Electrical Safety

PPE

Meter Safety

Hidden Hazards

Work Practices

Introduction

- 36 Years in the electrical field
- 31 Years as a Master Electrician
- 26 Years in the Pharmaceutical industry
- 14 Years CVECA apprenticeship program
- 9 Years BOD Region III VPP and SGE
- Electrical Safety for: NASA Goddard Space Center, Virginia Department of Corrections, International Paper, and Region III VPP Conferences

Electrical Safety-24/7

- This presentation is intended to increase your safety awareness
- It is intended to reveal hidden hazards you won't find in text books
- It is intended to educate you on the risk you or others may be taking everyday on the job
- It is intended to help you create a safer work environment and reduce the unnecessary risk workers take

Why Is Safety Important

- My Injury-It only takes a split second
- One person's mistake can injure or kill
- One person's mistake can bring your business operations to a screeching HALT!
- **You don't always get a second chance!!!!!!**

Conditions Providing Acceptable "Risks"

"The risk associated with normal operation of electrical equipment is minimal, given the following conditions:

1 – The equipment is properly installed, in accordance with applicable industry codes and standards including the manufacturer's instructions.

2- The equipment is properly maintained, in accordance with the manufacturer's instructions and applicable industry codes and standards.

3 – The equipment doors are closed and secured. All the equipment covers are in place and secured.

Conditions Providing Acceptable "Risks"

4- There is no evidence of impending failure, such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

5- The equipment is used in accordance with the manufacturer's instructions and it's listing.

Under such conditions the risks of an employee being shocked, electrocuted, or injured by an arc flash or blast or from fire caused from the use of electricity is minimal and considered acceptable. "

NFPA-Statistics Safety Triangle

When looking at the **standard** injury triangle, there are approximately 300-recordable injuries for every 1-fatality. These statistics change drastically for electrical injuries. The ratio for **electrical** recordable injuries to fatalities is 10 to 1. For every 10 electrical recordable injuries there is one fatality. **Why do you think this is so?**

Hidden Electrical Hazards

- Unlike other energy sources, you can't see, smell, or hear electricity (only the effects).
- Electricity travels through copper wire approximately 1/100 the speed of light or 1860 miles per second, too fast for you to get out of the way!
- Under the right conditions, it takes very little electricity to kill you.
- NFPA-70E requires special safety precautions when personnel are exposed to live parts operating at 50 volts or greater.

NFPA Reports Electrical Fatalities By Event

- 44%= contact with overhead power lines
- 27%= contact with wiring, transformers, and other electrical components
- 17%= contact with exposed energized parts of machines, tools, appliances, or light fixtures
- 12%= contact with underground power lines and wiring, struck by lightning, contact with electric current unspecified

Hidden Electrical Hazards

- OSHA estimates nearly 350 fatalities each year from electrocution, that's almost one per day!!
- Working equipment Hot and getting shocked is a "man-thing" a right of passage. Our industry needs a culture change. No other occupation permits so many near misses. (transportation example)
- No matter how qualified or experienced you are, OSHA does NOT recognize "skills" or training as a protective method against hazardous energy.

Electricity is Hazardous Energy

A phase to phase or phase to ground electrical fault

Copper vaporizes, expanding 67,000 times

Copper Penny = Refrigerator

Temperatures can reach as high as 36,000 degrees; that's 4 X hotter than the surface of the Sun

A flash burns eyes like a welding arc

A blast can breaks bones, rupture ear drums

A flash and blast can start fires, cause explosions, and cause injuries or fatalities

Hidden Hazards

Dr. A.G. Soto presented a white paper at the 2007 IEEE Electrical Safety Workshop discussing low-voltage shock exposures. In that paper, he stated that a 120-volt shock can **kill up to 48 hours later**. He also stated that many emergency room physicians are unfamiliar with electric shock and that an EKG may not show a problem. The injury to the heart muscle tends to spread over time and cannot always be identified using EKGs.

We Need A Culture Change

- I always thought if you walked away from a shock you were ok.
- On the contrary, a shock on Friday could lead to a heart attack on Sunday while watching your favorite football game.
- Educate your employees, educate your family, if a shock is encountered be on the "**48 hour watch"**
- Pay attention to the signs, if you start experiencing chest pains-go to the ER!!

Hidden Hazards

Unqualified employees and contractors-CVECA

Improper PPE-selection/storage/inspection

Improper meter selection and usage

Improper LOTO

Improper maintenance

Improper repair/replacement parts

Incorrect one line drawings

Incorrect panel schedules

NFPA-70 and 70E Define "Qualified" as:

"One who has **skills** and **knowledge** related to the construction and operation of the electrical equipment and installations and has received the **safety training** to recognize and avoid the hazards involved?"

Electrical PPE

- Electrical equipment must be properly identified according to the incident exposure. The employee must know what level of PPE is required-NO Guessing. Engineering studies, arc flash software, and NFPA-70E table can guide you
- PPE must be properly stored and inspected
- PPE must be worn even after LOTO until 0-energy has been verified.

PPE Hazard

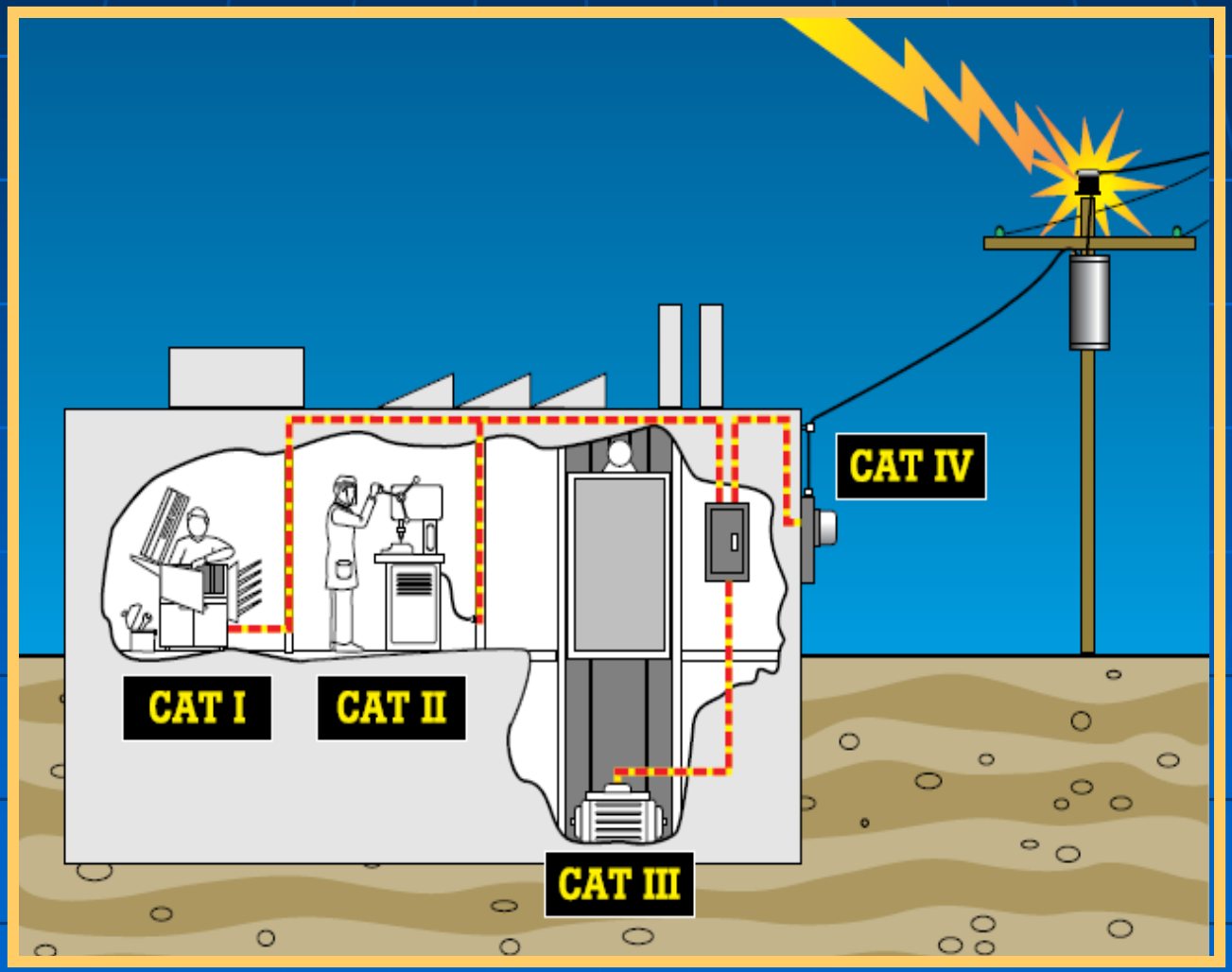
Electrical PPE Hidden Hazards

- In the event of an arc flash or blast the proper PPE will reduce the injury to a 2nd degree burn or a (sunburn), it doesn't prevent burn 100%.
- Arc shield skews wire colors (blue/green, yellow/white)
- Rubber electrical gloves must be worn with the leathers to provide shock and arcflash protection.
- Electrical gloves must be stored flat, in a cool dry location separately from the leathers.
- Petroleum based products deteriorate the rubber on electrical gloves
- Direct sunlight deteriorates the rubber gloves also

Meter Safety and Usage

- **OSHA-1910.334(c)(3)** – "Test instruments and equipment and their accessories shall be rated for the circuits and equipment to which they will be connected and shall be designed for the environment in which they will be used."

Meter Safety and Usage



Meter Safety and Usage

New

1000 V CAT III and 600 V CAT IV meters designed to withstand 8000 V transients

Use meters with these markings:
1000 V CAT III or 600 V CAT IV

Old

Fluke meters designed to older standards do not show category rating on front of instrument

Do not use meters without proper CAT markings on 480 V circuits

Meter Safety and Usage

When using a meter, NFPA-70E requires they be used by qualified persons

OSHA- Live Dead Live test circuits over 600 volts

NFPA-70E- Live Dead Live test circuits 50 volts and over

Meter Safety and Usage

- The insulated test point touches grounded metal.
- The cable being tested is partially buried.
- The user is isolated from ground.
- It is used inside a metal enclosure.
- **Not reliable for LOTOTO**
- Beware of voltage ratings

Meter Safety and Usage

EXAMPLE:

VFD's (variable frequency drives) can still be energized even after performing LOTO

Verification of 0-voltage must be checked on **AC** and **DC** meter settings

PPE MUST BE WORN DURING THE VERIFICATION PROCESS

Meter Safety and Usage

- Using the wrong fuse or jumping it out can create a thermal hand grenade.

- When using a DMM to measure voltage, amperage, or resistance, change lead configuration and meter settings.

Hidden Electrical Hazards

- There are 3-NFPA standards that directly affect electrical safety: NFPA-70, 70B. 70E
- NFPA-70 National Electrical Code- minimum electrical installation requirements
- NFPA-70B Recommended Electrical Maintenance these are industry standard recommended electrical maintenance requirements
- NFPA-70E Electrical Safety In The Workplace these are recommended safe electrical work place practices for employees and contractors
- All 3 are key to a successful electrical safety program and safe work place

Electrical Equipment Hazards

Many licensed electricians are not qualified to change out circuit breakers.

Circuit breakers can be very different even though they may look alike. Don't make a decision based entirely on price.

Some circuit breakers are manual switches, they will not "trip" when there is an overload or a fault.

In the event of a fault, some circuit breakers can explode or weld themselves closed if they don't have the proper fault current rating.

Looks Can Be Deceiving

This breaker will trip

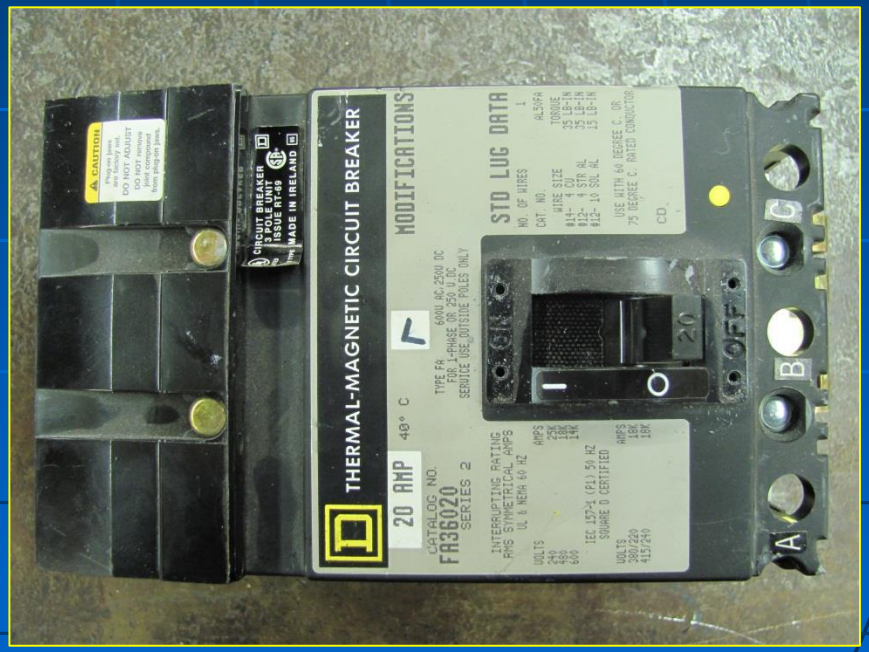
This breaker will Not

Know What You Are Buying

Both Breakers Are Square D I-Line 3-Pole 20-Amp

$900.00

$300.00



Electrical Equipment Hazards

Know the difference between equipment protection and personal protection for GFCI breakers. The difference can kill.

Locate GFCI cord sets on portable equipment to maximize protection, this may not always be convenient. (fatality)

Test GFCI's per mfg. instructions to ensure they will work when you need them. (monthly)

Electrical Equipment Hazards

Know the Difference
The Difference Can Kill

One Protects Equipment
The Other Protects You

Work Practices

- A planned outage is always less expensive than an accidental one
- Inconvenience is not an excuse for working it HOT
- Lack of illumination is not an excuse for working it HOT
- Production demands are not an excuse for working it HOT
- An electrical “HOT” work permit must be use when working on live equipment

Work Practices

Justification for Live Work

Metering

Troubleshooting / Start-up

Diagnostics / Testing / Calibrating

Life Support Equipment(not life safety)

Hazardous Location Ventilation

Emergency Alarm Systems

Increased hazard “environmental issues”

Infeasible, continuous process (Example)

Work Practices

Establishing an Electrically Safe Work Condition

6-Step Procedure:

Check drawings

Open disconnecting means

Verify all blades are OPEN (PPE)

LOTO-Lock Out Tag Out

Verify 0-electrical potential (PPE)-Try Out

Ground if necessary-over 600v, multiple sources

Work Practices
Permit Required

A permit is required if:

Voltage is greater than 49 volts

Work performed is not covered under "exceptions"

Permit is risk assessment, keep on file

Permit must be management approved

Work it hot as a last resort only and always wear the proper PPE!!!

Presentation Information Obtained From The Following:

- www.DOL.gov
- www.OSHA.gov
- www.cdc.gov/niosh/face/
- www.osha.gov/SLTC/electrical/index
- www.osha.gov/dts/shib/index
- www.osha.gov/dts/osta/oshasoft/index
- http://us.fluke.com/usen/Training/Safety/default.htm
- NFPA-70E 2015

Questions / Comments