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FATALITY ASSESSMENT AND CONTROL EVALUATION

Equipment Operator Fatally Crushed by the Bucket of a Front-End Loader at a Scrap Yard
Case #: 18NY019

INCIDENT HIGHLIGHTS

DATE:

May 26, 2018

TIME:

9:17 a.m.

VICTIM:

27-year-old equipment operator

INDUSTRY/NAICS CODE:

423930/Recyclable Material Merchant Wholesalers

EMPLOYER:

Metal recycling company

SAFETY & TRAINING:

No safety training

SCENE:

Scrap yard

LOCATION:

New York

EVENT TYPE:

Crushed by front-end loader bucket

SUMMARY

On May 26, 2018, a 27-year-old equipment operator at a metal recycling company was crushed and killed by the bucket of a front-end loader at the company's scrap yard. At the time of the incident, the operator was using the front-end loader to consolidate a ferrous scrap pile. At 9:17 a.m., while the loader was backing away from the pile with the bucket in the raised position, some of the scrap slid down the pile. Read the report (p.2)

CONTRIBUTING FACTORS

Key contributing factors identified in this investigation include:

- Procedures for controlling hazardous energies, i.e. lockout/tagout or "LOTO" were not established for front-end loader operations.
- Operators were not trained on installation of the lift arm lock.
- The loader's front wheel fenders were removed without consulting the manufacturer.

Learn more (p.6)

RECOMMENDATIONS

NY FACE investigators concluded that, to help prevent similar occurrences, employers should:

- Develop and implement a LOTO program for front-end loader operation to control hazardous energies and prevent crushing injuries.
- Ensure that all equipment operators receive proper and adequate training on LOTO procedures.

Learn more (p.6)

SUMMARY

On May 26, 2018, a 27-year-old equipment operator at a metal recycling company was crushed and killed by the bucket of a front-end loader at the company's scrap yard. At the time of the incident, the operator was using the front-end loader to consolidate a ferrous scrap pile. At 9:17 a.m., while the loader was backing away from the pile with the bucket in the raised position, some of the scrap slid down the pile. A piece of scrap became wedged between the bucket lift cylinder and the right front wheel (from the driver's point of view). The operator exited the loader without lowering the bucket. The manufacturer specifies that a lift arm lock must be installed to prevent the bucket from falling before a worker enters the "danger zone" under a raised bucket to troubleshoot or do maintenance work. The lift arm lock was not installed. The operator positioned himself underneath the raised bucket between the two front wheels, and he wiggled the jammed piece several times, trying to free it. The movement of the jammed metal pulled the pressurized hydraulic cylinder hose from its fitting. The bucket, which weighed over 2,000 pounds, fell to the ground immediately due to a sudden and complete loss of hydraulic pressure, crushing the operator. The yard staff called 911, and fire department paramedics arrived within minutes. A grapple (a material handler) was used to lift the bucket and free the operator, who was pronounced dead at the scene.

INTRODUCTION

On May 26, 2018, a 27-year-old equipment operator of a metal recycling company was crushed and killed by the bucket of a front-end loader at the company's scrap yard. New York State Fatality Assessment and Control Evaluation (NY FACE) staff learned of the incident from news media reports and initiated an investigation. A NY FACE investigator visited the incident site, met with employer representatives, observed the scrap yard operation, and examined the front-end loader that was involved in the incident. The case was discussed with the Occupational Safety and Health Administration (OSHA) compliance officer who investigated the incident. This report summarizes the findings of the NY FACE investigation.

EMPLOYER

The metal recycling company, a family-owned-and-operated business since 1938, employed approximately 400 employees working in seventeen recycling centers in both New York and Pennsylvania. These recycling centers, open to both business and the public, received and processed the scrap materials including cans, insulated wire, automobiles, appliances, and machines, as well as scrap generated from industrial manufacturing processes. The scrap materials were sorted and processed before being shipped to the company's main "shredder stations" where they were shredded and packaged, and the recovered metal was then sold to steel mills and iron foundries. The company processed approximately 1 million tons of ferrous and 125,000 tons of nonferrous metals annually. The employer was a member of the Institute of Scrap Recycling Industries, Inc. (ISRI).

WRITTEN SAFETY PROGRAMS AND TRAINING

The metal recycling company required that all of its recycling centers implement a set of corporate safety programs and provide worker training. The recycling center where the incident occurred had not implemented the corporate LOTO program, including the component for controlling worksite-specific hazardous energies. A job hazard analysis had not been conducted and there was no system set up to record and report safety incidents. The recycling center had not completed the weekly worker safety trainings that were required by the corporate office. Workers were asked to sign training completion sheets even though the training had not actually been provided.

WORKER INFORMATION

The operator began working at the recycling center in February 2018, three months before the incident. He was initially hired to work in the metal shop. He was quickly reassigned to be an equipment operator due to his previous experience: he had worked at another metal recycling company as an equipment operator for four years. The operator's job duties included operating a front-end loader to unload trucks, transport recycled automobiles, clear ground by consolidating scrap piles, and plow snow.

The recycling center did not provide the operator with any specific training on the hazards associated with operating a front-end loader. An experienced equipment operator reportedly assessed the operator's skill by

watching him operate a loader and concluded that “he was good”. There was no written documentation of the assessment. Although the operator’s primary language was Spanish, he was fluent in English and helped to translate for his Spanish-speaking co-workers.

MACHINERY INVOLVED IN THE INCIDENT

The front-end loader was a Liebherr L538 (Photo 1). The company purchased the loader new in 2015. The loader was powered by a 4-cylinder (4.5 liter) turbo-charged diesel engine with 154 HP and 454 ft-lb of torque. The loader’s maximum operating hydraulic pressure was 5076 psi. The capacity of the loader bucket was 4.6 cubic yards and the bucket was 8-feet wide and weighed 2039 pounds (lb).

Photo 1. The front-end loader that was involved in the incident

The two lift arm cylinders and the cylinder hoses were located between the loader frame and the front wheels on each side (photo 2). The width of the space was approximately 11 inches. There were two hydraulic hoses attached to each cylinder: the pressurized hose that was attached to the cap end and the return hose that was attached to the piston rod end. The hydraulic hose fittings were crimp fittings that were connected to the cylinders through split flange fittings.

Photo 2. This photo shows the location of the right lift cylinder, and its hydraulic hoses, between the right front wheel and the loader frame.

The loader was originally equipped with front wheel fenders (Photo 3). The company confirmed that the loader was purchased with the fenders. When pushing scrap metal with the loader bucket, the metal constantly jammed between the wheels and the fenders. The fenders were soon removed with the recycling center management's approval.

Photo 3. The front wheel fenders that were missing at time of the incident were reinstalled after the incident.

The manufacturer specifies in the Operator's Manual that a lift arm lock must be installed to prevent the bucket from falling before a worker enters the "danger zone" under a raised bucket to troubleshoot or do maintenance work. Used correctly, the 13" X 4"X 4" metal lift arm lock can be placed over the piston rod of the lift cylinder to secure the bucket and prevent it from falling and crushing workers (photos 4 and 5).

Photo 4. The lift lock, a metal piece (13" X 4"X 4") with two cotter pins, was used to secure the bucket.

Photo 5. The lift lock is placed on the piston rod of the lift cylinder to secure the bucket and prevent it from dropping.

The manufacturer requires that all hydraulic parts, including hoses, hose lines, and threaded couplings be checked at least annually for leaks and visible signs of damage. The manufacturer also specifies that hose line use should not exceed six years and storage should not exceed two years. At the time of the incident, the employer was not aware of these requirements. The loader was maintained by an equipment maintenance contractor who had last performed a preventive maintenance three months prior to the incident. During this last maintenance, no work was performed on the vehicle's hydraulics.

INVESTIGATION

The incident occurred over Memorial Day weekend. There were 17 workers, including the operator, on-site that day. Employees were receiving scrap from the public, working in the metal shop, and operating equipment in the yard. Neither the site manager nor the assistant manager was on site that day. The scrap yard was busy with people standing in line waiting for their scrap to be processed. Scrap was piling up and spreading in the yard. At the time of the incident, the operator was operating the front-end loader to consolidate the scrap pile. The yard surveillance video showed that the loader was pushing the scrap upward and inward toward the center of the pile.

Surveillance video footage at 9:17 a.m. shows that some of the scrap slid downward from the pile as the loader was backing away with the bucket in the raised position. A piece of scrap, composed of a square metal plate attached to metal tubing, fell and became jammed in the space between the right front wheel and the loader frame (from the driver's point of view). While the tubing end was resting on the ground, the end with the square plate was wedged in between the lift cylinder and the wheel (Photo 6). The operator, being aware of the jam, attempted to rid the loader of the jammed piece. The loader first moved in reverse and then forward slightly, before the operator exited the loader at 9:18 a.m. without lowering the bucket.

Photo 6. A scrap piece with a square plate became wedged between the lift cylinder and the wheel, and it pulled the hydraulic hose off its fitting.

The bucket may still have been operable with the jam. The exact reason why the operator did not lower the bucket remains unknown. Without installing the lift arm lock, the operator positioned himself underneath the raised bucket between the two front wheels. He lifted the jammed tubing and wiggled it several times, trying to free the piece. The movement of the jammed plate pulled the pressurized cap-end cylinder hose off its fitting. The sudden and complete loss of hydraulic fluid and pressure caused the bucket, which weighed approximately 2000 lbs., to fall to the ground immediately, crushing the operator underneath. It was less than two minutes between the time when the jam occurred, and the time when the operator was crushed.

Two customers were unloading scrap from a pickup truck, and another customer was unloading metal from a station wagon next to the front-end loader, when the incident happened. None of the three were aware of the incident. The incident was not noticed until five minutes later, when a third car arrived. The driver of the third car saw the operator under the bucket and alerted yard staff, who called 911 immediately. Fire department paramedics arrived within minutes. A grapple was used to lift the bucket and free the operator, who was pronounced dead at the scene.

CAUSE OF DEATH

According to the death certificate, the cause of death was compressive asphyxia due to blunt force trauma.

CONTRIBUTING FACTORS

Occupational injuries and fatalities are often the result of one or more contributing factors or key events in a larger sequence of events. The NY FACE investigation identified the following key contributing factors in this incident:

- Procedures for controlling hazardous energies, i.e. lockout/tagout or "LOTO" were not established for front-end loader operations.
- Operators were not trained on installation of the lift arm lock.
- The loader's front wheel fenders were removed without consulting the manufacturer.
- Yard management was not available at the time of the incident.
- No training on hazard identification was provided.
- No job hazard analysis was conducted.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should develop and implement a LOTO program for front-end loader operation to control hazardous energies and prevent crushing injuries.

Discussion: The front-end loader operator in this case often had to access the space under a raised bucket to clear jams, troubleshoot, or conduct machine inspections. The weight of a loader attachment, including the bucket, lift arms, and cylinders can weigh several thousand pounds. Employers should develop and implement a LOTO program to control hazardous energies by securing the raised bucket to prevent serious injuries and deaths. For this equipment, the manufacturer requires that a lift arm lock be installed on the piston of the lift arm cylinder prior to work underneath a raised bucket. In addition to following the manufacturer's requirement, employers should assess and identify other necessary measures to secure the bucket and prevent fatal crushing injuries. Employers should provide employee training to make sure that all workers understand the hazards and the consequences of not following the LOTO procedure. Employers should also conduct periodic inspections to make sure that lockout/energy control procedures are being strictly followed.

Recommendation #2: Employers should ensure that all equipment operators receive proper and adequate training on LOTO procedures.

Discussion: Employers should provide training to ensure that workers understand the hazards posed by uncontrolled energies, as well as how the LOTO program functions to control them. Workers should learn how to safely install and remove the lockout device during the training. When installing a lockout device, workers may be exposed to other hazards such as falling or being pinched or struck by the device. Standard procedures and training should also address these hazards, as well as prevention measures.

For employers in the recycling industry who face labor shortages and high employee turnover, employee training can be challenging. An employer should not assume that an equipment operator with years of experience at another recycling company does not need additional training. Each yard has unique hazards associated with its specific equipment, operations, and layout. For example, the lockout procedure for a Komatsu loader is different from that for a Liebherr loader. Therefore, it is critical for employers to provide site-, equipment-, and operation-specific training and to ensure worker proficiency in all hazardous energy control/ LOTO procedures.

Recommendation #3: Employers should ensure that all equipment operates without missing parts, and that all equipment modifications are approved by manufacturers.

Discussion: In this case, the front wheel fenders were removed with management knowledge due to their interference with the task of pushing scrap metal. It is not possible to be sure that a fender would have prevented this jam. However, a fender may have provided protection to the hydraulics by deflecting the scrap piece from this direction of fall. Employers should ensure that all equipment operates without missing parts and that all equipment modifications are approved by manufacturers.

Recommendation #4: Employers should ensure that hydraulic hoses and threaded couplings on front-end loaders are in safe and working condition.

Discussion: Front-end loaders are widely used in scrap yards to push scrap metal and consolidate metal piles. Scrap metal frequently jams between the wheels and the loader frame, causing wear and tear, as well as damage to the hydraulic parts. Although this investigation was not able to confirm whether the conditions of the hoses and hose connectors contributed to the incident, it is imperative that employers take measures to ensure that equipment hydraulics are in safe and working condition.

Employers should ensure that hydraulics are inspected annually, and that damaged parts are replaced immediately. For the front-end loader involved in this incident, the manufacturer specified that the hoses and hose lines should be replaced at least every six years. Employers should ensure that hoses and hose lines are replaced according to the manufacturer's specifications. Employers should also include inspection of hydraulics in daily equipment checklists. At the beginning of each shift, operators should check all hydraulic hoses, hose lines, and threaded couplings for leaks and visible signs of damage. Loaders with damaged hydraulic parts should be immediately removed from service and return to service only after repairs are made.

Recommendation #5: Employers should develop and implement an equipment inspection program to ensure that front-end loaders are inspected daily and needed repairs and maintenance are done timely.

Discussion: Employers should develop an equipment inspection program to ensure that front-end loaders are inspected at the beginning of each shift or on a daily basis. A safety checklist should be developed, and a system of recording and reporting for identified issues and needed repairs should be established. Equipment with broken or missing parts should be taken out of service immediately. The equipment should not be returned to service unless the repairs are completed.

Recommendation #6: Employers should conduct a Job Hazard Analysis (JHA) to identify high risk jobs and to determine appropriate employee training on recognized hazards and safe work procedures.

Discussion: Employers should conduct JHAs to identify hazards and develop specific prevention measures. A JHA focuses on the relationship between the worker, the task, the tools, and the work environment so that the hazards associated with each component and each step of the task can be identified before they occur. It is critical that one conducts a JHA on new or complex jobs, jobs with high injury or illness rates, jobs with the potential to cause severe or disabling injuries or illness, or jobs in which one simple human error could lead to a severe accident or injury. Based on the hazards identified through a JHA, employers can then develop and implement appropriate control and prevention measures and standard safe work procedures for workers to follow.

Employers should provide worker training in hazard recognition, avoidance of unsafe and hazardous conditions, and adherence to standard safe working procedures. Employee training should emphasize that under no circumstances should a worker circumvent the protection afforded by safety apparatus, such as guards or lockout devices, and that a worker should never risk physical harm to accomplish tasks.

Recommendation #7: Employers should establish a safety and health management system (SHMS) to effectively control and reduce workplace hazards, risks, and injuries.

Discussion: Employers cannot implement individual compliance programs successfully without the backing of a SHMS. Although the metal recycling company in this case had developed OSHA-required safety and health programs at the corporate level, the program implementation was not consistent across recycling centers, and worker training was not provided at the recycling center where the fatal incident occurred.

Without a SHMS, the approach to injury prevention tends to be reactive: problems are addressed only after a worker is injured or becomes sick, a new standard or regulation is published, or an outside inspection finds a problem that must be fixed. Finding and fixing hazards before they cause injury or illness is a far more effective approach, which can only be achieved through implementing a SHMS. In addition to better worker protection, an effective SHMS also improves productivity, product quality, workplace morale, recruitment and retention, and company image and reputation among customers and in the community.

Guidelines for setting up a SHMS are recommended by OSHA and are outlined in several major consensus standards such as ANSI Z10 and ISO 45001. Employers should incorporate key elements such as management

leadership, employee participation, worker participation, hazard identification and assessment, hazard prevention and control, education and training, and program evaluation and improvement into their SHMS.

Recommendation #8: Front-end loader manufacturers should develop lift cylinder guards to protect cylinders and hydraulics from mechanical damage.

Discussion: Metal recycling operations present unique operational needs and hazards to workers who perform these tasks. Equipment manufacturers should design and configure the equipment not only to meet the special industry needs but also to offer better worker protection. The front-end loader in this case had front wheel fenders, and scraps frequently jammed between the fenders and the wheels. The jammed metal can cause damage to the exposed hydraulics in this area, as well as serious worker injuries. Loader manufacturers should design tailored guards which shield the exposed hydraulics while not interfering with the task of pushing metal.

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INVESTIGATOR INFORMATION

This investigation was conducted by NY FACE, Bureau of Occupational Health and Injury Prevention, Center for Environmental Health, New York State Department of Health.

ACKNOWLEDGEMEMENT

The NY FACE Program would like to acknowledge the OSHA Albany Area Office for providing assistance and information for this investigation.

The New York State Fatality Assessment and Control Evaluation (NY FACE) is a research program funded by the National Institute for Occupational Safety and Health and administered by the New York State Department of Health. NY FACE collects information on work-related fatalities, investigates the incidents to identify the causes and contributing factors, proposes prevention measures, and shares the injury prevention information with employers, workers, and other organizations interested in promoting workplace safety. NY FACE does not determine fault or legal liability associated with a fatal incident. Names of employers, victims and/or witnesses are kept confidential. Additional information regarding the NY FACE program can be obtained from:

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