Welcome to the Hard Hat Training Series!

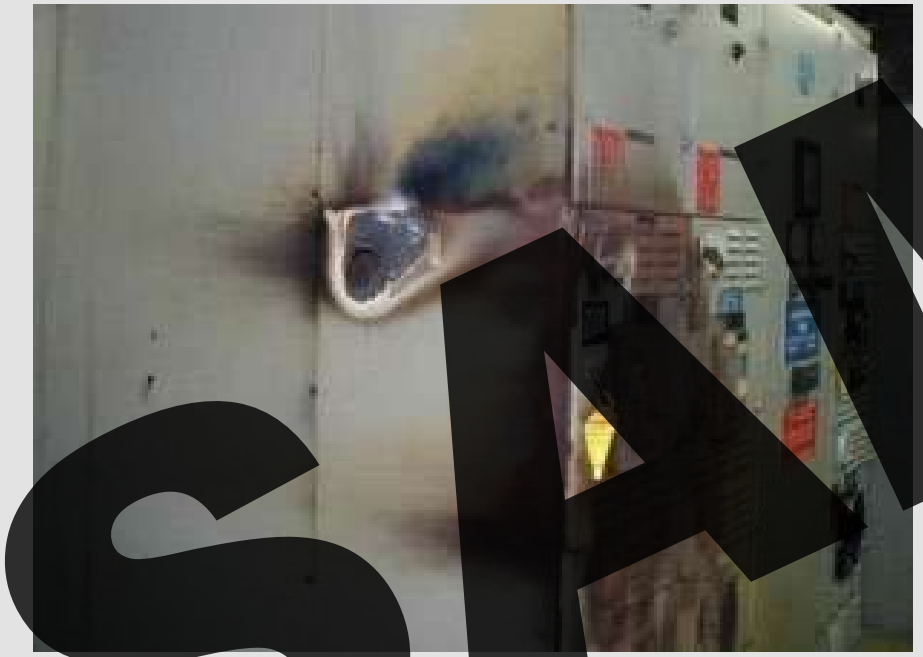
Welcome to the Hard Hat Training Series. Today, we will talk about electric utility safety. We will strive to provide the tools and information that will increase your knowledge and help to make you a better, safer operator.

On December 31, 1879, Thomas Edison did his first demonstration of the light bulb. This became the start of a new era, one where you didn't have to go to bed just because it was dark. People all over the world now use electricity in their everyday life. Some would even say that electricity was the greatest discovery ever made.

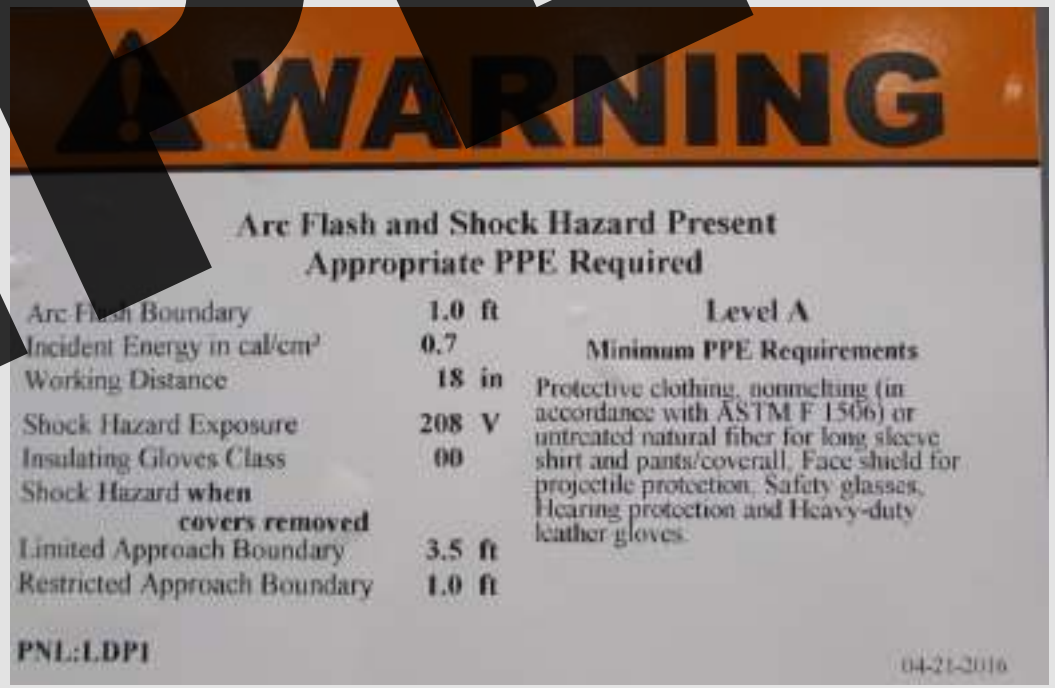
Image from PBS News Hour

While electricity has been a great tool, when you don't take the necessary precautions, it can be dangerous. Our goal today is to help you understand procedures and standards as they relate to electric utilities, thus encouraging safe work habits.

We will begin by defining some common terms associated with electric utilities. We will also briefly discuss the equipment you will likely use while doing this type of work, including MEWPS, cranes, and bucket trucks. We will then discuss the importance of job briefings and how to perform a proper job hazard analysis (JHA).



Next, we will discuss how to keep yourself and your coworkers safe by using controls. We will discuss Hazardous Energy Control Programs (HECPs), lockout/tagout, guarding, and training. Additionally, we will teach you how to properly utilize grounds and what kind of PPE your employer should be providing.



Next, we will discuss equipment in depth, including principles of stability and balance for heavy machinery and how to safely use the various hand and power tools at your disposal.

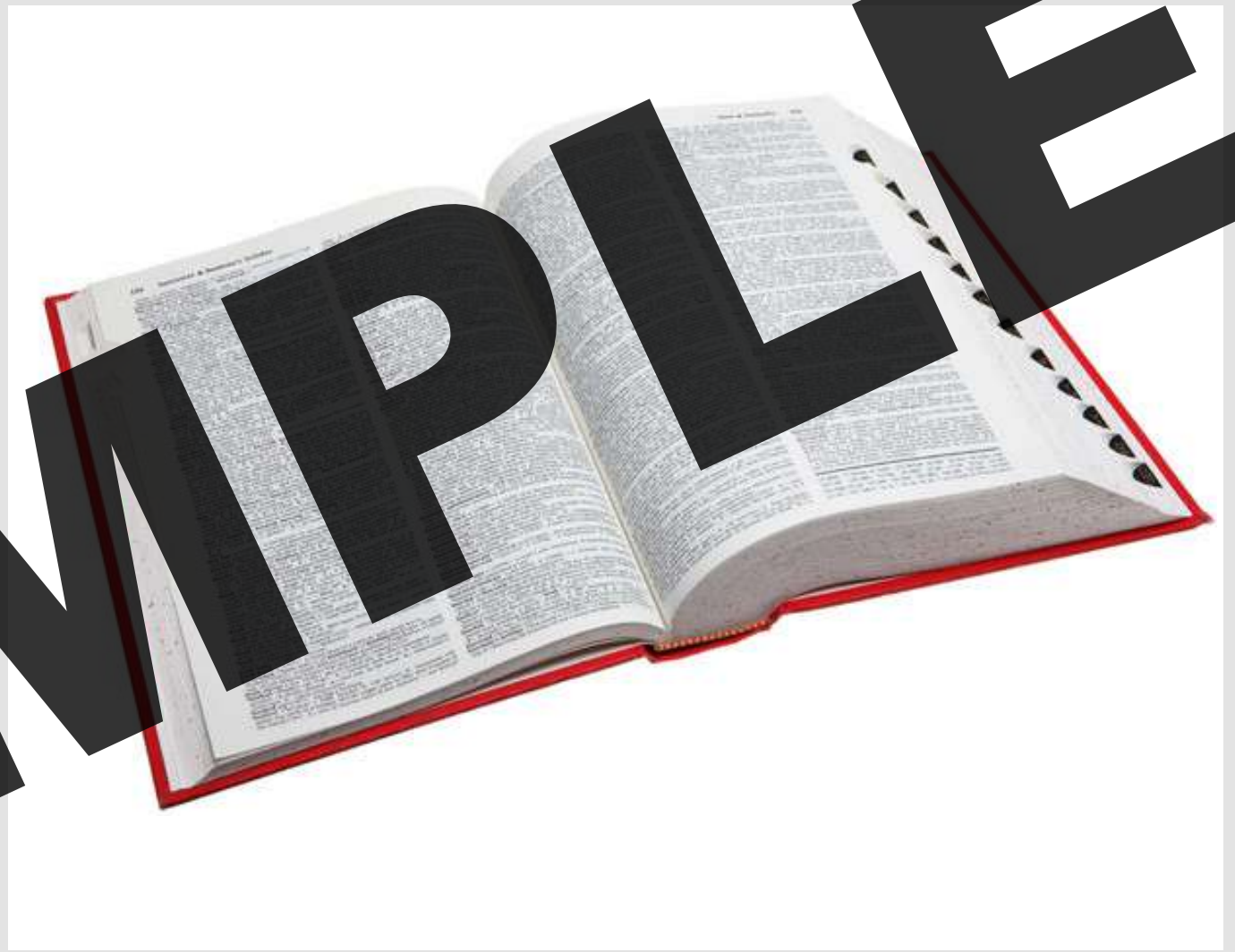
Image courtesy of Salisbury by Honeywell

We will then move into how to work safely in the field as well as in a utilities facility. We will teach you how to work safely in power generation and substation facilities, communication facilities, and pole-top and live-wire operations.

Finally, we give an overview of emergency response procedures for confined spaces as well as pole-top situations. This way, you know what to do and how to respond if an accident does occur.

Definitions

Let's begin by defining some important terms we'll be using throughout today's training. Some of these are likely familiar to you, but it is essential that you review them in order to fully understand the concepts explained later in the training.



NESC & IEEE

The National Electrical Safety Code (NESC) is a standard regarding the safe installation, operation, and maintenance of electric power and communication utility systems including power substations, power and communication overhead lines, and power and communication underground lines. It is published by the Institute of Electrical and Electronics Engineers (IEEE).

Image from Flickr (Mary (CC 2.0))

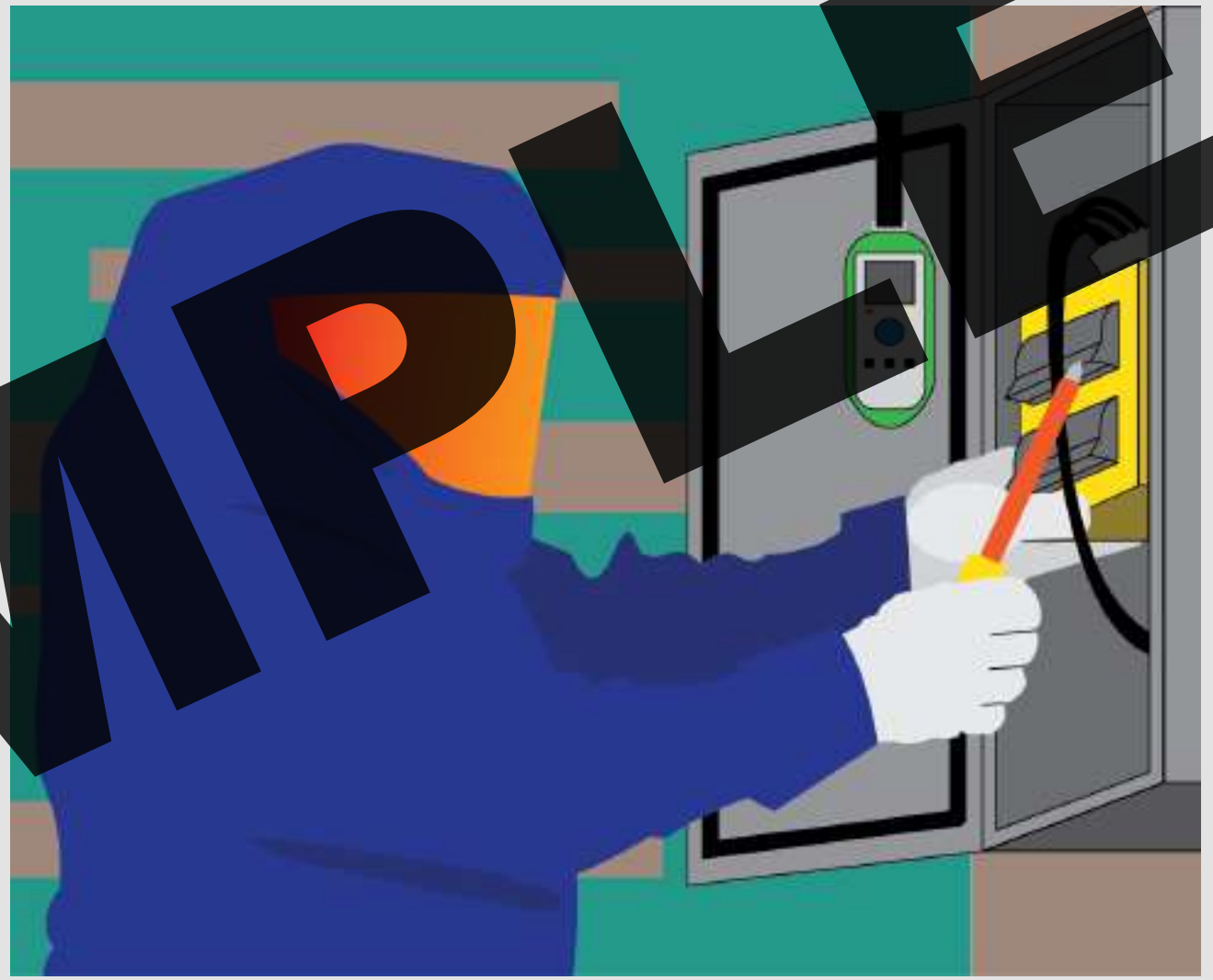
The NESC is a voluntary standard, but it is usually adopted by individual states and jurisdictions as law in some form or another. While we will reference the NESC and IEEE occasionally, it should be noted that this training has been built specifically to OSHA regulations, which we will discuss further a little later.

Take Note!

Do not confuse the NESC with the NEC, which is the National Electrical Code published by the National Fire Protection Association (NFPA). The NEC covers residential, commercial, and industrial building wiring.

Qualified Person

A **qualified person,** as defined by the NFPA and OSHA, is someone who has obtained a recognized degree or certification, along with extensive training and on-the-job experience. They have also demonstrated their ability to initiate programs or procedures, as well as a capability to identify and avoid hazards.



A qualified person is someone trained and trusted to work within the restricted work boundary. They are familiar with the pertinent instruments and equipment. The qualified person is familiar with the risks involved while working on energized equipment and has been trained to do so. Furthermore, they can identify hazards and use the necessary control methods to mitigate risks.

Only a qualified person may work on equipment with exposed energized parts. Additionally, only a qualified person may work unsupervised in areas with exposed energized parts of 50 volts or more.

Every individual within the limited approach boundary must, at a minimum, be trained in the material below according to the NFPA. Hazards will vary from site to site, so familiarize yourself with the list below.

1. Distinguish exposed energized electrical conductors and circuit parts from other parts.
2. Determine the nominal voltage of exposed energized electrical conductors and circuit parts.
3. Approach distances and the corresponding voltages to which the qualified person will be exposed.
4. Decision-making process necessary to do the following:
    a. Identify electrical safety hazards
    b. Assess the associated risk
    c. Perform the job safety planning
    d. Select the appropriate risk control methods from the hierarchy of controls including PPE.

Electricity

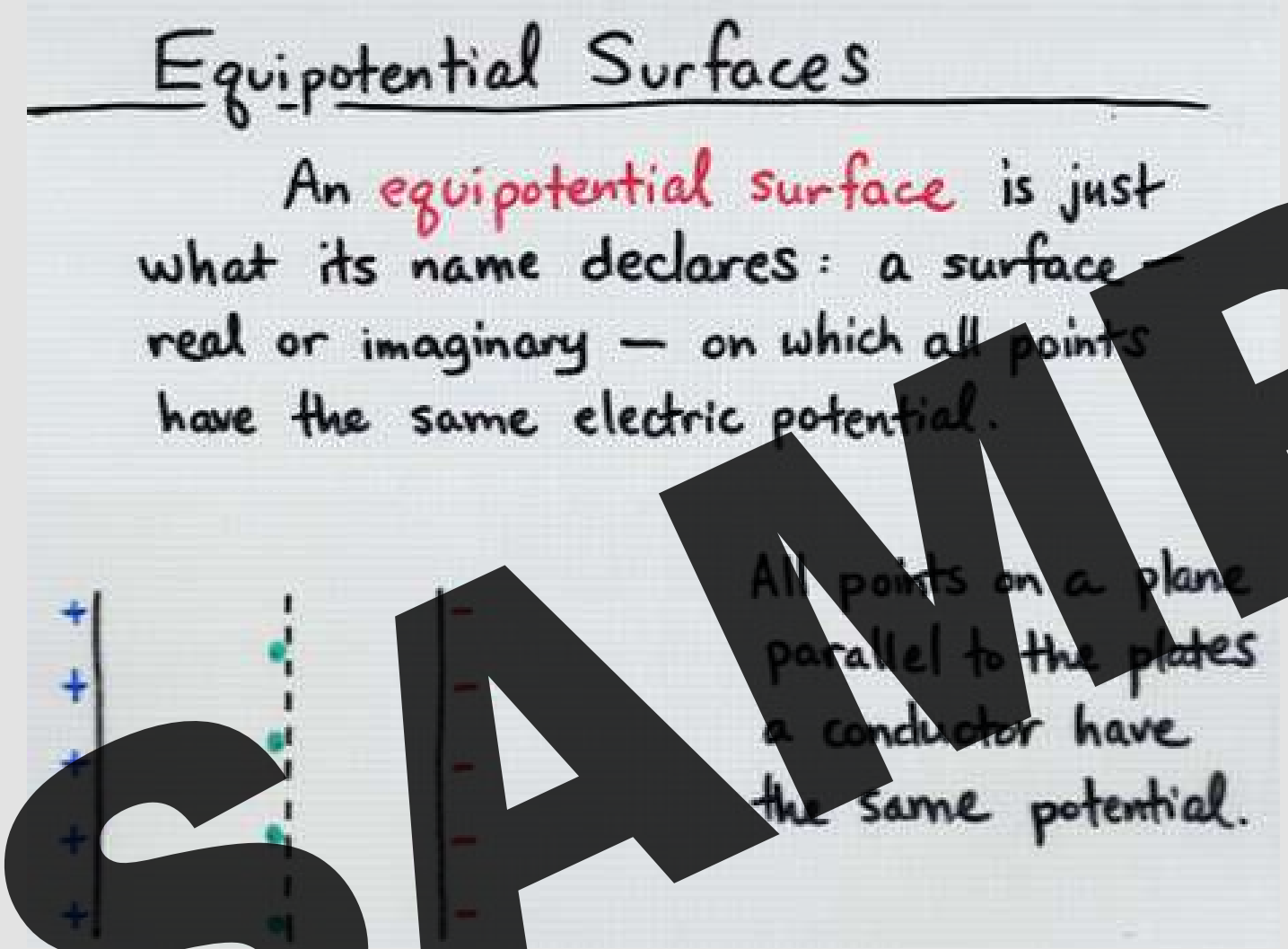
At its simplest, electricity is the difference in energy between two points. This difference is measured relative to the earth. In order to harness the tremendous energy of electricity, it must be isolated from the ground, as it will always take the path of least resistance back to the ground. This could be through a motor, a heater, or a worker.

Alive, Live, Energized

Any time machinery or utility lines are connected to a source that is electrically charged to the point of having a significant difference from that of the earth in the vicinity, it is considered energized. For the sake of this training, we will be using the words alive, live, and energized interchangeably.

Resistance

Electrical resistance measures how much a device or material reduces the electrical current through it. It is measured in ohms (Ω). Think of a pipe with water flowing through it. If the pipe is narrow, it has a higher resistance to the water, so the flow is decreased; if the pipe is wide, it has a lower resistance and the water flows freely.



Equipotential

When conductive surfaces are equipotential, they are either running the same voltage or have the same capacity. An equipotential surface neither helps nor hinders an electrical charge. Electrical field lines are always situated perpendicular to an equipotential surface.

Fault

A fault is when electricity finds its way from energized elements, usually cables, to another conductive material, or to the ground itself. This will cause the electrical current to be interrupted, and may cause a reclosure or breaker trip, and ultimately could result in power failure.

Conductor

A conductor is any material that can carry an electrical current. This is ideally a wire, cable, or bus bar, but tools and equipment can also become conductors if proper precautions are not taken.

Bond

Bonding is when metal elements are permanently joined together in order to form an electrically conductive path. This ensures that if a fault does occur, it will have a low-resistance path to take to trip the overcurrent devices as quickly as possible. It will also provide a path for static electricity and induced voltages to drain out. A bond must be able to safely conduct any fault current that is likely to be imposed on it.

Ground

A ground is anything that provides an electrical path to the earth. These can be intentional or accidental. Grounding elements can include conductors, electrodes, and any connections used to securely fasten these parts together.

Insulated

Insulators are materials that will not easily allow electricity to pass through them; for example, rubber. Insulation must be suitable to the job and conditions at hand.

Telecommunications Center

Telecommunication centers are, as you may guess, facilities meant to house communication equipment that allow people to communicate from across great distances. This includes phone, antenna television, or even telegraph equipment.

Vault

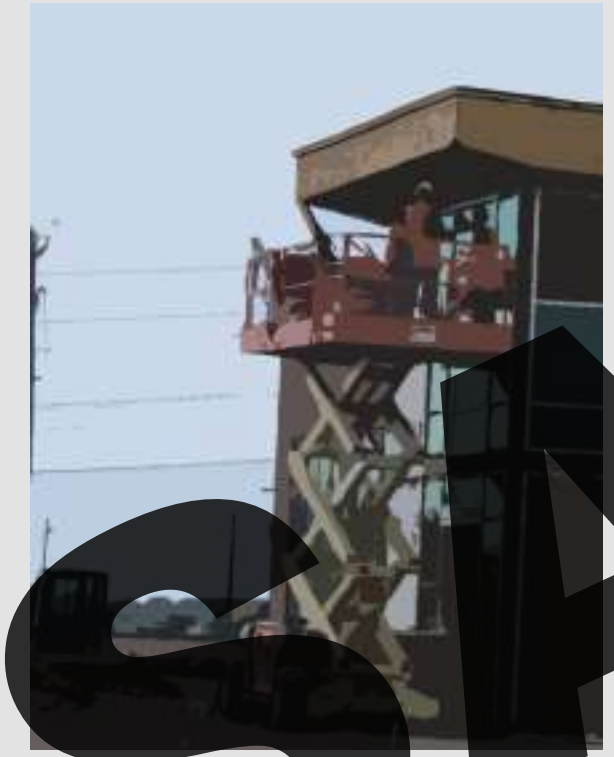
A vault is used for installing, operating, or maintaining equipment. It is an enclosed space, which can be located above or below ground. Some vaults are vented, which allows for temperature regulation.

Table of resistance values of Ohm

name	symbol	conversion	example
milli-ohm	mΩ	$1m\Omega = 10^{-3}\Omega$	$R_0 = 10m\Omega$
ohm	Ω	-	$R_1 = 10\Omega$
kilo-ohm	kΩ	$1k\Omega = 10^{3}\Omega$	$R_2 = 2k\Omega$
mega-ohm	MΩ	$1M\Omega = 10^{6}\Omega$	$R_3 = 5M\Omega$

Equipment

Over the next few slides, we will discuss some of the equipment and heavy machinery you may use when performing work at electrical or telecommunication lines or facilities. Note that you must receive additional training before operating any of these machines.



MEWPs

MEWPs are aerial devices that can be used to elevate a worker above the ground. They can include extendable boom platforms, bucket trucks, articulating boom platforms, and vertical towers.

Mobile Cranes

Mobile cranes can hoist, lower, and horizontally move a suspended load. Wheel-mounted cranes, articulating cranes (including knuckle-boom cranes), rough terrain cranes, and commercial truck-mounted cranes are all machines you will likely use while working with electric utilities.

Bucket Trucks

A bucket truck is an aerial lift. They have a basket or bucket at the end of an articulating boom, which can hold workers. These can be insulated or non-insulated.

Standards, Policies, & Processes

STANDARDS

29 CFR 1910.268 – Telecommunications

- **Subpart R**

29 CFR 1910.269 - Electric Power Generation, Transmission, and Distribution

29 CFR 1926 Subpart V – Electric Power Transmission and Distribution

- **1926.964 –** Overhead Lines and Live-line Barehand Work
- **1926 Subpart V App D –** Methods of Inspecting and Testing Wood Poles

29 CFR 1926.957 – Live-line Tools

29 CFR 1926.963 – Underground Electrical Installations

These are some of the main standards concerning electric utilities and telecommunications safety. Many states have additional standards, as do some industries. We have provided these as a guide, but it's your responsibility to know all federal, local, and company rules that apply to your job site.

Other Standards

ANSI and the IEEE have additional standards pertaining to electric utilities and communications. As we mentioned earlier, this training is in accordance with OSHA standards, unless otherwise noted.

Company policies and standard operating procedures (SOPs) should be established according to these standards, regulations, and guidelines. These should include a company safety program, an HECP, and an emergency action plan (EAP).

Electrical Safety Programs

Employers use electrical safety programs as a method to control and eliminate hazards by outlining and defining risks associated with electrical hazards and then explaining safe practices in the workplace. The employer must implement and document this program and make it available to anyone working with or around electrical hazards.

The safety program must be kept updated with current hazards and standards for the workplace, so employees can use it as a reference for safe operations. Elements of this program must include, but are not limited to:

- Maintenance
- Awareness
- Electrical safety program principles, controls, and procedures
- Risk assessment procedures
- Job briefing
- Electrical safety auditing

Maintenance

Equipment that isn't properly maintained is most likely going to fail and increase the chance of an arc flash or other electrical incident. An electrical safety plan should emphasize the importance of proper maintenance. It must also contain instructions for safely conducting maintenance.

Awareness

One of the main purposes of the electrical safety program is to increase awareness of the electrical hazards employees may be exposed to. It should also list controls and other ways to eliminate or lessen these hazards.

By showing appropriate respect for worksite hazards, procedures, and equipment, workers will ensure that safety is always the top priority. This may require retraining of employees at regular intervals, because it is easy to become complacent without realizing it.

Safety Principles

The employer must also outline general safety principles in the electrical safety program. These principles may include planning, inspecting, de-energizing, training, using the right tools, and auditing. Your employer may add or remove other items in this section, depending on the work to be done.

Images from Emerson Network Power

Program Controls

The electrical safety program should include program controls. These controls must include hazard identification and their associated risks, control methods to eliminate the hazards, and an outline of the qualified person's responsibilities working on the electrical equipment. The content of this section is determined by the type of work offered by the employer and the specific hazards the workplace presents.

Program Procedures

Also found in the electrical safety program is a section on program procedures. These may include justification of work to be performed, hazards involved, approach boundaries, safe work practices, PPE, and equipment diagrams and details. Many of these topics will be found in the energized electrical work permit, which will be explained further on. Much like the previous sections, the content involved here is also dependent upon the work and hazards involved.

Risk Assessment Procedure

An explanation of how to perform a risk assessment, in accordance with the pertinent equipment and tasks, must also be outlined in the safety program. Suggesting proper control methods associated with the hazards is a crucial part of this section.

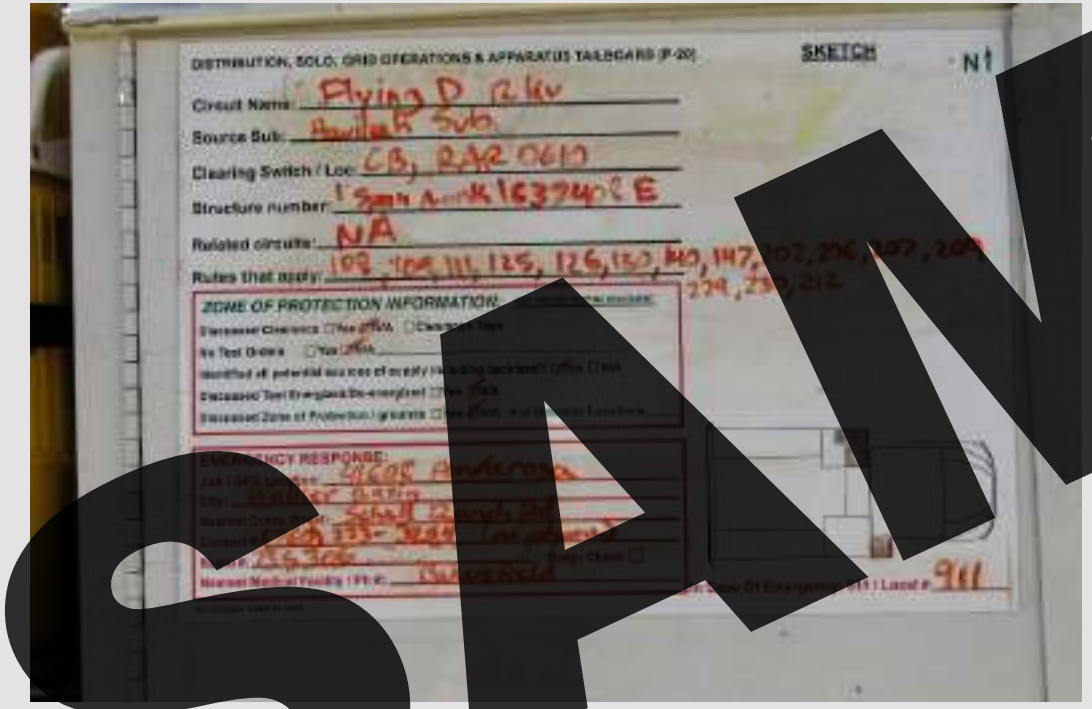
Job Hazard Analysis

Before working on energized equipment, qualified workers create and perform job hazard analysis (JHA), which identifies risks and hazards as well as ways to eliminate or control them before they occur. A JHA is one of the best ways to develop and establish proper work procedures. If uncontrolled hazards are found during the JHA, take steps to eliminate or reduce them to an acceptable risk level.

Job Briefings

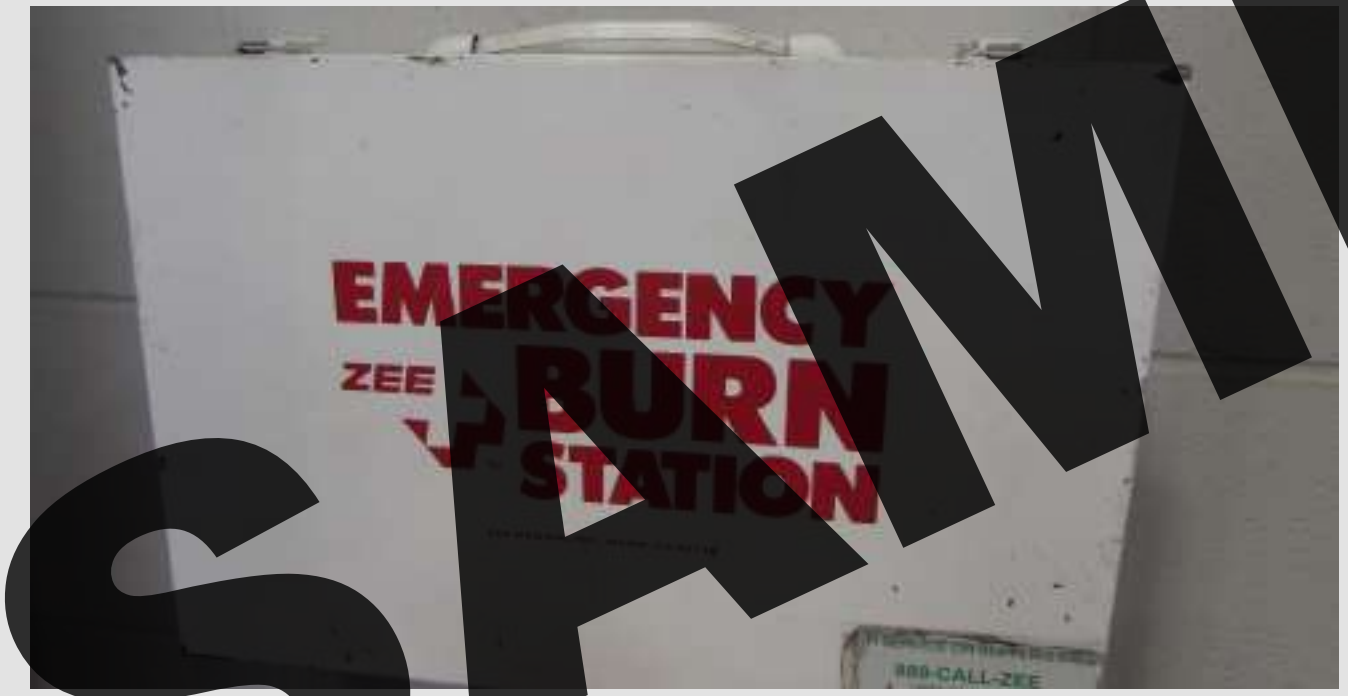
A job briefing must be performed and documented as a part of the safety program. The job briefing must take place prior to work beginning on the job. This will educate employees about hazards found during the JHA, as well as their specific tasks and responsibilities they are assigned to perform during operations.

Other items in the job briefing will vary from job to job but can include identification of hazards, describing the anatomy of the equipment being worked on, and mentioning the qualified persons and their job. A plan for safe work operations must be mentioned as well as an explanation of how to implement them.



Emergency Response Plan

An emergency response plan outlines what to do in the case of an arc flash and is vital to the job briefing. A response plan should include information on which employees know CPR, who has been trained in emergency response, and who to notify in the case of an emergency.



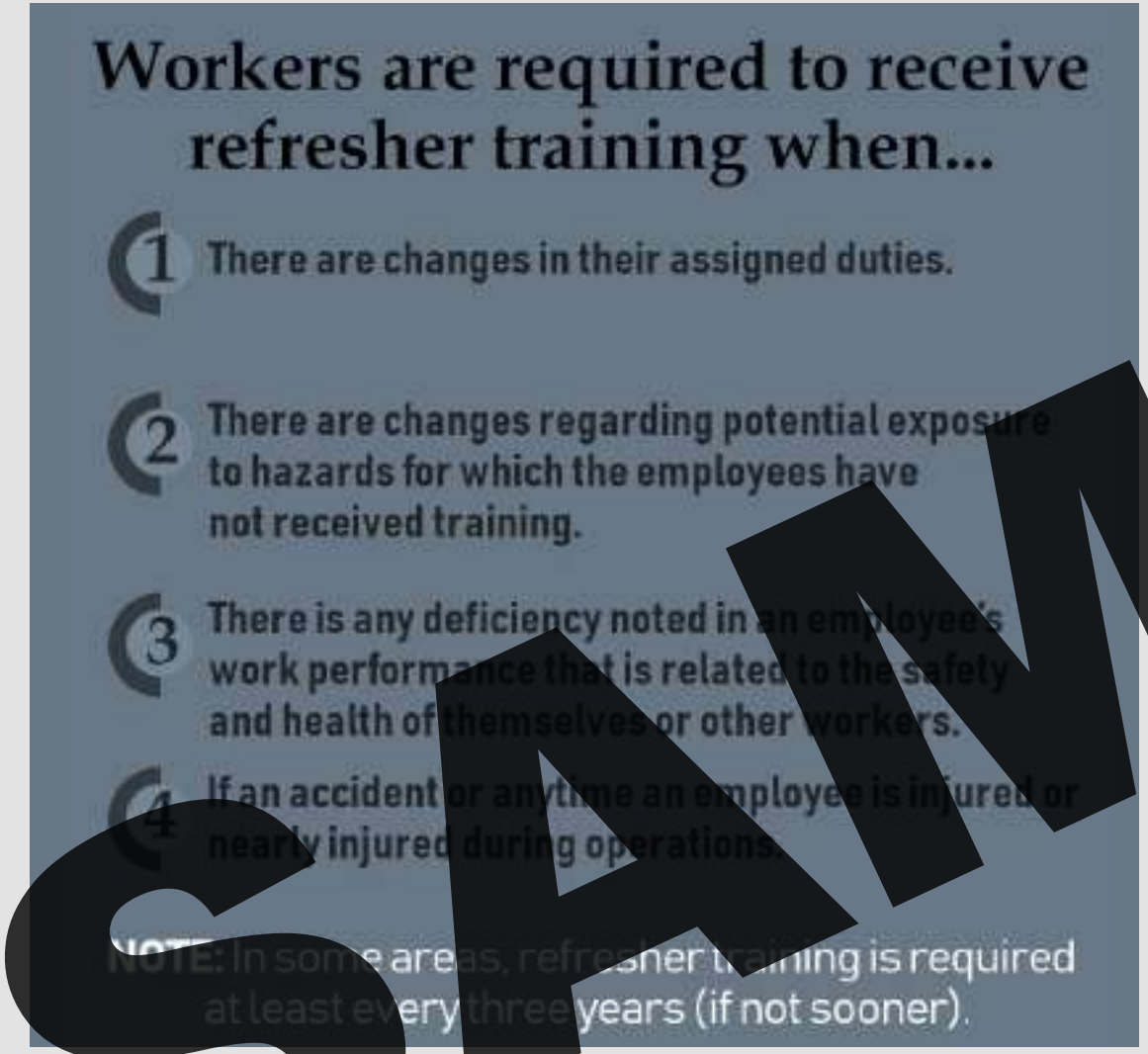
Auditing

Finally, a qualified person must audit and document the safety program to ensure all standards and information are up to date and complaint. They must inspect the company annually to ensure the standards are observed and practiced, and then inspect the program at three-year intervals to make sure its information is accurate.

Training

No matter the situation, it is common to hear workers and even employers ask “Where does it state we need to be trained? Can’t a worker also be deemed ‘qualified’ based on experience?” The answer is no. Experience helps, yes, but OSHA makes it clear that employees must be trained (no matter how long they’ve been on the job) and that it is the employer who is responsible for overseeing that safety training to confirm that the employees have the understanding, knowledge, and skills needed for safe electric utilities operations.

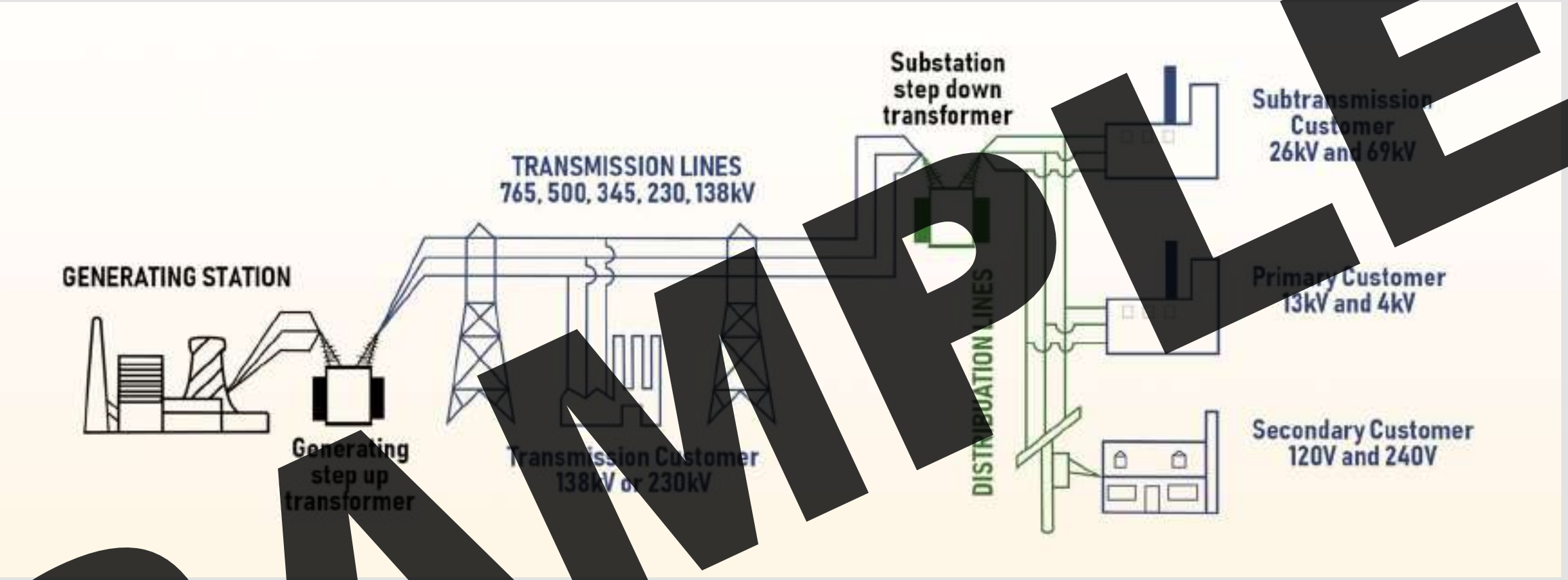
Initial training and refresher training, as well as any written and practical evaluations, must be documented and filed. At the very least, in the case of an investigation, OSHA will want to see proof of proper and consistent training (in the way of training outlines, class lists, training goals, tests, certificates, and so on.) These documents should include the name of the person who taught the class or conducted the evaluation.



Training is not just a one-and-done occurrence; it is on-going. In fact, similar to the guidelines set down for when initial training is required, OSHA is also specific when it comes to "refresher training." More specifically, OSHA acknowledges the need for "refresher" or "follow up" training whenever there is a demonstrated need for it.

The extent of training will be determined by the employer, but at the very least it should include classroom instruction followed by a written and practical examinations that prove continued competency.

This training will discuss many topics that you may already be familiar with, including lockout/tagout procedures, MEWPs (aerial lifts), and confined spaces safety. Remember, you are required to take specialized trainings on each of these topics in order to be compliant. For example, this training does not qualify you to work in confined spaces, except as needed in conjunction with installing, maintaining, or removing power and utility lines.



We will begin by discussing how to control the hazards associated with electrical utility and telecommunications work. You will learn about the hierarchy of controls and review some controls that are designed to keep you safe, including hazardous energy control plans (HECPs); job briefings and JHAs; lockout/tagout; guarding; grounding; and personal protective equipm