Operations Health & Safety

Bonding and Grounding Practice

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1.0 Purpose

This practice provides an overview of the requirements for bonding and grounding at Cenovus worksites. For information on bonding and grounding for the purposes of mitigating static accumulation, discharge and ignition of flammable fluids or vapours, see Flammable and Combustible Liquids Handling Practice (CEN-EHS8213).

Should conflict arise between the requirements of this practice and legislative requirements of an applicable jurisdiction, the more stringent requirements shall take precedence.

2.0 Scope

This practice applies to all Cenovus worksites and encompasses all bonding and grounding activities within their scope of work. Persons involved in operations, maintenance, and construction tasks at Cenovus worksites are required to understand and comply with this practice.

3.0 Process Requirements

3.1 Bonding and Grounding Limitations

Bonding and grounding are important and require safeguards, but under some circumstances **will not** prevent static discharge and ignition of flammable vapours by static sparks.

Bonding and grounding alone does not provide adequate fire safety for flammable liquids transfer. For this, approved safety cans, dispensing devices and drum safety vents are required. For details, see Flammable and Combustible Liquids Handling Practice (CEN-EHS8213).

3.2 Hazard Identification, Assessment, and Control

Business units must identify and assess the requirements for bonding and grounding in order to protect workers and facilities from hazards associated with the accumulation of static charge, work on or near to electrical installations, and lightning strikes.

Bonding and grounding measures must be implemented as necessary and will comply with the requirements of the jurisdiction having authority.

3.3 Electrical Hazards Overview

Bonding and grounding serves to mitigate electrical hazards associated with the following:

3.3.1 Static Electric Charge

Flammable and explosive atmospheres and fluids found throughout the oil and gas industry may be ignited by sparks resulting from the discharge of static electricity. For example, static electricity may accumulate during the flow of fluid in piping or vessels, during fluid loading or offloading, or during the transfer of fluids between containers. Subsequent discharge of

static electricity can ignite the fluid. This hazard is mitigated for fixed equipment by its engineered design.

For loading/offloading, fluid sampling, and fluid transfer between containers, bonding and/or grounding is often manually applied. Please see Flammable and Combustible Liquids Handling Practice (CEN-EHS8213) for more information.

Additionally, workers can accumulate static charge on their body, which must be discharged in a controlled and deliberate manner, prior to entering buildings at production facilities. Workers are required to follow the Cenovus Well Site and Facility (Process Building) Entry Practice (CEN-EHS131).

3.3.2 Contacting Tanks or Entering Buildings

It is recommended to adhere to the following precautions:

1. Ground by touching the building frame or piping when entering buildings that could contain flammable vapours. Ground periodically while working, especially if flammable gas/liquid vent points are in the proximity.

2. Be extremely cautious of contact with plastic tanks and other plastic components as clothing may accumulate static charge, which could be hazardous if discharged in a flammable environment. Ensure that static electricity is dissipated harmlessly away from vapour sources such as tank vents.

See Enform Safety Alert 14-2012 — Worker burned in methanol tank explosion.

3.3.3 Static Electricity Hazard of Fluids

The static electricity hazard of fluids is a complex subject, however it is widely recognized that the conductivity of the fluid is a key factor. Nonconductive or poorly conductive fluids are prolific accumulators of static charge. These fluids are also often flammable liquids and their vapours when mixed with air can form a flammable cloud or vapour space inside a tank or vessel. Some synthetic lubricants have been found to be very poor conductors and prolific accumulators of static electricity.

Contamination of fluids may change the static electricity accumulation and/or flammable properties of the fluid, increasing the likelihood of a fire or explosion.

When the static electricity and/or flammability properties are unknown:

- Consider the fluid as being prone to electric charge accumulation and flammable

- Apply the bonding and grounding requirements as described in this document

In many cases, key information on the static electricity properties of fluids, notably conductivity, is not indicated on Material Safety Data

Sheets (MSDS) and may not be published by the manufacturer. In such cases it is necessary to do independent laboratory testing of the fluid to understand its static electricity properties.

3.3.4 Filter Replacements on Screw Compressor Discharge Separators

Static electricity discharge can be a hazard during replacement of filters inside screw compressor discharge separators. At least one flash fire has occurred during filter changes on this equipment (see Cenovus Technical Alert – Hazards of static electric accumulation) when synthetic polyglycol lubricant was used.

Filters are known to cause electric charge accumulation on lubricants and other fluids. While such fluids may not be inherently flammable, they can absorb flammable gases during compressor operations. When the filter housing is opened, evolved gases will mix with air producing a flammable environment.

Filter removal may generate a static spark if un-bonded metal components exist on the filter housing.

Maintenance procedures for these filters should include sufficient time for static relaxation and ventilation of gases from the housing.

3.3.5 Electrical Equipment

Bonding and grounding requirements for the installation and maintenance of electrical equipment are detailed in the *Canadian Electrical Code* and other electrical installation codes in-force. Bonding and grounding electrical equipment serves to safeguard workers from electric shock. Additionally, the requirements detailed in these codes serve to protect equipment and facilities from electrical fires and explosions.

Portable or re-locatable electrical equipment includes, but is not limited to, generators, light standards, ground thawers, and temporary power. All portable electrical equipment must be bonded to ground as per the manufacturer's instructions, and any site-specific requirements.

Cord-connected portable appliances and power tools present a shock hazard when used outdoors, and in wet locations. All cord-connected portable appliances and tools shall be plugged-into an approved ground fault circuit interrupter (GFCI) receptacle. Battery-operated portable appliances and power tools present a shock hazard when used in wet locations, and therefore shall be used in accordance with the manufacturer's instructions.

Only qualified electrical workers shall install and maintain electrical equipment. All electrical work shall comply with the Cenovus Hot Work Practice (CEN-EHS095), the requirements of the *Cenovus Electrical Regulatory Management Plan* (ERMP), and the Cenovus Electrical Safety Program.

3.3.6 Induced Voltage and Current

Electrical equipment that is installed on or near non-electrical equipment may induce voltages and currents in to the non-electrical equipment. For

example, a substation fence that is not properly bonded to ground may have voltages and currents induced onto it by the high voltage equipment in the substation and it may therefore present a shock hazard. Also, metal building structural material may become energized if it is not properly bonded to ground when it comes into contact with a live conductor. The bonding requirements for non-electrical equipment are detailed in the *Canadian Electrical Code*.

Only qualified electrical workers shall bond and ground non-electrical equipment. All electrical work shall comply with the Cenovus Hot Work Practice (CEN-EHS095), the requirements of the *Cenovus Electrical Regulatory Management Plan* (ERMP), and the Cenovus Electrical Safety Program.

3.3.7 Lightning

All outdoor structures are prone to possible lightning strikes. Bonding and grounding provide an electrical connection between the earth and the air terminals of a lightning protection system. For example, in the event of a lightning strike, the lightning will preferentially hit the lightning rod and will safely conduct to earth via the lightning protection system, instead of passing through the building.

Only qualified electrical workers shall install and maintain lightning protection systems. All electrical work shall comply with the Cenovus Hot Work Practice (CEN-EHS095), the requirements of the *Cenovus Electrical Regulatory Management Plan* (ERMP), and the Cenovus Electrical Safety Program.

3.3.8 Piping and Hose Materials

The materials used in piping and hoses are important to consider. (Steel or other metallic piping with threaded or flanged joints is considered conductive and does not require special consideration from the standpoint of static electricity.) The static properties of elastomeric hoses can vary widely. Hoses and other flexible components should be approved by the appropriate authority (Canadian Standards Association, ULC, SAE) for conveying the specific fluid and prove their suitability in use with the fluid.

Always consult with facility and process engineering, and a fluid and tank vendor if you have any questions regarding piping and hose materials. Bonding and grounding must be employed for flammable and combustible liquid fluid transfer through flexible hoses.

3.3.9 Tank Materials

Plastic tanks containing flammable or combustible materials are often found at older legacy sites. Some of these tanks are conductive. Depending on the specific plastic, and the conductivity and fire hazard of the fluid handled, a fire or explosion may be possible during fluid transfer.

Always consult with facility and process engineering, and a fluid and tank vendor if you have any questions regarding tank materials. See Enform Safety Alert 14-2012 — Worker burned in methanol tank explosion.

3.3.10 Using Piles as Grounding Electrodes

Piles are often used as grounding electrodes. However, hydrocarbon gases can accumulate in piles thus creating a potential fire and explosion hazard when ignition sources are present. Therefore, the proper hot work procedures shall be followed when drilling or sawing into pilings. See the Cenovus Hot Work Practice (CEN-EHS095) for more information.

3.3.11 Oil and Gas Drilling and Service Rigs

The Canadian Electrical Code STANDATA, Section 10 — Grounding and Bonding CEC-10 provides additional information on electric power system bonding and grounding. This document is posted on the Alberta Municipal Affairs website under *Electrical STANDATA*. This document gives detailed information on bonding and grounding for oil and gas drilling and service rigs.

3.3.12 Management of Change (MOC) Considerations

There are several possible changes that could increase the risk of a static ignition incident, including a change:

1. To a fluid with a lower flash point
2. To a fluid with lower conductivity
3. In hose material to a material with lower conductivity
4. In resistance of the plant grounding system due to changes in the water table level (this can be detected by periodic testing)

Whenever a fluid or hose material is changed, an MOC review of the effect on the static electricity hazard should be completed and appropriate prevention and mitigation provided.

3.4 Specific Bonding and Grounding Precautions

3.4.1 Bonding and Grounding for Flammable and Combustible Liquid Transfer

There are many occasions where it is necessary to transfer flammable and combustible liquids from a tank or drum into a smaller container. Examples are transfers of flammable laboratory solvents or combustible solvents heated above their flashpoint.

The precautions are as follows:

1. Ground the wire from the drum to a grounded pipe, building framework, or other ground
2. Use a ULC/FM approved drum dispensing faucet with metallic flexible fill line, which can be placed in contact with the safety can and inserted into can to avoid splashing
3. Use a ULC/FM approved steel safety can for handling flammable solvents or chemicals, which has several fire safety features including:

- Self-closing, spring-loaded dispensing and fill spouts, which help prevent spills
- Integral flame arrestor on the fill spout
- Pressure vent on the fill spout to avoid can exploding when exposed to fire

4. Bond the wire clipped on to the drum to the safety can to ensure electrical continuity
5. Pressure/vacuum the drum safety vent to protect the drum against over and under-pressuring and to limit the venting of vapours

See Process Safety Beacon — Static electric discharge causes fire.

Important Note: Bonding and grounding alone does not provide adequate fire safety for flammable liquids transfer. For this, approved safety cans, dispensing devices and drum safety vents are required.

3.4.2 Bonding and Grounding for Fluid Transfer from Truck-in and Truck-out

Recommended bonding and grounding practices can be found in API 2003 and NFPA 77.

The following is a summary of precautions for truck-in and truck-out:

1. Ensure that bonding and grounding connections are used for truck-in and truck out. Signage and written Cenovus and contract truck company procedures shall emphasize these practices.
2. Inspect ground wires, clamps, and terminals and connections during all facility and equipment inspections.
3. Some bonding and grounding systems include a warning light indicating when proper bonding is achieved, or even an interlock (permissive) to prevent fluid transfer when un-bonded. Ensure that these warning lights and interlocks are operational and tested as part of the facility maintenance management system.
4. Ensure that the hoses used in any fluid transfer are approved for the fluid conveyed.
5. Ensure that an annual test of facility bonding and grounding is conducted as part of the facility maintenance management system.

3.4.3 Personal Precautions

Static electric charge can accumulate on clothing or body and can be a hazard if it is discharged in a flammable environment, such as at or near a flammable liquid tank vent or fill nozzle.

Observe the following precautions:

1. When fuelling a vehicle, do not enter and re-exit the vehicle while the vehicle is being filled. If you do, you must ensure that you dissipate any static charge away from the nozzle:

    - your clothing may accumulate static charge from the vehicle seats, and a static spark at the nozzle could ignite fuel vapours

2. Follow the service station's recommended practice of placing portable gasoline containers on the ground while filling. Do not fill fuel containers placed on a truck tailgate or truck bed.

3. Wear Cenovus approved, flame resistant antistatic clothing (NOMEX IIIA) and antistatic footwear to minimize the static electricity accumulation on your clothing.

4. Ground yourself to a building frame or piping when entering buildings that could contain flammable vapours. Ground periodically while working, especially if you will be working around flammable gas/liquid vent points.

5. Be extremely cautious of contact with plastic tanks and other plastic components. Your clothing may accumulate static electric charge, which could be hazardous if discharged in a flammable environment. Ensure that static electricity is dissipated harmlessly away from vapour sources such as tank vents.

4.0 Roles and Responsibilities

The following responsibilities apply to this practice:

Table 1: Roles and Responsibilities

Role	Description
Business Leaders and Frontline Supervisors	• Communicate and implement this practice at their operations or functional areas of authority • Demonstrate ownership and leadership by actively setting a positive example • Allocate and make available the necessary financial and human resources that are required to functionally implement this document • Confirm all workers are aware of their roles and responsibilities outlined in the process requirements section of this document • Confirm workers are trained, knowledgeable, experienced and competent on this subject • Coach and correct workers who do not understand or comply with the requirements of this document • Provide feedback to the document owner or representative concerning proposed changes or improvements to this document

Role	Description
Operations Health & Safety Field Teams	• Conduct worksite observations and assessments on a regular basis to verify compliance with the expectations described in this document • Assist with the implementation and communication of the documented requirements • Provide feedback to the document owner or representative concerning proposed changes or improvements to this document
Central Health & Safety Services	• Monitor and collect feedback related to this document to verify program effectiveness • Lead document reviews and revisions as per the expectations described in this document • Provide subject matter expertise when requested by Business Leaders or other functional teams
Assurance Teams (COMS Assurance and EHSR Compliance Audit)	• Lead, organize and conduct audits to verify compliance, identify gaps and suggest improvement opportunities
Business Support Teams	• Provide subject matter expertise when requested by Business Leaders or other functional teams
Service Providers	• Comply with the Cenovus confined space expectations described within this document • If required, develop and implement a Confined Space Entry (CSE) Code of Practice and entry procedures that satisfy company-specific operational needs and align with the minimum requirements set forth in this document

5.0 Training and Competency

Competency describes the knowledge and skills required to successfully perform the technical aspects of a job. A worker must be able to demonstrate competency in safely performing work tasks or using equipment.

5.1 Training

All Cenovus supervisors, staff, and service providers conducting tasks associated with those described within this practice shall review the guidelines provided.

Any questions shall be directed to the area H&S advisors, qualified electricians and the subject matter experts listed.

6.0 Quality Assurance

6.1 Performance Measurement

Compliance with this practice and program effectiveness shall be assessed through program assessments and internal audits, or other measurement criteria as specified in the COMS Assurance Standard.

Business functions or departments impacted by this practice must include compliance and program effectiveness verifications in their business assurance program. Performance will be monitored and reported within the responsible departments at least every three years.

6.2 Management of Change

The document owner will complete and document reviews of this practice as follows:

- at minimum once every three years
- if there is a significant regulation or industry best practice change that indicates the need for review
- if an incident investigation indicates the causes were related to unclear or inadequate written instructions described within this document

If frequent and multiple variances are required due to operational needs, the reason(s) will be investigated and the document owner will determine if there is a business need to update this document.

If submitted MOC requests indicate gaps or significant improvement opportunities, the document owner will determine if there is a business need to update this document.

Proposed changes to this practice can be directed to H&S Programs and Projects.

7.0 Glossary

Definitions and acronyms for safety documents are described in Definitions and Acronyms (CEN-EHS243). The following definitions and acronyms are specific to this document.

Table 2: Terms and Definitions

Term	Definition
Bonding	The process of connecting two or more conductive objects together by means of a conductor, which minimizes the difference in potential (voltage) between the objects. Bonding will equalize the potential between the objects that are bonded, but it will not eliminate a difference in potential between these objects and earth (ground). Some charge may remain unless one of the objects possesses an adequate conductive connection to earth.
Combustible Liquid	Liquids with a flash point at or above 37.8°C. Combustible liquids that are heated above their flashpoint must also be treated as flammable liquids.
Electric Power	Underground, surface or overhead systems, structures and

Term	Definition
System	equipment used for the generation, transmission, distribution, transformation and control of electric power. Overhead and underground power lines are included in this definition.
Electrical Equipment	Equipment that uses electricity, conductors, equipment and systems that connect utilization equipment to electric power systems, and equipment and systems that protect and control utilization equipment.
Flammable Liquid	Liquids with a flashpoint below 37.8°C.
Grounding	The process of connecting one or more conductive objects to earth, which minimizes the difference in potential between the object and earth.
Non-Electrical Equipment	With respect to this document, *Bonding and Grounding Practice*, this is conductive equipment or structures that are in close proximity to energized electrical equipment, and thereby may be subject to induced voltages and currents.
Qualified Electrical Worker	A worker, appropriately authorized by the jurisdiction having authority, who has sufficient knowledge, competency, training and experience to perform electrical work safely. For a complete definition of a qualified electrical worker, consult the Cenovus Electrical Safety Program Field Manual.
Static Electricity	The accumulation of electric charge on an object that can then be discharged via a connection to other objects of potential difference, or to earth.

Table 3: Acronyms, Initialisms and Abbreviations

Term	In Full
CSA	Canadian Standards Association
ULC	Underwriters Laboratories of Canada
SAE	Society of Automotive Engineers

8.0 References

8.1 External Documents

The following external documents support this practice:

Table 4: External Document References

Document Type	Document Title
Regulatory	Canadian Electrical Code Part I
Regulatory	Alberta Electrical Utility Code
Regulatory	Alberta OH&S Code (2009) — Part 2, 10, 19
Regulatory	Saskatchewan OH&S Regulation — Part X, XV, XXIX

Document Type	Document Title
Regulatory	Alberta Safety Codes Act
API 2003	Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents
-	Alberta Fire Code (AFC)
IEEE Std 142	IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
NFPA 30	Flammable and Combustible Liquids Code
NFPA 77	Recommended Practice on Static Electricity
NFPA 780	Standard for the Installation of Lightning Protection Systems
N/A	Canadian Electrical Code STANDATA, Section 10 — Grounding and Bonding CEC-10

8.2 Internal Documents

The following Cenovus documents support this practice:

Table 5: Internal Document References

Document Type or Number	Document Title
Policy	Corporate Responsibility Policy
Framework	Cenovus Operations Management System (COMS)
CEN-EHS243	H&S Definitions and Acronyms Standard
CEN-EHSReg787	Regulatory Definitions and Acronyms
CEN-EHS019	Cenovus Hazard Assessment and Control Practice
CEN-EHS022	Cenovus EH&S/Operations Risk Management Practice
CEN-EHS8213	Flammable and Combustible Liquids Handling Practice
CEN-EHS095	Cenovus Hot Work Practice
CEN-EHS108	Cenovus Personal Protective Equipment Practice
CEN-EHS131	Cenovus Well Site and Facility Entry Practice
CENPM020	Cenovus Electrical Safety Program Field Manual

