Health & Safety Standard

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1 Purpose

This standard sets requirements to reduce the risk of exposure to electric shock and arc flash hazards associated with direct or indirect electrical contact. It is intended for maintenance leaders, electrical supervisors, and managers responsible for guiding personnel working on or near electrical equipment or systems.

2 Application

This standard is supplementary to any federal, provincial, or local regulatory requirements and applies to the following:

- work performed on any Cenovus worksite
- electrical safety-related work practices, requirements, and controls for safeguarding workers from associated electrical energy hazards

This standard does NOT apply to:

- systems operating at 50 V or lower
- ignition hazards associated with the application of electricity in hazardous locations
- effects of arc blast

Notify the Electrical Engineering Functional Team:

- when the requirements of this standard are not aligned with electrical codes, governing standards or regulations, applicable local jurisdiction amendments, and, where appropriate, Alberta Electrical Utility Code
- for written clarification if a conflict arises

!	Report all power line contact incidents IMMEDIATELY to the Cenovus Electrical Engineering Functional Team.

3 Requirements

The Cenovus Electrical Safety Program is based on the following principles:

- electrical equipment shall be de-energized prior to performing work whenever practicable, unless de-energization will increase risk
- workers shall be trained to understand the electrical hazards and risks they are exposed to during the performance of their assigned work tasks
- NFPA 70E, CSA Z462 and CSA S801 standards shall guide the minimum requirements for electrical safety
- all electrical work shall be performed in conformance with the Safe Control of Work Standard and entity control of work processes
- All controls applied to electrical work shall apply the hierarchy of control in the Risk Management Standard

3.1 Roles and responsibilities

Table 1 Roles and responsibilities

Role	Responsibilities
Functional leaders (senior business leaders)	• implement the requirements of this standard within their functional group or asset locations • define key responsibilities for the electrical functional supervisor role and electrical worker role • ensure the system(s), process(es), procedures, training, and other supporting resources are in place to enable the requirements of this standard • provide input to the development and maintenance of this standard and the applicable functional communications
Functional supervisors (field supervisors responsible for worksites and execution of work)	• meet or exceed the requirements of this standard • provide guidance and supervision to workers regarding this standard • implement and communicate the requirements of this standard • ensure service providers comply with established work methods • ensure service providers use personal protective equipment (PPE) as required by this standard • review and verify that personnel involved with electrical work are authorized to perform the work • conduct assurance activities to verify compliance with the expectations outlined in this standard using the *Electrical Safety Standard Self-Assessment Audit Checklist* • report all electrical incidents

Cenovus electrical engineering team	• support Cenovus's business functions with requirements outlined in this standard • serve as the content owner and subject matter expert (SME) for the contents of this standard • communicate changes to this standard to functional supervisors • validate feedback for accuracy and submit change requests accordingly • provide technical support to facilitate the requirements of applicable codes for the electrical installation of equipment and systems • supply Arc Thermal Performance Value (ATPV) ratings for electrical equipment on-site or provide direction for PPE requirements when ATPV ratings are not in place
Electrical planner	• compile documentation required by the electrical work plan within the Maintenance Management System or equivalent system, for use by electrical workers
Qualified Electrical Person	• meet or exceed expectations of this standard • demonstrate technical knowledge, skills and experience with equipment to carry out the work safely • obtain safe work permit, approvals and authorizations as needed, before commencing electrical work • conform to the safe work permit requirements • participate in hazard assessments • confirm a hazard assessment is completed and documented for all electrical work • use proper tools, PPE, and procedures required to perform electrical work safely

3.2 Qualified electrical person

Only a qualified electrical person (QEP) shall perform electrical work. Only workers who meet the following criteria shall be considered a QEP:

- authorized by Cenovus to work on electrical equipment
- able to identify the hazards involved in the task being performed
- has demonstrated skills and knowledge related to the construction and operation of the electrical equipment and installations involved in the task being performed (e.g., holds a certificate in the electrical trade or other certification that is acceptable to the local authority having jurisdiction with respect to the task being performed)
- has received safety training to identify and avoid the hazards involved

3.3 Work execution

3.3.1 Planning and authorization

Ensure appropriate safety controls are in place before authorizing work, including:

- issue a Cenovus Energized Electrical Work Permit (EEWP) or equivalent for all energized electrical work
- use appropriate safety signs, barricades, warning tags, safety labels, or a safety watch to alert others about potential electrical hazards
- do not override or disable safety-critical controls and equipment without obtaining authorization
- energized equipment and circuit parts not being worked on shall be guarded against accidental contact, as appropriate
- obtain approval from Cenovus Electrical Engineering Functional Team for work above 40 cal/cm^2

!	An Energized Electrical Work Permit is not required when a knowledgeable worker (as deemed by functional level supervisor) is troubleshooting a circuit (e.g., measuring voltage, current or IR scanning), where voltage is less than 750V.

3.3.2 Safe approach distance

Observing a safe approach distance from exposed energized electrical conductors or circuit parts is an effective means of maintaining electrical safety. The likelihood of an incident increases as the distance between a person and the exposed energized conductors or circuit parts decreases. Figure 1 depicts hazard boundaries relative to an exposed energy source.

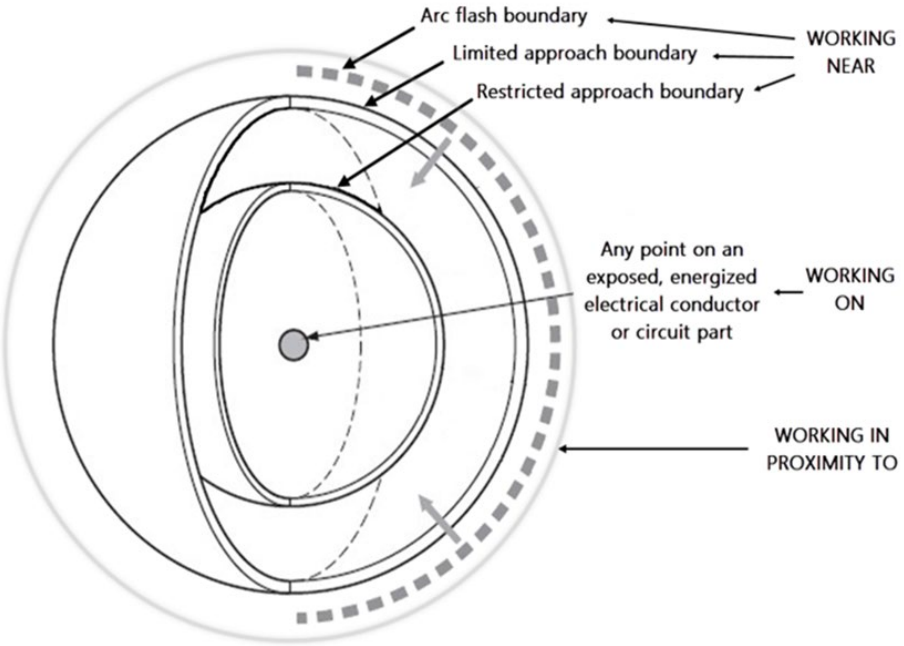

Figure 1 Hazard Boundaries

Table 2 provides boundary restrictions based on worker qualifications and voltage approach limits defined in tables 3 and 4.

Table 2 Boundary restrictions

Situation	Restriction
1. Approach by unqualified persons	Unless permitted by item 2 below, no unqualified person shall be permitted to approach nearer than the limited approach boundary of energized conductors and circuit parts
2. Crossing the limited approach boundary	Where there is a need for an unqualified person(s) to cross the limited approach boundary, a QEP shall advise them of the possible hazards, and continuously escort the unqualified person(s) while inside the limited approach boundary. Under no circumstance shall unqualified person(s) be permitted to cross the restricted approach boundary
3. Crossing the restricted approach boundary	QEPs shall not approach or bring conductive objects closer to exposed energized electrical conductors or circuit parts operating at voltages greater than 50 V than the restricted approach boundary unless at least one of the following applies: • the QEP is insulated or guarded from the energized electrical conductors or circuit parts operating at voltages greater than 50 V • rubber insulating gloves and sleeves shall be considered insulation only with regard to the energized parts on which work is being performed

	• the energized electrical conductors or circuit parts are insulated or guarded by an appropriate insulating barrier

The minimum safe distance to prevent a contact incident is called "limit of approach" and is depicted in Tables 3 and 4 for AC and DC voltage. Limits are determined by the voltage of the energized electrical conductors or circuit parts.

Table 3 AC Voltage Restricted Approach Boundary Distance

AC Voltages Electric shock protection boundaries to exposed energized parts			
Nominal potential difference	**Limited approach boundary**		**Restricted approach boundary**
	Exposed movable conductor	**Exposed fixed circuit part**	
Less than 50 V	Not specified	Not specified	Not specified
50 V - 150 V	3.1 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	Avoid contact
151 V - 750 V	3.1 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	0.3 m (1 ft 0 in.)
751 V - 15 kV	3.1 m (10 ft 0 in.)	1.5 m (5 ft 0 in.)	0.7 m (2 ft 2 in.)
15.1 - 36 kV	3.1 m (10 ft 0 in.)	1.8 m (6 ft 0 in.)	0.8 m (2 ft 9 in.)
For higher voltages, consult NFPA 70E or CSA Z462			

Table 4 DC Voltage Restricted Approach Boundary Distance

DC Voltages Electric shock protection boundaries to exposed energized parts			
Nominal potential difference	**Limited approach boundary**		**Restricted approach boundary**
	Exposed movable conductor	**Exposed fixed circuit part**	
Less than 50 V	Not specified	Not specified	Not specified
50 V - 300 V	3.1 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	Avoid contact
301 V - 1 kV	3.1 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	0.3 m (1 ft 0 in.)
For higher voltages, consult NFPA 70E or CSA Z462			

3.3.3 De-energization

All electrical equipment and systems shall be placed in an electrically safe work condition before commencing an electrical task, unless de-energization introduces additional or increased risk, or is impractical due to equipment design, operating limitations, or the nature of the task.

- all energized electrical work shall be approved by functional supervisors (e.g., Operations) and justified by a QEP

- initiate Test before Touch practices to verify the absence of voltage
- apply lock-out-tag-out devices according to COIMS Element 9 Safe control of work requirements and applicable functional level isolation practices

Complete these steps to establish an electrically safe work condition:

1. Determine all possible sources of electrical energy supply.
2. Properly interrupt the load current and turn off the electrical equipment.
3. Disconnect the electrical equipment from energized parts by operating the appropriate switch(es) or breaker(s):
   a. Visually verify, where possible, that all blades are disconnected, or that draw-out circuit breakers are withdrawn.
   b. Ensure all switches, breakers and other disconnect devices that could provide voltage to the electrical equipment remain open.
   c. The preferred method is lock out where possible.
4. Test all electrical equipment to verify zero voltage:
   a. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source.
   b. Utilize appropriate PPE required to perform test before touch.
5. When grounding is required to keep workers safe, appropriate protective grounding conductors, or other devices specifically manufactured and approved for this purpose shall be used.

3.3.4 Energization

Prior to energization of electrical equipment:

- conduct a hazard assessment before energizing the electrical equipment or system
- ensure all tools and temporary protective grounds (TPG) are removed from the equipment
- ensure that all the barriers and equipment parts that may have been removed during the electrical work have been reinstalled and are safe to operate
- walk down the equipment to be energized to ensure the equipment is ready for energization and all workers are clear of the equipment

3.3.5 Batteries

Workers working with exposed stationary storage batteries that exceed 50 VDC shall follow these principles:

- prior to any work on a battery system, perform a risk assessment to identify chemical, electric shock, and arc flash hazards, and assess the risks associated with the type of tasks to be performed
- basic PPE shall be worn as a minimum when working on battery systems
- use approved insulated tools when working on battery systems
- personnel shall not wear electrically conductive objects such as jewellery while working on a battery system

!	Batteries are stored energy devices, meaning no overload protection is available if the battery is connected improperly or short-circuited. Batteries contain

	volatile and potentially hazardous materials which can cause burns and other serious injuries. Always handle batteries with caution.

3.3.6 Grounding and bonding

Grounding and bonding equipment safeguard workers from electric shock and mitigates electrical hazards associated with static electricity charge. The grounding and bonding requirements below shall be observed in each named situation:

- bonding and grounding devices are the preferred method to safeguard workers when identified in the hazard assessment
- only a QEP shall install bonding and grounding devices to electrical equipment and systems
- refer to functional or area-specific bonding and grounding guidelines in addition to the requirements of this standard

3.3.6.1 General requirements

- conduct a hazard assessment to evaluate the effectiveness of the grounding devices for equipment operating under 750 V
- ensure test equipment and grounding devices are rated for the maximum expected voltage and current and are in good condition
- check all electrical sources for stray energy and ground them appropriately
- equipment parts for grounding shall be de-energized and verified by a voltage test before installing grounding devices
- to prevent shock from induced current, check and ground non-electrical equipment that may be in contact or positioned near a high voltage electrical source (e.g., a substation fence)

3.3.6.2 Well delivery

Well delivery refers to drilling, completion, well servicing, seismic and earthworks operations:

- all equipment and structures on a wellsite shall be interconnected by an approved bonding method
- grounding connections used to connect to the ground electrode (e.g., wellhead casing, conductor barrel or rig anchor) shall be in good condition and attached tightly to the ground electrode

3.3.6.3 Portable electrical appliances, equipment, and extension cords

All portable electrical equipment shall be bonded to the ground per the manufacturer's instructions and any site-specific requirements (e.g., generators, light standards, ground thawers, and/or temporary power):

- all cord-connected portable appliances and power tools used outdoors and in wet locations shall be plugged into an approved ground fault circuit interrupter (GFCI) receptacle
- power tools and portable electrical equipment shall be used in accordance with the manufacturer's instructions

- extension cords shall be inspected for frays, cuts, and damages before use, and defective cords shall be removed from service
- all electrical equipment shall be approved under the appropriate legislation and approved for the hazardous area classification where applicable

3.3.6.4 Lightning and static charge

Business functions shall develop site-specific procedures to safely address risks when dealing with the dangers of lightning and static charge:

- for protection from lightning strikes, equipment, buildings and tall structures shall be grounded and bonded to create low impedance paths to the ground
- workers shall ensure the clothing, or equipment used, dissipates the static electrical charge
- plastic tanks which contain flammable materials, and are susceptible to static charge build-up, shall be grounded and bonded adequately to avoid fire hazards during a fluid transfer
- tank trucks containing flammable, combustible, or explosive materials shall be bonded to a grounded system when being loaded or unloaded:
  - tank trucks loading and unloading in hazardous locations shall be bonded to a grounded system
  - examples of bonding equipment include but are not limited to: system indicators, system interlocks, or visual cable and clamp assemblies
  - tank truck loading and unloading stations shall include a ground plate or ground stub for the purpose of providing a solidly grounded connection point (refer to the Cenovus site-specific electrical engineered detail drawings for more information)

3.3.6.5 Temporary protective grounding equipment

TPG equipment shall:

- be placed at such locations and arranged in a manner that prevents every worker from being exposed to a shock hazard (hazardous differences in electrical potential)
- the location, sizing, and application of TPG equipment shall be identified as part of the job plan
- be capable of conducting the maximum fault current that could flow at the point of grounding for the time necessary to clear the fault
- have an impedance low enough to cause immediate operation of protective devices in case of unintentional energizing of the electric conductors or circuit parts
- be inspected as follows:
  - before initial use for cuts in the protective sheath and damage to the conductors
  - clamps and connector strain-relief devices shall be checked before initial use for tightness
  - these inspections shall be conducted thereafter as service conditions require, but at least every 12 months

Before being returned to service, TPG equipment that has been repaired or modified shall be tested. Guidance for inspecting and testing safety grounds is provided by ASTM F2249.

TPG is considered optional for low voltage systems. The decision to install TPG on low voltage conductors shall factor in the higher fault current typical of low voltage systems, which presents the following challenges:

- access to the conductors might not be readily available, or the equipment compartment could be too small to accommodate the temporary grounding equipment
- the size of the grounding clamps

3.3.7 Power lines

Work being done in the proximity of a power line shall include a pre-work hazard assessment with respect to the power line.

When working near overhead power lines, refer to the Overhead Powerline Encroachment standard.

When working near underground power lines:

- power lines, electrical cables, or conduits installed in a work area shall be located and marked before performing any electrical work activities
- if required, powerlines shall be unearthed, grounded and where possible adequately isolated per COIMS Element 9 Safe control of work requirements - Health & Safety Ground Disturbance standard
- notify the applicable Electrical Operating Authority for underground powerline safe distance and excavation concerns, including reporting of incidents

3.3.8 Physical protection

Suitable physical barriers shall be installed to protect power supply system installations.

3.3.9 Emergency response

Functional teams shall develop emergency response plans for high-risk electrical tasks.

3.4 Operation of electrical equipment

Normal condition includes:

- the equipment is installed, maintained, and used in accordance with the applicable code, equipment standards and the manufacturer's instructions
- the equipment's doors and covers are closed and secured
- there is no evidence of impending failure (e.g., smoke, abnormal sounds, etc.)

If equipment is NOT in normal condition and needs to be operated:

- a risk assessment shall be performed
- a QEP shall perform the operation with risks controlled to an acceptable level (including but not limited to required PPE being worn)

3.4.1 Re-energization after fault condition

Re-energization shall not be attempted in these situations until a QEP has investigated the condition and determined appropriate action to be taken:

- fault condition resulting in an auxiliary relay lockout (e.g., ANSI 86)
- overcurrent fault (e.g., main circuit breaker tripped, etc.)

3.4.2 Re-energization after motor overload trip condition

A qualified operator shall:

- investigate the reason/cause for the motor overload trip condition
- take corrective action if the reason for trip is identified
- reset overloads, provided overloads are accessible from the MCC dead front (e.g., systems in which all energized parts are contained fully within grounded or insulated enclosures)
- attempt to restart the process once
- if the overload trips a second time, the qualified operator shall lockout the motor and contact a QEP to investigate the trip condition and determined appropriate action to be taken

3.5 Maintenance of electrical equipment

Electrical equipment shall be regularly maintained, inspected, and tested to maintain or reduce the risk of electric shock or arc flash hazards.

- only a QEP shall perform maintenance activities on electrical equipment
- electrical equipment shall be maintained in accordance with the manufacturer's instructions or industry consensus standards to reduce the risk associated with failure
- maintenance, tests, and inspections shall be documented
- circuit breakers (and any associated sensing relays) that are relied upon to provide energy isolation to limit arc flash incident energy shall be tested at intervals to provide confidence the equipment will function as intended (e.g., 1, 3, or 5-year intervals)
- all working space and clearances for electrical equipment shall be maintained
- enclosures shall be kept free of material that would create a hazard (e.g., dust, dirt, moisture, oil, or grease build-up, etc.)
- an external visual inspection of electrical equipment shall be conducted at least once per year
- deficiencies noted during visual inspections shall be reported immediately and fixed promptly, including missing covers, fasteners, excessive dirt/dust, indications of excessive heat and thermal damage, etc.
- in facilities where an authorized and QEP service electrical equipment, the incident energy information may be documented (e.g., single line diagram (SLD), work plan, arc flash study, equipment labels) in a manner that is readily available to persons likely to perform examinations, adjustment, servicing, maintenance and troubleshooting of the equipment while energized
- where discrepancies exist between incident energy level equipment labelling and SLDs, contact Electrical Engineering Functional Team

3.6 Insulated tools and test equipment

3.6.1 Insulated Tools

- tools used on energized equipment below 1000 V shall be manufactured and certified to ASTM F1505
- tools used on energized equipment over 1000 V shall be rated for the applicable voltage

3.6.2 Test Instruments

- test instruments for use on circuits rated below 1000 V shall comply with CSA C22.2 61010-1 and 61010-2-033 (Canada), UL 61010-1 and 61010-2-033 (USA) or IEC 61010
- voltage detectors for use on circuits rated above 1000 V shall be rated for the voltage they will be used for and shall comply with IEC 61243-1

3.7 Personal protective equipment

When working on energized electrical equipment, use personal protective equipment (PPE) appropriately rated to the task, per Table 5. Wear ATPV rated garments as the outermost layer of clothing when conducting energized electrical work.

Table 5 Energized electrical work PPE

Coverall	Jacket
Arc flash suit jacket	Parka
Arc flash suit pants	Rainwear
Face shield	Hard hat liner
Rubber insulating blankets	Rubber insulating mats
Voltage-rated gloves	Balaclava
Flash suit hood	Long sleeve shirts and pants

!	Workers shall not wear jewelry (i.e., necklaces, earrings, bracelets, rings, metal headgear, or watches) while performing electrical work.

- select PPE per the electrical work pre-job hazard assessment; for more information, see Electrical Work Practice for the business function
- ensure electrical PPE is appropriate for the shock hazard, arc flash rating, and task
- where an arc flash hazard exists, all garments and face shields shall be ATPV rated
- insulating PPE, specifically voltage rated gloves, hot sticks, and rubber insulating mats shall be tested periodically, and per ASTM/CSA standards or manufacturer recommended testing methodology

3.8 Training

3.8.1 Basic training requirements

Functional Leaders shall ensure all workers under their supervision, who work on or near electrical equipment/systems, are qualified, trained, and knowledgeable about any applicable operating and maintenance policies, standards, business processes and procedures.

- training shall be aligned with COIMS Element 2 Training and Competency requirements
- all workers who are required to isolate hazardous energy shall be experienced in energy isolation and be trained on the applicable lockout procedure
- all service providers shall have an electrical safety program and ensure workers are trained according to their program
- personnel performing duties shall be trained to use proper body positioning to minimize risks
- site-specific electrical equipment owned by Cenovus, utilized by third-party service providers, and identified as a medium or high-risk electrical task, may require additional procedures or training support
- Cenovus may provide formal training on site-specific procedures and may qualify non-electrical persons for the task; contact the Cenovus Electrical Engineering Functional Team for additional information
- use existing industry standards and training for electrical work to promote electrical safety awareness among the workforce (e.g., online training, CSA Z462, NFPA 70E)

3.8.2 Cenovus training

Workers shall access Workday eLearning modules applicable to their area of work, or contact their direct supervisor for additional training information.

4 Related information

4.1 References

Table 6: Internal governing references

Document title or link	Relevance
Electrical Safety Standard Self-Assessment Audit Checklist	LOD1
Energized Electrical Work Permit	Each entity addresses energized electrical work using site specific process.
Electrical Work Practice	The entity specific electrical safe work practices that meet this standard.
NFPA 70E / CSA Z462	Published national standards for workplace electrical safety.
Safe Control of Work Standard	
Risk Management Standard	

Table 7: Abbreviations

Abbreviation	Full name
ATPV	Arc Thermal Performance Value
ASTM	American Society for Testing and Materials
CSA	Canadian Standards Association
GFCI	Ground Fault Circuit Interrupters
IEC	International Electrotechnical Commission
NFPA	National Fire Protection Association
QEP	Qualified Electrical Person
TPG	Temporary Protective Grounding
UL	Underwriters Laboratories