11 General Electrical Safety

11.1 Policy Statement

Electricity is an important tool in any work environment, but it poses significant hazards. Tim Foster – dba MPC (Maintenance Projects & Construction) has implemented this policy to reduce risks of employee exposure to electrical hazards in the workplace.

Tim Foster is the supervisor responsible for ensuring the following policy for controls, training, personal protective equipment, and safe work practices are enforced.

11.2 Responsibilities

Electrical safety is a responsibility shared between Tim Foster – dba MPC (Maintenance Projects & Construction) and its employees.

11.2.1 Employer Responsibilities

It is the responsibility of Tim Foster – dba MPC (Maintenance Projects & Construction) to:

• Ensure all electrical equipment and wiring is installed according to industry best practices and applicable regulations;
• Ensure periodic hazard analyses of work areas;
• Correct identified safety hazards;
• Provide electrical safety training for personnel;
• Review electrical equipment safe operating procedures as necessary;
• Ensure relevant safeguards against electrical hazards are in place;
• Ensure all authorized and qualified persons have received appropriate levels of training; and
• Provide appropriate personal protective equipment to staff who work with electrical equipment.

11.2.2 Safety Committee Responsibilities

It is the responsibility of the Tim Foster – dba MPC (Maintenance Projects & Construction) safety committee to:

• Assist in identifying electrical safety issues;
• Assist in providing electrical safety training for personnel; and
• Review electrical equipment safe operating procedures as necessary.
11.2.3 Employee Responsibilities

Every Tim Foster – dba MPC (Maintenance Projects & Construction) employee must:

- Be aware of electrical safety issues where they work;
- Follow company safety policy and the instructions of the supervisor;
- Comply with safe operating procedures when working with electrical equipment;
- Attend and participate in appropriate safety training; and
- Report safety concerns.

11.3 Training

Tim Foster – dba MPC (Maintenance Projects & Construction) will ensure every employee participates in a general electrical safety training program at no cost to the employee during working hours.

Tim Foster – dba MPC (Maintenance Projects & Construction) will provide training:

- At the time of assignment.
- At least annually thereafter; annual training for all employees will be provided within one year of their previous training.

Tim Foster – dba MPC (Maintenance Projects & Construction) will provide an employee additional training when adding or changing tasks or procedures that affect the employee’s work. It is acceptable for additional training to be limited to addressing only the changes or additions to the employees’ exposure.

Tim Foster – dba MPC (Maintenance Projects & Construction) will use only training material that is appropriate in content and vocabulary to educational level, literacy, and language of employees.

11.3.1 Training Components

Employees whose job duties do not bring them close enough to exposed parts of electrical circuits (50 volts or more to the ground) may not need electrical safety training.

Unqualified persons, including those employees who use power tools, perform service of equipment and machines and/or perform maintenance or repair functions on electrical equipment, and who are close enough to exposed parts of electrical circuits (50 volts or more to the ground), will have electrical safety training.

Training must be performed before the employee is assigned duties involving work around or on electrical systems.
Retraining will be performed whenever inspections indicate an employee does not have the necessary knowledge or skills to safely work on or around electrical systems.

Retraining will also be performed when policies or procedures change and/or new equipment or systems are introduced into the work area.

Training for qualified persons will include in the following:
- Distinguishing exposed energized parts from other parts of electrical equipment;
- Determine the nominal voltage of exposed energized parts;
- Approach distances;
- Hazardous Energy Control (Lockout/Tagout) procedures;
- Understand the specific hazards associated with electrical energy; and
- The electrical safety policy.

11.3.2 Training Records

Training records will include the following information:
- The dates of the training sessions;
- The contents or a summary of the training sessions;
- The names and qualifications of persons conducting the training; and
- The names and job titles of all persons attending the training sessions.

Tim Foster — dba MPC (Maintenance Projects & Construction) will maintain employee training records for 3 years from the date on which the training occurred.

11.4 Policy

11.4.1 Introduction

Electricity poses a range of workplace hazards including shock, electrocution, burns, fires and explosions.

Employees will familiarize themselves with electrical hazards and protect themselves when working on, near or with electricity. Tim Foster — dba MPC (Maintenance Projects & Construction) will select electrical and electronic equipment designed for both maximum safety and efficiency. However, potentially hazardous conditions such as contact with hazardous voltages may exist while performing servicing and maintenance, handling materials, or cleaning. The improper use of electrical extension cords and portable electrical equipment pose further hazards.
11.4.2 Controlling Electrical Hazards

Hazards

Electrical hazards need to be identified before they can be avoided or controlled. It is best to plan hazard recognition tasks with a team of co-workers (the safety committee). Employees working together help keep one another safe by identifying hazards and encouraging each other to work safely. However, a reckless coworker can talk a safe employee into taking an unnecessary risk. Careful and early planning of safety procedures reduces the risk of injury.

Shock

Electricity travels in a circuit. However, a person’s body can be a conductor of electricity if it closes a circuit. This is what causes electrical shock. A person can complete the circuit with the following:

- two wires of an electric circuit;
- one wire of an energized circuit and the ground;
- an accidentally energized metal part; or
- another conductor that carries a current.

During a shock, electricity flows through the body to a ground or the earth. The effects of an electric shock vary. The severity depends on the following:

- circuit characteristics;
- the amount of current flowing through the body;
- the current’s path through the body;
- the length of time the body remains in the circuit; and
- the current’s frequency.

Burns

Burns are the most common electricity-caused injury. An electrical incident can lead to an electrical burn, arc burn, thermal contact burn, or a combination of burns. When current flows through tissue or bone, it can generate heat and damage tissue. High temperatures in an arc or explosion can burn the victim — arc or flash burns. Overheated electric conductors, conduits, or other energized equipment can produce thermal burns, as can clothing caught on fire, as by an electric arc.

Delayed Effects

Damage to internal tissues may only become problematic well after contact with electric current. Delayed effects to electrical shock include internal tissue swelling and irritation. Prompt medical attention after every electrical incident is important to prevent these kinds of injuries.

Static Electricity

Static electricity also causes a shock, though potentially not as severe as shock described previously. Static electricity builds on an object’s surface and can discharge to a person.
When static electricity builds up at a specific spot on an object because of friction, static electricity can discharge near sufficient flammable or combustible substances to cause an explosion. Grounding or other measures may be necessary to prevent static electricity buildup and the results.

**Electrical Fires**

Electricity is one of the most common causes of fires and thermal burns in homes and workplaces. Defective or misused electrical equipment is a major cause of electrical fires. If there is a small electrical fire, and the emergency action plan allows workers to fight incipient-stage fires, use only a Class C or multipurpose (ABC) fire extinguisher.

**Flammable or Ignitable Materials**

Where flammable materials — e.g. flammable gases, vapors, or liquids; combustible dust and ignitable fibers or filings — are present, electric equipment capable of igniting them will not be used, unless measures are taken to prevent hazards.

In those situations where flammable vapors, liquids or gases, or combustible dusts or fibers are (or may be) present on a regular basis, Tim Foster – dba MPC (Maintenance Projects & Construction) will observe the electrical installation requirements contained in the OSHA standard regulating hazardous locations (29 CFR 1910.307).

**Overload**

Overloaded wires can get hot enough to ignite a fire. If insulation melts, arcing may occur. Arcing can even cause a fire inside a wall. To guard against overloaded circuits, breakers and fuses essentially do the same thing: shut off the electrical current by opening the circuit. Breakers trip open and can be reset; fuses blow and must be replaced. A frequently overloaded circuit indicates serious problems to remedy.

A circuit with improper overcurrent protection devices—or one with no overcurrent protection devices at all is a hazard.

**Wet Conditions**

Working around water and in wet conditions presents a hazard because touching a live wire or other electrical component while grounded in a small puddle of water will result in a shock.

Improperly grounded metal switch plates and ceiling lights are especially hazardous in wet conditions. If you touch a live electrical component with an uninsulated hand tool, you are more likely to receive a shock when standing in water. However, remember: you do not have to be standing in water to be electrocuted. Wet clothing, high humidity and perspiration also increase your chances of electrocution. *All wet conditions are electrical hazards.*

**Damaged Equipment**

Damaged insulation, equipment or tools can expose you to live electrical parts. A damaged tool may not be grounded properly. Damaged tools can overheat and cause a fire as well. A damaged tool is always a hazard and must be replaced or repaired.
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Other Hazards
Voltage sources that do not have dangerous current capabilities may not pose serious shock or burn hazards in themselves. However, voltage sources near lethal circuits could deal a minor shock to jolt a person into a lethal circuit. Such an involuntary reaction may also result in bruises, bone fractures, and even death from collisions or falls.

Evaluate Hazards
Identify all possible hazards before evaluating risk of injury from each hazard individually. Do not assume the risk is low until you evaluate the hazard. An overlooked hazard is the most dangerous one.

Most electrical accidents result from one of the following three factors:
- unsafe equipment or installation,
- unsafe environment, or
- unsafe work practices.

Combinations of hazards increase risk considerably. A damaged tool is dangerous, but a damaged tool in damp conditions is more so. You will need to make decisions about the nature of hazards to evaluate risk and control it.

Control Hazards
Tim Foster – dba MPC (Maintenance Projects & Construction) must control electrical hazards that have been recognized and evaluated as a threat to employees. There are two main ways to control electrical hazards: (1) address the work environment to control the hazard itself and (2) address work practices to control exposure to the hazard.

Some ways to prevent electrical accidents include insulation, guarding, grounding, electrical protective devices, and safe work practices.

Insulation
Insulators such as glass, mica, rubber, or plastic that coat metals and other conductors help stop or reduce the flow of electrical current to help prevent shock, fires, and short circuits. To be effective, insulation must be suitable for the voltage used and environmental conditions.

Guarding
Enclosing or guarding electric equipment keeps people from accidental contact with live parts. Effective guarding requires equipment with exposed parts operating at 50 volts or more to be accessible only to authorized people qualified to work with it. Recommended locations are a room, vault, or similar enclosure; a balcony, gallery, or elevated platform; or a site elevated 8 feet or more above the floor. Conspicuous signs posted at entrances to electrical rooms and other guarded locations alert people to the electrical hazard and forbid entry to unauthorized people. Signs with the word “Danger,” “Warning,” or “Caution,” and beneath that, appropriate concise wording can alert people to the hazard or give an instruction, such as “Danger/High Voltage/Keep Out.”
Grounding

"Grounding" an electrical system is creating a low-resistance path that connects it to the earth. This prevents buildup of voltages and can prevent an electrical accident.

Grounding is typically a secondary protective measure against electric shock. It does not prevent every shock, injury or death by an electrical current. However, grounding will substantially reduce the risk, especially when used in combination with other safety measures.

A service or system ground primarily serves to protect machines, tools, and insulation against damage. One wire, called the "neutral" or "grounded" conductor, is grounded. In an ordinary low-voltage circuit, the white or gray wire is grounded at the generator or transformer and at the building's service entrance.

An equipment ground helps protect the equipment operator. It furnishes a second path for the current to pass through from a tool or machine to the ground. This additional ground safeguards the operator from a malfunction that might energize the tool's frame. The resulting flow of current may activate circuit protection devices.

Circuit Protection Devices

Circuit protection devices limit the flow of current if there is a ground fault, overload or short circuit in the wiring system. Well-known examples of these devices are fuses, circuit breakers, ground-fault circuit interrupters, and arc-fault circuit interrupters.

Fuses and circuit breakers open or break the circuit automatically when too much current flows through them. When that happens, fuses melt and circuit breakers trip the circuit open. Fuses and circuit breakers serve to protect conductors and equipment. They prevent wires and other components from overheating and open the circuit when there is a risk of a ground fault.

Arc-fault devices provide protection from the effects of arc-faults by recognizing characteristics unique to arcing and de-energizing the circuit to protect against an arc-fault.

Ground Fault Circuit Interrupters

Ground fault circuit interrupters (GFCIs) are a type of circuit protection device designed to protect people from electric shock when they contact a "live" wire or part and a grounded object. The GFCI works by sensing a difference between the supply and return currents. When the difference exceeds five mA – indicating current is flowing to ground – the device switches off.

Although the GFCI is an effective safety device, it does not guarantee against shock in every situation. A GFCI does not protect against a line-to-neutral or a line-to-line shock. In addition, if GFCI-protected equipment contains transformers, a ground fault on the secondary side of the transformer may not trip the GFCI.

GFCIs are normally either circuit breakers or receptacles. In either case, the GFCI can protect multiple receptacles. Individual GFCI plug-in adapters are also available.
Tim Foster – dba MPC (Maintenance Projects & Construction) requires GFCI protection for the following conditions:

- any 120-volt convenience outlet located within 6 feet of a sink;
- any 120-volt convenience outlet located outdoors;
- any 120-volt convenience outlet located within 6 feet of a building entrance; and
- any extension cord providing power for construction activities. Outdoor receptacles must be enclosed with weatherproof (preferably metal) covers.

Receptacles in wet locations that are used, or intended to be used, unattended with a device plugged in must have an enclosure that is weatherproof with the attachment plug cap inserted or removed.

Appropriate testing is required for all indoor and outdoor GFCIs.

Personal Protective Equipment
Employees must use personal protective equipment as appropriate to the hazard where there are electrical hazards.

11.4.3 General Safety Rules

Qualified Person
Management will determine whether a person has sufficient understanding of the equipment, device, system, or facility to control the hazards it presents, and be "qualified." Only those persons who are qualified and authorized may install, fabricate, repair, test, calibrate, or modify electrical wiring, devices, systems, or equipment. Qualification and authorization to perform electrical or electronics work is based on a combination of formal training, experience, and on-the-job training.

Safe Practices
Electrical accidents are largely preventable through safe work practices. Examples of these practices include the following:

- de-energizing electric equipment before inspection or repair and use lockout/tagout procedures;
- keeping electric tools properly maintained;
- exercising caution when working near energized lines; and
- using appropriate protective equipment.

Design and Installation
Design and installation of equipment and facilities shall be in accordance with the applicable standards.

Safety is an integral part of the design process. Protective devices, warning signs, and administrative procedures are supplements to good design, but cannot compensate for its absence. Completed designs shall provide for safe maintenance as well.
All systems performing a safety function or controlling a potentially hazardous operation and any modifications made to those systems are subject to review and approval before implementation.

Managers are responsible for ensuring all electrical installations comply with safety and code requirements.

Common equipment

Flexible Cords
Flexible cords, and cord and plug assemblies provide AC power for machines, equipment and tools. Improper use of flexible cords can lead to shock, fires or other hazards because of overheated equipment.

Regulations permit flexible cords for the following purposes:

- Connections of portable lamps, portable and mobile signs or appliances;
- Connecting stationary equipment that requires frequent interchange;
- An appliance or equipment with fastenings and mechanical connections specifically designed to permit-ready removal for maintenance and repair and intended or identified for flexible cord connection;
- Pendants;
- Wiring of fixtures;
- Elevator cables;
- Crane and hoist wiring;
- Preventing transmission of noise or vibration;
- Data processing cables as permitted;
- Connecting moving parts; and
- Temporary wiring as permitted.

Adhere to the following conditions for flexible cords:

- When flexible cords and cables are used in the first three conditions above, they must be equipped with an approved attachment plug and energized from a receptacle outlet;
- Only qualified persons may install cord caps on flexible cords;
- Flexible cord and cable, attachment plugs, and receptacles must be of the proper type, size, voltage and current rating for the intended application; and
- Branch circuits that feed cord-and-plug-connected equipment must be in accordance with applicable codes, having overcurrent protection, and proper grounding.

Regulations forbid the following uses of flexible cords:

- Flexible cords used as a substitute for the fixed wiring of a structure;
- Flexible cords run through holes in walls, structural ceilings, suspended ceilings, dropped ceilings, or floors;
- Flexible cords run through doorways, windows, or similar openings;
- Flexible cords attached to building surfaces; and
- Flexible cords concealed behind building walls, structural ceilings, suspended ceilings, dropped ceilings, or floors.
Extension Cords
Extension cords serve to bring AC power to a device not near a power source and as temporary power sources.

Improper use of an extension cord creates shock hazards. In addition, use of an undersized extension cord may result in an overheated cord and insufficient voltage delivered to the device, possibly leading to a device failure and a fire hazard.

The following policy for use of extension cords at Tim Foster – dba MPC (Maintenance Projects & Construction) will be followed:

- UL or another nationally recognized testing laboratory must approve extension cords, maintained with no exposed live parts, exposed ungrounded metal parts, damage, or splices.
- Extension cords must be made of a heavy-duty or extra-heavy-duty rated cable and must be a continuous length.
- Protect extension cords with a GFCI around construction sites in damp areas, or in an area where a person may be in direct contact with a solidly grounded conductive object.
- Extension cords must be of sufficient current-carrying capacity to power the device. An undersized cord is a fire hazard.
- Extension cords must be three-conductor (grounded) – even if the device has a two-conductor cord. Never use two-conductor extension cords at Tim Foster – dba MPC (Maintenance Projects & Construction).
- Only qualified personnel may make repairs of extension cords.

The following uses of extensions cords are not permitted at Tim Foster – dba MPC (Maintenance Projects & Construction):

- Extension cords used in place of permanent facility wiring;
- Extension cords run through doors, ceilings, windows, or holes in the walls. If it is necessary to run a cord through a doorway for short term use, the extension cord must be:
  o Protected from damage
  o Removed immediately when no longer in use
  o Not a tripping hazard
- Extension cords plugged into another extension cord;
- Overloaded extension cords. The wire size must be sufficient for the current required;
- Extension cords with removed or compromised ground prong or ground protection;
- Extension cords with ground conductors that have less current-carrying capacity than the other conductors; and
- Frayed or damaged extension cords.
Power Strips
A power strip is essentially an extension cord that terminates in a row or grouping of receptacles. Power strips provide multiple receptacles for equipment. In general, the policies pertaining to extension cords apply to power strips.

Additional requirements are:
- Only UL (or other NRTL) approved devices.
- Do not mount power strips to any facility surface. Power strips may hang from screws or hooks if manufactured with slots or keyholes.
- In equipment racks, the preferred method of supplying 120/208-volt utility power to rack-mounted instruments is via a special power strip specifically designed to be rack-installed.

Electrical Rescue Technique
Approach the accident:
- Never rush into an accident situation.
- Call 911 as soon as possible.
- Get the aid of trained electrical personnel if possible.
- Approach the accident scene cautiously.

Examine the scene:
- Visually examine victims to determine if they are in contact with energized conductors.
- Metal surfaces, objects near the victim or the earth itself may be energized.
- You may become a victim if you touch an energized victim or conductive surface.
- Do not touch the victim or conductive surfaces while they are energized.
- De-energize electrical circuits if possible.

De-energize:
- An extension or power cord probably powers portable electrical equipment.
- Unplug portable electrical equipment to remove power.
- Open a disconnecting device or circuit breaker to de-energize fixed electrical equipment.

Hazards and solutions:
- Be alert for hazards such as stored energy, heated surfaces and fire.
- If you cannot de-energize the power source, use extreme care.
- Ensure that your hands and feet are dry.
- Wear protective equipment such as low voltage gloves and overshoes if available.
- Stand on a clean dry surface.
- Use nonconductive material to remove a victim from the conductor.
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High voltage rescue:
- Special training is required for rescues if high voltage is present.
- Wear protective equipment such as high voltage gloves and overshoes.
- Special insulated tools should be used

Insulated tools:
- Insulated tools, with high voltage ratings, are a lifesaver!
- Use devices such as hot sticks or shotgun sticks to remove a victim from energized conductors.
- In some cases, it may be possible to use nonconductive rope or cord to remove a victim from a conductor.

Rescuing the victim:
- Stand on a dry rubber blanket or other insulating material if possible.
- Do not touch the victim or conductive material near the victim until the power is off.
- Once power is off, examine the victim to determine if they should be moved.
- Give "First Aid."

First Aid (do not attempt to deliver any care beyond level of training and knowledge):
- A victim may require Cardio-Pulmonary Resuscitation (CPR).
- If the victim is breathing and has a heartbeat, give first aid for injuries and treat for shock.
- Ensure the victim gets medical care as soon as possible.
- Provide medical personnel with information on voltage level, shock duration & entry/exit points. The treating/attending physician must have detailed specific information to properly diagnose and care for the victim. The physician must determine whether the victim should be sent to a trauma or burn center.

Stay with the victim until help arrives.

11.5 Forms and Attachments

On the following pages, please find the following document:
- General Electric Safety Training Documentation

This form may be reproduced freely by Tim Foster – dba MPC (Maintenance Projects & Construction) for the purposes of implementing and maintaining an injury and illness prevention program.
# General Electrical Safety Training

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## Attendees

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(Retain at least 3 years)