D RF protective clothing (i.e., conductive suits);

E *Fall protection*;

F Climbing plans;

G Rescue training and emergency response; and

H Third party agreements.

NOTE: Refer to IEEE 1654, RF Protection of Personnel Working in the Vicinity of Wireless Communications Antennas Attached to Electric Power Line Structures. This IEEE document provides information on RF exposure limits, RF safety compliance steps, power frequency electric and magnetic field immunity of RF personal monitors (RFPM) and RF protective clothing.

10. WORKING ON ISOLATED ELECTRIC UTILITY SYSTEMS

10.1 FUNDAMENTAL REQUIREMENTS

10.1.1 One method of performing work safely on the power system involves isolation. When equipment or conductors are to be placed in an *isolated* state, appropriate safety precautions shall be taken. The following shall be considered:

A Whether there are multiple sources of *hazardous energy* supply;

B Whether the *circuit* has been unloaded, or is the isolating device capable of interrupting load; and

C Whether the equipment possibly develops a hazardous induced potential or capacitive charge.

10.2 ISOLATING AND GROUNDING/BLOCKING OF ELECTRIC UTILITY SYSTEMS

10.2.1 Conductors and electrical equipment shall be considered *live* and *minimum approach distances* shall be maintained (see Section 5., Minimum Approach Distances for Working Near or on Energized Electrical Lines or Equipment) unless the equipment is *isolated* and *grounded* or *blocked* to effectively control hazardous energies.

10.2.2 All electrical isolation shall provide a visual opening except when not *practicable* or an *authorized* equivalent is provided.

10.2.3 When work procedures or requirements are such that *portable grounding equipment* is left in service overnight or longer, it shall not be depended upon until a voltage absence test has been done.

10.2.3.1 For *grounding* equipment installed in an overhead location, a daily check to see that the assemblies are well secured shall be conducted.

10.2.3.2 For *grounding* equipment installed in underground locations where public access and weather impacts do not affect them, there is no requirement to check daily.

10.2.4 After isolating but before *grounding* or *blocking* and working on any *exposed* terminal, conductors, or equipment, the worker(s) shall verify the absence of operating voltage or other *hazardous energy* using a *voltage detector*.

10.2.5 If the terminals or conductors to be verified are not *accessible*, the removal or penetration of the *insulating* material shall be considered to be *live working*.

10.3 HAZARDOUS ENERGY CONTROL IN THE ELECTRIC UTILITY INDUSTRY

10.3.1 Fundamental Requirements

10.3.1.1 The *hazards* involved in generation, transmission and distribution of electricity require *engineered* controls and strict operating procedures by the utility in concert with appropriate industry standards and safety regulations.

10.3.1.2 All electric utilities shall ensure controls are in place for all hazardous energies to ensure worker safety..

10.3.1.3 All *hazard* control procedures shall be documented and readily available to any worker expected to know or follow the procedures.

10.3.1.4 All workers required to work on or *near* hazardous energies shall be trained in both *hazard* identification and in established control procedures.

10.3.2 Lockout and Tagging

10.3.2.1 Two methods of controlling hazardous electrical and mechanical energy are available: *lockout* and *tagging*. Whenever *tagging* is used, *lockout* shall also be used where *practicable*.

10.3.2.2 Either personal or non-personal utility (system) controlled locks shall be used to lock out equipment designed with this capability. If non-personal utility (system) controlled locks are used, *tagging* shall also be used.

10.3.2.3 The *lockout* requirements of CAN/CSA-Z460, Control of Hazardous Energy Lockout and Other Methods, or an industry standard(s) of equivalent or greater worker protection, shall apply to transmission and distribution systems operating at voltages greater than 750 V and auxiliary metering, and control *circuits* operating at lower voltages. For generating facilities the requirements of CAN/CSA-Z460, Control of Hazardous Energy Lockout and Other Methods shall be applied to all electrical apparatus. Personal *lockout*, group *lockout*, and complex group *lockout* are all acceptable and are to be supported by procedures.

10.3.2.4 To perform work on electric systems without *lockout* capability, utilities shall use isolation and *tagging* only; for example, when opening isolation points such as pole mounted disconnect switches, jumpers, etc. This equipment is *isolated* by physical (primarily vertical) space, which assures operation only under the direction of the operating authority by a *qualified worker* using appropriate tools and following strict system operating procedures.

10.3.2.5 Whether using *tagging*, personal locks, system locks or group *lockout* alternative methods, electric utility generation, transmission and distribution operators shall have appropriate operating procedures in place to assure an equivalent level of protection. These procedures shall consider, but are not limited to:

A Operating diagrams or equivalent devices indicating the operating condition of the electric system;

B System status documentation, logs or electronic records;

C Control authority (operator/person in charge), including transfer of control authority;

D Authorization to work on the system;

E Required worker qualifications and training;

F Equipment/location verification;

G Operation procedures for isolation;

H Voice commands and repetition of messages for both isolation and energization;

I Verification of absence of operating voltage or other *hazardous energy* on lines or equipment;

J Tag installation and logging of tags;

K Installation of *portable equipment for grounds and bonds* and/or other worker controlled protection procedures;

L Authorization to proceed with work;

M Authorization to return to normal;

N Removal of *portable equipment for grounds and bonds*;

O Tag removal;

P Closing of switches;

Q *Blocking* of *reclosing* devices; and

R Transfer of work permissions.

10.4 PROTECTIVE EQUIPOTENTIAL BONDING AND GROUNDING

10.4.1 Fundamental Requirements

10.4.1.1 An *equipotential bonding* and *grounding* (EBG) program shall be in place for electric utility systems above 1 000 V a.c. L-L to safeguard workers from exposure to voltages that may occur due to either inadvertent energization or induction (See Appendix D).

10.4.1.2 The EBG program shall provide for reduction (control) of the *hazard* to essentially eliminate the *risk* of electrical contact injury.

10.4.1.3 Trip *grounding* shall provide a dependable low impedance path to *ground* to assure tripping and to minimize step and touch potential.

10.4.1.4 Work procedures shall be established to align with the EBG configurations.

10.4.1.5 All portable *bonding* and grounding equipment shall be installed and removed following utility procedures and using approved *live working* tools and PPE as applicable.

10.4.2 Equipotential Bonding and Grounding (EBG) at the Worksite

NOTE 1: EBG is the preferred method for *grounding isolated* electrical lines and equipment at the *worksite*. *Engineered ground* grids form a valid part of establishing an *equipotential zone*.

NOTE 2: EBG is not required where additional *barriers* are in place to assure worker protection. For example the creation of a *worksite* where there is additional visible isolation points cut in and there is no possible way for the *worksite* to become accidentally *energized*. For obvious reasons these *worksites* cannot be created in areas of high induction. *Grounding* is still required to bleed static charge and *capacitive coupling*.

10.4.2.1 Voltage detection shall be performed immediately prior to the *manual* application of any *bonding* or *grounding* equipment.

10.4.2.2 EBG procedures shall be used in accordance with an approved EBG program.

10.4.2.3 EBG programs shall consider the following:

A Substations:

(i) Grid integrity;

(ii) Grid design;

(iii) *Engineered grounding* points;

(iv) *Grounding* locations;

(v) Cable entering and leaving the substation;

(vi) Crossing fence lines and *ground* grids; and

(vii) Temporary installments of equipment and trailers in and outside the fence line or *ground* grid.

B Distribution and transmission overhead and underground systems:

(i) Structure design and types.

C Induction situations:

(i) *Capacitive coupling*:

- Voltage; and
- Steady state current.

(ii) *Electromagnetic induction*:

- Circulating currents.

(iii) *Static charge*:

- Charge accumulation.

D Trip *grounds*:

(i) Resistance testing and monitoring;

(ii) Fault level availability;

(iii) *Ground* potential rise;

(iv) Temporary;

(v) Permanent *grounding* structures; and

(vi) Ampacity of *grounding* devices.

E Portable equipment for grounding:

(i) Rating of devices;

(ii) Inspection and testing;

(iii) Sequence of applying and removal of *portable equipment for grounding*; and

(iv) Current readings on *grounds* at the *worksite*, in high induction areas.

F Vehicles:

Work practices and procedures for *insulating* (*rated*) and non-insulating *aerial devices* and booms working *near energized* or *de-energized* facilities. This would include, but is not limited to:

(i) Non-insulating booms:

- When to *ground* the vehicle to trip the *circuit* in case of accidental contact;
- How to *bond* the vehicle into the zone to protect the worker aloft; and
- Installation and removal of *bonds*.

(ii) *Insulating* booms:

- Insulation rating and testing; and
- Removal of boom covers, cleaning and inspection.

(iii) Eliminating or controlling *hazards* to the workers on the ground:

- Working *near* and access to vehicle;
- *Barriers* around vehicles;
- *Portable bond mats* (installation and removal);
- *Insulating* mats;

- *Insulating* gloves or boots; and
- Locations of *bonds* and/or *grounds*.

G Storm damage and restoration; and

H Stringing of conductor *near energized* lines:

(i) Tension:

- Protecting the workers (non conductive pilot line) and protecting the conductor.

(ii) Slack stringing:

- Protecting the worker and the public.

10.4.2.4 EBG principles are the same for overhead and underground facilities.

10.4.2.5 A *grounding* plan shall be developed for complex *grounding* situations and all *hazard* shall be identified and eliminated or controlled.

10.4.2.6 Stringing inside and outside of an *energized* corridor should be done in compliance with the following standard(s), or an industry standard(s) of equivalent or greater worker protection:

A CAN/ULC-61328, Live Working – Guidelines for the Installation of Transmission Line Conductors and Earthwires – Stringing Equipment and Accessory Items;

B CAN/ULC-61911, Live Working – Guidelines for the Installation of Distribution Line Conductors – Stringing Equipment and Accessory Items; and

C IEC/TR 62263, Live working – Guidelines for the installation and maintenance of optical fibre cables on overhead power lines.

11. WORKING NEAR ELECTRIC UTILITY SYSTEMS

NOTE: This Section applies to work activities *near exposed energized* electrical lines and equipment that may present the possibility of encroachment on *minimum approach distances*.

11.1 FUNDAMENTAL REQUIREMENTS

11.1.1 *Minimum approach distances* shall be maintained as required by Section 5., Minimum Approach Distances for Working Near or on Energized Electrical Lines or Equipment.

11.1.2 The employer shall ensure that workers working *near energized* electrical lines and equipment shall have the appropriate tools, equipment, PPE and clothing for the application.

11.1.3 When necessary to measure and assure appropriate *clearances* are maintained from *exposed energized* electrical lines or other system parts, only devices approved for the purpose shall be used.

11.2 NON-UTILITY WORKERS AND OTHER PERSONS WORKING ON JOINT USE STRUCTURES OR NEAR ELECTRICAL LINES AND EQUIPMENT

11.2.1 General

11.2.1.1 Work *near energized* electrical lines and equipment by persons and equipment other than those covered by the scope of this Standard shall meet the requirements of the authority having jurisdiction.

11.2.1.2 Non-utility workers working *near energized* electrical lines and equipment shall comply with the following Sections of this Standard:

Section 4., Fundamental Requirements;

Section 5., Minimum Approach Distances for Working Near or on Energized Electrical Lines or Equipment; and

Section 11., Working Near Electric Utility Systems.

11.2.1.3 Non-utility workers shall adhere to the applicable federal/provincial /territorial and/or utility safety requirements.

11.2.1.4 Non-utility workers working on non-utility owned streetlights shall comply with the following Sections in this Standard:

Section 4., Fundamental Requirements;

Section 5., Minimum Approach Distances for Working Near or on Energized Electrical Lines or Equipment;

Section 6., Protective Tools, Equipment and Devices;

Section 7., Working on Energized Electrical Lines and Equipment;

Section 8., Arc Flash Protection; and

Section 11., Working Near Electric Utility Systems

11.2.2 Approach to Energized Conductors or Parts

11.2.2.1 Non-utility workers shall not approach nor bring any conductive object to any *exposed energized* part within the distances specified in the applicable federal/provincial/territorial regulations or by the electric utility.

11.2.3 Joint Use Structures

11.2.3.1 When working on jointly used poles or structures, non-utility workers shall not approach closer than the distances specified by the authority having jurisdiction or by the electric utility.

11.2.3.2 When repairing storm damage to communication lines that are supported by structures in joint use with electric supply lines, and power liens have become storm damaged, non-utility workers shall obtain the appropriate *approvals* from the electric utility.

11.2.4 Access to Subsurface Chambers by Non-Utility Workers

11.2.4.1 Non-utility workers requesting access to an electric utility's *subsurface chamber* shall comply with the electric utility's access requirements.

11.3 VEGETATION MANAGEMENT NEAR ELECTRICAL LINES AND EQUIPMENT

NOTE: This section applies to pruning and clearing of vegetation *near exposed energized* electrical lines or equipment during utility clearing operations.

11.3.1 Vegetation Management Plan

11.3.1.1 The utility shall have a vegetation management program in place to mitigate the *risk* of vegetation contacting *energized* lines or equipment or compromising the effectiveness of station *grounding* systems.

11.3.2 Worker Requirements (Qualifications)

11.3.2.1 All vegetation clearing work shall be under the direction of a *qualified worker*.

11.3.2.2 All pruning and clearing of woody plants *near exposed energized* lines or equipment shall be carried out by a *utility arbourist*, *utility arbourist in training*, or other qualified *utility workers*. These workers shall be *authorized* by the utility to carry out the work.

11.3.2.3 Where mechanized equipment such as a feller buncher is used, the operator shall be knowledgeable in identifying power system-related *hazards* and qualified in corresponding safe work procedures.

11.3.3 Protective Requirements

11.3.3.1 Pruning or clearing of woody plants shall not commence until *authorized* and appropriate work permits/protection or isolation and protective *grounding* have been established.

11.3.4 Use of Insulating Devices

11.3.4.1 *Insulating* line clearing tools are essential for pruning and clearing operations. *Insulating* hand tools and *insulating aerial devices* shall be used whenever pruning and clearing woody plants *near energized* lines or equipment.

11.4 GENERATION SYSTEMS

11.4.1 Electrical Rotating Machines

11.4.1.1 Inductive Circuits

11.4.1.1.1 When working on or troubleshooting field winding *circuits* with the machine in operation, approved work practices shall be followed.

11.4.1.1.2 The field winding shall not be worked on under load because hazardous voltages can occur.

11.4.1.2 Generator Isolating, Bonding and Grounding

11.4.1.2.1 Isolation and protection guarantees (i.e., *lockout* and/or *tagging*) shall be used (see Section 10., Working on Isolated Electric Utility Systems).

11.4.1.2.2 Utilities shall develop approved *equipotential bonding* and *grounding* (EBG) procedures when working on HV electrical generators and associated equipment.

11.4.1.3 Adverse Impact on Rubber Insulating Tools and Equipment

11.4.1.3.1 The deterioration of HV electrical insulation in electrical rotating machines can result in ozone being produced on the surface. Ozone readily reacts with and degrades *rubber insulating* equipment (gloves, matting, etc.). For this reason, *rubber insulating* equipment shall not be stored *near* HV machines.

11.4.1.4 Isolated Phase Bus

11.4.1.4.1 An *isolated* phase bus is constructed of high current, single phase conductors inside a concentric metallic enclosure. Significant induced currents can occur in the covers, the *isolated* phase bus *ground* leads and adjacent magnetic materials during operation. Care shall be taken to avoid inadvertently shorting the various external metallic parts together with foreign objects (e.g., slings, scaffolding, etc.) during operation. Significant heating caused by high currents can result.

NOTE: Removal of inadvertent shorts can cause significant electrical arcs as the two metallic objects are separated.

11.4.1.5 High Current, Single Phase Cables

11.4.1.5.1 In addition to the *hazards* identified for *isolated* phase bus above, dangerous electrical potential can exist on cable sheaths that are not *grounded* at both ends. Appropriate precautions shall be taken when working *near energized* single-phase power cables with an *exposed* metallic sheath.

APPENDIX A – SAFE WORK PLAN HAZARD ASSESSMENT AND EMERGENCY RESPONSE PLAN FORM & PROJECT PLANNING HAZARD ASSESSMENT FORM

(INFORMATIVE)

FIGURE A1 — SAFE WORK PLAN HAZARD ASSESSMENT AND EMERGENCY RESPONSE PLAN TEMPLATE

(Reference: Clause 4.4.3.1)

This form should be completed at the worksite daily or whenever there is a change in the work or conditions.

Safe Work Plan Prepare and review daily or when changes occur

Define the worksite:

Describe the work:

Crew Worker in Charge:

Is system work protection required? ❑

❑ Operator Administered ❑ Worker Administered

Date/Permit:

Isolation and grounding points reviewed ❑

Barrier Effectiveness Chart

NOTE: Barrier Effectiveness Chart lists most effective (1) to least effective (10)

↑ 1. Eliminate the hazard
| 2. Minimize energy to a safe level
| 3. Install physical barriers
| 4. Wear protective equipment
| 5. Install warning devices
| 6. Minimize chances of error
| 7. Use safe work procedures
| 8. Provide training
| 9. Provide supervision/observer
↓ 10. Accept risk, identify hazard only

Job Steps	High Risk Hazards	Required Barriers	Barrier Rating

Is there a Change in Conditions?

FIGURE A1 — SAFE WORK PLAN HAZARD ASSESSMENT AND EMERGENCY RESPONSE PLAN TEMPLATE (Continued)

Have we considered all the energies and hazards?		
Gravity	**Electricity**	**Mechanical**
Falling from a height	Live apparatus	Equipment failure
Falling objects	Induction / Backfeed	Flying objects
Falling structures	Static charge	Tension loads
Climbing obstructions	Ground gradients	Moving parts
Rigging	Flash potential / UV	Sharp objects

Kinetic / Vehicular	**Chemical**	**Body Mechanics**
Traffic conditions	Confined spaces	Slips or trips
Driving conditions	Toxic or poisonous	Lifting / twisting strains
Moving loads	Flammable	Repetitive strains
Vehicular stability	Explosive	Improper positioning
Blocker vehicles	Acidic or caustic	-

Noise	**Fire**	**Pressure**
Chronic > 85 dB	Wild fires	High pressure pipelines
Explosive	Flammable liquids	Compressed gases
Distraction levels	Hot objects	Compressed liquids
-	Ignition sources	-

Have we considered?	
People	**Timing**
Person in charge	Job coordination with others
Qualification of personnel	Work groups
Communication	Work schedules
Worker fatigue	In service date changes
General public	-
Customer requirements	-

Procedures	**Hardware / Equipment**
Lock out tag out	Inspection of vehicles/ equip.
Isolation of equipment and lines	Inspection of tools and PPE
Testing for isolation	Specialty equipment
Adequate grounding	Maintenance of equipment
Vehicle grounds	Structures and condition of
Limits of approach	Conductors and splices
Standard changes	Safe loads for rigging
Safe work procedures	Temporary support
Confined space entry	Warning devices
Emergency rescue plan	Physical barriers

Environment	
Locating U/G utilities	Soil conditions
Weather & light conditions	Location
Working space	Encounter with wildlife
Adjacent facilities	Housekeeping

Emergency Plan
1. What type of rescue/response is requirement (pole-top, platform, tower, bucket, confined space, medical aid, fire, etc.)?
2. Who can execute the rescue/response and location of rescue equipment?
3. Who can provide first aid, identify the location of first aid supplies and fire fighting equipment?
4. Provide directions to the worksite and the closest hospital or medical facility
5. Is ambulance service available to the worksite? If not, how will the injured be transported?
6. Do you have constant communication (radio, cell, satellite, other)?

Emergency Numbers:	**Office:**	**Control Centre:**
Ambulance:	**Police:**	**Fire:**
Date:	**Crew Members Present**	**Signature or Initials**: