

Corporate Policy and Procedure



POLICY	Energized Electrical Work
CATEGORY	Health & Safety
AUTHORITY	All workers
RELATED POLICIES	Lockout/Tagout Program Personal Protective Equipment Policy Contractor Management Program Job Hazard Analysis Policy
APPROVED BY	Executive Team
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Policy Statement

Guided by our corporate values, the City of Guelph is committed to ensuring workers required to work on or around exposed energized electrical equipment are provided with the appropriate tools, equipment and training to maintain their health and safety.

Purpose

The purpose of this document is to outline the procedure for conducting work on exposed, energized electrical equipment.

Scope

This procedure applies to all persons at City of Guelph facilities, including contractors, working on or near exposed, energized alternating current (AC) or direct current (DC) electrical equipment.

Definitions

Arc-Flash Analysis

Evaluation of a workplace facility by an electrical safety expert to determine hazards and risks in relation to electrical systems.

Arc-Flash Boundary

When an arc-flash hazard exists, an approach limit at a distance from a 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 possible release of energy caused by an electric arc.

Arc Rating

The value attributed to materials that describe their performance to exposure to an electrical arc discharge. The arc rating is expressed in cal/cm² and is derived from the determined value of the arc thermal performance Value (ATPV) or energy of breakdown threshold (EBT) (should a material system exhibit a break-open response below the ATPV value).

Circuit Breaker

A device designed to open and close a circuit by non-automatic means and to open the circuit automatically on a predetermined over-current without damage to itself when properly applied within its ratings.

Contractor

Any person or entity contracted or engaged to provide services to the City of Guelph, including outside maintenance and service providers.

De-energized or Dead

Means the current-carrying parts of electrical equipment are free from any electrical connection to a source of voltage and from electrical charge and do not have a voltage different from that of the earth.

Electrical Equipment

Any apparatus, appliance device, instrument, fitting, fixture, machinery, material, or thing used in or for, or capable of being used in or for, the generation, transformation, transmission, distribution, supply or utilization of electric power or energy.

Electrical Hazard

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

Electrical Work

Installing, maintaining or repairing electrical wiring, components, infrastructure, machinery and/or other electrical equipment.

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/tagged in accordance with procedures, tested to ensure the absence of voltage, and grounded if deemed necessary.

Energized Electrical Work (Also known as Live Electrical Work)

Any work to be done on or near un-insulated, unguarded, energized conductors or circuit parts where the potential exists for a tool, piece of equipment or body part to come into contact with an electrical energy source.

Energized Electrical Work Permit

A written document, completed and signed by an authorized person and a manager, with the appropriate level of responsibility as outlined in the procedure, prior to initiating energized electrical work, which verifies appropriate safety precautions have been completed.

Ground

A connection to earth obtained by a grounding electrode.

Hazard

A source of possible injury or damage to health.

Hazardous

Involving exposure to at least one hazard.

Live Work Assistant

An employee deemed competent by basis of knowledge, training and experience who is to support the Qualified Person in the execution of energized electrical work, and who is trained in CPR and is able to de-energize electrical equipment.

Limited Approach Boundary

An approach limit at a distance from an exposed live part within which an electrical shock hazard exists (**For distance see [Approach Boundaries to Electrical Conductors](#)**).

Lockout

The placement of a lock on an energy-isolating device in accordance with an established procedure to prevent accidental re-energization of de-energized equipment.

Qualified Person

One who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify and avoid the hazards involved. The Qualified Person shall hold a valid electrical trades license in the jurisdiction where the work is performed.

Restricted Approach Boundary

An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased risk of shock, due to electrical arc over combined with inadvertent movement, for personnel working in close proximity to the energized electrical conductor or circuit part. (**For distance see [Approach Boundaries to Electrical Conductors](#)**).

Risk

A combination of the likelihood of occurrence of injury or damage to health and the severity of injury or damage to health that results from a hazard.

Risk Assessment

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

Supervisor/Manager

A person who has charge of a workplace or authority over a worker.

Testing and Troubleshooting

Using an approved tester, with appropriately protected probes, to diagnose an electrical fault condition (*Should only be performed, while wearing the required protective equipment, by a person deemed competent through knowledge, training or experience to perform work of this nature*).

Worker

Means any of the following, but does not include an inmate of a correctional institution or like institution or facility who participates inside the institution or facility in a work project or rehabilitation program:

1. A person who performs work or supplies services for monetary compensation.
2. A secondary school student who performs work or supplies services for no monetary compensation under a work experience program authorized by the school board that operates the school in which the student is enrolled.
3. A person who performs work or supplies services for no monetary compensation under a program approved by a college of applied arts and technology, university, private career college or other post-secondary institution.
4. Such other persons as may be prescribed who perform work or supply services to an employer for no monetary compensation;

Roles & Responsibilities

Corporate Health & Safety

- Facilitate awareness training on energized electrical work procedures and practices for Qualified Persons.
- Work with Managers/Supervisors to identify appropriate personnel protective equipment.
- Review and update the procedure as required, ensuring it is done at least annually.
- Ensure appropriate revisions are made to training and this policy where required by changes in standards and legislation, or from audit findings of the electrical safety program.
- Audit implementation of this policy periodically, but no less than every two years, to ensure it is being successfully followed.

Live Work Assistant

- Be familiar with this procedure and ensure all requirements are met when performing energized electrical work
- Participate in training provided to all employees affected by energized electrical work
- Wear appropriate PPE
- Be able to de-energize electrical equipment in a safe manner
- Be trained in CPR and first aid techniques
- Follow the directions of the Qualified Person at all times
- In the event of an emergency situation, raise the alarm and summon the appropriate response

Maintenance Management (Corporate Building Maintenance or site Maintenance Depts)

- Ensure that all persons involved in work on electrical systems have been trained in Workplace Electrical Safety, which includes shock hazard and arc-flash awareness.
- Ensure that only Qualified Persons holding a valid electrical trades license are allowed to perform energized electrical work, including Contractors.
- Identify all equipment requiring [arc-flash hazard analysis](#), and ensure a full study is completed, including the application of the appropriate electrical hazard information labels (See [Appendix B – Example Label](#)).
- Ensure that a full risk assessment of the work, including assessment for risk of shock hazard and arc-flash, is completed, prior to starting the work, in order to assist with the

identification of the appropriate personal protective equipment (PPE) and tools, prior to starting.

- Ensure that all hazards identified in the risk assessment are communicated to the Qualified Person performing the work, including Contractors.
- Ensure that all required PPE, equipment and tools supplied, are in proper condition, appropriate for the work being performed, and any associated hazards.
 - a. Contractors are required to provide their own PPE, equipment and tools, which must meet requirements stated above.
- Ensure that when Qualified Persons are performing energized electrical work on equipment, a second person, the Live Work Assistant, trained in CPR, is able to observe the Qualified Person while they perform the work and is able to render immediate assistance.
- Ensure the Live Work Assistant knows how to safely shut down power to the equipment in the event of an emergency.
- Ensure that conductive articles and clothing are prohibited in or near the vicinity of all electrical work.
- Ensure an [Energized Electrical Work Permit](#) is completed prior to initiating energized electrical work, and that the appropriate authorizations have been given for the work being done.
- Sign off on [Energized Electrical Work Permit](#) (as required).
- Provide energized electrical work awareness training for employees involved in energized electrical work
- Conduct an annual audit of energized electrical work procedures, including audits of work conducted in the field. The audit shall include direct observation of electrical work and verification that procedures are appropriately understood and implemented.
- Maintain copies of expired [Energized Electrical Work Permits](#) for a minimum of two years.

Qualified Person

- Hold a valid electricians license in the jurisdiction where the work will be performed.
- Participate in training provided to all employees affected by energized electrical work.
- Be familiar with this procedure and ensure all requirements are met when performing energized electrical work.
- Wear all required personal protective equipment during the work.
 - Where the wearing of arc-flash protective equipment is required, clothing worn beneath the equipment must be of a non-melting material such as cotton or rayon.
- Ensure a valid work plan has been completed prior to beginning work.
- Where a work plan indicates work must be performed in an energized state, ensure completion of the [Electrical Risk Assessment Form](#) prior to the commencement of any work.
- Ensure a valid [Energized Electrical Work Permit](#) is completed and signed off by the relevant persons prior to commencing any work.
- Ensure the [Energized Electrical Work Permit](#) is posted at the job location.
- Ensure the Live Work Assistant wears the correct PPE and remains at a safe distance from the work being performed, but is within the Limited Approach Boundary unless instructed otherwise.
- Cease energized electrical work operations if unsafe conditions develop and notify the appropriate manager(s) to reassess conditions before re-starting work.
- File the completed [Energized Electrical Work Permit](#) with Maintenance at the conclusion of the job.

Supervisor/Manager (Department or Area)

- Ensure all electrical work is scheduled through the relevant Maintenance department, including the procurement of Contractors.
- Ensure that electrical work performed in an energized state is only completed when all requirements of this policy have been met.
- Sign off on the [Energized Electrical Work Permit](#) (as required).
- Provide energized electrical work awareness training to employees involved or impacted by energized electrical work.

Workers

- Understand and follow the contents of this policy
- Wear all required personal protective equipment during the work
- If working on electrical systems, whether energized or not, attend all required training associated with this policy as required.

Procedure

General Procedure

1. Prior to performing **any** electrical work, the Qualified Person or other person deemed competent by training, knowledge and experience to perform the work, must complete a written [Electrical Work Job Briefing & Planning Checklist](#).
2. Energized electrical work can only be performed if at least one of the following conditions are met:
 - The employer can show de-energizing the equipment will introduce or create additional hazards
 - The employer can demonstrate the task to be performed is infeasible in a de-energized state due to equipment design or operational limitations.
 - Testing or troubleshooting.

All other electrical work must be de-energized, locked out and tagged, as per the corporate **Lock-Out/Tag-Out Program**, prior to any service or installation where the worker is exposed to, or may come in contact with, electrical terminals or connections.

3. If the written [Electrical Work Job Briefing & Planning Checklist](#) determines that the electrical work must be performed in an energized state, this work must **only** be completed by a Qualified Person. This would include trouble-shooting and testing.
4. Energized electrical work, including trouble-shooting and testing, shall only be performed upon completion of a thorough risk assessment of the work, using the corporate [Electrical Risk Assessment Form](#)
5. Upon completion and review of the [Electrical Risk Assessment Form](#), and before the work is allowed to begin an [Energized Electrical Work Permit](#) shall be required if either of the following conditions are met:
 - a. When work is performed within the [restricted approach boundary](#); or
 - b. When the worker interacts with the equipment when conductors or circuit parts are not exposed, but an increased likelihood of injury from an exposure to an arc-flash hazard exists.

An Energized Electrical Work Permit is not required for the sole purposes of trouble-shooting and testing, however, all other requirements, including use of [personal protective equipment](#), must be in place.

6. The [Energized Electrical Work Permit](#) must be completed by the Qualified Person, and must be signed by persons with an appropriate level of approval. The level of approval must be based on the energy level (voltage) and the business interruption potential. The levels of approval are as follows:
 - a. Level 1 – 0-600V: Department or Area Supervisor/Manager and Maintenance Manager. In cases where the work is to be performed by a contractor, the contractor company supervisor or manager onsite must sign.
 - b. Level 2 – 601V+: Contractor company manager and Maintenance General Manager (work to be performed by qualified contractors only)
 - i. **Contractors engaged to perform energized work on systems in excess of 600V must provide adequate evidence of ability to perform such work prior to being hired.**
7. The [Energized Electrical Work Permit](#) must be issued to a Qualified Person, once all sections are completed and the permit is signed off, it is not transferrable to others, and is valid for the current immediate shift only.
8. No person shall enter the [Limited Approach Boundary](#) unless they are wearing the appropriate [personal protective equipment](#).
9. Only Qualified Persons are permitted to work on electrical systems or components where there is a potential for exposure to energized, exposed components (See [Approach Boundaries to Electrical Conductors](#)).
10. A second person, the Live Work Assistant, must be within visible distance during the work. The second person must know how to shut off all energy sources to the equipment in the event of an emergency, be trained in CPR, and be knowledgeable in how to safely release a victim. **Energized electrical work must never be performed alone.**
11. When energizing or de-energizing any “disconnecting means”, it is important to stand to one side and use the left hand, while facing away, to operate the disconnecting means.
12. All electrical equipment, circuits and conductors shall be considered to be energized until an absence of voltage verification is performed to ensure the equipment, circuit or conductors are “dead”
 - a. Prior to establishing an electrically safe work condition (Lockout) all Qualified Persons working within the presumed flash protection boundary of an exposed energized component must be suitably protected with arc flash rated personal protective equipment for that specific hazard/ risk category (Level). Once an electrically safe work condition has been established and verified, arc flash rated personal protective equipment can be removed
13. Electrically insulated tools must be used whenever working within the shock boundary on energized equipment.
14. Elevated work on energized electrical systems or equivalent must be performed in an approved personnel lift.
15. Only non-conductive material ladders (wood, fiberglass etc.) shall be used by employees working on electrical systems
16. When an employee works in a confined space that contains exposed energized parts, the employee must use appropriate shields/ barriers/ tools or insulating materials as necessary to avoid inadvertent contact with these parts.
17. Any worker who does not meet the requirements of a Qualified Person, and who is not suitably equipped must maintain a distance of 10 feet, when possible, from any exposed energized electrical equipment.
18. Any rings, bracelets, other jewelry and any other conductive material must not be worn while performing any energized work on electrical equipment

19. Only fiberglass, or other non-conductive, fish tapes must be used when fishing conductors through an existing installation where there may be exposure to energized parts
20. Ensure adequate lighting is provided to enable the work to be performed safely.
21. Upon completion of the work, a copy of the expired [Energized Electrical Work Permit](#) must be filed with and maintained by the Maintenance Department.

Approach Boundaries to Energized Electrical Conductors (AC Systems)

Approach boundaries to energized electrical conductors or circuit parts for shock protection (distance from energized electrical conductors or circuit part to worker).

(1)	(2)	(3)	(4)
Nominal system voltage range, phase to phase*	Limited Approach Boundary		Restricted Approach Boundary (includes inadvertent movement adder)
	Exposed movable conductor ‡	Exposed fixed circuit part	
Less than 50 V	Not specified	Not specified	Not specified
51-150 V	3.0 m (10 ft 0 in)	1.0 m (3 ft 6 in)	Avoid contact
151-750 V	3.0 m (10 ft 0 in)	1.0 m (3 ft 6 in)	0.3 m (1 ft 0 in)
751V – 15kV	3.0 m (10 ft 0 in)	1.5 m (5 ft 0 in)	0.7 m (2 ft 2 in)

Approach Boundaries to Energized Electrical Conductors (DC Systems)

Approach boundaries to energized electrical conductors or circuit parts for shock protection (distance from energized electrical conductors or circuit part to worker).

(1)	(2)	(3)	(4)
Nominal system voltage conductor to ground	Limited Approach Boundary		Restricted Approach Boundary (includes inadvertent movement adder)
	Exposed movable conductor ‡	Exposed fixed circuit part	
Less than 100 V	Not specified	Not specified	Not specified
100V – 300V	3.0 m (10 ft 0 in)	1.0 m (3 ft 6 in)	Avoid contact
301V – 1kV	3.0 m (10 ft 0 in)	1.0 m (3 ft 6 in)	0.3 m (1 ft 0 in)
1.1kV – 5kV	3.0 m (10 ft 0 in)	1.5 m (5 ft 0 in)	0.4 m (1 ft 5 in)

‡ A condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

Portable Electric Tools and Equipment

Portable electric tools and equipment shall be:

1. Approved by a registered standards body, acceptable in Ontario (CSA, UL, BSA, etc.)
2. Equipped with a three prong plug or be double insulated.
3. Be used in conjunction with a ground-fault circuit interrupter when used in highly conductive environments, in damp, wet locations and whenever used in outdoor locations.
4. Be visually inspected prior to each use.
5. Damaged tools and equipment shall be immediately removed from service and the supervisor informed.

Maintenance, Repair, Overhaul and Installation Work

1. Maintenance, repair, overhaul or installation work must never be performed on energized equipment. All sources of power must be disconnected and locked out. However, a person deemed competent through knowledge, experience and training in Workplace Electrical Safety, which includes shock hazard and arc-flash awareness, wearing appropriate personal protective equipment (PPE) and using listed and rated insulated tools, may perform the following work on energized equipment:
 - a. Testing, including voltage, current, phasing meter checks, system tuning and other testing;
 - b. Circuit identification or tracing;

Personal Protective Equipment

1. All Personal Protective Equipment (PPE) must be used as intended. Using PPE outside of the intended use will not afford the protection to employees that this policy is intended to ensure.
2. PPE is selected based on the hazard to which employees are exposed. PPE designed to provide protection from electrical shock might not be adequate for protecting people from arc-flash hazards. Similarly, PPE designed for arc-flash protection may not provide protection from electrical shock. Voltage-rated gloves may be used for arc-flash protection only when used with leather protectors.
3. Prior to doing work, the Qualified Person must **verify** the level of protection to be applied based on the [Protective Clothing and Personal Protective Equipment Matrix](#). If at any time the Qualified Person determines that additional Personal Protective Equipment or safety devices are required for the work to be performed they may request them and they must be made available to them, prior to the work commencing/continuing.
4. Equipment shall be inspected and tested according to manufacturer's recommendations. Equipment can include but is not limited to voltage-rated gloves, Arc Rated clothing, hearing protection, face shields, double layer hoods, and eye protection.
5. Employees are expected to inspect all equipment prior to each use.
6. All protective clothing must be laundered and maintained by a qualified uniform vendor. Employees are not permitted to launder, repair or make alterations to any protective apparel.
7. Workers engaged in energized electrical work must ensure that clothing worn beneath Flame Resistant (FR) outerwear and against the skin is made of fabrics or natural fibres that will not melt when exposed to heat.

Selection of Personal Protective Equipment

1. PPE must be selected and provided by the employer with the assistance of Corporate Health & Safety as required. Selection must take into account the expected hazards, voltage levels and conditions of work. Additional factors that must be considered include;
 - a. condition and age of the equipment;

- b. the equipment design;
 - c. the barriers that exist around the equipment.
2. PPE required must be determined by the **highest** energy that the worker can be exposed to while doing the work regardless of the voltage of the actual testing location. For example, if working near exposed live equipment of 600 volts while testing exposed live equipment of 120 volts, the requirements for 600 volts will apply.

General PPE Inspection, Use, Storage and Maintenance

1. All PPE used must be inspected in accordance with the manufacturer's instructions and immediately prior to each use. Any specific instructions for inspection of PPE in this or other approved procedures must be followed.
2. Personal Protective equipment and other related safety equipment must be stored and used in accordance with manufacturer's recommendations.
3. Any damaged PPE must not be used. Defective PPE must be tagged defective until repaired or destroyed.

Shock Protection

1. Voltage-rated Gloves
 - a. Only Type-II voltage rated gloves, which are ozone-resistant and made of an elastomer or combination of elastomeric compounds, and with a minimum class of "0", will be used.
 - b. Prior to every use of the voltage-rated gloves they must be visually inspected for any cuts, punctures, holes or damage that may affect their rating or effectiveness.
 - c. Leather protectors must be inspected before each use and determined to be free of holes, tears, and contamination. Insides of the leather protector gloves shall also be inspected for sharp or pointed objects that may damage voltage-rated rubber gloves.
 - d. Cleaning and maintenance of the voltage-rated gloves and leather protectors must be done as instructed by the manufacturer.
 - e. Only powder approved by the manufacturer is recommended for use on voltage-rated rubber products to prevent deterioration of the rubber.
 - f. Every in-service voltage-rated rubber glove and leather protector combination must be tested every 6 months by a qualified outside vendor in accordance with ASTM F-496.
 - g. Employees issued voltage-rated gloves must be provided with a second pair while the first pair of gloves is **out** for testing.
 - h. Voltage-rated gloves returned from testing must be held in storage until the pair in use requires testing.
 - i. Voltage-rated gloves must:
 - a. Be stored in a dry cool place
 - b. Not exposed to sunlight or ozone
 - c. Not be stored folded creased, inside out, compressed or in any manner that will cause stretching or compression
 - d. Be stored away from exposure to solvents, oils, greases or vapours from these materials.
 - j. Leather protectors for voltage rated-rubber gloves must be worn over the rubber gloves for protection from abrasion, cuts or punctures. The leather protectors shall not be used alone for shock protection at any time.
 - k. Protectors that have been used for other purposes must not be used to protect voltage-rated rubber gloves.
 - l. All voltage-rated rubber products that have been rejected by testing or found to be damaged during inspections must be defaced, cut up, or otherwise marked and

identified to indicate that they are not to be used for electrical service, and then disposed of from the workplace.

2. Rubber Matting
 - a. Rubber matting, commonly referred to as switchboard matting, must comply with ASTM D178 Class 2 specifications by being a minimum of 1/4" thick (6.4 mm) and tested to 20,000 volts.
 - b. Rubber matting must be made available to all electrical workers, and it must be at the Qualified Person's discretion as to whether to use the rubber matting while testing or troubleshooting energized equipment.
 - c. Rubber matting must be inspected prior to each use for damage, cuts or contamination that may reduce effectiveness. Rubber matting found to be damaged or otherwise unsuitable for electrical use must be removed from service in accordance with the removal requirements listed above.
3. Safety Footwear
 - a. All employees are required to wear safety footwear that has been approved by a registered standards body in the jurisdiction where the work is being done (CSA, ASTM etc.), while working. The footwear must be non-conductive and protect against high voltage.
4. Hard Hats/Bump Caps
 - a. Head protection, such as hard hats or bump caps worn when performing energized electrical work must, at minimum, meet CSA Standard Z94.1-15 Class G.

Arc-flash Hazard Analysis

1. An arc-flash hazard is considered to exist under the following circumstances:
 - a. Electrical conductors or circuit parts are energized.
 - b. Electrical conductors or circuit parts are exposed or a person is interacting with electrical equipment in a manner that could cause an electric arc.
 - i. Under normal operating conditions, enclosed energized equipment that has been properly installed and maintained is unlikely to pose an arc-flash hazard.
2. The level of risk posed by arc-flash should be based on a risk assessment. The assessment should take into account factors such as the maintenance and age of the equipment, the environment in which the equipment is installed, frequency of operation, damage from misuse and so on.
3. An arc-flash hazard analysis shall be used to determine the arc-flash boundary and the PPE that personnel within the boundary shall use.
4. The analysis shall be updated when a major modification or renovation takes place. It shall be reviewed periodically, not to exceed five years, to account for changes in the electrical distribution system that could affect the results of the analysis.
5. The analysis shall take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.
 - a. However, an arc-flash hazard analysis is not required when the following criteria are met:
 - i. circuit is rated 240V or less;
 - ii. circuit is supplied by one transformer; and
 - iii. transformer supplying the circuit is rated less than 125 kVA.

Arc-flash Protection

1. Arc-flash protection must be sufficient to protect the person from the flash hazard. In all conditions, arc-flash protection is considered to be the outermost garment.

- a. Gloves used for flash protection must be long enough to cover body parts such as hands, wrists, and arms that are exposed to the flash hazard. Gloves must be of sufficient length to cover these parts until they overlap other flash protection, such as the sleeve of a flash-protection garment. The glove must cover any openings in the sleeve, such as the slit for the cuff. Insulated Rubber Gloves with leather protectors provide additional arc-flash protection for the hands.
- b. When flash protection is required for the arms beyond the distances that a glove will provide, a long-sleeve flame retarded shirt, jacket, or coverall is required. Short sleeves or rolled up sleeves are not permitted when working where there is a risk of arc-flash. In addition, ensure that for tasks where arms are raised the wrist is protected from arc-flash.
- c. Safety glasses must be used to protect the eyes from impact injuries due to flying or falling objects. Safety glasses must be approved by a registered standards body in the jurisdiction where the work is being done. Safety glasses must be worn while performing testing, troubleshooting or verification where there is a possibility of arc-flash.
- d. Face shields shall be used to provide additional protection to the face. Face shields are not a replacement for safety glasses and safety glasses must be worn with the face shield. Face shields must not be cracked or broken.
- e. All FR clothing must cover associated parts of the body as well as all flammable apparel while allowing movement and visibility.
- f. All FR clothing must be maintained in a sanitary and functionally effective condition. Tight-fitting clothing shall be avoided. Loose-fitting clothing is preferred because it provides additional thermal insulation due to the creation of air spaces beneath the clothing.
- g. FR clothing must be inspected before each use, and work clothing or arc-flash suits that are contaminated, or damaged to the extent their protective qualities are impaired, shall not be used.
- h. FR clothing and any other protective items that become contaminated with grease, oil or flammable liquids or combustible materials must not be used.
- i. All FR clothing must be stored in a manner that prevents physical damage; damage from moisture, dust or other deteriorating agents, or contamination from flammable or combustible materials.
- j. Clothing made from flammable synthetic materials that melt at temperatures below 315c (600 F), such as acetate, acrylic, nylon, polyester, polyethylene, and spandex, either alone or in blends must not be worn. This includes clothing worn beneath the arc-flash rated PPE.

Arc-Flash Personal Protective Equipment

The following requirements shall apply to arc-flash PPE:

- a. Arc-flash suits: arc-flash suit design shall permit easy and rapid removal by the wearer. The entire arc-flash suit, including the hood's face shield, shall have an arc rating that is suitable for the arc-flash exposure. When exterior air is supplied into the hood by a hood ventilation system, all ventilation system components shall be
 - i. covered by arc-rated materials with an arc rating equivalent to the suit; or
 - ii. constructed of non-melting, non-flammable materials.
- b. Head protection:
 - i. An arc-rated balaclava shall be used with an arc-rated face shield when the back of the head is within the arc-flash boundary. An arc-rated hood may be used instead of an-arc rated face shield and balaclava.

- ii. An arc-rated hood shall be used when the anticipated incident energy exposure exceeds 12 cal/cm².
- c. Face protection:
 - i. Face shields shall have an arc rating suitable for the arc-flash exposure.
 - ii. Face shields shall have a wrap-around guarding to protect the face, chin, forehead, ears, and neck area.
 - iii. Face shields without an arc rating shall not be used.
 - iv. Eye protection (safety glasses or goggles) shall be worn under face shields or hoods.
- d. Hand protection:
 - i. Heavy-duty leather gloves or arc-rated gloves shall be worn where necessary for arc-flash protection.

Testing Equipment and Tools

1. The following general directions must apply to electrical test equipment, special tools, and their accessories:
 - a. Must be rated for the circuits and equipment to which they will be connected.
 - b. Must be used in accordance with the manufacturer recommendations and used as intended.
 - c. Must be approved by a registered standards body in the jurisdiction where the work is being done (CSA, ASTM etc.), and have a 600 vac rating or higher
2. Voltage testers must be based upon the intended use. Different types of voltage testers exist with specific uses and limitations. When testing for the absence or presence of voltage, voltage testers may be used where contact can be made and where contact cannot be made. Each type must comply with the requirements of this section.
 - a. The following features are required for multimeters used in measuring voltage and troubleshooting;
 - i. slip protection on test probes
 - ii. self-contained fault protection or limitation devices, such as internal current-limiting fuses or probe current-limiting resistors
 - iii. voltage/current path from the probes is not routed through the selector switching device
 - iv. conformation with applicable standards and appropriate voltage ratings
 - v. All multimeters, voltmeters, clamp-on meters must be at a minimum Category 3/ 600 Volt rating
3. Electrical test instruments and all associated test leads, cables, power cords, probes, and connectors must be visually inspected for external defects or damage by the employee before each use. If visible defects or evidence of damage that might expose an employee to injury are evident, the defective or damaged item shall not be used until any required repairs and tests have been made.
4. The employee must maintain electrical test equipment in good working condition in accordance with the manufacturer's instructions.
5. The employee is responsible to ensure that electrical test equipment and associated probes are stored in a manner that will protect them from moisture and dust, and will prevent damage and deterioration.
6. Any tools or equipment that may be used in the course of testing, troubleshooting or verification must not be capable of conducting electrical current to the employee if they come into contact with an exposed live conductor.
7. Only devices designed for the purpose of pulling fuses shall be used to remove and install fuses. The fuse-pullers shall be of the appropriate size and style.

Barriers and Guarding

1. The purpose of barriers and guarding are to provide insulation and physical separation. Wherever possible barriers and guards must be permanently installed to reduce and eliminate exposure to live electrical equipment. Installation of barriers or guarding requires planning and appropriate risk assessment to avoid creating a hazard.
 - a. Insulating barriers must be made of voltage-rated rubber products, voltage-rated tape, or certain plastics or composites particularly if flammability is deemed to be an issue. The material used depends upon the task. Insulating barriers may be placed directly on energized conductors and parts to prevent inadvertent contact with body parts and tools. The barriers must be rated according to ASTM standards for, or above, the circuit voltage involved.
 - b. Physical guarding must never be placed directly on an energized part or within the Prohibited Approach Boundary. They are installed to provide a physical restraint to prevent body parts or tools from getting near energized parts.
 - c. Physical guards must only be constructed of approved materials. No temporary guard of any material is to be used for any type of insulating or physical barrier.

Protective Clothing and Personal Protective Equipment Matrix

Determine the task to be completed using the first table, **Arc-flash hazard identification for alternating current (AC) and direct current (DC) systems**

1. If Arc-flash PPE is required, and the incident energy exposure (shown in calories/cm²) **has been determined**, refer to [Selection of arc-rated clothing for use when incident exposure is determined](#).

Or

2. Where the incident energy **has NOT been determined**, use either the [Arc-Flash Categories for AC Systems](#) or the [Arc-Flash Categories for DC Systems](#) to determine level of arc-flash PPE. The final table, [Arc-Flash Personal Protective Equipment](#) will advise the type of PPE required for each Arc-Flash Category.

Arc-flash hazard identification for alternating current (AC) and direct current (DC) systems

Task	Equipment Condition (2)	Arc-Flash PPE Required (1)
Reading a panel meter while operating a meter switch	Any	No
Normal operation of a circuit breaker (CB), switch, contactor or starter	All of the following: <ul style="list-style-type: none"> • the equipment is properly installed; • the equipment is properly maintained; • all equipment doors are closed and secured; • all equipment covers are in place and secured; and • there is no evidence of impending failure. 	No* <p>*Only if it can be shown that all of the items to the left are in place, and an Arc-Flash Analysis has been completed within the previous five years.</p>

	<p>One or more of the following:</p> <ul style="list-style-type: none"> • the equipment is not properly installed; • the equipment is not properly maintained; • equipment doors are open or not secured; • equipment covers are off or not secured; • there is evidence of impending failure. 	Yes
For AC systems: Work on energized electrical conductors and circuit parts, including voltage testing	Any	Yes
For DC systems: Work on energized electrical conductors and circuit parts of series-connected cells, including voltage testing	Any	Yes
Voltage testing on individual battery cells or individual multi-cell units	<p>All of the following:</p> <ul style="list-style-type: none"> • the equipment is properly installed; • the equipment is properly maintained; • covers for all other equipment are in place and secured; and • there is no evidence of impending failure. 	<p>No*</p> <p>*Only if it can be shown that all of the items to the left are in place, and an Arc-Flash Analysis has been completed within the previous five years.</p>
	<p>One or more of the following:</p> <ul style="list-style-type: none"> • the equipment is not properly installed; • the equipment is not properly maintained; • equipment doors are open or not secured; • equipment covers are off or not secured; or • there is evidence of impending failure. 	Yes
Removal or installation of CBs or switches	Any	Yes
Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare, energized electrical conductors, and circuit parts	<p>All of the following:</p> <ul style="list-style-type: none"> • the equipment is properly installed; • the equipment is properly maintained; and • there is no evidence of impending failure. 	<p>No*</p> <p>*Only if it can be shown that all of the items to the left are in place, and an Arc-Flash Analysis has been completed within the previous five years.</p>
	<p>One or more of the following:</p> <ul style="list-style-type: none"> • the equipment is not properly installed; • the equipment is not properly maintained; or • there is evidence of impending failure. 	Yes
<p>Removal of bolted covers (to expose bare, energized electrical conductors, and circuit parts)</p> <p>For DC systems, this includes bolted covers, such as battery terminal covers</p>	Any	Yes
Removal of battery intercell connector covers	<p>All of the following:</p> <ul style="list-style-type: none"> • the equipment is properly installed; • the equipment is properly maintained; • covers for all other equipment are in place and secured; and • there is no evidence of impending failure. 	<p>No*</p> <p>*Only if it can be shown that all of the items to the left are in place, and an Arc-Flash Analysis has been completed within the previous five years.</p>
	<p>One or more of the following:</p> <ul style="list-style-type: none"> • the equipment is not properly installed; • the equipment is not properly maintained; • covers for any other equipment are off or not secured; or 	Yes

	• there is evidence of impending failure.	
Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)	Any	Yes
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers	Any	No
Application of temporary protective grounding equipment, after voltage test	Any	Yes
Work on control circuits with exposed energized electrical conductors and circuit parts, 120 V or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access	Any	No
Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V	Any	Yes
Insertion or removal of individual starter buckets from motor control centre (MCC)	Any	Yes
Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed	Any	Yes
Insertion or removal of plug-in devices into or from busways	Any	Yes
Insulated cable examination with no manipulation of cable	Any	No
Insulated cable examination with manipulation of cable	Any	Yes
Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control centre	Any	Yes
Insertion or removal of revenue meters (kW-hour, at primary voltage and current)	Any	Yes
For DC systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure	Any	Yes
For DC systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack	Any	No
For DC systems: Work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a DC source	Any	Yes
Arc-resistant switchgear Type 1 or 2 (for clearing times of < 0.5 s with a prospective fault current not to exceed the arc-resistant rating of the equipment) and metal enclosed interrupter switchgear, fused or unfused of arc resistant type construction, tested in accordance with CSA C22.2 No. 022 or IEEE C37.20.7: • Insertion or removal (racking) of CBs from cubicles; • Insertion or removal (racking) of ground and test device; or • Insertion or removal (racking) of voltage transformers on or off the bus	All of the following: • the equipment is properly installed; • the equipment is properly maintained; • all equipment doors are closed and secured; • all equipment covers are in place and secured; and • there is no evidence of impending failure.	No*
	Any of the following: • the equipment is not properly installed; • the equipment is not properly maintained; • equipment doors are open or not secured; • equipment covers are off or not secured; or • there is evidence of impending failure.	Yes
Opening voltage transformer or control power transformer compartments	Any	Yes
Outdoor disconnect switch operation (hookstick operated) at 1 kV through 15 kV	Any	Yes
Outdoor disconnect switch operation (gang-operated, from grade) at 1 kV through 15 kV	Any	Yes

Notes:

(1) Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard, which could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this Table does not cover every possible condition or situation. Where this Table indicates that arc flash PPE is not required, an arc flash is not likely to occur.

(2) The phrase “properly installed” as used in this Table means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer’s recommendations. The phrase “properly maintained” as used in this table means that the

equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase "evidence of impending failure" as used in this table means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

Selection of arc-rated clothing for use when incident exposure is determined

Incident energy exposure	Protective clothing and PPE
< 1.2 cal/cm²	
Protective clothing, nonmelting (in accordance with ASTM F1506) or untreated natural fibre	Shirt (long sleeve) and pants (long) or coverall
Other PPE	Face shield for projectile protection (AN) Safety glasses or safety goggles (SR) Hearing protection Leather gloves or rubber insulating gloves with leather protectors (AN)
≥ 1.2 and 12 cal/cm²	
Arc-rated clothing and equipment with an arc rating equal to or greater than the incident energy determined in a hazard analysis (Note 3)	Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall or arc flash suit (SR) (Note 3) Arc-rated face shield and arc-rated balaclava or arc flash suit hood (SR) (Note 1) Arc-rated jacket, parka, rainwear, or hard hat liner (AN)
Other PPE	Hard hat Safety glasses or safety goggles (SR) Hearing protection Leather gloves or rubber insulating gloves with leather protectors (SR) (Note 4) Leather footwear
> 12 cal/cm²	
Arc-rated clothing and equipment with an arc rating equal to or greater than the determined incident energy (Note 3)	Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coveralls or arc flash suit (SR) Arc-rated arc flash suit hood Arc-rated gloves Arc-rated jacket, parka, rainwear, or hard hat liner (AN)
Other PPE	Hard hat Safety glasses or safety goggles (SR) Hearing protection Arc-rated gloves or rubber insulating gloves with leather protectors (SR) (Note 4) Leather footwear

AN = As needed SR = Selection Required of one in the group

Notes:

(1) Faceshields with a wrap-around guarding to protect the face, chin, forehead, ears, and neck area are required by CSA Z462-15 Clause 4.3.7.3.10 (c). For full head and neck protection, a balaclava with the face shield or an arc flash hood is used.

(2) All items not designated "AN" are required by CSA Z462-15 Clause 4.3.7.3.

(3) Arc ratings can be for a single layer such as an arc-rated shirt and pants or coverall, or for an arc flash suit or for a multi-layer system consisting of a combination of arc-rated shirt and pants, coverall and arc flash suit.

(4) Rubber insulating gloves with leather protectors provide arc flash protection in addition to shock protection. Higher class rubber insulating gloves with leather protectors due to the increased material thickness provide increased arc-flash protection.

Arc-Flash Categories for AC Systems

Equipment	Arc-Flash PPE Category	Arc-Flash Boundary
Panelboards or other equipment rated 240 V and below Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 s (2 cycles) fault clearing time; working distance 455 mm (18 in)	1	485mm (19 inches)
Panelboards or other equipment rated > 240 V and up to 600 V Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 s (2 cycles) fault clearing time; working distance 455 mm (18 in)	2	900mm (3 ft)
600 V class motor control centers (MCCs) Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 s (2 cycles) fault clearing time; working distance 455 mm (18 in)	2	1.5m (5 ft)
600 V class motor control centers (MCCs) Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 s (20 cycles) fault clearing time; working distance 455 mm (18 in)	4	4.3m (14 ft)
600 V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 s (30 cycles) fault clearing time; working distance 455 mm (18 in)	4	6m (20 ft)
Other 600 V class (277 V through 600 V, nominal) equipment Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 s (2 cycles) fault clearing time; working distance 455 mm (18 in)	2	1.5m (5 ft)
NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 s (15 cycles) fault clearing time; working distance 910 mm (36 in)	4	12m (40 ft)
Metal-clad switchgear, 1 kV through 15 kV Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 s (15 cycles) fault clearing time; working distance 910 mm (36 in)	4	12m (40 ft)
Arc-resistant switchgear Type 1 or 2 (for clearing times of < 0.5 s (30 cycles) with a prospective fault current not to exceed the arc-resistant rating of the equipment), and metal-enclosed interrupter switchgear, fused or unfused of arc-resistant-type construction, tested in accordance with CSA 22.2 No. 0.22 or IEEE C37.20.7, 1 kV through 15 kV: Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 s (15 cycles) fault clearing time; working distance 910 mm (36 in)	N/A (doors closed)	N/A (doors closed)
	4 (doors open)	12m (40 ft)
Other equipment 1 kV through 15 kV Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 s (15 cycles) fault clearing time; working distance 910 mm (36 in)	4	12m (40 ft)

Arc-Flash Categories for DC Systems

Equipment	Arc-Flash PPE Category	Arc-Flash Boundary
Storage batteries, direct current switchboards, and other dc supply sources 100 V < Voltage < 250 V Parameters: Voltage: 250 V Maximum arc duration and working distance: 2 s at 455 mm (18 in)		
Short-circuit current < 4 kA	1	900 mm (3 ft)
4 kA · short-circuit current < 7 kA	2	1.2 m (4 ft)
7 kA · short-circuit current < 15 kA	3	1.8 m (6 ft)
Storage batteries, direct current switchboards and other dc supply sources 250 V · Voltage · 600 V Parameters: Voltage: 600 V Maximum arc duration and working distance: 2 s at 455 mm (18 in)		
Short-circuit current < 1.5 kA	1	900 mm (3 ft)
1.5 kA · short-circuit current < 3 kA	2	1.2 m (4 ft)
3 kA · short-circuit current < 7 kA	3	1.8 m (6 ft)
7 kA · short-circuit current < 10 kA	4	2.5 m (8 ft)

Arc-Flash Personal Protective Equipment

Arc-Flash PPE Category	PPE
1	Arc-rated clothing, minimum arc rating of 4 cal/cm ² Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated faceshield or arc flash suit hood Arc-rated jacket, parka, rainwear, or hard hat liner (AN) Protective equipment: Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Heavy duty leather gloves (AN) Leather footwear (AN)
2	Arc-rated clothing, minimum arc rating of 8 cal/cm ² Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated arc flash suit hood; or arc-rated faceshield and arc-rated balaclava Arc-rated jacket, parka, rainwear, or hard hat liner (AN) Protective equipment: Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Heavy duty leather gloves (AN) Leather footwear
3	Arc-rated clothing, selected so that the system arc rating meets the required minimum arc rating of 25cal/cm ² Arc-rated long-sleeve shirt (AR) Arc-rated pants (AR) Arc-rated coverall (AR) Arc-rated arc flash suit jacket (AR) Arc-rated arc flash suit pants (AR) Arc-rated arc flash suit hood Arc-rated gloves Arc-rated jacket, parka, rainwear, or hard hat liner (AN) Protective equipment: Hard hat

	Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather footwear
4	Arc-rated clothing, selected so that the system arc rating meets the required minimum arc rating of 40 cal/cm2 Arc-rated long-sleeve shirt (AR) Arc-rated pants (AR) Arc-rated coverall (AR) Arc-rated arc flash suit jacket (AR) Arc-rated arc flash suit pants (AR) Arc-rated arc flash suit hood Arc-rated gloves Arc-rated jacket, parka, rainwear, or hard hat liner (AN) Protective equipment: Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather footwear

AN = as needed (optional); AR = as required; SR = selection required of one in the group

Training

All workers who required to perform or assist in any of the tasks listed in [Arc-flash hazard identification for alternating current \(AC\) and direct current \(DC\) systems](#) must receive Electrical Safety Awareness training to the standard of CSA Z462 upon hire, and no more than every three (3) years thereafter.

Reference Documents

CSA Z462-2018 Workplace Electrical Safety

NFPA 70E-2015 Standard for Electrical Safety in the Workplace

CSA Z463-13 Maintenance of Workplace Electrical Systems

Canadian Electrical Code 2015, Part I

Occupational Health and Safety Act, R.S.O. 1990, c. O.1

R.R.O. 1990, Reg. 851: INDUSTRIAL ESTABLISHMENTS

O. Reg. 213/91: CONSTRUCTION PROJECTS

Revision History

Document Owner	Issue / Revised Date	Reason For Changes
Health & Safety	January 1, 2017	Initial draft
Health & Safety	January 4, 2019	Addition of Appendix E – Electrical Risk Assessment Form

Document Owner	Issue / Revised Date	Reason For Changes
Health & Safety	March 7, 2019	<ul style="list-style-type: none"> • Added definition for Electrical Work • Updated definition of Worker • Added new responsibilities for Qualified Person to ensure a work plan and risk assessment are completed • Under <i>General Procedure</i> added requirement to complete the Job Planning and Briefing Checklist is completed • Under <i>General Procedure</i> changed the persons required to authorize a Live Work Permit to include contracted work • Under <i>Shock Protection</i> added classification of head protection to be worn • Under <i>Arc-flash hazard identification for alternating current (AC) and direct current (DC) systems</i> added requirement that arc-flash PPE is only not required for certain tasks when it can be shown all qualifying requirements are met and an arc-flash analysis has been completed in the last five years • Updated <i>Training</i> requirement to show that all persons involved in energized electrical work must complete training in the CSA Z462 standard • Added Appendix D - Electrical Work Job Briefing & Planning Checklist

Appendix A – Energized Electrical Work Permit

Part 1 – to be completed by the Requester

Job/Work Order Number		Date	
Requester Name			
Requester Title			
Description of circuit/equipment/job location			
Description of work to be completed			
Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next scheduled outage			

Part 2: to be completed by the electrically qualified person conducting the work

Please complete ALL sections, including description of what was done to ensure all necessary work was completed prior to work being performed in an energized state.

		Completed?
Detailed job description procedure to be used in performing the above-detailed work (Please provide a copy to the Maintenance approver)	Describe:	<input type="checkbox"/>
Description of the safe work practices to be employed	Describe:	<input type="checkbox"/>
Results of the shock hazard analysis	Describe:	<input type="checkbox"/>
Determination of shock protection boundaries	Describe:	<input type="checkbox"/>
Results of flash hazard analysis	Describe:	<input type="checkbox"/>
Determination of the flash protection boundaries	Describe:	<input type="checkbox"/>
Necessary personal protective equipment	Describe:	<input type="checkbox"/>

to safely perform the assigned task		
Means employed to restrict the access of unqualified persons to the work area	Describe:	<input type="checkbox"/>
Evidence of completion of a job briefing, including discussion of any job-related hazards (Please provide a copy to the Maintenance approver)	Describe:	<input type="checkbox"/>
Do you agree the above described work can be done safely? <input type="checkbox"/> Yes <input type="checkbox"/> No (if no return to requester)		

Part 3: Approval(s) to perform the work while electrically energized

Qualified Person	Name			
	Title			
	Signature		Date	
Departmental Approval	Name			
	Title			
	Signature		Date	
Maintenance Approval	Name			
	Title			
	Signature		Date	

Note – Once the work is complete, forward this form to Maintenance for retention

Appendix B – Example Electrical Hazard Information Label

! **WARNING**

Arc Flash and Shock Hazard

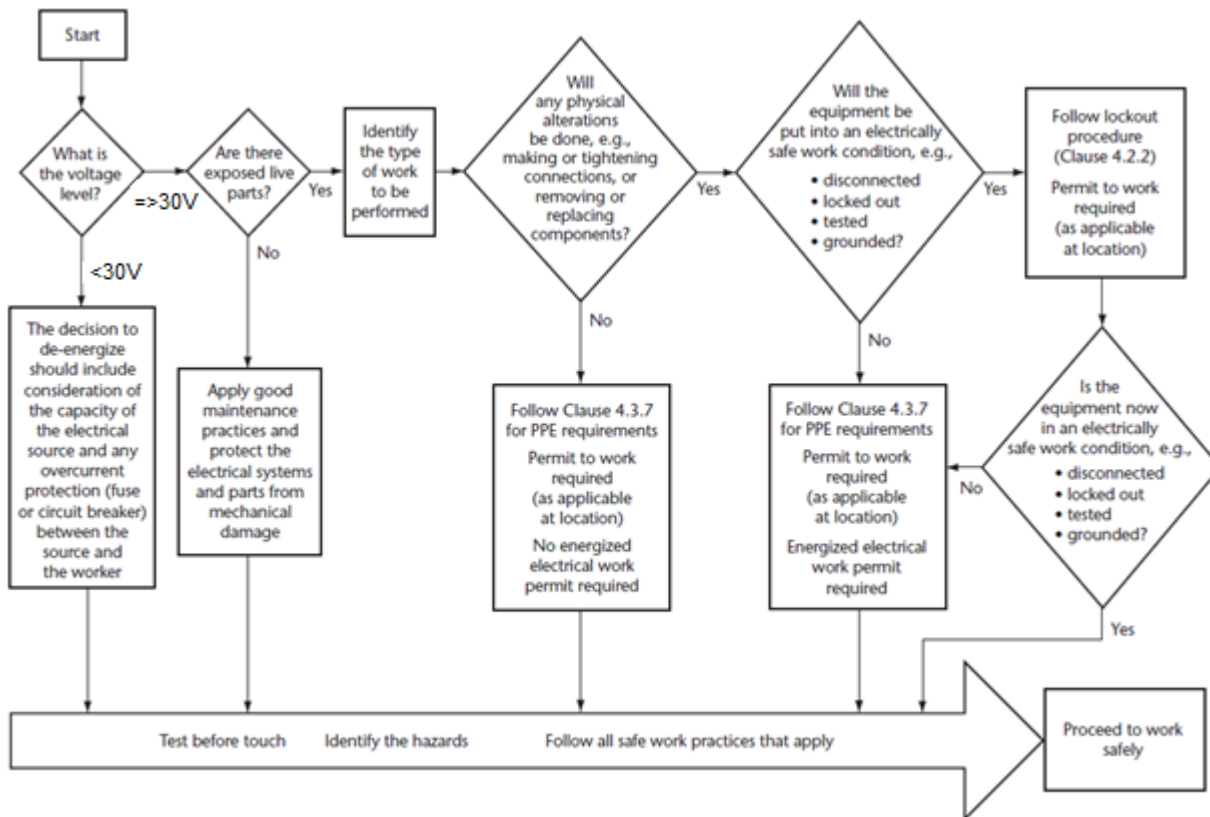
ARC FLASH PROTECTION Working distance: 460 mm (18 in) Incident energy: 5.0 cal/cm² Arc flash boundary: 1.2 m (46 in) Refer to CSA Z462 for PPE requirements	SHOCK PROTECTION Shock hazard when cover is removed: 600 VAC Limited approach: 1.0 m (42 in) Restricted approach: 300 mm (12 in) Glove class: 0
--	--

Equipment Name: **MCC#3**
 File: "ABC PLANT Rev X.xyz"

Arc Flash Analysis by: **XYZ Consulting**
 March 14, 2011 Std. IEEE 1584

Appendix C – Energized Electrical Work Decision Tree

(Taken from CSA Z462-18: Workplace Electrical Safety)



Appendix D - Electrical Work Job Briefing & Planning Checklist

Prior to any electrical work, the worker in charge must conduct a job briefing with the workers involved and complete this checklist. This checklist has been adapted from the CSA Z462-18 Standard. **An Electrical Risk Assessment and Live Work Permit must also be completed for ALL energized work.**

Please provide a brief description of the work to be completed: _____

1. IDENTIFY

- All hazards
- The voltage levels involved
- Skills required
- Any secondary voltage source(s)
- Any unusual work conditions
- Number of people needed to do the job
- The shock protection boundaries

2. ASK

- Can the equipment be de-energized?
If no, complete Section 7.
- Can work be done after hours?
If no, complete Section 7.

3. CHECK

- Job plans
- Single line diagrams and vendor prints
- Status board
- Information on site and vendor resources is up-to-date
- Applicable safety policies and procedures
- Vendor information
- Individuals involved in work are familiar with the facility

4. KNOW

- What the job is
- Who the Supervisor in charge is
- Who else may be impacted by the work
Communicate with Supervisors/ Team Leads before starting work.

5. THINK

- About unexpected events. What are they?
- Lock – Tag – Test – Try
- Test for voltage – FIRST
- Use the right tools, equipment, and PPE
- Install and remove grounds
- Install barriers and barricades
- Anything else?

6. PREPARE FOR AN EMERGENCY

- Is at least one person on the crew trained in CPR?

- Is the required emergency equipment available? Where is it?
- Where is the nearest telephone?
- Is the fire alarm one or two stage?
- What are the emergency phone numbers?
- What is the exact work location? How will you direct emergency personnel to your location?
- All workers know the process to shut down the equipment in an emergency?

7. LIVE WORK

Why must this work be conducted live? Explain in detail. *Example: It will introduce additional hazards, such as...; It is not feasible because...*

Why must this work be conducted during regular hours? Explain in detail.

What are the limited approach boundaries and how were they determined?

Appendix E – Electrical Risk Assessment Form

1. GENERAL		
Date:	Equipment:	System Voltage:
Company:	Location:	<input type="checkbox"/> Movable circuit part <input type="checkbox"/> Fixed Circuit Part
Qualified Personnel:	Normal operating conditions exist? <input type="checkbox"/> Y <input type="checkbox"/> N	Arc Flash label present on equipment? <input type="checkbox"/> Y <input type="checkbox"/> N Date on Label: _____
2. TASK		
<ul style="list-style-type: none"> <input type="checkbox"/> Reading a panel meter while operating a meter switch <input type="checkbox"/> Normal operation of a circuit breaker (CB), switch, contactor, or starter <input type="checkbox"/> Work on energized electrical conductors and circuit parts, including voltage testing <input type="checkbox"/> Voltage testing on individual battery cells or individual multi-cell units <input type="checkbox"/> Removal or installation of CBs or switches <input type="checkbox"/> Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts <input type="checkbox"/> Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). <input type="checkbox"/> Removal of battery internal connector covers <input type="checkbox"/> Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts) <input type="checkbox"/> Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers. <input type="checkbox"/> Application of temporary protective grounding equipment after voltage test <input type="checkbox"/> Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access <input type="checkbox"/> Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V <input type="checkbox"/> Insertion or removal of individual starter buckets from motor control center. <input type="checkbox"/> Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed <input type="checkbox"/> Insertion or removal of plug-in devices into or from busways <input type="checkbox"/> Insulated cable examination with no manipulation of cable <input type="checkbox"/> Insulated cable examination with manipulation of cable <input type="checkbox"/> Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panel board or motor control center. <input type="checkbox"/> Insertion and removal of revenue meters <input type="checkbox"/> For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure or open rack. <input type="checkbox"/> For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack <input type="checkbox"/> For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source <input type="checkbox"/> Insertion or removal (racking) of CBs from cubicles <input type="checkbox"/> Insertion or removal (racking) of ground and test device <input type="checkbox"/> Insertion or removal (racking) of voltage transformers on or off the bus <input type="checkbox"/> Opening voltage transformer or control power transformer compartments <input type="checkbox"/> Outdoor disconnect switch operation (hook stick operated) at 1 kV through 15 kV <input type="checkbox"/> Outdoor disconnect switch operation (gang-operated, from grade) at 1 kV through 15 kV. <p>EXPLAIN TASK / ADDITIONAL DETAIL:</p>		

3. POTENTIAL ELECTRICAL HAZARDS	
Shock hazard <input type="checkbox"/> Yes <input type="checkbox"/> No	
Likelihood of an arc flash incident? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Potential for an arc blast <input type="checkbox"/> Yes <input type="checkbox"/> No	
4. POTENTIAL RISKS	
Potential Severity of Injury or Damage to Health	
<input type="checkbox"/> Irreversible — trauma, death <input type="checkbox"/> Permanent — skeletal damage, blindness, hearing loss, third degree burns <input type="checkbox"/> Reversible — minor impact, hearing damage, minor laceration, bruises, first/second degree burns	
Likelihood of Hazardous Event	Likelihood of Avoiding Injury
<input type="checkbox"/> Very high <input type="checkbox"/> Likely <input type="checkbox"/> Possible	<input type="checkbox"/> Impossible <input type="checkbox"/> Probable
Protective Measures	
<input type="checkbox"/> Physical barrier at _____ feet (based on boundary information below) <input type="checkbox"/> Signage <input type="checkbox"/> SOPs	
<input type="checkbox"/> Training <input type="checkbox"/> PPE (see below) <input type="checkbox"/> Other Controls, Explain	
5. APPROACH BOUNDARIES <i>(Refer to City of Guelph Energized Electrical Work Policy)</i>	
Restricted Approach Boundary (feet) = _____	Limited Approach Boundary (feet) = _____
6. ARC FLASH BOUNDARY	
Method for determining Arc Flash Boundary:	
<input type="checkbox"/> Arc Flash PPE Categories Method	Arc Flash Boundary (feet) = _____
<input type="checkbox"/> Incident Energy Analysis Method	
Incident energy = _____ cal/cm ²	
7. ARC FLASH PPE REQUIREMENTS <i>(Refer to City of Guelph Energized Electrical Work Policy)</i>	
PPE Category = _____ and/or PPE Calorie Rating = _____	
Arc flash PPE conforms to CSA Z462-18? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Protective Clothing and PPE:	Protective Equipment:
8. REQUEST PERMIT	
Does work include more than voltage verification, troubleshooting, or thermal imaging? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Is equipment operating condition abnormal? <input type="checkbox"/> Yes <input type="checkbox"/> No	
<i>If any answer is yes, then work must be completed under an approved Energized Electrical Work Permit</i>	

Note: This ERA must be completed by a Qualified Person per City of Guelph Energized Electrical Work Policy. Workers must review this ERA prior to starting work. This ERA must be available at the job site during work activities.