# PRESENTER'S GUIDE

# "ELECTROCUTION HAZARDS PART I: WORKSITE SAFETY"

**Part of the Construction Safety Kit Series**

**Quality Safety and Health Products, for Today... and Tomorrow**

# OUTLINE OF MAJOR PROGRAM POINTS

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The following outline summarizes the major points of information presented in the program. The outline can be used to review the program before conducting a classroom session, as well as in preparing to lead a class discussion about the program.

- **Getting things done on a busy job site requires plenty of energy, and a lot of that energy is electrical.**
  - Electricity powers most of the tools and equipment that you use.
  - It lights your work area.
  - It can even help keep you cool on the job.

- **But using electricity all the time makes it easy to forget that it can cause painful shocks, burns, even "electrocution".**
  - Every year, hundreds of injuries and deaths in the construction industry are caused by electricity.
  - Most of these incidents could have been prevented.

- **More than a hundred construction workers are killed by electricity each year.**
  - "Electrocution" is the fourth leading cause of death in the construction industry.

- **Construction workers also suffer more than half of the electrical injuries that occur on the job.**

- **To address these hazards, the Occupational Safety and Health Administration (OSHA) has established electrical safety standards for construction and general industry.**
  - OSHA's standards are based on the National Electric Code NFPA 70E, created by the National Fire Protection Association.

- **OSHA regulations emphasize the importance of employee training. Workers are required to receive training on:**
  - The electrical hazards that they can encounter on a job site.
  - Their employer's responsibility to provide protection from those hazards.

- **OSHA has defined six general types of electrical hazards.**
  - To make them easy to remember, their initials spell out the phrase "BE SAFE".

- **"B" stands for "burns", which are a common shock-related injury.**
  - Burns can be caused by exposure to electric current, being close to an arc flash, or contact with a surface that's been heated by an electrical overload.

- **"E" stands for "electrocution", which means being killed by exposure to a lethal amount of electricity.**

- **"S" stands for "shock".**
  - Shock occurs when electricity passes through part of your body.

- **"A" stands for "arc flash", a violent electrical explosion that occurs when an electrical system is disturbed so that the energy suddenly leaps through the air like lightning.**

- **Arc flashes are particularly dangerous, since they can create:**
  - Heat as high as 35,000 degrees Fahrenheit.
  - Light that is bright enough to burn the skin.
  - Deafening noise.
  - A pressure wave or "arc blast" that can break bones, damage internal organs and blow a person across the room.

- **"F" stands for "fire", which can be caused by cords, wiring, receptacles and switches that are faulty or overloaded with too much current.**

- **"E" stands for "explosions".**
  - Explosions can occur when electricity creates sparks that ignite explosive or flammable vapors or dusts in the air.

- **That's a pretty grim list, but to help you avoid these hazards OSHA has also identified the most common ways that construction workers can be exposed to them on a job site. They include:**
  - Contact with overhead power lines.
  - Contact with "energized sources" such as exposed electrical components and faulty or damaged equipment and tools.
  - Improper use of extension cords and electrical connectors.

- **The amount of electricity carried by a high-voltage power line can range from 120 to three quarters of a million volts.**
  - So the first time you touch one is also usually the last.

- **Accidental contact with overhead power lines on job sites is a major cause of electrocution among construction employees.**
  - OSHA has established specific safety standards to address this hazard.

- **About 20% of power line electrocutions occur when workers themselves touch a power line.**

- **But even more occur when the tools and materials that they are carrying, or the equipment they are operating, either touch the lines or get a little too close to them.**
  - If you're carrying an aluminum ladder or length of rebar... operating a boom crane or dump truck... or working from a manlift... you can be killed by electricity jumping to them and then to you.

- **If a metal ladder just gets too close to a power line, it can act just like a lightning rod.**
  - You should always use ladders that are made of non-conductive material, such as fiberglass, when working around utility lines.

- **While power lines do have "protective coatings", they are there to protect the wires from the weather.**
  - They won't protect you from the electricity in the lines.

- **So whenever possible, arrangements should be made for the utility company that operates the lines on a job site to de-energize and ground them.**
  - If they cannot power down the lines, they may be able to install insulated sleeves over them to provide some degree of protection.

- **For "live" power lines it's critical to determine how much voltage is being carried in the lines.**
  - That number will tell you how far you need to stay away from the lines to avoid electrocution.

- **If you don't know the voltage in a line, you should assume that it's enough to kill you and stay at least 10 feet away.**

- **When you do know the voltage, you can use the table in OSHA's Electrical Safety Standards to determine the "safe working distance".**
  - This distance increases as the voltage increases.

- **Flagged warning lines, caution tape and signs should always be set up to mark both the horizontal and the vertical safety limits around overhead wires.**
  - High-visibility markings, spotters, barricades and other devices should also be used to prevent vehicles and equipment from getting too close to them.

- **If you ever have questions about how to work safely around overhead power lines, ask your supervisor.**

- **Not all power lines are above ground.**
  - Like other utilities, electric power lines are sometimes buried underground.
  - Accidentally coming into contact with a buried line when using a backhoe, auger or other digging device can lead to fires, arc flash explosions, even electrocution.
  - Water in trenches around buried wires can also create serious electrical hazards.

- **So before work begins on any construction site, you should contact the 811 *"Call Before You Dig"* number to determine whether any utilities lines are buried there, and if so, where they are located.**

- **If there are utilities onsite, the company that operates them will send a "locator" to mark where the lines run.**
  - It's important to find and understand these markings before you start digging.

- **Excavation should always be performed with caution around the lines, and hand tools should be used within three feet of them.**
  - Remember, there may be more than one line buried in the same location.

- **Construction work can cause serious wear and tear on electrically-powered hand tools and extension cords, as well as the receptacles that they plug into.**
  - Cords fray, insulation cracks and parts wear, break or get lost.
  - Unauthorized alterations and amateur "repairs" can make things even worse.

- **Eventually, tools and equipment that used to be safe can expose workers to shocks, burns and electrocution.**
  - You can avoid these hazards by following the safe work practices that are included in OSHA's Electrical Safety Standards.

- **Begin with a careful inspection of all electrical equipment before you use it.**

- **Check tools for:**
  - Cracked housings.
  - Loose or missing parts.
  - Rust or corrosion.

- **Inspect the tools' power cords for:**
  - Fraying.
  - Cracked insulation.
  - Exposed wires.

- **If you find problems with a tool, do not use it.**
  - Take it out of service and replace it.

- **When using electrical tools, you should always follow the operating instructions that have been provided by its manufacturer.**

- **Safe work practices for power tools include:**
  - Never carrying a tool by its cord.
  - Keeping your fingers away from the on/off switch until you're ready to use it.
  - Unplugging the tool before you change blades or bits, or perform other maintenance.
  - Putting the tool away, unplugged, in a dry place when you're done.

- **Before using extension cords, you should inspect them for fraying, damaged insulation and exposed wires as well.**

- **Only heavy-duty, grounded cords with "three pronged" plugs should be used on a worksite.**
  - Never use "homemade" or "makeshift" extension cords made with ROMEX wire, or receptacle boxes that were designed to be mounted on studs in a wall.

- **To avoid damaging electrical cords, you should protect them from:**
  - Rough surfaces and sharp edges.
  - Excessive strain and heat.
  - Exposure to oil, which can degrade the insulation.

- **Never yank on a cord to remove its plug from a receptacle.**
  - Pull on the plug itself.

- **Never remove the ground prong from a plug, or use an adapter as a "quick and easy" way to connect a three-prong plug to an ungrounded, two-prong outlet.**
  - Proper "grounding" helps protect you from being injured or killed by stray electricity.

- **If you find a grounded plug that has the third prong removed, or an adapter being used without the ground wire connected to the receptacle, take that equipment out of service at once.**

- **Avoid plugging multiple cords into a single receptacle.**
  - Drawing too much current can overload the circuit, heat up the wiring and even start a fire.

- **A receptacle that is missing its faceplate can expose you to live wires and other energized parts as well.**
  - If you encounter one of these, don't plug anything into it until a faceplate has been installed.

- **Since construction work can take you to a variety of different types of job sites, it's important to remember that water can increase electrical hazards.**
  - Water conducts electricity, so if it gets on or into electrical equipment it can cause ground faults, shocks, burns or worse.
  - You should avoid using electrically-powered tools or extension cords in a wet or damp environment.

- **If you must work in the wet:**
  - Be sure the tools you use are double-insulated.
  - Never plug in anything that has water on it or in it.

- **If you're going to use portable electric tools and cords outside, make sure beforehand that they are rated for outdoor use.**

- **Most of the time, electricity flows in circular systems called "circuits".**
  - But if something interferes with the circuit, such as when an extension cord frays and exposes a live wire, the energy will try to find the shortest and easiest path to the earth, which is called "ground".

- **Electricity jumping out of a circuit to ground is called a "ground fault".**
  - If the current surges through your body on its way to the earth, ground faults can cause shocks, burns... even electrocution.

- **To protect construction workers from these hazards, OSHA's Electrical Safety Standards require employers:**
  - To implement an "Assured Equipment Grounding Conductor Program" (AEGCP) on their job sites.
  - Or to equip the sites with devices called "ground fault circuit interrupters" (GFCIs).

- **To understand how these options reduce electrocution hazards, it helps to know a little more about "grounding".**

- **One way to protect people from being electrocuted by electricity that is trying to jump to ground by going outside of the equipment that they are using, is to provide a safe path to ground on the inside of the equipment.**
  - Power tools, cords and receptacles that have this feature are called "grounded" equipment.
  - Grounded equipment will always have three "prongs" on their plugs or three holes in the receptacles.

- **If problems cause electricity to "leak" in equipment that is grounded, it should jump to this "internal ground".**
  - To make sure that this happens, the internal ground connection has to be "continuous".
  - A continuous ground has no gaps or restrictions that could prevent the stray energy from flowing easily all the way to the earth.

- **This is where the "Assured Equipment Grounding Conductor Program" (AEGCP), comes in.**
  - An employer that chooses this option must create and implement a program to ensure that the ground connections on each of their job sites are continuous.

- **The program designates qualified personnel who test tools, equipment, cords, wiring, and connectors for grounding continuity on an ongoing basis.**
  - A copy of the written program must be made available on each job site and results of the testing must also be kept on file.

- **However, on some job sites it may not always be possible to ensure that a continuous ground connection is available in all areas or for all equipment.**

- **So as an alternative to an Assured Grounding Program, OSHA also allows employers to protect against ground fault hazards by using ground fault circuit interrupters (GFCIs).**
  - GFCIs can provide protection against leaking electricity and short circuits without having a continuous ground connection.

- **Built into receptacles and extension cords, GFCIs monitor the flow of current in a line so they can "sense" when the electricity is trying to jump to ground.**
  - Then they act like circuit-breakers, cutting off the power in as little as one fortieth of a second.
  - This prevents stray electricity from damaging anything or anyone.

- **GFCIs can also be built into the breakers on a main fuse panel to protect workers from ground fault hazards on entire circuits.**

- **To safely accomplish any of the maintenance or repair tasks that electrically-powered equipment can require throughout the day, you first need to shut off all of the electricity that powers the equipment.**

- **And the electricity has to stay off while the work is being done.**
  - Switching the power back on could seriously injure, even kill the person servicing the machine, either because of the sudden flow of electrical current or the moving parts that it sets in motion.

- **To prevent this from happening, OSHA's Electrical Safety Standards require workers to follow lock-out/tag-out procedures, so that when power is shut off, it can't be restored until it's safe to do so.**

- **"Lock-out/tag-out" begins with identifying all of the sources of energy to the equipment that needs to be serviced, and determining how to shut them off.**
  - This includes any backup power sources such as generators and batteries.

- **All workers who will be affected by the shutoff, such as other employees who use the machinery or the power from the circuit that it's on, should be informed that a lock-out/tag-out is being performed.**

- **The energy sources should then be turned off, and locks applied to secure the switches in the "off" position.**
  - Only dedicated lock-out/tag-out locks should be used for this purpose.
  - Padlocks that just "happen to be available" are not permitted.

- **In some situations, several people can be involved in locking out power sources.**
  - In these cases each of them should apply their own locks.
  - Special lock-out devices are made that allow multiple locks to be attached to a single switch.

- **The equipment that is being worked on and its electrical circuitry should then be tested by a "qualified person" to verify that the power is off.**
  - OSHA defines a qualified person as a worker who is familiar with the construction and operation of the equipment, as well as the hazards that can be associated with it.

- **The qualified person should also release any electrical energy that has been stored in the equipment, such as in charged capacitors.**

- **Once the equipment is completely de-energized, a special tag should be filled out and attached to the switch along with the lock. The tag explains:**
  - That lock-out/tag-out procedures are in effect.
  - Why the equipment has been powered down.
  - Who is involved in the process.

- **At this point the maintenance or other service tasks can be performed safely.**

- **When the work on the equipment is complete, and all workers are physically clear of the equipment, the qualified person will determine if it is safe to restore the power.**

- **Tags and locks can then be removed.**
  - When multiple locks have been used, each of them must be unlocked by the person who originally applied them.

- **The power can then be turned back on.**

- **Even if you are not personally involved in performing lock-out/tag-out, you can help to ensure the safety of your coworkers.**
  - If you ever encounter a power source that has been locked out, you should never attempt to remove the lock or turn anything on.

*** * * SUMMARY * * ***

- **Electrocution is one of the leading causes of death among construction workers.**

- **To address electrocution and other electrical hazards, OSHA has established Electrical Safety Standards for the construction industry.**

- **OSHA has also identified the top three causes of electrocution on construction worksites:**
  - Contact with high-voltage power lines.
  - Contact with energized parts due to faulty or damaged tools and equipment.
  - Misuse of electric cords and connectors.

- **OSHA Safety Standards require employers to protect their employees from electrical hazards on the job.**

- **The standards also include safe work practices that employees should know and follow whenever they work with or around electricity.**

- **Now that you understand the hazards that electricity can create on a construction site, and know the equipment and procedures you should use to prevent accidents and injuries, you can help ensure that you and your coworkers go home safe at the end of every day.**