THE UNIVERSITY OF IOWA

COLLEGE OF PUBLIC HEALTH
Department of Occupational and Environmental Health

TO: **Director, National Institute for Occupational Safety and Health**

FROM: **Iowa FACE** **Case No. 2004IA051** **Report Date: 26 August 2008**

SUBJECT: **Driver pinned under haul truck that went off quarry road and tipped over**

SUMMARY

A 58-year-old man with many years of mining experience had been driving a haul truck for only a couple of weeks before he was crushed under it in the autumn of 2004. The loaded haul truck he was driving had a gross vehicle weight rating of approximately 63 ton (57 tonne), including its maximum payload of 35 ton (31.8 tonne). The truck went off the left (pit) side of the haul road and continued downhill across a slope covered with loose rocks. The driver was ejected or jumped and was pinned under the front left corner of the haul truck cab as the truck came to rest on its left side. The truck's braking systems were not well maintained and lack of seat belt use contributed to this miner's death.

RECOMMENDATIONS

1. *Operators and/or maintenance personnel should perform pre-operation inspections to ensure haul trucks are free of visible problems which could adversely impact safety.*

2. *Operators should check the function and performance of service, retarder, parking and secondary or supplemental braking systems to ensure they are working properly before putting haul trucks into service.*

3. *A service technician should perform regularly-scheduled inspection and maintenance of braking and steering system components.*

4. *Operators of haul trucks should keep their seatbelt fastened whenever the truck is moving.*

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INTRODUCTION

A 58-year-old man died mid autumn 2004 at a surface limestone quarry in southeast Iowa. The loaded haul truck he was driving down the pit road went off the pit side of the roadway. It continued down slope across the rock-covered bank. The driver jumped or was ejected and was pinned under the left front corner of the cab as the truck came to rest on its left side near the base of the slope (Photo 1).

Photo 1 – Haul truck came to rest on its unbelted operator who was ejected or jumped.

Iowa FACE personnel were made aware of this incident six weeks after it occurred through information provided by the Medical Examiner's Office. Photographs and additional information acquired from the County Sheriff and other investigators contributed to this report. Their investigations included inspection of the site and equipment, interviews with employees, and reviews of training records and work procedures.

INVESTIGATION

This surface limestone quarry was operated five days a week by a team of three employees. They all started work at 5 AM and worked a 12-hour shift. The crew leader operated a front-end loader. A second member of his crew ran an excavator. A third crew member operated the haul truck. The haul truck driver, the 58-year-old male victim in this fatal incident, had 17 years of mining experience but had worked at this quarry only two weeks and two days. He had received training as required by the U.S. Code of Federal Regulations (30 CFR Part 46) for miners engaged in surface limestone mining.

Limestone was drilled then blasted from a single bench or shelf in this open quarry. It was loaded into a rock crusher by the front-end loader. The crushed limestone was then conveyed from the crusher into the waiting haul truck. The haul truck transported this crushed material up the pit haul road to the rim of the quarry and dumped it in a stockpile for later processing.

Last manufactured in 1986, the rigid frame haul truck in this incident could carry a maximum 35 ton (31.8 tonne) payload. It was coming down the haul road on its fifth round trip of the day yet it

was still early in the shift. The crew leader/loader operator noticed the truck moving slowly and sensed there was something wrong: the haul truck was returning without having dumped its load at the stockpile.

The crew leader went to the excavator operator. They waited a few moments and watched for the haul truck to come back into view on the haul road. When it did not, the crew leader moved to where he could see that the haul truck had tipped over. Together the two men rushed to the scene. Although the incident was not witnessed, absence of crushed rock in the haul truck box suggests it may have rolled and not simply tipped onto its side.

It was a short haul road, about a fifth of a mile (one third kilometer). It had a variable 10-13% grade along its way from the rim to the quarry floor. The driver had steered the haul truck most of the way down from the quarry rim and rounded a 90-degree curve to the right before the truck ran off the roadway. It angled left across the 48 ft (14.6 m) haul road then pushed through and over a 40 inch (1 m) berm of quarry rock along the pit side of the roadway. It continued forward at an angle down and across the slope. Near the base of the slope, at an elevation approximately 20 ft (6 m) below the roadway, the truck came to rest on its left side.

The excavator operator rushed to the victim and told the crew leader to call for help. The truck driver, who was not wearing a seatbelt, had jumped or was ejected from within the rollover protection afforded by the truck's cab. He was pinned face up under its front left corner. Portions of the cab pressed across his upper chest, neck, and right side. Hydraulic fluid and fuel were leaking from the truck, but its engine was not running. When emergency medical personnel arrived they could not detect the victim's pulse and the medical examiner later pronounced the victim dead at the scene.

Subsequently, investigators at the scene noted the fuel shutoff control was in the "run" position. The transmission control was in neutral. The supplemental steering switch was "off". The parking brake control was in the "on"/"applied" position and the hand brake control was in the "fully released" position. The seat belt ends were not buckled together.

When righted, the truck's engine started immediately. Neither the service brake nor the parking brake was able to hold the empty haul truck stationary, although the dashboard pressure gauge showed normal system operating pressure. There was brake fluid that had leaked from the brake actuators, mixed with dirt, and caked on the brakes of the right front and left rear wheels so those two wheels had no functional braking. Water and sludge had to be removed from the brake system tanks and valves before rated operating pressures could be attained in all brake system tanks. Nevertheless, when the service brake was fully applied less than a third of the expected pressure reached the front brake actuators. This results in proportionate reduction in braking ability. Correct operating pressures were restored to the front axle brakes after brake fluid was added and the actuators on the front axle were bled. Similarly, the parking brake needed to be adjusted before it would automatically apply (when the braking system air

pressure fell below its threshold value) and hold the empty truck in a full throttle 5th gear stall test.

The system for supplemental steering on this haul truck was designed to be “on” whenever the truck was in service and to operate when the engine stopped or the primary steering pump failed. Wires to the supplemental steering system pump and flow sensing valve were broken. Therefore, the supplemental steering system was not operational. However, the truck’s ability to dump a full load, proper operation of the transmission and retarder system, and acceptable latching and unlatching of the seat belt were confirmed.

Why the haul truck was returning without dumping its load, why it angled toward the left shoulder after rounding the right hand curve on the haul road, why the parking brake control was in the engaged position, why and when the truck’s engine stopped running are all unknowns. The mass of crushed limestone in the truck box certainly made it more difficult to brake the truck, and certainly more difficult than stopping the typically empty truck going downhill. The truck was initially seen traveling slowly down the haul road. Whether it gained significant speed before going through the berm and down the embankment was not observed. The location of the operator suggests he jumped or was ejected near the end of the event. It is not known if he was wearing the seat belt and released it in a failed attempt to jump clear.

CAUSE OF DEATH

The cause of death per autopsy was compressional asphyxia with multiple blunt force injuries.

RECOMMENDATIONS AND DISCUSSION

Recommendation #1 – *Operators and/or maintenance personnel should perform pre-operation inspections to ensure haul trucks are free of visible problems which could adversely impact safety.*

Discussion: In addition to a thorough understanding of how the machine works and how to operate it, operators should learn to recognize visible and audible indications of potential problems, especially those that could adversely impact their safety or the safety of others. Broken, missing or damaged parts need to be fixed. Tires should be properly inflated and replaced if they are badly worn, cut or have bulges. Mechanical, hydraulic, electrical, and pneumatic systems should be checked for anything that could prevent proper operation, such as hydraulic leaks or oil on braking surfaces. For example, the braking system of the haul truck in this incident was not able to perform effectively because of leaking brake actuators and dirt caked on braking surfaces, both of which could have been seen in a visual examination.

Recommendation #2 – *Operators should check the function and performance of service, retarder, parking and secondary or supplemental braking systems to ensure they are working properly before putting haul trucks into service.*

Discussion: Operators of machinery should perform all operating checks recommended by the manufacturer to ensure that all components and systems are able to perform their intended function acceptably before putting the machine to work. Operators must ensure they can control the machine with braking, steering, and other control systems before they operate it. Critical systems that are unable to perform acceptably must be maintained or repaired, the machine locked and tagged, until it is ready to be returned to service. In addition, operators should know normal operating parameters and how to respond in emergency situations. If all braking systems are ineffective and there is no emergency escape ramp or other runaway truck option available, the operator should attempt to slow and stop the haul truck by crowding the bank side of the haul road, stay in the operator seat, and keep the seat belt/operator restraint snug.

Recommendation #3 – *A service technician should perform regularly-scheduled inspection and maintenance of braking and steering system components.*

Discussion: Brakes which are worn or not adjusted properly can result in a collision or a runaway machine. Air, water, or sludge trapped in lines, fittings, valves, or reservoirs can cause loss of function or erratic performance. Routine maintenance and regularly-scheduled inspections as recommended by the manufacturer can identify and prevent problems before they are experienced. For example, brake system air reservoirs should be drained of moisture daily and more frequently in cold weather. The leaking brake actuators and grit caked on braking system surfaces, as well as broken wiring in the supplemental steering, could have been identified during either routine maintenance or a regularly-scheduled inspection.

Recommendation #4 – *Operators of haul trucks should keep their seatbelt fastened whenever the truck is moving.*

Discussion: Haul trucks are equipped with a rollover protective structure. The rollover protective structure cannot perform its intended function of helping to protect the operator from crushing injuries in the event of an overturn if the operator is outside the protective volume afforded by the structure. One of the functions of a seat belt in a haul truck is to keep the operator within this protective volume in an overturn event. Haul truck operators should fasten the seat belt before the truck is moved and should never unfasten it in an overturn. The better, safer choice is to stay belted within the rollover protective structure.

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Fatality Assessment and Control Evaluation
FACE

Fatality Assessment and Control Evaluation, FACE, is a program of the *National Institute for Occupational Safety and Health* (NIOSH), which is part of the *Centers for Disease Control and Prevention* of the *U.S. Department of Health and Human Services*. Nationally, the FACE program identifies traumatic deaths at work, conducts in-depth studies of select work deaths, makes recommendations for prevention, and publishes reports and alerts. The goal is to prevent occupational fatalities across the nation.

The NIOSH head office in Morgantown, West Virginia, carries out an intramural FACE case surveillance and evaluation program and also funds state-based programs in several cooperating states. In Iowa, *The University of Iowa* through its *Injury Prevention Research Center* works in conjunction with the *Iowa Department of Public Health* and its *Office of the State Medical Examiner* to conduct the Iowa FACE program.

Nationally, NIOSH combines its internal information with that from cooperating states to provide information in a variety of forms which is disseminated widely among the industries involved. NIOSH publications are available on the web at http://www.cdc.gov/NIOSH/FACE/ and from the NIOSH (1-800-CDC-INFO (1-800-232-4636) or email cdcinfo@cdc.gov).

Iowa FACE also publishes its case studies, issues precautionary messages, and prepares articles for trade and professional publications. In addition to postings on the national NIOSH website, this information is often posted on the Iowa FACE website at http://www.public-health.uiowa.edu/FACE/. Copies of FACE case studies and other publications are also available by contacting Iowa FACE directly.

The Iowa FACE team includes the following specialists from the University of Iowa: Craig Zwerling, MD, PhD, MPH, Principal Investigator; John Lundell, MA, Co-Investigator; Murray Madsen, MBA, Chief Trauma Investigator; and Co-Investigator/specialists Risto Rautiainen, PhD, and Wayne Sanderson, PhD, CIH. Additional expertise is provided from the Iowa Department of Public Health, including Rita Gergely, Principal Investigator, and John Kraemer, PA, from the Office of the State Medical Examiner.

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