SUBJECT: Hispanic heavy equipment operator was killed while jump-starting a pad-foot drum compactor.

SUMMARY

On April 1, 2004, a 62-year-old Hispanic equipment operator for a road construction company was crushed by a pad-foot drum compactor while attempting to manually start the machine. Prior to the incident, the victim and his co-workers were compacting soil and preparing to lay a new road surface. The workers, employed by the site's subcontractor, did not have one of the company-owned compactors available at the site, so one was borrowed from the general contractor. Due to a faulty starter system, the machine's engine would frequently die when used over rough terrain, requiring a manual jump-start. After running over a rock, the decedent attempted to jump-start the equipment with a hand tool, while it was in high gear and the propulsion lever was full forward. While leaning over the rear tire, the decedent was pulled in between the tire and the fender assembly and crushed when the machine engaged and moved forward. The compactor continued moving with no operator until crashing into a tree ¼ mile away. Co-workers did not witness the incident, but did see the equipment moving and the victim lying on the ground unresponsive. The victim was pronounced dead at the scene.

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

- Ensure that all defective equipment is removed from service until repaired.
- Ensure that workers are knowledgeable of the manufacturer's recommended operating procedures and safety practices for equipment that they are assigned to operate.
- Periodically monitor and evaluate employee conformance with safe operating procedures and provide re-training and corrective action as necessary when the procedures are not followed.

Additionally,

- Manufacturers should not provide instructions for actions that counter their safety recommendations and should consider additional fail-safe measures to prevent tampering.

INTRODUCTION

On April 1, 2004, an equipment operator was crushed by a pad-foot drum compactor (Figure 1) while attempting to start the machine manually. OKFACE investigators

Figure 1. Pad-foot drum compactor similar to the one involved in the incident

were notified of the incident and conducted an interview with company officials on June 10, 2004. OKFACE investigators reviewed the death certificate and reports from the Medical Examiner, the investigating law enforcement officer, and the Occupational Safety and Health Administration (OSHA).

Employer. The victim was employed by a highway and general construction contracting company. The company had been in business for 45 years and employed approximately 200 full-time workers. On the day of the incident, the victim and four other employees were at the site. The company had an active comprehensive written safety and health program, which included a management safety and health committee. There were written task-specific safe work procedures and machine-specific safe operating instructions for all tasks and equipment. Documentation of all training, safety meetings, and certifications were kept on file and maintained by the company.

Victim. The 62-year-old Hispanic male victim had 15 years of experience in road construction and had been employed as an equipment operator with the company for one year. He was operating a piece of equipment for which he had many years of experience. The victim had attended the required training and had completed all requirements to meet the company's "Experienced Operator" certification. It was documented that he had been trained and was well aware of the limitations of pad-foot compactors. The decedent's direct supervisor was bilingual and communicated with him in Spanish, since the decedent could not speak English well.

Training. Tailgate-style safety meetings were conducted at the job site on a weekly basis and were conducted by the field supervisor. Full-day supervisors' safety meetings were held semi-annually and a management safety workshop was conducted annually. Machine-specific training was provided for all equipment operators and utilized equipment manuals, hands-on experience, and on-the-job mentoring in order to meet the company's "Experienced Operator" certification. The company ensured that all operators met the regulatory agency licensing requirements for machine operators and measured the effectiveness of training by a combination of testing and demonstration. Records of employee training were maintained, and training was conducted in both Spanish and English.

Incident Scene. The employer was subcontracted to work on a highway construction project and had been working at the site where the incident occurred for 14 months. Many roadway construction procedures were being performed at this site, one of which was to compact the base footing of the roadway. The road base was being compacted by the decedent and his four co-workers, using a borrowed 28,440 pound pad-foot drum compactor. The incident occurred at the end of the workday, around 5:50 p.m., when the compactor was being driven to the parking area. The crew had been working since 7:00 a.m. that morning.

Weather. On the day of the incident, the weather was dry and sunny. The temperature was about 75 degrees Fahrenheit and there was a brisk wind blowing. The ground and site conditions were flat and dry.

INVESTIGATION

On the day before the incident, the highway construction project had progressed to a point that required the use of a compactor. Because the company did not have one of its own

compactors present at the site, the superintendent borrowed one from the site's general contractor. Apparently, the general contractor was unaware that the machine's starter system was defective when the agreement to borrow it was made. The superintendent and the decedent discovered the inoperative starter system, but were shown how to bypass it manually by a worker from a third construction company who had been using it. This worker had reported the problem to the general contractor's maintenance personnel and a starter switch had been ordered four days before the incident. It was decided that the compactor would be used despite its deficiencies. The decedent was shown how to jump across the starter solenoid terminals with a metal hand tool, such as a screwdriver or wrench, to start the engine.

The compactor was used throughout the workday, although the malfunctioning starter system had to be bypassed several times. Whenever the machine traveled over a rough or rocky surface, the engine would stall. To restart the engine, the decedent stood on the rim of the left rear wheel assembly, leaned across the tire to reach the starter solenoid, and then jumped across the terminals with a 7/16"-3/8" offset open end wrench. A guard over the side of the engine where the solenoid was located was missing, in addition to the operator's manual, which had clear recommendations pertaining to the situation. For example, the operator's manual required a daily pre-start inspection in which broken or missing parts had to be corrected or replaced prior to use: "INSPECT your compactor daily. Ensure the routine maintenance and lubrication are being dutifully performed. Have any malfunctioning, broken or missing parts corrected or replaced before use. DO NOT operate a damaged or poorly maintained compactor. You risk lives when operating faulty equipment, INCLUDING your own." Additionally, the solenoid had an orange and black pictorial decal warning (Figure 2) against the startup procedure used by the decedent, and the manual outlined the following guidelines: (1) "READ and FOLLOW ALL instruction decals"; (2) "START the engine from the operator's position only"; (3) "Jump starting the engine is NOT RECOMMENDED. If you do jump start, use EXTREME CAUTION. Prior to jump starting, ENSURE propulsion (travel) control lever is in 'Neutral', a TRAINED OPERATOR is at the controls when the engine starts, and the parking brake is 'Applied'."

Figure 2. Compactor warning decal

Figure 3. Compactor after the crash

The decedent had finished working for the day and was driving the compactor to the parking area when he ran over a rock, causing the engine to die. The machine was in high gear and the propulsion lever full forward. The decedent dismounted from the operator's position and stepped onto the wheel assembly as he had done several times earlier in the day. The machine was left

in gear and the parking brake was not applied as he performed the jump-start. In addition, the neutral safety switch, which prevented the engine from starting while in gear, was bypassed as a result of the jump-start, thereby increasing the safety hazards present. As the engine engaged and the machine moved forward, the decedent was caught between the tire and the fender assembly and crushed. Co-workers did not witness the incident, but did notice the compactor run off the roadway and crash into a tree ¼ mile away (Figure 3). Upon seeing the machine without an operator, the crew noticed the decedent lying unresponsive at the point where he had attempted the jump-start and immediately called 911. The decedent was pronounced dead at the scene.

CAUSE OF DEATH

The Medical Examiner's report listed the cause of death as multiple injuries.

RECOMMENDATIONS

Recommendation #1: Employers should ensure that all defective equipment is removed from service until repaired.

Discussion: Although the compactor's malfunctioning starter system had been identified, the danger posed by that deficiency was underestimated and the equipment was used anyway. Because the inoperative starter system necessitated an alternate method for starting the machine, other safety features were bypassed, posing additional hazards to the workers. Employers should follow the manufacturer's recommendations for inspecting equipment daily and correct any malfunctions prior to use. This inspection should be performed on all equipment whether it is company-owned, borrowed, or rented. Managers and supervisors should be provided with risk management training, which would give them tools for making difficult decisions that balance production demands with worker safety and health. In addition, the employer should consider developing and implementing procedures and policies regarding rented or borrowed equipment, including the steps for inspecting the equipment and what to do if it is found to be defective, as well as procedures for reporting hazards at multi-employer worksites. Even if the operator's manual is not available on the machine, as in this incident, the signage and decals located on the equipment itself indicate dangers and warnings that should be heeded.

Recommendation #2: Employers should ensure that workers are knowledgeable of the manufacturer's recommended operating procedures and safety practices for equipment that they are assigned to operate.

Discussion: The decedent was an experienced equipment operator and had completed all company training requirements. The decedent, who spoke little English, was communicated with in Spanish, thereby improving his understanding of the assigned tasks and training. When the superintendent decided to use the defective compactor, the decedent was shown how to jump-start the engine. It is unclear whether the manufacturer's recommendations were discussed with the decedent; however, it is known that the operator's manual was missing. The manufacturer clearly recommended avoiding machine jump-starts, but in necessary instances, the propulsion lever and parking brake needed to be set so that there would be no movement upon ignition. Had the compactor not been left in gear, or even in use to begin with, this incident may have been prevented. Employees need to be knowledgeable of the

manufacturer's recommendations, the hazards posed by not following the recommendations, and how to eliminate the hazards, which may include reporting malfunctions or requesting that equipment be taken out of service. Employees should also be trained on how to conduct pre-start inspections and assess the condition of their equipment. Furthermore, they should be trained on the purpose of machine guards, the OSHA regulatory standards for machine guards and safety devices, and the consequences of operating without guards or removing them without authorization.

Recommendation #3: Employers should periodically monitor and evaluate employee conformance with safe operating procedures and provide re-training and corrective action as necessary when the procedures are not followed.

Discussion: The employer should charge an individual who is knowledgeable and experienced in the specific equipment operation and job procedures, otherwise known as a "competent person" by OSHA, with randomly monitoring the inspection process to ensure compliance with company procedures and all regulatory standards. Safe operating procedures were not utilized in this incident. A defective piece of equipment, with an inoperative starter system and missing guarding, was utilized instead of taken out of service. Additionally, during its use, more safe operating procedures were disregarded when the recommended jump-start procedure was not followed multiple times throughout the workday. Had corrective action been initiated earlier, the incident may have been prevented.

Recommendation #4: Manufacturers should not provide instructions for actions that counter their safety recommendations and should consider additional fail-safe measures to prevent tampering.

Discussion: The operator's manual in this incident recommended against jump starting the compactor, but continued to provide safety warnings and instructions on how to jump-start with caution. Manufacturers should consider not providing detailed information on actions that counter their safety recommendations, and instead, note in the manual that if a compactor is having a starting problem, the owner/operator should remove it from service until repairs can be performed. Additionally, manufacturers should consider the use of safety interlock switches that cannot be bypassed (e.g., during a jump-start) and prevent the engine from starting while in gear.

REFERENCES

- Occupational Safety and Health Administration, 29 CFR 1926.32(f). *Competent Person.*
- Occupational Safety and Health Administration, 29 CFR 1910.147. *The Control of Hazardous Energy (Lockout/Tagout).*
- Specific Compactor Manufacturer's *Operation and Maintenance Manual*.

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.

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