SUBJECT: A county employee died when he was crushed between two heavy equipment compaction vehicles.

SUMMARY

On May 20, 2004, a 63-year-old heavy equipment operator was crushed between two compaction vehicles in a road construction work zone. Prior to the incident, the decedent and his co-workers were in the process of laying an open stretch of county road and were preparing for the compaction of materials from a chipper and oil dispersion unit. After positioning their compaction units to begin the operation, the decedent and two other compactor drivers dismounted their parked vehicles. While waiting for road oil, the decedent walked between two of the parked compactors in search of a secluded area to use the restroom. While the victim was between the two vehicles, a dump truck was backing up into position. The dump truck driver, who was only using the driver's side rear view mirror, hit one of the compactors, pushing it into the other compactor and crushing the victim. The parking brake was not functioning on the compactor that was struck. Seeing and hearing the compactors hit, the decedent's co-workers immediately freed the victim and called for emergency help. The victim was transported to the nearest medical facility where he was pronounced dead on arrival.

Oklahoma Fatality Assessment and Control Evaluation (OKFACE) investigators concluded that to help prevent similar occurrences, employers should:

- Develop and implement written, standardized procedures for backing and maneuvering in work zones, particularly where sight distance is limited, adequate maneuvering space is restricted, or pedestrian traffic is present.
- Consider the use of a spotter when backing trucks in a work zone.
- Develop and implement written, standardized procedures involving the hazards of walking, standing, or working near any type of mobile heavy equipment.
- Ensure that all equipment is functioning properly and has the required safety features in place.
- Require all workers to wear the required personal protective equipment appropriate for the job task and work environment.

INTRODUCTION

On May 20, 2004, a county employee was crushed between two heavy equipment compaction vehicles during a road resurfacing project. OKFACE investigators reviewed the death certificate, Medical Examiner's report, and Public Employee Occupational Safety and Health report. An interview with county officials was conducted on August 2, 2004.

Employer: The victim was one of 140 county employees and worked in county road maintenance and construction. On the day of the incident, a crew of 10 employees had just begun working at the site and had been there for approximately 1 ½ to 2 hours. At the time of the incident, the crew was still setting up to begin work. The county did have an active comprehensive written safety and health program, including a labor/management safety committee, a safety officer, and written task-specific safe work procedures. The safety officer did have other duties and was not present at the worksite.

Victim: The 63-year-old male victim had been working for the county in road construction and maintenance for almost 11 years, primarily as a truck driver and heavy equipment operator. On the day of the incident, he was operating a compaction unit, which he had operated many times before. He had been trained on the hazards associated with the equipment and with the work zone in general. The victim was wearing a retro-reflective vest and used ear protection if needed.

Training: Safety meetings were conducted at least monthly by the safety officer, and training was provided on-the-job to employees. Trainings covered specific topics as required by state and federal regulations, while other task-specific trainings were conducted as needs arose. Training involved the use of lecture, demonstration, testing, hands-on experience, and videos. Documentation of all trainings and safety meetings was kept on file and maintained by the county. Special training was not required for the operation of the compaction unit. Employees were trained on the hazards of working around heavy equipment and to not enter areas that would place them between pieces of machinery. Written procedure called for the use of a spotter in situations involving the backing of a vehicle in limited spaces with limited site distance.

Incident Scene: The incident occurred along a straight stretch of 2-lane rural county road. The road maintenance crew was preparing to begin work and was in the process of positioning vehicles and equipment. One lane was closed for the work zone and was marked with detour signs and channelizing devices. The posted speed limit outside the work zone was 45 miles per hour, with a posted speed limit of 20 miles per hour inside the work zone. The roadway had a line of sight over one mile. Ground conditions were firm and dry.

Weather Conditions: On the day of the incident, the weather conditions were excellent. The temperature was in the low 70 degrees Fahrenheit with a clear sky and slight breeze.

INVESTIGATION

On the day of the incident, the victim had begun work at the site around 7:30 a.m. In preparation for paving, equipment, including dump trucks and compactors (“packers”), was being positioned in the work zone. The victim, an experienced heavy equipment operator, was operating one of the compactors. He and two other compactor drivers had parked their vehicles and were waiting for road oil before continuing their work. They had dismounted their vehicles and were standing in the work zone area. Vehicles and equipment were inspected daily; however, one of the compactors (#6 on Figure 1) did not have a functioning parking brake, yet it remained in service. All three compactors were not running at the time of the incident. While waiting, the victim needed to use the restroom, and since this was a moving operation, there were no restrooms available (although the mobile crew should have had prompt access to nearby facilities as specified by OSHA standards). Attempting to find a

secluded area, the decedent walked between the first two compactors (#5 and #6 on Figure 1), blocking his view from co-workers.

At the time of the incident, 8:35 a.m., there were two moving vehicles (#8 and #9 on Figure 1) within the work zone. There was no intrusion from outside of the work zone. While the decedent was between the compactors, one of the dump truck drivers attempted to position his dump truck in line by maneuvering in a narrow space around the line of compactors. As the dump truck driver backed into position, only the driver's side rear-view mirror was used, not the one on the passenger's side. As a result, the rear end of the dump truck hit one of the compactors, pushing it into the compactor behind it. The dump truck was equipped with a backup alarm, but it was not functioning on the day of the incident. It was later determined that the alarm had been connected to the reverse lights' electrical wires. When the lights came on, so did the alarm. At the time of the incident, one of the lights was burned out, which disabled the backup alarm as well. Even though the speed of the dump truck was extremely slow, the massive weight of the vehicle and the lack of a set parking brake on the compactor caused the compactor to move. The compactor rolled straight into the other compactor and crushed the victim.

The second truck driver (#9 on Figure 1) saw the collision about to occur and tried to radio to the driver to stop, but there was not enough time. Another worker on the ground was yelling for the truck to stop, but the driver did not hear. The truck driver was not aware of making contact with the compactor. Co-workers immediately responded to the pinned victim, with one worker starting and moving the compactor, while another lowered the victim to the ground. Emergency medical services responded and transported the victim to a local hospital where he was pronounced dead on arrival.

CAUSE OF DEATH

The Medical Examiner's report listed the cause of death as crushing abdominal trauma.

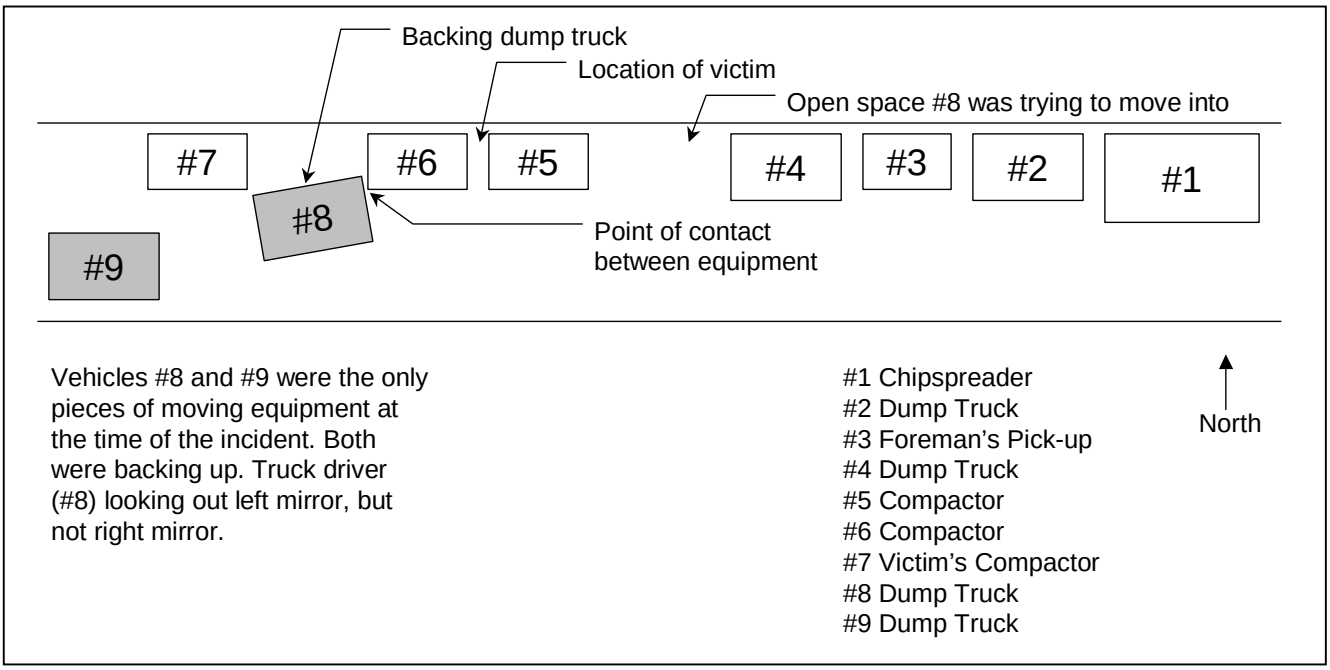

Figure 1. Diagram of Work Zone (not to scale)

RECOMMENDATIONS

Recommendation #1: Employers should develop and implement written, standardized procedures for backing and maneuvering in work zones, particularly where sight distance is limited, adequate maneuvering space is restricted, or pedestrian traffic is present.

Discussion: A written and enforced procedure for maneuvering any vehicle or equipment in a work zone or restricted area is critical to protecting employees and pedestrians. While work zone planning and layout should involve the development of a traffic control plan to ensure the safety of motorists traveling through the work zone, employers should also develop an internal traffic control plan (ITCP). This plan coordinates the flow of construction vehicles and equipment within the work zone area, details safe operating procedures, and ensures the safety of workers on foot and those operating the machinery. Depending on the scope of the project and the length of time at the worksite, the ITCP could be a checklist or a complete detailed document. The plan and procedures should detail site-specific hazards and means of control, as well as a communication plan and a means for pedestrian workers to talk with equipment operators. It should also specify that operators be trained to use the equipment they are working with and be oriented to the worksite. In this incident, an ITCP may have helped improve the movement of heavy equipment through the narrow work zone and provided for a better means of communicating with the truck driver.

Recommendation #2: Employers should consider the use of a spotter when backing trucks in a work zone.

As part of an ITCP, the use of spotters should be considered to assist truck drivers and equipment operators backing in work zones. The risk of injury to pedestrian workers and others is increased when construction vehicles move in and out of congested and confined work zones. When backing becomes necessary, a spotter, with instructions from the ITCP coordinator, should be positioned in an area with an unobstructed view of the intended path. Using predetermined means of communication, such as radios, hand signals, or other devices, the spotter and operator should work together to maneuver the vehicle safely into position. Training on proper truck backing techniques, dealing with obstructed views, communicating with on-the-ground workers, and use of spotters should be provided to employees.

Recommendation #3: Employers should develop and implement written, standardized procedures involving the hazards of walking, standing, or working near any type of mobile heavy equipment.

Discussion: An internal traffic control plan would also help manage the positioning of pedestrian workers. The ITCP should delineate potentially hazardous areas around equipment and within particular operations where workers on foot are prohibited. In this incident, it would include the areas around and between the compactors, particularly while other vehicles are being positioned. Workers on foot and equipment operators should be trained to follow written procedures and use appropriate communication methods when it is necessary for both to be in the same area at the same time. Daily toolbox safety meetings are helpful for discussing and reporting hazards and safety concerns for the operations required that day. Workers should be trained to recognize and avoid the hazards of being on

foot, and a supervisor should monitor the worksite for compliance. Workspaces should be designed to decrease backing and blind spots as much as possible, and equipment operators should never move equipment without making visual contact with spotters on the ground.

Recommendation #4: Employers should ensure that all equipment is functioning properly and has the required safety features in place.

Discussion: All equipment and machinery should be maintained with regular, thorough safety checks. Pre-start safety inspections should be conducted by trained and authorized operators at the beginning of the shift or day. A supervisor should be designated to ensure that inspections are performed daily, necessary repairs are made, and records are kept on file. Workers should have the authority to take unsafe equipment out of service without repercussions. In this incident, one of the compactors had a malfunctioning parking brake, and the dump truck had an inoperable backup alarm. Workers should be required to set parking brakes when leaving equipment unattended and further immobilize the machinery with chocks, particularly if on an incline. Furthermore, all vehicles and equipment should have functioning backup alarms. These safety features, had they been properly functioning, may have prevented this fatal incident.

Employers may also consider equipping vehicles with devices or sensors that detect individuals or objects behind the vehicle. Many devices are available that can alert operators to hazards in their blind spots, such as electromagnetic signal detection systems, infrared detection systems, ultrasonic systems, and video cameras. In addition to the standard equipment backup alarms, which workers may become desensitized to after prolonged daily exposure, employers may consider the use of other warning devices that involve different noises or strobe lights. Particularly in instances where existing standard practices have failed, employers should consider adding these different types of technologies.

Recommendation #5: Employers should require all workers to wear the required personal protective equipment appropriate for the job task and work environment.

Discussion: Personal protective equipment is required for all highway/roadway work zones. Brightly colored safety vests are required for all employees on site. Hard hats may be required for jobs where there is a chance of falling or flying debris. In some areas, noise levels may require appropriate noise suppression through the use of earplugs, canal caps, or muffs. Safety glasses, shields, or goggles for eye protection, safety shoes for foot protection, or a vast array of other equipment may be appropriate to the job, materials, or equipment in use. In this incident, employees were required to wear the high visibility safety vests to make themselves more noticeable to internal and external traffic. All safety gear should be regularly checked to ensure proper condition and/or retro-reflective properties.

REFERENCES

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- U.S. Department of Transportation, Federal Highway Administration. *Manual on Uniform Traffic Control Devices for Streets and Highways,* section 1A-2.
- *Controlling and Abating Hazards in Highway Construction,* Publication 16001, National Safety Council, 1999.

The Oklahoma Fatality Assessment and Control Evaluation (OKFACE) is an occupational fatality surveillance project to determine the epidemiology of all fatal work-related injuries and identify and recommend prevention strategies. FACE is a research program of the National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research.

These fatality investigations serve to prevent fatal work-related injuries in the future by studying the work environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in injury, and the role of management in controlling how these factors interact.

For more information on fatal work-related injuries, please contact:
Oklahoma State Department of Health
Injury Prevention Service
1000 NE 10th Street
Oklahoma City, OK 73117-1299
nancyk@health.ok.gov
1-800-522-0204 or 405-271-3430
www.health.state.ok.us/program/injury