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

REPORT OF INVESTIGATION

Surface Nonmetal Mine
(Sand and Gravel)

Fatal Powered Haulage Accident
May 27, 2004

MDC Contracting LLC
#1313 Cedarapids
Charlevoix, Charlevoix County, Michigan
Mine I.D. No. 20-02940

Investigators

Stephen W. Field
Mine Safety and Health Specialist

Ronald Medina
Mechanical Engineer

Gerald P. Pifer
Civil Engineer

Jon Montgomery
Mine Safety and Health Specialist

Originating Office
Mine Safety and Health Administration
North Central District
515 West First Street, Room 333
Duluth, MN 55802-1302
Steven M. Richetta, District Manager


644G

OVERVIEW

On May 27, 2004, Justin P. Lowe, head truck driver, age 37, was fatally injured when a conveyor support arm broke away from the fixed fastening base on a portable crusher, allowing the conveyor to suddenly swing upward and strike him.

The accident occurred because the procedures used to prepare the crusher for shipment were inadequate. The victim was not aware of the hazards associated with removing the lock pins from the two diagonal support members of a discharge conveyor to raise it to a vertical position. The conveyor was being raised by a rubber-tired front-end loader with a 15-foot-long jib boom attached to the loader bucket.

GENERAL INFORMATION

#1313 Cedarapids, a surface sand and gravel operation, owned and operated by MDC Contracting LLC, was located at Charlevoix, Charlevoix County, Michigan. The principal operating officials were Mark L. Manthei and James Manthei, members. The mine normally operated one, 10-hour shift, five days a week. Total employment was three persons.

Sand and gravel was mined from a single bench open pit and discharged into a portable crusher by a rubber-tired front-end loader. The material was crushed, screened to size, and hauled to the stockpile by a front-end loader. The finished products were sold for use in the construction industry.

The last regular inspection of this operation was completed on December 10, 2002.

DESCRIPTION OF ACCIDENT

On the day of the accident, Justin P. Lowe (victim) reported for work at 7:00 a.m., his normal starting time. He drove a Kenworth tractor to the mine site to hook up a #1313 Cedarapids portable crushing/screening plant to transport it to a new mining location. Mitchell E. Cunningham, crushing supervisor/loader operator, Billie Jean Habel, loader/plant operator, and Lowe began preparing the crusher for shipment. They shoveled spillage from the plant catwalks and from the area below the kingpin at the front of the crusher. When enough material had been removed to allow the Kenworth tractor to back under and hook onto the crusher king pin, Cunningham attached a 15-foot-long jib boom to the bucket of a John Deere 644-G loader.

Cunningham positioned the loader at the front of the crusher to raise the free end of the discharge conveyor to relieve the load acting on the pins in the arms supporting it. Lowe told Habel that he would attach the cable from the jib pole to the conveyor. Habel told Lowe to remember to remove the pins from the diagonal support members. Habel saw Lowe climb up the crusher framework and onto the conveyor. She went to get wrenches needed to remove the support members from the crusher framework after the conveyor had been raised.

Cunningham saw Lowe attach the cable from the jib boom to the conveyor d-ring and thought Lowe went back to the catwalk. Lowe signaled Cunningham to raise the conveyor slightly so he could remove the pins from the top ends of the support members. Cunningham watched Lowe remove the left side pin. Cunningham saw Lowe walk to the right side of the conveyor where he could only see Lowe's hand and arm signaling him to raise the conveyor. Cunningham's view of the conveyor and Lowe was blocked by the loader bucket. Cunningham heard a pop and stopped raising the conveyor.

Habel returned with the tools, heard a pop, saw the conveyor jerk upwards, and yelled to Cunningham to stop. Habel and Cunningham found Lowe unresponsive. He had been pinched between the conveyor drive motor and the crusher framework. Cunningham radioed the main office to call 911, returned and pulled Lowe onto the catwalk, and immediately began cardio pulmonary resuscitation (CPR). A short time later David Golavich and Todd Essenberg, company employees and emergency medical technicians (EMTs), arrived and took over CPR efforts until emergency personnel arrived. Lowe was transported to a local hospital where he was pronounced dead. Death was attributed to severe chest wall trauma.

INVESTIGATION OF THE ACCIDENT

MSHA was notified of the accident at 11:00 a.m. on May 27, 2004, by a telephone call from Christine Gengle, office manager, to Donald Stefaniak, mine safety and health inspector. An investigation was started the same day. An order was issued pursuant to Section 103(k) of the Mine Act to ensure the safety of the miners.

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 mine management and employees.

DISCUSSION

Location of the Accident: The accident occurred at the portable crushing/screening plant located four miles south of Charlevoix, Michigan at a sand and gravel open pit. The plant had been set up in the pit ¼ mile from the highway.

Weather Conditions

Reportedly the temperature was about 40 degrees with rain.

Portable Crusher/Screening Plant

The plant was a Cedarapids (El-Jay), Model 1313, portable, closed circuit crusher/screening plant. The plant, manufactured in 1993, consisted of an El-Jay Model RC-54 standard roller cone crusher, complete with a three-deck horizontal screen and a series of under crusher, overhead feed, and under screen, bottom deck, trough conveyors. The plant was powered with electricity from a diesel generator.

The unit was mounted on an all-steel trailer, complete with crib supports, triple axle walking beam suspension, and a standard fifth wheel pin for transport. The

trailer had ground pads, screw jacks, and folding support legs to stabilize the plant during operation. A mounting ladder and a series of walkways provided access to the various components of the plant.

The plant weighed approximately 110,000 pounds. About 59,000 pounds were distributed over the rear wheels and 51,000 pounds over the kingpin. The overall dimensions of the plant, as originally manufactured, were 10 feet wide, 14 feet 6 inches high, and 53 feet 2 inches long. The overall height of the plant extended to 15 feet 9 inches during normal operations.

Discharge Conveyor (Original/Modified Design)

The discharge conveyor was located at the kingpin end of the portable crusher/ screening plant. The support arms for the discharge conveyor, originally designed and fabricated by the manufacturer, consisted of two continuous pieces of square structural tubing (2½ inches x 2½ inches x ⅛ inch thick). The ends of the square structural tube were welded rigidly to the frame work supporting the discharge conveyor and to the trailer chassis. One tube was located on each side of the discharge conveyor.

Modifications were made to the discharge conveyor in 1994 after it left the factory and prior to being placed in operation. The discharge conveyor framework was cut and a hinge point was added by the equipment supplier, allowing the conveyor to be rotated upward into a transport position when the plant was moved from one location to another. The support arms were also cut and a bolted, spliced joint was added to each of the support arms to allow the conveyor to swing upward when the bolts were removed. The splice was located approximately 12 inches above the original connection where the support arm was factory welded to the trailer chassis. At each splice, 3-inch x 5⅞-inch x ¼-inch connection plates were welded to the ends of the structural tubing. These connection plates were drilled to accommodate two, ½ inch diameter, SAE Grade 8 bolts. These modifications were made so the plant could be transported by the tractor from one mine site to another. Company personnel indicated that the crusher/screening plant was moved approximately 10 to 12 times a year.

The support arms for the discharge conveyor were further modified by MDC Contracting LLC in the spring of 2003. The upper end of each support arm was cut approximately 8 inches below the framework for the discharge conveyor. This allowed a portion of each support arm to be completely removed if the bolted, spliced joint on the lower end was also unbolted. A 10-inch-long piece of structural tubing (3 inches x 3 inches x ⅛ inch thick) was installed as a coupling sleeve between the 8 inch section of support arm attached to the conveyor and the removable portion of each support arm. This sleeve was welded to the removable portion of each support arm. The sleeve could be slid over the 8 inch section of support arm attached to the conveyor and pinned. By unbolting the bottom splice and pulling the pin at the upper sleeve, the removable section of each support arm could be taken out to facilitate transport.

The support arms for the discharge conveyor were examined during the investigation.

No significant damage was observed to the support arm located on the opposite side of the motor. The bolts were loosely fitting at the bottom bolted connection. Minor bending was observed at the splice plates for the lower bolted connection. The investigators could not determine if this bending occurred before the accident or as a result of the accident. The welds for the bottom bolted connection were intact. The welds for the upper spliced connection were also intact. The pin for the upper splice connection was removed. The square tubing attached to the discharge conveyor framework was pulled out of the larger square structural tubing used to splice the upper and lower portion of the support arm. The original factory weld from the support arm to the framework for the discharge conveyor remained intact. The original factory weld from the support arm to the trailer chassis also remained intact.

A substantial amount of damage was observed to the support arm on the motor side. One of the two bolts used in the bottom bolted connection was missing and could not be located. The second bolt and nut were still in place. The splice plates at the bottom bolted connection were severely bent. The fillet weld attaching the plate to the removable portion of the arm was completely broken. The upper splice connection, welds, and pin were intact. The original factory weld from the support arm to the discharge conveyor framework remained intact. The original factory weld from the support arm to the trailer chassis also remained intact.

Front-end Loader

The John Deere Model 644G wheel loader had an articulated frame and was powered by a six-cylinder diesel engine. The loader weighed 34,544 pounds and was equipped with hydraulic wet disc service brakes in the front and rear axles. The service brake could be applied using either of two pedals. One pedal was on the right side of the steering column and the other was on the left. Pushing the left side pedal also neutralized the transmission in addition to applying the brake if the clutch cut-off switch was in the “clutch disengaged” position. If this switch were left in the “clutch engaged” position, the left side pedal would apply the brake but not neutralize the transmission.

The parking brake consisted of a spring applied, hydraulically released, external caliper-disc driveline brake.

The service brake was tested according to the Service Brake Capacity Check described in the 644G operator’s manual. This test consisted of placing the transmission into second gear forward, and attempting to drive through the fully applied service brake at full throttle. The machine did not move when this test was conducted, indicating acceptable performance according to the manual.

Service brake and parking brake grade holding tests were also conducted. The service brake stopped and held the machine on a 15% grade when either of the two brake pedals was pushed. The parking brake also had the capability of holding the machine on a 15% grade in both directions of travel.

Jib Boom

MDC Contracting LLC had fabricated a 15-foot-long, removable, jib boom. This jib boom was attached to the bucket of the wheel loader. The jib boom consisted of a wide flange beam (W 8 x 31) welded to a structural angle (L 5 x 5 x ⅜ x 63 inches long) in a T configuration. This angle could be butted against the leading edge of the wheel loader bucket to support the base of the jib boom. Two additional angles were welded diagonally for additional bracing. These angles were installed from the end of the T and extended back to the wide flange beam.

Two steel cables (¾-inch diameter) were attached diagonally from the end of the jib boom to two fabricated hooks welded near the top outer edges of the bucket. These cables provided support for the end of the jib boom. "Swaged-sleeve" thimble attachments were installed at the ends of both cables. Weldless shackles constructed of drop forged steel were used to attach the cable assembly to gussets welded at the end of the jib boom. The jib boom could be raised and lowered by tilting the bucket or moving the bucket lift arms.

Two, ¾-inch-diameter static cables were suspended from the end of the jib boom. These cables were approximately 12 feet 6 inches long with "swaged-sleeve" thimble attachments on each of the ends. Eye hoist hooks manufactured from drop forged steel were attached to the working end of each of the two cables.

The bucket arm and bucket tilt joystick control operated as described in the operator's manual. Moving the control to the left rolled the bucket back and moving it to the right dumped the bucket. Moving it forward lowered the bucket lift arms and moving it backward raised the lift arms. When released, the control returned to neutral from these four positions.

A load weighing approximately 1,600 pounds was repeatedly lifted and lowered with the jib boom using both the bucket curl and lift functions. No hydraulic control defects were found.

The steering wheel was mechanically linked to a steering valve. The steering valve controlled the hydraulic oil flow to the steering cylinders. No steering defects were found.

The throttle pedal was evaluated and no defects were found.

Visibility

During the pin pulling operation, the loader operator's view of the conveyor and victim was blocked by the bucket. The loader operator could only see the victim's hand and arm indicating the desired direction of motion in preparation for pin removal.

Tractor

The tractor typically used to transport the crusher/screening plant from one location to another was a Kenworth tandem axle (Model Number T800 CAT). The manufacturer's gross vehicle weight rating (GVWR) axle ratings were 16,000 pounds for the front axle and 22,000 pounds per each drive axle or 44,000 pounds for the tandem axles. This resulted in a total of 60,000 pounds capacity (GVWR).

Training and Experience

Lowe had four years mining experience and had received training in accordance with 30 CFR, Part 46. Although Lowe had experience hooking up and hauling the plant to various mining locations in the past, he had no prior experience or new task training to fold the hinged end of the conveyor to a vertical position after the modifications in 2003.

ROOT CAUSE ANALYSIS

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

Causal Factor - The victim was standing on the hinged section of the conveyor to remove the lock pins from the two diagonal support members while the hinged end of the conveyor was being hoisted with a jib boom mounted to a rubber-tired front-end loader bucket.

Corrective Action - Establish safe procedures prior to performing any maintenance work. Analyze all maintenance tasks to identify possible hazards. Thoroughly train employees in safe job procedures and hazard recognition before any work begins. The established safe job procedures should require that no work be performed from or on loads being hoisted and that proper hoisting equipment be used when conducting repairs or dismantling the plant.

Causal Factor - The victim and co-workers had not received new task training before they were assigned the task to remove the lock pins from the two diagonal support members of the discharge conveyor.

Corrective Action - Employees should be thoroughly trained in safe job procedures and hazard recognition before they perform any new tasks.

Causal Factor - The loader operator's view of the victim and the conveyor was blocked by the loader bucket. During the pin pulling operation, the loader operator could only see the victim's hand and arm.

Corrective Action - Establish safe job procedures that ensure employees are in sight of, or in communication with, equipment operators at all times.

CONCLUSION

The accident occurred because the procedures used to prepare the crusher for shipment were inadequate. The victim was attempting to remove the lock pins from the two diagonal support members of a discharge conveyor to raise it to a vertical position. The conveyor was being raised by a rubber-tired front-end loader with a 15-foot-long jib boom attached to the loader bucket. An excessive force was applied using the jib boom while lifting the discharge conveyor to remove the pins from the sleeve connection of the motor side support arm. As the wheel loader attempted to lift the conveyor, tension energy was stored in the lifting cables. The lifting placed a tensile load on the support arm connection. This resulted in the tensile failure of one bolt, deformation of the plates, and failure of the weld. The force applied by the wheel loader combined with the failure of the support arm caused the discharge conveyor to suddenly rotate upward. The victim was standing in the area above the discharge conveyor and was struck in the chest by the drive motor. No new task training had been given to miners before they were assigned to perform this new task.

ENFORCEMENT ACTIONS

Order No. 6150486 was issued on May 27, 2004, under Section 103(k) of the Mine Act:

> A fatal accident occurred at this operation on May 27, 2004, when three miners were raising the No. 1313 Cedarapids portable crushing plant discharge conveyor belt in preparation to move the plant. Also, a John Deere 644-G rubber-tired front-end loader with a hoisting boom mounted to the bucket was being used to aid in raising the conveyor. This order is to assure the safety of all persons at this operation. It prohibits all activity at the No. 1313 Cedarapids plant and the John Deere 644-G front-end loader until MSHA determines that it is safe to resume normal mining operations in this area. The mine operator shall obtain prior approval from an authorized representative for all actions to recover and/or restore operations to the affected area.

This order was terminated on June 9, 2004, after the conditions that contributed to the accident no longer existed.

Citation No. 6140043 was issued on July 1, 2004 under Section 104(a) of the Mine Act for violation of 30 CFR 46.7a:

> A fatal accident occurred at this operation on May 27, 2004, when a miner was pinched between the hinged end of the Cedarapids portable crushing/screening plant discharge conveyor belt and the crusher framework. The victim was standing on the hinged end of the conveyor removing pins from the two diagonal support members while the conveyor was being hoisted with a boom (jib boom) mounted on a loader bucket. The company had not provided new task training in the health and safety aspects and safe work procedures specific to performing this task.

This citation was terminated on July 1, 2004. All miners were given training for performing the task of raising or lowering the conveyor. The mine operator created a new task training checklist and recording system to ensure miners are task trained in any new tasks.

Approved By: Date:

Steven M. Richetta
District Manager
North Central District

APPENDIX A

Persons Participating in the Investigation

MDC Contracting LLC

James Manthei	member
Mark L. Manthei	member
Ben Manthei	secretary-treasurer
Abraham Manthei	contract administrator
Christine F. Gengle	office manager

Mine Safety and Health Administration

Stephen W. Field	mine safety and health specialist
Ronald Medina	mechanical engineer
Gerald P. Pifer	civil engineer
Jon Montgomery	mine safety and health specialist