Why Construction Workers are Getting Electrocuted

Michael McCann, PhD, CIH
Director of Safety and Ergonomics
The Center to Protect Workers’ Rights

mmccann@cpwr.com
Causes of Death in Construction, 1992-98

- Falls: 2,304 deaths
- Transportation incidents: 2,029 deaths
- Contact with objects and equipment: 1,406 deaths
- Contact with electric current: 1,006 deaths
- Fires/explosions due to arc flashes: 17 deaths
- Other: 727 deaths

Total deaths: 7,489

Source: U.S. Bureau of Labor Statistics data
Types of Electrical Injury

- Electrical Shock
- Electrical Burns
- Arc-Flash Burns
- Arc Blast
- Falls
- Fire
Causes of Construction Electrocutions, 1992-98

- **Overhead power lines**: 56%
- **Electrical equipment**: 31%
- **Electrical wiring**: 18%
- **Light Fixtures**: 14%
- **Appliances and machinery**: 10%
- **Energized objects**: 9%
- **Lightning**: 5%
- **Buried, underground power lines**: 4%
- **Unknown cause**: 3%

Source: U.S. Bureau of Labor Statistics data
Over half of electrocutions of electrical workers were due to working on or near live parts.
Electrocutions Among Electrical Workers from Direct Contact with Electrical Equipment, 1992-98

- **Electrical equipment (68 deaths)**
  - electrical control panels (16 deaths)
  - switching gear (14 deaths)
  - transformers (13 deaths)
  - circuit breakers/fuse holders (8 deaths)
  - junction boxes (5 deaths)
  - other (12 deaths)

- **Electrical wiring (59 deaths)**

- **Light fixtures (29 deaths)**
  - 3/4 building light fixtures
  - others: airport runway lights
  - neon signs, street lights

Other Causes of Electrocutions of Electrical Workers, 1992-98

- Contact with energized objects (29 deaths)
  - accidentally cutting energized wires (10 deaths)
  - energizing wires by contact with energized wires (7 deaths)
  - deliberately cutting or stripping energized wires (5 deaths)

- Contact with live parts of appliances and machinery (11 deaths)

- Contact with overhead power lines (102 deaths)

Contributing Factors to Electrocutions of Electrical Workers

- Lack of proper personal protective equipment
- Lack of insulated tools
- Working from aerial lifts (33 deaths)
- Working in attics or above drop ceilings (16 deaths)
Over half of electrocutions of non-electrical workers were due to contact with overhead power lines.
Causes of Electrocutions Among Non-Electrical Workers, 1992-98

- Overhead power lines (376 deaths)
- Electrical wiring (69 deaths)
- Appliances/machinery/power tools (68 deaths)
  - air-conditioners (22 deaths)
  - portable lights (11 deaths)
  - power tools (7 deaths – 5 involved electric drills)
  - welding units (7 deaths)
  - other home appliances (6 deaths)
  - pumps (5 deaths)


- **Contact with energized objects (52 deaths)**
  - Metal ladders (11 deaths)
  - Metal pipes (5 deaths)
  - Accidentally cut live wire (5 deaths)

- **Electrical equipment (31 deaths)**
  - Electrical control panels (10 deaths)
  - Transformers (5 deaths)

- **Lightning (31 deaths)**

- **Buried, underground power lines (16 deaths)**

- **Light fixtures (10 deaths)**

- **Unknown (24 deaths)**

Contributing Factors to Electrocutions of Non-Electrical Workers

- Working under houses or in basement crawlspace (27 deaths)
- Contact with water (20 deaths)
- Defective extension or power cords (15 deaths)
- Working in attics or above drop ceilings (9 deaths)
Danger of “Low Voltage”

• **120/240 volts**
  - 1/8 of all construction worker electrocutions

• **Total low voltage (600 volts or less)**
  - 1/3 of electrical worker electrocutions
  - 1/4 of non-electrical worker electrocutions

Source: U.S. Bureau of Labor
Statistics data, 1992-98
Electrical Injuries Requiring Emergency Department Treatment

- 61 (1.8%) of ED-treated injuries were electrical injuries

Source: GWU Construction Workers Surveillance Program, 1992-98
Electrical Injuries Requiring Emergency Department Treatment

• ED-Treated Electrical Injuries
  – 20% (12/61) of ED-treated electrical injuries required hospitalization (compared to 3.4% of all injuries)
  – 66% (40/61) of ED-treated workers were electrical workers

• Types of Electrical Injury Requiring ED Treatment
  – 60% (25/42) of electrical shock injuries involved electrical workers
  – 79% (15/19) of arc flash injuries involved electrical workers

Source: GWU Construction Workers Surveillance Program, 1992-98
Causes of Electrical Injuries Requiring Emergency Department Treatment

- **Electrical wiring**: 45% of workers (26% electrical shock, 19% arc flash)
- **Electrical equipment**: 53% of workers (11% electrical shock, 53% arc flash)
- **Light Fixtures**: 10% of workers (7% electrical shock, 11% arc flash)
- **Energized objects**: 7% of workers (5% electrical shock, 2% arc flash)
- **Power tools**: 5% of workers (3% electrical shock, 2% arc flash)
- **Unknown**: 28% of workers

Source: GWU Construction Workers Surveillance Program, 1992-98
Falls from Ladders As a Result of Electrical Injury

- 36% (15/42) of ED-treated electrical shock injuries resulted in falls from ladders

- 5% (1/19) of ED-treated arc flash injuries resulted in falls from ladders

Source: GWU Construction Workers Surveillance Program, 1992-98
Diagnoses from Emergency Department Treatment of Electrical Injuries

Electrical shock only: 45% of diagnoses
Skin burn: 43% of diagnoses
Eye injury (including burns): 2% of diagnoses
Lacerations: 9% of diagnoses
Contusions/Abrasions: 11% of diagnoses
Sprain/strain pain: 7% of diagnoses
Other (fractures, infections): 4% of diagnoses

Source: GWU Construction Worker Surveillance Program, 1992-98
Controlling Electrical Hazards
Precautions for Electricians

- Get training as qualified person
  “One familiar with the construction and operation of the equipment and the hazards involved”
- De-energize and lock out or tag out equipment
- Isolate other exposed live parts
- Use proper PPE & insulated tools
- Have a permit system for working live
To De-Energize
or
Not to De-Energize
Reasons for Working Live

- **De-energizing creates additional or greater hazards**
  - interruption of life-support systems
  - deactivation of emergency alarm systems
  - shutdown of ventilation equipment for hazardous locations

- **De-energizing is infeasible**
  - testing of live circuits
  - work on circuits that are part of a continuous process
Barriers to Lockout/Tagout

- Schedule pressure
- Refusal of owner to allow power to be shut off
- Peer pressure especially new journeymen
- Safety culture Electricians work live
- Lack of awareness of danger, especially low voltage
- Lack of training on lockout/tagout
- Other trades don’t want power shut off
Live Work Permit

- Date and time covered by the permit
- Why live work will be done
- Who will perform the work
- Tasks to be performed
- Personal protective equipment to be worn
- Other precautions
  - insulated tools
  - insulated barriers for nearby live parts
  - warning signs
- Have owner sign off on working live
Precautions for Non-Electricians

• Get electrical safety training
• Check for:
  – overhead power lines
  – buried, underground power lines
  – other live circuits
• Make sure temporary wiring has GFCIs
• Lock out/tag out equipment to be worked on
• Only qualified persons may work on electrical wiring and equipment
• Check cords and equipment for damage
As You Work

- In wet, damp, or hazardous locations use tools or equipment designed and labeled for such areas
- Keep metal ladders, pipes, etc. away from live circuits or power lines
- Make sure electric systems, machinery and power tools are grounded or double insulated
- Use extension cords marked for hard or extra-hard usage
- Protect cords from damage
Further Information on Construction Safety and Health

Electronic Library of Construction Safety and Health (eLCOSH):

www.elcosh.org

The Center to Protect Workers’ Rights

www.cpwr.com

This presentation was funded by research grant U60 CCU 317202 from the National Institute for Occupational Safety and Health (NIOSH) through The Center to Protect Workers’ Rights, Silver Spring, Md. The contents are solely the responsibility of the authors and do not necessarily represent the official views of NIOSH.