FACE Fatality Assessment and Control Evaluation Program

NIOSH • 1095 Willowdale Road, Morgantown, West Virginia 26505 • 304-285-5916

REPORT#: 2015-02 **REPORT DATE:** May 28, 2019

Two Tower Climbers Fatally Injured When a Cellular Tower Collapsed While Performing Tower Upgrades – West Virginia.

INCIDENT HIGHLIGHTS

DATE:
February 1, 2014

TIME:
11:37 a.m.

VICTIM:
27-year old tower climber

32-year old tower climber

INDUSTRY/NAICS CODE:
Communication Tower/23

EMPLOYER:
Communication tower servicing. 15 employees, 6 working at the incident location

SAFETY & TRAINING:
Employer conducted training on tower climbing and rescue. Weekly safety meetings on various topics

SCENE:
Site covered more than 2.5 acres on top of a hill

LOCATION:
West Virginia

EVENT TYPE:
Tower collapse

SUMMARY

On February 1, 2014, at approximately 11:37 am, two tower climbers were fatally injured when a 340-foot, Rohn 80 series cellular tower collapsed during upgrading/construction activities. Four employees were working on the tower removing diagonal tower supports and no temporary supports were installed. As a result, the tower collapsed and two employees were killed and two others were injured.... READ THE FULL REPORT> (p.3)

CONTRIBUTING FACTORS

Key contributing factors identified in this investigation include:

- Removal of multiple support structure braces of the tower before reinforcing the tower's structural integrity
- Lack of engineering analysis
- Lack of rigging plan LEARN MORE> (p.9)

RECOMMENDATIONS

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

- Consult with an engineer to conduct a structural analysis
- Develop a written rigging plan
- Provide employees with training on hazard recognition
- Conduct a job hazard analysis (JHA)
- Train communication tower employees on the proper use of tower climbing anchor points and fall protection equipment LEARN MORE> (p.9)

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 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 rule making, 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).

Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

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SUMMARY

On February 1, 2014, at approximately 11:37 am, two tower climbers were fatally injured when a 340-foot, Rohn 80 series cellular tower collapsed during upgrading/construction activities. Four employees were working on the tower removing diagonal tower supports and no temporary supports were installed. As a result, the tower collapsed and two employees were killed and two others were injured. The tower fell onto the guy wires of an adjacent smaller cell tower and caused it to collapse, also killing a firefighter while he was attempting to rescue the injured employees on the ground. The collapse of the smaller tower is not covered in this report, but further information can be found in the NIOSH report F2014-03 [NIOSH 2014].

INTRODUCTION

On February 1, 2014, a Rohn, series 80, cellular tower collapsed while four tower climbers were completing renovations on the tower. On January 15, 2015, a safety and occupational health specialist from the NIOSH Division of Safety Research, and a guest researcher from the West Virginia University Occupational Medicine Residency Program met with the area director of the West Virginia Occupational Safety and Health Administration (OSHA) and reviewed the circumstances of the incident. Photos from the incident site, witness statements, and the medical examiner's report were provided to NIOSH.

EMPLOYER

The employer has been in business since 2000 and provides services across the nation to the telecommunication industry, such as, cell tower upgrades and tower erection. The company employs approximately 15 employees, 6 working at the location of this incident. The towers were inspected in May 2013, and the company was hired to conduct maintenance and perform upgrades.

WRITTEN SAFETY PROGRAMS and TRAINING

Prior to the fatal incident, the employer conducted training for employees related to tower climbing and rescue. The foreman conducted weekly safety meetings on various topics; a test was given to the employees in the form of a multiple choice and/or true and false format. Examples of topics covered are: Fall Prevention, Site Security, Hearing Protection, and Crane Safety. Some employees received certification in first aid/CPR, OSHA 10 hour, and Radio Frequency (RF) Site Safety Awareness. The employer did not have a written rigging plan as required by the communication tower industry standard [OSHA 2017].

As a corrective action after this fatal incident, a third-party organization conducted a much more in-depth training on Tower Climbing Safety and Rescue. The training included sessions to review both proper anchor points and proper connection to those points, along with methods of creating an acceptable anchor point if none existed.

WORKER INFORMATION

Tower Climber #1 was 27 years old. He had been with the company for 11 months as a tower climber. He was removing diagonal tower supports on a 60–80-foot section of the tower when the tower collapsed.

Tower Climber #2 was 32 years old. He had been with the company for 9 years as a tower climber. He was fitting a new leg stiffener to the leg of the tower on the 20–40-foot section of the tower when it collapsed.

On January 27, 2014, both employees completed a daily inspection sheet on fall protection climb belts, harnesses, and hardware.

This was the first day of working on this tower for both employees. The employees had been removing diagonal bracing from the tower for approximately 2–3 hours before the tower collapsed at 11:37 am.

INCIDENT SCENE AND TOWER DESCRIPTION

The site covered more than 2.5 acres on top of a hill. The site contained two cell phone towers and three structures that housed electrical components and a generator to support the operation of the cell phone towers. The towers were located at the end of a dirt and partially graveled road.

Tower 1 was 340 feet tall and triangular in shape. Each tower leg consisted of 2-inch-diameter steel pipes that were 41 inches apart, connected with diagonal support braces (approximately 3 foot 10 inches) forming the shape of a triangle. The tower was secured with guy wires connecting it to the ground by concrete anchor blocks. The guy wires were attached to Tower 1 at elevations of 80 feet, 160 feet, 240 feet, and 320 feet. Tower 1 was the first tower to collapse.

The second tower was much smaller and located beside the larger tower. Tower 2 consisted of three sides approximately 16 inches wide and three round legs fastened together with a continuous 3/8-inch solid bar welded to the legs in a diagonal pattern along its entire 312-foot height. Tower 2 was also secured with guy wires attached to it and to the ground by concrete anchor blocks. During the collapse of Tower 1, the top portion of Tower 2 also collapsed, most likely from some of the guy wires on Tower 1 contacting the top of Tower 2 and pulling it to the ground. Note: the collapse of the smaller tower is not covered in this FACE investigation report. The 2nd tower collapse is covered in NIOSH F2014-03 [NIOSH 2014].

Six employees were at the site the day of the incident. Four employees were on Tower 1 when it collapsed, and a foreman was on the ground with a worker who was cutting sections to replace the diagonal support bracing that was removed. Three employees were removing diagonal supports on the tower at 60–80 feet, one on each face of the tower, and one employee was replacing a tower leg at 20–40 feet up on the tower. The foreman was on the ground giving instructions to his employees.

A tower inspection was last completed on May 6, 2013. The results of the inspection found 34 improvement recommendations for Tower 1. The employer was hired to modify the cellular tower and components for the improvements such as the replacement of tubular bracing with stronger steel angles.

WEATHER

The weather was clear with an approximate temperature of 35 degrees Fahrenheit (F) when the incident occurred [Weather Underground 2014]. Winds were recorded at less than 2 mph at the time of the tower collapse. It was 26 degrees the night before, and snow was on the ground from a previous snow storm. Weather does not appear to be a contributing factor in this incident.

INVESTIGATION

On February 1, 2014, a Rohn, series 80, cellular tower collapsed while four tower climbers were working on the tower. Three tower climbers were removing diagonal support bracing (3 foot 10 inches) (Photo 1) from the 60–80-foot section while a fourth worker was at the 20–40-foot section examining the legs and test-fitting a section of the leg stiffener to the tower leg to make sure the materials they had were appropriately sized. Another worker was on the ground, cutting sections of the bracing to length to replace the diagonal bracing that was removed. In addition, the foreman was located on the ground, communicating by radio and shouts to the employees on the tower.

Photo 1. One of five diagonal support braces (3 foot 10 inches) that were removed from Tower 1.
(Photo courtesy of WV OSHA)

The three employees on the 60–80-foot section of the tower removed eight bolts (Photo 2) and five diagonal angle support braces: two angles from the A-B face, two angles from the C-B face, and one angle from the A-C face. The removal of the eight bolts also disconnected one end of the other diagonal bracing section on the tower. At each welded lug of the tower leg, one bolt connected two diagonal support braces. One diagonal had two holes for connection, one at each end. Removing one bolt would disable two diagonal support braces, although they would still be connected to the tower at the other ends (Figure 1). Because of this, 6 diagonal angle braces were weakened in addition to the 5 that were completely removed from the structure. The diagonals were removed without installing any temporary supports to offset the structural weakening of the tower.

Photo 2. One of the eight bolts removed from Tower 1.
(Photo courtesy of WV OSHA)

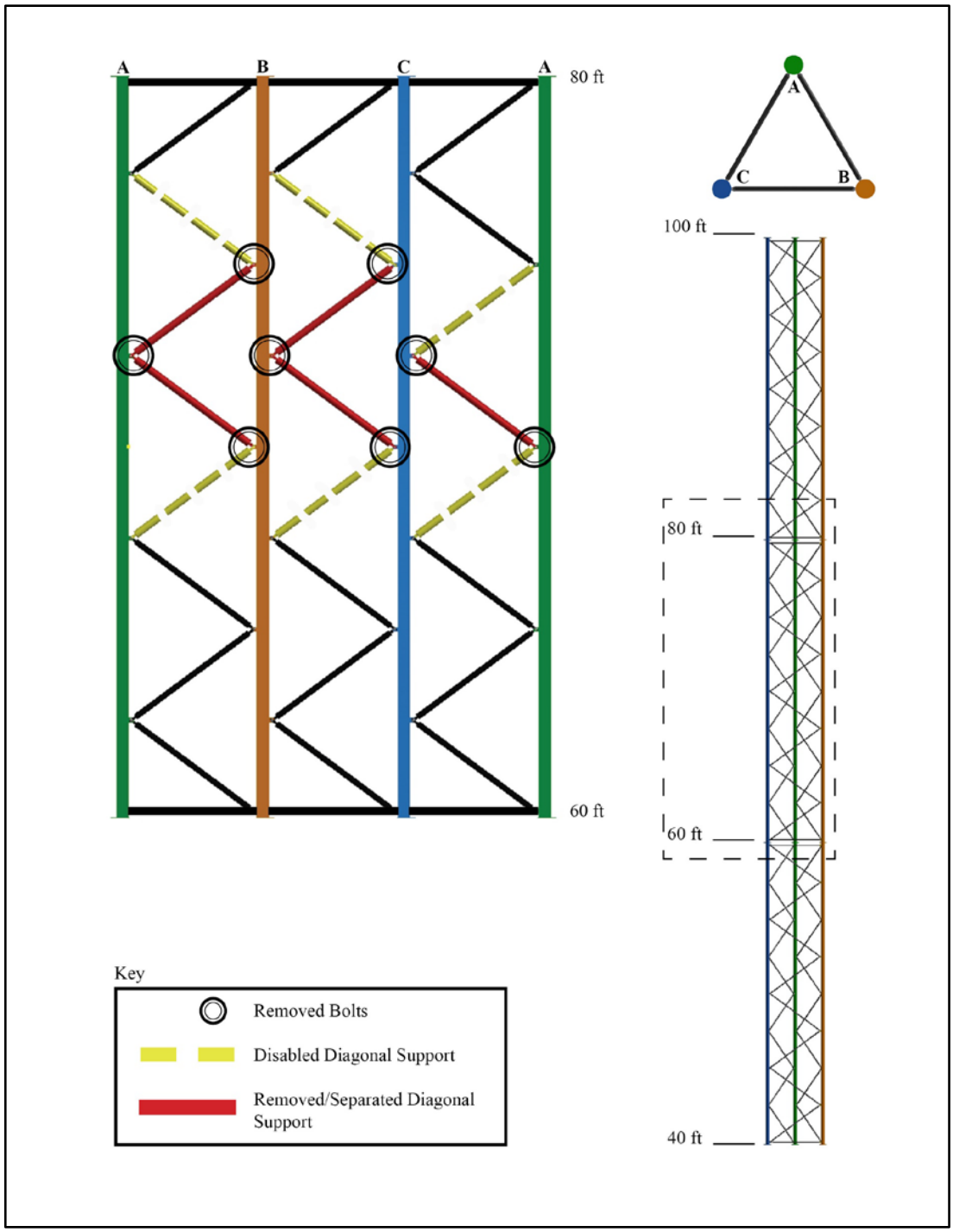

Figure 1. Section of Tower 1 shown with removed bolts and diagonal support braces.

At approximately 11:37 am, the Tower 1 collapsed. As Tower 1 fell, it contacted guy wires to Tower 2, causing it to become unstable. Tower 1 fell to the ground, with a section of the tower landing on the top of the small building on the site (Photo 3). The 4 workers on the tower were thrown to the ground, resulting in crushing and impalement traumatic injuries to each of the workers. Two employees died either instantly or within a few seconds from injuries sustained from the tower collapse. The other two employees were sent to the hospital and subsequently recovered. In addition, a fire fighter was fatally injured while trying to rescue one of the injured tower climbers when the weakened Tower 2 collapsed [NIOSH 2014].

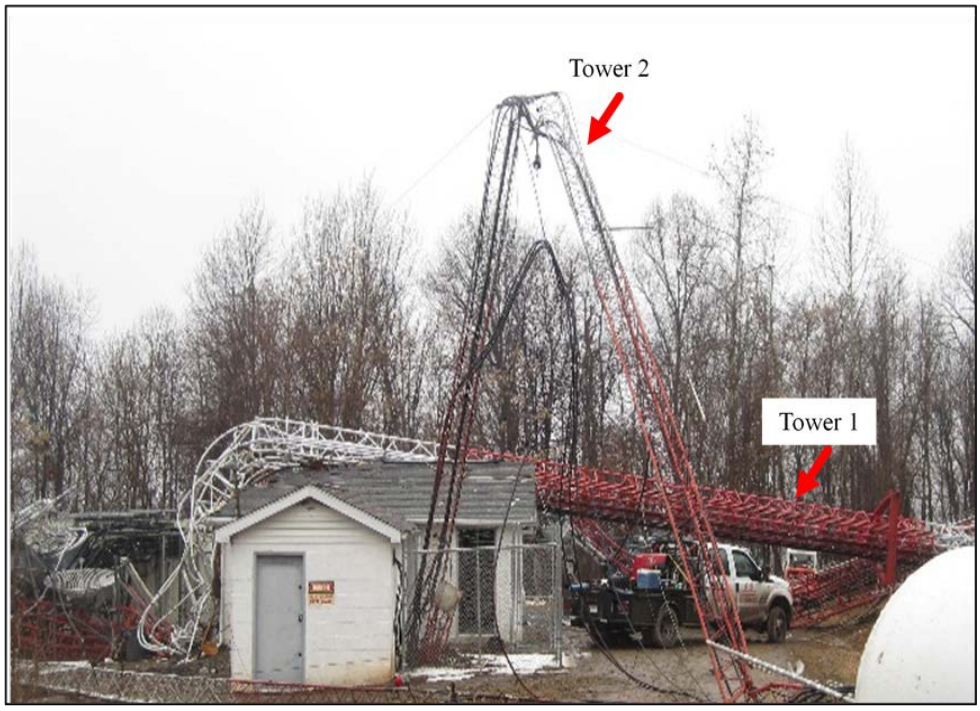

Photo 3. Incident scene of the two towers
(Photo courtesy of WV OSHA)

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 unrecognized hazards as key contributing factors in this incident:

- *Removal of multiple structural support braces of the tower without reinforcing the tower's structural integrity*
- *Lack of engineering analysis*
- *Lack of rigging plan*

CAUSE OF DEATH

The medical examiner listed the cause of death as major body trauma for both tower climbers.

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RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should consult with a qualified engineer to conduct a structural analysis before workers are assigned any tasks related to tower maintenance or upgrading.

Discussion: Employers should consult with a qualified engineer to conduct a structural analysis before workers are assigned any tasks related to tower maintenance and upgrading. A structural analysis will give an employer very detailed data to determine when an object such as a beam, connection, or in this case, a tower may collapse. According to ANSI A10.48 – 2016, a qualified engineer is responsible for designing permanent or temporary fall protection systems on a communication structure and will be knowledgeable and experienced with this standard [ANSI, ASSP 2016]. In this case, the employees were removing multiple diagonal structural members, and were not using any temporary braces or supports. They stated they had never heard of anyone using temporary bracing when doing this type of work on communication towers. Employers should not do any work on towers until a thorough structural analysis is completed by a qualified engineer. The structural analysis should be used when completing a daily Job Hazard Analysis (JHA). Once the structural analysis is completed, employees will be able to create a more accurate JHA since they will then have a better understanding of how they will complete tasks that day.

Recommendation #2: Employers should develop a written rigging plan based on the guidelines established in American National Standards Institute/Telecommunication Industry Association (ANSI/TIA -1019-A-2012).

Discussion: Employers should develop a written rigging plan following the guidelines established in ANSI/TIA-1019-A 2012 Standard for Installation, Alteration and Maintenance of Antenna Supporting Structures and Antennas. ANSI/TIA-1019-A-2012 details the construction sequence and procedures for the removal or reinforcing of structural members. ANSI/TIA-1019-A, 2.7 Temporary Supports states: “The potential for partial or complete collapse of a structure may exist when constructing, dismantling or altering structural components of a structure. A procedure defining critical steps in the process shall be provided and followed by the rigging crew during all phases of the work. Such a procedure shall take into consideration temporary reinforcing of members to support the structure while structural components are disconnected or altered” [ANSI, TIA 2012].

The National Association of Tower Erectors (NATE) outlines the minimum level of responsibility needed to evaluate a job based on the complexity of construction, using various construction classes defined in ANSI/TIA-1019-A (Table 1) [NATE 2013]. The least complex classes are defined as Class I and the most complex as Class IV. Once the rigging class has been determined, the qualified person creates a rigging plan that is based on the statement of work, structure, and safety requirements [ANSI, TIA 2012]. A rigging plan is a set of procedures and techniques that may include a requirement for temporary supports to complete the transformation of the existing structure into the modified structure [ANSI, TIA 2012]. ANSI/TIA-1019-A-2012 identifies diagonals as structural members [ANSI, TIA 2012], with the removal of a structural member falling under the Class IV Construction Classification, which establishes a minimum level of responsibility to a “qualified person with qualified engineer” [NATE 2013].

Class	Description	Minimum Level of Responsibility
I	The scope of work does not affect the integrity of the structure and the proposed rigging loads are minor in comparison to the strength of the structure, but not exceeding rigging forces greater than 650 lbs.	Competent Rigger
II	The scope of work involves the removal or the addition of appurtenances, mounts, platforms, etc. that involve minor rigging loads in comparison to the strength of the structure, but not exceeding rigging forces greater than 1,000 lbs.	Competent Rigger
III	Rigging plans that involve work outside the scope of Class I, II, or IV construction.	Qualified Person
IV	The scope of work involves custom or infrequent construction methods, removal of structural members or unique appurtenance, special engineered lifts, and unique situations.	Qualified Person with Qualified Engineer

Table 1. National Association of Tower Erectors (NATE) Construction Classifications and Minimum Level of Responsibility recommendations.

A competent rigger is defined as a person knowledgeable and experienced with the procedures and equipment common to the communication structures industry and trained to identify hazards with authorization to take prompt corrective measures. A qualified person is a person knowledgeable and experienced in the communication structures industry capable of developing rigging plans and who has successfully demonstrated the ability to coordinate construction related to the communication structures industry. A qualified engineer is a professional engineer who is knowledgeable and experienced in the communication structures industry [ANSI, TIA 2012].

After the incident, ANSI A10.48 – 2016 was released. This version of the standard states that all construction, including maintenance and hoist activities, shall have a rigging plan classification outlining the project and responsibilities within that project [ANSI, ASSP 2016]. Depending on the classification of the construction type, a qualified person will assign a competent rigger to ensure the proper procedures, equipment, and rigging are used for the operation [ANSI, ASSP 2016]. At a minimum, the rigging plan will consider operational and non-operational loads, construction equipment, supporting structures, construction sequence and duration, and required load testing and field monitoring [ANSI, ASSP 2016].

In this incident, ANSI/TIA-1019-A-2012 was not followed: No written rigging plan was established showing the manner, sequence, and number of diagonals to be removed at a time; no temporary supports were provided when removing structural members; and no qualified engineer, qualified person, or competent rigger were identified.

Recommendation #3: Employers should provide employees with training on hazard recognition and prevention.

Discussion: Employers should provide employees with training on hazard recognition and prevention before they begin work on a communication tower construction or maintenance job site [OSHA 2017]. Employees should be well educated

on the potential dangers that come with their industry. Moreover, in an industry such as communication tower maintenance/construction, employees should be trained to be on the lookout for hazards since their worksite and environment can change dramatically throughout a year. Employers should also give refresher training to employees on new industry standards and update company policy and procedures periodically [OSHA 2017].

In this incident, the employer did not have any formal rigging plan in place on the day of the incident.

Recommendation #4: Employers should conduct a job hazard analysis (JHA) and develop standard operating procedures to be followed for each tower climb where workers are assigned tasks.

Discussion: OSHA recommends that a thorough JHA be completed before employees begin work at a location [OSHA 2010]. It is recommended a JHA be performed every day on-site and when jobsite conditions change, such as weather. Multiple JHAs might need to be performed in 1 day in order to make employees aware of new hazards. A JHA can include environment, exposure, and consequence. The JHAs should include management, supervisors, and employees in order to allow everyone who is on the worksite to be involved with the JHA and be aware of the hazards associated with tasks and the preventative measures necessary to avoid those hazards [OSHA 2017].

A comprehensive JHA can identify specific risk factors. Standard operating procedures should be developed based on the results of the JHA to control and reduce the risk and ensure worker safety [OSHA 2010].

In this incident, no JHA was completed for the jobsite. The fatal incident occurred the first day the employees were working on the tower. A JHA could have made the employees more aware of the hazards they faced for their work day.

Recommendation #5: Employers should train communication tower employees on the proper use of tower climbing anchor points and fall protection equipment.

Discussion: Employers should train employees on the proper use of tower climbing anchor points and fall protection equipment [NIOSH 2001]. Although not directly related to the cause of the tower collapse, the employer had not done any type of engineering test to determine what the appropriate anchor points would be for employees while climbing on the tower. Employers need to first understand what acceptable anchor points are while on the tower and then train employees on those acceptable anchor points. According to ANSI A10.48 – 2016 (written after the incident), anchorages need to be identified at all transition points prior to ascending the structure [ANSI, ASSP 2016]. Ultimately, the fall protection was not a major contributor to the fatalities in this incident, but the fall protection requirements by the employer did not meet OSHA regulations on anchor points defined under 29 CFR 1926.502(d)(15). At a minimum, fall protection training needs to cover regulations and standards, employer responsibilities, fall protection hierarchy, primary and secondary connections, anchorages, anchorage connectors, full body harnesses, and energy absorbing lanyards [Code of Federal Regulations 2016].

After this fatal incident, the employer conducted an in-depth training with a third-party organization and employees earned Tower Climbing Safety and Rescue Certifications. Training included sessions to review proper anchor points and connection, along with methods of creating acceptable anchor points if none existed.

REFERENCES

ANSI, ASSP [2016]. ANSI/ASSP A10.48-2016 Criteria for Safety Practices with the Construction, Demolition, Modification and Maintenance of Communication Structures. Washington, DC: American National Standards Institute. Alexandria, VA: https://webstore.ansi.org/Standards/ASSE/ANSIASSEA10482016.

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ADDITIONAL RESOURCES

The National Association of Tower Erectors (NATE) is a non-profit trade association in the wireless and broadcast infrastructure industries providing a unified voice for tower erection, maintenance and service companies. NATE offers a vast array of educational videos and resources. The NATE website is available at: https://natehome.com/

The US Department of Labor Safety and Health Topics Page for Communication Towers is available at: https://www.osha.gov/doc/topics/communicationtower/. The website provides highlights with links to many communication tower resources such as Communication Tower Best Practices.

OSHA News Release: 14-198-NAT. No more falling workers. OSHA focuses on protecting cell tower employees after increase in worksite fatalities. https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=NEWS_RELEASES&p_id=25593

OSHA [2014]. Investigation of the February 1, 2014 Collapse of a Telecommunication Tower at the Summit Park Community in Clarksburg, WV. Rev. Washington, DC: Occupational Safety and Health Administration, https://www.osha.gov/doc/engineering/pdf/2014_r_06.pdf. Directorate of Construction [July 2014].

INVESTIGATOR INFORMATION

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