MAI–2016-04

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

REPORT OF INVESTIGATION

Surface Metal Mine
(Copper)

Fatal Electrical Accident
April 09, 2016

Freeport-McMoRan Safford, Inc.
Freeport-McMoRan Safford, Inc.
Safford, Graham County, Arizona
ID No. 02-03131

Investigators

Lee A. Hughes
Mine Safety and Health Inspector

Ernesto A. Vasquez
Mine Safety and Health Inspector

Stephen B. Dubina
Mine Safety and Health Specialist, Electrical Engineer
(Mine Electrical Systems Division)

Hilario S. Palacios
Mine Safety and Health Specialist (Training)

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Rocky Mountain District
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Richard Laufenberg, District Manager

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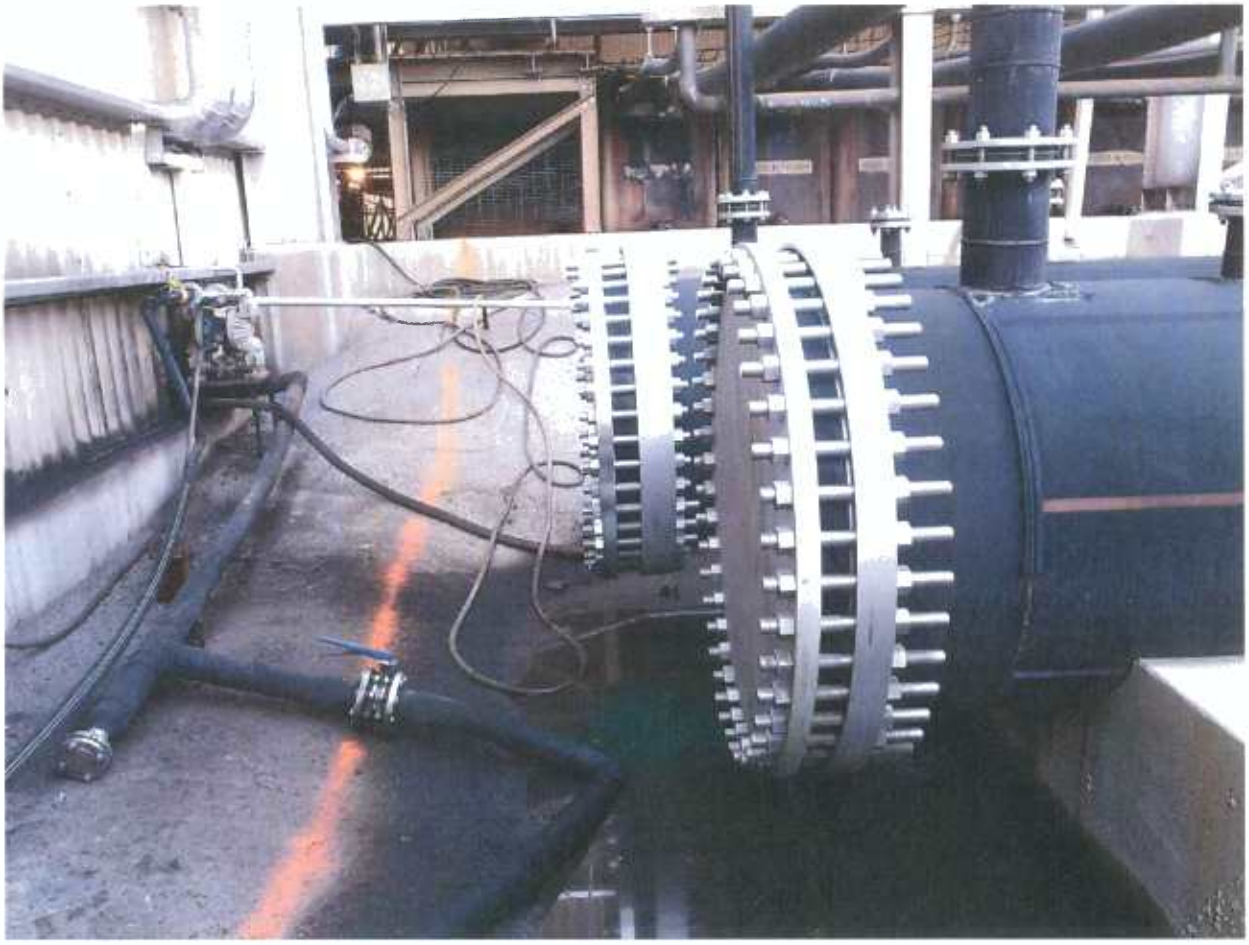

OVERVIEW

On April 9, 2016, Bryan Ortiz, Hydromet Electrowinning Operator I, age 25, was seriously injured when he was electrocuted by an energized flange on the electrolyte return line. Ortiz was instructed to prime a pump in the area and was found incapacitated kneeling in electrolyte solution with his head contacting an energized flange. Ortiz died of his injuries on April 10, 2016.

The accident occurred due to management's failure to insulate or guard energized flanges on the electrolyte return piping and failure to provide adequate personal protective equipment (PPE) for the electrical hazards that existed.

GENERAL INFORMATION

Freeport-McMoRan Safford Inc. (Freeport-McMoRan), a surface copper mine owned and operated by Freeport-McMoRan Safford Inc., is located near Safford, Graham County, Arizona. The principal operating official is Harry M. Conger, President. The mine operates multiple shifts, seven days a week. Total employment is 697 persons.

The operator mines material using a multiple bench method. The material is drilled, blasted and crushed. The crushed material is processed using electroextraction and the resultant high quality copper is sold as a final product.

To process the copper, the crushed material is fed into an agglomeration drum where water and sulfuric acid are added while tumbling the crushed material to obtain more uniform particle size to facilitate the leach process. The material is then placed in heap leach piles, and a weak sulfuric acid solution is used to leach copper out of the material. After sulfuric acid passes through the leach piles, the acid is laden with copper and other metal impurities. This solution, pregnant leach solution or PLS, then goes through solution extraction (SX) and electrowinning processes (EW). For the SX, using a selective organic reagent, the copper ions are stripped from the PLS and concentrated in an electrolyte solution of strong sulfuric acid. The rich electrolyte solution is pumped to the operator's tank house where it is then subjected to the EW process. Electrical current is passed through the solution causing the copper to plate from solution onto stainless steel starter plates located in cells. The operator harvests the plates from the cells with an overhead crane and sends them to the Stripping Process. The operator then removes or "strips" the copper from the starter plates, and the plates are returned to the cells for further plating. See Appendix C for a basic flow chart of the process.

The Mine Safety and Health Administration (MSHA) conducted its last regular inspection of Freeport-McMoRan on December 3, 2015.

DESCRIPTION OF ACCIDENT

On the day of the accident, Bryan Ortiz (victim) started his shift at 5:00 am. Ortiz was assigned to operate the stripping machine, and continued his normal duties through the afternoon.

At 1:52 pm, Ortiz left the stripping machine to prime a diaphragm pump located on the outside east wall of the stripping building. At 2:00 pm, Derrick Hedges, Tank House Trainee, exited the building to assist Ortiz with the diaphragm pump. Hedges found Ortiz incapacitated kneeling in a puddle of water with the left side of his face against the stainless steel flange of the high density polyethylene

(HDPE) return line for the electrolyte solution. There were no witnesses as to what occurred from the time Ortiz left the building to the time Hedges found him. Hedges returned to the stripping machine controls to locate a radio, but was unable to find one. Hedges ran to the control room and had Ross Hunt, Hydromet SX Operator, and Raymond Boni, SX Operator I, call a mayday over the radio.

Brett Barela, Hydromet Supervisor, was in his office eating lunch when he heard the mayday over the radio. Barela arrived at the accident scene and attempted to talk to Ortiz, but Ortiz was unresponsive. Barela grabbed Ortiz behind his neck and on his right arm. Barela received an electrical shock causing him to release Ortiz's neck. Ortiz's head fell into the water that he was found kneeling in, breaking contact with the flange. When Barela touched Ortiz again, he did not receive any further shock. Barela pulled Ortiz out of the water and checked for breathing and a pulse, but found none. Barela immediately began chest compressions but was unable to get a pulse.

At 2:04 pm, the Safford Mine Rescue Team arrived on scene and assumed control of rescue efforts. At 2:20 pm, Southwest Ambulance Service arrived on site and assumed control of patient care. The EMS crew utilized a defibrillator to obtain a pulse. Ortiz was transported to Mount Graham Regional Medical Center where he was placed on life support.

On April 10, 2016, Ortiz was pronounced dead. The cause of death was attributed to probable electrocution and the manner of death was accidental.

INVESTIGATION OF ACCIDENT

Drew Borcherding, Health and Safety Manager, notified MSHA of the accident at 2:16 pm on April 9, 2016, by a telephone call to the Department of Labor's National Contact Center (DOLNCC). The DOLNCC notified James Eubanks, Supervisory Mine Inspector. MSHA issued an order under the provisions of Section 103(k) of the Mine Act to ensure the safety of the miners when the first Authorized Representative arrived at the mine.

MSHA's accident investigation team traveled to the mine, conducted a physical inspection of the accident scene, interviewed employees, and reviewed documents and work procedures relevant to the accident. MSHA conducted the investigation with the assistance of Freeport-McMoRan mine management, mine employees, and Arizona State mine inspectors.

DISCUSSION

As previously discussed, Freeport-McMoRan uses electroextraction to process copper ore. The process takes place in the Tank House on the mine property.

Tank House Design and Operation

1. **Cell Design**: The Tank House was designed with 182 cells with 72 stainless steel cathodes and 73 lead-cadmium-tin anodes per cell. The cells operate at approximately 2.1 volts per cell and are made of non-conductive material.

2. **Rectifier Circuit**: Electrical power was provided to the cells by 2 floating rectifiers connected in parallel. Each rectifier had a maximum output of 440 volts DC and 38,300 amperes DC. The maximum output of the combined rectifiers was 76,600 amperes and 440 volts DC. The rectifiers are fed from a single substation. At the time of the accident, the rectifier circuit was operating around 370 volts, 65,000 amperes DC.

3. **Electrolyte Piping**: Electrolyte for the SX process is provided to the cells through a series of HDPE piping. The HDPE piping is connected in pipe sections with flange-fitting endcaps made of stainless steel. After flowing through cells, the depleted electrolyte free-falls through a pipe to provide air break, to minimize current transfer. Depleted electrolyte is then pumped back to SX.

4. **System Isolation and Grounding**: The rectifiers and Tank House are a floating system. That is, they are not grounded and are isolated from earth ground. Cell lines are isolated from the building structure and earth ground. Outlet plugs are not grounded to maintain isolation.

5. **Other Safety Precautions**: Metal tools that are long enough to bridge cells or contact the building structure are prohibited unless properly insulated. Battery powered tools are used instead of corded hand tools.

Location of the Accident

The accident occurred near a temporary diaphragm pump located on the outside east wall of the stripping building. The diaphragm pump was installed approximately five years ago to replace temporarily, a permanent bull pump that quit functioning. To operate the pump, employees had to travel between the pump and an air compressor tank. The walkway, located next to the HDPE lines, had discharge lines and air lines presenting tripping hazards. The walkway grade was measured with a varying slope of 17-35 degrees toward the

containment area. The walkway was wet and along with the tripping hazard created a hazardous condition that was cited under a separate event.

Electrical Testing

The accident team performed a number of electrical tests under various conditions at the location where Ortiz was found. Testing using a 1000-ohm resistor indicated a potential current and voltage of 500 milliamps and 100 volts, respectively. These values indicate a fatal electrocution potential.

Personal Protective Equipment

The electrical hazard-rated boots that Ortiz was wearing had multiple holes through the soles and toes, negating any electrical protection. Ortiz was not wearing any other personal protective equipment for electrical hazards at the time of the accident.

Weather Conditions

The weather conditions on the day of the accident were clear skies with a temperature around 78 degrees Fahrenheit.

TRAINING AND EXPERIENCE

Bryan Ortiz had 4 years, 46 weeks of mining experience all at Freeport-McMoRan. A representative of MSHA's Educational Field and Small Mines Services conducted a review of the mine operator's training records. The records were found to be up to date and in compliance with MSHA requirements.

ROOT CAUSE ANALYSIS

The accident investigation team conducted a root cause analysis to identify the underlying cause of the accident. The team identified the following root causes and the corresponding corrective actions implemented to prevent a recurrence of the accident.

Root Cause: Management failed to ensure that the stainless steel endcaps on the HDPE electrolyte return lines were not electrified when the rectifier circuits were energized.

Corrective Action: Management has placed insulating covers over metal flange fittings and provided a fence around the area to prevent accidental contact.

Root Cause: Management failed to provide adequate personal protective equipment for electrical hazards.

Corrective Action: Management developed and trained employees in new procedures for persons entering the fenced containment area around the electrolyte piping. Dielectrically-rated rubber boots and gloves are required to be worn when in the containment area.

CONCLUSION

The accident occurred due to management's failure to insulate or guard the energized flanges on the electrolyte return piping and failure to provide adequate PPE for the electrical hazards that existed.

ENFORCEMENT ACTIONS

Order No. 8940472- Issued April 10, 2016, under the provisions of Section 103(k) of the Mine Act:

> *A miner experienced a possible medical episode in conjunction with a potential electrical shock on 04/09/2016 at approximately 14:03. The miner was found unresponsive and given CPR, and is hospitalized as a result. This order was verbally issued to Martin Salazar--Safety at 15:15. This order is issued to assure the safety of all persons at this operation. It prohibits all activity at the diaphragm pump near the commercial and return HDPE pipes near the hydraulic room. The mine operator shall obtain prior approval from an authorized representative for all actions to recover and/or restore operations to the affected area.*

Citation No. 8838363- Issued under the provisions of Section 104(a) of the Mine Act for a violation of 30 CFR 56.12030:

> *A fatal accident occurred at this operation on April 9, 2016 while a plant operator was priming a diaphragm pump located on the outside east wall of the stripping building. The plant operator was found kneeling with his face against the stainless steel flange that capped a high density polyethylene pipe. The pipe transported electrolyte solution from the tank house for recovery of copper ore. The electrolyte solution is electrified as part of the recovery process. The stainless steel flange was adjacent to a travel way to the diaphragm pump and was found to have electrical amperage on it high enough to cause an electrocution hazard. The area was traveled multiple times per shift.*

Citation No. 8838364- Issued under the provisions of Section 104(a) of the Mine Act for a violation of 30 CFR 56.15006:

> *A fatal accident occurred at this operation on April 9, 2016 while a plant operator was priming a diaphragm pump located on the outside east wall of the stripping building. The plant operator was found kneeling with his face against the stainless steel flange that capped a high density polyethylene pipe. The pipe transported electrolyte solution from the tank house for recovery of copper ore. The electrolyte solution is electrified as part of the recovery process. The plant operator's boots were in disrepair with multiple holes through the soles, negating the electrical hazard protection afforded by them. No other electrical PPE was provided to the victim. Despite having improper PPE, the plant operator was required to work in the area where electrical and chemical hazards existed. Management failed to recognize and correct this electrical hazard.*

Approved By: Richard Laufenberg Date: 12/01/2016

Richard Laufenberg,
District Manager

Appendix A

Persons participating in the investigation

Freeport-McMoRan Safford Inc.

Drew Borcherding	H&S Manager
Martin Salazar Sr.	Senior H&S Specialist
Brett Barela	Hydromet Supervisor

Arizona State Mine Inspectors

Jack Speer	Deputy Mine Inspector
John Stanford	Senior Deputy Mine Inspector
Bill Schifferns	Deputy Mine Inspector

Mine Safety and Health Administration

Lee A. Hughes	Mine Safety and Health Inspector
Ernesto A. Vasquez	Mine Safety and Health Inspector
Stephen Dubina	Electrical Engineer
Hilario Palacios	Educational Field and Small Mine Services

Appendix B

Victim Data Information

Accident Investigation Data - Victim Information
Event Number: 6 6 9 6 1 5 8

U.S. Department of Labor
Mine Safety and Health Administration

Victim Information: 1

1. Name of Injured/Ill Employee:	2. Sex	3. Victim's Age	4. Degree of Injury:
Bryan A. Ortiz	*M*	*25*	*01 Fatal*

5. Date(MM/DD/YY) and Time(24 Hr.) Of Death:	6. Date and Time Started:
a. Date: 04/10/2016 b.Time: 23:35	*a. Date: 04/09/2016 b.Time: 5:00*

7. Regular Job Title:	8. Work Activity when Injured:	9. Was this work activity part of regular job?
189 Hydromet EW Operator I	*098 Priming a Diaphragm Pump*	Yes X No

10. Experience	Years	Weeks	Days		Years	Weeks	Days		Years	Weeks	Days		Years	Weeks	Days
a. This Work Activity:	*4*	*11*	*0*	b. Regular Job Title:	*4*	*11*	*0*	c: This Mine:	*4*	*46*	*0*	d. Total Mining:	*4*	*46*	*0*

11. What Directly Inflicted Injury or Illness?	12. Nature of Injury or Illness:
042 48" Stainless Steel Flange	*210 Electrocuted*

13. Training Deficiencies:
Hazard: | New/Newly-Employed Experienced Miner: | Annual: | Task:

14. Company of Employment: (If different from production operator)
Operator
Independent Contractor ID: (if applicable)

15. On-site Emergency Medical Treatment:
Not Applicable: | First-Aid: | CPR: X | EMT: X | Medical Professional: | None:

16. Part 50 Document Control Number: (form 7000-1)
17. Union Affiliation of Victim: *9999* *None (No Union Affiliation)*

Appendix C

Process Flow Charts