MAI-2005-08

UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION

REPORT OF INVESTIGATION

Underground Nonmetal Mine
(Trona)

Fatal Powered Haulage Accident

April 4, 2005

Big Island Mine and Refinery
OCI Wyoming LP
Green River, Sweetwater County, Wyoming
Mine I.D. No. 48-00154

Investigators

Dale D. Teeters
Mine Safety and Health Inspector

Dennis A. Jorgensen
Mine Safety and Health Inspector

F. Terry Marshall
Mechanical Engineer

Thomas E. Lobb
Physical Scientist

Originating Office
Mine Safety and Health Administration
Rocky Mountain District
P.O. Box 25367, DFC
Denver, CO 80225-0367
Irvin T. Hooker, District Manager

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Big Island Mine and Refinery
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Accident Site

OVERVIEW

On April 4, 2005, Terry A. Bigler, mechanic, age 47, was fatally injured when a forklift drifted and pinned him against a continuous mining machine. The forklift was being used to position and install a motor on the continuous mining machine.

The accident occurred because the forklift's service brake system was not maintained in a functional condition. Policies, standards, and controls were inadequate because examinations of the forklift failed to identify all safety defects. The service brakes would not hold the forklift when the engine was turned off.

GENERAL INFORMATION

Big Island Mine and Refinery, an underground trona operation, owned and operated by OCI Wyoming LP, was located off U.S. Highway 372, 25 miles northwest of Green River, Sweetwater County, Wyoming. The principal operating official was Tim D. Morrison, site manager. The mine normally operated two, 12-hour production shifts a day, seven days a week. Maintenance personnel normally worked one, 8-hour shift per day, five days a week. At the time of the accident, maintenance personnel were working 11-hour shifts per day. Total employment was 418 persons.

Trona was mined using conventional room and pillar mining. Five sections operated in two seams approximately 40 feet apart. Ore was mined using continuous mining machines. Shuttle cars hauled ore from the continuous mining machines and unloaded ore onto conveyors that transported it to loading pockets at two shafts. Ore was hoisted to the surface, processed at a plant on the mine site and sold for use in the glass industry. Trona was also used as an ingredient for sodium-based intermediates, such as sodium bicarbonate, and was used in the beverage, coatings, food, and personal care markets.

The last regular inspection of this operation was completed on March 3, 2005.

DESCRIPTION OF ACCIDENT

On the day of the accident, Terry A. Bigler (victim) reported to work at 7:45 a.m., his scheduled starting time. Jack Beasley, mine maintenance supervisor, rode the man cage into the mine with the rebuild shop crew. Beasley briefed the crew regarding previous work completed and gave work assignments to reassemble the continuous mining machine. Jack Riddle, forklift operator, and Bigler were assigned the task of installing the cutting motors on the continuous mining machine. The rest of the crew was assigned other tasks related to rebuilding the continuous mining machine.

Bigler and Riddle gathered the necessary tools to install the cutting motors that were delivered to the rebuild shop that morning. About 11:00 a.m., an Eimco 913 forklift was brought to the rebuild shop to facilitate installing the cutting motors. The crew completed installing the right side cutting motor about 3:10 p.m.

Riddle backed the forklift away from the continuous mining machine about 10 feet up the incline and applied the service brakes. Beasley asked Riddle if he should remove the come-a-long on the tines of the forklift. Riddle could not hear Beasley because he was wearing ear plugs and the forklift's engine was noisy. Riddle shut the engine off and the forklift began to roll forward towards the continuous mining machine. He attempted to stop the forklift by applying the service brake, but the brakes would not hold it. The forklift's left tine struck Bigler and pinned him against the continuous mining machine.

Crew members administered first-aid to Bigler, placed him on a backboard, and transported him to the surface. Bigler was transported to a local hospital where he was pronounced dead at 4:25 p.m. The cause of death was attributed to blunt trauma to the chest.

INVESTIGATION OF ACCIDENT

MSHA was notified of the accident at 3:45 p.m. mst on April 4, 2005, by a telephone call from Terry Adcock, safety superintendent, to Irvin T. Hooker, district manager. An investigation was started the same day. An order was issued under the provisions of 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, miners' representatives, and employees.

DISCUSSION

Location of the Accident

The accident occurred in the underground rebuild shop located in the upper bed east, panel 1 south, room 1 west.

Forklift

The forklift was a 1978 Eimco 913C, equipped with a set of forks as a front attachment instead of a bucket. The forklift was powered by a Caterpillar 3304 diesel engine, had three speeds in both forward and reverse, and had articulated steering.

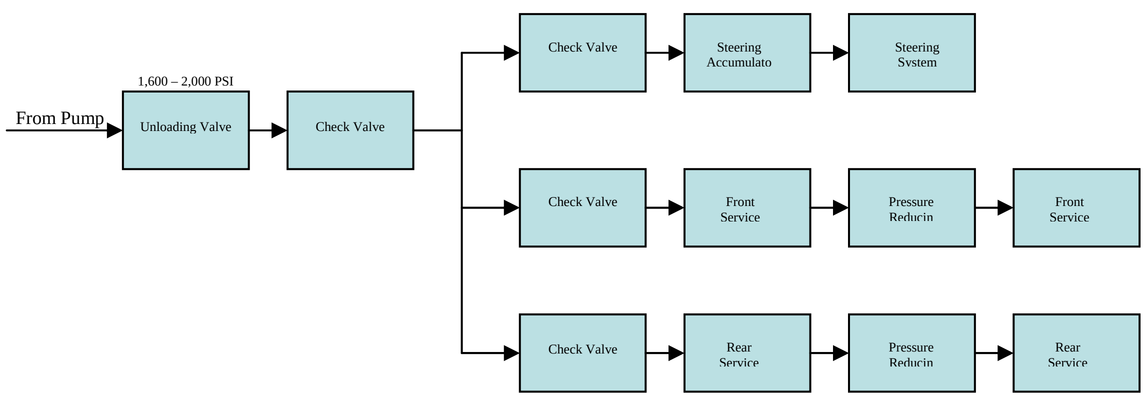
The operator's compartment was laterally oriented on the left side of the machine immediately behind the articulation area. The operator sat on the left side of the machine facing the right side of the machine. The forklift had a wheelbase of approximately 9-1/2 feet, an overall track width of approximately 6 feet on both the front and rear axles as measured from outside tread edge to outside tread edge (of the tires), a canopy height of approximately 6 feet, 5 inches from the top of the canopy to the ground, and an overall length of approximately 27 feet (including forks).

Steering and Service Brake System

The forklift had a, hydraulic actuated, articulated steering system and a dual-circuit hydraulic brake system (one circuit for the front-axle service brakes and one circuit for the rear-axle service brakes) with caliper disc brakes at all four wheels. Figure No. 1 shows a simplified block diagram of steering and service brake hydraulic system design. The steering and brake systems were designed so a common pump provided supply pressure to both systems. Supply pressure was maintained between 1,600-2,000 pounds per square inch gage (PSIG) when the engine was running through the use of an unloading valve.

Each of the three circuits (steering, front and rear service brakes) had a check valve that isolated the respective circuits in the event of a single component failure in one of the other circuits. An accumulator provided reserve pressure to bring the machine to a controlled stop in the event of an engine shut down. A one gallon, nitrogen charged bladder-type accumulator was used in the steering system and a one quart, nitrogen charged bladder-type accumulator was used in each of both the front and rear service brake systems. The service manual for the machine stated that the pre-charge pressure for all three accumulators was 900 PSIG. Hydraulic pressure to the front and rear brake circuits was modulated through pressure reducing valves controlled by the service brake foot pedal.

Figure No. 1: Simplified Block Diagram of Steering and Service Brake Hydraulic System Design



1978 Eimco 913C LHD
S/N 0320
MSHA Approval No. 31-56-1

Each of the three circuits had a pressure gage mounted in the dash board panel so the operator could monitor the respective accumulator hydraulic pressures within the system. Visual observations and testing indicated that the gage for the front service brake accumulator hydraulic pressure was defective because the needle would only drop down to approximately 900 PSIG without any system pressure. However, the pressure reading of the front service brake gage would reflect the hydraulic pressure readings in this system when pressures were within the 900 – 2,000 PSIG range. The defect in this gage would not allow verification of the accumulator pre-charge pressure.

The steering system was functionally tested and no problems were identified with the steering circuit downstream of the check valve located immediately downstream of the unloading valve.

The caliper disc brake assemblies at each wheel were visually inspected. All four brake calipers were observed to actuate when the foot pedal was cycled with the engine running. The approximate brake lining thicknesses are summarized in Table No. 1. The manual for the wheel brakes stated that the minimum recommended lining thickness was 1/8 inch. None of the lining thicknesses were observed to be below the manufacturer's recommended thicknesses.

	Left Side Lining Thicknesses (inches)	Right Side Lining Thicknesses (inches)
Front Axle	9/16	9/16
Rear Axle	1/2	1/2

Table No. 1: Approximate Brake Lining Thicknesses

The brake rotor thicknesses are summarized in Table No. 2. The manual for the wheel brakes stated that the minimum recommended brake rotor thickness was 0.450 inches. One brake rotor, on the left rear wheel brake, was measured to be below the manufacturer's recommended thickness.

	Left Side Rotor Thicknesses (inches)	Right Side Rotor Thicknesses (inches)
Front Axle	0.492	0.465
Rear Axle	0.415	0.495

Table No. 2: Approximate Rotor Thicknesses

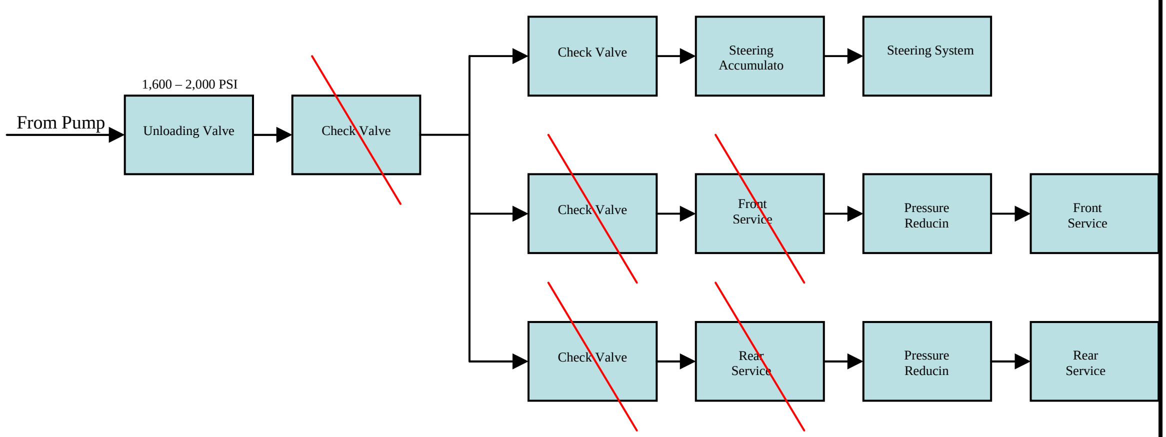
The nitrogen pre-charge pressures were checked by connecting a gage to the charge valve of each accumulator with the hydraulic system pressures bled to 0 PSIG. The results are summarized in Table No. 3.

	Pre-Charge Pressure (PSIG)
Steering System	800
Front Brake System	0
Rear Brake System	0

Table No. 3: Approximate Accumulator Pre-Charge Pressures

Functional tests conducted on the service brake system and a visual inspection of selected components that were removed identified that the check valve immediately downstream of the unloading valve, the check valves for each of the service brake systems, and both accumulators for each of the service brakes systems were defective. Figure No. 2 represents the simplified block diagram of steering and service brake hydraulic system with the defects identified (illustrated with a line through the respective defective component blocks).

Figure No. 2: Simplified Block Diagram of Steering and Service Brake Hydraulic System in the As-Found Condition



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The effect of these defects did not allow the forklift to maintain pressure in either of the two service brake circuits once the engine was shut down.

Two significant results were found when the service brakes were tested. The operator would not be able to apply the service brakes once the engine was shut down because both service brake circuits would immediately lose pressure. Also, the operator would not be able to continue to hold the machine on the grade in the accident area with the service brakes once the engine was shut down because both circuits would immediately lose total pressure.

Visual inspection of all three check valves indicated that they would not prevent backflow due to missing and/or damaged internal components. Attempts were made to charge the two service brake accumulators after they were removed from the machine but neither of them would hold any significant pressure. Audible leaks were detected within the bladders of these two accumulators.

The defective components (the check valve immediately downstream of the unloading valve, the two service brake check valves, and the two service brake accumulators) were replaced and the system was re-tested. With the forklift maintained as recommended by the manufacturer, the operator would be able to continue to hold the machine with the service brakes applied with the engine shut down.

Hydraulic

The filters and screens for the hydraulic system were removed from the machine and visibly inspected and no significant debris was observed. The reservoir for the hydraulic system was drained and visually inspected for debris. A small metallic object, which appeared to be a curved portion of a wire-type spring approximately 3/4 of an inch long, was visibly observed to be in the bottom of the hydraulic reservoir. No other debris was observed in the hydraulic reservoir.

Parking/Emergency Brake System

The parking/emergency brake system was a spring-applied, hydraulic release, internal wet disc-type brake acting on the transmission. The system had two modes of application, manual or automatic. This system was designed so it could be manually applied using a push-pull control mounted in the dash panel (pull to apply, push to release). Automatic application would occur if the steering circuit pressure dropped below approximately 900 PSIG. Although tests conducted indicated that both modes of application functioned, the parking/emergency brake system was not designed to automatically apply in the event of a loss of pressure in the service brake systems (front and/or rear).

A pull-through type test was conducted on the parking/emergency brake system as per the manufacturer's recommendation. The parking brake was applied, the transmission was placed in 2nd gear (forward direction), and the engine speed increased from idle to wide-open-throttle. The parking brake held the machine.

Environment

The temperature was 62 degrees and the working area was dry. Lighting from the shop lights and the miners' lights provided adequate lighting. The environment was not considered a factor in the accident.

Training and Experience

Bigler had received training in accordance with 30 CFR, Part 48. Bigler had 28 years and 19 weeks mining experience, all as a mechanic.

ROOT CAUSE ANALYSIS

A root cause analysis was conducted and the following causal factor was identified:

Causal Factor: Management standards, polices, and controls were inadequate because pre-operation inspections to identify safety defects failed to identify that the forklift's service brake did not hold the machine with the engine turned off.

Corrective Action: Procedures should be established to ensure that all mobile equipment is inspected for defects prior to being placed into operation. Defects that affect safety should be corrected prior to persons using the equipment. Equipment operators should be trained and knowledgeable in identifying safety defects.

CONCLUSION

The accident occurred because the forklift's service brake system was not maintained in a functional condition. Policies, standards, and controls were inadequate because the examinations of the forklift failed to identify all safety defects. The service brakes would not hold the forklift when the engine was turned off.

ENFORCEMENT ACTIONS

Order No. 7914800 was issued on April 4, 2005, under the provisions of Section 103(k) of the Mine Act:

> A mechanic installing a motor on a drum miner in the rebuild shop was fatally injured. This order is issued to ensure the safety of all persons at this operation. It prohibits activity in the rebuild shop area and the use of EIMCO 913 #4 forklift until MSHA has determined that it is safe to resume normal activities and use of the EIMCO 913 forklift. The mine operator shall obtain prior approval from an authorized representative for all actions to restore operations and use the affected area and equipment.

This order was terminated on May 5, 2005. Conditions that contributed to the accident have been corrected and normal mining operations can resume.

Citation No. 6312946 was issued on April 11, 2005, under the provisions of Section 104(a) of the Mine Act for violation of 57.14101(a) (1):

> A fatal accident occurred at this mine on April 4, 2005, when a mechanic was struck by a forklift that was being used to position a motor for installation. When the forklift engine was shut off, the service brakes failed and the unit drifted forward and pinned the victim. The service brake system was not capable of stopping or holding the forklift. The service brake system components were found to be defective in that the check valves and the accumulators were inoperative. This condition also constitutes in the alternative, a violation of 30 CFR. 57.14101(a) (3).

This citation was terminated on May 5, 2005. The service brake system components were found to be effective in that the check valves and the accumulators were operative.

Citation No. 6312947 was issued on April 11, 2005, under the provisions of Section 104(a) of the Mine Act for violation of 57.14100(a):

> A fatal accident occurred at this mine on April 4, 2005, when a mechanic was struck by a forklift that was being used to position a motor for installation. The forklift involved in the accident was not adequately inspected prior to being placed in operation on the shift when the accident occurred. The forklift service brakes were not inspected with the engine off prior to use on the shift when the accident occurred.

This citation was terminated on May 5, 2005. New procedures for conducting pre-shift inspections have been implemented for this type of machine. Operators have been trained on the new procedures, which require testing of the braking system with both the engine running and shut off.

Approved by, Date: June 15, 2005

Irvin T. Hooker
District Manager

APPENDIX A
Persons Participating in the Investigation

OCI Wyoming LP

Tim Morrison	site manager
Barry Bundy	human resource manager
Roger A. Hoops	mine manager
Terry Adcock	safety superintendent
David A. Anderson	miners' representative

State of Wyoming

Donald G. Stauffenberg	state inspector of mines
Hector Castillon	state inspector
Michael McCain	state inspector

Mine Safety and Health Administration

Dale D. Teeters	mine safety & health inspector
Dennis J. Jorgensen	mine safety & health inspector
Thomas E. Lobb	physical scientist
F. Terry Marshall	mechanical engineer