

ELECTRICAL SAFETY

I. PURPOSE

To establish a program meeting or exceeding minimum acceptable standards for electrical safety-related work practices. The program includes requirements for the comprehensive training of qualified and unqualified workers relating to the use of personal protective equipment, proper use of tools while working near electrical apparatus, testing procedures, working with specialized fixed equipment for various job functions, understanding working clearance and approach boundaries, determining nominal voltages and identifying exposed energized parts. More detailed information for site or job-specific procedures is given to employees through additional classroom and on-the-job training. CSA 462-12 Regulations and other pertinent standards or local laws are incorporated in this program by reference.

II. OBJECTIVE

- a. To avoid injuries related to electrical contacts.
- b. To provide guidance in determining the level of protection needed by various electrical exposures.
- c. To determine the training required by employees in the operations, production or maintenance areas.

III. SCOPE

This program applies to qualified and non-qualified employees with exposure to electricity through the inspection, testing, troubleshooting installation of equipment, operation of switches, controllers, lockout procedures, power supply installations or maintenance with direct exposure to energized parts. It is not the intent of this program to detail procedures required to protect equipment, apparatus or wiring systems.

- a. Responsibility of Company Principle
 - 1) Assure the requirements of this policy are followed.
 - 2) Annual review, and, if necessary, revise the Electrical Safety Program.
 - 3) Ensure training and retraining is made available to qualified employees.
- b. Supervisor
 - 1) Conduct periodic inspection using the *Worksite Observation Form* to ensure safe work practices are followed.
 - 2) Ensure that protective equipment is available and tested as required.
 - 3) Discuss hazards with employees as determined through a documented conversation with host employer or contractors.

IV. DEFINITIONS

- a. Approach Distances – Must be established whenever work is to be conducted on electrical systems or components not in an electrically safe work condition.
 - Flash Protection Boundary – Distance beyond which appropriate flash protection equipment is required to prevent incurable 2nd degree burns.
 - Limited Approach Boundary – Shock protection boundary designed to keep nonqualified persons at a safe distance away from exposed electrical components. Only qualified workers are allowed within this boundary.
 - Restricted Approach Boundary – Secondary shock protection measure whereby accidental movement can put a body part or conductive object in contact with live parts. Approach distances listed in Table 1 represent minimum distances required between energized parts to an unprotected person or equipment. Only qualified personnel with proper protective equipment is allowed within this boundary.
- b. Disconnecting means – A device by which the conductors of a circuit can be disconnected from their source of electrical supply. As an energy isolation control, it shall have the capability of being locked out.
- c. Enclosure – A case or housing of apparatus surrounding an installation to prevent personnel from accidentally contacting energized parts. If the enclosure is conductive it must be grounded or bonded to a grounding system.
- d. Exposed – Capable of being inadvertently touched or approached nearer than a safe distance by a person. Not insulated.
- e. Ground – A conducting connection to the earth.
- f. Guarded – Covered, shielded, fenced, enclosed to otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats or platforms to remove the likelihood of approach to a point of danger or contact by persons or objects.
- g. Isolated – Not readily accessible to persons unless special means for access are used.
- h. Non-Qualified Worker – One who is not exposed to hazards and will not approach exposed parts of electric circuits operating at 50 volts or more to ground.
- i. Outlet – A point on the wiring system at which the current is taken to supply utilization equipment.
- h. Qualified Worker – One who has demonstrated an understanding of construction and operation of the equipment and has a full understanding of the associated hazards.

V. WORK PROCEDURES

The following procedures apply to both qualified and non-qualified personnel unless specifically referenced to qualified employees.

- a. Job Briefing – Before starting each job involving exposed live equipment, the employee in charge shall conduct a Job briefing with the employees involved. The briefing shall cover the following:
 - Hazards associated with the job where applicable. This includes identifying the exposures of shock (nominal voltage) and arc flash hazards.
 - Work procedures
 - Special precautions include un-shunted CTs, draining capacitors for 5 minutes and gradient potential issues.
 - Energy source controls includes all lockout tag-out points
 - Personal protective equipment
 - Emergency Response Procedures
 - 1) Additional job briefings shall be conducted if significant changes that might affect the safety of the employee occur during the course of the work.
 - 2) If working alone, the items listed above shall be carefully considered before working on or near energized systems.
 - 3) The ***Energized Work Permit*** may be used as a pre-work hazard assessment tool.
- b. Selection and Use of Safe Work Practices – Safety-related work practices shall be employed to prevent electric shock or other injuries resulting from electrical contacts. Electrical work may only be performed by a competent electrical worker.
 - 1) A thorough inspection of all equipment shall be done to evaluate for potential hazards. Ensure the integrity of all enclosures and insulation. Any defective tools or supplies are to be marked as defective and removed from the location of the work immediately.
 - 2) Live parts to which an employee may be exposed shall be de-energized by a qualified worker as specified in the Lockout Tag-out Program before the employee works on or near them unless a greater hazard is introduced. Only qualified workers are allowed to complete tasks such as testing, voltage measuring, and troubleshooting within the limited approach boundary. The qualified worker shall test to ensure that the previously energized part is de-energized using a UL listed meter rated for the voltage being tested. Testers shall be verified in good condition by testing before and after the test at a known source. Conductors and parts of electrical equipment that have been de-energized but not been locked or tagged out shall be treated as live parts.
 - 3) If it is not feasible to de-energize exposed live parts, other safety-related work

practices shall be used to protect the exposed employees. Only qualified personnel are allowed to work where exposed to energized equipment. Procedures utilized to perform this work shall include special precautionary techniques such as use of personal protective equipment, insulating and shielding material or insulated tools. An ***Energized Work Permit*** shall be completed before beginning this work. The form is not required for troubleshooting or testing processes.

- 4) No work on or near exposed live parts is permissible without proper illumination.
- 5) Work on live parts should not be completed in the vicinity of flammable materials or substances. Flammable materials must not be stored in the presence of electrical equipment.
- 6) Employees working in confined or enclosed spaces shall de-energize or effectively barricade with protective shields or barriers any exposed live parts. Doors or hinged panel shall be secured to prevent swinging freely.
- 7) Conductive materials and ladders shall be handled in such a manner that will prevent them from encroaching clearances as specified in Table 1. Only non- conductive ladders are allowed for use near energized parts.
- 8) Conductive apparel such as chains, watches or rings shall not be worn while working within the limited approach boundary.
- 9) Interlocks shall not be bypassed unless a qualified person (see definitions) is temporarily working on equipment rated at less than 600 volts. For equipment rated at more than 600 volts, interlocks shall NEVER be bypassed.
- 10) Working on energized parts rated at 50-600 volts shall only be performed by qualified personnel who have had specific training on the particular parts and equipment to be worked on. The qualified employee's supervisor shall be contacted and an energized work permit shall be completed before starting work on energized equipment with exceptions including testing, troubleshooting and inspections.
- 11) Work on exposed energized systems greater than 600 volts is not permitted unless specifically trained. Two qualified workers are required to open/close, rack out/in, test, and install temporary grounds on medium voltage equipment. Before grounding and working on medium voltage parts as de-energized, the parts must be tested using a proper tester rated for the voltage with a hot stick only.
- 12) Unqualified personnel are restricted from access to exposed energized parts of voltages greater than 50 volts. Qualified personnel shall place a barricade, guard energized parts, or have an attendant to prevent unqualified personnel from encroaching the limited approach or flash protection boundary, whichever is greater.
- 13) Blind reaching is not allowed in any electrical panels or equipment.
- 14) All Troubleshooting (and or) Testing above 50 Volts, require voltage insulating gloves and other appropriate PPE (as outlined in section e).

- 15) Inform the host employer if a hazardous condition is introduced or identified including corrective measures taken or required to make the condition safe.
- 16) All personnel shall maintain 10 feet from overhead power lines including handheld equipment and vehicles. (see table 1 limited approach listed in Table 1)

Table 1. Approach Boundary to Live Parts for Shock Protection

VOLTAGE RANGE Phase to Phase	LIMITED APPROACH BOUNDARY	RESTRICTED APPROACH BOUNDARY	MIN. FLASH PROTECTION BOUNDARY
0 - 50	Avoid Contact	Avoid Contact	N/A
51 - 250 volts	3 ft. 6 in. (1 m)	Avoid Contact	4 ft. (1.2 m) *
251 - 750 volts	3 ft. 6 in. (1 m)	1 ft. 0 in. (.3 m)	10 ft. (3.3 m) *
751 - 15,000 volts	5 ft. 0 in. (1.5 m)	2 ft. 2 in. (.7 m)	10 ft. (3.3 m) *

*** If an arc flash study has been completed, the arc flash boundary shall be as indicated on the arc flash label.**

- c. Use of Portable Electric Equipment – Applies to cord and plug connected Equipment.
 - 1) This equipment shall be handled in a manner which will not cause damage. Avoid raising and lowering the equipment using flexible cords. Do not fasten cords with staples or other fasteners that may damage the outer jacket.
 - 2) Portable cord and plug equipment shall be inspected before use. If damage is detected it shall be removed from service. Extension cords shall periodically be given a continuity test along with the inspection to determine open points or short circuits (test for full continuity on each wire and zero continuity from wire to wire).
 - 3) Grounded type tools or equipment shall have the grounded-type plug and shall be inspected to ensure compatibility with the receptacle. Adapters may not be used.
 - 4) Ground Fault Circuit Interrupter (GFCI) devices shall be used for all cord and plug activities unless permanent GFCI installations are available. Wet locations such as vehicle parking areas, loading docks or where receptacles may be used to plug in equipment outside. Devices in these locations may include GFCI receptacles, receptacles protected by GFCI breakers, or field operations - portable cord-connected GFCI.
 - 5) All equipment and tools used must be used in a manner consistent with their original intended use and the manufacturer’s instructions.
- d. Power and Lighting Circuits – Includes the use of circuit breakers and fuses.
 - 1) Load rated circuit breakers shall be used for opening and closing circuits. Fuses, terminal lugs and cable splice connections shall not be used to make or break load.

- 2) After a circuit has been de-energized by a circuit protective device, the circuit shall not be reenergized until it has been determined safe to do so by a qualified employee
 - 3) Only qualified workers may perform testing work on electrical circuits. Test equipment shall be rated for the voltage to which they will be connected. A hot stick applied voltage tester is required to test voltages greater than 600 volts. ALL test equipment shall be UL listed as CAT IV and shall be tested at a known source before and after testing the previously energized parts. Proper testing de-energized parts is shall include testing for impressed (line) to ground, back-feed (load), and residual energy (phase to phase on line and load).
 - 4) Electrical equipment capable of igniting a spark shall not be used near flammable or ignitable material. Combustible material shall be removed if in proximity of an electrical panel or cabinet before work is allowed.
 - 5) Materials shall not be stored on equipment. Before removing covers, material shall be removed.
- e. Safeguards for Personal Protection – Includes the use of personal protection equipment (PPE). Selected employees will be furnished with and shall use PPE at all times. The level of PPE used is determined by conducting a hazard assessment and choosing a level of protection that significantly reduces or eliminates the risk of injury related to the hazard. Conducting a job briefing and consulting the information in this program prior to performing any work will determine the hazards associated with the job. This process in conjunction with information on the Tables within this program will assist in determining the level of protection needed to work with or near electrical apparatus. See Table 2 to determine hazard risk classifications and PPE requirements. A simplified program is used as follows:
- 1) If the task is identified by a hazard risk category of 1 or 2, the qualified employee shall wear HRC 2 protect equipment.
 - 2) If the task is identified by a hazard risk category of 3 or 4, the qualified employee shall wear HRC 4 protective equipment.

Table 2. Hazard Risk Category Classification

TASK	RATING
Electrical work on systems rated 240 volts or less including: Operate circuit breakers or fused switches and disconnects with doors closed, cable trough or tray cover removal, work on control circuits 120 volts or less.	0
Working on electrical systems rated at 240 volts or less including: removal of bolted covers on control circuit enclosures and voltage testing.	1
Working on or near exposed energized parts rated at 600 volts or less where exposed to electrical parts where the arc flash hazard is determined to be less than 8 cal/cm ² and no physical work is performed that may cause a serious arc flash and that is not listed in HRC 3 or 4 categories.	2
Working on or near exposed energized parts rated at 600 volts or less including removing bolted covers on exposed 480 volt cabinets where the hazard risk category is greater than 8 cal/cm ² or unknown, open cover to exposed parts of an ATS, racking in or out 480 volt generator breakers on an energized bus.	3

Work on exposed parts rated greater than 25 cal/cm ² including energized parts of pad-mounted 480 volt transformers, main switchgear bus, racking in or out medium voltage breakers and transfer switches, phasing or other energized work, testing and grounding with a hot stick.	4
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Note 1: Table 2 may be use where available fault current is less than 25,000 amps. If fault current exceeds 25 kA an engineering study must be performed to determine the arc flash hazard.

Note 2: The hazards may be identified on an equipment label where an arc flash study has been conducted. This data will take precedence over information in Table 2.

- f. Personal protective equipment shall be used to protect from electrical hazards that have not been eliminated by de-energizing or guarding. All personal protective equipment shall be inspected prior to each day's use and immediately following any incident.
 - 1) Eye Protection – Plastic rimmed safety glasses with side shall be used at all times while working on or near exposed live parts.
 - 2) Face Protection – A tinted arc shield with a balaclava-style hood shall be worn when working where there is a danger of flying objects from an electrical arc for HRC 1 or 2 hazards. Safety glasses shall be worn in conjunction with the shield. A full FR hood (beekeeper style) shall be used for high incident energy levels on category 3 or 4.
(Hazard Rating 1-4)
 - 3) Head Protection – Non-conductive hard hats shall be worn where employees are exposed to electrical conductors that could contact the head such as open bus work. (Hazard Rating 0-4)
 - 4) Hearing Protection – Arc-rated hearing protection is required for all electrical switching of devices or where exposed to energized electrical parts rated greater than 50 volts.
 - 5) Insulated Equipment
 - a.) Rubber gloves rated for the voltage shall be worn when working withing the restricted approach boundary on exposed parts with voltages over 50 volts. Rubber gloves shall be air tested before each days use and dielectrically tested every 6 months. Class 0 rubber gloves may be used on voltages up to 750 volts (or 1000 volts DC). Class 2 rubber gloves are required for voltages greater than 750 volts but less than 15,000 volts, however direct contact with energized parts using rubber gloves with voltages exceeding 750 volts from a ground position is prohibited. (Hazard Rating 0-4)
 - b.) Insulated barriers (rolled rubber material) approved for use on energized equipment may be used to isolate the employee from the energized parts in lieu of using rubber gloves to avoid contact on lower voltages. Rubber gloves shall be used to install barrier material. (Hazard Rating 1-4)

- 6) Clothing – Only natural fiber clothing (cotton or wool) shall be used at a minimum while working near exposed live parts including undergarments. In addition, if conditions dictate that an arc flash hazard exist, arc-rated (AR) clothing may be required.(See Table 2 for HRC levels and Table 3 for calorie/cm² ratings)

Table 3. Protective Clothing Requirements

HAZARD RISK CATAGORY	CLOTHING DESCRIPTION	Minimum ATPV*
0	Untreated cotton clothing	N/A
1 and 2	AR shirt and AR pants or AR Coveralls	8
3 and 4	AR switching coat and pants, Arc Hood	40

* ATPV – Arc Thermal Performance Exposure Value
AR – Arc Rated

- 7) Hot-Line Tools – Hot line tools shall be used to test voltages or place protective grounds on systems greater than 600 volts. An approved hot-line voltage tester connected to a hot-stick (shotgun) shall be used to verify that all circuits to be worked on are de-energized. The tester shall first be brought into contact with a live source (if possible) to ensure it operates correctly, then it shall be put into contact on all phases of the previously energized parts and then again to an energized source. If no such source is available, the self-test method shall be utilized by engaging the test mechanism on the tester.
- 8) Grounding for Protection – No work may be performed on any electrical components rated at greater than 600 volts without first testing to ensure parts are de-energized (USING ONLY A VOLTMETER RATED FOR THE VOLTAGE), then installing grounds to all previously energized parts. Effective barricades shall be in place to avoid contact with any other source of electrical energy before attempting to install grounds. Temporary grounding equipment shall be tested every 3 years.
- 9) Foot Protection – Safety-toe leather boots shall be worn at all times. Electrical- rated boots shall be considered to provide additional resistance for protection of the worker. Extreme care shall be maintained in the immediate area where hazardous step potential or voltage gradients on the earth may be present. Short heel-to-toe steps will minimize gradient potential should be used when a fault occurs on medium voltage equipment.
- g. Additional Safety Requirements – Includes the use of signs and barriers.
- 1) Safety symbols or signs shall be prominently displayed to warn employees about electrical hazards. This may include warning signs on panel doors, doors to electrical rooms or any hazardous location which may endanger employees. If signs are not in place on customer-owned equipment and voltage is unknown, covers or doors shall not be opened until these voltages are determined.
- 2) Protective shields, protective barriers, or insulating material shall be used to protect employees from shock, burns or electrically related injuries while the employee is working near exposed energized live parts. Conductive barricades shall not be used. Barricades i.e. “Danger Tape” shall be use used to prevent non- qualified workers from

entering an electrical exposure limited approach boundary.

VI. TRAINING

The training requirements contained in this section apply to employees who face a risk of electric shock that is not reduced to a safe level by electrical installation requirements. Employees that face such a risk are required to be trained. Other employees who may reasonably be expected to face comparable risk of injury due to electric shock or other electrical hazards must also be trained.

- a. Type of training – The training required by this section may be of the classroom or on-the-job type. The degree of training provided must be determined by the risk to the employee.
- b. Content of Training – Qualified employees shall be trained in and familiar with the safety-related work practices that pertain to their respective job assignments.
- c. Frequency of Training - For the purposes of this document a person must have the above training in order to be considered qualified. Qualified persons whose work on energized equipment involves either direct contact or contact by means of tools or materials shall be capable of working safely on energized circuits and shall be familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials and insulated tools. New hires shall be trained upon assignment. Refresher training shall be done if a deficiency is identified during an audit but should not exceed 3 years. Training shall be documented.
- d. Each qualified electrical worker shall be instructed in CPR, first aid, AED and techniques needed to safely releasing victims.
- e. A demonstration of employee's knowledge shall be documented. This can be via written test, documentation of successful completion of training, and by on-site demonstration of understanding through workplace observations. Each employee shall be evaluated at least annually to ensure continued understanding by using Form B (attached).
- f. A qualified employee shall also demonstrate knowledgeable of the construction and operation of equipment and specific work methods associated with the electrical task. Employees who are not qualified persons shall also be trained in and familiar with any electrically related safety practices not specifically addressed in this document but which are necessary for their safety. Qualified persons (i.e., those permitted to work on or near exposed energized parts) shall, at a minimum, be trained in and familiar with the following:
 - 1) The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment by identifying exposed conductive parts that are isolated from ground and performing a voltage test.

- 2) The skills and techniques necessary to determine the nominal voltage of exposed live parts by examining labels, nameplates, one-line diagrams, or for medium voltage, the construction and spacing. Colored tape may be an indicator but should not be relied upon to determine nominal voltage.
 - 3) The approach boundaries specified in Table 1 and the corresponding voltages to which the qualified person will be exposed.
 - 4) The proper inspection, donning and use of personal protective equipment including EH hardhat, arc protection equipment and clothing, rubber gloves and insulating materials and tools.
- g. Retraining will be conducted when:
- 1) An employee is not in compliance with safe work practices.
 - 2) There is a change in the workplace that requires different safe work practices than those an employee would normally use.

VII. COMPLIANCE:

All electrical work shall be done to electrical standards. No short cuts are permitted. Electrical work will be performed by qualified personnel only. On-site training will be conducted by qualified personnel.

Conscientious observance of electrical safety procedures is expected of all qualified and nonqualified personnel; neglect of such responsibilities may subject the individual to serious injury. Failure to follow these procedures may result in disciplinary action.

Workplace Safety Observations shall be conducted for each affected employee at least once annually using Attached Form B Workplace Observation Form.