



Portland State UNIVERSITY

Energized Electrical Work Policy

Revised: 2/20/2015

Purpose

This policy is specifically intended to protect employees and the public from the risks of electrical shock and Arc flash/Arc blast, AND protect Portland State University (PSU) from the risk of electrical equipment damage, fire damage and disruption of essential business functions. This policy has been written to comply with Oregon OSHA requirements. It also incorporates additional provisions from NFPA 70E, Standard for Electrical Safety in the Workplace, to further minimize risk from electrical hazards.

Portland State University's signing Electrical Supervisor must approve any and all energized electrical work (EEW) that is performed by PSU employees or contracted firms. The Electrical Supervisor reserves the right to deny EEW until a written method of procedure (MOP) is created and meets his/her standards. PSU's signing Electrical Supervisor requires an EEW Plan (refer to the PSU ENERGIZED ELECTRICAL WORK PLAN and AUTHORIZATION form, Appendix A) when it is necessary to remove any electrical distribution equipment or disconnect the cover that breaks the integrity of the cabinet/enclosure, exposing the qualified person to the PPE ratings, except as allowed under the exception on page 2. An EEW Plan is also required when opening utilization equipment (e.g. HVAC, FVDs, PLC cabinets, etc...) where exposure would be encountered. Should a situation be uncertain, the person performing or managing work will call PSU's signing Electrical Supervisor to clarify the activity.

Failure to perform the actions described will be considered "working without the permission of the PSU Electrical Supervisor" and relieves both the PSU Electrical Supervisor and PSU of all liability if an incident should occur.

Energized Electrical Work

Energized Electrical Work as a Last Resort

OSHA and NFPA 70E require that all energized circuit parts and equipment be de-energized and locked out before any employee works on them, unless it can be demonstrated that de-energizing "Introduces additional or increased hazards, or is infeasible due to equipment design or operational limitations" (e.g. interruption of life support equipment; diagnostics and testing work). Oregon OSHA has stated that all circuit parts and equipment are to be considered energized until tested by qualified individuals. If it is determined that energized work must be performed, only qualified individuals, who meet the definition and training requirements within this policy shall perform energized work in accordance with this policy.

Energized Electrical Work (EEW) Plan

If live parts are not placed in an electrically safe work condition (see definition), an EEW Plan shall be completed prior to starting work (see Appendix A). The purpose of the EEW Plan is to:

1. Demonstrate that de-energizing is infeasible or creates additional hazards,
2. Assess exposure risk, and
3. Control exposure risk.

The EEW Plan shall be reviewed and signed by person requesting authorization for the work, along with:
PSU Signing Electrical Supervisor; or
PSU Assistant Director of Operations and Maintenance.

Exception

Diagnostics, testing, troubleshooting, voltage measuring by qualified persons shall be permitted to be performed without an EEW Plan, provided appropriate safe work practices and personal protective equipment* is provided and used. The Electrical Supervisor must be notified.

*Shock and Arc Flash Hazard Protective Requirements. NFPA 70E shall be consulted for determining required Personal Protective Equipment.

Maintenance of Protective and Voltage Rated Equipment

Insulating Equipment Certification Test intervals

- Gloves: Within 6 months prior to first issue, and every 3 months after issue for use.
- All other insulating equipment and hot sticks shall be tested prior to first issue, and at least every 12 months after issue for use.
- Records shall be kept of dates of issue and all certification testing for all insulated protective equipment.

Insulating Equipment Inspection Criteria (user inspection)

- Gloves, mats, blankets and other insulating materials must be inspected before every use. Discard if there is any evidence of: holes, tears, punctures, cuts, or embedded foreign objects.
- Age and ozone (corona) cracking, caused by prolonged folding or storage near ozone producing equipment.
- Signs of texture changes: Swelling, softening, hardening, or becoming sticky or inelastic, such as from chemical damage.
- Sun checking, appearing as fine, "spider web" cracks in the rubber from prolonged exposure to sunlight.

Air test rubber insulating gloves before each use as follows:

- Roll the sleeve of the glove to lock air into the hand and fingers.
- Visually inspect the fingers and hand for the defects listed above.
- Feel and listen for air leakage from the hand or fingers while squeezing the glove to increase air pressure inside. Discard if any evidence of leakage.

Approved for voltage: tools and test instruments

Voltage rated tools and test equipment shall be tested and certified as determined appropriate by the manufacturer. Records shall be kept of all testing and/or certification.

Maintenance of Safe Distances

The following distances shall be determined and maintained prior to work on energized equipment or systems:

Limited Approach Boundary

An approach limit at a distance from an exposed live part within which a shock hazard exists. This zone is entered only by qualified persons or unqualified persons that have been advised and are escorted by a qualified person.

Restricted Approach Boundary

An approach limit at a distance from an exposed live part within which there is an increased likelihood of electric shock, due to electrical arc over combined with inadvertent movement, for personnel working in close proximity to the live part. This zone is entered only by qualified persons, required to use shock protection techniques and PPE.

Limited Approach Boundary NFPA 70E 2015 Handbook PAGE 116 AND 117. Tables 130.4(D) (a) and 130.4(D) (b). Examples from tables are provided below. See NFPA 70E for complete tables.

Phase to Phase: Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection for Alternating-Current Systems (Less than 50 volts not specified)

Nominal System Voltage Range, Phase to Phase	Limited Approach Boundary		Restricted Approach Boundary (Includes Inadvertent Movement Adder)
	Exposed Movable Conductor	Exposed Fixed Circuit Part	
50 V - 150 V	10 ft	3 ft 6 in	Avoid contact
151 V - 750 V	10 ft	3 ft 6 in	1 ft 0 in
751 V - 15 kV	10 ft	5 ft 0 in	2 ft 2 in
15.1 kV - 36 kV	10 ft	6 ft 0 in	2 ft 7 in

Single Phase: Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct- Current Voltage Systems (less than 100 volts not specified)

Nominal Potential Difference	Limited Approach Boundary		Restricted Approach Boundary (Includes Inadvertent Movement Adder)
	Exposed Movable Conductor	Exposed Fixed Circuit Part	
100 V - 300 V	10 ft	3 ft 6 in	Avoid contact
301 V - 1 kV	10 ft	3 ft 6 in	1 ft 0 in
1.1 kV - 5 kV	10 ft	5 ft 0 in	1 ft 5 in
5 kV - 15 kV	10 ft	5 ft 0 in	2 ft 2 in

Note: For single phase voltages, select range that is equal to the maximum phase-to-ground Voltage and multiply by 1.73 to obtain correct voltage level to be used (NFPA 70E, Annex C.2.1.1)

Flash Protection Boundary

The Flash Protection Boundary is an approach limit at a distance from exposed live parts within which an unprotected person could receive a second degree burn if an electrical arc flash were to occur. When an energized conductor is exposed, **absolutely no one** may approach closer than the Flash Boundary without wearing the appropriate arc protection.

An arc flash hazard analysis shall be done in order to protect personnel from the possibility of being injured by an arc flash blast. **The analysis must be documented on the PSU Energized Electrical Work Plan and Authorization Form (Appendix A) and be reviewed and approved as indicated on the form.** The analysis shall determine the Flash Protection Boundary and the personal protective equipment that shall be used within the boundary.

For systems under 600 Volts, NFPA 70E sets up two possible ways to calculate the Flash Boundary:

$$D_c = \sqrt{2.65 \times MVA_{bf} \times t} \quad (1)$$

– or –

$$D_c = \sqrt{53 \times MVA \times t} \quad (2)$$

Where: D_c = The flash boundary radius

MVA_{bf} = The bolted fault MVA at the point of exposure

MVA = the maximum fault MVA from the transformer feeding the circuit

T = The time of arc exposure (based on protective device operation)

Notes:

- Equation (1) provides generally smaller distances.
- Equation (1) may not be applied without an accurate, up-to-date short circuit analysis at the point of exposure.
- For voltage levels in excess of 600 Volts, other formulas may be used. The Flash Boundary is defined as that distance at which the worker is exposed to 1.2 cal/cm² (for exposures of more than 0.1 seconds or 1.5 cal/cm² for exposures of less than or equal to 0.1 seconds). If the flash boundary is smaller than the limited approach boundary, the limited approach boundary is the closest that unqualified persons may approach.

Overhead lines

Inside electricians or equivalent do not meet OR-OSHA's definition of qualified persons for working on overhead lines and should not enter the restricted area (i.e., minimum boundary of 10 feet). When a qualified person is working in the vicinity of overhead lines (i.e., a contractor, as PSU does not have qualified persons for overhead lines), that person may not approach or take conductive objects (without an approved insulating handle) closer than the distances shown in OSHA 1910.333(c), Table S-5.

Safe Work Practices

Safety related work practices found in OR OSHA 1910-331 through 335 shall be met. These sections include safety related work practices, training, selection and use of work practices, use of equipment, and safeguards for personnel protection. Prior to performing energized electrical work jointly with contractors or utility staff, a pre-job coordination meeting shall be conducted with appropriate representatives of PSU.

Outside Contractors and Public Utility Workers.

A pre-job meeting shall cover, at a minimum:

1. The specific planned work activities,
2. Specific energy control methods, and
3. Emergency response procedures.

Outside Contractors and Public Utility Workers shall be responsible for the safety of their own personnel. PSU and the PSU Electrical Supervisor shall not be held liable for any accidents involving contractor personnel under any circumstances.

Note: The appropriate PSU Project Manager and the PSU Electrical Supervisor must be notified prior to shutting down any utility system.

Training Qualified Person

Training for energized electrical work shall consist, at a minimum, of the following:

- The skills and techniques necessary to distinguish exposed energized parts from other parts of electrical equipment.
- The skills and techniques necessary to determine nominal voltages of exposed live parts.
- The decision-making process necessary to determine the degree and extent of the hazard and the personal protective equipment and job planning necessary to perform the task safely.
- Safety related work practices required by OR OSHA 1910.331-335 pertaining to job assignments.
- PSU's Lockout/Tag out policy requirements.
- The requirements of this policy and OR-OSHA 1910, Subpart S.

Qualified Person refresher training shall be conducted every three years.

Unqualified workers who may be potentially exposed to the risk of electric shock that is not reduced to a safe level by OSHA requirements 1910.303 – 1910.308, must also be trained. This training, at a minimum, shall consist of:

- Safety related work practices that apply to their respective job assignments as required by OR OSHA 1910.331 through 1910.335 (OR OSHA 1910.332 (b) (1))
- Any other electrically related safe work practices which are necessary for their safety.

Retraining will be provided whenever there is a change in job assignment, a change in equipment or process that presents a new hazard, a change in the energy control procedures, or revision of control methods. Additionally, retraining will be conducted whenever it is determined that an employee has deviated from appropriate energy control procedures. The retraining will re-establish employee proficiency and introduce new or revised control methods and procedures, as necessary.

Failure to Follow Energized Electrical Work Requirements

PSU employees who fail to follow established EEW requirements may undergo re-training and/or possible disciplinary action determined by an investigation. Incidents involving contractors failing to follow appropriate energized EEW protocols will be referred to the Director of Facilities and Property Management and/or the Director of Capital Projects and Construction for appropriate action.

Periodic Review

The Energized Electrical Work policy shall be reviewed annually by the Director of Facilities and Property Management, the Signing Electrical Supervisor, Employees and Environmental Health & Safety staff for its effectiveness. At a minimum, scope, clarity, code changes, and lessons learned from actual/potential incidents should be considered for revision to the policy. Policy must have the endorsement of the Facilities and Property Management Electrical Supervisor and follow the minimum requirements set by the authority having jurisdiction, OSHA and NFPA70E.

This Energized Work Policy was drafted, reviewed, and approved to be the minimum standards that will apply to all persons working on any of Portland State University's electrical systems. It does not replace any other laws, regulations, statutes, policies, etc. from any other entity that would apply to the type of work described in this policy.

Director, CPC:	<u>Ron Blais</u>	Date:	<u>3/19/15</u>
Director, EHS:	<u>Heather Lane</u>	Date:	<u>3/18/15</u>
Director, FPM:	<u>Jim J. Joch</u>	Date:	<u>3/19/15</u>

Definitions

Approved - Acceptable to the authority having jurisdiction.

Approved Test Instrument - Any UL approved equipment designed to verify parameters of electrical systems and equipment. All testing equipment shall be maintained as per manufacturer's instructions and must be used in a manner for which it was designed.

Approved for Voltage - Equipment that is rated at system voltage and will have current applicable test certifications.

Arc Flash Boundary - An approach limit at a distance from prospective arc source within which a person could receive a second-degree burn if an electrical arc flash were to occur.

Arc Flash Hazard - A dangerous condition associated with the release of energy caused by an electric arc.

Arc Flash Risk Assessment - A study investigating a worker's potential exposure to arc-flash energy, conducted for the purpose of injury prevention and the determination of safe work practices and the appropriate levels of PPE.

Arc Flash Suit - A complete arc rated clothing and equipment system that covers the entire body, except for the hands and feet. This includes pants, jacket, and bee-keeper-type hood fitted with a face shield.

Arc Rating - The maximum incident energy resistance demonstrated by a material (or a Layered system of materials) prior to break open or at the onset of a second-degree skin Burn. Arc rating is normally expressed in calorie / cm².

Barricade - A physical obstruction such as tapes/ropes, cones, or other structures intended to provide warning and to limit access.

Barrier - A physical obstruction that is intended to prevent contact with equipment or live parts or to prevent unauthorized access to a work area.

Buddy System - Minimum of two qualified electrical safety trained Journeyman Electricians working together.

Calorie per centimeter squared (cal/cm²) - The unit of measurement used to express the amount of thermal energy released during an arc flash event. 1 calorie is equal to the amount of thermal energy needed to raise 1 gram of water 1 degree Celsius.

Dead front equipment - A grounded conductive or insulating barrier that prevents the operator from being exposed to energized parts on the operating side of the equipment.

De-energized Work Activities - Work performed on equipment or systems that are disconnected from the electrical source and with safety grounds applied. The equipment or systems are to be locked out and/or tagged out with the circuits or systems containing stored hazardous energy blocked, discharged, and/or released.

Electrical Equipment - Equipment that transmits or utilizes electricity directly to perform a function.

Electrical Hazard - A dangerous condition such that contact or equipment failure can result in electrical shock, arc flash burn, thermal burn, or blast.

Electrically Safe Work Condition - A state in which the conductor or circuit part to be worked on or near has been disconnected from energized parts, locked and tagged in accordance with established standards, tested to ensure the absence of voltage, and grounded if determined necessary.

Energized (as applied to live parts) - Capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to parts that are not suitably guarded, isolated or insulated.

Energized Electrical Work - Working on or near exposed energized parts 50 volts or greater and/or within the flash protection boundary.

Energized Testing Activities - To verify parameters of electrical circuits using approved insulated test equipment and designated PPE.

Energized Electrical Work (EEW) Plan - A written plan detailing processes for the assigned work task.

Exposed live parts - Energized electrical parts that are not isolated from the worker by a grounded conductive barrier or an insulating barrier.

Incident Energy - The amount of thermal energy impressed on a surface, a certain distance from the source, generated during an electrical arc event. One of the units used to measure incident energy is calories per centimeter squared (cal/cm²).

Limited Approach Boundary - An approach limit at a distance from an exposed live part within which a shock hazard exists.

Listed - Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that the equipment, material, or services either meets appropriate designated standards or has been tested and found suitable for a specified purpose.

PPE - Personal Protective Equipment. Refers to the various approved insulating gloves, aprons eye and face protection, and flame resistant clothing that are associated with work on or around electrically energized equipment.

Qualified Person (OSHA) – By OSHA and NFPA 70E definition, a Qualified Person is a person who has demonstrated skills and knowledgeable related to the construction and operation of electrical equipment and installations and has received safety training identify the electrical hazards involved. Such persons shall also be familiar with the proper use of special precautionary techniques, personal protective equipment, including arc flash, insulating and shielding Materials, insulated tools and test equipment, and emergency procedures.

Qualified Person (PSU) - PSU Recognizes a "Qualified Person" as a person with a General Journeyman (J), General Supervising (S), Limited Maintenance Electrician (LME), Limited Journeyman Manufacturing Plant (PJ), or Limited Supervisor Manufacturing Plant (PS) electrical license as defined by the Oregon State Law, AND one who receives specific training as mentioned above.

Rescue Plan - A Rescue Plan is a process for contacting and initiating rescue, which is included in the **Energized Activity Work Plan**. The two main components of a Rescue Plan are:

- Identifying a process for eliminating and/ or breaking the contact with the energy source (in a safe manner so persons rendering assistance are not hurt).
- Initiating Rescue services, which includes calling the Dispatch Center.

Restricted Approach Boundary - An approach limit at a distance from an exposed live part within which there is an increased likelihood of shock, due to electrical arc over combined with inadvertent movement, for personal working in close proximity to the live part.

Risk Assessment – A process that identifies the hazards, estimates the potential severity of injury or damage to health, estimates the likelihood of the injury occurrence or damage to health, and determines if protective measures are required.

Secured Area - Securing the electrical work perimeter by notification, labels, lockout/tagout devices or barricades.

Shock Hazard - A dangerous condition associated with the possible release of energy caused by contact or approach to live parts.

Switching Procedure - Written instructions to transfer the load from one energy source to another.

Testing of Systems - Use of UL approved test equipment by qualified personnel to determine the electrical parameters.

Touch Potential - A ground potential gradient difference that can cause current flow from hand to hand or hand to foot through the body.

"Trouble Shooting" - Use of UL approved test equipment to diagnose the cause of a malfunction, to diagnose possible solutions to malfunctions.

Working Near (live parts) - Any activity inside a Limited Approach Boundary or an Arc Flash Boundary.

Working On (live parts) - Coming in contact with live parts with the hands, feet, or other body parts, with tools, probes, or with test equipment, regardless of the personal protective equipment a person is wearing.

Appendix A: PSU ENERGIZED ELECTRICAL WORK PLAN and ENERGIZED ELECTRICAL WORK AUTHORIZATION

Extended Duration

One-time Use Only

Building: _____ Room/Area: _____ Authorization # _____

Job Supervisor: _____ Date Start: _____ Expiration Date: _____

Description of work to be done:

Description of Circuit/Equipment:

Justification for why equipment cannot be de-energized:

Results of Shock Risk Assessment (NFPA-70E 2015 130.4)

Maximum Voltage: _____ Glove Voltage Rating: _____ (Inspect gloves before use, check certification date)

Limited Approach Boundary: _____ (ft.) Restricted Approach Boundary: _____ (ft.) Prohibited Approach Boundary: _____ (ft.)

Results of Arc Flash Risk Assessment (NFPA-70E 2015 130.5)

Risk Category: _____ Flash Protection Boundary: _____ (ft.)

All Natural Fiber Outerwear

Fire Retardant Clothing _____ Cal/cm² ATPV Rating: _____

Required Additional PPE:

Safety Checklist (Verify that proper controls are in place):

Workers must be trained, qualified, and have full knowledge of equipment.

Safety watch is required. This person must be trained, qualified, be able to cut off all power sources, and have immediate access to a telephone or radio to call 911 in case of emergency.

Insulated tools and equipment required.

Remove all jewelry and metal apparel.

Use barricades and warning signs.

Documented job briefing including discussion of any job-specific hazards (e.g., NFPA-70E 2015 Annex I).

See attachment for added information, special requirements, procedures, or written work plans.

APPROVALS

Person requesting authorization for above work: _____ Date: _____

ONE of the following signatures is REQUIRED:

PSU Electrical Manager: _____ Date: _____

OR

PSU Assistant Director of Operations and Maintenance: _____ Date: _____

AUTHORIZED WORKERS that understand and agree to the above:

Printed or typed name(s):	Signature(s)	Date(s)

Appendix B

Resources and References

Oregon OSHA, OAR 437, Division 2, Subdivision S, AO 3-1994 "Electrical" (OR OSHA 1910.301 through 399).
http://www.cbs.state.or.us/external/osha/pdf/rules/division_2/div2_s.pdf

NFPA 70E, Standard for Electrical Safety in the Workplace, Article 130, "Work Involving Electrical Hazards," 2015.

Oregon OSHA, OAR 437, Division 2, Subdivision I, AO 3-1998 "Personal Protective Equipment" (OR OSHA 1910.132 through 139, "Electrical Protective Equipment").
http://www.cbs.state.or.us/external/osha/pdf/rules/division_2/1910-137.pdf

Oregon OSHA, OAR 437, Division 2, Subdivision J, AO 5-1999 "General Environmental Controls" (OR OSHA 1910.147 The Control of Hazardous Energy (Lockout/tag out)).
http://www.cbs.state.or.us/external/osha/pdf/rules/division_2/div2_j.pdf

Oregon OSHA, OAR 437, Division 2, Subdivision O, AO 5-1990 "Machine Guarding" (OR OSHA 1910.211 Through 219).

Oregon OSHA, OAR 437, Division 3, Subdivision K, AO 8-1989 "Electrical" (OR OSHA 1910.400 Through 449).