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# Electrical Safety Management for Facility/Operations Work Environments

## 1. Purpose / Background

**Purpose:** The purpose of this SOP is to outline requirements and procedures relative to management of electrical hazards to which MIT Department of Facilities (DOF) employees are potentially exposed during installation, repair, maintenance, or troubleshooting (“work on”) electrical equipment, devices, and circuits.

EHS and the MIT campus in general, have implemented an Environment, Health, and Safety Management System (EHS-MS) to address environmental and occupational safety risks. This SOP is integral to the EHS-MS and is designed to provide guidance for all DOF employees regarding the hazards associated with electricity, including electric shock, electrical burns, electrical arc flash, and how to control these hazards.

**Background:** Electrical hazards are common throughout the various activities undertaken by DOF and should be managed effectively through various measures. Safe work practices must be understood and practiced by those who work on or near exposed electrical equipment or circuits. The consistent implementation of safe work practices is required and is the focus of this SOP.

In addition, OSHA regulates workplace electrical hazards as identified in the References section of this SOP.

## 2. Scope

This SOP is intended to address the MIT Department of Facilities (hereinafter referred to as “DOF” or “Facilities” employees) regarding management of electrical safety hazards. DOF employees who are engaged in any installation, repair, maintenance, or troubleshooting and who, in the course of their work, perform tasks on or near exposed electrical equipment at greater than 50 volts AC, where conductive un-insulated or unshielded parts of the circuit are present, are the intended audience of this SOP.

DOF groups or projects that hire contractors to work on electrical equipment, devices, or circuits are required to implement the Contractors section of this SOP.

Electrical safety hazards present in research-related work environments or projects are addressed in a separate SOP (EHS-0060), Electrical Safety Management for Research Work Environments.

Building renovation, construction, laboratory design, redesign, or modification, requires the assistance of topic experts, e.g., regulatory, code enforcement, engineering, and others, to ensure that all appropriate electrical safety hazards and controls are identified, evaluated, and managed. Review or use of this SOP does not qualify a person to work on electrical equipment.

Only qualified persons can perform electrical work activities. A qualified person (QP) must have training on and knowledge of the construction and operation of equipment, or a specific work method, and be trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method. A qualified person must also be familiar with the proper use of the special precautionary techniques; personal protective equipment including arc flash protective clothing; insulating and shielding materials; and insulated tools and test equipment. A person can be considered qualified with respect to certain equipment and methods but still be unqualified for others. MIT's broad range of electrical systems on campus and in laboratories make this a helpful distinction.

### 3. Prerequisites

Generally, persons with adequate experience in the relevant regulatory standards, industry standards, and understanding of electrical safe work practices may implement and monitor the requirements of this SOP. In addition, good familiarity with DOF operations is desirable.

Only Qualified (see Section 10: Definitions) employees may work on or near electrical equipment which contain greater than 50 volts AC, wherever conductive parts of the circuit are exposed during work on or near the equipment.

**Training:** Employees who require qualified status as described in Scope must complete electrical safety training prior to working independently on activities covered by this SOG.

**Limitations:** The SOP is not designed to cover all electrical or safety hazards an employee may encounter, nor the measures to reduce the hazards. Additional guidance to identify, evaluate, and control electrical hazards can be obtained through consultation with the EHS Office and the Department of Facilities.

### 4. Guidelines

Guidance and recommendations for basic good work practice can be found in the References section below.

**EHS-MS:** Roles and responsibilities of EHS relative to the EHS-MS can be found in the EHS-MS Manual via the EHS website. Generally, with respect to MIT DOF, the EHS Coordinator for DOF will ensure that specified job tasks or positions are evaluated with respect to electrical hazards as described in the Scope above. Based on this evaluation, these employees will be required to participate in appropriate training and implement respective safe work practices.

## 5. Roles & Responsibilities

### 5.1. Employees shall:

- Participate in safety training as required by DOF management for related tasks/work.
- (DOF supervisors) Review the electrical SOP and follow its guidance.
- Contact the EHS Office and/or the Department of Facilities for guidance, with questions, or when unsafe electrical hazards are recognized or suspected.

### 5.2 Department of Facilities shall:

- The EHS Coordinator for DOF will ensure that specified job tasks or positions are evaluated with respect to electrical hazards as described in Scope.
- Maintain a list of “qualified” DOF personnel who can work independently within the scope of this SOP.
- (Supervisory and employees) Repair or remove defective or unsafe electrical equipment.
- Maintain a list of personnel trained on safe electrical work practices.
- Assign new employees a mentor from the electrical team to observe and train safe work practices and procedures. Maintain documentation of behavior-based assessments of “qualified” personnel.
- When applicable, control hazardous energy sources through application of the DOF Lock-out/Tag-out procedures (LOTO) when “affected” employees will service or maintain equipment or systems that contain hazardous energy. (**Note:** As used here, “affected” employee means: “An employee whose job requires them to operate or use a machine or equipment on which servicing, or maintenance is being performed under LOTO, or whose job requires them to work in an area in which such servicing or maintenance is being performed.” OSHA’s control of hazardous energy (aka LOTO) standard: 29 CFR 1910.147.)
  - **Note:** Employees covered by this SOP, e.g., non-electrical trained DOF employees, are not permitted to perform LOTO procedures unless they have been specifically trained to perform such duties
- Periodically offer the required training courses for Qualified work as required in OSHA 1910.330 through 335. Courses may be offered for Basic or Advanced electrical hazards based upon the working experience and knowledge of employee.
- Verify that equipment has been effectively de-energized in accordance with LOTO procedures unless Department personnel are trained, qualified, and authorized by the DOF to perform equipment/systems LOTO procedures.

### 5.3. EHS Office shall:

- Work with the Department of Facilities to evaluate an employee’s capabilities to understand safe electrical work practices, as outlined, herein, and qualify the employee to work independently.
- Maintain a list of personnel trained on safe electrical work practices through the Atlas Learning Center.
- Assist with evaluating appropriate training for qualified and non-qualified electrical workers.

### 5.4 Contractors’ Electrical Safety

An official hardcopy of this document exists in the EHS Office or on the EHS website.  
External links are subject to change, please contact [environment@mit.edu](mailto:environment@mit.edu) if you encounter a broken link.  
See Legal Disclaimer at: <http://ehs.mit.edu/legal-disclaimer>

Electrical service, repair, and maintenance contractors shall provide the DLC that they are contracting with, evidence or assurance of the status of all employees, with respect to OSHA requirements for Qualified and Authorized staff.

Contractors shall ensure that employees assigned to work in DLCs have licensure issued by the Commonwealth of Massachusetts for electrical trades work, and sufficient job experience relative to the work under contract.

## 6. Training

Affected Facilities staff, as described in Scope and Prerequisites, must complete electrical safety training appropriate to the electrical work tasks expected to be performed by their job activities. Generally, training requirements are determined by job position/title as well as determined through their supervisor, EHS and the DOF EHS Coordinator.

Upon successful completion of training and adequate supervised practical experience, the staff member may perform work on electrical circuits as described in Scope, using appropriate skills, knowledge, and as defined in OSHA's regulatory requirements.

Only Qualified MIT staff may work on electrical equipment which has greater than 50 volts AC, wherever conductive parts of the circuit are exposed during work on or near the equipment. **To become qualified to work on or near live circuits between 50 volts and 400 volts, requirements for training within MITs EHSMS and described within this SOP, as well as sufficient practical work experience working with Qualified electrical staff must be completed.**

DOF persons affected by this SOP shall receive appropriate training within 90 days of assignment to a new position which involves exposures as described in Scope above. Additional refresher training shall take place at intervals in line with NFPA electrical standard 3-year update schedule.

## 7. Monitoring Requirements

A periodic evaluation of a sample of qualified employees should be done to determine if training requirements have been met or if additional safe work practices should become part of training and recommended safe work practices. Post investigations involving electrical exposures shall be investigated thoroughly by DOF in conjunction with EHS to determine the effectiveness of this SOP.

## 8. Record Management

### 8.1 Department of Facilities:

- Maintain a roster of "qualified" personnel and identify employees (new or transfer) who require training with respect to hazards identified in Purpose and Scope.
- Ensure that employees of DOF receive the appropriate training and work experience necessary to become Qualified where indicated.
- Participate in the requirements of the EHSMS with respect to inspections and training updates.

## 8.2 EHS Office:

- Assist DOF management with identifying and providing training with sufficient frequency to support DOF schedules. Maintain a roster of personnel trained on electrical safety work practices.
- Periodically audit safe electrical work procedures.

## 9. References

### 9.1 Standards

- OSHA Standards for General Industry, 29 CFR 1910., Subpart S, U.S. Department of Labor, Occupational Safety and Health Administration
- OSHA Standards for the Construction Industry, 29 CFR 1926. U.S. Department of Labor, Occupational Safety and Health Administration
- Massachusetts Electrical Code, 527 CMR 12.00
- National Fire Protection Association; 70 and 70 E.

### 9.2 Other SOP/ SOGs

To view the SOPs/SOGs go to <https://ehs.mit.edu/sops/> and search for the SOP/SOG listed. MIT Certificates are required to view SOPs/SOGs.

- DOF SOP: EHS-R&M-04 Repair and Maintenance Control of Hazardous Energy Program.
- EHS-0060: Electrical Safety Management for Research Work Environments
- EHS-0002: Guidelines for Use and Inspection of Extension Cords and Power Strips

### 9.3 Supplementary Documents

- Electrical Safety for Electrical Trades, NIOSH, Pub No. 2009-113.
- Electrical Safety Handbook – Guidelines for the Massachusetts Institute of Technology
- DOF Contractor Policy

### 9.4 Basic safe work practices

The following sections represent basic procedures, configurations, and practices that should be adhered to when working with electrical circuits or devices. This section does not represent training and should not be used in lieu of training as described in the EHS-MS and above.

**Standard Electrical Safety Practices:** Observe the following practices when working with electricity or electrical equipment:

- Plug power equipment into wall receptacles with devices' power switches in the off position.
- Unplug electrical equipment by grasping the plug and pulling. Do not use the cord to unplug equipment.

- Check the electrical outlet (receptacle) for missing or damaged parts, broken face plates or receptacle plastic, missing screws, loose plug tension, etc. Do not plug equipment into defective receptacles. Submit work order to have these areas fixed.
- Regularly evaluate wiring and equipment cords for fraying, cracking, or exposed inner wires (typically found where the cord and plug meet.)
- Check for damaged cord connections and defective cords clamps or grommets where the power cord enters the equipment or attach to the plug.
- Remove and discard: “cheater plugs” (devices that permit grounded, three-prong plugs to be inserted into two-prong receptacles); non-standard extension cords such as those with terminal junction box receptacles, or other jury-rigged equipment.
- Contact MIT’s Electrical Services if a circuit breaker or Ground Fault Circuit Interrupter (GFCI) unexpectedly trips, a wire or fuse box feels warm, or a burning or electrical odor is noticed. These issues could indicate an electrical defect requiring repair to prevent hazard exposure, fire, etc.
- Recognize the difference between personnel and equipment protective devices. Over current protection devices, (e.g., circuit breakers, fuses, etc.), are designed to protect equipment and structures from fire, not people from electric shock. GFCIs are designed to protect people by detecting a ground fault and shutting down before an employee receives an electrical shock. See below.
- Ensure that high current consumer electrical equipment such as toaster ovens, blenders, etc. or other appliances are grounded or “double insulated” design.
- Identify the location and ensure accessibility to electrical circuit breaker panels, circuits and equipment disconnects controlling equipment, and work area lighting.
- Maintain a 36” clearance around all electrical panels or permanent electrical equipment installations.
- Ensure power cords are not draped over hot pipes, radiators, or sharp objects.
- Treat all exposed conductors, even when “de-energized”, as if they are live until LOTO is confirmed. Never defeat or remove a LOTO device.
- Label each shut off or disconnect unless the circuit it controls is obvious.
- Use the right length, size (gauge) and type (service rating) of cord to prevent wiring overload. Refer to manufacturers limitations of use and determine current load that devices will create. Use circuits, cords, and outlets within capacity and use limitations.
- Use GFCI's where/when appropriate; see below.
- Never insert objects, (e.g., pencils, fingers, metal tools, paper clips, conductive debris, etc.) into receptacles or unused conduit openings in junction or circuit breaker boxes.
- Tag defective electrical equipment with a “do not operate” tag, remove from service, and either discard or provide to a qualified and authorized electrical repair person for maintenance, repair, or disposal.

**Emergency Assistance, Response, and Rescue:** Consider the following action in the event of an employee contact with live electrical current:

- Shut off the electrical current if the victim is still in contact with the energized circuit.



- Call or have someone else call for Police, Fire, or Emergency Medical Services (EMS). If another person calls for EMS, have them return to verify that the call and contact was made.
- If you are unable to reach the main circuit switchgear (circuit breakers) quickly, pry the victim from the circuit with a **non-conductive** object such as dry wood or plastic. Never touch or contact the victim
- Stay with the victim until emergency medical responders arrive. Do not leave the victim unless there is no other option.
- Once you know that the victim is no longer energized, call to the victim to see if s/he is conscious. If conscious, reassure them and tell the victim not to move. Quickly examine the victim for signs of:  
**Unconscious:** If the victim is unconscious, check for signs of breathing. While you do this, move the victim as little as possible. If the victim is not breathing, someone trained in CPR should begin artificial rescue breathing, and check to see if the victim has a pulse. Quick action is essential! To be effective, CPR must be performed within 4 minutes.

**Bleeding:** If there is major bleeding, place a cloth over the wound and apply pressure. If the wound is in an arm or leg and continues bleeding, gently elevate the injured area while keeping pressure on the wound. Keep the victim warm and talk to him or her until EMS arrives.

### **Ground Fault Circuit Interrupters (GFCI):**

GFCIs are designed to protect people from serious injury or death. A GFCI is a fast-acting device that detects a difference in current between two circuit conductors. If either conductor contacts an unintended electrical path (a situation known as a ground fault), the GFCI opens the circuit in a fraction of a second. Should a difference as small as 4 to 6 mA be detected, the GFCI is tripped and the current is shut off.

GFCI's are usually in the form of a duplex receptacle. They are also available in portable and plug-in designs and as circuit breakers that protect an entire branch circuit. GFCI's can operate on both two- and three-wire ground systems. For a GFCI to work properly, the neutral conductor (white wire) must (1) be continuous, (2) have low resistance, and (3) have sufficient current-carrying capacity which is generally the case with a good condition circuit and outlet.

GFCI's help protect from electrical shock by continuously monitoring the circuit. However, a GFCI does not protect from line-to-line hazards such as simultaneously touching two "hot" wires (240 volts) or touching a "hot" and neutral wire simultaneously. The National Electric Code (NEC) requires that GFCI's be used in the following:

- Receptacles located within 6 feet of a sink.
- Receptacles installed outdoors.
- Electrical use near water.
- Electrical equipment user is grounded (by touching grounded material).

**Functional Testing:** Test GFCI's regularly by pressing the "test" button. If the circuit does not trip, the GFCI is faulty and must be replaced. Tag the receptacle and contact DOF.

Indicate locations or equipment where GFCI are required by MIT but may not be appropriate, e.g., receptacles dedicated to refrigerators or other heavy equipment.

**Extension Cords and Power Strips:** See Guideline for Use and Inspection of Extension Cords and Power Strips, EHS-0002.

**Electrical Equipment Clearance:**

Maintain a minimum working clearance of 36 inches on each side of electrical enclosures, e.g., circuit breaker boxes, electrical panels, etc. Working clearance may not be less than 30 inches wide in front of the covered electric equipment / enclosures.

**(Supplemental language:** The space in front of electrical enclosures may not be used for storage. This access and working space shall be kept clear at all times for operation and maintenance personnel and may not be used for intermittent/incidental storage of nonpermanent equipment or furniture, which could interfere with ready access to the electric equipment in the event of an emergency.)

## 10. Definitions

- **Authorized:** Trained by MIT's EHS Office on electrical safety principles and practices and control of hazardous energy methods and techniques and authorized by MIT's Electrical Services (Department of Facilities) and EHS Office to perform lock-out/tag-out and electrical installation, modification, repair, replacement, or rehabilitation.
- **Qualified Person:** A person trained through the MIT's EHSMS on electrical safety principles and practices and authorized by his/her supervisor to have the skills, knowledge, and abilities to safely perform the work to which he/she is assigned (expected to work on or near electrical equipment as described in this SOP).
- **Non-qualified Person:** A person trained through the MIT's EHSMS on electrical safety principles and practices, who will not be exposed to live / energized conductors or circuit parts as part of their duties.
- **Work on or near exposed electrical conductors:** Working in proximity to circuits or parts of circuits which, in a manner during the work task in question is not protected by normal configuration or insulation of the electrical parts or circuit. Work that involves tools or techniques that intentionally or otherwise could be reasonable expected to contact potentially conductive parts of the circuit are affected. This would include painting near circuit or circuit parts where normal coverings are removed or missing, installation or repair of non-electrical parts or systems near exposed or uncovered electrical panels, and work within electrical enclosures for testing, repair, or modification of any part of the device or system.