

ADMINISTRATIVE REPORT
PUBLIC HEALTH SERVICE/CDC/NIOSH/DSR
FACE-99-01

DATE: June 3, 1999

TO: Director, National Institute for Occupational Safety
and Health

FROM: Division of Safety Research, NIOSH

SUBJECT: Tower Hand Dies After 230-Foot Fall From Communications
Tower--North Carolina

SUMMARY

A 40-year-old male tower hand (the victim) died after falling 230 feet from a 250-foot communications tower. The victim was a member of a four-man crew which was installing a new phone service on the tower. Two tower hands, one of whom was the company owner, were at the base of the tower while the victim was on the north side of the tower connecting co-axial cable to an antenna arm 230 feet above the ground. A co-worker was working with his back toward the victim at the same height and approximately 6 feet to the victim's right, performing another task. The victim had completed his task on the antenna and may have unhooked his positioning equipment in order to move south (right) toward the tower leg where the safety-climb device/system was located, when he fell. Co-workers did not see what the victim was doing at the time of the fall. They heard a sound, which may have been the metal hook from the victim's positioning equipment hitting the tower. Within seconds they saw the victim's body strike boxes on the ground and then come to rest on the ground. Crew members at the base of the tower called for emergency medical services (EMS). EMS and sheriff's department personnel responded within 10 minutes of the call. Due to the extent of injuries, no first aid or CPR was initiated. The victim was pronounced dead at the scene. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- o *provide workers with a 100 % fall-protection system compatible with the tasks to be performed, instruct employees in the proper use of the system and equipment, and ensure their use*

- o *provide workers with a proper work-positioning system, instruct workers in the proper use and limitations of the system, and ensure its use*

- o *develop, implement, and enforce a comprehensive written safety program which includes, but is not limited to, a commitment to 100% tie-off and written procedures for employees to implement 100% fall protection.*

Additionally, manufacturers of tower components and tower owners:

- o *should consider installing fall-protection fixtures on tower components during fabrication or erection that would facilitate the use of fall-protection systems.*

INTRODUCTION

On November 13, 1998, a 40-year-old male tower hand (the victim) died after falling 230 feet from a 250-foot communications tower. Officials of the North Carolina Occupational Safety and Health Administration (NCOSHA) notified the Division of Safety Research (DSR) of this fatality. DSR offered technical assistance and on December 15, 1998, a safety specialist from DSR conducted an investigation of the incident. The incident was reviewed with the NCOSHA compliance officer assigned to the case, the tower-owner representative, and the county sheriff and coroner offices. The site was visited and photographs were obtained during the investigation.

The employer was a cable-installation service that had been in operation for 1 year. The company owner and three permanent employees worked together, referring to themselves as tower hands. The company had no written safety policy or safety program, but the owner held a safety meeting with the crew each morning before work began to discuss the job and to check personal protective equipment. The victim had worked as a tower hand for 20 years and was an experienced climber. He had worked for the employer for 1 year and had been on the job site with the rest of the crew for 5 days when the incident occurred. This was the first fatality experienced by the employer.

INVESTIGATION

The employer had been contracted by a telecommunications company to install 12 new antennae and run new co-axial cable to a location 230-feet high on a three-legged cellular phone tower which had been completed in August, 1998. The crew consisted of the company owner and three tower hands. All four were experienced climbers. The work was to be completed in four stages. They began their work on Monday and by Tuesday had assembled 12 antennae on the ground. On Wednesday they rigged the tower to lift the antennae and cable in place. In order to rig the tower, two of the men, each in full

body-harness, hooked onto the safety climb device/system located on the south tower leg and climbed to 237 feet where they hung the hoisting block. On Thursday two men worked on the ground hoisting the cable, while two men worked on the tower installing the antennae and securing the cable.

On Friday, the day of the incident, the 4-man crew began work at 6:30 a.m. They met to discuss the job and to inspect the climbing equipment of each climber as they had done each day before climbing the tower. The victim was wearing a full-body harness with a saddle belt and carried three 6-foot nylon-rope lanyards.

When it was light, at approximately 6:50 a.m., the victim and a co-worker climbed the south leg of the tower. Each in turned used the safety-climb device pictured or attached his own cable grab to the safety-climb system to climb the tower leg and reach the area 230 feet up (figure 1). The remaining two tower legs were not equipped with a safety-climb device/system. This was the first climb for the victim on this job. He had worked on the ground the first 4 days. It took the men approximately 30 to 35 minutes to climb the tower. They rested at regular intervals during their ascent. After each worker stepped off the safety-climb system, they free-climbed (moved on the tower without fall protection) to the location of their work. According to the victim's co-worker, they used positioning lanyards to secure themselves while they were working on their cable-installation tasks. They worked for approximately 6 hours, taking periodic breaks to eat, drink, and rest.

At approximately 1:15 p.m., the owner radioed up to the men telling them to come down for lunch. Minutes later, the victim, who had completed securing co-axial cable to the antenna, fell from the tower. He fell 230 feet and landed first on boxes located 10 feet away from the tower structure and then on the gravel. See figure 2 for the victim's work position just prior to his fall. The co-worker was working with his back to the victim at the time of the incident and therefore did not see what happened just prior to the fall. Crew members at the base of the tower called for emergency medical services (EMS). EMS and sheriff's department personnel responded within 10 minutes of the call. Due to the extent of the injuries no first aid or CPR was initiated and the victim was pronounced dead at the scene at 1:30 p.m.

The equipment the victim was wearing when he fell was photographed by sheriff's department personnel. The equipment was inspected and the photographs reviewed during the course of the investigation. The victim had been wearing a lineman's full-body harness and had three 6-foot lanyards with him. Each lanyard was made of 1/2-inch nominal three-strand nylon rope and had connectors on each end with

1-inch openings. One of the lanyards had been altered to make it function as a makeshift work-positioning device. A ladder hook with a 1 1/4-inch throat opening had been looped through the center of the lanyard and one of the connectors at the end of the lanyard was damaged and could not be opened.

Measurements of the tower were obtained from the manufacturer. The tower involved is a three-legged, self-supporting tower. At the base of the tower, the solid round legs measure 3 3/4-inches in diameter and are set in concrete pads. The diagonal tower components (angle iron) measured 3 1/2 by 3 1/2 by 1/4-inch at the base. The grits, which are horizontal angle iron members, measured 2 1/2 by 2 1/2 by 1/4-inch at the base. The tower is built in sections and at higher levels the components used are smaller. The distance between members decreases as well. At the level where the victim was working, the solid round tower legs measured 2 1/4-inches in diameter and were approximately 5 feet apart and the diagonal angle iron measured 2 by 2 by 3/16-inches. The horizontal members cease at the 200-foot level. According to the co-worker, the connectors on the lanyards used by the victim were not large enough to fit around the angle iron or the tower legs. Measurements taken of the connectors used by the victim support this statement as his ladder hook had a 1 1/4-inch throat opening and the connectors at the ends of his lanyards had 1-inch openings. The worker did not carry a tie-off adapter with which to establish a means to tie-off.

CAUSE OF DEATH

The coroner listed the cause of death as massive head injury due to fall from cellular tower.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should provide employees with a 100% fall protection system compatible with the work being performed, instruct employees in the proper use of the system and equipment, and ensure their use.

Discussion: In this incident, the employee was not using a personal fall-arrest system and no other fall-protection system was in place to protect him as he moved on the tower. Employers should provide employees with a 100% fall-protection system compatible with the tasks being performed, instruct workers in the proper use of the system and equipment, and ensure its use.

Fall-protection is defined as follows: Employees at risk of falling from work levels over 6 feet above the ground or working surface must be protected by some conventional means of fall protection,

which may include an integral fall-arrest system. This applies to ascending, descending, moving point-to-point, or any other tower construction or alteration-work activity conducted at an elevated work station. Employers should also require a minimum of three-point contact (two hands and one foot or two feet and one hand) at all times when employees are moving on the tower.

Fall protection for tower work is more easily provided when the employee is stationary and can tie-off at one location on the structure. When employees are required to move about on the tower, other means of fall protection are recommended, which can include, but are not limited to, the following: A split lanyard with connectors at each end large enough to completely encircle tower members to which they are to be attached (these large connectors may require a special order from a fall-protection equipment manufacturer as the throat opening must be large enough to encircle the member) or a split lanyard made of reinforced fabric. The reinforced lanyards can be looped around the tower member. The connector at the terminal end of each lanyard is snapped around the lanyard itself. Each of these split lanyards has a Y configuration, with the end of the Y attached to the D-ring at the center back (dorsal position) of the employee's full-body harness. The connector at the end of each forked lanyard is released and moved one at a time, as the worker moves on the tower. This may be the most feasible method for fall protection when moving horizontally on the tower. When there is an anchor point above the worker's head, a properly installed and used retractable lifeline or retractable lanyard may be considered.

An additional system should be in place to protect the worker while climbing the tower. There are several systems available that provide fall protection as the employee climbs the tower; examples include the use of a safety-climb device/system (metal cable equipped with a cable-grab device) installed on the tower leg and a rope lifeline attached at the tower top which hangs vertically and next to the safety-climb device/system. The worker attaches the front (sternal) D-ring on his harness to the cable grab device on the metal cable of the safety-climb device/system, using a connector. Additionally, a lanyard is used with the connector at one end snapped into the D-ring in the back of the worker's harness and the other end connected to a rope-grab device on the vertical rope lifeline. As the worker moves up the ladder, he reaches above his head and slides the rope grab up so that it remains overhead. Should the worker begin to fall, the grab will stop his fall in seconds.

The first person going up the tower is at greatest risk as there has been no vertical lifeline established. To ensure 100% fall

protection during the initial ascent, an anchor hook can be used to establish temporary anchor points. The anchor hook is attached to a telescoping pole to which a lifeline or retractable lanyard is attached. The retractable lanyard extends between the D-ring in the middle of the harness back and the anchor hook. If a lifeline is used, a rope grab travels on the rope and is attached to the center D-ring on the harness back. The other end attaches to the anchor hook. When the employee moves the hook, he must always be attached to the structure. Once he reaches the top of the structure he secures the lifeline to an anchor point and can then use the lifeline and rope grab for future climbs. Tie-off adaptors should be issued to each employee to allow them to establish an anchorage on the tower.

For more information regarding these and other available methods to achieve 100% fall protection, employers should consult with safety professionals and fall-protection-equipment sales representatives to learn more about systems available that meet their particular needs. Employers should keep in mind that when there are no specific OSHA regulations governing the safety of workers performing these tasks, the OSHA general duty clause (Public Law 91-596, Section 5 (a) (1) may apply¹.

Recommendation #2: Employers should provide workers with a proper work-positioning system, instruct workers in the proper use and limitations of the system, and ensure its use.

Discussion: A work-positioning system is required if a worker must be held in place while his hands are free to work. A positioning device system is defined as follows: a positioning device system means a body belt or body harness rigged to allow an employee to be supported on an elevated vertical surface, such as a wall, and work with both hands free while leaning. The system includes an anchor point, a belt or harness and a connecting device. Work-positioning systems are to be used only for the assistance for which they are designed, they must not be relied upon to provide fall arrest. In this incident, the employee was not equipped with a proper work-positioning system. The system the victim was using to tie onto the tower consisted of a ½-inch nylon-rope lanyard with a connector looped into the center of the lanyard and connectors on each end. Proper systems require that all connectors on the work-positioning equipment be installed properly at the time of manufacture and prohibits looping rope through the eye of a

¹General Duty Clause: Each employers shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or likely to cause death or serious physical harm to his employees.

connector as was done in this incident. The size of the connectors must be compatible with the members to which they must be connected and all connectors must be in working condition. Employers should provide a proper and effective work-positioning system, ensure its use and inform employees that a positioning system alone, does not provide 100% fall protection.

Recommendation #3: Employers should develop, implement, and enforce a comprehensive written safety program which includes a commitment to 100% tie off and written procedures to implement 100% fall protection.

Discussion: The evaluation of tasks to be performed at the work site forms the basis for development, implementation, and enforcement of a safety program. Key elements of such a program should include, at minimum, frequent and regular inspection of the work site and should include provisions for training employees in hazard identification, avoidance and abatement. The comprehensive safety program should include a clear statement indicating the employer's commitment to providing 100% fall protection, to preventing worker death and minimizing injury due to falls, and a commitment to meeting OSHA safety requirements, including the general-duty requirements. The fall protection plan should include, but may not be limited to, identification of worksite activities that require fall protection, any methods to be used to eliminate the fall hazard, all protective systems and PPE to be used for worker protection, training for workers, minimum standards for protection systems and their use, ongoing evaluation to correct any deficiencies in the system or in the use of the system by workers, a plan for worker involvement in identifying fall hazards, and a plan for systematic review of the plan.

Recommendation 4: Manufacturers of tower components and tower owners should consider installing fall-protection fixtures on tower components during fabrication or erection that would facilitate the use of fall protection.

There are fall protection fixtures that can be engineered into the tower design and added during component fabrication or erection that would facilitate the use of fall protection systems; for example, the installation of safety-climb devices/systems on all tower legs, the installation of permanent horizontal and vertical lifelines, and the installation of anchorage points. These and other methods should be researched and evaluated keeping in mind that employees will need to perform work on existing towers whenever services are to be changed or maintained.

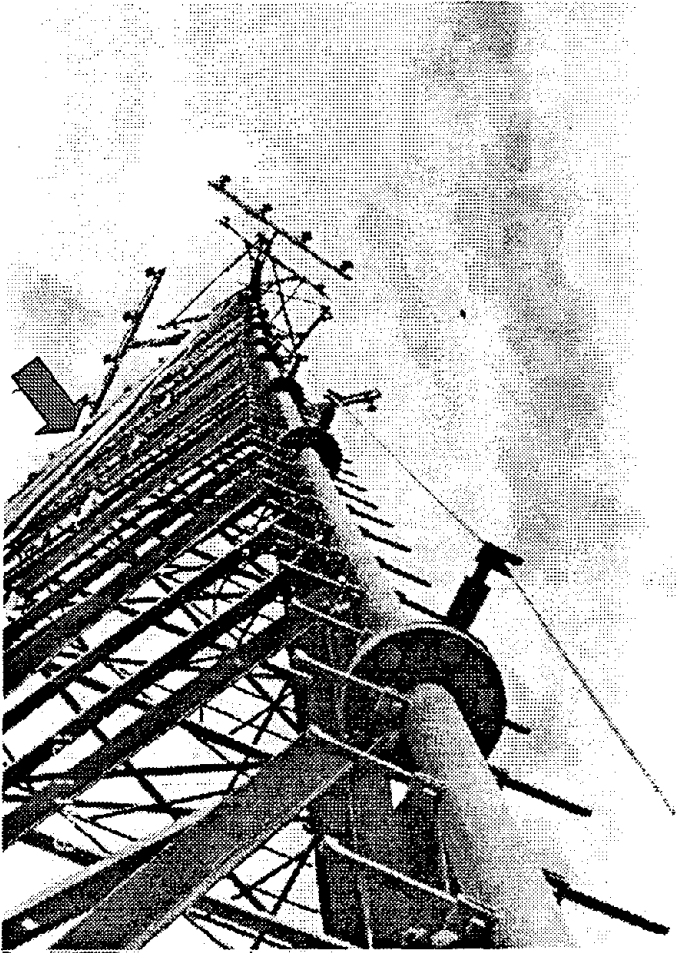
REFERENCES

Code of Federal Regulations 29 CFR 1910, 1997 edition. U.S. Government Printing Office, Office of the Federal Register, Washington, DC.

Public law 91-596, December 29, 1970, Occupational Safety and Health Act of 1970, Section 5(a)(1).

Figure 1

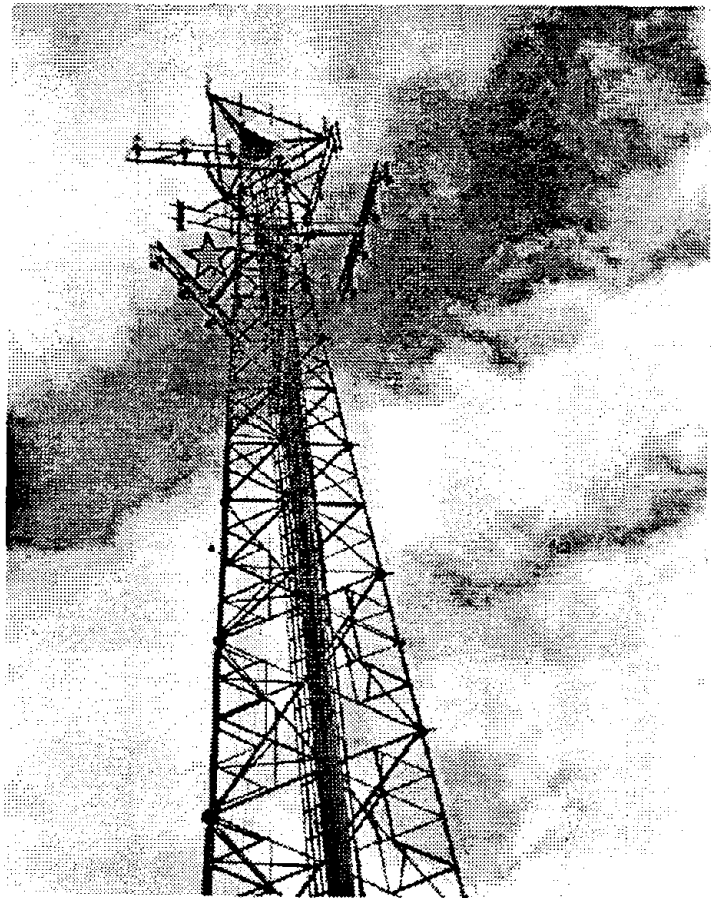
Safety-climb device/system on tower leg in foreground



The arrow indicates the approximate location of the victim just prior to his fall.

Figure 2

Victim's working position is marked with a ☆



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Fatality Assessment and Control Evaluation (FACE) Project

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatality Assessment and Control Evaluation (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.

States participating in this study: North Carolina, Pennsylvania, South Carolina, Tennessee, and Virginia.

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