MAI-2003-23

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

REPORT OF INVESTIGATION

Surface Metal Mine
(Gold Ore)

Fatal "Other" Accident

November 19, 2003

Goldstrike Mine
Barrick Goldstrike Mines Inc
Carlin, Eureka County, Nevada
Mine ID No. 26-01089

Investigators

Rick D. Dance
Mine Safety and Health Inspector

Richard Wilson
Mine Safety and Health Inspector

Juan Wilmoth
Mine Safety and Health Specialist

Phillip McCabe
Mechanical Engineer

Originating Office
Mine Safety and Health Administration
Western District
2060 Peabody Road, Suite 610
Vacaville, California 95687
Lee D. Ratliff, District Manager

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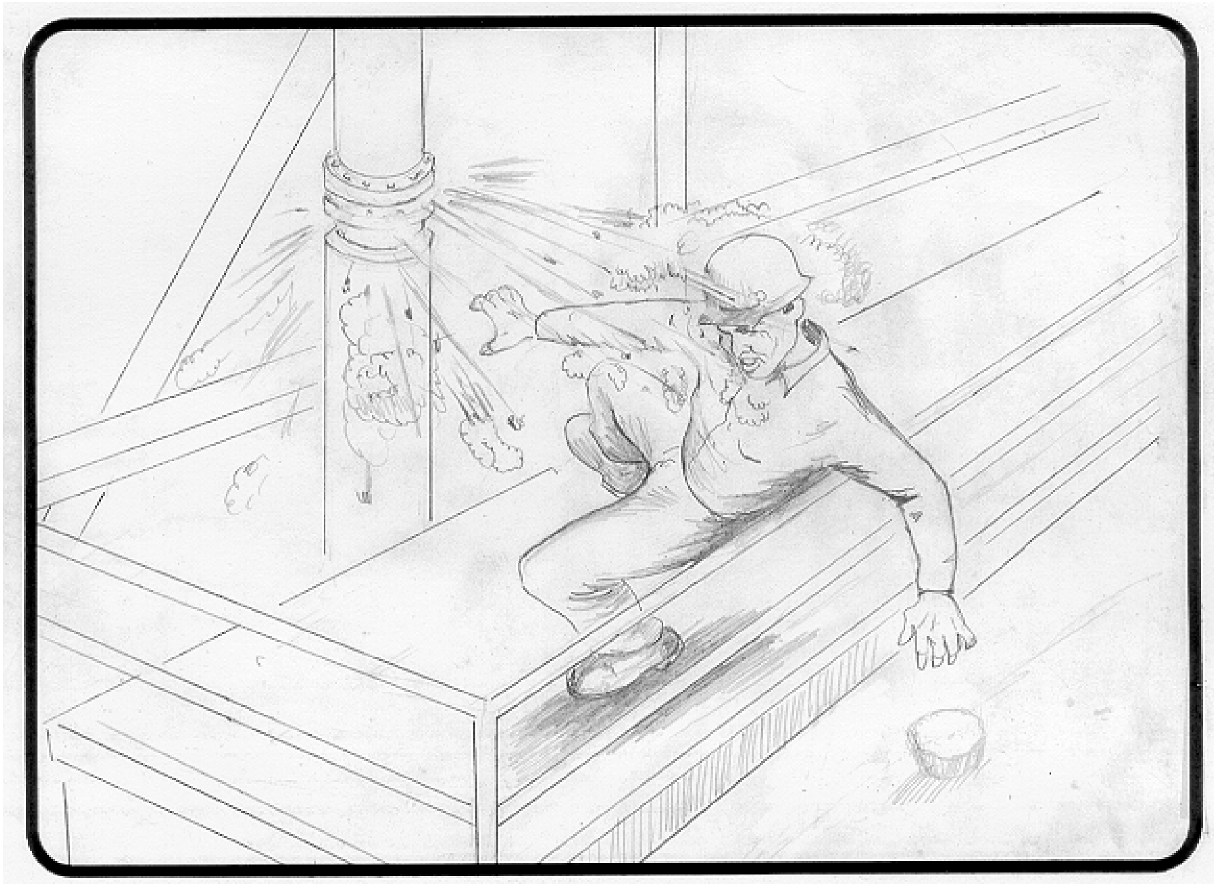

OVERVIEW

Ernest A. Spalding, trainer, age 38, was fatally injured on November 19, 2003, when he fell from a work level to a concrete floor below. A maintenance crew was replacing a gasket in a discharge pipeline that transferred hot calcine dust from a roaster to a quench tank. After the crew went to get some parts, Spalding entered the area where the gasket was being replaced and received burns when the hot calcine dust unexpectedly released through the open pipeline.

The accident occurred because the procedures being used to perform this repair work at the discharge pipeline were inadequate. The roaster had not been emptied of the hot calcine dust before the maintenance work was performed. A task analysis identifying all hazards associated with this maintenance task was not conducted. No training was provided for the employees regarding the safe work procedures while working at the roaster.

GENERAL INFORMATION

Goldstrike Mine, a surface gold ore mine and refining operation, owned and operated by Barrick Goldstrike Mine, Inc., was located 40 miles north of Carlin, Eureka County, Nevada. The principal operating officials were John Carrington, chief executive officer, and Michael Feehan, acting plant manager. The mine operated 7 days a week, 24 hours a day using shift work. Total employment was 1,140 employees.

Gold ore was mined and hauled to the crushers where it was crushed and milled to a fine powder. The raw ore was fed into one of two identical roasters that heated the ore to 1,000 degrees Fahrenheit to burn off all impurities. The ore flowed from the roaster through two discharge pipes, designated as an A-leg and B-leg, to quench tanks where it entered a refining process that separated the metals. The finished product was sold to commercial industries.

The last regular inspection of this operation was completed on September 10, 2003.

DESCRIPTION OF ACCIDENT

On the day of the accident, Ernest Spalding, (victim) started work at 6 a.m. At 6:15 a.m., the ore that supplied the roaster was depleted. Mine management decided to perform maintenance while the feed supply to the roaster was down. Spalding went to assist locking out the dust scrubber recycle pumps. This system was also scheduled for repairs while the roaster feed supply was down.

At 7 a.m., a safety meeting was conducted in the maintenance shop and tasks were assigned. Gerald Chadwell and Kevin McFarland, maintenance men, were assigned to replace a leaking gasket on a knife gate valve on the B-leg #1 north Roaster. At 7:30 a.m., they cleaned a fan while waiting for the roaster feed and oxygen valves to be locked out. At 8:30 a.m., they put their locks on the lock box for the roaster feed and started repairs to the gasket on B-leg #1. They removed the defective gasket, leaving a 2 ½ to 3 inch gap in the pipeline. They found the 16 inch B-leg #1 pipe full of cool calcine dust. After finding that the internal metal deflector ring was worn, they went to the shop for new bolts, flange spreaders, and a new deflector ring.

Unable to find a new deflector ring, they went to the Motor Control Center in the roaster building located on the floor above the knife gate valve. They called on the radio to the control room operator and requested him to actuate the knife and cone valves. The control room operator informed them that control had been given to the electricians who locked the valves out. They then called the electricians to unlock the controls so the control room operator could actuate the knife and cone valves to clear the calcine dust from the B-leg pipe.

At about the same time, Ernie Ray, foreman, received a radio call from Spalding to meet him at the 5421 level; the level below the knife gates. Ray entered the Roaster Building from the outside stairs and found the building filling with dust. He immediately went to the knife gate valve area to try to locate Spalding but was turned back by the heat and hot calcine dust. He heard a high pressure air leak and went back to where he entered the building. He met John Rodriguez and Neil Shole, employee/EMTs. The visibility in the building appeared to stabilize. They begun a thorough search on that level but were unable to find Spalding. As they searched the levels directly above and below the roaster, they learned that Spalding had been found on the bottom floor near the quench tanks. Spalding was moved outside and given cardio-pulmonary resuscitation (CPR). Medics on staff with Barrick continued CPR until an air ambulance arrived. Spalding was transported to a local hospital where he was pronounced dead. Death was attributed to blunt force trauma.

INVESTIGATION OF ACCIDENT

MSHA was notified of the accident at approximately 11 a.m., the same day by Craig Ross, supervisor for health & safety for Barrick Goldstrike Mines, Inc. An investigation was started that day. An order was issued pursuant to Section 103(k) of the Mine Act to ensure the safety of the miners. MSHA accident investigators traveled to the mine, made a physical inspection of the accident scene, interviewed employees, and reviewed conditions and work procedures relevant to the accident. MSHA conducted the investigation with the assistance of mine management and employees.

DISCUSSION

Accident Scene

The accident occurred in the roaster building on the 5431 level (third floor) about 30 feet above ground. The 200 feet tall, multi-level building contained two roasters and other gold ore processing equipment.

Roaster General Operation Process

The roasting reaction was a basic process of burning the raw ore using excess oxygen for combustion. The control of the process required multiple devices and equipment for proper operation. The two stage roaster was essentially an oven for the combustion of sulfides and other mineral waste byproducts in the gold ore prior to the extraction of the gold. The fuel to maintain the autogenous reaction was contained within the raw ore; however, coal could be added as required if the ore chemistry was not correct. The roasting process also made the ore more friable to enhance the gold extraction process. The process began after the gold ore (rock) was mined and crushed; this material was referred to as roaster feed, double refractory ore.

On the initial startup of a cold dormant roaster unit, the material had to be heated with fuel and have an oxygen rich environment to start the autogenous self-generating roasting process. Once the roaster reaction was started, the refractory ore was then continuously gravity fed into the top of the large, cylindrical, two-stage roaster. The ore was enriched with oxygen from below to maintain the roasting reaction in a fluidized bed which burned the sulfides and waste products. The temperature of the fluidized bed normally operated in the range of 1,000 degrees Fahrenheit. The off-gases of combustion were collected by mechanical cyclones and neutralized.

After the ore was roasted, the product was called calcine. The hot calcine behaved similar to a liquid and flowed easily. The calcine was then metered by automatic cone valves into a quench tank through two legs, referred to as A-leg or B-leg, which were located in the 16 inch vertical pipelines. The calcine was mixed with liquid in the quench tank and pumped to other equipment to complete the gold extraction process.

Roaster Layout

Roaster Description: The two-stage roaster was comprised of several mechanical components. The main body of the roaster consisted of two large cylindrical shaped metal housings stacked on top of each other. The first stage was slightly larger in diameter and could hold more ore than the lower second stage. The roaster housings, sides and top, were lined with a thick layer of refractory material to provide protection from the heat and to maintain the roaster temperature. The bottoms of the roaster stages consisted of beds of tuyeres or oxygen inlets. These tuyeres prevented the fine ore powder from falling down through, yet allowed the oxygen to percolate up through the fluidized bed. The tuyeres acted like the roof on a house where the ore was on the roof and the oxygen was fed from under the eaves of the roof.

Oxygen Pipeline Description: The oxygen was supplied to the roaster from an oxygen plant located at the facility. It was delivered by a single large pipeline that split into two smaller pipelines that supplied oxygen to each roaster unit. Each of the smaller pipelines from the main split had a total of five valves to control the oxygen flow and to manually isolate the oxygen flow during maintenance.

Ore Feed Description, First Stage: The roaster feed double refractory ore was gravity fed into the top of the roaster through distribution piping which filled the bed in the upper or first stage of the roaster. As the waste materials were being consumed, the ore was being fed through an external chute located at the bed level of the upper, or first stage, through an external vertical pipe into an external chute located near the bed level of the lower or second stage of the roaster. The volume of material was controlled by an automatic cone valve installed in the vertical pipeline.

Ore Feed Description, Second Stage: After the reaction was completed, the calcine was fed into the slurry tank through an external vertical pipeline located on the bottom of the lower or second stage of the roaster where it was mixed with liquid for further processing in the gold extraction process. The volume of material was controlled by an automatic cone valve installed in the vertical pipeline.

Ore Feed Control: The roasting process was continuous. The primary volume control was regulated by two automatic cone valves in each A-leg and B-leg. One interstage cone valve was located in the external vertical pipe that connected the first and second roaster stages. The other discharge valve was located in the external vertical pipe that connected the discharge of the second stage to the inlet of the slurry tank. These cone control valves acted as throttles to regulate the volume of ore in each roaster stage and were operated from pressure indicating transmitters located in the fluidized beds.

The first stage bed operated in the 150 inches of water range and the second stage bed operated in the 32 inches of water range. The exact total volume of material was not monitored, only the operating pressure of the fluidized beds. These bed pressures were monitored and controlled during operation but not monitored during a roaster shutdown.

Automatic Cone Valves: Occasionally, the cone control valves needed to be maintained and repaired. To perform maintenance on the cone valves, a large pneumatically controlled, 16 inch diameter, slide gate valve, located above the cone valve, in the external vertical pipeline was used to isolate the material discharge from the roaster. Large expansion joints were located between the slide gate valve and the cone gate valve and the cone valve to permit the bolted flanges to be mechanically spread enough to change gaskets and the deflector ring.

The slide gate valve, a large flat piece of metal, was pushed in and out of the valve body by a pneumatic cylinder. It was used to isolate the discharge cone valve from the roaster stage material. The action of the slide gate valve was controlled by a small electrically controlled pneumatic solenoid valve. This solenoid valve was activated from the control room. The air supply for the slide gate valve was supplied by instrument air. The slide gate valve had two electrical proximity switches to indicate an opened or closed condition.

The valve position indication from the proximity switches was monitored in the control room but there was no electrical power supplied to the controls at the time of the accident. The electrical solenoid control valve could be activated manually by a small spring loaded plunger located on the centerline of the valve spool. This solenoid valve and position indication was normally controlled and monitored from the control room. The valve was electrically interlocked with the other automatic control devices. The plunger could physically move the spool in the control valve. The slide gate pneumatic activation cylinder could be operated if the instrument air was available. The slide gate valve was designed to be fail safe to the closed position.

Roaster Control: The operations of the roaster were computer controlled and the operating conditions were monitored by video screens. The controls for the roaster had multiple interlocks to prevent the operation of the roaster when the roaster was turned off from the control room. These controls turned off the electrical and pneumatic features of the roaster but did not physically lock-out any mechanically controlled devices to prevent inadvertent operation.

Roaster Shutdown for Maintenance

The physical characteristics of the structure and the desirable operating conditions of the roaster dictated the shutdown procedure. During a roaster shutdown, the feed to the roaster would be disabled and the roaster would be permitted to cool for a few days. The roaster was lined with refractory material that did not react well to heating and cooling. The heating and cooling cycles of the refractory lining accelerated heat stress cracks, shortening its life and integrity. This caused an increase of nuisance repair shutdowns and capital equipment losses. Management preferred to keep the ore material within the fluidized beds high and hot.

Restarting the autogenous reaction after a complete shutdown required great effort. The cold material would have to be relighted to start the process. Large quantities of air, oxygen, and fuel were required to get the material up to operating temperatures where the autogenous reaction would continue to burn.

Several Chicago air couplings, located on the external vertical pipes, were used during the maintenance of the valves. When maintenance would be performed on the slide gate valve, personnel would clear the external vertical pipes by forcing air through the Chicago couplings and clearing any loose material on the upside of the slide gate valve. This would clear the vertical pipes and allow the material to gravity feed into the slurry tank. However, a quantity of hot material could remain in the beds in the bottom of the roaster stages after the external vertical pipelines were cleared.

Equipment Lockouts

As part of the investigation, the electrical switchgear room, that housed the primary electrical motor power switches, was examined. The material handling equipment and blower systems were electrically isolated and locked-out from the roaster operational circuit during the roaster shutdown. The roaster master controls were turned-off from the control room. The system interlocks were disabled during the shutdown indicating there was no electrical power supplied to the roaster controls or any feedback sensors. The oxygen supply line was turned off but the manual oxygen valves were not physically locked-out. There were no level controls on the roaster stages, just feedback control from the pressure transmitters. The lower bed could have contained approximately 28 cubic yards of hot calcine.

Training and Experience

Spalding had 8 ½ years roaster experience, 3 years at this roaster position and 3 ½ weeks as a trainer. He had received training in accordance with 30 CFR, Part 48.

ROOT CAUSE ANALYSIS

A root cause analysis was conducted on this accident and the following causal factors were identified:

Causal Factor: A risk assessment to determine possible hazards and to establish safe work procedures was not conducted prior to changing the gasket on the knife gate valve.

Corrective Action: A written procedure and pre-job risk analysis identifying all hazards associated with the task should be conducted before any repair or maintenance tasks are started. Tasks should be monitored periodically throughout the shift to ensure safe job completion.

Causal Factor: The hot calcine in the roaster was not emptied. No means was provided to block or control the flow of hot calcine from the discharge pipe before any maintenance work began.

Corrective Action: A written plan should be developed and implemented to ensure the contents of the roaster are contained and do not pose a hazard to persons performing work on the roaster or its components. This plan should also include a requirement that all personnel wear protective clothing to ensure their safety.

CONCLUSION

The accident occurred because safe procedures had not been established prior to performing repairs on the B-leg of the #1 Roaster (North) knife gate valve. The roaster was shut down with a large quantity of hot calcine in the upper and lower beds. A gasket in the knife gate valve was removed before the roaster was emptied and the system was allowed to cool.

ENFORCEMENT ACTIONS

Order No. 6280782 was issued on November 19, 2003, under the provisions of Section 103(k) of the Mine Act:

> A fatal accident occurred at this operation on November 19, 2003, when a roaster operator was attempting to work on the #1 Roaster on the second floor of the hopper. This order is issued to assure the safety of persons at this operation. It prohibits all activity at the #1 Roaster and affected area until MSHA has determined that it is safe to resume normal mining operations in the area. The mine operator shall obtain prior approval from an authorized representative for all actions to recover and or restore operations in the affected area.

This order was terminated on December 2, 2003. The conditions that contributed to the accident no longer exist and normal mining operations can resume.

Citation No. 6350872 was issued on January 13, 2004, under the provisions of Section 104(d) (1) of the Mine Act for violation of 30 CFR 56.16002:

> A fatal accident occurred at this operation on November 19, 2003, when a miner was engulfed with hot calcine material that slid through the “B” leg discharge line on the North roaster tank. The victim was in the area where the replacement of a gasket at the “B” leg knife gate valve was being done. A mechanical device or other means was not provided to prevent injuries created by sliding materials. Failure to provide means of controlling the hot calcine material when the “B” discharge line was disconnected at the slide gate constitutes more than ordinary negligence and is an unwarrantable failure to comply with a mandatory standard.

This citation was terminated on January 13, 2004. The company has established a written safe job procedure and miners have been instructed in this procedure while performing maintenance on the roaster discharge legs.

Citation Order No. 6350873 was issued on January 13, 2004, under the provisions of Section 104(a) of the Mine Act for violation of 30 CFR 56.15006:

> A fatal accident occurred at this operation on November 19, 2003, when a miner was engulfed with hot calcine material that slid through the “B” leg discharge line on the North roaster tank. The victim was in the area where the replacement of a gasket at the “B” leg knife gate valve was being done. Special protective clothing and equipment was not provided and used to prevent injuries created by the hot calcine material.

This citation was terminated January 13, 2004. The company has established a written safe job procedure which includes using protective clothing when maintenance is performed on the roaster discharge legs. Miners have also been trained in this procedure.

Approved by

____Date:________________

Lee D. Ratliff
District Manager

APPENDICES

A. Persons Participating in the Investigation
B. Persons Interviewed
C. Sketch of Accident Scene

APPENDIX A

Persons Participating in the Investigation:

Barrick Goldstrike:

Craig Ross	safety manager
Paul Wilmot	roaster operations supervisor
Steve Lambert	Barrick safety and health
Andy Cole	acting process manager
Dan Stevenson	process safety director
Mike Heenan	attorney

Mine Safety & Health Administration:

Rick Dance	mine safety and health inspector
Richard Wilson	mine safety and health inspector
Juan Wilmoth	mine safety and health specialist
Phillip McCabe	mechanical engineer

Nevada Mine Safety:

Edward Tomany	Nevada state mine inspector
Joe Rhoades	Nevada state mine inspector

APPENDIX B

Persons Interviewed Barrick Goldstrike:

Charlie Beatty	maintenance superintendent
Gerald Chadwell	maintenance man
Kevin McFarland	maintenance man
Paul Wilmot	roaster operations supervisor
Mike Pritchett	roaster control room operator
Jon Dietsche	roaster control room operator
Ernie Ray	foreman
Confidential Miner #1	Barrick employee
Confidential Miner #2	Barrick employee

APPENDIX C

Sketch of Accident Scene: