken in the mine by the teams were phoned to the surface where they were logged. Readings logged on October 17, 2002, are as follows:

#### **Team No. 1**

| <b>Location</b>      | <b>Oxygen</b>        | <b>Temperature</b> |
|----------------------|----------------------|--------------------|
| 500 feet from portal | 19.5 to 20.0 percent | none reported      |
| 800 feet from portal | 18.5 percent         | 103 degrees F.     |

#### **Team No. 2**

| <b>Location</b>        | <b>Oxygen</b>        | <b>Temperature</b> |
|------------------------|----------------------|--------------------|
| 800 feet from portal   | 10.2 to 10.3 percent | none reported      |
| 1,000 feet from portal | 17.3 percent         | 103 degrees F.     |
| 2,000 feet from portal | none reported        | 104 degrees F.     |

### **MSHA Air Samples**

Air samples were collected by MSHA on November 7, 2002, using a remote control robot that was able to advance 900 feet into the Storm Decline. The results of those samplings are listed in Appendix E.

Air samples were collected at the surface opening of the Storm Decline on November 7, 2002, from an existing 2-inch-diameter water pipe. The pipe, installed along the mine roof, extended into the decline for an unknown length. The analysis found 16.78 percent oxygen and 2.12 percent carbon dioxide.

### **Biomarine User Instructor Manual**

The Biomarine User Instruction Manual directed persons preparing the apparatus for use to obtain a frozen coolant canister charge (Gel-Pak/Gel-Tube) and install it into the coolant canister. The frozen Gel-Pak/Gel-Tube, required by MSHA/NIOSH approval, can reduce the temperature of the breathing gas entering the canister to maintain the gas temperature and dew-point below 90 degrees F (according to Biomarine manuals). The Biomarine breathing apparatus No. 10 worn by Milligan and No. 15 worn by Spring did not contain frozen Gel-Paks/Gel-Tubes as required. MSHA standards require that miners use respiratory protective equipment in accordance with training and instruction. (citation listed in report)

The Biomarine User Instruction Manual cautions that a poor face piece seal will cause a significant decrease in Biopak duration. Both of the victims had not shaved off their goatees prior to wearing the self-contained breathing apparatus on the day of the accident. MSHA standards require that miners use respiratory protective equipment in accordance with training and instruction. Although not listed in this report as contributory to the fatality, Barrick was issued a citation for a violation of 57.5005(b) which prohibits the use of respirators

(apparatus) when conditions such as a beard project under the face piece and prevent a good face seal.

The third member of team three, Brett Campbell, was clean-shaven and had inserted a frozen Gel-Pak/Gel-Tube in his apparatus as required. Members of teams one and two were also clean-shaven and had inserted frozen Gel-Paks/Gel-Tubes in their apparatus.

## Testing

Tests were conducted on the four Biomarines, Biopak 240S, closed-circuit self-contained breathing apparatus (SCBA) involved in the fatalities and rescue efforts. The testing was performed jointly by the National Institute for Occupational Safety and Health (NIOSH) and MSHA's Office of Technical Support. The testing began on November 25, 2002, at NIOSH's laboratory facility at Bruceton, Pennsylvania, and concluded on December 16, 2002.

Tests conducted on apparatus No. 15 worn by Spring determined the presence of a leak in the high pressure oxygen gauge line that resulted in the gauge reading 800 PSIG less than the actual oxygen pressure available in the unit's compressed oxygen cylinder. A second leak was found in the oxygen line threaded connection near the compressed oxygen cylinder. Neither defect was found to contribute to the cause of the accident. Although not listed in this report as contributory to the fatality, Barrick was issued a citation for a violation of 57.14100(b) for the failure to correct defects that affect safety in a timely manner.

The log-book at Barrick's mine rescue station documented that all self-contained breathing apparatus had been inspected and tested on September 27, 2002, and found to be free of defects.

Results of all tests conducted on Barrick's apparatus jointly by the MSHA and NIOSH are listed in Appendix D.

## Training

Both Milligan and Spring had received training in accordance with 30 CFR, Parts 48 and 49.

## ROOT CAUSE ANALYSIS

A root cause analysis was performed on the accident. The following causal factors were identified:

**Causal Factor:** The risk assessment process, conducted by Barrick's management, prior to sending the mine rescue team to conduct an exploration of the inactive Storm Decline was inadequate. Procedures were not established to address all hazards affecting the safety of the rescue team members while performing this task.

The Storm Decline had been inactive for more than 2 years. Management knew the mine was not ventilated and the temperature in the mine was expected to be near 100 degrees F with high humidity, possible low oxygen levels, and elevated levels of carbon dioxide.

The mine rescue team coordinator was informed that he should utilize mine rescue personnel to assess the physical conditions of the Storm Decline. However, mine management did not correctly evaluate the hazards that this assignment presented. Management was aware of low oxygen levels and high temperatures prior to the rescue team members entering the mine.

The mine rescue team coordinator was left to direct this task and was not assisted by management to develop a protocol that listed a specific sequence of exploration along with procedures to be followed.

Even though all mine rescue team members were trained and experienced, management was responsible for communicating with teams in these circumstances and for safely directing their actions.

**Corrective Action:** A plan should be developed to establish exploration procedures. The plan should address the specific tasks each team is to complete. The procedures should include actions that must be initiated by the team to ensure their safety and limit the distance they can explore.

**Causal Factor:** The apparatus manufacturer's User Instruction Procedures were not followed while readying the self-contained breathing apparatus in that the frozen Gel-Paks/Gel-Tubes were not installed in the apparatus' coolant canisters worn by Milligan and Spring.

When the team wore their apparatus during underground training the established practice at Barrick was to have the mine rescue team trainer and rescue team members coordinate the training exercise. It was determined through interviews that some of the miners had not installed the frozen Gel-Paks/Gel-Tubes in their apparatus during prior underground training as required.

**Corrective Action:** Mine rescue training procedures should be reviewed to ensure that responsibilities regarding the testing and use of self-contained breathing apparatus are clearly established. All mine rescue team members must be familiar with these procedures and management should actively participate during practice and training to ensure that self-contained breathing apparatus are properly maintained and utilized.

**Causal Factor:** Communication between the rescue team underground and the surface was inadequate.

The rescue team carried 500-foot spools of two-stranded blasting wire along with a Femco mine pager phone. This method of communication required the team to cut the blasting wire and connect it to the pager phone each time they wanted to communicate to the surface.

This method of communication did not provide a means for the surface to remain in constant communication with the team to ascertain their location and their condition at all times while they remained underground.

**Corrective Action:** Mine rescue training procedures should be reviewed to ensure that sound powered communication systems are used at all times when teams enter unknown underground atmospheres. These communication systems must be approved as stipulated by Code of Federal Regulations, Part 23, and must be capable of providing continuous voice contact between the fresh air base and the mine rescue team.

**Possible Causal Factor:** The apparatus manufacturer's User Instruction Procedures were not followed in that both victims had failed to shave off their goatees prior to wearing the self-contained breathing apparatus.

The Biomarine User Instruction Manual stipulated users of Biopak 240S apparatus should be clean-shaven because the presence of facial hair could interfere with the apparatus' face piece seal, resulting in a significant decrease in the duration of service time.

The Biopak 240S apparatus maintains a positive pressure inside the face piece to prevent the user from breathing gases outside the face piece. A poor face piece seal would cause the unit to send larger amounts of compressed oxygen from its cylinder in the effort to maintain the proper pressure inside the face piece.

Milligan was aware that his team had encountered oxygen levels below 11 percent in one area of the decline as they advanced. Although the investigation was not able to determine why Milligan had removed his mask, it was determined that his oxygen cylinder contained less than 3000 PSIG when he donned his apparatus. It is also likely that his goatee prevented an air tight seal around his face piece. This condition would have caused oxygen to leak continuously as Milligan wore the apparatus. It is unlikely that he would have removed his mask unless he had exhausted his oxygen supply knowing that low oxygen levels had been measured in the mine.

The established practice at Barrick was to allow mine rescue team members to wear the Biopak 240S apparatus during underground practice, in known fresh air, without having to be clean-shaven. Although this practice was not uncommon, it was mine management's responsibility to ensure that all required procedures were being followed when teams enter unknown underground atmospheres.

**Corrective Action:** Mine rescue training procedures should be established to ensure that every mine rescue team member is clean-shaven to ensure that no facial hair is present that would interfere with the face piece seal prior to donning self-contained breathing apparatus when entering unknown atmospheres.

## CONCLUSION

On October 17, 2002, two mine rescue team members collapsed, and later died, while attempting to climb a 15-percent decline to the surface for a distance of about 2,000 feet.

The victims were part of a mine rescue team that had been directed to explore a gold mine that had been inactive for over two years. Two weeks prior to the accident, Barrick's management requested that the next scheduled underground mine rescue training be conducted at the Storm Decline to map underground conditions to evaluate the mine for the possibility of reactivating it.

Mine management was aware that this mine had not been ventilated since April 2000. They also knew the temperature in the mine was expected to be near 100 degrees Fahrenheit with very high humidity. On June 23, 2002 two Barrick supervisors entered the Storm Decline for a distance of about 600 feet before low oxygen readings forced their retreat.

On the day of the accident, a three-man team had entered the mine and advanced 800 feet before the effects of high heat, high humidity, and foggy conditions forced their return to the surface. The failure to recognize the hazards presented by this environment resulted in the second team being allowed to advance into the mine and travel about 2,000 feet before returning to the surface.

The accident resulted from a failure to accurately assess the risks from environmental exposure to excessive heat and humidity. Contributing to the severity of the accident was the failure to maintain the Biopak 240S apparatus properly by ensuring that all units were equipped with a frozen Gel-Pak/Gel-Tube.

## ENFORCEMENT ACTIONS

Order No. 6279135 was issued on November 5, 2002, under the provisions of Section 103(k) of the Mine Act:

A fatal accident occurred at this operation on October 17, 2002, when a mine rescue team entered an old abandoned mine. This order is issued to ensure the safety of all persons at this operation and prohibits any work in the affected area until MSHA determines that it is safe to resume normal operations as determined by an authorized representative of the Secretary of Labor. The mine operator shall obtain approval from an authorized representative for all actions to recover and/or restore operations in the affected area.

The order was terminated on February 27, 2003. The mine operator has formulated a plan to ensure the health and safety of the employees in the rehabilitation of the Storm Decline.

Citation No. 7907269 was issued on February 27, 2003, under the provisions of Section 104(a) of the Mine Act for violation of 30 CFR 57.5005(a):

Two miners were fatally injured at this mine on October 17, 2002. Both miners collapsed while wearing self-contained breathing apparatus during exploration of an inactive underground mine. The atmosphere in this mine was unventilated and the concentrations of oxygen and possible toxic gases were unknown. The air temperature was expected to be near 100 degrees Fahrenheit with very high humidity. The self-contained breathing apparatus that were worn by both victims were not being used in approved condition and in accordance with the prior training and instruction in that frozen



GelPaks/GelTubes had not been inserted into each unit's cooler as required by the manufacturer's User Instruction Manual and as required by joint MSHA and NIOSH certification criteria.

This citation was terminated on February 27, 2003. The company ensured that they will follow the guidelines set in the Biomarine User Instruction Manual.

## Appendix D

- [MSHA/NIOSH Apparatus Test Results](#)
- [Figures, Spreadsheets, Charts](#)

## Appendix E

- [Summary of Gas Readings](#)

## Appendix F

- [Map](#)

## Related Fatal Alert Bulletin:

 [FAB02M36 and FAB02M37](#)

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## APPENDIX A

### Persons Participating in the Investigation

#### Barrick Goldstrike Mine, Inc.

Dan Hagy ..... underground safety director  
Craig F. Ross ..... safety and health superintendent  
Jerry Murphy ..... underground safety and health coordinator  
Scott Herr ..... mine operations superintendent

#### Durney & Brennan, Ltd.

A. Grant Gerber ..... attorney

#### State of Nevada

Edward M. Tomany ..... chief administrative office, mine inspector  
Joseph Roades ..... mine inspector

#### Mine Safety and Health Administration

Michael S. Okuniewicz ..... supervisory mine safety and health inspector  
Richard M. Wilson ..... mine safety and health inspector  
Joseph A. Olivier ..... mine safety and health specialist

Jeffery H. Kravitz ..... chief mine emergency operations  
Charles D. Campbell ..... senior mining engineer  
Jerry W. Antel ..... engineering Technician  
Virgil F. Brown ..... mine emergency unit specialist

## APPENDIX B

### Persons Interviewed

#### Barrick Goldstrike Mine, Inc.

Kurt M. Tomten ..... miner/mine rescue member  
Daniel D. Marquis ..... miner/mine rescue member  
Gary W. Pitt ..... Part 48 Trainer/mine rescue member  
Brett D. Campbell ..... mechanic/mine rescue member  
Len E. Wilcox ..... miner/mine rescue member  
Barton L. Freitag ..... miner/mine rescue member  
Lee R. McCombs, Jr. .... miner/mine rescue member  
Lauren Roberts ..... superintendent of continuous improvement  
Lonnie Foutch ..... underground supervisor  
Patrick Gazewood ..... miner/mine rescue member  
Carl Graham ..... supervisor for mining operations  
George B. Wallis ..... miner/mine rescue member  
Rodney Christensen ..... miner/mine rescue member  
Jason Mayne ..... miner/mine rescue member  
Anthony Sanchez ..... mechanic/mine rescue member