98 F-31
NIOSH
Fire Fighter Fatality Investigation and Prevention Program

Death in the line of duty...

A Summary of a NIOSH fire fighter fatality investigation *January 21, 1999*

Two Career Fire Fighters Electrocuted After the Aluminum Extension Ladder They Were Using Contacted a 7,620-volt Overhead Powerline - Kansas

SUMMARY

Two male career fire fighters, ages 27 and 46 years old (the victims) were electrocuted when the aluminum extension ladder they were positioning against a church contacted an overhead powerline. A painting contractor who had been hired by the local church to paint it discovered that the ladders they were using were not long enough to reach the upper section of the church. The contractor talked with a church representative about the problem, and the representative made a request through city hall for the fire department to provide an aerial truck so that the painters could finish painting the church. After receiving a call from city hall, the fire department Chief surveyed the job at the church and determined that an extension ladder could be used to finish the painting. A crew of four fire fighters and one Captain were dispatched to deliver a 36-foot aluminum extension ladder to the church. After delivering the ladder, the crew decided to help raise and position the ladder since it was heavy and cumbersome for the two painters to handle. After several attempts were made to raise and position the ladder, it was still out of position and had to be moved again. The ladder was raised about 35 feet, its top was placed against the side of the church, and its feet were set on the ground directly under a single phase of an overhead powerline, which was 34 feet 3 inches above the ground. The crew attempted to reposition the ladder. One fire fighter was grasping the halyard (rope), while the remaining three fire fighters and Captain steadied the ladder and pulled it back to a vertical position. As the ladder was being repositioned, the top of the ladder contacted the 7,620-volt overhead powerline. Electrical current passed through the ladder, and through the fighters and the Captain who were in contact with the ladder, to the ground. The Captain and three fire fighters were knocked to the ground, and the remaining fire fighter who was holding the halyard was uninjured. The uninjured fire fighter ran to the Engine and called 911 for assistance. The Police Department heard the call and dispatched personnel to the scene. Police personnel arrived in 2 minutes, and along with the

Figure 1. Incident Scene

The **Fire Fighter Fatality Investigation and Prevention Program** is conducted by the National Institute for Occupational Safety and Health (NIOSH). The purpose of the program is to determine factors that cause or contribute to fire fighter deaths suffered in the line of duty. Identification of causal and contributing factors enable researchers and safety specialists to develop strategies for preventing future similar incidents. To request additional copies of this report (specify the case number shown in the shield above), other fatality investigation reports, or further information, visit the Program Website at:

http://www.cdc.gov/niosh/firehome.html

or call toll free **1-800-35-NIOSH**

Two Career Fire Fighters Electrocuted After the Aluminum Extension Ladder They Were Using Contacted a 7,620-volt Overhead Powerline - Kansas

uninjured fire fighter, started cardiopulmonary resuscitation (CPR). An ambulance arrived shortly thereafter, paramedics continued CPR, and they transported the victims to a local hospital. About 1 hour later the Captain and one fire fighter were pronounced dead, and the two injured fire fighters were hospitalized. NIOSH investigators concluded that, to prevent similar occurrences, fire departments should:

- ***identify potential hazards and appropriate safety interventions in the planning phase of work projects***
- ***eliminate the use of conductive ladders in proximity to energized electrical conductors (powerlines)***

Additionally, ladder manufacturers should consider:

- ***incorporating non-conductive materials in the manufacture of aluminum ladders.***

INTRODUCTION

On November 24, 1998, two career fire fighters ages 27 and 46 years old (the victims) were electrocuted when the aluminum extension ladder they were using contacted an overhead powerline. On November 26, 1998, the U.S. Fire Administration notified NIOSH of the incident. On December 14, 1998, a Safety and Occupational Health Specialist from NIOSH investigated the incident. The incident was reviewed with the attorney for the City, the Chief of the fire department and two of the fire fighters at the scene of the incident, a representative of the local utility company, an investigator from the Kansas Human Resources Department, and the Chief and an investigator from the local police department. Photographs of the incident site and ladder were taken and the medical examiner's report was requested.

The fire department involved in the incident serves a population of 12,000 in a geographic area of 10 square miles and is comprised of 19 fire fighters. No training is required to become a fire fighter in this State, but the fire department provides all new fire fighters with applicable training. The training is designed to cover personal safety, forcible entry, ventilation, fire apparatus, ladders, self-contained breathing apparatus, hose loads, streams, hazardous materials, structure fire, pumps, rappeling, search and rescue, terrorism, vehicle extraction, cardiopulmonary resuscitation, first aid, aerial operations, and electrical emergencies. The victims had 5 and 20 years of fire fighting experience, respectively.

INVESTIGATION

On November 24, 1998, the wife of the pastor of a local church telephoned City Hall and requested the use of an aerial ladder. The aerial ladder was to be used by a painting contractor to finish painting the upper section of the church (see Figure 1), which was about 30 feet from the ground and could not be reached from the ladders the painters were using.

A representative from City Hall called the fire department and appraised the Chief of the request. The Chief, traveling to the church and accessing the situation, determined that an extension ladder would be sufficient to paint the upper section of the church. The Chief dispatched two vehicles, an aerial truck and an engine, and four fire fighters and one Captain to deliver the ladder. Traveling to the vehicle maintenance department, the crew retrieved a 36-foot aluminum extension ladder from an Engine that was out of service. The crew arrived at about 0900 hours, unloaded the ladder, and placed it on the ground on the north side of the church. Since the ladder was heavy and difficult to maneuver, the crew decided to raise and position the ladder for the two painters. The four fire fighters picked up and carried the ladder to the east side of the church, and with the retracted ladder in a vertical position, placed the feet

Two Career Fire Fighters Electrocuted After the Aluminum Extension Ladder They Were Using Contacted a 7,620-volt Overhead Powerline - Kansas

of the ladder on the ground about 13 feet horizontally from the east side of the church (see Figure 1). *NOTE: A 7,620-volt, three-phase overhead powerline was located 34 feet, 3 inches above the ground and 12 feet 6 inches horizontally from the east side of the church; however, the location of the powerline as it related to the ladder's positioning was never discussed among the fire fighters and Captain.*

The Captain oversaw the ladder raising and positioning as three fire fighters steadied the ladder (one on each side rail and one in the middle). The fourth fire fighter used the halyard to raise the ladder. The crew first raised the ladder to about 30 feet and laid it against the side of the church below the peak of the roof. Since the top of the ladder was contacting the frame of a 2-foot by 3-foot vent, which made the ladder unsteady, a decision was made to pull the ladder back, raise and reposition it. The ladder was pulled back to a nearly vertical position a second time, raised to about 35 feet and laid back against the side of the church. This time the ladder was extending over the peak of the church's roof and again was not in the correct position for use by the painters. A decision was made to reposition the ladder a third time by lifting and sliding the butt section a couple of feet and then pulling the ladder back to a vertical position before again positioning it against the side of the church. The Captain, who had been overseeing the operation, moved to the ladder and grasped a side rail to help steady it. The top of the ladder was resting against the side of the church, and its feet on the ground directly under a single phase of an overhead powerline, which was 34 feet 3 inches from the ground. The crew then attempted to reposition the ladder. One fire fighter was grasping the halyard (rope), while the remaining three fire fighters and Captain steadied the ladder and pulled it back to a vertical position. As the ladder was being repositioned, the top of the ladder contacted the 7,620-volt overhead powerline (see Figure 2). Electrical current passed through the ladder, and through the fire fighters and Captain who were in contact with the ladder, to the ground. Three fire fighters and the Captain were knocked to the ground. The fire fighter who was holding the halyard was uninjured. The uninjured fire fighter ran to the engine and called 911 for assistance. The Police Department heard the call and dispatched personnel who arrived on the scene within 2 minutes. The police personnel, along with the uninjured fire fighter and a slightly injured firefighter, checked for vital signs and provided CPR to the Captain and one fire fighter, who were in cardiopulmonary arrest. An ambulance arrived shortly thereafter and paramedics continued CPR while transporting the injured to the hospital. About 1 hour later the Captain and one fire fighter were pronounced dead, one fire fighter was hospitalized in serious condition, and the other fire fighter was treated and released. The fire fighter hospitalized in serious condition was subsequently discharged from the hospital.

CAUSE OF DEATH

The medical examiner reported the cause of death for both victims as electrocution.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Fire department personnel should identify potential hazards and appropriate safety interventions in the planning phase of work projects.

Discussion: Since fire departments often provide important community services, fire fighter safety should be addressed and incorporated into all work projects, whether they involve fire-related projects or community services, during both the planning and operational phases of the work projects. The planning phase should identify all hazards that may be encountered and the procedures and safety interventions to be implemented to control or eliminate such hazards. These procedures should

include, but not be limited to, inspecting the work environment before initiating work, developing safe work practices and procedures, providing training in hazard recognition and abatement, and identifying and addressing personal protective equipment (PPE) needs where applicable. In this case an assessment of the work project was completed. However, the overhead powerline hazard was not recognized as a hazard and therefore was not abated or controlled. When work must be done in proximity to energized powerlines, the local utility company should be contacted who can either de-energize, if practicable, or cover the powerlines with insulating line hoses or blankets.

Recommendation #2: Fire departments should consider eliminating the use of conductive ladders in proximity to energized electrical conductors [1] ***(powerlines).***

Discussion: In some cases the use of conductive ladders may be unavoidable, but when work projects are not of an emergency nature, fire departments should consider eliminating the use of conductive ladders (aluminum) in proximity to energized electrical conductors (powerlines). Although all fire departments are not subject to Occupational Safety and Health Administration (OSHA) Standards, OSHA Standard 29 CFR 1926.1053(b)(2) states that "portable metal ladders shall not be used for electrical work or where they may contact electrical conductors." Ladders made of non-conductive materials, e.g., fiberglass, should be used for work near energized conductors.

Recommendation #3: **Ladder manufacturers should consider incorporating non-conductive materials in the manufacture of aluminum ladders.** [2]

Discussion: The use of nonconductive materials in the manufacture of aluminum ladders could provide passive protection to all affected workers in the event of an inadvertent contact with an electrical conductor. One possibility to consider is the placement of a fiberglass link in the side rails of new aluminum ladders. This link would provide isolation so electricity does not have a path to ground. Additionally, incident data from the U.S. Consumer Product Safety Commission suggest that approximately 42% of ladder contact with powerlines occurs within the top 3 feet of the ladder.[2] Therefore, consideration should be given to insulating the ladder's top few feet with a material that is non-conductive (e.g., heavy Teflon).

REFERENCES

1. 29 CFR 1926.1053 (1998) Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

2. Bellegarde, Marie L. Human Factors Analysis of Aluminum Ladder/Powerlines Electrocution Hazard, U.S. Consumer Product Safety Commission: pp. 5-9, October 1988.

INVESTIGATOR INFORMATION

Richard W. Braddee, Safety and Occupational Health Specialist, Surveillance and Field Investigations Branch, Division of Safety Research.

Two Career Fire Fighters Electrocuted After the Aluminum Extension Ladder They Were Using Contacted a 7,620-volt Overhead Powerline - Kansas

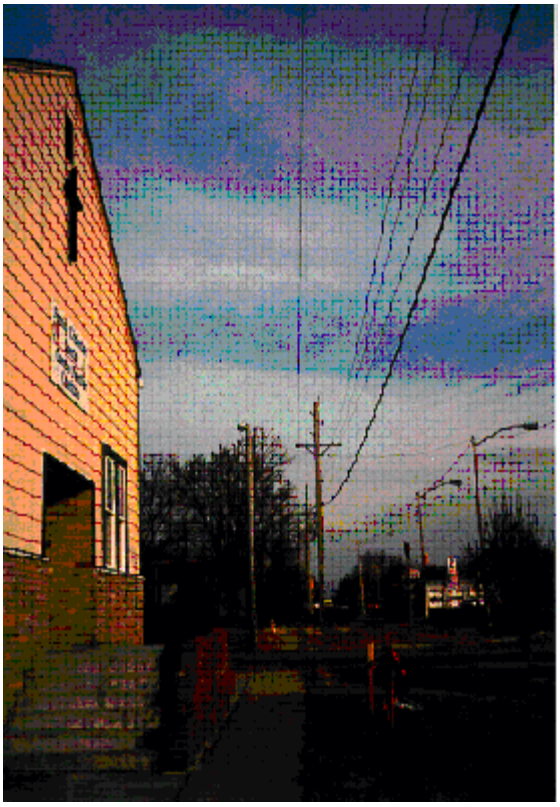

Figure 1. Incident Scene where ladder contacted overhead powerline.

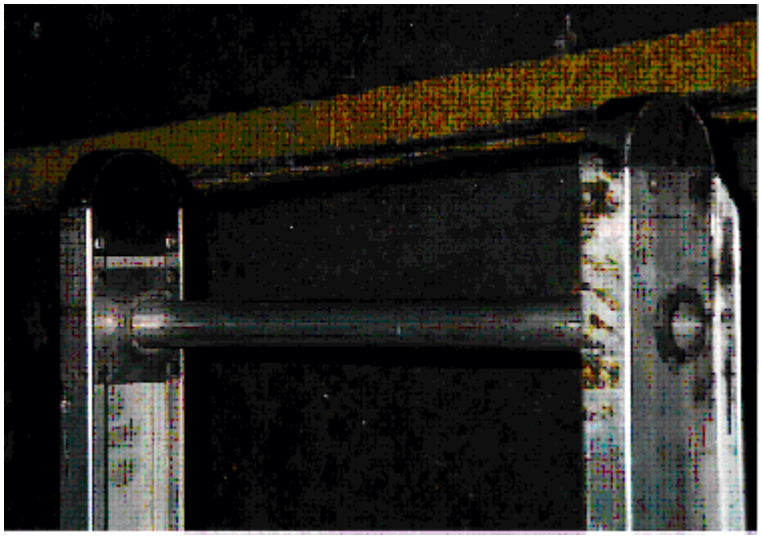

Figure 2. Top section of ladder with burn marks.