

FACE 86-10: 33 Year-Old Apprentice Substation Electrician Fatally Injured

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), is currently conducting the Fatal Accident Circumstances and Epidemiology (FACE) Project, which is focusing primarily upon selected electrical-related fatal injuries and confined space fatalities. By scientifically collecting data from a sample of fatal accidents, it will be possible to identify and rank factors which influence the risk of fatal injuries for selected employees.

On November 6, 1985, a 33 year-old electrician came in contact with electrical energy while cleaning a substation switch. He died on November 8, 1985, from injuries sustained as a result of falling from the aerial bucket from which he was working.

CONTACTS/ACTIVITIES

Officials of the responsible Occupational Safety and Health Program notified DSR of this fatality and requested technical assistance. This case has been included in the FACE Project. On January 10, 1986, a member of the DSR research team (a physician) met with representatives of the company and the Occupational Safety and Health Program compliance officer, who investigated this case. The site of this fatality was visited and photographed. Interviews were conducted with two workers with essentially the identical job classification as the victim. A next-of-kin interview was conducted on January 9, 1986.

OVERVIEW OF THE COMPANY AND SAFETY PROGRAM

The victim worked for a large utility company employing over 5000 employees. This company provides both electrical and natural gas services to approximately one-third of the state. The victim worked for the electricity distribution division, which has 178 employees. These employees are classified as either journeyman or apprentice substation electricians. The training program for a substation electrician is approximately 6 years. Five and one-half years consist of both classroom and on-the-job training. Formal testing is done to ensure adequate understanding of classroom work. The last six months of the training is used for final evaluation, prior to attaining journeyman status. The victim was an apprentice substation electrician in his final six months of training. The victim would have been made journeyman substation electrician in March of 1986.

The company has a budgeted safety department and a program which emphasizes three functions: (1) to formulate and communicate a safety program for the entire company; (2) to deal with workman's compensation claims; and (3) to provide industrial hygiene services for the company.

The safety department has six full-time employees and is headed by a safety engineer with eleven years of experience in occupational safety and health, in addition to formal training in safety management. The safety staff also employs an industrial hygienist and a specialist in worker's compensation claims.

A written safety policy and safety program exist for this company. Several safety committees exist involving various levels of management and union employees. Formal task training is provided by a department whose only function is training. Safety rules are communicated to new employees at the time of initial orientation. Each new employee is given a written safety manual and formal classroom instruction

in safety. New employees are formally tested within ninety days of being hired to ensure adequate understanding of the safety rules.

SYNOPSIS OF EVENTS

The four-man crew consisted of two journeyman substation electricians and two apprentice substation electricians. The apprentice substation electricians (one of whom was the victim) were both in their final six months of training. The crew was cleaning high voltage disconnect circuits at a large substation. This is considered to be routine maintenance, is performed using established procedures, and had been done by all members of the crew for at least five years.

The crew was to clean five circuits (15 switches) on the day of the accident. Each circuit consists of three switches (one for each phase), located 40 feet above ground on a steel frame structure. The switches are cleaned with solvents, steel wool, and occasionally filed to remove corrosion. The crew was using an aerial bucket to access the switches. The three switches for each circuit are operated by a single control lever and are either all open or all closed. The control lever is operated from ground level. Prior to cleaning switches, the system must be de-energized. The crew foreman is ultimately responsible for this activity. Once the incoming lines are de-energized, the line is tested using a method called "fuzzing". "Fuzzing" consists of wrapping insulating material around one end of a metal object and holding it close to the incoming power line. If no noise is heard, the line is assumed to be dead and grounds are placed from the incoming line to the steel support structure. The system is also grounded on the outgoing side of the circuit so that there is no possibility of feedback into the three switches. The switches are to remain in the open position during this maintenance procedure.

On the day of the accident, several crews were working at the substation site. One crew was removing obsolete equipment and had placed grounds on the outgoing side of the circuits that were to be cleaned. After lunch, this crew left the substation removing their grounds. These grounds were not replaced. The victim had completed cleaning the fourth circuit shortly before 3:00 p.m. He left the 4th circuit closed to drain off any static charge that may have built up in the system. (There would have been no static charge had the outgoing side of the circuit been grounded.) The victim was asked if he wanted the fourth circuit opened by two different crew members. He supposedly told them he would do it himself. The victim moved the truck so that the aerial bucket could be positioned for cleaning the fifth circuit. The fourth circuit was re-energized. The crew foreman de-energized the incoming line to the fifth circuit. The line was "fuzzed" and grounds were placed on the incoming line. At 3:14 p.m. the victim was in the process of cleaning the switches when he contacted both sides of one of the three switches. This action completed the connection, as if the switch itself were closed and current flowed through the victim's body and to ground by way of the ground on the incoming line. The system was energized by feedback through the fourth circuit. The victim fell from the aerial bucket approximately forty feet to the ground. The victim had extensive burns of both arms and hands. It is estimated that the victim completed a single-phase circuit of approximately 20,000 volts. First aid was administered at the accident site by co-workers and subsequently paramedics. The victim was transported to a local hospital approximately 20 minutes after the accident occurred. He was later transferred to another medical center and died two days later on November 8, 1985.

Standard operating procedure was not followed by the crew while cleaning the switches. The fourth circuit should have been left open. The crew was aware of this. The outgoing side of the circuit was not grounded as required by the company. The victim did not have himself belted to the aerial bucket as required. This would have prevented his fall and the injuries sustained in the fall.

CAUSE OF DEATH

Following an autopsy, it is the opinion of the medical examiner that the victim "died as a result of cerebral injuries when he fell from a height of 40 feet." The victim's contact with electricity is noted in the medical examiner's report as the cause of the fall.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Standard operating procedures and hazard awareness should be routinely presented and reviewed at safety meetings. Employers should enforce strict adherence to company policy. Employees should follow all standard operating procedures.

Discussion: The crew did not follow standard operating procedure while providing maintenance to the substation. Three violations of standard operating procedure occurred that contributed to this fatality: 1)the switches on the fourth circuit were left closed when they should have been open; 2)the outgoing side of the circuits were not grounded; and 3)the victim was not secured to the bucket from which he was working. Had standard operating procedure been followed, this fatality would not have occurred.

Recommendation #2: De-energization of both sides (incoming and outgoing) of the substation circuit should be verified.

Discussion: The incoming line to the circuit is "fuzzed" as part of the standard operating procedure to verify that the line is de-energized. The outgoing side of the circuit should also be checked to verify that no voltage is present (from feedback). Additionally, the absence of low voltage (not detected by "fuzzing") should be verified by a low voltage testing device, prior to grounding. Had both sides of the circuit been tested, the victim would have been alerted that the system was not de-energized.

FACE 88-46: Female Receiving Clerk Dies in Fall in Warehouse

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying: the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On September 3, 1988, a 33-year-old female receiving clerk died as the result of a fall sustained on September 2, 1988, while trying to locate misplaced merchandise on 7-foot-high steel shelving. The attending physician determined that the victim landed head first on the concrete floor.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On September 20, 1988, a research safety specialist met with company officials and the victim's immediate supervisor, photographed the incident site, and discussed the incident with the county coroner and the Occupational Safety and Health Administration (OSHA) compliance officer.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim was employed by a wholesale merchandise distributor that has been in operation for 55 years. The company employs 240 workers, including 3 receiving clerks. The company has no written safety program and all training for work-related tasks is conducted on the job.

SYNOPSIS OF EVENTS

On the day of the incident, the victim was assigned by her supervisor to locate misplaced merchandise that was previously stocked. The merchandise was on 7-foot-high by 3-foot-wide rows of steel shelving spaced 5 feet apart in a 25,200 square yard warehouse. The shelving was arranged so that four shelves existed for inventoried merchandise. The top of the shelving was used to store excess merchandise. The victim decided to check the storage area at the incident site even though a co-worker informed her that the storage area had already been searched. Co-workers noted that the victim apparently climbed the shelves to reach the top shelf instead of using an available 6-foot-high wheel-mounted ladder with handrails.

A fork-truck driver passing the scene offered the victim assistance in getting down, but she declined. A short time later workers in the area heard a scream and found the victim lying in the aisle between two rows of shelves. The emergency medical service arrived in 10 minutes and summoned a medical helicopter. The victim was flown to the local hospital where emergency neurosurgery was performed. However, the victim died the following morning as a result of injuries received in the fall.

CAUSE OF DEATH

The attending physician listed accidental closed-head injuries as the cause of death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should perform task hazard analysis for all tasks performed at their establishments, adopt safe work procedures for the performance of these tasks, and ensure that workers adhere to these procedures at all times.

Discussion: As previously stated, the employer had no written safety program or task procedures. Hazard analysis should be performed to identify any hazards that may be encountered by workers during the performance of their duties. Although a receiving clerk might not be identified as a dangerous occupation, there may be unanticipated hazards. One hazard encountered by receiving clerks is a fall hazard, especially while working at the level of the top of the shelving (i.e., 7 feet). The employer provides 6-foot-high, wheel-mounted ladders for working at this level or below, if necessary.

Written safety procedures should be developed that address the task of stocking shelves. These procedures should require the use of ladders. If a ladder had been used in this incident, the possibility of a fall would have been reduced once these procedures are developed, workers should be trained to perform their duties in the safest possible manner. Employers must ensure adherence to these safe job procedures in order to provide workers with the safest possible work environment.

FACE 89-45: Welder Dies in Fall from Fork Lift

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On July 16, 1989, a 47-year-old male welder died as the result of falling approximately 7 feet from a fork truck (commonly referred to as a fork lift or towmotor).

CONTACTS/ACTIVITIES

The county coroner contacted DSR about this fatality and requested technical assistance. On July 27, 1989, a research team consisting of a safety specialist and an epidemiologist discussed this case with state officials, conducted an investigation, met with the company owner, and photographed the site of the incident.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim had been employed for 5 years as a welder for a welding and machining services company that has been in operation for 21 years. The company employs 45 workers, including 35 welders. The employer uses written safety rules and procedures and provides on-the-job training. The company owner is also the safety officer. Jobsite foremen are responsible for administering and enforcing the safety program. This fatality is the first in the history of the company.

SYNOPSIS OF EVENTS

On the day of the incident, welding and machining tasks were being performed throughout the plant as usual. The welder (victim) was performing welding tasks assigned to him earlier that morning. A co-worker (fork lift operator) was moving wheel sets (steel axles with steel wheels attached) inside the building where the victim was welding.

The co-worker had just off-loaded a wheel set when he noticed that the fork carriage (assembly to which the forks or other attachments are mounted) was jamming on the mast (upright steel assembly consisting of hydraulic cylinders, inner channels, telescoping outer channels, chains, and guide rollers) (see Figure). The co-worker and victim decided to solve the problem without removing the fork truck from service, a violation of company maintenance procedures.

They backed the fork lift (i.e., a 1979 V225 diesel-powered fork truck with an 11-ton lifting capacity) out of the work area, set the brakes, blocked the wheels, raised the fork carriage up the mast to the point where it jammed, and shut off the engine.

The victim noticed that a wear guard strip, attached to the side of the telescoping channel on the mast, had come loose and was binding against the guide roller. This caused the top of the fork carriage to jam

approximately 8 feet from the ground. The victim, carrying a cutting torch, climbed up the carriage and stood on an angled, 6-inch-wide steel support to cut out a section of the wear guard strip as the co-worker observed. The victim then used a pry bar to move the wear guard strip away from the guide roller. As the strip dislodged from the roller guide, the carriage dropped approximately 1 foot.

Due to the jerking motion of the carriage, the victim fell from the angled steel support headfirst onto a concrete pad. The local emergency medical service (EMS) was summoned and arrived approximately 4-5 minutes later. Approximately 35 minutes thereafter, the victim was air-evacuated to the hospital where he died 2 days later.

CAUSE OF DEATH

The medical examiner's report listed blunt force trauma to the head as cause of death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should review, revise where applicable, and enforce current safety programs.

Discussion: Although the company has a written safety program, including maintenance procedures for fork trucks, the procedure was not followed. If the victim and co-worker had informed the jobsite foreman of the fork lift problem, according to procedure, the truck could have been moved to the maintenance shop and repaired according to company maintenance procedures, thereby avoiding the incident. Employers should review, revise where applicable, and enforce the current safety program. The program should be clear and should emphasize the importance of following established operating procedures.

Recommendation #2: Employers should ensure that employees are aware of, and fully understand the risks associated with, failing to comply with established operating procedures.

Discussion: Unscheduled maintenance by unauthorized personnel can and does lead to injury and even death. Apparently the two workers (the victim and co-worker) did not perceive the 8-foot distance as a hazard associated with working on the fork lift, and a fatality resulted. If the standard operating procedure had been followed, this incident may have been avoided. Employers should ensure that all employees are aware of, and fully understand, the risks associated with not complying with established operating procedures.



Figure. Fork Truck Components: 1) fork carriage (assembly to which the forks or other attachments are mounted, and 2) mast (steel upright assembly consisting of hydraulic cylinders, inner channels, telescoping outer channels, chains, and guide rollers).

FACE 90-35: Electrical Lineman Dies After Falling 35 Feet to the Ground from a Burning Aerial Bucket in South Carolina

SUMMARY

An electrical lineman died 5 days after attempting to jump from a burning aerial bucket and falling 35 feet to the ground. The lineman was adjusting the slack in the middle phase of a three-phase, 14,200-volt powerline. The hydraulic hose attached to the impact wrench he was using burst. Hydraulic fluid spraying from the hose ignited, covering part of the aerial bucket in flames. As the lineman was rotating the aerial bucket away from the powerlines, he lost power to the controls. He attempted to escape the intensifying fire by jumping laterally from the bucket's edge to an adjacent earthen bank approximately 15 feet away. However, his foot caught on the lip of the bucket, and he fell 35 feet straight down to the ground. The investigation revealed that the metal-reinforced hydraulic hose used for the impact wrench attachment was simultaneously in contact with two phases of the powerline. The heat generated in the hose caused it to melt and burst at one of the points of contact with the powerlines. NIOSH investigators concluded that, to prevent future similar occurrences, employers and/or equipment, tool, and hose manufacturers, should:

- *ensure that metal-reinforced hydraulic hoses are not installed on any part of the boom, aerial bucket, or hydraulic attachments on aerial bucket trucks that may be used near powerlines*
- *ensure that fluids used to power hydraulic hand tools are fire resistant*
- *install all hydraulic hoses for impact attachments in such a manner that the flow of hydraulic oil can be stopped by the worker in the aerial bucket during an emergency*
- *label or color code hydraulic hoses to identify hoses that may be used on an aerial bucket*
- *design a hydraulic coupling system that would ensure that any hydraulic hoses unsuitable for use on booms, aerial buckets, or aerial bucket attachments, could not be connected to these components of aerial bucket systems*
- *provide task-specific training to workers that includes training in the identification and control of potential hazards*
- *stress the importance of adherence to established safe work procedures.*

INTRODUCTION

On June 30, 1990, a 37-year-old lineman died of injuries sustained on June 25, 1990, when he attempted to jump from a burning aerial bucket, and fell 35 feet to the ground. On July 16, 1990, officials of the South Carolina Occupational Safety and Health Administration notified the Division of Safety Research (DSR) of the death, and requested technical assistance. On August 9, 1990, a safety specialist and a public health intern traveled to the incident site to conduct an investigation. The incident was reviewed with employer representatives, the county sheriff's office, and the county coroner. Photographs of the incident site were obtained.

The employer in this incident is an electrical contractor who has been in business for 44 years and employs 550 workers, including 100 electrical linemen. The contractor employs three full-time safety officers and has a written safety policy, a comprehensive written safety program, and a worker training program. A comprehensive safety manual is provided to each employee. Daily safety tailgate meetings are held at the jobsite, and weekly safety meetings are held at the office. During weekly safety meetings, a section of the safety manual is read and discussed and all personnel are required to sign a statement documenting their attendance. The employer maintains a video library of safety films dealing with all aspects of powerline construction. These films are shown in the field, and in the office on days that operations are canceled due to inclement weather. Supervisors are required to complete a daily safety checklist for each job completed.

INVESTIGATION

The employer was contracted to upgrade an existing electrical system by installing new utility poles parallel to an existing three-phase electrical system, and transferring the 12,400-volt powerlines to the new utility poles.

On the day of the incident, the victim and a co-worker were transferring the energized powerlines to the last new utility pole in the system. As each phase was transferred, it was "dead-ended" (attached at the pole without further connection to the rest of the power system). Once all three phases were attached, they were "sagged" (the slack was adjusted) by the lineman. The center phase was sagged first, then the two outside phases. The center phase was sagged a second time to take out additional slack. The conductor was held in place by a come-along during attachment to the insulators on the utility pole. A hydraulic impact wrench was used to tighten connectors around the powerline and insulator.

As the lineman was tightening the center phase connectors, the hydraulic hose supplying fluid to the impact wrench burst. The hydraulic fluid spraying from the ruptured hose ignited, covering part of the aerial bucket with flames. The lineman rotated the aerial bucket away from the utility pole. When the bucket was approximately 12 feet away from the utility pole, the lineman lost power to the controls as additional hydraulic hoses burst and burned. The lineman attempted to jump laterally to an earthen bank approximately 15 feet away. However, his foot caught on the lip of the bucket and he fell 35 feet to the ground, landing on his head and chest. The victim rose to his feet but was lowered back to the ground by the co-worker. The co-worker radioed the company dispatcher from the truck and requested the emergency medical squad (EMS). The victim was transported to the hospital where he died 5 days later from injuries sustained in the fall. The bucket burned for approximately 20 minutes until a second line crew de-energized the powerlines and the fire department extinguished the fire.

Investigation revealed that a field mechanic had installed a metal-reinforced hydraulic hose on the impact wrench 5 months prior to the incident. When the hose simultaneously contacted two of the energized phases, electrical continuity was established through the hose's metal reinforcement. The heat generated by the resistance to the phase-to-phase current melted the hose, and partially melted the metal in the hose. When the hose ruptured, the spraying hydraulic fluid contacted the hot metal and ignited.

Standard employer practice required the use of common hydraulic hoses (without metal reinforcement) on any area of the boom or aerial bucket that might be placed near energized powerlines. The mechanic told investigators that he knew he was installing the wrong type of hose, but did not understand the potential hazards involved. The electrical contractor had the hydraulic hoses on all aerial bucket trucks inspected and no other metal-reinforced hoses were found in the bucket area. However, when informed of the cause of

the fire, the local electric utility company inspected its aerial bucket trucks and found metal-reinforced hydraulic hoses on several.

CAUSE OF DEATH

The attending physician listed trauma-closed head injury as the cause of death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should instruct maintenance and mechanical personnel not to install metal-reinforced rubber hydraulic hoses on any part of the boom, aerial bucket, or hydraulic attachments of aerial bucket trucks that may be used to work on or near energized high-voltage powerlines.

Discussion: As seen in this case, electrical continuity established between two powerline phases or powerline phase-to-ground through a metal-reinforced hydraulic hose, can generate heat sufficient to rupture the hose and cause a fire. Current flowing through the metal reinforcement could also be conducted to the truck chassis, creating an electrocution hazard. All hydraulic tools used on or near energized lines or equipment must be equipped with nonconducting hoses, according to 29 CFR 1926.951(f)(3).

Recommendation #2: Employers should ensure that fire-resistant hydraulic fluid is used to power hand tools that may be exposed to ignition sources.

Discussion: Fluids used in hydraulic-powered tools must be approved, fire-resistant fluids according to 29 CFR 1926.302(d)(1). In this case, use of a fire-resistant hydraulic fluid could have prevented the ensuing fire.

Recommendation #3: Employers should ensure that hydraulic hoses for impact attachments are installed so that the flow of hydraulic fluid can be stopped by the worker in an aerial bucket during an emergency.

Discussion: A control valve incorporated into the hydraulic system of the aerial bucket would allow a worker in the bucket to immediately stop the flow of hydraulic fluid to any attachment. In the event of a fire, the control valve would enable a worker in a bucket to shut off the supply of hydraulic fluid fueling the fire. Although use of a metal-reinforced hose was a primary cause of fire in this instance, this safeguard should be incorporated for all hydraulic hoses due to the potential that any type of hydraulic hose could burst.

Recommendation #4: Employers should label or color code hydraulic hoses to identify those that are appropriate for specific applications on certain areas of machinery (such as aerial buckets).

Discussion: A method or system for labeling or color coding hydraulic hoses might prevent the hazards introduced when different types of hoses, designed for use in different applications, are used interchangeably.

Recommendation #5: Equipment and tool manufacturers should cooperatively design an independent coupling system, utilizing a new variation of matched connection components, that could be incorporated into aerial bucket system designs.

Discussion: Such an independent coupling system would ensure that any hydraulic hoses unsuitable for use on booms, aerial buckets, or aerial bucket attachments could not be connected to these components of aerial bucket systems.

Recommendation #6: Employers should provide task-specific training to workers that correlates steps in the task with control of the identified potential hazards.

Discussion: In this instance, the field mechanic was aware that he was installing the incorrect type of hose; however, he was not aware of the fire hazard associated with the use of a metal-reinforced rubber hose near energized high-voltage powerlines.

Recommendation #7: Employers should ensure that workers are aware of the importance of adherence to established safe work procedures.

Discussion: Employers should continually stress the importance of adherence to established safe work procedures. Established safe work procedures required covering energized powerlines in the immediate work area with insulated line hoses prior to the start of any work. It is not known, however, if insulated line hoses would have prevented the ignition of the hydraulic fluid in this case.

REFERENCES

1. 29 CFR 1926.951(f)(3) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register. pg. 286.
2. 29 CFR 1926.302(d)(1) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register. pg. 133.

FACE 91-30: Tree Trimmer Dies After Falling 65 Feet From Tree in Virginia

SUMMARY

A 34-year-old male tree trimmer died after falling 65 feet from a tree. The victim was limbing and topping the three forks of a large oak tree with a chain saw in preparation for felling the tree. The victim had limbed and topped two of the forks and had started on the third. As the limbs fell to the ground, the victim's brother and a general contractor were cutting them into pieces. The victim's cousin looked up to check on the victim, then began to cut the branches when he noticed the victim's belt rope falling. He looked up to see the victim falling to the ground. The victim's climbing cradle had failed. An investigation revealed that the connectors on both ends of the climbing cradle rope were fastened with wire and electrical tape. NIOSH investigators concluded that, in order to prevent similar occurrences, employers should:

- *ensure that proper fastenings are used at the connectors for all climbing cradle ropes*
- *ensure that workers inspect all fall protection equipment each day prior to use*
- *evaluate the feasibility of a redundant fall-arresting system.*

INTRODUCTION

On September 3, 1991, a 34-year-old tree trimmer died after falling 65 feet from a tree. On September 5, 1991, officials of the Virginia Occupational Safety and Health Administration notified the Division of Safety Research (DSR) of this fatality, and requested technical assistance. On September 18, 1991, a DSR safety specialist traveled to the incident site to conduct an investigation. The incident was reviewed with the investigating police officers, the county coroner, and the OSHA compliance officer. Photographs of the site were obtained during the investigation.

The victim was employed full time as a tree trimmer by a tree care service. However, during off-duty hours, the victim and his brother performed tree trimming and tree removal jobs on their own. There were no written safety rules or safe work procedures for the work that the victim and his brother were performing on their own time.

INVESTIGATION

The victim, with his brother, had been contracted by a general contractor to remove a large oak tree from the yard of a private residence on their own time during a weekend.

The large tree had three main forks. The victim decided that he would limb and top each of the forks before felling the tree, while the victim's brother and the contractor would remain on the ground and cut up the limbs as they fell. The victim climbed the first fork and tied a rope around it near the top. He would use this rope to assist him as he made his way up the fork, cutting off the limbs as he went. The victim wore a body harness, tree climbers, and a climbing cradle (a length of rope with connectors on each end that is placed around the tree and snapped to the "D" rings on each side of the body harness) as he ascended the tree. The climbing cradle assisted the victim while climbing and held him in place while he made his cuts with the chain saw. The victim also had a tool rope hanging from the harness with which he could raise and lower tools.

At the time of the incident, the victim had completed work on the first two forks and was approximately three quarters finished with the third fork (60 feet above ground). The contractor looked up to check on the victim, then began to cut branches on the ground. The contractor then noticed a rope falling to the ground and looked up to see the victim falling to the ground. The victim landed on his head and right shoulder. The owner of the residence immediately called the emergency medical service (EMS). EMS personnel arrived 5 minutes after being dispatched and transported the victim to the hospital, where he was pronounced dead by the attending physician.

Investigation into the incident revealed that the connectors on both ends of the climbing cradle ropes were fastened with wire and electrical tape. While the victim was leaning back making a cut, the pressure caused the rope to pull loose and the victim fell to the ground. The connector was still attached to the D-ring on the harness.

CAUSE OF DEATH

The medical examiner listed massive internal trauma as the cause of death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that proper fastenings are used at the connectors for all climbing cradle ropes.

Discussion: All rope connectors should be interwoven or mechanically clamped in compliance with manufacturer's recommendations to ensure that the integrity of the connections is continually maintained.

Recommendation #2: Employers should ensure that workers inspect all fall protection equipment for defects each day prior to use.

Discussion: In this instance, the victim, working as a self employed tree trimmer, did not inspect the connectors on the climbing harness prior to use. If a visual inspection of the harness had been conducted, the loose connector might have been identified and could have been repaired. Any defective equipment should be immediately repaired or removed from service.

Recommendation #3: Employers should evaluate the feasibility of a redundant fall-arresting system.

Discussion: In this instance, the victim relied solely on the climbing cradle as the fall arresting system. When the connector on the cradle failed, there were no other system components present to prevent the fall. The victim had tied a rope to the top of the forks prior to beginning the climbing work. This rope could have doubled as a lifeline. A lanyard attached to the body harness and the rope would have provided a second suspension point.

[A "rope grab"--a friction activated deceleration and locking device--could have been fitted onto the lifeline; this would have slowed and stopped the victim's fall. Several design configurations are available for these devices--inertial locking, cam/lever locking, or both--and each is effective against this kind of fall hazard. An alternative safety device would be a self-retracting lanyard; this is another kind of deceleration and locking device, which contains a drum-wound line. The line can be wound and unwound within certain limits to accommodate normal worker movements; however, during a fall, centrifugal force activates locking devices which stop drum rotation and arrests the fall. Either a rope grab or a self-retracting lanyard would have protected the victim when the cradle connector failed.]

FACE 94-02: Stocker/Order Picker Dies After 12-Foot Fall From An Elevated Pallet--South Carolina

SUMMARY

A 25-year-old male stocker/order picker (the victim) died after falling 12 feet to a concrete floor. The victim was re-stocking the third tier of a row of 36-inch-wide steel shelving units while working from a 47 1/2-inch-long by 40-inch wide-pallet supported by a cherry picker. A co-worker, facing away from the victim, was opening boxes of merchandise at floor level on the same row. The victim was wearing a safety belt, and a permanently affixed 5-foot nylon lanyard was attached to the cherry picker's falling-object protective structure, above the victim; however, the victim had not attached the lanyard to his safety belt. As the victim was stepping from the shelving to the pallet, he lost his balance and fell backward off the pallet, 12 feet to the concrete floor below, landing on his back and striking his head. The co-worker, hearing the victim fall, ran to him and found him semiconscious but breathing. The co-worker alerted the shift supervisor, who summoned the emergency medical service (EMS) by phone. The EMS transported the victim to the local hospital where he died 5 days later. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *ensure that workers continually adhere to the safe work practices that have been established by the employer*
- *encourage all employees to actively participate in workplace safety*
- *routinely conduct scheduled and unscheduled worksite safety inspections.*

INTRODUCTION

On September 15, 1993, a 25 year-old male stocker/order picker died from injuries he received in a 12-foot fall from an elevated pallet on September 10, 1993. On September 30, 1993, officials of the South Carolina Occupational Safety and Health Administration (SCOSHA) notified the Division of Safety Research (DSR) of this fatality, and requested technical assistance. On December 21, 1993, a DSR safety specialist conducted an investigation of this incident. The incident was reviewed with employer representatives, the coroner, and the SCOSHA compliance officer assigned to the case. Photographs of the incident site taken immediately following the incident were reviewed during the investigation.

The employer was a multistate retail merchandise distributor that had been in operation for 40 years and employed 16,000 employees. Two hundred thirty-five workers were employed at the facility where the incident occurred, including 11 stocker/order pickers. The employer had a comprehensive safety program. Each new employee received an employee handbook and a "Think Safety" pamphlet that contained general safety rules. New employee orientation was conducted under the direct supervision of the shift supervisor until such time that the supervisor felt the employee could perform the job correctly. Employees received training on such topics as the correct use of personal protective equipment and proper lifting techniques. Safety inspections were conducted daily by the shift supervisor on all three shifts, weekly safety meetings were conducted for all personnel, and all personnel received yearly hazard awareness training. Cherry picker operators received 3 days of specialized training from the shift supervisor before operating the machines on their own. The victim had been employed at the facility for 2 months. This was the first fatality experienced by the employer.

INVESTIGATION

The retail distribution center operated on three shifts--7 a.m. to 3:30 p.m., 2:30 p.m. to 10:30 p.m., and 10:30 p.m. to 6 a.m. Goods, such as non-perishable foods, household items, and various other items were received from the manufacturer and warehoused. The merchandise was stored on rows of 3-tiered steel shelving. The top shelf was 12 feet above floor level and the rows were located 102 feet apart. When orders were received, the merchandise was pulled from the warehouse, transferred to a truck, and then shipped to the desired destination.

On the day of the incident, the victim and a co-worker were re-stocking shelves on the 10:30 p.m. to 6 a.m. shift. They began the shift by loading the first batch of merchandise brought to the warehouse on pallets. Two sizes of pallets were used (472" by 40" and 30" by 38"). At approximately 1 a.m., they began to stock the shelves. The co-worker raised the victim on a loaded pallet to the top shelf using a cherry picker, then left the cherry picker and began to load more pallets at floor level. The victim was wearing a safety belt that was required, by company policy, to be attached to a 5-foot nylon lanyard that was permanently affixed to the cherry picker's falling-object protective structure above him. A sign, warning workers to keep the lanyard attached to their safety belt at all times, was posted on the cherry picker. It could not be determined if the lanyard had been attached to the victim's safety belt at this time. The men continued this activity until the first batch of merchandise was warehoused.

At approximately 4 a.m. the men began to stock the second batch of merchandise. When the second batch of merchandise was warehoused, the co-worker raised the victim on an empty 472" by 40" pallet to the top shelf to pull goods to fill an order. He then turned away from the victim and began to load pallets on the same row, approximately 20 feet from the cherry picker. As the co-worker was loading a pallet he heard a sound and turned to see the victim lying on his back on the concrete floor. The co-worker ran to the victim and found him semiconscious but breathing. The co-worker alerted the shift supervisor, who called the emergency medical squad (EMS). The EMS arrived on the scene 12 minutes later and transported the victim to the local hospital where he died 5 days later.

The victim apparently lost his balance as he was loading the pallet and fell backward off the pallet. The victim was wearing his safety belt but was not attached to the lanyard. An examination of the lanyard showed it to be free from defects.

CAUSE OF DEATH

The attending physician listed the cause of death as closed head trauma.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that workers continually adhere to established safe work procedures.

Discussion: Employers should continually stress the importance of adherence to established safe work procedures. In this instance, the victim was wearing a safety belt but did not attach the permanently affixed lanyard to it as required by company safe work procedures and as taught in new employee orientation.

Recommendation #2: Employers should encourage workers to actively participate in workplace safety.

Discussion: Employers should encourage all workers to actively participate in workplace safety and should ensure that all workers understand the role they play in the prevention of occupational injury. In this instance, the victim was working without being attached to the lanyard, in violation of established safety rules. Workers and co-workers should look out for one another's safety and remind each other of the proper way to perform their tasks. Employers must instruct workers of their responsibility to participate in making the workplace safer. Increased worker participation will aid in the prevention of occupational injury.

Recommendation #3: Employers should routinely conduct scheduled and unscheduled worksite safety inspections.

Discussion: Although the shift supervisor conducted a safety inspection during each shift, additional scheduled and unscheduled safety inspections should be conducted by a competent person¹ to ensure that company safe work procedures are being followed. No matter how comprehensive, a safety program cannot be effective unless implemented in the workplace. Even though these inspections do not guarantee the elimination of occupational injury, they do demonstrate the employer's commitment to the enforcement of the safety program and to the prevention of occupational injury. Competent person: One who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authority to take prompt corrective measures to eliminate them.

¹Competent person: One who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authority to take prompt corrective measures to eliminate them.

FACE 94-14: Construction Foreman Dies After Falling From Aerial Lift Bucket Truck--South Carolina

SUMMARY

On June 20, 1994, a 46-year-old male construction foreman (the victim) fell 16 feet from the bucket of an aerial lift truck. He died the following day as a result of his injuries. He had been attempting to estimate the height of telephone and television cables that were stretched across a two-lane roadway. The roadway had been guarded against moving traffic by two other employees, but just prior to the incident, the victim reassigned the employees to a different job. The victim positioned himself in the one-man bucket of the hydraulically-operated, articulated-boom, aerial lift truck and raised the bucket about 16 feet above ground level without first donning a safety belt and lanyard and attaching it inside the bucket. As the victim was judging the height of the cables, a tractor-trailer attempted to drive under the outstretched cables. The top of the trailer caught the cable and pushed it toward the victim. The cable contacted the victim's abdomen, and knocked him out of the bucket causing him to fall to the concrete roadway. The victim was immediately rushed to the local hospital, then transferred to a trauma center. The victim died of internal hemorrhaging the following day. Although fall protection equipment (a safety belt and lanyard secured to an anchor point inside the bucket) was provided on the truck, the victim was not wearing the equipment as required by company policy.

NIOSH investigators concluded that, to prevent future similar occurrences, employers should:

- *ensure that appropriate fall protection equipment is available and correctly used when working from elevations where there is a danger of falling*
- *review and revise, where applicable, existing safety programs*
- *encourage workers to actively participate in workplace safety.*

INTRODUCTION

On June 21, 1994, a 46-year-old male construction foreman (the victim) died as a result of injuries sustained after falling from the bucket of an aerial lift truck the previous day. On July 23, 1994, officials of the South Carolina Occupational Safety and Health Administration notified the Division of Safety Research (DSR) of this fatality, and requested technical assistance. A DSR safety specialist traveled to the site on September 23, 1994, to conduct an investigation of the incident. During the investigation, the company's plant superintendent was interviewed, photographs of the site and vehicle were taken, and a copy of the death certificate was obtained.

The employer was a telephone cooperative that has been in operation for 42 years and employed 220 workers, 3 of whom were construction foremen. The company's plant superintendent managed field operations, as well as performing part-time safety responsibilities. The company maintained a written safety policy and safety rules, and employees received both formal classroom and on-the-job training. The company required pre-employment and random drug testing for employees required to drive company vehicles. Monthly safety meetings were held, quarterly safety films were shown, and speakers were hired semi-annually to present safety related topics. The victim, a journeyman line mechanic, worked as a foreman 8 of the 15 years he was employed by the company. This was the first fatality experienced in the company's history.

INVESTIGATION

The victim and four crew members had been assigned to replace a cracked wooden utility pole located alongside a two-lane roadway. The top of the pole was about 20 feet above ground. The pole supported two sets of telephone and television cables which were strung 16 feet above the roadway. One set of cables ran parallel with the roadway; the other set ran across the roadway to a pole on the opposite side (Figure).

On the day of the incident, the victim and four other crew members arrived at the jobsite shortly after lunch in preparation to perform the routine pole replacement. Two crew members were assigned to direct traffic around the jobsite, while two other crew members and the victim used an aerial lift bucket truck and a derrick truck to remove the cables from the cracked pole and the pole itself from the ground, respectively.

After the task was completed, the cables running across the roadway were supported, in absence of the cracked pole, by the telephone and television cables which ran parallel to the road. The victim instructed the two crew members directing traffic to cease their work and help with setting the new pole. The victim stated he was going to use the bucket truck to check the height of the cables running across the roadway. Without donning the fall protection equipment provided on the truck (safety belt and lanyard which secured to an anchor point in the inside of the bucket), he entered the bucket and raised it about 16 feet from ground level to a position adjacent to where the cables running across the roadway intersected the cables running parallel with the roadway. As the victim was occupied judging the height of the cables, a tractor-trailer attempted to drive under the outstretched cables. The top of the trailer caught the cables, which were about 13 feet 6 inches above ground at that point, and pushed them toward the victim. The cable contacted the victim's abdomen and knocked him out of the bucket, causing him to fall to the concrete roadway below. The local emergency medical squad (EMS) responded 5 minutes after notification by a paramedic who had witnessed the incident and provided first aid to the victim. The victim was transported by the EMS to a local hospital. He was later transported to a trauma center, where he died the following day.

CAUSE OF DEATH

The death certificate listed the cause of death as internal hemorrhage.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that appropriate fall protection equipment is available and correctly used when working from elevations where there is danger of falling.

Discussion: The company had provided appropriate fall protection equipment on the aerial truck, a safety belt and lanyard to be secured to an anchor point inside the bucket. However, the victim was not wearing the safety equipment while inside the bucket as required by the Code of Federal Regulations 1926.556(b)(2)(v), which states "A body belt shall be worn and a lanyard attached to the boom or basket when working from the an aerial lift." Employers should ensure that workers follow established procedures for wearing fall protection equipment. Use of fall protection equipment may not have prevented the victim from being thrown out of the bucket, but it could have prevented his falling to the concrete roadway.

Recommendation #2: Employers should review and revise, where applicable, existing safety programs.

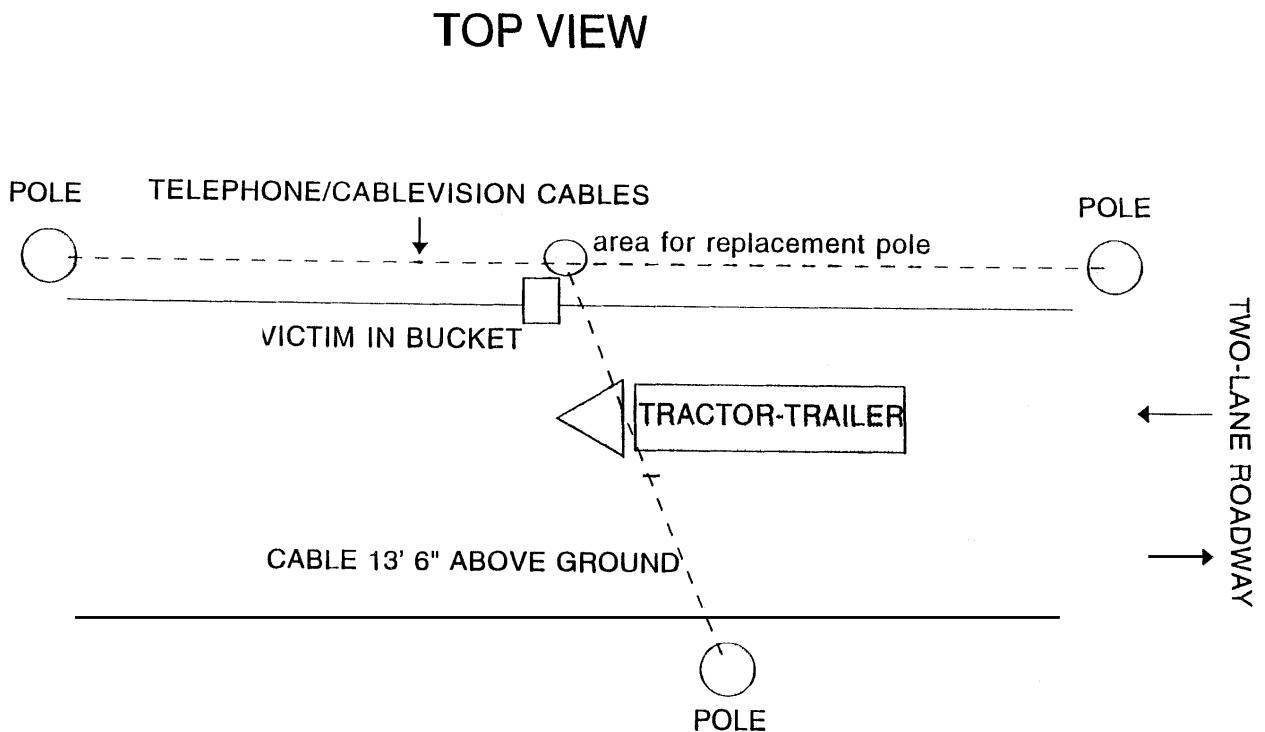
Discussion: Although the employer had a written safety program, there were no specific procedures regarding the management of traffic at jobsites. Prior to the incident, a temporary detour had been established around the jobsite by two workers. If the detour had been maintained by the workers, the incident may have been prevented. Consideration should be given to the review and possible revision of safety programs to include provisions that address all facets of traffic control at jobsites.

Recommendation #3: Employers should encourage workers to actively participate in workplace safety.

Discussion: Employers should encourage all workers to actively participate in workplace safety and should ensure that all workers understand the role they play in the prevention of occupational injury. In this incident, the victim boarded the aerial lift truck, entered the bucket, and raised the bucket without first donning a safety belt and lanyard and attaching it to the inside of the bucket. Workers and co-workers should look out for one another's safety and remind each other of the proper way to perform their tasks. Employers should instruct workers of their responsibility to participate in making the workplace safer. Increased worker participation will aid in the prevention of occupational injury.

REFERENCES

29 CFR 1926.556 (b)(2)(v) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register.



FACE 95-20: Assistant Manager Dies After 15-Foot Fall From Forklift-Suspended Pallet—South Carolina

SUMMARY

On September 6, 1995, a 47-year-old male assistant warehouse manager (the victim) of an automotive tire and service center died after falling 15 feet from a forklift-suspended pallet and striking his head on a concrete floor. The victim was working with a forklift, pulling tires for orders and logging tire-inventory sheets. The men were pulling the tires from a section of bins, 4-bins high and 8-bins wide. The men set a 5-foot-square wooden pallet on the forks of the machine, then set a steel rack on top of the pallet to help secure the tires when loading and unloading. The steel rack was not attached to the pallet. The forklift driver then raised the victim, who was standing on the pallet but not wearing a safety belt or lanyard, to the top row of bins, approximately 16 3/4 feet above the concrete floor. The victim had placed 10 to 12 tires on the pallet when the forklift operator looked up and saw that the pallet and rack were unstable. The victim lost his balance and fell to the floor, striking his head. The forklift operator saw the victim try to stand and then saw him fall. He went to the front counter and told a worker to call the emergency medical service (EMS) then returned to the warehouse to assist the victim. The victim was found unconscious but breathing. The EMS responded within 8 minutes and transported the victim to the hospital. The victim was removed from life support 1 week later and pronounced dead. NIOSH investigators concluded that, in order to prevent similar incidents, employers should:

- *ensure that workers continually adhere to the safe work procedures that have been established by the employer*
- *provide workers with a firmly secured work surface*
- *encourage all employees to actively participate in workplace safety*
- *routinely conduct scheduled and unscheduled worksite safety inspections.*

INTRODUCTION

On June 6, 1995, a 47-year-old male assistant warehouse manager (the victim) of an automotive tire and service center died after falling 15 feet from a forklift-suspended pallet and striking his head on a concrete floor. On August 22, 1995, officials from the South Carolina Occupational Safety and Health Administration (SCOSHA) notified the Division of Safety Research (DSR) of this fatality, and requested technical assistance. On September 21, 1995, a DSR safety specialist conducted an investigation of the incident. The incident was reviewed with employer representatives and the SCOSHA compliance officer. Photographs of the scene taken immediately after the incident were reviewed during the investigation.

The employer in this incident was an auto and tire service center with a tire warehouse that had been in operation for 13 months under the present management and employed 6 workers. The company had written safe-work procedures which were presented to new employees during their orientation training. This training involved, but was not limited to, safety and environmental issues, proper use of personal protective equipment, and employee standards of conduct. Additional training was performed on the job. Forklift drivers attended company operator safety training. Warehouse managers and assistant managers completed monthly safety/quality inspection reports and were responsible for enforcing safety rules on work activities, use of PPE, and forklift safety in the warehouse. The victim had worked for the employer for 1 month. This was the first fatality experienced by the present management.

INVESTIGATION

Daily activities in the warehouse included the receipt and storage of bulk tires and auto parts. Inventory was then pulled and shipped to other stores or used to repair cars at the facility.

On the day of the incident, the victim was working with a forklift driver pulling tires for orders and logging tire inventory sheets. The men were pulling the tires from a section of bins, 4-bins high and 8-bins wide. Each bin was 5-foot-square by 67-inches high. Normal procedures directed the men to set a 5-foot-square wooden pallet on the forks of the machine, then set a steel rack measuring 5-foot-square by 69-inches high on top of the pallet to help secure the tires when loading and unloading. The pallet was not secured to the forks, nor was the steel rack secured to the pallet. After this was accomplished, the victim stood on the pallet and was raised approximately 16 3/4 feet above the concrete floor to the top row of bins by the driver. The victim was not wearing his safety belt or lanyard as required by company safety procedures.

The victim had placed 10 to 12 tires on the pallet when the driver looked up and noticed that the pallet and rack were becoming unstable as the victim reached into a bin. The pallet began to move and the victim lost his balance and fell to the floor, striking his head. The rack and tires followed the victim to the floor.

The driver saw the victim attempt to stand, then fall over, and ran to the front counter to tell a worker to call the emergency medical service (EMS). He then returned to the warehouse to assist the victim. He found the victim breathing but unconscious. The EMS personnel arrived within 8 minutes and transported the victim to the hospital. The victim was removed from life support 7 days later and declared dead.

CAUSE OF DEATH

The medical examiner listed the cause of death as skull fracture.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that workers continually adhere to the safe work procedures that have been established by the employer.

Discussion: Employers should continually stress the importance of adherence to established safe work procedures. In this instance, a safety belt and lanyard were provided, and required when work was performed above ground. During employee interviews it was learned that the workers often did not wear the safety belts and lanyards because the lanyard had to be wrapped around the forklift mast to tie off, restricting movement. Since the incident, the employer has attached an anchor point to the mast carriage that allows the employee to move freely when the lanyard is attached.

Recommendation #2: Employers should provide workers with a firmly secured work surface.

Discussion: In this incident, a pallet to be used as a work surface was placed unsecured on the forks of the lift and a steel rack was placed unsecured on the pallet. This created the potential for dislodging the pallet due to bumping by the tires when they were placed on the pallet, or uneven loading of the pallet, making the work surface unstable. In this instance, when the pallet became unstable, the victim lost his balance and fell, causing the rack and tires to fall. Since the incident, the employer has permanently anchored the rack to the pallet with bolts, providing for a more stable work surface. Additionally, 29 CFR 1926.602

(c)(1)(viii)(A) requires that whenever a truck is equipped with vertical only, or vertical and horizontal controls elevatable with the lifting carriage or forks for lifting personnel, a safety platform firmly secured to the lifting carriage and/or forks shall be used as an additional precaution for the protection of the personnel being elevated. Although this regulation pertains to construction activities, all work platforms should be secured to forklift forks to ensure worker safety.

Recommendation #3: Employers should encourage all employees to actively participate in workplace safety.

Discussion: Employers should encourage all workers to actively participate in workplace safety and should ensure that all workers understand the role they play in the prevention of occupational injury. In this instance, the victim, a supervisor, stepped on the pallet without attaching his lanyard, in violation of established safety rules. Workers and co-workers should look out for their personal safety and the safety of co-workers. When workers observe hazardous conditions or activities, they should, depending on the circumstances, notify management and/or remind co-workers of the proper way to perform their tasks and protect themselves. Employers must instruct workers of their responsibility to participate in making the workplace safer. Increased worker participation will aid in the prevention of occupational injury.

Recommendation #4: Employers should routinely conduct scheduled and unscheduled worksite safety inspections.

Discussion: Employers should be aware of any potential hazards or unsafe work conditions or practices in the workplace and should take an active role to eliminate them. Scheduled and unscheduled safety inspections should be conducted by a competent person¹ to ensure that the workplace is free of hazardous conditions. Even though these inspections do not guarantee the prevention of occupational injury, they may identify hazardous conditions and activities that should be rectified. Further, they demonstrate the employer's commitment to the enforcement of the safety program and to the prevention of occupational injury.

REFERENCES

29 CFR 1926.602 (c)(1)(viii)(A) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register.

¹Competent person: One who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authority to take prompt corrective measures to eliminate them.