SUBJECT: A heavy equipment operator was killed when he was crushed between the lift arm and the rollover protection cage of a skid-steer loader.

SUMMARY

An 18-year-old heavy equipment operator died on August 6, 2004 from internal injuries he received after being crushed between the lift arm and the top edge of the rollover protection cage of a skid-steer loader. On July 24, 2004, the decedent was attempting to reinsert a pin that had slipped out of the arm where the bucket was attached. He had lifted the safety lap bar, stood up in the cab, and then pushed the lap bar back down on the empty seat, which allowed the vehicle to run without the operator in the seat. While attempting to move the lift arm up and down to reposition the pin in the arm assembly, the decedent actuated the foot pedal and the bucket moved up and back, pinning the victim between the lift arm and the top edge of the rollover protection cage. Coworkers quickly responded to the victim and removed him from the skid-steer loader. The decedent was transported to the hospital and died 13 days later from his injuries.

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

- Ensure that skid-steer loader operators do not position themselves outside of the operator's compartment while the machinery is in use.
- Ensure that skid-steer loader operators do not bypass or override safety guards, switches, or devices and properly use seat belts and restraint bars.
- Ensure that all equipment is secured before servicing and maintenance are performed and that only authorized employees perform that maintenance.
- Ensure that employees are aware of the specific hazards and limitations of the equipment they use and work around on jobsites.

INTRODUCTION

On August 6, 2004, an 18-year-old skid-steer loader operator for a rock crushing facility was killed while attempting to reinsert a pin in the bucket/lift arm assembly. OKFACE investigators were notified of the incident and an interview with company officials was conducted on October 8, 2004. OKFACE investigators also reviewed the death certificate and Medical Examiner's report.

Figure 1. Skid-steer loader involved in the incident

Employer: The victim was employed at a rock crushing facility. The company had been in business for 63 years and employed 45 people locally and over 1,000 across the country. The company had been working at the site where the incident occurred for approximately six years and was in operation six days per week. Between 6 and 12 employees were working at the site at the time of the incident. The company had a comprehensive safety and health program, which included task-specific work procedures, an active labor/management safety committee, and a management safety and health committee.

Victim: The 18-year-old worker had been a skid-steer loader operator for approximately eight months, but had been employed by the rock crushing company for only one week. He had completed the company's mandatory 24-hour new employee training and was performing work with which he had experience. He was working alone at the time of the incident; however, several other employees were nearby.

Training: Company personnel conducted all training and kept documentation on file of all training completed. In addition to the new employee orientation training, monthly safety meetings were mandatory for employees. Training was conducted in various forms, including classroom, on-the-job, video, and reviews of manufacturers' manuals and company procedures. Machine operators were provided with machine-specific training and were tested for proficiency; it is unknown if the decedent had received any of this specific training.

Incident Scene: The incident occurred at a rock crushing facility on a day reserved for cleanup and equipment maintenance. The decedent was working under a conveyor, which moved rock from the crusher to large piles awaiting transport. The ground surface consisted of crushed rock and gravel. The incident occurred near the end of the second work shift at approximately 8:30 p.m.

Weather: The weather was cloudy and it started to rain after the incident; however, prior to the incident, the ground and site conditions were dry.

INVESTIGATION

On the day of the incident, July 24, 2004, the victim had been assigned to use a skid-steer loader (Figure 1) to clean crushed rock from underneath a rock conveyor. The material had accumulated there during the week as rock was moved from the crusher to storage piles. After the skid-steer loader had been running for approximately 16 hours, the decedent noticed a pin, which held the bucket to the lift arm, had became loose and slipped out of its seating. The pin (Figure 2) was threaded and it was not uncommon for one to become loose or fall out. However, company policy specified employees should stop using equipment when maintenance was needed. The decedent, who was still considered to be in training, attempted to repair the loose pin.

Figure 2. Pin attaching bucket to lift arm

Operators gained access to the cab of the skid-steer loader through the front, in between the lift arms, and over the bucket. The machinery was operated using hand and foot controls.

The loader had a safety system in which the operator's seat was equipped with a lap bar (Figure 3) connected to interlocks on the pedals. The machinery could not operate unless this bar was lowered across the lap. Once the bar was lowered, the pedal interlocks were released and the pedals could operate freely. In an attempt to repair the loose pin, the decedent raised the lap bar and stood up with his feet inside the operator's cab. By standing up, his body was extended above and in front of the protective operator's cage. With the engine still running, the victim put the lap bar down on the seat, releasing the interlocks, so that the loader could function despite having no operator in the seat.

Figure 3. Skid-steer loader operator's seat and lap bar

After activating the hydraulics for attachment operation (Figure 4), the decedent bent over and tried to reposition the pin. In the process of maneuvering the lift arm and bucket, the decedent depressed the foot pedal (Figure 5) that tilted the bucket up and back. Unable to stop the lift arm from moving and unable to move out of the way, the victim was pinned between the lift arm and the top edge of the rollover protection cage. There was no one working directly with the decedent; however, a coworker noticed the pinned employee, called for help, and ran to his aid. Coworkers tilted the bucket back down to release the victim, lifted him out of the loader, and started cardiopulmonary resuscitation immediately. Emergency medical services arrived within 20 minutes and transported the victim to a local hospital. The victim was flown by helicopter the next day to a major trauma center where he died on August 6, 2004, nearly two weeks after his injuries.


Figure 4. Button to control attachment operation hydraulics inside the operator's cab


Figure 5. Pedal that was depressed to raise bucket

CAUSE OF DEATH

The Medical Examiner's report listed the cause of death as internal injuries due to blunt force trauma.

RECOMMENDATIONS

Recommendation #1: Employers should ensure that skid-steer loader operators do not position themselves outside of the operator's compartment while the machinery is in use.

Discussion: Employers should train employees to follow the safe operating procedures for skid-steer loaders and the accompanying manufacturer's recommendations for operating and servicing. Supervision, testing, and periodic retraining should also be included with proper instruction. Operators should be instructed not to position themselves or any parts of their bodies outside of the operator's compartment while the machinery is running. Furthermore, no one should pass or work under elevated portions of the equipment unless well-maintained lift arm supports are used. Operators should enter the loader only when the bucket or attachments are on the ground or lift arm supports are in place. Supports, other than those provided or recommended by the manufacturer, should not be used because they may not be capable of supporting the load.

Recommendation #2: Employers should ensure that skid-steer loader operators do not bypass or override safety guards, switches, and devices and properly use seat belts and restraint bars.

Discussion: Employers should train employees on the safety features of the skid-steer loader and the importance of their proper use. Occupational Safety and Health Administration (OSHA) standards state that employees must follow all company procedures and should not disengage, remove, or bypass any switches, guards, or other safety devices. Operators should be instructed not to bypass or modify the safety features, such as in lowering the lap bar without being seated. Interlocked controls rely on the operator being appropriately positioned in the seat in order to function correctly. Interlock controls should also be inspected and maintained regularly to ensure that they are in proper working order. In addition, operators should be instructed to use seat belts. On some skid-steer loader models, the seat belt may be part of the interlock control system. They also protect the operator from being caught or crushed by the lift arms or attachments and from being ejected during a rollover incident.

Recommendation #3: Employers should ensure that all equipment is secured before servicing and maintenance are performed and that only authorized employees perform that maintenance.

Discussion: According to OSHA regulations for motor vehicles, mechanized equipment, and marine operations, all controls shall be in the neutral position, with the motors stopped and the brakes set, unless work being performed requires otherwise. Before a skid-steer loader is serviced, the parking brake should be engaged, the bucket or other attachments should be lowered to the ground, the engine should be turned off, and the key should be removed from the ignition switch. In instances where the maintenance cannot be performed with attachments on the ground, appropriate lift arm supports recommended by the manufacturer should be used. Furthermore, there may be instances where the operator's manual requires the engine to be running while maintenance is performed. In these events, the manufacturer's directions should be followed along with all safety recommendations, including having two or more people work on the task.

Employers should train operators and other employees who service and maintain skid-steer loaders to read and follow all of the manufacturer's procedures. For operators not authorized to perform maintenance, they should be instructed by employers on the proper procedures for taking equipment out of service and safely exiting the loader. When operators become aware that maintenance is required, they should stop using the equipment until it is repaired. Before exiting the loader, the operator should follow the steps listed above.

Recommendation #4: Employers should ensure that employees are aware of the specific hazards and limitations of the equipment they use and work around on jobsites.

Discussion: Employees should be trained on the specific hazards associated with the type of equipment they operate and with the type of work being performed. The training should address the equipment, materials used, environment, and all other conditions that could expose, or have the possibility of exposing, the employee to hazards. Other workers should be trained to stay away from the equipment and attachments while they are in use. Operators of skid-steer loaders should not carry riders, use the equipment as a manlift, or raise the lift arms or attachments over other workers. Equipment manufacturers can be good sources of training information, including safety recommendations, operator's manuals, warning decals, instructional videos, and operator training courses.

Additional information useful for training workers about skid-steer loader safety can be found in a NIOSH Alert: Preventing Injuries and Deaths from Skid Steer Loaders *available through the NIOSH website at http://www.cdc.gov/niosh or by calling 1-800-356-4674. The Alert is available in both English and Spanish (http://www.cdc.gov/spanish/niosh/docs/98-117sp.html). The Alert contains a tear-out sheet (reprinted in English and Spanish in the Appendix) that summarizes safety precautions for operators of skid-steer loaders. Posting this tear-out sheet at the worksite may serve as an additional means of communicating safe work procedures to workers.*

REFERENCES

- National Institute for Occupational Safety and Health, *Preventing Injuries and Deaths from Skid Steer Loaders,* DHHS (NIOSH) Publication No. 98-117.
- Occupational Safety and Health Administration, 29 CFR 1926.600(a)(3)(i), *Subpart O – Motor Vehicle, Mechanized Equipment, & Marine Operations*
- Occupational Safety and Health Administration, 29 CFR 1910.211, *Subpart O – Machinery and Machine Guarding*

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:
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