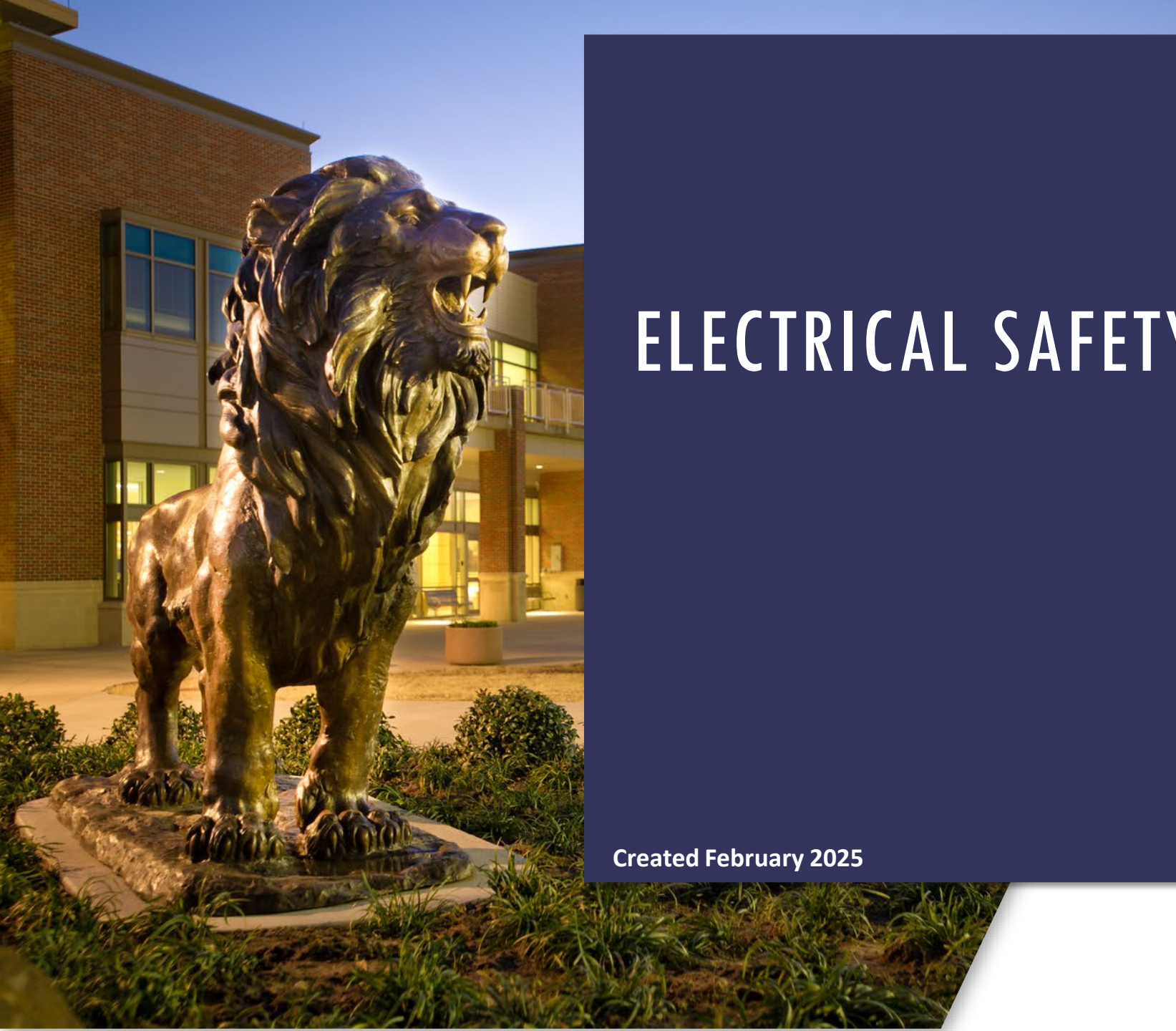

ELECTRICAL SAFETY

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Environmental Health and Safety

EAST TEXAS A&M

INTRODUCTION

- An average of one worker is electrocuted on the job every day

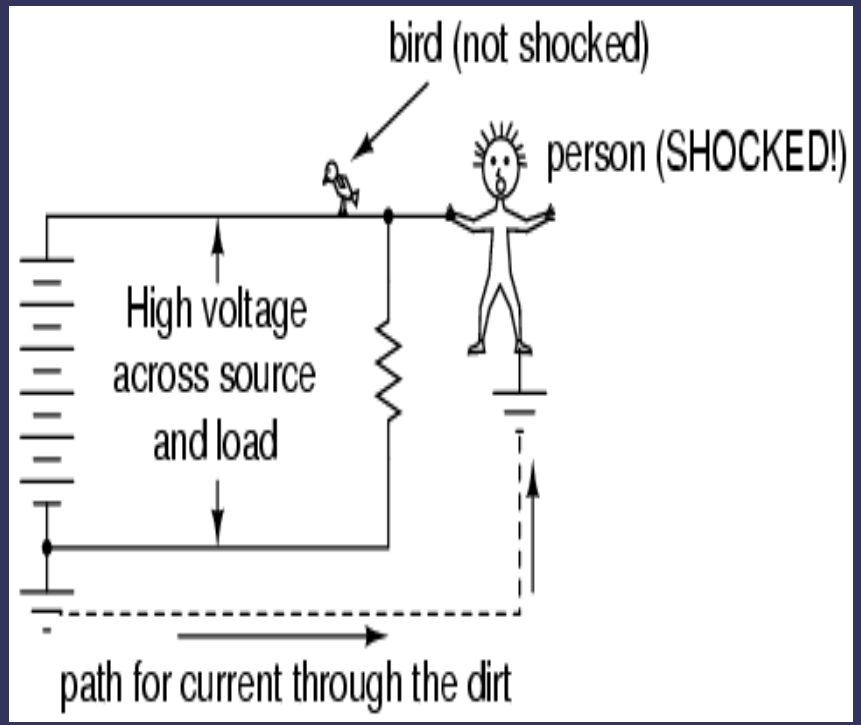
- There are four main types of electrical injuries:
  - Electrocution (death due to electrical shock)
  - Electrical shock
  - Burns
  - Falls

ELECTRICAL TERMINOLOGY

- **Current**- the movement of electrical charge
- **Resistance**- opposition of current flow
- **Voltage**- a measure of electrical force
- **Conductors**- substances, such as metals, that have little resistance to electricity
- **Insulators**- substances, such as wood, rubber, glass, and bakelite, that have high resistance to electricity
- **Grounding**- a conductive connection to the earth which acts as a protective measure

ELECTRICAL SHOCK

- Received when current passes through the body
- Severity of the shock depends on:
  - Path of the current through the body
  - Amount of current flowing through the body
  - Length of time the body is in the circuit
- LOW VOLTAGE DOES NOT MEAN LOW HAZARD



DANGERS OF ELECTRICAL SHOCK

- Currents greater than 75mA* can cause ventricular fibrillation (rapid, ineffective heartbeat)
- Will cause death in a few minutes unless a defibrillator is used
- 75mA is not much current – a small power drill uses 30 times as much

*mA= milliampere = 1/1,000 of an ampere

HOW IS AN ELECTRICAL SHOCK RECEIVED?

- When two wires have different potential differences (voltages), current will flow if they are connected together
  - In most household wiring, the black wires are at 110 volts relative to ground
  - The white wires are at zero volts because they are connected to ground

- If you come in contact with an energized (live) black wire, and you are also in contact with the white grounded wire, current will pass through your body and YOU WILL RECEIVE A SHOCK

HOW IS AN ELECTRICAL SHOCK RECEIVED? (CONT)

- If you are in contact with an energized wire or any energized electrical component, and also with any grounded object, YOU WILL RECEIVE A SHOCK
- You can even receive a shock when you are not in contact with a ground
  - If you contact both wires of a 240-volt cable, YOU WILL RECEIVE A SHOCK and possibly be electrocuted

MOST COMMON CAUSES OF ELECTROCUTION

- Contact with Overhead power lines
- Contact with live circuits
- Not following Lock-out / Tag-out procedures
- Poorly maintained extension cords
- Defective power tools

DIRECT AND INDIRECT TYPES OF ELECTRICAL INJURIES

Direct

- Electrocution or death due to electrical shock
- Electrical shock
- Burns
- Hearing loss from arc blast

Indirect

- Falls
- Fire

ITS YOUR RESPONSIBILITY TO KNOW THE WORK HAZARDS

- Know the hazards of electricity
- Know the equipment
- Use safe work practices
- Inspect your PPE before each use
- Don’t work on energized circuits without permission

OVERHEAD POWER LINE HAZARDS

- High wires are usually not insulated
- Examples of equipment that can contact with these power lines:
  - Crane
  - Ladder
  - Scaffold
  - Backhoe
  - Scissor lift
  - Raised dump truck bed
  - Aluminum paint roller

OPERATING EQUIPMENT NEAR OVERHEAD POWER LINES

- The OSHA requirements limit crane operations to a minimum clearance of 10 feet for lines rated at 50 kilovolts (kV)
- Follow safe distance operating instructions for all power lift equipment

29 CFR 1926.1408
Table A

Voltage	Minimum Clearance Distance
Up to 50 kV	10 feet
Above 50-200 kV	15 feet
Above 200-350 kV	20 feet
Above 350-500 kV	25 feet
Above 500-750 kV	35 feet
Above 750-1000 kV	45 feet
Above 1000 kV	(As established by the utility owner/ operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution)

Figure 1. OSHA's minimum clearance distances.

FLASHOVER

- High-voltage electrical short circuit made through the air between exposed conductors
- Can occur when equipment is operating too close to overhead power lines

ARC BLAST/FLASH

- When an arc fault occurs, the result is a massive electrical explosion. The light and heat emitted by the explosion is known as the arc flash, and the pressure wave is known as the arc blast
- Pressure waves generated by an arc flash explosion can carry a force up to thousands of pounds per square inch
- Powerful enough to knock down or throw nearby workers, and cause damage to the eardrums, lungs, brain and other organs. Other effects of arc blast include: High temperatures

PROPER PPE FOR ELECTRICAL SAFETY WORK

- 100% cotton long sleeve shirts
- Heavy duty leather coat
- Heavy duty cotton long pants
- Safety glasses or arc flash shield
- Hearing protection
- Leather work boot – non-steel toe
- Gloves rated for the electrical work with outer leather
- DO NOT WEAR polyester clothing or clothes that are highly flammable

ELECTRICAL SAFE WORK PRACTICES INCLUDE

- Use barriers and guards to prevent passage through area of exposed energized equipment
- Pre-plan work, post hazard warnings
- Keep working spaces and walkways clear of slip, trip, and fall hazards

CONTROL – USE OF GFCI (GROUND-FAULT CIRCUIT INTERRUPTER)

- Detects the difference in current between the black and white wires as low as 2mA
- If ground fault is detected, GFCI shuts off the electricity in 1/40th of a second
- Protects you from the most common form of electrical shock hazard, the ground fault
- Will not protect you from line contact hazards – such as holding two hot wires and hot wire and neutral in each hand or from an overhead power line

OSHA'S ELECTRICAL STANDARDS, NFPA 70 AND 70E

- OSHA's electrical standards are based on the National Fire Protection Association Standards NFPA 70, and NFPA 70E, Standard for electrical safety for employee workplaces

- Only qualified employees may conduct electrical work

- Special training is required for qualified employees:
  - Safe work practices
  - Isolation of electrical sources
  - Test equipment
  - Tools and PPE

Is compliance with NFPA 70E standard for electrical safety in the workplace mandatory?

Answer: No

NFPA 70E is a national consensus safety standard published by NFPA primarily to assist OSHA in preparing electrical safety standards. Federal OSHA has not incorporated it into the CFRs

Can I be cited for not complying with NFPA 70E?

Answer: Yes

The employer must asses the workplace for electrical hazards and the need for PPE under 29 CFR 1910.335(a)(I)(i)
The employer is expected to use the best means available to comply with this requirement that is done through consensus standards
In the event of an injury or death due to an electrical accident, if OSHA determines that compliance with 70E would have prevented or lessened the injury, OSHA may cite the employer under the general duty clause