UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION

REPORT OF INVESTIGATION

Surface Nonmetal Mine
(Sand and Gravel)

Fatal Machinery Accident

October 1, 2003

Red Bluff Pit
Red Bluff Sand and Gravel, LLC
Prattville, Autauga County, Alabama
Mine I.D. No. 01-03272

Investigators

Clyde R. McMillian
Supervisory Mine Safety and Health Inspector

Jose J. Figueroa
Mine Safety and Health Inspector

Terence M. Taylor
Senior Civil Engineer

Ronny E. Jones
Mine Safety and Health Specialist

Originating Office
Mine Safety and Health Administration
Southeast District
135 Gemini Circle, Suite 212; Birmingham, AL 35209
Michael A. Davis, District Manager

OVERVIEW

Tommy D. Ellis, mine superintendent, age 45, was fatally injured on October 1, 2003, when the crane he was operating tipped over.

Ellis was using the crane to lift a power pack for a sump pump. While moving the load, the crane became unstable and tipped over, crushing Ellis in the cab.

The accident occurred because the crane was positioned too close to the berm and the outriggers on the crane could not be properly set. The weight of the load exceeded the rated lift capacity of the crane with the outrigger configuration used at the time of the accident.

The Red Bluff Pit, an open pit sand and gravel operation, owned and operated by Red Bluff Sand and Gravel, LLC (Red Bluff), was located adjacent to US Highway 31, about two miles south of Prattville, Autauga County, Alabama. The principal operating official coordinating construction was Charles T. Spencer, managing member. Six persons were employed by the company at this operation. They worked one, ten-hour shift a day, 5 days a week. The mine had been in the development stage since July, 2003. No mining or processing of sand and gravel had begun at the time of the accident.

Approximately three acres of overburden material had been removed. A sump area, that measured about 40 square feet and 30 feet deep had been dug and the water pump was in place. The mine was expected to begin production in early spring.

MSHA had not been notified that the mine was under construction. An inspection of this mine was conducted following completion of the fatal investigation.

DESCRIPTION OF ACCIDENT

On the day of the accident, Tommy Ellis (victim) reported to work at 6:30 a.m., his normal starting time. His responsibilities included supervising company employees and coordinating and supervising contractors working at the site.

Ellis met with James Goggins, a self-employed subcontractor, and Kenneth Booker, fabricator for Red Bluff, to complete work that had been started on a pump flotation device. The device would support a pump that was connected to a power pack located along the edge of the pond near the roadway.

They finished fabricating the device at about 7:30 a.m., loaded it on the boom truck, and transported it to the pond area where they met Ellis. Because there was little water in the pond, a small area of the sump near the pump was excavated. This provided enough water to accommodate the floatation device. Using the boom attached to the boom truck, the flotation device was removed from the truck and positioned on the ground behind the truck.
Ellis used the crane to lift the water pump out of the pit pond and set it on

top of the flotation device. Goggins and Booker disconnected the hydraulic lines from the pump, installed the flotation device to the water pump, and re-connected the hydraulic lines. Ellis then lifted the pump and placed it in the water, about 70 feet away from the power pack.

Ellis noticed that there was not enough slack on the hydraulic lines from the power pack to the water pump. A decision was made to move the power pack to allow more slack in the lines. Ellis moved the crane about 20 feet away from the power pack with the crane positioned parallel, and adjacent to the berm. The left rear tire was positioned about 18 inches from the berm. The pump was located to the left of the crane in the sump area. Ellis set the two front outriggers and the right rear outrigger.

Goggins and Booker rigged the power pack with hi-test steel chain (double wrapped) to enable Ellis to lift the power pack with the crane. When the power pack had been raised about 3 feet, the hydraulic lines attached to the power pack and the pump, caught on the berm. Ellis stopped and told Goggins and Booker that it would be too difficult to move the hydraulic lines by hand. He planned to swing the power pack slightly over the pond (to the left of the crane). When the lines cleared the berm, he planned to move the boom in toward the crane.

As Ellis was swinging the power pack to the left, the crane toppled over, crushing the cab. The boom landed on the slope, with the end pulled into the water by the weight of the power pack. Goggins ran to the back of the crane, went down the pit slope, and saw Ellis pinned inside the cab. Mitchell Edwards, lead man and equipment operator, was working on the other side of the pond. He saw the crane tip over and immediately ran to the crane cab where he found Ellis.

Goggins called 911 on his cell phone. Local emergency fire rescue personnel arrived at the site. Steel cables were used to secure the crane to a dozer. Buckets from two excavators were used to hold the crane in place to keep it from sliding further down the embankment. The crane was pulled back enough to enable paramedics to extract Ellis from the cab and administer first aid. Ellis was transported to a local hospital where he was pronounced dead as a result of crushing injuries.

INVESTIGATION OF THE ACCIDENT

MSHA was notified of the accident at 11:10 a.m., on October 1, 2003, by a telephone call from Robin Wade, president of Red Bluff, to Curtis R. Moore, mine safety and health inspector. An investigation was started that day. An order was issued under the provisions of Section 103(k) of the Mine Act to ensure the safety of the miners. MSHA's 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

Location of the Accident

The accident occurred at the water sump located on the west side of the mine. The sump was about 40 feet long and 40 feet wide. The excavation was about 35 foot deep. Water in the sump at the time of the accident was about 5 feet deep.

The site soil profile consisted of approximately 15 feet of overburden soils underlain by 40 feet of sand and gravel. The ground water table was approximately 25 feet below the surface.

The crane was positioned on soil that was dry, hard-packed, and slightly uneven. Moist, stiff clay was immediately below the top few inches of soil.

An earthen berm approximately 2½ feet high, was located along the edge of the roadway, adjacent to the sump area. The crane and power pack were positioned at the top of the slope on the west side of the sump. The berm separated the crane and power pack from the sump area.

Sump Pump

The pump was a Heidra 200 hydraulic submersible pump. It was used to pump water through an 8-inch discharge line to the pollution control pond located south of the pit.

Power Station (Weight of Lift)

The power station, manufactured by Godwin Pumps, was rented from Hydra Service, Incorporated. The station unit, including the full fuel tank and all the components attached to the steel skid, weighed 6,531 pounds. Two sets of 50-foot long hydraulic hoses (total length of 100 feet) were attached to the power station at the time of the lift. Each set of hoses weighed about 300 pounds. Since the entire length of the hoses was not raised into the

air

at the time of the accident, only the weight of one set of hoses was used to calculate the weight of the lift.

A four-part line was being used to raise and lower a 587-pound Johnson hook block. The power station, which was positioned to the south of the crane, was rigged with a double-wrapped sling that was not recovered from the sump. Its weight was estimated to be 20 pounds.

The total crane lift of the fully-fueled unit was approximately 7,438 pounds. When the power station was retrieved from the sump pond, it weighed 6,200 pounds. An estimate was made to determine the actual weight based on fuel consumption. Prior to the accident, the pump had run for approximately 18 hours. According to the pump manufacturer, the pump uses approximately 4.5 gallons of fuel per hour. The loss of weight due to fuel consumption would have been approximately 575 pounds. The total approximate weight, including the hook block, sling, hoses, and power station, with partial fuel consumption, was determined to be 6,863 pounds. This exceeded the tipping load of the crane on either mid-length outriggers or on tires.

Crane Involved in the Accident

The crane was a rubber-tired, rough terrain Grove RT530E. It had a 30-ton lift capacity when it's boom was fully retracted and operated at a 10-foot lift radius. It was rented from Cowan Equipment Company, Inc. and had been on site for approximately two months. It had a total of 2369 operating hours.

The crane was equipped with four outriggers, one on each corner of the crane. The operator's manual that was permanently attached to the cab of the crane, stated that all four outrigger beams must be equality extended to the mid-position vertical stripe or the fully extended position before beginning operation. The total spread of the outriggers was 168" if extended mid-way.

An inspection of the crane after the accident showed that the outriggers had been extended to varying lengths. The left front outrigger had been extended approximately half way. The mid-length set pin had not been engaged. The manufacturer's operators manual states that when operating the machine in the "on outriggers 50% extended " mode, the outrigger beam pins must be engaged. Failure to do so could result in structural damage or loss of stability of the machine.

The right front outrigger was fully extended. The left rear outrigger was not being used so the left rear support was provided by the size 50.5x25 crane

tire only. This tire had an inflation pressure of 67 pounds per square inch (psi). The right rear outrigger was extended to two-thirds length. There was no cribbing used beneath any of the outrigger pads. The crane was

equipped with a leveling device. Equipment brought in to raise the crane had disturbed the area, but slight indentions were found where the two front outrigger pads would have been positioned.

The spread between the two front outriggers was 194 inches. The pad prints on the ground measured about188 inches. There was no evidence that the hydraulic lines had ruptured.

The left front outrigger pad imprint was located adjacent to the berm protecting the edge of the slope above the sump. After Ellis positioned the crane to lift the power pack, the left front and rear outriggers could not be fully extended because there was inadequate clearance between the crane and the berm.

The crane boom was about 30 feet long and positioned on a turntable that could rotate 360 degrees. The outer three segments of the crane were equally extended approximately 10 feet. Full reach was 60 feet. The boom swing-away attachment (jib) was in the stowed position. The boom angle was found to be at 29 degrees and the lift radius 47.5 feet. If the outriggers had all been fully extended, the crane would have had the capacity to lift 8,610 pounds (in at 360 degree working area) with the lift radius and boom angle used at the time the accident occurred. If the outriggers had all been set to mid-length (50% extension) position, the crane would have had a 360-degree lifting capacity of 4,220 pounds. This value would be 85% of the tipping capacity of the crane; therefore, the tipping load would have been 4,965 pounds.

The operator's manual contained copies of the allowable load charts. They represent the absolute allowable loads the crane can lift based on either tipping or structural failure limitations under specific conditions. The manual states that the rated loads at the rated radius shall not be exceeded.

According to the manufacturer, if one of the outriggers was not set, the entire lift is considered to be on the rubber tires. The 360-degree lift capacity for rubbber tires inflated to 75 psi is only 1,090 pounds for a 60-foot boom length and a 45-foot lift radius. Applying the 75% rule for stability on rubber, the tipping load would have been 1,453 pounds. The minimum allowable boom angle for a 60-foot boom length operating on rubber tires with no load being lifted was 34 degrees. Since the actual boom angle was 29 degrees, the crane was being operated in an unstable configuration. Once the load was swung to the left of the left front outrigger, the left rear

tire would probably have experienced tire compression from the heavy load.

Load Moment Indicating System

The crane was equipped with a computerized Load Moment Indicator System (LMI) that used inputed values and measured parameters to assist the operator in conducting a lift. Pressure transducers mounted on the crane measured the weight of the lift. The system provided the operator with a continuous reading of the crane's capacity as it moved through the motions needed to make a lift. The LMI provided information on the length and angle of the boom, working radius, rated load, and the total calculated weight being lifted. If unstable conditions were to occur, the LMI would warn the operator by sounding an audible alarm, lighting a warning light, and locking out those functions that compromise the crane's condition.

The LMI was dependent on the operator's inputted values. The operator must input one value for the correct outrigger configuration for all four outriggers. If the input did not accurately describe the condition of all four outriggers, the LMI would not be able to detect an unstable lifting condition. The operator's manual states that the LMI should not be relied upon to replace the use of capacity charts and operating instructions.

The crane was not equipped with a data logger. Information from the LMI could be retrieved within a two hour time period following equipment shutdown. This data was not retrieved following the accident.

Swing Control

The swing control lever allowed the crane to swing or slew through any location 360 degrees around the crane. When the lever was pressed forward, the turntable and boom rotated clockwise. When the lever was pressed backward, the turntable and boom rotated counter clockwise. The crane was considered a free swing model and would continue to swing when the operator released the swing control lever unless the brake pedal was pressed.

In addition to suddenly changing direction of a swing with the swing control lever, there were four ways to stop or prevent swing action of the boom: the swing brake pedal, the swing brake control switch, the swing lock control pin, and the 360 degree lock control.

The swing brake pedal, used to slow or stop swing motion, was located on the floor of the cab. When the pedal was depressed, a swing power brake valve was actuated to apply pressure to the brake assembly.

The swing brake control "on/off" rocker switch was located on the

dashboard. Positioning the switch in the “on” position applied the swing brake. The “off” position released the swing brake. After the crane had been uprighted, the switch was found in the “on” position. Considering the

extensive damage to the cab and the position of the victim against the console, the switch position may have moved during the accident or recovery.

The pin swing lock control and the 360 degree swing lock control were both used to lock the boom superstructure in place by preventing the turntable bearing from rotating. The pin swing lock was a pin that dropped down through the turntable bearing and prevented it from rotating when the boom was positioned directly over the crane for pick up and carry load operations. The 360 degree swing lock control was a toothed lock that secured onto the turntable gear and locked it into any desired position around the 360 degree radius. Neither the swing lock pin nor the 360 degree swing lock control were engaged.

Crane Instability

At the beginning of the lift, the 6,863 pound load was over the front of the crane. The two front outriggers acted as the tipping fulcrum of the crane. With the load in front of the crane, the crane was stable. As the load was slewed to the left and the boom reached the left side of the left front outrigger, the tipping fulcrum became a diagonal line between the mid-extended left front outrigger and the centerline of the left rear tire support. This fulcrum was much closer to the center of gravity of the body of the crane and offered less tipping resistance. As the load was moved to the left side of the left front outrigger, the crane toppled over the edge of the sump pit slope. The power pack fell into the water sump, approximately 30 feet below the top of the slope.

The pit slope was found to be in stable condition and did not contribute to the crane instability.

Weather

Weather on the day of the accident was warm, dry, and clear. The National Weather Service reported that the wind did not exceed 3½ miles per hour at the time of the accident.

Training and Experience

Ellis had not received training in accordance with 30 CFR, Part 46. He had approximately 20 years experience as a crane operator.

ROOT CAUSE ANALYSIS

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

Causal Factor: The crane was positioned too close to the berm to enable the operator to fully extend the outriggers. The outriggers had not been properly extended prior to lifting and swinging the load with the crane.

Corrective Action: Procedures should be established to ensure equipment operators are knowledgeable of, and follow, the manufacturer's requirements and recommendations while operating equipment. Equipment operators should consult the operator's manual for proper procedures prior to performing tasks.

Causal Factor: A risk assessment to determine possible hazards and to establish work procedures was not conducted prior to changing the lift procedure.

Corrective Action: Employees should be trained and knowledgeable of the procedures involved in conducting a task risk assessment. Management should implement procedures that require risk assessment be conducted to identify and correct potential hazards associated with the task to be performed.

Causal Factor: Instructions in the operator's manual were not followed prior to making the lift with the crane. The weight of the load being lifted was not within the manufacturer's specified lift capacity based on the positions of the outriggers.

Corrective Action: Procedures should be established that require equipment operators to understand and use the manufacturer's load charts when loads are being lifted and moved.

CONCLUSION

The accident occurred because the crane was positioned too close to the berm and the outriggers on the crane could not be properly set. The weight of the load exceeded the rated lift capacity of the crane with the outrigger configuration used at the time of the accident.

VIOLATIONS

Red Bluff Sand and Gravel, LLC

Order No. 4885284 was issued on October 1, 2003, under the provisions of Section 103(k) of the Mine Act:

> A fatal accident occurred at this operation on October 1, 2003, when a Grove RT 530E crane overturned on its side, crushing the operator inside the cab. This order prohibits all activities at the location where the crane overturned until MSHA determines that it is safe to resume normal 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 October 3, 2003. Conditions that contributed to the accident have been corrected and normal mining operations can resume.

Citation No. 6070319 was issued on November 7, 2003, under the provisions of Section 104(a) of the Mine Act for violation of 30 CFR, 56.14205:

> A mine superintendent was fatally injured at this operation on October 1, 2003, when the crane he was operating overturned. The victim had positioned the crane near the edge of a pit slope and was in the process of lifting a power pack for a water pump when the crane became unstable and tipped over on its side. The crane was used beyond the manufacturer's design capacity in that the weight of the load exceeded the rated lift capacity for the outrigger configuration used during the lift. The operator failed to follow the manufacturer's instructions for proper outrigger set-up as specified in the operator's manual found in the cab of the crane.

This citation was terminated on December 11, 2003. The mine operator has established policy that requires a manufacturer representative to conduct training for all crane operators. Training has been provided for all crane operators at this site.

Approved by: _____ Date: _____

Michael A. Davis
District Manager

APPENDIXES

A. Persons Participating in the Investigation
B. Persons Interviewed

APPENDIX A

Persons Participating in the Investigation

Red Bluff Sand and Gravel, LLC

Charles T. Spencer	managing member
Joe Garcia	safety director
Mitchell Edwards	lead man/equipment operator
Kenneth Booker	fabricator
Richard A. Huwitt	truck driver

Self Employed Independent Contractor

James Goggings	fabricator (independent contractor)

Mine Safety and Health Administration

Clyde R. McMillian	supervisory mine safety and health inspector
Jose J. Figueroa	mine safety and health inspector
Terence M. Taylor	senior civil engineer
Ronny E. Jones	mine safety and health specialist

State of Alabama

Don A. Keith	mine inspector

APPENDIX B

Persons Interviewed

Red Bluff Sand and Gravel, LLC

Mitchell Edwards	lead man/equipment operator
Kenneth Booker	fabricator
Richard A. Huwitt	truck driver

Self Employed Independent Contractor

James Goggings	fabricator (independent contractor)