OSHA's electrical standards include:

- **29 CFR 1910 Electrical Subpart S, 1994 revision**
- **29 CFR 1910.147 - Control of Hazardous Energy (Lockout/ tagout)**
- **29 CFR 1910.137 - Personal Protective Equipment Standard, Electrical Protective Equipment.**

Electrical Safety

Preparation

1. Read Applicable Background information and related Company Policy Chapter.
2. Make _____ Copies of this Lesson Plan for Personnel
3. Make Transparency, procure transparency pens, etc.
4. Coffee, tea, snacks

Other:

Material

1. Portable Ground Fault Interrupter
2. PPE (safety glasses, gloves, other)
3. Circuit Tester

Objective

By the end of this session, personnel will:

- demonstrate an understanding of the principles of electricity and associated terminology
- explain responsibilities regarding and using electrical equipment
- define electrical safety procedures to be used at the Company
- identify the importance of lockout/tagout
- identify the hazards associated with electricity
- explain what a GFCI is
- ways of minimizing electrical hazards
- conduct an electrical safety checklist

Background

One of the biggest misconceptions of electrical safety is that it takes high voltage to kill you. The reality is that it is current, not voltage, that causes electrical shock. Electric shock occurs when current flows through your body. Studies have shown that 1 milliamp of current, under worst case conditions of resistance, can cause electrical shock. System voltages as low as 30 volts AC can supply enough current to shock or possibly even kill.

Notes

Lesson

Notes

Principles of Electricity and Terminology

Understanding Electricity in Simple Terms

An easy way to understand electricity is to think of it like water flowing through a pipe. In order to have a flow of water three things must occur. First, there must be a source of water, like a reservoir. Second, the water must be transported on or in something... like a pipe. Third, there must be a source of pressure, like a water pump, to make the water flow. Electricity is similar! Like the water reservoir, the **source** of electricity is a battery, generator, or power station. A "conductor" is a term used for anything that can **transport** electricity, like a wire, the air, and even the human body. An electric generator provides the "**pressure**" to transport electric **current** in a conductor.

What is "Current?"

Simply put, current is the flow of electric charge, or electrons. Just as water flows in a pipe, charged particles flow in a conductor. For example, we use the term "flow" to describe how much water flows through a pipe in a given amount of time. In electrical terms, "current" describes how many electrons flow through a conductor in a given amount of time. Current is measured in amps.

How else is electricity related to water flow?

In many ways, but we'll discuss only three more. We mentioned water pressure previously. In electrical terms, "voltage" is the pressure that drives charged particles to move.

Another important concept is "resistance". Inside a water pipe, friction occurs between the walls of the pipe and the water. This causes a drop in water pressure along the length of the pipe. Resistance is like friction which causes a drop in voltage.
The water flow at a given pressure is controlled largely by the pipe size. A larger pipe will allow more gallons per minute of water to flow than a smaller pipe at a given pressure. Similarly, larger wires allow more current to flow at a given voltage. Wire sizes are determined by their American Wire Gauge (AWG) numbers. The larger the number, the smaller the diameter of the wire. In general, larger wires have less resistance than smaller wires.

Responsibilities Regarding and Using Electrical Equipment

The following practices are to be followed by all employees:

- Follows the Company's electrical safety policies and procedures and instructions of responsible Supervisors and the Safety and Health Manager.
- Brings to the attention of the supervisor and/or Health and Safety Branch potential hazardous situations such as discrepancies between instruction, procedures, policies and manual, faulty equipment, misapplication of device, etc.
- Electrical equipment known to be malfunctioning must be repaired or replaced before use. The repair must be initiated as soon as possible after the malfunction is noted.
- The user is responsible for obtaining necessary tools and safety equipment from the designated storage area, checking it for discrepancies, returning it to storage in good condition and identifying any faulty equipment to his/her supervisor.
- Eye protection is required during any electronic or electrical hardware repair, installation and/or open front operation.
- Electrical safety shoes, long sleeve non-polyester, low flammability shirts and insulating gloves will be worn when operating or testing 600 volt or higher equipment.
- Protective apron will be worn over polyester or other highly flammable clothing during soldering operations.

Electrical Safety Procedures at the Company

- Make sure all equipment is grounded. Ground fault circuit interrupters (GFCIs) should be used in areas where workers are exposed to wet or humid conditions.
- Do not touch exposed surface connectors.
- Never reverse the polarity when plugging in equipment. That is, do not reverse the plug and put the small prong into the larger socket hole and the large prong into the smaller hole. When you reverse the polarity, in many instances, the voltage will still be present in the piece of equipment when it is turned off. If that piece of equipment is dropped into water, shock may occur.
- Do not use extension cords that are damaged or have cuts in the insulation. Only use extension cords that have a ground wire (i. e., three pronged).

Notes

Electrical Safety Procedures at the Company (continued)

- Never break off the ground prong of a three-prong plug to allow you to use it in a two-prong outlet. Any cord with the prong missing should be put out of service. If the ground prong is removed the piece of equipment is no longer grounded.
- Whenever you have to work on a piece of equipment, lockout and tag the electrical source to that piece of equipment to make sure that it is de-energized.
- Routinely inspect all cords, plugs, and electrical equipment for damage.

The Importance of Lockout/Tagout

Lockout/ Tagout is a method of keeping equipment from being set in motion and endangering workers. The OSHA lockout/ tagout standard is designed to prevent needless deaths and serious injuries to service and maintenance workers.
Before any maintenance is performed on equipment all sources of electricity shall be locked-out and tagged-out.
Lockout/ tagout procedures usually include:

- Identifying all energy sources to the piece of equipment.
- Turning off and shutting down all appropriate valves, switches, and circuit breakers.
- Locking out the piece of equipment by applying a lockable device over the energy- isolating mechanism to hold it in the safe or off position. Every worker who will be working on the equipment should attach his personal lock to the isolating device.
- Applying a tag to the isolation source identifying the work to be done and the person who applied it.
- After the piece of equipment is locked and tagged out, it should be checked to make sure that energy sources were not missed.
- Verify the main disconnect switch or circuit breaker can't be moved to the on position.

Removing Lockout/Tagout Equipment

Lockout/ tagout equipment should only be removed when the maintenance work is complete and the equipment has been determined ready for operation by qualified personnel. Except in emergencies, the person who put it on should only do the removal of lockout/ tagout devices.

Notes

Hazards Associated with Electricity

The five primary hazards associated with electricity and its use are:

1. **Shock-** Electric shock occurs when the human body becomes part of a path through which electrons can flow (i.e., the circuit). The resulting effect on the body can be either direct or indirect:
   - **Direct-** Injury or death can occur whenever electric current flows through the human body. Currents of less than 30 milliamps (mA) can result in death.
   - **Indirect-** Although the electric current through the human body may be well below the values required to cause noticeable injury, human reaction can result in falls from ladders or scaffolds, or movement into operating machinery. Such reaction can result in serious injury or death.

There are three basic ways which shock occurs:

- A person comes in contact with both wires of an electric circuit.
- A person comes in contact with a wire from an electric circuit and the ground source.
- A person comes in contact with a ground source and a metal part that is in contact with a wire from an electric circuit.

2. **Burns-** Burns can result when a person touches electrical wiring or equipment that is improperly used or maintained. Typically, such burn injuries occur on the hands.

3. **Arc-Blast-** Arc-blasts occur from high-amperage currents arcing through air. This abnormal current flow (arc-blast) is initiated by contact between two energized points. This contact can be caused by persons who have an accident while working on energized components, or by equipment failure due to fatigue or abuse. Temperatures as high as 35,000 ^{0}F have been recorded in arc- blast research.

4. **Explosions-** Explosions occur when electricity provides a source of ignition for an explosive mixture in the atmosphere. Explosive atmospheres can result from the accumulation of flammable vapors or gases generated by nearby sources and processes. Ignition can be due to overheated conductors or equipment, or normal arcing (sparking) at switch contacts. OSHA standards, the National Electrical Code and related safety standards have precise requirements for electrical systems and equipment when applied in such areas.

Notes

Hazards Associated with Electricity (continued)

5. **Fires-** Electricity is one of the most common causes of fire both in the home and workplace. Defective or misused electrical equipment is a major cause, with high resistance connections being one of the primary sources of ignition. High resistance connections occur where wires are improperly spliced or connected to other components such as receptacle outlets and switches. This was the primary cause of fires associated with the use of aluminum wire in buildings during the 1960s and 1970s.

What is a GFCI?

A GFCI is a fast acting device that monitors the current flow of a circuit. In the event of leakage of 5 milliamps or more, the GFCI, in a fraction of a second, shuts off the current to the appliance. GFCIs do not stop shock, but limit the duration.

GFCIs are commonly used in bathroom and kitchen outlets in homes and generally have a small reset button on the outlet.

Minimizing Electrical Hazards

Electrical hazards, while always present at the Company, can be minimized. There are various ways of protecting from electrical hazards. These include:

- Locking and tagging equipment
- Guarding
- Grounding
- Mechanical devices
- Personal protective equipment
- Safe work practices
- Safe practices when working with portable equipment
- Proper use of electrical cords and plugs
- Safe practice when working at heights

This section describes each of these protective methods.

Locking and Tagging Equipment

The Company has written Lockout / Tagout programs. The purpose of this program is to isolate sources of electrical energy from equipment undergoing repair or maintenance. Personnel who employ lockout/ tagout procedures are give specific training and must be approved to repair and maintain electrical equipment.

Notes

Guarding

Live parts of electrical equipment operating at 50 volts or more must be guarded against accidental contact. Guarding of live parts may be accomplished by:

- Locating equipment in rooms, vaults, or enclosures accessible only to qualified personnel.
- Use of permanent, substantial partitions or screens to exclude unqualified persons.
- Locating equipment on a suitable balcony, gallery, or platform elevated and arranged to exclude unqualified personnel.
- Elevation of equipment 8 feet or more above the floor.

In addition, entrances to rooms and other guarded locations containing exposed live parts must be marked with conspicuous warning signs forbidding unqualified persons to enter.

Equipment Grounding

By grounding a tool or electrical system, a low resistance path to the earth through a ground connection is created. When properly done, this path offers sufficiently low resistance and has sufficient current carrying capacity to prevent the buildup of voltages which may result in a dangerous shock. This does not guarantee that no one will receive a shock, be injured, or killed from grounded equipment. However, it substantially reduces the possibilities of such accidents. OSHA requires that all exposed non- current carrying metal parts of permanently installed equipment which may become energized be grounded when the equipment is:

- Within eight feet vertically and five feet horizontally of ground or grounded metal objects and subject to employee contact.
- Located in a wet or damp location and not isolated.
- Connected by cord and plug.

Mechanical Protection Devices

Mechanical protection devices are designed to shut off the flow of electricity in the event of a ground fault, overload, or short circuit in a wiring system. Fuses, circuit breakers, and ground fault circuit interrupters are three examples of mechanical protection devices.

Notes

Fuses and circuit breakers monitor the amount of current that a circuit will carry. They automatically open or break the circuit when the amount of current flow becomes excessive and therefore unsafe. Fuses are designed to melt when too much current flows through them. Circuit breakers are designed to trip open the circuit. Fuses and circuit breakers are intended primarily for the protection of conductors and equipment. They prevent overheating of wires and components which might otherwise create hazards to operators.

The ground fault circuit interrupter, or GFCI, is designed to shut off electrical power within as little as 1/ 40th of a second. It works by comparing the amount of current going to an electrical device against the amount of current returning from the device. The GFCI is used in high risk areas such as wet locations and construction sites. To ensure that a GFCI is operating properly, most GFCIs have a test feature. Test the GFCI regularly.

Personal Protective Equipment

OSHA requires that personnel working on electrical systems be provided with and use electrical protective equipment that is appropriate for the specific parts of the body to be protected for the work performed. The types of electrical safety equipment, protective apparel, and protective tools available are quite varied and include: rubber gloves, leather gauntlets, insulating sleeving, insulating blankets, face shields, safety glasses, linehoses, hot sticks, and voltage detectors.

Safety Work Practices

Perhaps the single most successful defense against electrical accidents is the continuous exercising of good judgment or common sense. All personnel working at the Company should be thoroughly familiar with the safety procedures for their particular jobs. In general, however, the following safety rules must be followed at the Company:

- Personnel must operate electrical equipment in accordance with the manufacturer's recommendations. The safety instructions and operating procedures for all equipment shall be followed.
- Employees may not enter spaces containing exposed energized parts, unless illumination is provided to enable the employee to perform the work safely. Employees must not reach blindly into areas which may contain energized parts where lack of illumination or an obstruction precludes observation of the work to be performed.

Notes

- Unauthorized personnel shall not occupy areas around electrical switchgear, panel boards, or load centers.
- When working with electrical equipment, always work with a partner. The partner should observe the work from a safe distance and be trained in first aid/ CPR.
- Where live parts present an electrical contact hazard, employees may not perform housekeeping duties at such close distances to the parts that there is a possibility of contact, unless adequate safeguards (such as insulating equipment or barriers) are provided. Electrically conductive cleaning materials may not be used in proximity to energized parts unless procedures are followed which will prevent electrical contact.

Portable Electric Equipment Safety

Portable electrical equipment found at the Company may be Company- owned equipment or personal property. All Company- owned equipment must be inspected by the Facilities Maintenance Group prior to use. Personal portable electric equipment should not be used at the Company.
Inspection of Company- owned portable electrical equipment is necessary to ensure that the equipment is electrically safe and compatible with the installed power receptacles.

Types of Portable Electrical Equipment

Portable electrical equipment is normally classified according to the number of insulation barriers provided between the electrical conductors in the equipment and the user. Equipment which has two insulation barriers and does not have exposed metal parts are called double insulated. Double insulated tools provide reliable shock protection without third- wire grounding. Conventional electric tools have a single layer of functional insulation and are metal encased. Double insulation can be provided by encasing the entire tool, or at least the part of the tool which is handled, in a nonconductive material, such as plastic, which is also shatterproof. The National Electric Code permits double insulation on portable tools and appliances. Double-insulated tools that have been tested by Underwriter's Laboratories carry the square- in-square UL mark. Equipment with only two prongs on the electric plug and without the UL mark is not considered double insulated and is not approved for use at the Company.

Notes

Equipment that does not possess a two pronged plug and a UL mark must have a three prong electric plug. The third prong is used to ground exposed metal parts on the equipment.

Pre-Use Inspection of Portable Electric Equipment

Prior to using portable electrical equipment at the Company, the user must first perform a safety inspection. This inspection consists of looking for external defects and for evidence of possible internal damage. If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged equipment shall be removed from service, and no employee may use it until necessary repairs and tests render the equipment safe for use. The pre-use inspection will include inspection of the tool casing for cracks, dents, contamination (oil, moisture, dirt, corrosion). See Electric Cords, below, for inspection of cords and plugs.

Electric Cords and Plugs

Electric Cords

Faulty or misused electric cords can present serious hazards. Basic electric cord safety practices include:

- Inspect cords regularly. Look for signs of stretching, insulation damage, and kinking. Don't use if these conditions are evident.
- Keep cords and cables clean and free from kinks. Kinking can damage both the cord's insulation and internal wire.
- Never carry a tool by its cord!
- When using tools which require a third wire ground use only three wire extension cords with three- pronged, grounding plugs and three hole electric outlets. Never cut off the grounding plug from a cord! If you see a cord with the grounding plug missing, have an electrician replace the plug.
- Pulling on electric cords can damage the cord insulation and cause electric sparks. Always remove the cord at the plug.
- Extension cords may present a tripping hazard. Make sure that cords are not located in walking paths or a non- trip cover is placed over cords.
- Always use the correct extension cord for the job. An undersized cord can cause a drop in tool power and overheating. Check the manufacturer's recommendations for the wire gage (or thickness) and length of the cord based on your application.

Notes

- Portable electric equipment and flexible cords used in highly conductive work locations (such as those inundated with water or other conductive liquids), or in job locations where employees are likely to contact water or conductive liquids, shall be approved for those locations.
- Hands must be dry when plugging and unplugging flexible cords and cord- and plug- connected equipment, if energized equipment is involved.

Plugs and Receptacles

Electric plugs and receptacles are designed for different currents and voltages so that only matching plugs and receptacles will fit together, preventing a piece of equipment, a cord, and a power source with different voltage and current requirements to be plugged together. These standard configurations have been established by the National Electric Manufacturer's Association (NEMA).

In addition to proper selection of electric plugs, the electric plug must also be inspected properly. Inspection of plugs shall include signs of damaged or chafed insulation, overheating, prong condition, and installation of a ground plug if required.

Working at Heights

When an unqualified person is working in an elevated position near overhead lines, the location shall be such that the person and the longest conductive object he or she may contact cannot come closer to any unguarded, energized overhead line than the following distances:

- For voltages to ground 50kV or below -10 feet.
- For voltages to ground over 50kV - 10 feet plus 4 inches for every 10kV over 50kV. In addition, portable ladders shall have non-conductive siderails if they are used where the employee or the ladder could contact exposed energized parts.

Notes

Conducting an Electrical Safety Checklist

- ☐ Do you specify compliance with OSHA for all contract electrical work?
- ☐ Are all employees required to report as soon as practicable any obvious hazard to life or property observed in connection with electrical equipment or lines?
- ☐ Are employees instructed to make preliminary inspections and/or appropriate tests to determine what conditions exist before starting work on electrical equipment or lines?
- ☐ When electrical equipment or lines are to be serviced, maintained or adjusted, are necessary switches opened, locked-out and tagged whenever possible?
- ☐ Are portable electrical tools and equipment grounded or of the double insulated type?
- ☐ Are electrical appliances such as vacuum cleaners, polishers, and vending machines grounded?
- ☐ Do extension cords being used have a grounding conductor?
- ☐ Are multiple plug adapters prohibited?
- ☐ Are ground-fault circuit interrupters installed on each temporary 15 or 20 ampere, 120 volt AC circuit at locations where construction, demolition, modifications, alterations or excavations are being performed?
- ☐ Are all temporary circuits protected by suitable disconnecting switches or plug connectors at the junction with permanent wiring?
- ☐ Do you have electrical installations in hazardous dust or vapor areas? If so, do they meet the National Electrical Code (NEC) for hazardous locations?
- ☐ Is exposed wiring and cords with frayed or deteriorated insulation repaired or replaced promptly?
- ☐ Are flexible cords and cables free of splices or taps?
- ☐ Are clamps or other securing means provided on flexible cords or cables at plugs, receptacles, tools, equipment, etc., and is the cord jacket securely held in place?
- ☐ Are all cord, cable and raceway connections intact and secure?
- ☐ In wet or damp locations, are electrical tools and equipment appropriate for the use or location or otherwise protected?
- ☐ Is the location of electrical power lines and cables (overhead, underground, underfloor, other side of walls) determined before digging, drilling or similar work is begun?
- ☐ Are metal measuring tapes, ropes, hand lines or similar devices with metallic thread woven into the fabric prohibited where they could come in contact with energized parts of equipment or circuit conductors?
- ☐ Is the use of metal ladders prohibited in areas where the ladder or the person using the ladder could come in contact with energized parts of equipment, fixtures or circuit conductors?
- ☐ Are all disconnecting switches and circuit breakers labeled to indicate their use or equipment served?
- ☐ Are disconnecting means always opened before fuses are replaced?
- ☐ Do all interior wiring systems include provisions for grounding metal parts of electrical raceways, equipment and enclosures?
- ☐ Are all electrical raceways and enclosures securely fastened in place?
- ☐ Are all energized parts of electrical circuits and equipment guarded against accidental contact by approved cabinets or enclosures?

Notes

Background

Each individual working in the Company is at risk of being injured by electric shock. The magnitude of this risk is dependent on the employee's job tasks and work location(s). In order to maximize each individual's safety at the laboratory, each employee must be familiar with the Company electrical distribution system, the hazards of electricity, and safety procedures and precautions.

During this training we described the basics of electricity, the hazards of electricity, the Company electrical distribution system including high voltage areas, and electrical protection measures for minimizing electric hazards.

What questions do you have?

Notes

29 CFR 1910 Electrical Subpart S, 1994 revision 29 CFR 1910.147 - Control of Hazardous Energy (Lockout/ tagout)
29 CFR 1910.137 - Personal Protective Equipment Standard, Electrical Protective Equipment.

Electrical Safety-Assessment

Name: _____ Date: _____

Fill in the Blanks

1) What is "Current?" Simply put, current is the _____ of electric charge, or _____. Just as water flows in a pipe, charged particles flow in a conductor. In electrical terms, "current" describes how many _____ flow through a conductor in a given amount of time. Current is measured in _____.

Responsibilities Regarding and Using Electrical Equipment- The following practices are to be followed by all employees:

2) Follows the Company's electrical safety policies and _____ and instructions of responsible Supervisors and the Safety and Health Manager.

3) Brings to the attention of the supervisor and/or Health and Safety Branch potential _____ situations such as discrepancies between instruction, procedures, policies and manual, faulty equipment, misapplication of device, etc.

4) Electrical equipment known to be malfunctioning must be repaired or _____ before use. The repair must be initiated as soon as possible after the malfunction is noted.

5) The _____ is responsible for obtaining necessary tools and safety equipment from the designated storage area, checking it for discrepancies, returning it to storage in good condition and identifying any faulty equipment to his/her supervisor.

6) _____ protection is required during any electronic or electrical hardware repair, installation and/or open front operation.

7) Do not use extension cords that are damaged or have cuts in the insulation. Only use extension cords that have a _____ wire (i. e., _____ pronged).

8) Before any maintenance is performed on equipment all sources of electricity shall be _____ -out and _____ -out.

9) Except in emergencies, the person who put it on should only do the _____ of lockout/ tagout devices.

10) A _____ is a fast acting device that monitors the current flow of a circuit. In the event of leakage of 5 milliamps or more, the _____, in a fraction of a second, shuts off the current to the appliance. _____ do not stop shock, but limit the duration.

Check all that apply

11) There are three basic ways which shock occurs:

- ____ A person does not use a grounded extension cord
- ____ A person comes in contact with both wires of an electric circuit
- ____ A person comes in contact with a wire from an electric circuit and the ground source
- ____ A person comes in contact with a ground source and a metal part that is in contact with a wire from an electric circuit

12) Minimizing Electrical Hazards- Electrical hazards, while always present at the Company, can be minimized. There are various ways of protecting from electrical hazards. These include:

- ____ Locking and tagging equipment
- ____ Guarding
- ____ Grounding
- ____ Mechanical devices
- ____ Working under the influence of alcohol
- ____ Personal protective equipment
- ____ Safe work practices
- ____ Safe practices when working with portable equipment
- ____ Proper use of electrical cords and plugs
- ____ Safe practice when working at heights

13) Basic electric cord safety practices include:

- ____ Inspect cords regularly. Look for signs of stretching, insulation damage, and kinking. Don't use if these conditions are evident.
- ____ Keep cords and cables clean and free from kinks. Kinking can damage both the cord's insulation and internal wire.
- ____ Carry a tool by its cord
- ____ When using tools which require a third wire ground use only three wire extension cords with three- pronged, grounding plugs and three hole electric outlets.
- ____ Never cut off the grounding plug from a cord unless it’s for a short period only
- ____ Pulling on electric cords can damage the cord insulation and cause electric sparks. Always remove the cord at the plug.

29 CFR 1910 Electrical Subpart S, 1994 revision 29 CFR 1910.147 - Control of Hazardous Energy (Lockout/ tagout)
29 CFR 1910.137 - Personal Protective Equipment Standard, Electrical Protective Equipment.

Key-Electrical Safety-Assessment

Fill in the Blanks

1) What is "Current?" Simply put, current is the **flow** of electric charge, or **electrons**. Just as water flows in a pipe, charged particles flow in a conductor. In electrical terms, "current" describes how many **electrons** flow through a conductor in a given amount of time. Current is measured in **amps**.

Responsibilities Regarding and Using Electrical Equipment- The following practices are to be followed by all employees:

8) Follows the Company's electrical safety policies and **procedures** and instructions of responsible Supervisors and the Safety and Health Manager.

9) Brings to the attention of the supervisor and/or Health and Safety Branch potential **hazardous** situations such as discrepancies between instruction, procedures, policies and manual, faulty equipment, misapplication of device, etc.

10) Electrical equipment known to be malfunctioning must be repaired or **replaced** before use. The repair must be initiated as soon as possible after the malfunction is noted.

11) The **user** is responsible for obtaining necessary tools and safety equipment from the designated storage area, checking it for discrepancies, returning it to storage in good condition and identifying any faulty equipment to his/her supervisor.

12) **Eye** protection is required during any electronic or electrical hardware repair, installation and/or open front operation.

13) Do not use extension cords that are damaged or have cuts in the insulation. Only use extension cords that have a **ground** wire (i. e., **three** pronged).

8) Before any maintenance is performed on equipment all sources of electricity shall be **locked**-out and **tagged**-out.

9) Except in emergencies, the person who put it on should only do the **removal** of lockout/ tagout devices.

10) A **GFCI** is a fast acting device that monitors the current flow of a circuit. In the event of leakage of 5 milliamps or more, the **GFCI**, in a fraction of a second, shuts off the current to the appliance. **GFCIs** do not stop shock, but limit the duration.

Check all that apply

11) There are three basic ways which shock occurs:

- ____ A person does not use a grounded extension cord
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- **____ A person comes in contact with a ground source and a metal part that is in contact with a wire from an electric circuit**

12) Minimizing Electrical Hazards- Electrical hazards, while always present at the Company, can be minimized. There are various ways of protecting from electrical hazards. These include:

- **____ Locking and tagging equipment**
- **____ Guarding**
- **____ Grounding**
- **____ Mechanical devices**
- ____ Working under the influence of alcohol
- **____ Personal protective equipment**
- **____ Safe work practices**
- **____ Safe practices when working with portable equipment**
- **____ Proper use of electrical cords and plugs**
- **____ Safe practice when working at heights**

13) Basic electric cord safety practices include:

- **____ Inspect cords regularly. Look for signs of stretching, insulation damage, and kinking. Don't use if these conditions are evident.**
- **____ Keep cords and cables clean and free from kinks. Kinking can damage both the cord's insulation and internal wire.**
- ____ Carry a tool by its cord
- **____ When using tools which require a third wire ground use only three wire extension cords with three- pronged, grounding plugs and three hole electric outlets.**
- ____ Never cut off the grounding plug from a cord unless it’s for a short period only
- **____ Pulling on electric cords can damage the cord insulation and cause electric sparks. Always remove the cord at the plug.**