

FACE Report Number 2009-02

August 19, 2011

Revised on March 27, 2014 to remove a duplicate sentence from Rec#1

Hispanic Worker Dies When a Sixty-Foot Tree Falls Onto the Hydraulic Excavator He Was Operating to Clear Land – Tennessee

SUMMARY

On February 7, 2009, a 28-year-old Hispanic worker suffered fatal injuries when a tree he was attempting to fell struck the cab of the hydraulic excavator he was operating. At the time of the incident, the victim was working for a site development company that was preparing land to construct a parking lot and driveway for a golf course. He was operating the hydraulic excavator to push down trees by first digging around the base of the tree to loosen the root system, placing the bucket of the hydraulic excavator against the trunk of the tree and extending the boom outward to push the tree away from the hydraulic excavator. There were no witnesses to the incident; however, it is believed that the victim was engaging the boom to push a sixty-foot tall sweet gum tree over when it fell backwards onto the cab. The weight of the tree caved in the cab's roof and trapped the victim inside.

According to the county medical examiner's office, the victim's death was due to mechanical asphyxia caused by being pinned in a contorted position. Key contributing factors identified in this investigation include failure to consider and prepare for the environmental conditions of the work area, such as wet and unstable soil, shallow root system of the trees to be felled, and wind speeds which may hamper the hydraulic excavator operator's ability to control the direction the tree will fall.

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

- *ensure that prior to commencing tree-felling operations, a plan is developed that includes guidelines for continual evaluation of the worksite for safety hazards, as well as procedures for implementing hazard control measures*

Fatality Assessment and Control Evaluation (FACE) Program

The National Institute for Occupational Safety and Health (NIOSH), an institute within the Centers for Disease Control and Prevention (CDC), is the federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. In 1982, NIOSH initiated the Fatality Assessment and Control Evaluation (FACE) Program. FACE examines the circumstances of targeted causes of traumatic occupational fatalities so that safety professionals, researchers, employers, trainers, and workers can learn from these incidents. The primary goal of these investigations is for NIOSH to make recommendations to prevent similar occurrences. These NIOSH investigations are intended to reduce or prevent occupational deaths and are completely separate from the rulemaking, enforcement and inspection activities of any other federal or state agency. Under the FACE program, NIOSH investigators interview persons with knowledge of the incident and review available records to develop a description of the conditions and circumstances leading to the deaths in order to provide a context for the agency's recommendations. The NIOSH summary of these conditions and circumstances in its reports is not intended as a legal statement of facts. This summary, as well as the conclusions and recommendations made by NIOSH, should not be used for the purpose of litigation or the adjudication of any claim. For further information, visit the program website at www.cdc.gov/niosh/face/ or call toll free at 1-800-CDC-INFO (1-800-232-4636).

- *ensure that the safety program, manual, and training include specific guidance on recognizing and mitigating hazardous work site conditions*
- *ensure that the equipment being used on the job provides the highest level of physical protection for the workers and is the most appropriate for the work being done*

INTRODUCTION

On February 7, 2009, a 28-year-old Hispanic worker (the victim) died when a tree he was attempting to push over with a hydraulic excavator fell onto the cab, pinning him inside. The force and weight of the tree collapsed the roof of the cab and the victim was asphyxiated due to his body being pinned in a contorted position within the cab. On August 26, 2009, officials of the Tennessee Occupational Safety and Health Administration (TOSHA) notified the National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR) of the fatality. On September 15, 2009, two DSR Safety and Occupational Health Specialists conducted an investigation of the incident and reviewed the incident circumstances with the investigating TOSHA safety compliance officer assigned to the case and the victim's employer. Photographs of the incident site, and statements that were taken by TOSHA from workers who were in the same general area were reviewed.

EMPLOYER

The victim's employer was a construction site development contractor that has been in business since 2006. The company employs, on average, nine employees, and it was reported that three employees were working at the site where the fatality occurred. The bulk of their work appears to be mainly in the same geographic area where the incident occurred. This was the company's first fatality.

On this job, they were contracted to clear and level undeveloped land for extensive renovations to a golf course. The victim was working in an area that was being prepared for a driveway and parking lot for the course. The road was to be 60 feet wide and approximately ½ mile long. Employees of the contractor, including the victim, were operating equipment to fell and remove trees, and level and stabilize the soil for the road and driveway.

WRITTEN SAFETY PROGRAMS and TRAINING

The employer had a generic occupational safety and health manual. The manual stated that the site supervisor is the designated safety officer for the worksite. Interviews indicate that the safety manual was reviewed with all new employees and a copy was maintained by the supervisor at all job sites. The office manager had attended an OSHA 10 hour safety course and

was responsible for initial employee safety training and maintaining safety training records. Employees who were on the site at the time of the incident reported that the crew supervisor conducted formal safety meetings every Monday morning and informal tailgate safety briefings each morning. According to the TOSHA report, the employees who were interviewed were aware of the safety manual and had attended daily and weekly safety meetings.

VICTIM

The 28-year-old Hispanic male victim's native country was Mexico. However, he had been in the United States since 2000 and according to the employer and TOSHA, he could read and speak English fluently. He had worked for the site development company for two months, having worked the entire time at the golf course renovation work site. His brother had worked for the site development company for several years. The site supervisor reported that the victim was hired as an equipment operator due to his extensive experience, and on the recommendation of his brother. He had received formal training on hydraulic excavator operation while working for a prior employer and also participated in safety training provided by the current employer. The site supervisor and co-workers stated that they had never seen him do anything unsafe.

INCIDENT SCENE

The ground at the scene where the incident occurred was partially covered by standing water (Photos 1 and 2). The swampy and marsh-like environment was incorporated into the design of the golf course to preserve the wetland appearance. The depth of the standing water is not known, but review of the photos of the hydraulic excavator following the incident (Photo 1) show a portion of the upper structure and the operator cab (Diagram) to be partially submerged in the mud due to the weight of the tree causing the hydraulic excavator to tilt to one side.

EQUIPMENT

The victim was operating a 1996 hydraulic excavator at the time of the incident. The cab was enclosed with safety glass on four sides. The roof of the cab was steel with a hatch that opened but was closed at the time of the incident. According to the TOSHA investigator, the canopy roof was constructed of two-ply steel, each measuring 3/32" (total 3/16") which met the OSHA requirement of 1/8". However, the weight of the tree produced a large indentation in the roof of the cab (Photo 3).

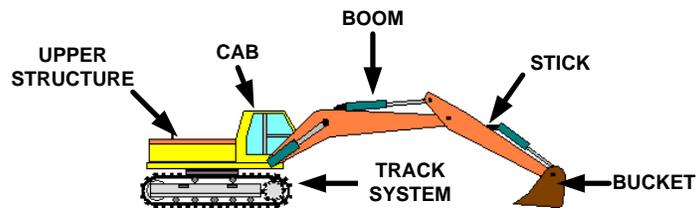


Diagram: Basic components of a hydraulic excavator.

Diagram courtesy of Safety Provisions, Inc. (Home of the Hard Hat Training Series)

WEATHER

The incident occurred in the morning at approximately 8:15 a.m. At that time, the skies were overcast with a temperature of 57° and humidity of 77%. Winds were from the south with sustained speed of ~9 miles-per-hour (MPH) with wind gusts of 19.6 MPH recorded in the area at 8:10 a.m.¹

INVESTIGATION

On February 7, 2009, at approximately 7:00 a.m. the victim began his workday operating a hydraulic excavator to clear trees from a wooded area that was being developed for a driveway and parking area for a golf course. According to statements given to TOSHA, three workers were assigned to the area that morning. The victim was operating a hydraulic excavator to push the trees over and another worker was nearby operating a bulldozer to move the downed trees into a pile for burning. The supervisor was the third worker and he was operating a bulldozer to blade the road on a hillside away from, and above, the area where the victim was working.

The dozer operator who was working closest to the victim reported that they had been working about an hour and the victim had downed several trees. He stated that at approximately 8:15 a.m., as he was moving one of the downed trees, he saw the victim working on pushing a tree that was “shaking and kind of wiggling,” and when he looked toward the victim again, the tree was down but the hydraulic excavator had not moved. At that point, he could not see that the tree was lying on the cab of the hydraulic excavator. He moved the bulldozer closer and saw that the tree had fallen onto the cab of the hydraulic excavator and the victim appeared to be pinned in the cab and was not moving. He used his cell phone to call the other dozer operator who was at the worksite, told him that the victim had pulled a tree onto the hydraulic excavator and he thought that he was dead. The other worker called 911 and moved closer to the hydraulic excavator to check on the victim. However, he reported that he could not get out to where the victim was located because the water was too deep.

Paramedics arrived and had to cut the cab to remove the victim who was pronounced deceased at the scene by the medical examiner. He was transported to the medical examiner’s office where

cause of death was determined to be mechanical asphyxia from being pinned in a contorted position within the cab, and not due to trauma from being struck by the falling tree.

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 that ultimately result in the injury or fatality. NIOSH investigators identified the following items as key contributing factors in this incident.

- failure to consider and prepare for the environmental conditions of the work area, such as wet and unstable soil, shallow root system of the trees to be felled, and wind speeds which may hamper the excavator operator's ability to control direction the tree will fall.

CAUSE OF DEATH

The medical examiner listed the cause of death as mechanical asphyxia.

RECOMMENDATIONS / DISCUSSION

Recommendation #1: Employers should ensure that prior to commencing tree-felling operations, a plan is developed that includes guidelines for continual evaluation of the worksite for safety hazards, as well as procedures for implementing hazard control measures.

Discussion: The work being performed at this worksite falls under the OSHA logging standard (29 CFR 1910.266), which interprets the felling of trees in preparation for construction activities, such as the building of roads, to be a logging operation.² OSHA Regulation 29 CFR 1910.266 (h)(2)(ii) requires that when working at a logging site, before cutting operations are begun, the immediate supervisor be consulted for approval when unusually hazardous conditions are encountered.³ OSHA included this provision because records indicate that injuries occur when inexperienced employees encounter unfamiliar situations; or even when experienced operators wrongly believe they can handle hazardous situations on their own. While there cannot be an exhaustive list of the situations which may necessitate the employee consult with a supervisor, there are certain situations that OSHA identifies as clearly covered by this regulation. These situations include deepening mud which begins to affect a logger's mobility and cutting trees whose location make it difficult to fell in the desired or safest direction. OSHA states that, "these are situations in which workers cutting trees have been killed or severely injured because the conditions caused unexpected results during felling. When these conditions arise, adding the supervisor's knowledge, training, and experience to the decision making process should help minimize the hazards to which the worker may be exposed."⁴

In this incident, as evidenced by the photographs taken shortly after the fatality, the area in which the victim was working consisted of mud and ponding water (Photos 1 and 2). Prior to commencing work, a thorough evaluation of the ground conditions may have indicated that the area was not conducive to heavy equipment stability and it would be unsafe to conduct tree-felling activities until conditions improved.

An additional factor, which may have contributed to the incident, was the type of tree the victim was attempting to fell. The tree, a sweet gum, was reported to be 60' tall with an 18" diameter. According to the *Landowner's Guide to Determining Weight of Standing Hardwood Trees*, the tree would have weighed approximately 1.34 tons.⁵ Sweet gum trees are described as typical southern bottomland trees that prefer rich, moist, well-drained soil. In wet areas with poor drainage, the root system will be shallow with no, or very little, taproot^a development which negatively impacts the stability of the tree.⁷ Even though the tree-felling procedure has more of an impact on the direction the tree will fall than does the tap root, equipment operators should be trained to recognize all factors affecting tree stability and consider all hazards before commencing tree-felling operations.

In addition to the mud and ponding water and the size and shallow root system of the tree, the weather service reported wind gusts of close to 20 MPH in the area at the time of the incident.¹ There is no way to predict sporadic wind gusts such as those occurring on the morning of the incident. However, it is possible that the wind direction and speed, combined with the unstable soil conditions, and the type and size of the tree, affected the victim's ability to control the direction that the tree would fall. A thorough analysis of all of these conditions prior to commencing tree-felling operations may have alerted the victim to the hazards and thus prevented the fatality.

Companies involved in tree-felling operations should develop a "felling plan" in accordance with the OSHA regulation 1910.266(h)(2)(ii). Developing a felling plan and training equipment operators on the plan, would have provided the operator with the understanding of the hazards created in the felling process. It is possible that the victim misread the tree's lean and the wind direction, which were both elements that contributed to the fatality. Additionally, the operator had the tree on the cab side of the boom and stick which may have increased the severity of the consequences of losing control of the tree. Making the first dig in the intended direction of the fall and the subsequent dig with the boom and stick between the tree and the cab may have prevented the tree from falling on the cab.

Recommendation #2: Employers should ensure that the safety program, manual, and training include specific guidance on recognizing and mitigating hazardous work site conditions.

^a The main root of a plant, usually stouter than the lateral roots and growing straight downward from the stem.⁶

Discussion: A comprehensive safety program should include hazard recognition and the avoidance of unsafe conditions with respect to environmental conditions at the work site. The program should include provisions for equipment operators and site supervisors to be trained in the proper and safe use of the equipment adhering to all manufacturer recommendations (including conducting routine operational checks) as well as how to recognize hazards presented by the equipment and the work environment. Equipment manufacturers recommend that owner/operator manuals be read completely and carefully before operating any piece of equipment, and the manual be kept with the equipment at all times

The safety program should include the stipulation that an assessment be conducted to identify the suitability of the machine in relation to the site and the task to be undertaken before any work begins. Features of the machine that should be considered are stability, traction, and ground clearance. The risk assessment should also identify the level of operator protection that is required on the machine such as operator protective structures. The operator should be aware of the limitations of the machine on soft ground or other obstacles, and avoid any ground condition that could cause the machine to be unstable.⁸ Employers should adhere to manufacturer's guidelines in the safe operation of machinery. These guidelines should be included in operator training and enforced by site supervisors and safety personnel.

In addition to a comprehensive safety program, employers should develop and implement a site-specific safety plan that identifies hazards and details safe operating procedures for all job tasks, including equipment-specific operating procedures. The plan should be continually evaluated for changing conditions at the worksite and modified as needed. All employees must be made aware of hazards that are identified and trained in how to abate the hazards. The enforcement of knowledge gained and behaviors learned by employees because of safety training is as important as designing and implementing the safety program. Employers must enforce safe behaviors and strict adherence to company safety rules and procedures by all employees.

Even though employees who were on the site at the time of the incident reported that the crew supervisor conducted formal safety meetings every Monday morning and informal tailgate safety briefings each morning, there is no evidence that particular hazards of the worksite were identified and addressed. In this incident, the equipment operators should have been trained to recognize hazards associated with tree-felling operations in ponding water or deep mud, such as the likelihood of being unable to control the direction the tree will fall.

Recommendation #3: Employers should ensure that the equipment being used on the job provides the highest level of physical protection for the workers and is the most appropriate for the work being done.

Discussion: OSHA has exempted machines capable of a 360° rotation, such as hydraulic excavators, from the falling object protective structures (FOPS) and rollover protective structures (ROPS) requirement and according to the TOSHA investigator, the canopy roof was constructed

of two-ply steel, each measuring 3/32" (total 3/16") which met the OSHA requirement of 1/8". However, the weight of the tree produced a large indentation in the roof of the cab (Photo 3). Had the canopy been reinforced with FOPS, it is logical that the intrusion of the tree into the cab would have been less severe; thereby maintaining the integrity of the operator compartment and increasing the probability that the operator could have survived the incident. Although there is no regulation that prohibits using hydraulic excavators to fell trees, and it is not an uncommon practice, it is recommended that employers use excavators equipped with FOPS that meet current applicable consensus standards for operator protection, or a forestry machine specifically designed for the type of tree removal to be performed. Presently owned excavators that will be used to fell trees can be retrofitted with appropriate guarding packages that are available separately.

The owner's manual for the hydraulic excavator involved in this incident gives no specific reference to felling trees; however, it does give guidance to operators when they are operating in water. The manual states that when operating in water:

- The water level must not be deeper than the top of the tracks.
- Make sure that the bottom of the stream or pond where you will work will support the machine.
- Do not operate your machine in a fast current.

Equipment operators at the scene reported that they believed the area where they were working met the requirements as listed in the operator's manual.

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INVESTIGATOR INFORMATION

The investigation was conducted by Nancy T. Romano and Virginia Lutz, Safety and Occupational Health Specialists, Fatality Investigations Team, Surveillance and Field Investigations Branch, Division of Safety Research. The report was authored by Virginia Lutz. An expert technical review was provided by the Association of Equipment Manufacturers and Dr. Matthew Smidt, Associate Professor/Extension Specialist, Forestry Operations, Auburn University.

ACKNOWLEDGEMENT

The NIOSH FACE Program and the Safety and Occupational Health Specialists would like to acknowledge the Compliance Officer and staff of the Tennessee Occupational Safety and Health Division (TOSHA) program for providing information for this investigation.

PHOTOS

Photo 1. Photo of the incident scene showing location of the hydraulic excavator following the incident. *(Photo courtesy of TOSHA)*



Photo 2. Photo of the incident scene showing the tree that fell onto the cab roof of the hydraulic excavator. *(Photo courtesy of TOSHA)*



Photo 3. Photo of the cab roof showing the indentation made by the tree. *(Photo courtesy of TOSHA)*