Bonding and Grounding for the Prevention of Fire and Explosion Hazards

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1.0 Purpose

This protocol defines Encana's minimum standards and expectations for bonding and grounding to prevent electrical (alternating or direct current, static, etc.) discharge or spark at all Encana field worksites. This protocol provides requirements for bonding and grounding in Section 3.7.1 of the Fire and Explosion Hazards Management Practice.

2.0 Scope

The scope of this protocol is limited to bonding and grounding for the prevention of fire and explosion hazards. This is not a procedure; however, elements of this protocol must be incorporated into procedures that require bonding and grounding.

3.0 Bonding and grounding requirements

3.1 Procedural and equipment requirements during loading/off-loading operations

- No smoking or other sources of open flame. This includes cell phones and cameras. Refer to applicable regulatory requirements for equipment and other spacing requirements on drilling/completions sites.
- In Canada, all sources of ignition must be a minimum of 7.5 meters from the area involved in the handling and transfer (e.g., loading/off-loading) of flammable liquids

- Workers must use personal protective equipment (PPE) suitable for the flammable liquid being transferred in accordance with corresponding Safety Data Sheet (SDS) for the liquid and Encana's Ethos Personal Protective Equipment & Personal Gas Monitors Practice
- Wheels must be chocked prior to and while loading/off-loading flammable liquids
- Hoses and fittings used for the transfer of flammable liquids must be rated (pressure and compatibility) for the product being transferred
- Both tank(s) and truck must remain effectively bonded and grounded
- Servicing and maintenance must not be carried out on a tank truck when transferring flammable liquids
- A worker's sole duty during the transfer of flammable liquids is to monitor and operate equipment used during the transfer operation. This worker must remain in the immediate area and must be able to promptly shut off equipment if required.
- Nozzles must not be propped open, except with a device designed and approved for the task by a manufacturer
- When possible, all vehicles involved in loading/off-loading flammable liquids must be shut off prior to transfer beginning
- If a tank is pressurized as part of the off-loading process, the truck must be fitted with a pressure relief valve, a regulator, a pressure gauge, and a mechanism for quickly shutting off supply to the tank. The controls must be readily accessible to the operator.
- When loading/off-loading flammable liquids, all vent lines and hoses required by the manufacturer and legislation must be in place. The outlet of these must be in an area that does not impact workers in case of a release and has no risk of flash fire/explosion at Encana sites.
- Tanks being used to store flammable liquids must be rated for the product
- Cam locks utilized for connecting hoses must have a means of secondary securement, such as cable ties or strapping
- Prior to loading/off-loading flammable liquids, connections must be checked and verified to ensure no leaks
- All spills, regardless of size or material, must be immediately reported to the site supervisor
- All diesel-powered equipment within the hazardous location must be equipped with a positive air shut off (PASO) or shut off. Encana recommends the use of an automatic PASO over a manually activated one. A PASO must be function tested as per manufacturer's recommendations.
- Workers must be properly trained in the use of any safety equipment used in the course of the operation, including breathing equipment, gas detection, and explosive atmosphere monitoring devices
- The atmosphere around the truck must be tested and continuously monitored for Lower Explosive Limit (LEL) and toxicity during loading/off-loading
- Internal combustion engines needed for the work process (non-mobile) that are temporarily positioned in areas where flammable gas vapor could be present require atmospheric testing (documented on the JSA/SWP) and may require a Hot Work Permit (US) when determined necessary by operations and EHS. In Canada, a SWP/Hot Work is required within 7.5m from potential flammable gas vapors.

3.2 Bonding and grounding in the transfer of flammable liquids

- Proper grounding cables shall be used at all times when transferring flammable liquids and must remain effectively attached until all other connections are removed. Static discharging hoses do not substitute as a grounding/bonding cable.
- In temporary situations (e.g., tank truck loading/off-loading) where there is little or no foot/machine traffic and the chances of dislodgment of the bonding cables is negligible, alligator clamps may be used (providing they are in good condition and make sufficient surface contact(e.g., non-corroded surface, or un-painted surface)
- Ensure containers are in contact with each other or connected using a bonding cable and remain continuously electrically bonded throughout the transfer to prevent accumulation of static electric charge
- Ensure containers are made from a conductive material compatible with the fluid being transferred. Tanks constructed of non-conductive materials are not permitted for storage of National Fire Prevention Association (NFPA) Class I, Class II, and Class IIIA liquids unless otherwise approved in writing by an engineer. Tanks, mixers, and process vessels used for flammable or explosive substances must be bonded and grounded together during liquid transfer.
- Keep vessel filling rates low until the loading spout is submerged in the liquid to help avoid excessive turbulence and separation between the liquid and the loading spout
- Place fill spouts as low as possible and fill the containers to help dissipate any charge build-up
- Monitor lower explosive limits (LELs) and wear proper PPE as required depending on the substance being transferred (see appropriate SOPs/SDSs)

3.3 Bonding and grounding of non-electrical equipment on Drilling and Completions sites

- Ensure metal parts of equipment (e.g., mud pumps, mud tanks, centrifuges, boilers or large generators) on Encana sites are electrically bonded together and grounded (e.g., rig anchors, well casing) to prevent dangerous electrical potentials in the event of an electrical fault and reduce any potential difference from accruing that could lead to an explosion
- Use bonding wires no smaller than American Wire Gauge (AWG) number 6 to prevent physical damage; AWG number 4 is recommended
- Attach wires with approved lugs/clips to unpainted, clean, and dedicated locations. Use an Ohm meter with a Hot Work Permit to test the connection if unsure. Alligator clamps or spring enabled booster clamps are not acceptable as they may easily dislodge.
- Ensure bonding and grounding wires are without joints or splices throughout their length
- Ensure continuity of bonding and grounding system controls (e.g., by flagging, traffic control, inspections)

3.4 Bonding and grounding of electrical equipment

- For bonding and grounding requirements of electrical equipment refer to SARP ECA-X-ELEC-R-020
- Light plants and portable generators need not be grounded to earth when the frame serves as the ground and:

  - The portable generator or light plant supplies only equipment mounted on the generator or light plant and/or cord and plug-connected equipment through GFCI receptacles mounted on the generator or light plant, and
  - The noncurrent-carrying metal parts of the portable generator or light plant equipment (e.g., fuel tank, engine, generator's housing) are bonded to the generator or light plant frame, and the equipment grounding conductor terminals (of the power receptacles that are a part of the generator or light plant) are bonded to the frame.
- If a light plant or portable generator is not grounded to its frame or this condition cannot be verified and controlled, the light plant or portable generator must be grounded to earth in accordance with Encana's SARP ECA-X-ELEC-R-020 or the directions provided with the equipment (in other words, *when in doubt, ground it out)*.

3.5 Steam cleaning/high pressure washing

- Ensure proper atmospheric monitoring is conducted prior to cleaning any vessel containing hazardous materials. Atmospheric monitoring must be done with the proper equipment and by personnel with the proper training.
- Bond the steam hose nozzles and steam lines to the vessel being cleaned. Ensure all components of the steaming system are conductive and grounded. A second bonding wire from the nozzle to the vessel is recommended. Ensure no insulated or spark-promoting objects are present inside the vessel.
- Ensure all conductive components of the tank are bonded together and grounded
- Start the initial flow of steam at a low rate until most of the atmosphere in the vessel is replaced by steam
- Pressure washing/vacuum truck operators must bond their trucks to the equipment being cleaned prior to commencing work.

4.0 Revision history

Rev #	Description of Change	Date	Sign-off	
			Owner	Reviewer
01	Development of protocol	January 17, 2019	Occ. Health & Industrial Hygiene	EH&S Directors
02	Clarification of grounding requirements related to portable generators and light plants	October 16, 2019	Occ. Health & Industrial Hygiene	N/A