Electrical Work Safety & Compliance Game Plan

Electrocution and electrical burns are responsible for:

- Roughly 3 of every 100 workplace deaths in Canada.
- The deaths of 33 Ontario workers from 2008 to 2017.
- 15 in every 1,000 (1.5%) workers comp claims for nonfatal injuries across all of Canada in 2010 (Human Resources and Skills Development Canada).

Electrical hazards are also a serious compliance challenge. OHS electrical safety regulations are extensive and complex and failure to comply with them is likely to result in significant fines, stop work orders, and other penalties, not to mention avoidable injuries and deaths. And OHS laws are just the beginning. Protecting workers against electrical hazards requires compliance with a host of other laws and standards, including:

- The *Canadian Electrical Code* (CEC), a national safety standard containing over 900 pages of safety requirements for installation, operation and servicing of electrical equipment operating at all voltages.
- Provincial electrical codes and regulations.
- CSA Z462, a Canadian standard that incorporates the requirements of another highly recognized standard from the US, NFPA 70E, listing specific technical measures for protecting workers against electrical shock, arc

flash, and arc blast.

Electrical safety is an enormous subject involving a wide range of activities, equipment and training. While non-electric workers may also be exposed to electrical workers, the focus of this Game Plan is protecting workers who actually perform electrical work on energized electrical equipment at dangerous voltages. Its objective is to provide not comprehensive detail but a general strategy for compliance organized around nine basic steps that you can incorporate into an electrical safety policy or program for your workplace.

Lockout and Deenergize, Where Possible

The best way to protect workers who work on electrical equipment is to implement lockout tagout procedures to deenergize the electrical equipment they're working on it and ensure it's completely isolated from its power source before the work begins. Work should be done on energized equipment only when lockout tagout isn't practicable. These are the nine basic types of safety measures required when working on or near energized equipment can't be avoided.

Step 1. Determine Limited Approach Boundary

In planning a job that involves working on or near energized equipment, you must have a qualified person assess both electrical flash and arc flash hazards. The shock hazard assessment determines the likelihood and severity of injury from electrical shock taking into consideration the electrical design, the guarding of energized electrical conductors and circuit parts, the operating conditions and the condition of maintenance.

Use the findings of the shock hazard analysis to determine what additional safety measures and PPE are necessary to protect the workers performing the job and to mark out the so-called limited approach boundary or distance from an exposed live part within which a shock hazard exists. Only qualified workers should be allowed to cross the limited approach boundary as long as they wear appropriate flash protective equipment. You must also ensure that unqualified workers stay outside the boundary at all times.

Step 2. Determine Arc Flash Boundary

Arc flash occurs when electrical energy passes through air from a high voltage down to a low voltage (usually ground) conductor, causing extreme heat and a blinding flash of light that may ignite a fire or explosion. It only takes a few milliseconds to happen, typically as a result of deteriorating insulation in aging equipment, poor installations, dust, and debris in the electrical components, and improper or accidental connection of tools. Before workers work on or near exposed energized electrical equipment, a qualified person must perform a hazard assessment in accordance with CSA Z462 standards to determine if arc flash hazards exist and, if so, how to control them. As part of the assessment, the qualified person must perform an incident energy analysis to determine the incident energy exposure of the worker in calories per square centimetre.

Using the results of both assessments, the qualified person must determine what's called the arc flash boundary, or distance workers and equipment must maintain from the energized electrical equipment to avoid secondary degree burns, more precisely, the distance at which the incident energy equals 5 Joules/cm2(1.2 calories/cm2).

Step 3. Ensure Equipment Is Properly Labeled

There must be a label on the exposed, energized electrical equipment that warns of the danger of arc flash and lists all of the following:

- The nominal system voltage.
- The arc flash boundary.
- The required PPE within the arc flash boundary, that is, either the available incident energy with corresponding working distance, or PPE category from tables listed in CSA Z462.
- The date the information was determined.

Step 4. Post Appropriate Warning Signs

Entrances to rooms or areas containing exposed live electrical parts must have a conspicuous warning sign stating **"DANGER – ENERGIZED EQUIPMENT"** or **"DANGER – HIGH VOLTAGE"** and forbidding unauthorized persons to enter.

Step 5. Guard Energized Equipment

Electrocution and arc flash may occur when workers, machinery, tools, or equipment touch energized equipment. Accordingly, OHS regulations require that energized electrical machinery, conductors, circuit parts, and other equipment be properly guarded to prevent inadvertent or dangerous contact.

Step 6. Designate a Safety Watcher

As with entry into hazardous confined spaces, many provinces require employers to designate a specially trained worker to act as a safety watcher to watch over the work and ensure it's carried out safely. The safety watcher should:

- Have training and instruction in the work hazards, required safety measures, and emergency procedures.
- Have the authority to stop the work immediately if any danger is detected.
- Have no other duties or responsibilities while serving as safety watcher.

Step 7. Don't Let Unqualified Workers Do Electrical Work

Work on energized equipment above certain voltages may only be performed by "qualified workers" or "qualified electrical workers" who have the training, certifications and other credentials specified in the OHS regulations and/or CEC. Here are some general guidelines based on Ontario OHS laws. **Caveat:** Definitions of "qualified workers" and the types of work they may perform and training they need, vary by jurisdiction so you need to be aware of the requirements in your particular province.

Required Training & Qualifications for Electrical Work

Role	Required Training	Jobs Not Permitted to Do
Apprentice Electrician	• Lockout tagout • CPR • CSA Z462 Workplace Electrical Safety. • Arc flash training applicable to local site requirements.	• Being in charge of a group or complex lock out. • Working or being within the limited or restricted approach boundary. • Diagnostic testing.
Journeyman (or higher) Electrician	• Lockout tagout • CPR • CSA Z462 Workplace Electrical Safety. • Arc flash training applicable to local site requirements.	High voltage work (unless trained in accordance with below).

Role	Required Training	Jobs Not Permitted to Do
Electrician performing High Voltage Work	• Lockout tagout • CPR • CSA Z462 Workplace Electrical Safety. • Arc flash training applicable to local site requirements. • Powerline Technician (aka Linesman) training OR qualified electrician with high voltage training.	N/A
Operating engineers, building engineers, TSSA certified elevating device mechanics	• Lockout tagout • CSA Z462 Workplace Electrical Safety. • Arc flash training applicable to local site requirements.	• Any work requiring a licensed electrician. • Operating Engineers and TSSA certified elevating device mechanics (nonelectrical workers) may per local conditions operate Low Voltage electrical equipment but only when wearing PPE required for the equipment rating.
Other non-electrical workers or supervisors of maintenance workers accessing electrical rooms	• Lockout tagout • CSA Z462 Workplace Electrical Safety. • Arc flash training applicable to local site requirements. • Site-specific training or instruction.	• Any work requiring a licensed electrician. • Any work involving touching of electrical equipment unless properly trained. • Where permitted, equipment rated less than 1.2 cal/cm2, may be operated provided appropriate PPE is worn. • If a breaker trips repeatedly, staff should get advice from facilities owner and not reset it repeatedly on their own.

Step 8. Implement Safe Work Procedures for Electrical Work

There must be procedures in place to ensure that work on energized equipment is carried out safely and in accordance with manufacturer's instructions, OHS requirements, and CSA and other applicable standards. Among other things, permits should be required to perform electrical work the way it is with confined space entry work. Ensure that all workers performing the electrical work receive training in how to carry out your company's particular safety procedures, even if they're experienced electricians with extensive electrical and technical training.

Step 9. Require Appropriate PPE &

Protective Clothing

A qualified person must determine what PPE and protective clothing that personnel within the arc flash and limited approach boundaries must wear, which might include:

- Loose fitting clothing made of nonflammable materials like cotton, rayon, wool, silk, or blends of these materials.
- Protective headwear meeting the most current version of CSA Z94.1, i.e., i. Type 2, Class 'E' (Electrical): rated for 20,000 volts; or ii. Type 2, Class 'G' (General): rated for 2,200 volts. (**Note:** Type 2, Class 'C' (Conductive), doesn't offer electrical protection and shouldn't be used for electrical work).
- Protective eyewear meeting the most current version of CSA Z94.3.
- Rubber insulating gloves that are air (inflation) tested and inspected and that provide protection against the maximum voltage to which workers will be exposed.
- Protective footwear meeting the most current version of CSA Z195.
- Rubber mats, leather aprons, and other insulating equipment to protect against shock.
- Arc-rated clothing.

There are two basic methods for selecting electrical PPE and protective clothing:

Option 1 – Incident energy analysis method: The preferred method is to select PPE and arc-rated clothing based on the incident energy exposure associated with a specific task. Incident energy varies with distance from the arc source. A working distance of 18 inches is typically used for equipment rated at 600 volts and below. Additional PPE must be used for any parts of the body that are closer than the working distance.

Option 2 – Table method: Select PPE and protective clothing based on the task to be performed using the default working distance of 18 inches. The Standard includes tables listing the Hazard/Risk Category (HRC) of particular tasks.