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***NIOSH***

# ***ALERT***

**Preventing Injuries and Deaths  
from Falls during Construction and  
Maintenance of Telecommunication  
Towers**

DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health

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## Preventing Injuries and Deaths from Falls during Construction and Maintenance of Telecommunication Towers

### WARNING!

**Workers involved in construction and maintenance of telecommunication towers are at high risk of fatal falls.**

**WORKERS** should take the following steps to protect themselves from falls during tower construction and maintenance:

- Use 100% fall protection when working on towers at heights above 25 feet.
- Participate in all training programs offered by your employer.
- Follow safe work practices identified by worker training programs.
- Use OSHA-required personal protective equipment and make sure you are trained in its proper use.
- Inspect equipment daily and report any damage or deficiencies to your supervisor immediately.

**EMPLOYERS** should take the following steps to reduce the risk of worker injuries and deaths from falls during tower construction and maintenance:

- Comply with OSHA Compliance Directive 2-1.29.
- Ensure that hoisting equipment used to lift workers is designed to prevent uncontrolled descent and is properly rated for the intended use.
- Ensure that hoist operators are properly trained.

- Ensure that workers use 100% fall protection when working on towers at heights above 25 feet.
- Provide workers with a 100% fall-protection system compatible with tower components and the tasks to be performed.
- Ensure that gin poles are installed and used according to the specifications of the manufacturer or a registered professional engineer.
- Ensure that tower erectors are adequately trained in proper climbing techniques, including sustaining three-point contact.
- Provide workers with OSHA-required personal protective equipment and training in its proper use.
- Ensure that workers inspect their equipment daily to identify any damage or deficiencies.
- Provide workers with an adequate work-positioning device system. Connectors on positioning systems must be compatible with the tower components to which they are attached.
- Supplement worker training on safe work practices with discussions of FACE case reports.
- Know and comply with child labor laws that prohibit hazardous work by workers under age 18.

For additional information, see ***NIOSH Alert: Preventing Injuries and Deaths from Falls during Construction and Maintenance of Telecommunication Towers*** [DHHS (NIOSH) Publication No. 2001-156]. Single copies of the Alert are available free from the following:

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## Preventing Injuries and Deaths from Falls during Construction and Maintenance of Telecommunication Towers

### WARNING!

Workers involved in construction and maintenance of telecommunication towers are at high risk of fatal falls.

The National Institute for Occupational Safety and Health (NIOSH) requests assistance in preventing deaths and injuries from falls of workers during construction and maintenance of telecommunication towers. Recent NIOSH fatality investigations suggest that employers, supervisors, workers, tower owners, tower manufacturers, and wireless service carriers may not recognize or appreciate the serious fall hazards associated with tower construction and maintenance. As a result, they may not follow safe work practices for controlling these hazards. This Alert describes seven deaths resulting from falls during construction and maintenance of telecommunication towers. The Alert also includes recommendations for preventing similar incidents. The seven deaths were investigated by the NIOSH Fatality Assessment and Control Evaluation (FACE) Program.

### BACKGROUND

The widespread use of wireless communication services has resulted in the construction of telecommunication towers to

hold transmitting devices for cellular phones, personal communication services, and television and radio broadcast antennas. The Federal Communications Commission (FCC) estimates that at least 75,000 telecommunication towers have been constructed in the United States, and industry groups indicate that more than 1,000 telecommunication towers are erected each year [Chiles 1997]. The Telecommunications Act of 1996 (Public Law 104–104) is expected to promote more tower construction to meet the increased demand for wireless communication services [OSHA 1998].

Telecommunication towers may be of several types and range in height from 100 to 2,150 feet or more [OSHA 1998]. Three general forms of telecommunication towers are

- monopoles that consist of tapered steel tubes that fit over each other to form a stable pole,
- guyed towers that are stabilized by tethered wires, and
- self-supporting towers that are free-standing lattice structures (Figure 1).

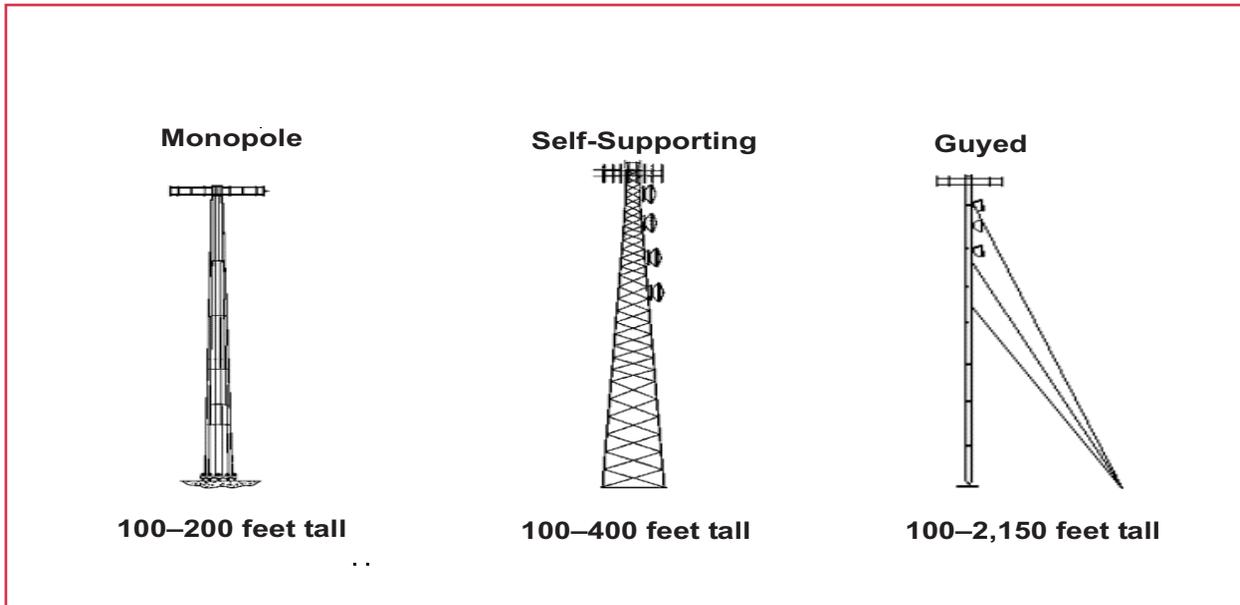


Figure 1. Tower types.

Telecommunication towers are generally manufactured as sections and constructed onsite by hoisting each section into place and bolting sections together. Some models of shorter towers are self-erecting. For most towers that are constructed onsite, cranes and gin poles attached to the tower being erected are generally used to hoist each section into place. A gin pole is a device unique to the telecommunication tower industry. The gin pole is used to raise successive sections of steel, equipment, or workers into position. This temporary lifting device uses cables and pulleys to allow enough head room to accommodate the length of the next tower section or equipment being installed (Figure 2).

The exact number of workers involved in tower construction and maintenance is unknown. Workers are categorized in a variety of occupational subgroups for which employment data are collected. These groups include communications workers, painters, steel erectors, and electrical and electronic equipment repairers. This type of work also occurs in several industrial subgroups such as the following:

- SIC<sup>\*</sup> 623—Water, sewer, pipeline, and communications and power line construction (subcategory—radio transmitting tower construction)
- SIC 1731—Electrical work (subcategory—telecommunications equipment installation)
- SIC 1791—Structural steel erection
- SIC 1799—Special trade contractors not elsewhere classified (subcategory—antenna installation, except household type)

In addition to telecommunication towers, transmitting devices for wireless communication services are often mounted on the roof perimeters of buildings, exposing workers to fall hazards. However, the mounting and maintenance of these devices on buildings require fall protection measures that are not addressed in this document.

<sup>\*</sup>Standard Industrial Classification (SIC) [OMB 1987].

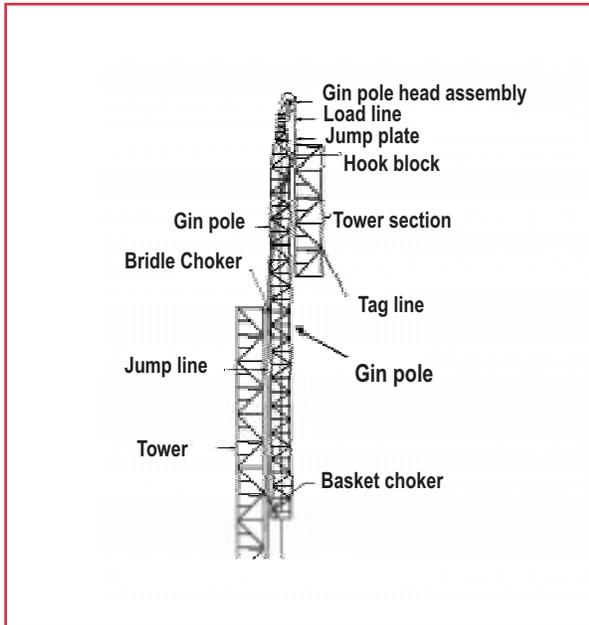


Figure 2. Gin pole attached to communication tower.

## FATALITY DATA

The Census of Fatal Occupational Injuries (CFOI) is a multisource data system maintained by the Bureau of Labor Statistics to identify work-related deaths in the United States. A NIOSH review of the CFOI data identified 118 deaths associated with work on telecommunication towers from 1992 through 1998. These deaths included 93 falls, 18 telecommunication tower collapses, and 4 electrocutions. However, the number of deaths identified here should be considered a minimum because identification methods are not exact [NIOSH 2000a].

Estimates vary greatly about the number of workers in telecommunication tower construction and maintenance. In 1993, estimates ranged from 2,300 to 23,000 workers in this field [OSHA 1998]. These estimates suggest fatality rates of 49 to 468 deaths per 100,000 workers—nearly 10 to 100 times the average rate of 5 deaths per 100,000 workers across all industries.

## CURRENT STANDARDS

### OSHA

The Occupational Safety and Health Administration (OSHA) safety standard for fall protection in the construction industry [29 CFR<sup>†</sup> 1926, Subpart M] excludes steel erection activities on nonbuilding structures such as towers. Subpart R of the OSHA fall protection standard in construction [29 CFR 1926] has a proposed effective date of September 18, 2001, and does not apply to transmission towers, communication and broadcast towers, and tanks.

### Compliance Directive

To address hazards associated with telecommunication tower construction and maintenance, OSHA formed a multiagency Tower Task Force in August 1997. The Task Force (with representatives from Regional and Federal OSHA offices, the Federal Aviation Administration, the U.S. Army Corps of Engineers, NIOSH, the U.S. Navy, and others) has worked with the National Association of Tower Erectors (NATE) to develop a compliance directive to protect workers from hazards in the tower construction industry.

The OSHA compliance directive (CPL 2–1.29, *Interim Inspection Procedures During Communication Tower Construction Activities*) became effective January 15, 1999 [OSHA 1999]. The directive addresses fall protection and safe tower access during construction. Specifically, the directive does the following:

<sup>†</sup>Code of Federal Regulations. See CFR in references.

- Establishes uniform policies and procedures for OSHA compliance officers when conducting inspections of towers under construction
- Describes best practices for use by the industry
- Requires telecommunication tower workers to maintain 100% fall protection when working 25 feet or more above the ground (this requirement applies to workers ascending, descending, or moving from point to point)
- Specifies procedures and allowable conditions under which workers may access the tower by “riding the line” (a practice in which workers are directly lifted up a tower by a hoist line):
  - Prohibits riding the line for work at heights less than 200 feet above the ground. Requires instead that workers access workstations at these heights using conventional methods such as climbing with fall protection or use of a personnel platform
  - Permits up to two tower erectors at a time to ride the line for work at heights more than 200 feet above the ground when (1) towers are erected with gin poles, (2) conditions preclude the use of a personnel platform, and (3) other conventional methods of climbing using a ladder or other approved climbing devices might create a greater hazard from fatigue or repetitive stress
- Specifies minimum requirements for allowing workers to be hoisted on the hoist line, such as the following:
  - Worker training
  - Use of hoisting equipment that has been approved, certified, and/or inspected by a registered professional engineer or other designated professional
  - Trial lift and proof-testing procedures
  - Pre-lift meetings
  - Documentation of procedures used
  - Continuous communication between hoist operator and workers being hoisted
  - Consideration of environmental conditions
  - Specifications and maintenance for hydraulic hoists and gin poles

### Addendum on the Use of Gin Poles

The OSHA Tower Task Force may develop an addendum to the OSHA compliance directive (CPL 2.129) or a new directive specific to the use of gin poles. Such a directive would draw on guidelines that already exist or are under development [NATE 1998, 1999]. For example, NATE has developed industry guidelines for the use of gin poles. In addition, the Telecommunications Industry Association/Electronic Industries Association (TIA/EIA) is developing a gin pole standard [TIA/EIA 2001]. OSHA is considering components from both the NATE gin pole guidelines and the TIA/EIA standard for use in any future compliance directive addressing gin poles.

At a minimum, any future directive on gin poles would require that a registered professional engineer’s drawing be available at the site. The drawing must

- show the gin pole and its track (if any) and indicate lifting capacity and the manner of attachment to the tower,
- indicate track attachment to at least two places (top and bottom), and
- indicate how high the gin pole can be raised above its uppermost attachment to the tower.

In addition, any future directive would require inspection records, documented worker training, and an anti-two block device (a device that prevents contact between the lower load block or hook assembly and the gin pole head assembly).

### Fair Labor Standards Act and Youth Employment

The Fair Labor Standards Act (FLSA) [29 USC<sup>‡</sup> 201 et seq.] includes work declared hazardous for youth by the Secretary of Labor. Hazardous Order No. 7 *Power Driven Hoisting Apparatus Occupations* prohibits workers under age 18 from work in all occupations involved in the operation of a power-driven hoisting apparatus, including riding on a manlift. The Act defines the term *manlift* as “a device intended for the conveyance of persons which consists of platforms or brackets mounted on, or attached to, an endless belt, cable, chain, or similar method of suspension; such belt, cable, or chain operating in a substantially vertical direction and being supported by and driven through pulleys, sheaves, or sprockets at the top and bottom.”

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<sup>‡</sup>United States Code.

## CASE REPORTS

The cases presented here were investigated by the NIOSH FACE Program. The goal of this program is to prevent occupational fatalities across the Nation by (1) identifying and investigating work situations that involve high risk for worker injury and (2) formulating and disseminating prevention strategies.

### Case 1

On December 3, 1999, the 40-year-old owner of a tower-painting company, his 16-year-old stepson, and a 19-year-old employee died after falling 1,200 feet to the ground. The company had been at the site for 2 weeks repairing the beacon light at the top of a 1,500-foot radio broadcast tower, painting the tower, and installing rest platforms. On the day of the incident, the owner had planned to work on the beacon light at the top of the tower while the other two workers continued painting the tower. A 3,000-foot length of ¾-inch nylon rope and a 1,000-pound-capacity portable electric capstan hoist were used to raise the workers up the outside of the tower. Three loops were tied into the hoist line approximately 6 feet apart. The workers used these loops to help them ride the hoist line. The stepson was first on the line, followed by the 19-year-old, and then the company owner. Using a length of woven rope, the workers had attached one of the rest platforms to the end of the nylon rope 62 inches below the last loop. The company owner’s wife was operating the capstan hoist using a foot pedal located on the ground. As the wife was hoisting the workers up the side of the tower, the hoist line began to slip around the capstan. The wife was unable to hold the rope and the workers fell to the ground. The hoist used in this

incident was not manufactured or rated for lifting people. In addition, the load was likely to have exceeded the lifting capacity of the hoist [NIOSH 2000b].

## Case 2

On December 8, 1998, a 21-year-old male tower erector died after sliding approximately 1,000 feet down a supporting guy wire. The victim and coworkers were attaching dampeners to the tower guy wires when the incident occurred. The tower being constructed was a 1,040-foot, high-definition digital television tower. When the incident occurred, the victim was at the 1,000-foot level and was wearing a positioning safety belt with a T-bar attached to the D-rings on his belt. Attached to one end of the T-bar was an adjustable-length lanyard with a large hook as its terminal device. Attached to the other end of the lanyard was a large hook. The victim placed the large hook over the guy wire but did not attach the adjustable lanyard to the tower before sliding out on the guy wire. Although he had one foot draped over the wire, he could not keep himself from sliding. The victim slid rapidly down the wire, striking the anchor point of the guy wire. He was pronounced dead at the scene [Missouri FACE 1998].

## Case 3

On November 13, 1998, a 41-year-old male tower erector fell 240 feet from a 260-foot telecommunication tower while attempting to install a new phone service device on the tower. The victim and a coworker attached their lanyards to the cable climb positioned on one leg of the tower and climbed to the 240-foot level of the tower. The owner and a third tower erector remained on the ground. Both workers wore two 6-foot lanyards attached to the

side D-rings on their body harnesses. The terminal devices on the coworker's lanyards were two large pelican hooks. The terminal device on one of the victim's lanyards was a large pelican hook, but the other lanyard had a smaller snaphook as a terminal device. The victim began to attach a coaxial phone cable to an antenna arm while the coworker, with his back to the victim, was attaching cable tray components to the tower. A short time later, the victim fell, unwitnessed, from the tower to the ground. The coworker stated that two pelican hooks were necessary because the smaller snaphook could not be attached to the larger tower components [NIOSH 1999].

## Case 4

On July 16, 1998, a 23-year-old male tower erector died after falling 200 feet from a telecommunication tower while attached to an 80-foot section of cable tray. He was a member of a nine-man crew erecting a 240-foot, three-sided telecommunication tower. The crew bolted a 140-foot section of the tower together on the ground. Next this section was set in place by a crane. The workers then erected the final 100-foot section on the ground, and three tower erectors climbed the 140-foot section. The final section was set in place by the crane, and the workers bolted the two sections together. The crane then lifted an 80-foot section of cable tray to the top of each side of the tower. As each section was lifted into place, an erector began to attach it to the tower using four J bolts every 10 feet. The victim began working down the tower, attaching the cable tray and tightening all bolted connections as he descended. After approximately 1 hour, the victim was at the 200-foot level of the tower. The victim then repositioned himself and connected both of his lanyards to

the partially attached cable tray. Shortly thereafter, the section of cable tray gave way, falling to the ground with the victim attached [NIOSH 1998a].

## Case 5

On December 8, 1997, a 32-year-old male tower erector was working with a crew of two others on a 160-foot cellular phone tower. The crew had completed the tower erection and was in the process of lowering the gin pole (the lifting device used to hoist tower sections into place) to the ground. The tower erector had removed two choker cables securing the upper section of the gin pole to the tower and was attempting to ride the hoist cable down to the two lower chokers. The terminal device on the victim's lanyard was a pelican hook with a 4-inch-wide by 7¼-inch-long interior opening. The terminal device on the hoist cable was a 3-inch clevis. Either the victim tried to hook to the cable and missed or the larger opening of the pelican hook on his lanyard slipped off the hoist cable. He fell 130 feet to the ground [NIOSH 1998b].

## CONCLUSIONS

These incidents suggest that employers, workers, tower owners, tower manufacturers, and wireless service carriers may not fully appreciate or recognize the serious hazards associated with the construction and maintenance of telecommunication towers and the need to follow safe work procedures that include the use of 100% fall protection.

FACE investigations identified the following contributing factors in fatal falls from telecommunication towers:

- Hoist failure

- A hoist that is not rated to hoist workers
- Truck-crane failure
- Inadequate fall protection
- Failure to attach the lanyard to the tower
- Terminal devices on the lanyard that are not compatible with tower components
- Attachment of lanyard to unstable tower components
- Failure to ride the line under prescribed conditions
- Inadequate worker training
- Potential fatigue and repetitive strain

Failure by employers, workers, tower owners, tower manufacturers, and wireless service carriers to address these factors could result in future fatalities.

## RECOMMENDATIONS

NIOSH recommends that employers and workers comply with OSHA directives, maintain equipment, and take the following measures to prevent injuries and deaths when constructing or maintaining telecommunication towers.

### Employers

Employers should take the following steps to reduce the risk of worker injuries and deaths during tower construction and maintenance:

- Comply with OSHA Compliance Directive 2–1.29 *Interim Inspection Procedures During Communication Tower*

*Construction Activities.* OSHA inspectors use these guidelines in tower inspections. Employers should ensure that workers follow these guidelines.

- Ensure that hoisting equipment used to lift workers is designed to prevent uncontrolled descent and is properly rated for the intended use.
- Ensure that hoist operators are properly trained.
- Ensure that workers use 100% fall protection when working on towers at heights above 25 feet.
- Provide workers with a 100% fall-protection system compatible with tower components and the tasks to be performed.
- Ensure that gin poles are installed and used according to the specifications of the manufacturer or a registered professional engineer.
- Ensure that tower erectors are adequately trained in proper climbing techniques, including sustaining three-point contact.
- Provide workers with OSHA-required personal protective equipment and training in its proper use.
- Ensure that workers inspect their equipment daily to identify any damage or deficiencies.
- Provide workers with an adequate work-positioning device system. Connectors on positioning systems must be compatible with the tower components to which they are attached. (Note that a work-positioning device system does not constitute 100% fall protection.)

- Supplement worker training on safe work practices with discussions of FACE case reports to help assure that workers fully appreciate the serious hazards involved with their tasks and the need for strict safe work practices.
- Know and comply with child labor laws that prohibit hazardous work by workers under age 18. An example of hazardous work is any task involving power-driven hoisting apparatus.

## **Tower Owners and Manufacturers**

Tower owners should take the following steps:

- Use contracts requiring that workers adhere to OSHA-required safety measures (including Compliance Directive 2–1.29) while construction or maintenance is being performed on your towers.
- Require contractors to have a formal safety and health program relating to tower construction and maintenance.
- Include a provision in your contracts for frequent and regular jobsite inspections by a competent person who has expertise in tower erection and worker fall protection.

Both manufacturers and tower owners should install fall-protection fixtures for workers to use as anchor points on tower components during fabrication or erection.

## **Workers**

Workers should take the following steps to protect themselves during tower construction and maintenance:

- Use 100% fall protection when working on towers at heights above 25 feet.
- Participate in all training programs offered by your employer.
- Follow safe work practices identified by worker training programs.
- Use OSHA-required personal protective equipment and make sure you are trained in its proper use.
- Inspect equipment daily and report any damage or deficiencies to your supervisor immediately.

## ACKNOWLEDGMENTS

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Dr. Nancy A. Stout, Director  
 Division of Safety Research  
 National Institute for Occupational Safety and Health  
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 Morgantown, West Virginia 26505-2888  
 Telephone: 304-285-5894

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