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REPORT#: 2019-01 **REPORT DATE: July 29, 2021**

City Electric Maintenance Worker Electrocuted While Installing Lines for Security Cameras – Ohio

INCIDENT HIGHLIGHTS

DATE:
June 17, 2019

TIME:
1:28 p.m.

VICTIM:
48-year old electric maintenance worker

INDUSTRY/NAICS CODE:
Services/81

EMPLOYER:
City

SAFETY & TRAINING:
Comprehensive safety training program

SCENE:
Residential street

LOCATION:
Ohio

EVENT TYPE:
Electrocution

SUMMARY

On June 17, 2019, a 48-year-old city electric maintenance worker was electrocuted while installing lines for security cameras. The electric maintenance worker arrived at the work site and was instructed to run approximately 2,000 feet of triplex service wire for police surveillance cameras on the light poles along a residential street. READ THE FULL REPORT> page 3

CONTRIBUTING FACTORS

Key contributing factors identified in this investigation include:

- Proximity to energized power lines
- Placement of elevated bucket truck and pole
- Lack of lone/remote worker assignment safety assessment
- Lack of hazard identification and situational awareness
- LEARN MORE> page 9

RECOMMENDATIONS

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

- Determine appropriate safety distances while working near electrical hazards prior to assigning work
- Develop, implement, and train on hazards, safety, and communication plans for lone workers
- Provide competent and qualified person training to enable workers in high risk occupations to assess routine and non-routine job tasks…. LEARN MORE> page 10

FACE IT: 2019-01 REPORT VISUAL EXTENSION

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).

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SUMMARY

On June 17, 2019, a 48-year-old city electric maintenance worker was electrocuted, while installing lines for security cameras along a residential area cul-de-sac. The electric maintenance worker arrived at the city workshop at 7 am and was instructed to install approximately 2,000 feet of triplex service wire on the light poles along a residential street for police surveillance cameras. The electric maintenance worker arrived at the work site at 10:24 am, with 2,000 feet of triplex service wire on a roll and placed the boom truck under light pole #1. He proceeded to install the triplex service wire on the first light pole connecting to light pole #2. According to a GPS tracker in the elevated bucket truck, the electric maintenance worker turned the elevated bucket truck around and drove up the street to position the truck in front of a newly placed camera pole. The 1,300 volt electric power lines running to the housing development were adjacent to the newly placed camera pole and beyond these lines were 3-phase 7,200 volt power lines. The electric maintenance worker got in the basket and raised it to approximately 28 feet. He began pulling some triplex service wire and installing it on the security pole. It is believed the worker did not realize his proximity to the power lines while performing this task and contacted his right shoulder with the energized power line. At 1:32 pm 911 was contacted because a residential home had experienced flickering lights and heard a loud noise. At the scene, the responders from the fire department found a truck with a raised basket in the air and a hard hat on the street. Once the fire department ladder truck was raised above the basket, the responders saw the electric maintenance worker laying on the floor of the basket. There was indication that a power line had arced, burnt through, and landed on the ground. The electric maintenance worker had signs of electrical burns on his right shoulder, hand, and clothing. He was pronounced dead on the scene at 2:28 pm.

INTRODUCTION

On the afternoon of June 17, 2019, a 48-year-old city electric maintenance worker was electrocuted while installing lines for security cameras in a residential area. At the request of the city and the union, the National Institute for Occupational Safety and Health (NIOSH) initiated an investigation of this incident. On August 13, 2019, a health scientist, an environmental health officer and a safety and occupational health specialist, from the NIOSH, Division of Safety Research, Fatality Assessment and Control Evaluation (FACE) team met with and interviewed city officials, labor representatives, supervisors, and employees. On August 14, 2019, NIOSH FACE met with a Compliance Safety and Health Officer from the Ohio Bureau of Workers' Compensation 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 electric maintenance worker was employed by a large city, with 29 departments, and approximately 9,000 employees. The deceased worker was employed in the public services department, which had 45 employees. More specifically, he worked in the traffic engineering electrical department where there were a total of 18 employees with 10 performing construction and 8 carrying out maintenance activities. The normal work schedule was from 7 am to 3 pm.

WRITTEN SAFETY PROGRAMS and TRAINING

The employer had existing programs to protect the safety and health of the workers. Prior to the incident, the employer had established an Electrical Safety Program (ESP). The ESP program applied to all workers who could encounter risk of electrical shock and/or thermal burns from an electrical arc during their job assignments and tasks. The ESP program stated, "that all work was to be performed at 600 volts or less (low voltage), and absolutely no work over 600 volts (high voltage) was to be performed." Worker training as part of the ESP included: identification, recognition, and avoidance of

electrical hazards; electrical injury hazards in work practices, procedures, job assignments and tasks; and the operation of equipment. ESP retraining for a worker is required: (1) prior to completing job tasks that are performed less than annually; (2) when observation indicates that the employee is not complying with established safety-related work practices; and (3) when new technology is introduced, new equipment is introduced, or changes in procedures necessitate the use of safety-related work practices that are different from those that the employee would normally use.

The ESP requires supervisors to ensure that all workers who work on or near electrical equipment receive the necessary electrical safety training prior to any work being performed. The ESP specifies that work is not permitted within 10 feet of high voltage (600 volts or more) live overhead lines unless the operation supervisor is notified, and contact is made with appropriate electrical transmission authorities to de-energize or insulate the lines prior to any work being performed. The ESP requires that protective measures must be taken to prevent employees from directly contacting lines with any part of their body and to prevent indirect contact through conductive materials, tools, or equipment.

The ESP requires that workers:

- participate in training, review of electrical safety procedures and annual review of this program;
- ensure understanding and compliance with electrical safety-related work practices, policies and procedures;
- use the correct tools, equipment and PPE (Personal Protective Equipment) for the required work;
- stop work and inform management immediately of potential hazardous situations, such as discrepancies between instructions, procedures, and policies; faulty equipment; or misapplication of electrical devices;
- immediately take out of service for proper repair or replacement any malfunctioning electrical equipment and notify supervision.

The electric maintenance worker in this incident received the following training:

- The Electrical Safety Program for the Traffic Services Bureau, OSHA Electrical Standards and Energy Control Procedures, and Lockout/Tagout requirements (Annually);
- NFPA 70 E Low Voltage and High Voltage training courses (Every 3 years);
- Specific hazards associated with electrical energy;
- Safety-related work practices and procedural requirements as necessary to provide protection from the electrical hazards associated with their respective job or task assignments;
- Methods of release of victims from contact with exposed energized electrical conductors or circuit parts;
- First aid and CPR training (Every 2 years);
- Proper use of special precautionary techniques, PPE, including arc-flash, insulating and shielding materials, an insulated tools and test equipment;
- Selection of an appropriate voltage detector and demonstration on how to use a device to verify the absence of voltage, including interpreting indications provided by the device and understanding all limitations of each specific voltage detector used;
- The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment;
- The skills and techniques necessary to read and interpret an installation and maintenance diagram;
- The skills and techniques necessary to determine the nominal voltage of exposed energized electrical conductors and circuit parts;
- The decision-making process necessary to determine the degree and extent of the hazard and the use of proper tools

and equipment, including PPE, and job planning necessary to perform the task safely; and
- A thirty-minute overview training on aerial equipment operation

WORKER INFORMATION

The 48-year-old electric maintenance worker had over fourteen years of commercial, industrial, and residential experience. The electric maintenance worker was a Journeyman Electrician with an Associate of Applied Science Degree in Electronics Engineering. The promotion sequence for the city required the electric maintenance worker to work for one year as an electrical helper, 2 years as an electrical maintenance worker 1, then as an electrical maintenance worker 2. The electrical maintenance worker 1 was approaching the 2 year qualification for electric maintenance worker 2 at the time of the incident. His work unit was housed in the city's department of traffic engineering. At the time of the incident, the electric maintenance worker was working alone in the raised basket of the bucket truck. He was wearing a hard hat, reflective vest, a fall arrest harness, and regular (non-electrical) work gloves. He worked dayshift from 7 am to 3 pm.

General duties for an electric maintenance worker 1 include: installing and modifying electrical lines, circuits, systems, fixtures, controls, and equipment so that the employer can provide services such as traffic controls and lighting of streets and highways. Other duties include maintaining existing lines, circuits, systems, fixtures, controls, and equipment in efficient operating condition, and troubleshooting, repairs, and/or modifications and replacing damaged, malfunctioning, and worn electrical lines, circuits, systems, fixtures, controls, and equipment. Employees that are designated as an electrical maintenance worker 1 also direct and demonstrate work to new workers who are assigned to assist on a given project in order to familiarize them with equipment, tools, and work procedures, and to ensure safety.

General duties for and electric maintenance worker 2 include: performs, inspects, and may direct work of others in the more difficult types of electrical construction and maintenance, repair, replacement, adjustment, inspecting, cleaning, testing, and troubleshooting of electric and electro-mechanical systems and component parts of traffic signal and street lighting systems including high voltage series systems and low voltage systems; works in confined areas; performs work from elevated surfaces such as scaffolding, aerial ladders, bucket trucks, poles, or other structures; works on equipment that operates on voltages up to 5,000 volts single phase and three phase wiring which may include distribution systems, switchgear, transformers, sub-stations, control circuits and their components.

EQUIPMENT

The equipment on-site on the day of the incident was a 2008 Freightliner M2 utility truck mounted with an Altec aerial articulating lift truck and basket rated for 46kV and below with dielectric usage category C (Photo 1). The employer conducted regular routine maintenance of the utility truck and maintained service records. The vehicle mounted lift was inspected on July 7, 2018 and passed an annual dielectric test but failed the annual visual inspection of equipment test including vehicle body, outriggers, controls, boom and bucket. The employer removed the equipment from service, completed the necessary repairs and placed it back in service. At the time of the incident the lift truck was compliant with all annual testing requirements.

INCIDENT SCENE

The incident occurred in a residential area at the end of a cul-de-sac (Diagram). The city was in the process of installing surveillance cameras along the cul-de-sac. The cameras were to be attached to the light poles along the street (Photo 2). The light poles were on the South side of the street running East/West. At the end of the cul-de-sac was a housing

Photo 1. Freightliner M2 Aerial Lift Boom Truck *Courtesy of the City*

development sign with the housing development driveways on each side of the sign. Above the sign were a series of power lines, cable lines, and phone lines attached to light poles mounted near the development driveways. These utility lines supplied the nearby housing developments. Next to the development sign was a newly placed camera pole where one of the future surveillance cameras would be placed (Photo 3). The electric power lines running to the housing development were 1,300 volt lines, beyond these lines were 3-phase 7,200 volt power lines. The electric maintenance worker was found by firefighters in the raised basket of the bucket truck, which was parked near the new pole under the series of power, cable, and phone lines (Photos 3 and 4).

WEATHER

The weather was clear with an approximate temperature of 83 degrees Fahrenheit with relative humidity between 74% and 89% and thunderstorms in the vicinity when the incident occurred [Weather Underground 2020]. Winds were recorded around 10 mph with 20 mph wind gusts. Weather does not appear to be a contributing factor in this incident.

INVESTIGATION

The electric maintenance worker arrived at the workshop at 7 am, and his supervisor instructed him to run approximately 2,000 feet of triplex service wire for police surveillance cameras on the light poles along the residential street. It was anticipated that it would take two to three workers two to three days to run the triplex wire on the 12 poles on the residential street. The usual co-worker for the electric maintenance worker had called off work for the day, so an electric maintenance worker 2 was going to assist him after finishing up another job at a different location. Prior to leaving the workshop, the supervisor discussed the work with the electric maintenance worker and showed him the work location area visually on an online map. He was tasked with pulling the triplex service wire from a roll on the back of the truck to

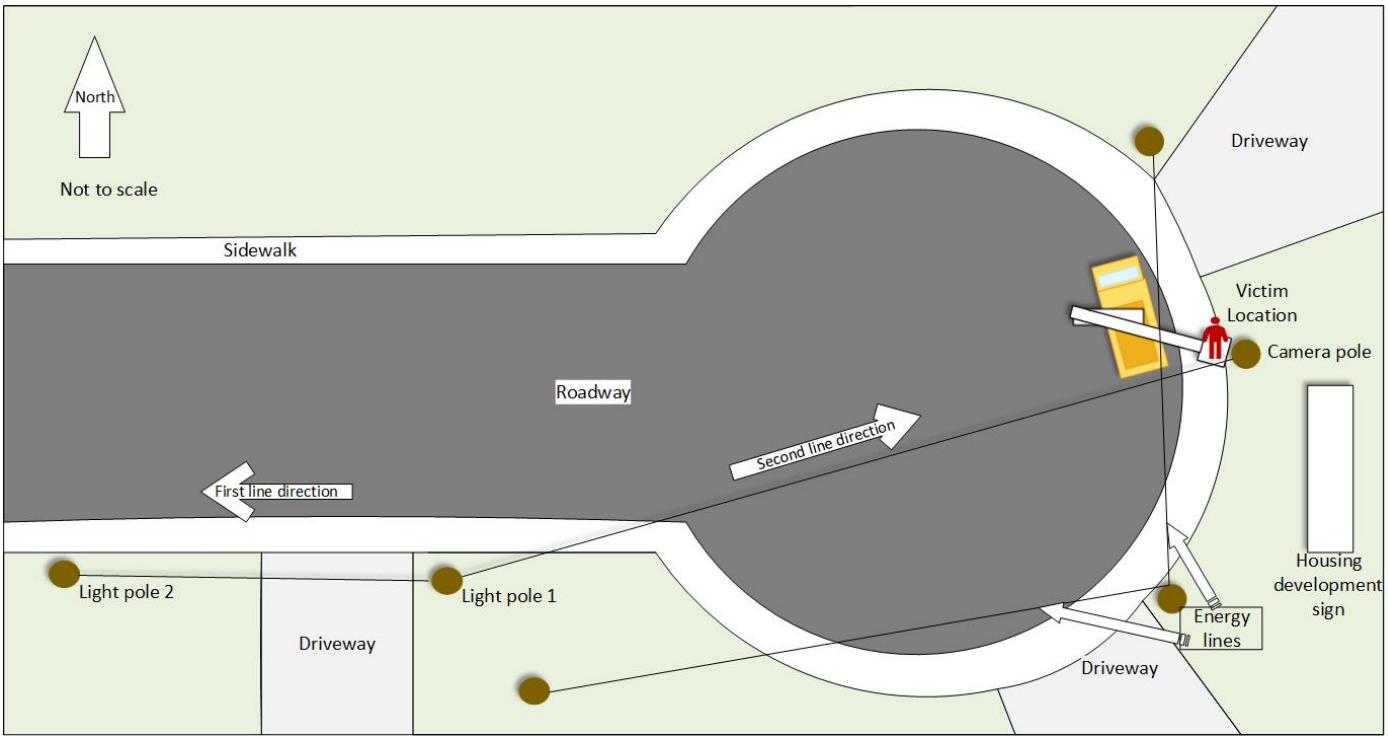

Diagram. Incident scene

Photo 2. Lighting poles along street *Courtesy of the Public Employment Risk Reduction Program*

Photo 3. Photo of new camera pole at end of cul-de-sac *Courtesy of the Public Employment Risk Reduction Program*

Photo 4. Position of bucket truck in cul-de-sac at the time of the incident *Courtesy of the City*

the basket, starting at light pole #1 and working his way up the road to the other light poles that ran from the cul-de-sac area to the main roadway (from East to West) (See Diagram).

The electric maintenance worker arrived at the work site at 10:24 am, with 2,000 feet of triplex service wire on a roll. He placed the boom truck under light pole #1 and proceeded to install the triplex service wire on the first light pole. The light poles were deemed deenergized by the city because the lights were controlled through photocells that only turned on at nighttime. Photocells are most commonly hard-wired via 120-240V line voltage. The supervisor arrived around 11 am and the electric maintenance worker was running the triplex wire on light pole #1 to light pole #2 in sections. The supervisor informed him that the electric maintenance worker 2, his co-worker for the day, would be late because he was held up on another job installing police cameras. The supervisor left for another job site at approximately 11:15 am. At 12:08 pm the electric maintenance worker called the supervisor to verify how the triplex service wire was to be installed from light pole #1 to light pole #2. After completing the wiring to both light poles, he moved the elevated bucket truck.

According to a GPS tracker in the elevated bucket truck, the electric maintenance worker left light pole #1, turned the elevated bucket truck around and drove up the street to position the truck in front of the newly placed security pole. A 1,300 volt power line was located in close proximity to the camera pole. The electric maintenance worker got in the basket and raised it approximately 28 feet. He began pulling some triplex service wire and installing it on the security pole. It is believed he did not realize his proximity to the power lines while performing this task and contacted his right shoulder with the energized power line.

At 1:32 pm, 911 was phoned because a residential home had experienced flickering lights and heard a loud noise. The fire department was dispatched and arrived on the scene at 1:41 pm. Once on the scene, responders from the fire department found the elevated bucket truck with a raised basket in the air and a hard hat on the street. Residents on the scene reported to the fire department that the noise and flickering lights occurred about an hour prior to calling 911. The 911 call was made, because in addition to the previous flickering lights and loud noise, the elevated bucket truck had not moved, and the basket looked empty. The fire department ladder truck was raised above the basket and responders saw the electric maintenance worker laying on the floor of the basket. The backside of the basket showed burn marks. The fire department contacted the energy company and requested the power lines be deenergized.

At 2:11 pm the supervisor called the electric maintenance worker because he heard there was a problem at the job site. When the call was unanswered, he drove to the job site. When he arrived, other workers were there along with the power company, fire department, and the police. There were indications that a power line had arced, burned though, and landed on the ground. Once the power company deenergized the power lines, the raised basket was lowered to the ground. The electric maintenance worker had signs of electrical burns on his right shoulder, hand, and clothing. He had a triplex service wire in his right hand, and his reflective vest and gloves were melted. He was pronounced dead on the scene at 2:28 pm.

CAUSE OF DEATH

The medical examiner listed the cause of death as electrocution.

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:

- *Proximity to energized power lines*
- *Placement of bucket truck and pole*
- *Lack of lone/remote worker assignment safety assessment*
- *Lack of hazard identification and situational awareness*
- *Non-typical job task*
- *Lack of safety standard operating procedures*
- *Lack of appropriate PPE*
- *Lack of training*

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Prior to assigning work, employers should determine appropriate safety distances while working near electrical power line hazards.

Discussion: A job site hazard survey and evaluation should be performed by a competent person prior to assigning work. A competent person is someone who has had training, is capable of identifying existing and predictable hazards in the surroundings or working conditions which are hazardous, or dangerous to employees, and has authorization to take prompt corrective measures to eliminate the hazards. Energized power lines in proximity to a work area constitute a serious safety hazard. The hazard survey should identify: the location, voltage, and height of all overhead power lines, equipment to be placed under or near the power lines and the size (maximum height) of this equipment, tasks to be performed underneath and in proximity to overhead power lines, and workers who are to perform those tasks. Once potential hazards are identified, appropriate control measures should be developed and implemented. Control measures should be taken to maintain a minimum safe distance between the power lines and the workers or equipment. If the minimum safe distance cannot be maintained, the employer should contact the power company to de-energize the power lines or otherwise protect employees from incidental contact.

In this incident, because the operation was a new installation of telecommunication equipment, the OSHA telecommunication standard 29 CFR 1910.268 applies because the OSHA construction standard does not cover the installation of telecommunication equipment. The telecommunications standard 29 CFR 1910.268, provides regulations for employers and workers in "the installation, operation, maintenance, rearrangement, and removal of conductors and other equipment used for signal or communication service, and of their supporting or containing structures, overhead or underground, on public or private rights of way, including buildings or other structures." The standard also covers how work should be performed and PPE required for installation of cable while exposed to energized power conductors including insulating gloves, insulating blankets, tools, and eye protection.

29 CFR 1910.268(b)(7) includes "approach distances to exposed energized overhead power lines and parts. The employer shall ensure that no employee approaches or takes any conductive object closer to any electrically energized overhead power lines and parts than prescribed in Table R-2 [See Table 1], unless: the employee is insulated or guarded from the energized parts (insulating gloves rated for the voltage involved shall be considered adequate insulation), or the energized parts are insulated or guarded from the employee and any other conductive object at a different potential, or the power conductors and equipment are deenergized and grounded." The standard also requires, "vehicle-mounted elevating and rotating work platforms shall not be operated with any conductive part of the equipment closer to exposed energized

power lines than the clearances set forth in Table R-2." 29 CFR 1910.268(j) provides information for vehicle-mounted elevating and rotating work platforms. 29 CFR 1910.268(j)(3) includes "these devices shall not be operated with any conductive part of the equipment closer to exposed energized power lines than the clearances set forth in Table R-2 of this section." Table 1 below from 29 CFR 1910.268 provides approach distances to exposed energized overhead power lines and parts.

Table 1

Voltage range (phase to phase, RMS)	Approach distance (inches)
300 V and less	Avoid contact
Over 300V, not over 750V	12
Over 750V not over 2 kV	18
Over 2 kV, not over 15 kV	24
Over 15 kV, not over 37 kV	36
Over 37 kV, not over 87.5 kV	42
Over 87.5 kV, not over 121 kV	48
Over 121 kV, not over 140 kV	54

The electrical maintenance worker had NFPA 70E electrical safety training and this training includes a certification for a qualified worker. As a qualified worker through the NFPA 70E training, the electrical maintenance worker with appropriate PPE and equipment insulated from voltage, would have been permitted to work 18 inches from the 1,300 volt power line. In this incident the worker placed the basket of the elevated bucket truck approximately 28 inches from the power lines that supplied the housing developments. The basket was within the permitted requirements found in Table 1 [Table R-2 as per 29 CFR 1910.268(j)(3)], but the worker's position within the basket would have been closer than 28 inches to the power line and his right shoulder inadvertently contacted the power line.

Recommendation #2: Employers should develop, implement, and train on hazards, safety, and communication plans for lone workers.

Discussion: Employers should develop policies which promote lone worker safety that includes communicating with workers and using available technology to track worker location and movement [Musick 2015]. The Washington State Department of Labor and Industries (WSDLI), Division of Occupational Safety and Health, developed a guidance document that provides advice on identifying hazards, assessing risks and establishing preventive control measures when working alone [WSDLI 2010]. The guidance document provides examples of high-risk activities that require at least one other person be present, including during electrical work at or near exposed live conductors. The procedures in the WSDLI guidance document include: conducting risk assessments to determine if work may be done safely by lone workers; setting limits for what is permissible during lone work; and using an automatic warning device that sends an alert, if signals are not received periodically from a lone worker. OSHA 29 CFR 1910.269(l)(1)(i), electric power generation, transmission, and distribution, does not specifically apply to this situation; however in the interest of providing additional protection, it is recommended that at least two employees be present "if an employee is exposed to contact with other parts energized at more than 600 volts, work using mechanical equipment, other than insulated aerial lifts, near parts energized at more than 600 volts."

Working alone cannot always be avoided, but work activities and safety measures can be put into place to reduce the risk of working alone. Employers and employees should discuss the potential hazards of job tasks and the additional risks imposed by working alone, and employers should mitigate these hazards. Employers should train employees on the hazards of working alone and the hazard mitigation strategies being used. Employers should develop a communication plan for lone workers [NIOSH 2015]. Some hazard mitigation strategies include:

- Work in pairs when possible.
- Establish a daily employee check in and check out system.
- Identify specific work tasks and methods that will be accomplished and set limits on what is permissible during lone work.
- Establish employee check procedures and radio, phone, or other formal communication every 20 to 30 minutes and more frequently for inclement weather. Information on location should be conveyed during this communication.
- Develop a hand signal communication system.
- If possible, maintain visual contact with other workers and wear high-visibility apparel.
- Use technology like automatic warning devices to track lone workers [Blackline Safety n.d.; Grace Industries n.d.; Lone worker solutions n.d].
- Require supervisors to check on lone workers periodically throughout the day.
- Require supervisors to report to the job site to physically locate a worker if they can't be reached otherwise.
- Assure that everyone knows the emergency response plan, has current first aid and CPR training, has a way to contact emergency services, and knows how to direct emergency response to the job site [Musick 2015; Iowa FACE 2005; Oregon FACE 2006; WSDLI 2011].

Recommendation #3: Employers should provide competent and qualified person training to enable workers in high risk occupations to assess routine and non-routine job tasks for job site hazards to determine appropriate safety precautions and PPE.

Discussion: Before beginning work at a job site, a qualified person should evaluate the site to identify any potential hazards, implement appropriate control measures, and determine appropriate tools, safety precautions, and employer provided PPE for the job tasks and hazards. 29 CFR 1910.268(c) outlines training requirements for telecommunications which states "employers shall provide training in the various precautions and safe practices described in this section and shall ensure that employees do not engage in the activities to which this section applies until such employees have received proper training in the various precautions and safe practices required by this section. Where training is required, it shall consist of on-the-job training or classroom-type training or a combination of both. The employer shall certify that employees have been trained by preparing a certification record which includes the identity of the person trained, the signature of the employer or the person who conducted the training, and the date the training was completed. The certification record shall be prepared at the completion of training and shall be maintained on file for the duration of the employee's employment." At this job site, a 1,300 volt power line was located in close proximity to the camera pole. The company had energy control procedures in place for working in pairs or working alone. When a potential electrical hazard is identified, mitigation strategies should be implemented including: deenergizing electrical sources; positioning equipment and personnel to avoid unintentional contact with the power lines; utilizing appropriate insulated, electrical rated tools; and utilizing electrical insulating safety blankets and electrical safe PPE. Employer provided PPE, such as electric resistant helmets, gloves, and boots, should be used. Several standards apply to insulated tools: IEC 60900:2018,

ASTM F1505-16, ISO ISC 13.260, and NFPA 70E. These standards cover dimensions, guards, test procedures and electric shock, arc-flash, and arc-blast safety in the workplace. If the minimum safe distance cannot be maintained, the employer should contact the power company to de-energize the power lines or otherwise protect employees from incidental contact. In this incident, the elevated bucket truck was placed on the roadway and the basket was positioned approximately 28 inches from the 1,300 volt power line, the worker's position within the basket would have been closer than 28 inches to the power line and his right shoulder inadvertently contacted the power line.

Recommendation #4: Employers should implement pre-work hazard identification with corrective action/peer-check, self-check and daily safety talks that address hazard recognition and avoidance of unsafe conditions.

Discussion: Healthy safety culture and thorough safety programs are essential to ensure worker safety. Employer safety and health programs should include the systematic identification, evaluation, and prevention or control of general workplace hazards and the hazards of specific jobs and tasks. Training on the safety program and procedures should be provided to all employees. Additional training should be provided on job specific hazard recognition and the avoidance of unsafe conditions. All training provided to employees should be documented.

Core elements of a safety and health program are management leadership, worker participation, hazard identification and assessment, hazard prevention and control, education and training, and program evaluation and improvement. Safety and health programs should be developed using hazard identification and analysis of all routine tasks performed by employees. These analyses should incorporate information about the identified hazards and their controls into the program. Safety and health programs should also address non-routine activities, including the process of assessing and mitigating unique hazards. Employers should also have daily pre-work hazard identification talks for workers in hazardous occupations. These daily talks should include a description of the work tasks, hazard awareness, identification, control, injury prevention, appropriate PPE, and emergency response protocols. These are off referred to as tool box talks.

Employers should seek employee input and expertise throughout the safety and health program development process and during routine updating of the program. The program should be updated when safety concerns arise and when new equipment, tasks, or chemicals are introduced into the workplace, and workers trained on any new safety procedures and equipment. In addition, for industries where work sites change with each job, the safety and health program should require that a hazard analysis be performed for each job site before work begins to ensure that safe work procedures are implemented and the required tools and personal protective equipment (PPE) are available. Employers should ensure that they have fully and effectively implemented their safety and health program by routinely performing peer-checks, self-checks and task assessments and immediately address any observed unsafe conditions.

Recommendation #5: Employers should develop periodic and regular testing, inspection and maintenance of elevated work platforms.

Discussion: Employers should develop and implement periodic and regular testing and maintenance procedures for elevated work platforms based on ANSI/SAIA A92.2-2015. Although not considered a contributing factor in this incident, NIOSH is providing this recommendation as a matter of good safety practices. In this incident the category C utility truck mounted with an Altec aerial articulating lift truck and basket was inspected on July 7, 2018, the equipment passed an annual dielectric test, minor repairs were made and the equipment was returned to service. The ANSI/SAIA A92.2-2015 provides standard guidance on elevated work platforms design requirements, electrical systems devices and test

procedures, and responsibilities of manufacturers, dealers, installers, owners, users, operators, lessors, lessees, and brokers. Section 5.3.3 of the standard states that "each insulating aerial device shall be periodically electrically tested in accordance with Section 5.4.3 to verify the dielectric resistivity and detect conductivity changes in its insulating sections" periodically. Section 5.3.4 of the standard states that "each insulating aerial device may be electrically tested before use in accordance with paragraphs 5.4.3.1 (11) (c), 5.4.3.1 (11) (d), and 5.4.3.2 (5) (c) to measure boom current from phase conductor to ground" before each use. There are different test procedures depending on the category of aerial device (A and B Insulating and C, D and E Non-Insulating). Maintenance and equipment operators should know the category of the equipment before equipment maintenance or use. Section 8.2.2 requires regular inspection and tests of elevated work platforms. Inspection procedures are divided into two classifications based upon the intervals at which inspections and tests shall be performed. The two classifications are frequent inspection and test (daily to monthly intervals) and periodic inspection and test (one to twelve-month intervals). Intervals are set by the owner in accordance with the manufacturer's recommendations. The inspection and test intervals are dependent upon component function and exposure to wear, deterioration, and other agents which adversely affect component life.

Section 8.2.3 states the following "inspections and tests shall be performed by the operator immediately prior to first use at the beginning of each shift:

(1) Conduct walk around visual inspection looking for damaged components, cracks or corrosion, excessive wear, and any loose, deformed, or missing bolts, pins, fasteners, locking devices, and covers.

(2) Check all controls and associated mechanisms for proper operation to include, but not limited to, the following:

a) Proper operation of interlocks.

b) Controls return to neutral when released and not sticking.

c) Control functions and operation clearly marked.

(3) Check visual and audible safety devices for proper operation.

(4) Visually inspect fiberglass and insulating components for visible damage and contamination.

(5) Check for missing or illegible operational and instructional markings.

(6) Check hydraulic and pneumatic systems for observable deterioration and excessive leakage.

(7) Check electrical systems related to the aerial device for malfunctions, signs of excessive deterioration, and dirt and moisture accumulation.

(8) Perform functional test to include, but not limited to, the following:

(a) Set up the aerial device for operation, including stabilizers.

(b) Cycle the aerial device functions through the complete range of motion from the lower controls, except where operation through the complete range of motion would create a hazard.

(c) Check emergency stop(s) for proper operation any suspected items shall be carefully examined or tested and a determination made by a qualified person as to whether they constitute a safety hazard. All unsafe items shall be replaced or repaired before use." [ANSI/SAIA A92.2-2015]

Section 8.4 states that "maintenance and frequency of maintenance shall be determined by the owner in accordance with the manufacturer's recommendations, and the owner shall train their maintenance personnel in inspection and maintenance of the aerial device in accordance with the manufacturer's recommendations and Section 8 of this standard." [ANSI/SAIA A92.2-2015]

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Recommendation #6: Employers should train and evaluate employees on the selection, inspection, and safe operation of elevated bucket trucks.

Discussion: Employers should train employees on the selection, inspection and safe operation of elevated bucket trucks in consideration of the environments where the equipment will be operated. In this incident the electrical maintenance worker selected a category C aerial device and had a thirty-minute overview training on aerial equipment operation. An aerial boom or elevated bucket truck is typically outfitted with a rotating center post, a fixed or telescopic boom, outriggers or stabilizers, and one or more operator's stations on a commercial truck chassis designed to lift, lower, and swing loads, with a capacity to lift a payload. OSHA 1910 Subpart F, the powered platforms, manlifts, and vehicle-mounted work platform standard, 29 CFR 1910.67, states that "only trained persons shall operate an aerial lift." Specific requirements for aerial lift operation training are not outlined. However, OSHA has developed a fact sheet on aerial lifts. [OSHA 2011] This fact sheet outlines hazards associated with aerial lifts, examples of training on aerial lift operation and what to do before and while operating an aerial lift. Training should be provided on operating equipment and working around power lines and understanding visual limitations [WorkSafeBC 2011; 2014]. The ANSI/SAIA A92-2018 "aerial work platform standards provides criteria for vehicle-mounted rotating and elevating work platforms, elevating aerial platforms, boom supported elevated aerial platforms, and a series of equipment related to the aerial platform and access industry." ANSI/SAIA A92.22-2018 provides information on safe use of mobile elevating work platforms. ANSI/SAIA A92.24-2018 provides training requirements for the use, operation, inspection, testing and maintenance of mobile elevating work platforms. The standard states that training shall be provided by a qualified person to operators and supervisors and include both classroom and hands on training and participants shall be evaluated. The standard states training and evaluation of mobile elevating work platforms (MEWPs) shall include selection, familiarization, purpose, use and storage of operation manuals, placards and decals, and safety rules, inspections, troubleshooting malfunctions, stability factors, operation and weather hazards, MEWP components controls functions and features, regulations, PPE, fall protection system integration and use, transport and traveling, authorized users, hazardous atmospheres, high pressure line hazards, platform occupant safety and parking and securing the MEWP. ANSI/SAIA A92.2-2015 provides requirements vehicle-mounted elevated and rotating aerial devices. Section 8.12.1 of states that "only personnel who have received general instructions by a qualified person regarding the inspection, application, and operation of aerial devices, including recognition and avoidance of hazards associated with their operation, shall operate an aerial device." Section 9.2 also states that "only trained and authorized personnel shall be permitted to operate the aerial device." Training shall include:

- "(1) The purpose and use of manuals.
- (2) That operating manuals are an integral part of the aerial device and must be properly stored on the vehicle when not in use.
- (3) A pre-start inspection.
- (4) Responsibilities associated with problems or malfunctions affecting the operation of the aerial device.
- (5) Prohibition of overriding safety devices except as approved by the manufacturer (see 8.5.2).
- (6) That secondary operating systems shall not be used for purposes other than test or recovering the work platform.
- (7) Factors affecting stability.
- (8) The purpose of placards and decals.
- (9) Workplace inspection.
- (10) Applicable safety rules and regulations, such as Part 4, ANSI C2-2007, National Electrical Safety Code (applies to utility workers as defined in ANSI C2). The above standard is an example; other industries using aerial devices have safety rules pertinent to that industry.

- (11) Authorization to operate.
- (12) Securing the aerial device and mobile unit (MEWP) from unauthorized use.
- (13) Operator warnings and instructions.
- (14) Proper use of personal fall protection equipment. Fall protection systems criteria and practices are covered in 29 CFR 1926.502.
- (15) Actual operation of the aerial device. Under the direction of a qualified person, the trainee shall operate the aerial device for a sufficient period of time to demonstrate proficiency in the operation of all control functions of the aerial device and safe use at operating height and reach.
- (16) Stowing the aerial device for transport and precautions related to moving the mobile unit (MEWP)." [ANSI/SAIA A92.2-2015]

Recommendation #7: Prior to assigning work, employers should identify and establish safe work practices such as lockout/tagout (LOTO) procedures.

Discussion: Although not considered a contributing factor in this incident, NIOSH is providing this recommendation as a matter of good safety practices. The company had energy control procedures in place. However, during the installation of the cabling on the lighting pole, the photocells on the light poles were not identified as a safety or electrical concern because they were only electrified at night. Automatic lighting, such as streetlights, often uses photocell sensors—also known as photoeyes—to sense the level of ambient light. A factory-installed photocell tells the fixture when it should turn exterior lights on and off based on the amount of ambient light. Semiconductors control the electric current of photocells. When the semiconductor is exposed to a certain level of light, current starts to flow and the fixture will be shut off. Some photocell sensors are adjustable, allowing you to choose the ambient light level that will activate the semiconductor. The photocell is made up of a resistor attached to photosensitive plates, exposure to ambient light changes the resistance and turns the light on and off. Photocells are most commonly wired for 120-240V line voltage [Rensselaer Polytechnic Institute 2005]. If the photocells are activated because of clouds or shadows, electrical circuits they control can become energized.

When working near light poles such as streetlights that are controlled by photocell sensors, the possibility of electrocution can pose a significant risk to workers should the photocell activate to turn on the light. Therefore, as a matter of good safety practices, the NIOSH investigators determined a need to recommend utilizing lockout/tagout (LOTO) procedures per 29 CFR 1910.333 (a) and (b) "While any employee is exposed to contact with parts of fixed electric equipment or circuits which have been deenergized, the circuits energizing the parts shall be locked out or tagged."

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ADDITIONAL RESOURCES

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Electrical Safety Foundation International [n.d.] Overhead Power line Safety https://www.esfi.org/overhead-power line-safety

Electrical Safety Foundation International [n.d.] Industry Codes & Regulations

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