

Electrical Safety Program

(EHS Program Manual 7.8)



1.0 Overview

Environmental Health and Safety (EHS) at Weill Cornell Medicine (WCM) has developed this Electrical Safety Plan to promote a safe work environment for employees who work with or maintain electrical systems and equipment, and to comply with 29 CFR 1910 Subpart S.

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3.0 Objective

The Electrical Safety Program aims to prevent exposure to hazardous electrical conditions and ensure compliance with the regulatory requirements applicable to electrical systems. The hazards associated with electricity are electrical shock and fire.

All maintenance work on electrical equipment must be performed in a de-energized state unless de-energizing introduces an increased hazard or is not feasible for the work to be performed (such as voltage testing to troubleshoot).

This program is designed to provide guidance, protect the WCM community from electrical hazards, and ensure that any energized electrical work is performed safely by qualified electrical workers who have the proper training and utilize safe work procedures (e.g., personal protective equipment and other safety controls).

4.0 Applicability

This program applies to anyone who may be exposed to electrical hazards at WCM, including all employees, students, contractors, and volunteers working in the laboratory, clinical, and administrative/service work environments.

5.0 Responsibilities

5.1 ENVIRONMENTAL HEALTH AND SAFETY (EHS)

EHS duties include:

- Assist the WCM community in the implementation of this program.
- Provide or coordinate general training for groups on the content of this program, as requested.
- Impart or assist in training for electrical work qualifications.
- Retain all training records.
- Review and update this written program periodically.
- Assess work being performed and determine compliance with this program.
- Evaluate the overall effectiveness of the electrical safety program regularly.

5.2 ENGINEERING AND MAINTENANCE (E&M)

E&M responsibilities include:

- Assist employees in the implementation of electrical safety practices addressed in this program.
- Ensure employees comply with all provisions of the electrical safety program.
- Verify that employees receive training appropriate to their assigned electrical tasks.
- Develop and maintain a listing of all qualified employees under their supervision.
- Confirm that employees receive and use appropriate protective equipment.
- Coordinate the completion of arc flash analyses required by this program as needed and during equipment replacement or upgrading.
- Minimize electrical hazards through the application of engineering and design controls.
- Promote consistency in electrical installations throughout the various facilities.
- Report any safety concerns regarding electrical installations to EHS.

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5.3 SUPERVISORS

Supervisors' responsibilities include:

- Assist employees in the implementation of electrical safety practices addressed in this program.
- Ensure that employees comply with all provisions of the electrical safety program.
- Confirm that employees receive training appropriate to their assigned electrical tasks.
- Verify that employees receive and use appropriate protective equipment.

5.4 ELECTRICAL USERS

Electrical users' responsibilities include:

- Follow the work practices described in this document, including the use of appropriate protective equipment and tools.
- Attend all required training relative to this program.
- Report any concerns related to electrical safety to their supervisor immediately.

6.0 Emergency Response

6.1 ELECTRICAL INJURIES

If someone has received an electrical shock, do not touch the person, equipment, cord, or any other objects touching them or in the immediate vicinity. Call EMS immediately: 212-472-2222 on campus (2-2222 from a campus phone) or 911.

If it is safe to do so, disconnect the power source immediately. Do not touch any power source or energized equipment if unsure whether it is safe to do so.

6.2 FIRE EXTINGUISHERS FOR ELECTRICAL FIRES

If an electrical fire occurs, leave the area immediately and follow your [Building Specific Fire Safety and Emergency Action Procedure](#).

If it is safe to do so, shut down the power source while exiting the area.

Only employees trained in the use of a fire extinguisher may use one to extinguish an electrical fire. A type C fire extinguisher must be used on electrical fires. If a fire extinguisher does not have type C classification, it can NEVER be used to extinguish an electrical fire. The ABC or BC fire extinguishers installed in many locations on campus are also suitable for electrical fires.

7.0 General Requirements

7.1 SAFE WORK PRACTICES

- Inspect the wiring of equipment before each use. Replace damaged or frayed electrical cords immediately, and do not use equipment with damaged or frayed electrical cords.
- Use safe work practices every time electrical equipment is used.
- Know the location and how to operate shut-off switches and/or circuit breaker panels. Use these devices to shut off the equipment in the event of a fire, electric shock, or electrocution.
- Limit the use of extension cords and only use them for temporary operations. In all other cases, request installation of a new electrical outlet.

7.2 EXTENSION CORDS

Extension cords are only permitted for temporary operations.

The following requirements apply to the use of extension cords:

- Extension cords must be visually inspected before use for defects such as loose parts, deformed or missing pins, damage to the outer jacket or insulation, or possible internal damage such as a pinched or crushed outer jacket.
- Extension cords must be of the three-wire type and designed for hard or extra-hard usage (for example, types S, ST, and SO). The rating or approval must be visible.

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- Extension cords must be protected from damage and cannot be run through windows or doors unless protected from damage, and even then, only on a temporary basis. Extension cords may not be draped above ceilings or inside or through walls, ceilings, or floors and may not be fastened with staples or otherwise hung in such a fashion as to cause damage to the outer jacket or insulation.
- Extension cords must be covered by a cord protector or tape when extending into a walkway or other path of travel to avoid creating a trip hazard.

Any defective or damaged cord must be removed from service and immediately discarded, or tagged and repaired by a qualified person.

7.3 ELECTRICAL REPAIRS OR MODIFICATIONS

Electrical repairs and modifications may only be performed by a qualified person.

Unauthorized modifications are not permitted under any circumstance.

7.3.1 Building and Laboratory Wiring, Outlet Receptacles, and Breaker Panels

Any modifications to existing electrical service in a laboratory or building must be coordinated and approved with E&M.

Only E&M or a licensed electrician may perform maintenance or modifications to existing electrical services, such as breaker panels, outlet receptacles, wall switches, or wiring.

Laboratory personnel may reset ground fault circuit interrupters (GFCIs) if needed. E&M must be contacted to shut off or reset tripped breakers.

7.3.2 Commercial Appliances, Instruments, and Equipment

Maintenance or modifications to commercial appliances, instruments, and equipment may only be performed by the manufacturer or an authorized service representative. All interactions with the electrical system in WCM spaces must be coordinated with E&M.

8.0 Electrical Safety in the Laboratory

In addition to the General Electrical Safety requirements, the following are requirements specific to electrical safety in the laboratory. This section applies to all staff conducting work in a laboratory at WCM.

8.1 SAFE WORK PRACTICES

- Keep corrosive chemicals and organic solvents away from electrical cords, as these can easily corrode the insulation on wires.
- Keep flammable materials away from electrical equipment.
- Extension cords and outlet strips are not permitted in chemical hoods or areas where flammable vapors may be present.
- When it is necessary to handle equipment that is plugged in, be sure hands are dry and, when possible, wear nonconductive gloves and shoes with insulated soles.
- Minimize the use of electrical equipment in cold rooms or other areas where condensation is likely. If equipment must be used in such areas, mount the equipment on a wall or vertical panel.
- If water or a chemical is spilled onto equipment, shut off power at the main switch or circuit breaker and unplug the equipment.
- Ensure that any equipment used near water sources is plugged into outlets with ground-fault circuit interrupter (GFCI) capability.

8.2 PERMANENT ELECTRICAL WIRING

Permanent electrical outlets must be installed for all stationary electrical equipment (e.g., refrigerators, freezers). Stationary electrical equipment may not be plugged into extension cords, power strips, or other non-permanent outlets.

8.3 ELECTROPHORESIS EQUIPMENT

Electrophoresis equipment can pose a significant electrical hazard. This equipment is capable of providing a lethal shock if used improperly.

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8.3.1 Safe Work Practices

- All employees must be trained on the proper use of electrophoresis equipment before use.
- All pieces of equipment must be inspected before each use.
- All leads and power cords must be inspected for any deficiencies in insulation and other damages.
- All equipment must be operated as detailed in the manufacturer's instructions.
- The gel chamber and other exposed parts must be guarded against accidental contact. The gel chamber must also have a lid or interlocked cover to prevent accidental contact with energized electrodes or buffer solution.
- Equipment must always be attended to while energized.
- Equipment must be kept clear of all conductors and grounding points (e.g., water sources, metal plates, jewelry, aluminum foil, etc.).
- Equipment must be turned off before the gel chamber is opened.

8.3.2 Electrical Leads

- Turn off the power supply before connecting or disconnecting leads.
- Always connect leads with dry hands.
- Leads must be connected one at a time, using one hand only.

8.3.3 Power Supplies

- Equipment must be labeled with a "Danger" warning.
- Equipment must have 3-prong plugs with a proper ground prong.
- Power supplies may only be connected to power strips if the power strips have safety features that detect changes in load, no-load, overload, short circuits, and ground leaks.

8.3.4 Laboratory Electrical Equipment and Motors

In areas where volatile flammable materials are used, motor-driven electrical equipment must be equipped with non-sparking induction motors or air motors. Avoid series-wound motors (e.g., vacuum pumps, rotary evaporators and stirrers, blenders, mixers, vacuum motors, and power drills).

If non-intrinsically safe equipment is used, flammable vapors must be adequately controlled before using any of this equipment in a laboratory, and control must be verified by standard EHS ventilation-inspection procedures.

9.0 Electrical Safety for Engineering

9.1 CONTROL OF HAZARDOUS ENERGY

The Hazardous Energy Control (Lockout/Tagout) Program aims to protect employees from exposure to all forms of hazardous energy while performing maintenance or work on WCM equipment, systems, and/or utilities. Equipment is isolated from energy sources, and injuries to workers are prevented by using specific procedures that involve applying locks and tags. Refer to the [EHS Manual 7.4 – Hazardous Energy Control \(Lockout/Tagout\)](#) program manual for more information.

9.2 SPACE AROUND ELECTRICAL EQUIPMENT

9.2.1 Spaces Around Electrical Equipment

- **Access.** Sufficient access and working space must be provided and maintained around all electric equipment to permit ready and safe operating and maintenance of such equipment. Enclosures that house electric apparatus and are controlled by lock and key and must only be accessible to qualified persons.
- **Working Space.** Working space for equipment operating at 600 volts, nominal, or less to ground, and likely to require examination, adjustment, service, or maintenance while energized, must comply with the dimensions of 1910.303(g) Table S-1 or as required or permitted elsewhere in the OSHA Subpart S Standard.

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- **Depth of Working Space.** The depth of the working space in the direction of access to live parts may not be less than indicated in NFPA 70E. Distances shall be measured from the live parts if they are exposed or from the enclosure front or opening if they are enclosed.
- **Dead-front Assemblies.** Working space is not required in the back or sides of assemblies (such as dead-front switchboards or motor control centers) where all connections and all renewable or adjustable parts (such as fuses or switches) are accessible from locations other than the back or sides. Where rear access is required to work on non-electrical or de-energized parts on the back of enclosed equipment, a minimum horizontal working space of 30 in. must be provided.
- **Low Voltage.** Smaller working spaces are permitted where all insulated parts operate at not greater than 30 volts RMS, 42 volts peak, or 60 volts dc.
- **Existing Buildings.** In existing buildings where electric equipment is being replaced, Condition B working clearance shall be permitted between dead-front switchboards, panelboards, or motor control centers located across the aisle from each other. Conditions of maintenance, supervision, and written procedures must be adopted to prohibit equipment on both sides of the aisle from being open at the same time. Qualified and authorized electrical workers must service the installation.
- **Width of Working Space.** The width of the working space in front of the electrical equipment shall be the width of the equipment or 30 in., whichever is greater. In all cases, the workspace shall permit at least a 90-degree opening of equipment doors or hinged panels.
- **Height of Working Space.** The workspace shall be clear and extend from the grade, floor, or platform to the height required by paragraph (g)(1)(vi) of the Subpart S 1910.303 standard. However, other equipment associated with the electrical installation and located above or below the electric equipment may extend not more than 6 in. beyond the front of the electric equipment.
- **Clear Spaces.** Working space required by the Subpart S 1910.303(g) Table S-1 standard shall not be used for storage. When usually enclosed live parts operating at 50 volts or more are exposed for inspection or service, the working space must be adequately guarded if this space is in a passageway or general open area.

9.2.2 Access and Entrances to Working Space

- **Minimum Required.** At least one entrance of sufficient area must be provided for access to the working space about electric equipment.
- **Large Equipment.** For switchboards, overcurrent devices, and control panels on equipment rated 1200 amperes or more and over 6.0 ft. in width, there shall be one entrance at each end of the working space. If the location of the equipment permits a continuous and unobstructed way of exit travel, or unless the workspace is doubled, only one means of exit is required.
- **Unobstructed Exit.** Where the location permits a continuous and unobstructed exit travel route, a single exit to the working space is allowed.

9.2.3 User Request

- **General.** Employees must not enter spaces containing electrical hazards unless there is sufficient illumination that enables the employees to perform the work safely. Lighting must be able to be manually controlled.
- **Obstructed View of Work Area.** Where lack of illumination or an obstruction precludes observation of the work to be performed, employees must not perform any task within the Limited Approach Boundary on energized electrical conductors or on circuit parts operating at 50 volts or more or where an electrical hazard exists.

9.2.4 Headroom

The minimum headroom of working spaces above service equipment, switchboards, panelboards, or motor control centers must be 6.5 ft.. Where the electrical equipment exceeds 6.5 ft. in height, the minimum headroom must not be less than the height of the equipment.

9.2.5 Dedicated Equipment Space

All switchboards, panelboards, distribution boards, and motor control centers must be located in dedicated spaces and protected from damage. As an exception, control equipment—because of its nature or other standard rules—must be within sight or adjacent to the operating machinery and therefore is permitted in those locations.

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9.3 ELECTRICAL EQUIPMENT LABELING

Article 110.16 of the NEC 2020 code requires switchboards, panel boards, industrial control panels, motor control centers, and service equipment rated 1200 amps or more to be field or factory marked to warn workers of potential electric arc flash hazards.

9.3.1 General Requirements

- The term “Industrial Control Panel” must be visible on every enclosure that may contain exposed energized conductors or components.
- Markings are designed to reduce the risk of severe injury or death due to arcing faults to workers working on or near energized electrical equipment.
- Markings (labels) must be located in an area visible to personnel before the examination, adjustment, servicing, or maintenance of the equipment.
- The DANGER label should be used to notify a qualified worker who intends to open the equipment for analysis or work of the following:
 - Electric arc flash hazard exists.
 - Turn off all power before opening.
 - Follow all requirements of NFPA 70E for safe work practices and wear appropriate personal protective equipment (PPE) for the specific hazard.
- When arc flash and shock data are available for industrial control panels, WARNING labels must include information on flash hazard boundary, the hazard category, required PPE, minimum arc rating, limited approach distances, restricted approach distances, and prohibited approach distances.
- Labels for service equipment must include the nominal system voltage, available fault current at the service overcurrent protective devices, clearing time of overcurrent protective devices, and the date the label was applied.
- Unqualified person(s) may not be near open energized equipment.



9.4 ARC FLASH HAZARD ANALYSIS

An arc flash hazard analysis is required for all work presenting an arc flash hazard.

A hazard analysis includes the following steps:

1. Collect data on the facility’s power distribution system:
 - Arrangement of components on a one-line drawing with nameplate specifications of every device.
 - Lengths and cross-section area of all cables.
 2. Contact the electrical utility (i.e., ConEd) or WCM E&M for information, including the minimum and maximum fault currents that can be expected at the entrance to the facility.
 3. Conduct a short circuit analysis followed by a coordination study.
 4. Feed the resultant data into the NFPA 70E-2020 or IEEE Standard 1584-2002 equations.
 - These equations produce the necessary flash protection boundary distances and incident energy to determine the minimum PPE requirement.
 - The flash protection boundary is the distance at which PPE is needed to prevent incurable burns (2nd degree or worse) if an arc flash occurs. (It is still possible to suffer 1st or 2nd-degree burns).
- For systems of 600 volts and less, the flash protection boundary is 4 feet, based on an available bolted fault current of 50 kA (kiloamps) and a clearing time of 6 cycles (0.1 seconds) for the circuit breaker to act, or any combination of fault currents and clearing times not exceeding 300 kA cycles (5000 ampere-seconds).
 - For other fault currents and clearing times, see NFPA 70E.
 - If an arc flash analysis has not been performed, refer to NFPA 70E for proper PPE.
 - The analysis should be updated when changes occur in the electrical distribution system that can affect the results of the study and should be reviewed for accuracy at a minimum every five years.

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10.0 Training

Each department must maintain documentation of training and experience of Qualified Electrical Workers.

Documentation is necessary to demonstrate that individuals have met the training and experience requirements for the types of work being performed. Retraining in safety-related work practices and applicable changes to any relevant standards must be completed at a minimum every three years and more frequently if additional training is considered necessary.

11.0 Record Retention, Ability, and Revisions

11.1 ARC FLASH HAZARD ANALYSIS

Supervisors are responsible for maintaining all hazard analyses for 1 year.

11.2 TRAINING RECORDS

Individual departments must maintain the training records of qualified workers for at least three years. EHS will retain all other training records.

11.3 REVISIONS

EHS will review the Electrical Safety Program annually. The program will be revised if any deficiencies are identified during the annual review. Updates to the OSHA or NFPA 70E standards will also prompt a review of this manual.

12.0 References

- [Occupational Safety and Health Administration \(29 CFR 1910 Subpart S, "Electrical"\)](#)
- [Occupational Safety and Health Administration \(29 CFR 1910.147, "The Control of Hazardous Energy"\)](#)
- [National Fire Protection Association \(70-E "Standard for Electrical Safety in the Workplace" 2020 Edition\)](#)
- [Institute of Electrical and Electronics Engineers \(Standard 1584-2002, "Guide for Performing Arc Flash Hazard Calculations"\)](#)

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