

**TES-CT-OHP-GL Pipeline Construction and Maintenance in Proximity to Overhead Powerline Specification (CAN-US-MEX)**

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**PURPOSE**

This specification defines requirements for conducting pipeline construction and maintenance in proximity to overhead power lines rated at 25 kV and above.

This specification includes applicability requirements specific to the work being performed and provides advanced planning requirements to ensure appropriate training, equipment, and communication plans are in place prior to the work commencing.

This specification applies to pipeline construction and maintenance activities and provides:

- electrical safety requirements applicable to all activities which involve contacting the pipeline where it is not normally accessible
- minimum requirements for mitigating risks associated with conducting work activities in proximity to overhead power lines.

**SCOPE/APPLICABILITY**

This Specification applies to all assets which are owned and/or operated by the Company and applies to all Company workers and contractors. This document is applicable but not limited to Company facilities, rights-of-ways, and work sites.

This Specification applies to all divisions of the Company and its wholly or partially owned subsidiaries, and all operated entities/facilities in Canada, the United States (U.S.), and Mexico.

This Specification does not apply to travel or transport of machinery on developed road allowances. However, operators are expected to be aware of municipal over-dimensional restrictions and are responsible for completion of permitting and notifications for over-dimension loads as applicable. Nevertheless, if any portion of a developed road allowance becomes an active worksite for the purposes of offloading equipment, road restoration, etc. this procedure will apply. If the requirements of this Specification cannot be met (e.g., grounding wire and/or ground rods cannot be installed due to working on rock) the Site Owner will contact the Company with a proposed written solution, which is required to be approved in writing by the Company prior to work commencement using the Controlled Document Library Variance Procedure [Item ID 007728702](#).

Within this document, the following terms and definitions apply for requirements:

- “Company” means the TC Energy entity for whom work, services and/or materials are being provided.
- “Site Owner” Any person, firm or corporation contracting with or employed directly by the Company who has operational control over a work site.

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- “Shall”, “Must” or similar term is used to express a requirement (meaning a provision that the user is obliged to satisfy in order to comply with the document or applicable standard).
- “May” is used to express an option or that which is permissible within the limits of the applicable standard.
- “Should” shall in all instances be interpreted in the same manner as “Shall”, unless one of the following requirements has been met:
  - to the extent the Company has expressly waived in writing strict compliance with such standard in such circumstance; or
  - the Contractor has performed a detailed documented analysis provided to the Company in advance of taking action, which analysis justifies, on reasonable grounds, the action taken to a level consistent with the applicable standard.

Wherein governmental or regulatory requirements conflict with this Specification, the more stringent requirement shall govern.

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**1 GLOSSARY****Autoreclosure**

A circuit breaker equipped with an autoreclosure function restores power to the circuit by automatically re-closing the breaker after it has been tripped open due to a momentary fault or potential overhead powerline contact.

**Distribution Powerline**

A powerline operating at or above 25 kV and less than or equal to 60 kV.

**Gradient Control Mat**

A system of bare conductors on the surface of the earth, arranged and interconnected to provide an area of equal voltage within the range of step and touch distances. For the purposes of this standard, Gradient Control Mats are portable devices.

**Grounding Crew**

A two-person crew designated by the Powerline Safety Coordinator (PSC) to conduct grounding and bonding per Section 2.1.10

**High Voltage Powerline**

A powerline operating above 60 kV.

**Pipe-Grounding System**

A secure electrical connection to the pipe to be used for temporary grounding during construction and maintenance activities.

**Powerline**

In the context of this standard, powerline refers to an overhead powerline operating at 25 kV and above.

**Powerline Safety Coordinator (PSC)**

A qualified person designated by the Site Owner to implement and maintain safe working conditions as outlined in this document and within the respective regulations.

**Powerline Safety Procedure**

A written procedure which forms part of the Site-Specific Safety Plan (SSSP) and incorporates the requirements resulting from this specification.

**PPE**

Personal Protective Equipment

**Proximity (See Appendix C)**

In the context of this standard, proximity means that the pipeline and powerline interact electrically resulting in an electrical hazard.

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**Qualified Person (See Appendix C)**

A person who has demonstrated skills and knowledge related to the required task(s) and has received safety training to identify the hazards and mitigate the associated risk.

**RoW**

Right-of-way

**Safe Clearance Limit (SCL) -See Appendix A**

Threshold established in all directions around an overhead powerline in which any portion of equipment, loads, rigging, attachments or personnel are prohibited from encroaching. Threshold is established at 25 ft (7.5 m) unless otherwise determined based on communication with an electric utility representative and using the Variance procedure.

**Signaller**

A qualified person assigned and dedicated to managing the work and traffic near overhead powerlines for the purpose of ensuring defined clearances are maintained.

**Site Specific Safety Plan (SSSP)**

A written document outlining how to manage the risk on a specific project site and the health and safety requirements for the specific project.

**Step Voltage**

Potential difference between two points on the earth's surface separated by a distance equal to one human step, which is assumed to be 1 m, in the direction of maximum voltage gradient.

**Step Potential**

A ground potential gradient difference that can result in current flow from foot to foot through the human body.

**Work Radius**

Maximum reach in all directions of any part of the equipment, load line or load (including rigging and lifting accessories).

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## 2 REQUIREMENTS

### 2.1 General Requirements

#### 2.1.1 Applicability Determination

2.1.1.1 This Specification is applicable to pipeline work when at least one of the following conditions applies (See Appendix C):

- a) pipeline located within a powerline RoW, including crossings.
- b) pipeline RoW and a powerline RoW are parallel to each other and have adjacent boundaries within 300 m (984 ft.) for High Voltage Powerlines or within 30 m (98 ft.) for Distribution Powerlines.
- c) pipeline is a lateral or extension and is electrically continuous with a pipeline satisfying a) or b).
- d) pipeline workplace requires the crossing of an overhead powerline or is in proximity to an overhead powerline

2.1.1.2 The applicability conditions shall be identified using the following:

- a) visual confirmation of the presence of overhead powerlines near the work area, i.e. within 300 m (984 ft.) for High Voltage Powerlines or within 30 m (98 ft.) for Distribution Powerlines. Note: where satellite imagery is used to establish the presence or absence of high voltage powerlines for planning purposes, the site-specific safety measures shall include visual confirmation at the work site.
- b) drawings, geospatial records, crossing agreements and/or AC interference reports.
- c) if a) and b) cannot be reliably used to identify powerlines, then if the following conditions are met, it can be concluded that the pipeline is not in proximity to powerlines and subsequently this specification is not applicable:
  - existing pipelines: an AC voltage measurement recorded during the annual survey of less than 2 V for the AC voltage measurement at the closest upstream and downstream test posts, where the closest test post is within 3000 m (1.9 miles).
  - new pipelines (proximity to High Voltage Powerlines only): No AC interference study was conducted as part of the new pipeline design, based on the extensive information collected via site surveys, crossing lists and environmental studies.
  - for pipelines that rely on electrical isolation between sections, facilities, at tie-in points, and points of delivery or receipt adjacent to pipelines covered by this specification, the isolation is documented to be operating effectively against AC interference.

#### 2.1.2 Powerline Safety Procedure

2.1.2.1 The Site Owner shall develop a written Powerline Safety Procedure as part of the Site-Specific Safety Plan (SSSP) for the work. Findings of any preliminary desktop assessments to evaluate risk of AC hazards shall be incorporated into the SSSP. The SSSP shall document the

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applicability determination from Section 2.1.1 and shall incorporate all the resulting requirements from this specification. Appendix B summarizes the safety measures applicable to various construction and maintenance activities. Additionally, the SSSP shall document key accountabilities for managing conformance with this specification.

- 2.1.2.2 Prior to commencing the work, the Site Owner shall receive approval from the Company for the Powerline Safety Procedure as part of the SSSP verification.
- 2.1.2.3 A copy of the SSSP shall be kept at site for the duration of the work.
- 2.1.2.4 Unless a desktop assessment has been completed to evaluate the level of AC electrical risk of touching the pipe, in accordance with the requirements in this specification a qualified person shall measure the exposed pipe in any excavation, and it shall be confirmed that the AC voltage is below 15 VAC as measured between the pipe and a Cu-CuSO<sub>4</sub> reference cell, before workers are permitted to touch the pipe. If the voltage of the exposed pipe is determined to exceed 15 VAC work shall stop immediately. Grounding crew shall then install grounding rods electrically connected to the pipe as per section 2.1.10. The AC potential shall be measured again after grounding rod installation, and if the measured AC potential remains above 15 VAC, then mitigation of hazardous pipe to ground voltages as per section 2.1.8 is required and this shall be documented in the SSSP. In such cases, continuous monitoring of AC potentials is required, and work shall be halted during any time the AC voltage exceeds 30 VAC.

**2.1.3 Powerline Safety Coordinator (PSC)**

- 2.1.3.1 For all pipelines in Proximity to Powerlines, the Site Owner shall designate a Qualified person as the PSC. The PSC shall oversee electrical safety, liaise with the electric utility, understand this standard, and be familiar with the implementation of the requirements of this standard, including:
- grounding and bonding works and connecting and disconnecting temporary and permanent grounding equipment
  - hazards and mitigation requirements associated with capacitive, inductive and resistive coupling, lightning, fault currents, etc.
  - safeguards to maintain safety while working near overhead conductors
  - instrumentation, equipment and procedures required to maintain safe working conditions

**2.1.4 Planning**

- 2.1.4.1 The PSC shall identify all overhead powerlines prior to any on-site construction related activity by performing site visits, site/area assessments and a thorough review of drawings, documents, and crossing records. In addition to the actual worksite, the locations of powerlines shall also be marked on plans and drawings as applicable for equipment-offloading sites, access routes to/from worksites, and material storage areas.
- 2.1.4.2 The PSC shall approve the selection of locations for marshalling yards, storage facilities, equipment offloading, staging, and camps in order to prevent and eliminate potential



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equipment contact with overhead powerlines. The PSC shall consult with equipment operators and delivery drivers to identify equipment offloading and staging areas and confirm they will be situated away from overhead powerlines.

- 2.1.4.3 The PSC shall review and verify that all required crossing agreements are in place for the construction and installation of new infrastructure, as applicable, and ensure that all conditions/restrictions are implemented.
- 2.1.4.4 The PSC shall plan for resource requirements such as number of required personnel, signage, non-conductive ropes and guard poles (“goalposts”), appropriate communication devices for use by the signaller, and requirements for electric utility representation.
- 2.1.4.5 The PSC shall provide the electric utility companies with minimum of 72 hours’ notice, or as otherwise stipulated in the crossing agreement, before undergoing any operations within the safe clearance limit of an overhead powerline. Longer lead-time may be required if on-site support from the electric utility company is necessary.
- 2.1.4.6 Prior to commencing work, at a minimum, obtain the following information in writing from the electric utility company and store with the Powerline Safety Procedure:
- procedures to obtain on-site electric utility representation or actions, if necessary
  - scheduled switching operations for the expected duration of the project and 24 hours notification for any changes (applicable for High Voltage Powerlines only). (See Appendix C)
  - line voltages (applicable for High Voltage Powerlines only)
  - safe clearance limit (minimum approach distance) (See Appendix C)
  - maximum allowed height for any part of equipment crossing or working near a powerline between two poles or towers. Alternatively, height of the lowest conductor.
  - For High Voltage Powerlines only, if the electric utility cannot provide the list of scheduled switching operation or cannot guarantee that the PSC will be notified for any change per Section 2.1.4.5 then the PSC shall communicate, at least daily, with the dispatcher controlling the involved electric lines, to ascertain if any switching might be expected during the work period.

**2.1.5 Training**

- 2.1.5.1 The PSC shall make all site personnel aware of the potential for hazardous AC voltages on the pipeline or equipment including the following (See Appendix C):
- inductive coupling occurring primarily with existing pipelines
  - resistive coupling occurring as a result of a fault current from the power line grounds or towers due to a fault along the power line or lightning

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- capacitive coupling occurring primarily with piping on sleepers (skids) or equipment operating near power lines (applicable for High Voltage Powerlines only)
- 2.1.5.2 The PSC shall ensure training and qualification requirements are in place to ensure personnel performing, monitoring, and supervising work activities related to this Specification are qualified persons for the role assigned, and suitably trained as per the SSSP. Training measures shall include measures to be taken in the case of accidental contact with a powerline. All training and qualification/competency verification documentation shall be filed and provided to the Company on request.
- 2.1.5.3 The PSC shall assure appropriate assignment of accountabilities and responsibilities for all personnel involved in planning, supervising and executing work activities in proximity to overhead powerlines. Roles shall be in accordance with this specification and as documented in the Powerline Safety Procedure, and shall include the following key roles, as required:
- signallers
  - mobile equipment operators
  - truck drivers
  - brush clearers
  - grounding personnel
- 2.1.5.4 The PSC shall emphasize that all powerlines are deemed energized unless the electrical utility owner/operator confirms that the powerline has been, and continues to be, de-energized and visibly grounded at the worksite.
- 2.1.6 Work Stoppage (See Appendix C)
- 2.1.6.1 Work shall be suspended during any thunderstorm activity following the 30/30 rule:
- When there is less than 30 seconds between the flash of lightning and the bang of thunder, the lightning is too close, and workers must seek shelter
  - Workers shall stay in a sheltered location for 30 minutes from the last flash of lightning or bang of thunder
  - For areas where electrical storms occur unexpectedly (i.e. work in high mountains), it is best practice to utilize an on-site lightning detector.
- 2.1.6.2 Work shall be suspended in case of wet snow, high winds or freezing rain.
- 2.1.6.3 The PSC shall suspend work during switching operations until voltages can be re-measured per 2.1.7 or otherwise establish engineered controls jointly with the power utility (applicable for High Voltage Powerlines only).
- 2.1.6.4 Workers and the PSC shall ensure adequate communication with all personnel on site regarding work suspension and duration.
- 2.1.7 **Monitoring of Hazardous Voltages** (See Appendix C):

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For existing pipelines, the simplified protocols in Section 2.1.7.1 and Section 2.1.7.2 can optionally be applied for proximity to High Voltage Powerlines and Distribution Powerlines, respectively.

Otherwise, the requirements of Section 2.1.7.3 and following shall apply.

See Appendix D for a flowchart to help guide the application of the monitoring and mitigation requirements of Section 2.1.7

- 2.1.7.1 For work on existing pipelines near High Voltage Powerlines, as an alternative to the full monitoring requirements in Sections 2.1.7.3 to 2.1.7.7, the PSC can ensure 48 hours of AC voltage data is recorded at the closest test station to the work location. If the AC voltage remains below 15 V throughout the 48-hour period, the PSC shall validate that the AC voltage is below 15 V with an instant measurement conducted per Section 2.1.7.7. Otherwise, the full monitoring requirements for Section 2.1.7.3 and following shall apply.
- 2.1.7.2 For work on existing pipelines near Distribution Powerlines, as an alternative to the full monitoring requirements in Sections 2.1.7.3 and section 2.1.7.7, the PSC can either implement PPE per Section 2.1.9 or ensure 24 hours of AC voltage data is recorded at the closest test station to the work location and validate that the AC voltage is below 15 V with an instant measurement conducted per Section 2.1.7.7. If the AC voltage remains below 15 V throughout the 24-hour period and when the pipeline is exposed, no further monitoring is required. Otherwise, the full monitoring requirements for Section 2.1.7.3 and following shall apply.
- 2.1.7.3 The PSC shall measure the pipe-to-ground AC voltage per Section 2.1.7.7 each day prior to any construction activity and repeat the measurement immediately prior to any activity involving pipe contact work. If the measurement exceeds 5 V, respond per Section 2.1.7.4 or Section 2.1.7.5.
- 2.1.7.4 If the AC voltage exceeds 15 V, work shall be stopped immediately. If grounding has not been installed, a Grounding Crew shall mitigate hazardous voltages per Section 2.1.8. If grounding has been installed, the PSC can either mitigate per Section 2.1.8 or require any workers who may come in contact with the pipe to use PPE per Section 2.1.9 or portable gradient control mats per Section 2.1.11
- 2.1.7.5 If the measured voltage exceeds 5 V, the PSC shall monitor the voltages per this section OR the PSC shall ensure any workers who may come in contact with the pipe shall use PPE per Section 2.1.9 or portable gradient control mats per Section 2.1.11

If monitoring voltages, if the measured voltage exceeded 5 V but not 10 V, the PSC shall either:

- install a recording AC voltmeter to monitor the pipe-to-ground induced AC voltage per paragraph 2.1.7.7. Re-measure the voltage every 30 minutes and check the voltage record prior to work the next day.
- install an alarm device that will always effectively alert nearby workers to the presence of 15 V or greater

If monitoring voltages, if the measured, re-measured, or recorded voltage exceeds 10 V but not 15 V, the PSC shall do one of the following:

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- require any workers who may come in contact with the pipe to use PPE as per Section 2.1.9 or portable gradient control mats as per Section 2.2.11 OR
- install grounding per Section 2.1.8 to reduce the voltage below 10 V OR
- install an alarm device that will always effectively alert nearby workers to the presence of 15 V or greater

If the alarm device activates at 15 V or the measured voltage exceeds 15 V, work in the affected area shall be stopped immediately and the PSC shall follow Section 2.1.8.

2.1.7.6 Each time a voltage measurement is made, the following data shall be recorded and filed at site:

- location (e.g. pipeline station. GPS co-ordinates or chainage)
- time
- date
- pipe-to-ground voltage
- name(s) of personnel who performed the test

2.1.7.7 The PSC (or qualified delegate) shall measure the pipeline AC voltage-to-ground using a portable voltmeter as follows:

- Connect one terminal of the portable voltmeter to a copper-copper sulphate reference electrode placed on the earth or a metal pin inserted at least 25 cm (10 in.) into the ground.
- Connect the other terminal of the portable voltmeter to a sharp instrument (e.g. an awl) which is used to penetrate the coating or oxide layer to contact the underlying steel. Repair any damage to the coating.
- Use PPE per Section 2.1.9
- Take caution, prior to measuring the pipeline AC voltage-to-ground, to make sure no one contacts the pipeline directly

**2.1.8 Mitigation of Hazardous Pipe-to-Ground Voltages (See Appendix C)**

If mitigation of hazardous pipe-to-ground voltages is required, the PSC shall follow the protocol in this section.

2.1.8.1 A Grounding Crew shall install grounding per Section 2.1.10.

2.1.8.2 The PSC or Grounding Crew shall re-measure the voltage per Section 2.1.7.7.

2.1.8.3 If the measured voltage continues to exceed 15 V, the Grounding Crew shall either install additional grounding, require the use of PPE per Section 2.1.9 or install a temporary gradient control mat per Section 0.

2.1.8.4 If the measured voltage continues to exceed 10 V but not 15 V, respond per 2.1.7.5

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**2.1.9 Personal Protective Equipment (PPE) (See Appendix C)**

If PPE is required, the workers shall wear minimum class 0 rubber insulating gloves complete with protective leathers and rubber boots. Protective equipment shall be maintained in a safe, reliable condition. Gloves shall be inspected for tears, holes, ozone cuts and other defects before each use. In addition, rubber insulating gloves are to be electrically tested and certified at a six month minimum frequency by an industry compliant testing facility.

**2.1.10 Temporary Grounding and Bonding (See Appendix C)**

This section describes the protocols that shall be followed by the PSC when temporary grounding of pipelines or bonding is required. Refer to Section 2.1.7, Section 2.3 and Section 2.4 to determine when these protocols apply.

2.1.10.1 Grounding and bonding shall be performed by designated Grounding Crews who are properly trained and equipped by the PSC to conduct grounding and bonding of the pipe/pipelines.

2.1.10.2 Each two-person Grounding Crew shall be equipped by the PSC with:

- two sets of PPE per Section 2.1.9
- a digital multimeter capable of measuring root mean square (RMS) within  $\pm 2\%$  accuracy, voltage range up to 1000 V, and input impedance greater than 10 M $\Omega$  and certified CAT IV
- an AC clamp-on ammeter capable of accurate measurement from 1.0 amperes to 100.0 amperes and certified CAT IV
- 15 mm (5/8 in.) diameter x 1.8 m (6 ft.) long galvanized steel or equivalent ground rods
- Burndy #GAR-6426 or equivalent ground rod clamps
- one ground rod driving device for installing and removing the ground rods
- bare AWG #2 copper cable
- insulated AWG #2 copper, neoprene insulated welding cable or equivalent grounding cable
- a pipe-grounding system designed to provide an adequate and secure electrical connection to the pipe shall be used for grounding during construction and maintenance activities. The pipe-grounding system shall incorporate either a mechanical connector or a magnetic welding connector. In either case, the metallic contact surface shall be at least 1200 mm<sup>2</sup> (1.9 sq.in.) and contoured to conform to the outer pipe surface with a brazed or welded metallic connector to accept the grounding cable. A magnetic welding connector shall have a minimum 50 lb. pull and mechanical support such as a ratchet strap or equivalent.

Note: for existing pipelines that are not fully exposed, it is acceptable to omit the mechanical support. A thermite weld can also be substituted.

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- 2.1.10.3 The Grounding Crew shall wear PPE per Section 2.1.9 when installing or removing a grounding or bonding facility on a pipeline.
- 2.1.10.4 The Grounding Crew shall use the approved pipe-grounding system per Section 2.1.7.2 for temporary grounding and bonding connections.
- 2.1.10.5 The Grounding Crew shall complete connections to grounding facilities in the following order:
- pipe-grounding system shall be connected to the pipeline
  - grounding cable shall be connected to the ground
  - grounding cable shall be connected to the pipe-grounding system
- 2.1.10.6 The Grounding Crew shall complete disconnections from grounding facilities in the following order:
- grounding cable shall be disconnected from the pipe-grounding system
  - grounding cable shall be disconnected from the ground
  - pipe-grounding system shall be removed from the pipeline
- 2.1.10.7 The Grounding Crew shall connect the pipe-grounding system to existing grounding or a dedicated temporary ground using AWG#2 copper cable or equivalent.
- 2.1.10.8 The Grounding Crew shall make temporary bonds using AWG#2 copper cable or equivalent.
- 2.1.10.9 Temporary grounding installations shall consist of one or more ground rods installed vertically to a depth of at least 1.25 m (4 ft.). If multiple ground rods are used, they shall be connected in series using an AWG #2 bare copper cable.
- 2.1.10.10 The Grounding Crew shall take measures to prevent inadvertent contact with temporary grounding installations.
- 2.1.10.11 Temporary Grounding of Unburied/Above-Ground Pipe Strings
- Ground any string of continuously welded pipe at intervals not in excess of 300 m (980 ft.) located on a powerline RoW. Grounds are to be no more than 300 m (980 ft.) apart.
  - Limit strings of pipe to 900 m (2950 ft.) in length unless longer lengths are authorized by the Company.
  - Maintain temporary grounds until the sections are tied into portions of line that have been permanently grounded with mitigation devices (i.e. as required) and backfilled.
- 2.1.10.12 Both sections of pipe shall be bonded together prior to making tie-ins or performing cut-outs.
- 2.1.10.13 At tie-ins, follow the requirements of Section 2.1.7 for each loose end.
- 2.1.10.14 At cut-outs, follow the requirements of Section 2.1.7.

**2.1.11 Temporary Gradient Control Mats (See Appendix C)**

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When temporary gradient control mats are used, the PSC shall follow the protocol in this section.

2.1.11.1 The temporary gradient control mat shall be installed by the Grounding Crew and:

- be a metallic grid under the entire work area where personnel will be contacting the pipe
- have 150 mm or smaller grid spacing
- have a minimum of two bonding cable connections per Section 2.1.10 between the mat and the pipe
- have each bonding cable connected to at least 5 separate locations on the grid
- extend a minimum of 1 m in all directions outside the work area

2.1.11.2 When a gradient control mat is relied on, there shall be no contact, including the handing over of tools, instruments, or other materials, between persons on the mat and those not on the mat.

2.1.11.3 The persons on the mat shall use rubber boots to avoid hazardous step voltages when leaving the mat.

**2.1.12 Follow-up actions**

The PSC shall communicate any safety issues discovered during the work that indicates an inadequacy of the existing AC mitigation to Corrosion Prevention and Operations. Additional testing and mitigation processes shall be as per the Corrosion Prevention Standard.

2.1.12.1 For AC voltage safety threshold exceedances that are not temporary in nature (i.e. caused solely by the work being conducted and returned to nominal safety levels upon completion, after all temporary safety measures have been removed), the appropriate Business Unit Operations and Engineering groups must be notified of the safety hazard so appropriate follow-up testing and installations can be initiated. For these situations, the PSC shall:

- a. Leave the temporary safety measures in place in consultation with applicable Operations and Engineering personnel, including a full accounting of the measures left in place
- b. Provide all pertinent data and measurements to Operations and Engineering for analysis
- c. Provide as-built information from the project to Operations and Engineering

2.1.12.2 Operations and Engineering personnel shall initiate follow-up work per TEN-CP-PRGM-GL Corrosion Prevention Program Standard ([Item ID 1003439231](#)) to mitigate the safety issue.



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**2.2 Safety Requirements to Mitigate Risk of Powerline Contact and Capacitive Coupling Hazards****2.2.1 General requirements (See Appendix C)**

2.2.1.1 The PSC shall identify, document, and communicate all hazards and the applicable hazard control measures. The hazard assessment is included in the SSSP and shall be kept at site for the duration of the work. Hazards may include, but are not limited to, the following:

- equipment offloading and equipment and/or materials staging near powerlines
- spoil piles
- dump trucks travelling with raised boxes
- poor visibility due to rain, snow, or fog
- high winds, wet snow, or freezing rain
- proximity to overhead power lines, power poles and guy wires
- changes to scope of work- including unexpected foreign structures exposed during construction. MOC process is required.
- brushing and felling activities or requirements

2.2.1.2 Prior to commencing work each day, a pre-job meeting shall be held to review the SSSP and relevant hazard assessments. Update the SSSP when new hazards are identified, or tasks or site conditions change.

2.2.1.3 Provisions shall be made for satisfying all “One-Call” and company excavation procedure requirements, prior to any work, ground disturbances or installations required by this document (e.g., excavation, driving of ground rods).

2.2.1.4 Work shall only be permitted around powerlines during daylight hours or with adequate artificial lighting. Modify or stop work as required and as dictated by poor visibility conditions (e.g., rain, snow, fog).

2.2.1.5 All workers in the vicinity of heavy equipment working near overhead powerlines shall remain clear and out of contact with the frame of the equipment, hoisting lines or hoisted load.

2.2.1.6 The PSC shall ensure that any tree located within 1.5 times its height from the safe clearance limit is mechanically felled. Conventional hand falling shall not be used to fell trees within this perimeter. Alternatively, use specialized fallers or certified utility arborists in circumstances where the terrain or conditions do not permit the use of machines for mechanically felling trees.

**2.2.2 Construction Vehicles and Equipment (See Appendix C)**

2.2.2.1 The PSC shall evaluate and document all worksites, including offloading sites, material storage areas, and access routes to predetermine requirements for signage, barriers, and/or signallers, based on crossing agreements and including the following considerations:

- Signage and barriers are required if an overhead powerline crosses or travels parallel to the proposed worksite and potential exists for any mobile equipment to



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encroach on the safe clearance limit (distance). For details regarding signage and barriers requirements, see Section 2.2.3.

- Designated signallers are required to guide the movement of equipment any time potential exists for encroaching on the safe clearance limit of an overhead powerline. For signaller requirements, see Section 2.2.4.
- Crossing locations assessments are required to ensure crossing location terrain (e.g. unstable ground or steep slopes) will not cause mobile equipment or components to lose control, weave or bob resulting in potential encroachment on the safe clearance limit or contact with the overhead powerline.

2.2.2.2 Dump trucks and track hoes shall not be allowed to travel with a raised box or upright booms within the safe clearance limit of overhead powerlines.

2.2.2.3 Offloading or storing material under or in the vicinity of overhead powerlines shall not be allowed unless immediately prior to work or installation of the material.

2.2.2.4 Parking, fueling, or servicing of machinery and/or equipment under or within the safe clearance limit of overhead powerlines shall not be allowed.

2.2.2.5 All vehicles and equipment shall be bonded to the fuelling facility prior to fuelling on a powerline RoW. Bonding shall be maintained throughout the fuelling operation.

2.2.2.6 This section is mandatory for High Voltage Powerlines only:

Every effort shall be made to park construction vehicles and equipment away from overhead High Voltage Powerlines as vehicles parked on a High Voltage Powerline RoW can collect a considerable charge of static electricity. In order to avoid this build-up of static electricity the following procedures are required:

- Park vehicles no closer than 30.5 m (100 ft.) from the base of High Voltage Powerline towers.
- Equip all vehicles parked on a High Voltage Powerline RoW with a connecting cable assembly and a static strap attached to the vehicle. The connecting cable assembly shall be at least AWG #1 with insulated clips capable of completing an electrical bond between the ground rod and the vehicle while the vehicle is parked.
- Ground all vehicles parked on the High Voltage Powerline RoW per Section 2.2.2.7

2.2.2.7 Vehicles parked on High Voltage Powerline ROW shall be grounded to a 1.27 cm (½ inch) diameter ground rod driven to a minimum depth of 1.22m (4 ft.). Attach the vehicle cable connecting assembly's insulating clips per Section 2.2.2.6 to the driven ground rod. Maintain the bond as long as the vehicle is parked on the powerline RoW. As an industry best practice, it is recommended to use mechanically tightened clamps.

2.2.2.8 If equipment contacts a powerline, the operator must:

- Move the vehicle away from the line if it is safe to do so.

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- Stay on the machine until the equipment is a minimum of 10 meters (33 feet) away from overhead line or the overhead powerline has been deenergized and locked out. It is possible that machine is at an elevated voltage even after it has been cleared from overhead line or overhead line has been locked out- see below for instructions of how to safely exit machine.
- Ensure that no one approaches the machine or a downed power line; all personnel must stay as far away as practical, but no closer than 10 m (33 ft.) from any equipment in contact with a live power line.
- If the machine must be exited, the operator shall **jump off with both feet close together**, the operator shall **shuffle** his/her feet, moving from the equipment until at least 10 m (33 ft.) away. **Caution: Do not step off of vehicle.** By stepping off, part of the body (either a foot or a hand) could be in contact with the machine when the other foot touches the ground. This would give the electricity a path for current to flow through the body. If feet are separated, the feet could be in differing areas of voltage causing a path for current to flow.
- Call 911 if the equipment cannot be moved away from a contacted powerline, or if the powerline is downed.
- Immediately notify the owner of the powerline.

**Note:** Any piece of heavy equipment that has been energized through accidental contact with a powerline must be grounded to flash off any potential residual charge prior to being touched or re-entered. Prior to continued use- the equipment will require an engineering re-certification.

## 2.2.3 Signage and Barriers

- 2.2.3.1 Adequate signage warning of possible electrical hazards shall be posted at each access to the RoW, using warning signs of standard design at least 60 cm × 60 cm (24 in. × 24 in.) in size.
- 2.2.3.2 Warning signs shall be placed on each side of the overhead powerlines, and in plain view of those travelling in either direction under, or adjacent to, the lines. Ensure visibility of warning signs by placing them at a height of 1.8 m (6 ft) and approximately 1m (3 ft) outside the applicable safe clearance limit as illustrated in Figure 2-1. Do not place warning signs inside the safe clearance limit.

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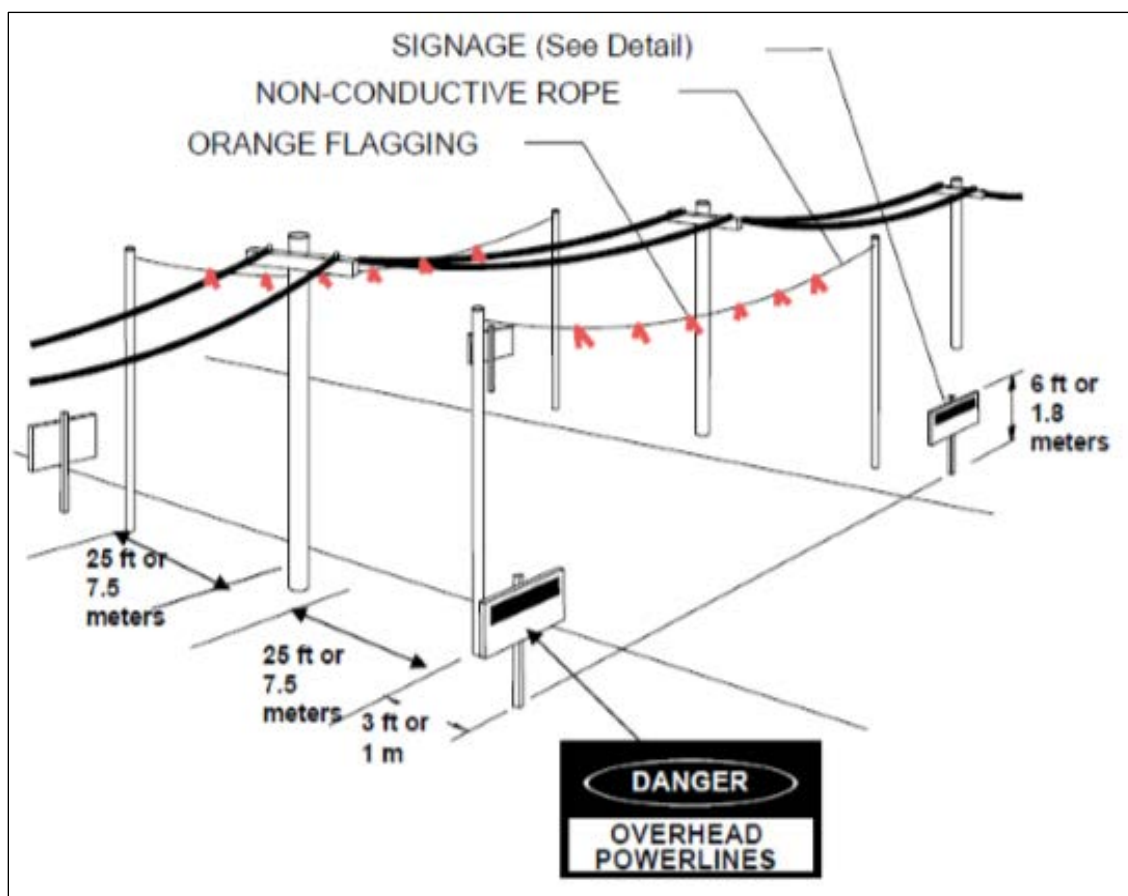

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**Figure 2-1: Signage Placement**

- 2.2.3.3 Place non-conductive guard poles (“goalposts”) and connect them with non-conductive rope at the applicable safe clearance limit distance from the overhead powerline, as illustrated in Figure 2-1. Do not use metal guard poles/goalposts or guy wires. Use non-conductive polypropylene rope and enhance rope visibility by attaching short pieces of surveyor’s ribbon intermittently along its length.

**Note:** Install goalposts at an appropriate elevation to maintain vertical separation between the powerline and equipment travelling underneath.

- 2.2.3.4 Place signs and barriers, as illustrated in Figure 2-1, before work begins and keep them in place until all work is completed. Inspect condition and effectiveness of barriers and signage daily whenever work is being conducted around overhead facilities.
- 2.2.3.5 Cord off any areas within marshalling yards, storage facilities or RoW that are within proximity to overhead facilities and therefore at risk for being inadvertently utilized for storage. Erect signage around the cordoned off area to warn of the overhead powerline hazard.
- 2.2.4 Signaller and Equipment Operator

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- 2.2.4.1 The Site Owner shall provide a designated signaller to guide the equipment operator where there is potential for the danger zone of the mobile equipment to encroach on the safe clearance limit.
- 2.2.4.2 The signaller shall be provided with full authority and responsibility to stop work if safe clearance limits are encroached upon or unsafe conditions are identified. This requires the signaller to have full understanding of the following:
- true height, width and maximum reach of the mobile equipment
  - safe clearance limits
- 2.2.4.3 The signaller shall be provided with a high visibility vest, harness, markings or other method of identification to be worn at all times during signaller work, such that it is clear they are the designated signaller and distinguished from other workers.
- 2.2.4.4 The designated signaller will assume responsibility to guide the equipment operator, and to signal for discontinuation of mobile equipment operation when anyone signals an emergency stop or an emergency stop is required for any reason.
- Note: The approach of any equipment within 3 m (10 ft.) of an energized powerline is prohibited in all circumstances.
- 2.2.4.5 The designated signaller shall establish a protocol for the equipment operator to review the scope of work, drawings and hazard assessment to ensure potential site hazards are identified and addressed prior to beginning work.
- 2.2.4.6 The PSC shall establish a protocol for the equipment operator and the signaller to review together and come to common understanding of the height, width and maximum reach of the mobile equipment prior to beginning work.
- 2.2.4.7 Establish a protocol for establishment and verification of recognizable hand signals to be used for non-verbal communication between the equipment operator and the signaller during the work (i.e., industry standards such as those published by construction safety associations).
- 2.2.4.8 Establish and maintain reliable communication between the equipment operator and the signaller using additional means of communication where necessary (e.g., horn, intercom, two-way radios) throughout the work.
- 2.2.4.9 The equipment operator shall immediately discontinue mobile equipment operation until communication is restored and understood, if the following situations ever occur:
- communication with the signaller is lost
  - visibility of the signaller is lost
  - the signaller's directions are not clear
  - anyone signals an emergency stop

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**2.2.4.10 The signaller shall:**

- remain within view of the equipment operator at all times while the mobile equipment is operating
- maintain an unobstructed view of the mobile equipment as it passes under the overhead powerline
- ensure his/her location is always within the operator's line of sight
- ensure his/her location is always safe (i.e., clear of ditches, excavations, other potential risk locations)
- only signal for a maximum of one piece of mobile equipment at a time
- not perform any other duties except communicating with and directing one equipment operator
- require a separate signaller for guidance for excavating or operating taglines

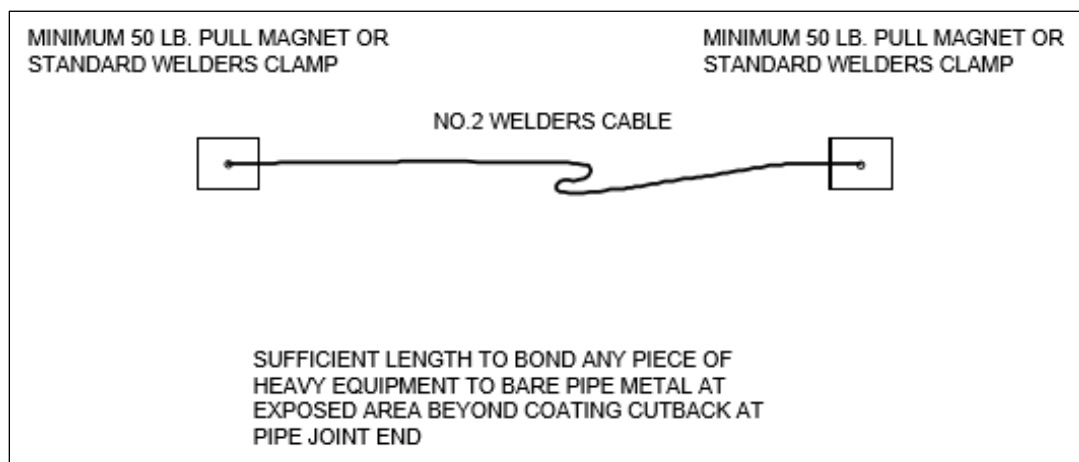
**2.3 Safety Requirements for Handling Pipe Outside Trench**

The requirements in this section shall apply when pipe and/or handling equipment is in a powerline RoW or within 100 m (328 ft.) of a High Voltage Powerline or within 10 m (33 ft.) of a Distribution Powerline.

2.3.1 Each metallic piece of equipment used to handle pipe in any way (e.g., unloading, picking up, transporting, bending, or "lowering-in") shall be grounded per Section 2.2.2.7 where applicable, and equipped with a cable assembly capable of grounding the joints of pipe to the piece of equipment handling that pipe as illustrated in Figure 2-2, including the following:

2.3.1.1 Complete the ground between the joint of pipe and the equipment involved with handling that joint of pipe, before any joint of pipe is picked up or moved in any way.

2.3.1.2 Equip "lowering-in" booms with ground cable, where applicable, and maintain the ground at least until the stringer bead is completed. Prior to welding, bond the joints together.



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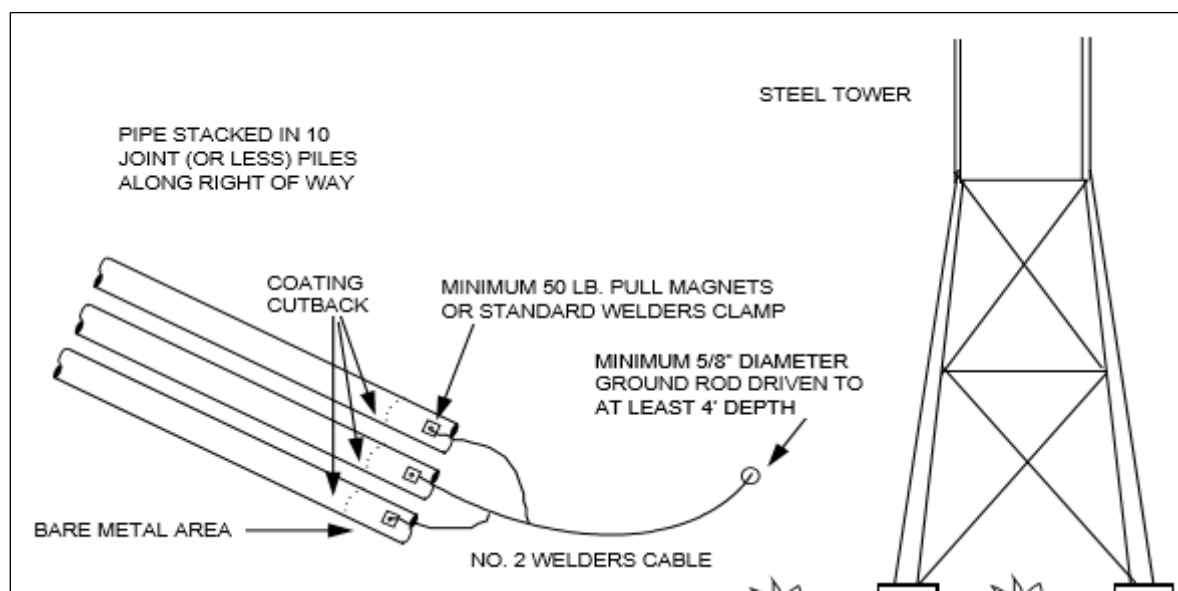
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**Figure 2-2: Approved Bonding Cable for Pipe to Equipment**

- 2.3.2 Equipment operators shall ensure pipe is unloaded from stringing trucks using equipment with grounding cable per Section 2.3.1. Grounds shall be completed between all joints of pipe to be unloaded and equipment unloading cables or metallic slings attached to the pipe in areas of potential influence from electric lines.
- 2.3.3 Hauling and stacking of pipe shall be completed in accordance with the requirements of *TES-PROJ-STK Specification for the Temporary Stockpiling of Steel Pipe (CDN-US)* (Item ID 005415573) in 10 (or less) joint stacks in areas of electrical influence. Additionally, the following requirements apply:
- 2.3.3.1 Grounding of each joint of pipe in the stack shall be completed as per Section 2.1.10 and as illustrated in Figure 2-3.
- 2.3.3.2 Grounding shall be maintained at all times until all individual joints of pipe are removed from the stack.


**Figure 2-3: Approved Method of Bonding Stacking Pipe.**

**Note:** Magnets may also be placed on bare metal inside pipe joints. Remove all magnets prior to welding and backfill activities.

- 2.3.4 Grounding attachments or removals shall be completed by a Grounding Crew.
- 2.3.5 Temporary grounds shall be made, where applicable, for each string of welded pipe per Section 2.1.11.
- 2.3.6 For tie-ins, bonds between loose ends shall be completed per Sections 2.1.12 and 2.1.13.
- 2.3.7 For the lowering-in operation, the coated pipeline shall be handled with non-conductive slings. Extra caution is required during this operation because it may not be feasible to maintain proper grounding.

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**2.4 Safety Requirements for Buried Pipe & Pipe in Trench (See Appendix C)**

- 2.4.1 The PSC shall apply the requirements of Section 2.1.7.
- 2.4.2 Regardless of pipe-to-ground voltage, tie-ins and cut-outs shall be bonded (also known as “jumping”) per Section 2.1.10.12.
- 2.4.3 A warning sign shall be made clearly visible near the electrical connections to the pipe and grounding, ensuring that workers do not remove or accidentally damage the integrity of the cables or connections, e.g. “Warning: Removal or damage to this equipment may result in electrical hazards to workers at this work site or in the general area.”
- 2.4.4 An inspection of any open excavations requiring worker entry shall be completed prior to permitting workers to enter the excavation, to ensure that there are no indications of electrical cables or equipment (e.g. power cables, CP anodes, CP cables, grounding ribbon, bare copper cable), which have not been de-energized and locked out already. Where any such energized cable or equipment is discovered, electrical isolation from the work area shall be verified. Any such inspectors entering the work area shall wear rubber gloves and rubber boots, until the excavation has been deemed free and clear of any energized infrastructure which may be hazardous.
- 2.4.5 Equipment connected to buried pipe such as directional drilling equipment and hydrostatic test equipment shall be temporarily grounded per Section 2.2.2.7 and bonded to the pipe per Section 2.3.1. Electrical continuity shall be ensured between different pieces of metallic equipment.

**3 VARIANCES**

Any deviation shall follow the Controlled Document Library Variance Procedure [Item ID 007728702](#). Contractors shall contact the Company for variance approval.

**4 ROLES AND RESPONSIBILITIES**

Table 4-1 below outlines the roles and responsibilities required for the use of this Specification.



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**Table 4-1: Roles and Responsibilities**

Role	Responsibilities
Project Manager (PM)	<p>The Company Project Manager (PM) is responsible for ensuring:</p> <ul style="list-style-type: none"> <li>Site Specific Safety Plan and the Powerline Safety Procedure has been reviewed and signed off by Company and that the SSMP ensures key accountabilities are documented in regard to the conformance to this specification. (includes roles specified in this table)</li> <li>Work is being performed in accordance to this specification.</li> </ul>
Project Engineer/SME	<p>The Project Engineer is responsible for ensuring:</p> <ul style="list-style-type: none"> <li>Appropriate Company review and signoff of the Site-Specific Safety Plan and the Powerline Safety Procedure</li> <li>Technical support as required to help ensure compliance with this specification.</li> </ul>
Site Owner (Contractor)	<p>The Site Owner (Contractor) is responsible for ensuring:</p> <ul style="list-style-type: none"> <li>Assigning PSC</li> <li>The appropriate development of the Site-Specific Safety Plan and the Powerline Safety Procedure and adherence to work procedures outlined in this specification. Any ambiguities in roles, responsibilities, or accountabilities in the contractor work force are identified, resolved, and documented in order to demonstrate conformance with this specification. The Company reserves the right to request such documentation at any time to evaluate the safety of the work as it relates to conformance with this standard.</li> </ul>

**5 REFERENCES**

This document is designed to satisfy and incorporate a number of references to regulation, industry codes and standards, general industry guidance as well as internal Company references. These documents are listed in Table 5-1, Table 5-2 and Table 5-3. Use the latest document revision, unless otherwise approved by the Company.



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**Table 5-1: Regulatory References**

Organization/Document No.	Title
CAN/ULC-60903	Live Working – Gloves of Insulating Material
CAN/CSA-C22.1	Canadian Electrical Code Part 1
CAN/CSA-C22.3 No. 6-13	Principles and practices of electrical coordination between pipelines and electric supply lines
CAN/CSA-Z662	Safe Design, Construction and Maintenance of Pipeline Systems
Occupational Safety and Health Administration	1910.137 Electrical Protective Equipment 1926.1408 Power line safety (up to 350 kV)- equipment operations

**Table 5-2: External Industry References**

Organization/Document No.	Title
NACE International SP0177-2019	Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems
ASTM F 496-06	Standard Specification for the In-Service Care of Insulating Gloves and Sleeves

**Table 5-3: Internal References**

Document No.	Title
<a href="#">Item ID.007728702</a>	<i>Controlled Document Variance Procedure (Can-US-Mex)</i>
<a href="#">Item ID 005415573</a>	<i>TES-PROJ-STK Specification for the Temporary Stockpiling of Steel Pipe (CDN-US)</i>
<a href="#">Item ID 1003439231</a>	TEN-CP-PRGM-GL Corrosion Prevention Program Standard
<a href="#">Item ID 003839327</a>	<i>Service Care and Inspection of Electrical Safety Equipment</i>

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## 6 DOCUMENT HISTORY

Rev.		
02	<b>Description</b>	<b>Effective Date</b>
	Major revision to TES-PROJ-OHP Overhead Powerlines Specification and renamed to TES-CT-OHP-GL Overhead Powerline Specification	2020- Nov-06
	<b>Rationale Statement</b>	<b>Responsible Engineer</b>
	<p>This document was developed / revised to address the following requirements:</p> <ul style="list-style-type: none"> <li>Consolidation of specifications. The following specifications/documents have been combined into this document: <ul style="list-style-type: none"> <li>TES-PROJ-OHP Overhead Powerlines Specification ID #006179816</li> <li>Overhead Powerlines Procedure ID#: 003672640</li> </ul> </li> </ul>	Mike Fitzpatrick
	<b>Impact Assessment Summary</b>	<b>Document Owner</b>
	Identify and address the potential impacts to operations, training, competency, safety and the environment, lines of business, based on the impact analysis done prior to the creation of the document.	Facility Integrity
01	<b>Description</b>	<b>Effective Date</b>
	New document.	2017-Aug -03
	<b>Rationale Statement</b>	<b>Responsible Engineer</b>
	<p>This document was developed in order to address the following requirements:</p> <ul style="list-style-type: none"> <li>Consolidation of specifications. The following specifications/documents have been combined into this document: <ul style="list-style-type: none"> <li>TES-PROJ-OHP Overhead Powerline Specification (CDN-US-MEX)</li> <li>70.002.055 Minimum Requirements for Pipeline Construction in Close Proximity of High Voltage AC Overhead Electric Power Lines</li> </ul> </li> </ul>	Mike Fitzpatrick and Paul Shauffer
	<b>Impact Assessment Summary</b>	<b>Document Owner</b>

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Rev.		
	n/a	Facility Integrity
00	<b>Description</b>	<b>Effective Date</b>
	New document.	2013-Oct -02
	<b>Rationale Statement</b>	<b>Responsible Engineer</b>
	n/a	Mike Fitzpatrick and Paul Shauffer
	<b>Impact Assessment Summary</b>	<b>Document Owner</b>
	n/a	Facility Integrity

## 7 DESCRIPTION OF CHANGE

Section	Description of Change
<b>Regulatory</b>	
N/A	N/A
<b>Industry Standards</b>	
N/A	N/A
<b>General</b>	
N/A	N/A



<b>APPROVALS</b>	
<b>Document Contact</b>	Mike Fitzpatrick, P.Eng. Facility Integrity
<b>Document Owner Manager</b>	Rachelle Gordon Facility Integrity
<b>Discipline Checker</b>	Tim Leitao CP Engineering
<b>Responsible Engineer</b>	Mike Fitzpatrick, P.Eng.  Signature/Date
<b>Corporate Authorization</b>	Antonio Cordido Facility Integrity

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**APPENDIX A: MINIMUM CLEARANCE DISTANCE REQUIREMENTS TO OVERHEAD POWERLINES**

Voltage (nominal, kV, alternating current)	Minimum clearance distance*** Meters (feet)
Up to 50	7.5m (25ft)**
Over 50 to 200	7.5m (25ft)**
Over 200 to 350	7.5m (25ft)**
Over 350 to 500	7.5m (25ft)
Over 500 to 750	10.7m (35ft)
Over 750 to 1000	13.7m (45ft)
Over 1000	(as established by the utility owner/ operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution)

**Note 1:**

The value that follows “to” is up to and including that value (e.g., over 50 to 200 means up to and including 200kV).

\*\* Based upon OSHA Occupational Safety and Health Administration Minimum Safe Clearance Distances Table with minimum distance increased to 7.5m (25 ft) to meet Company standard.

\*\*\*Minimum clearance distances meet or exceed Canadian provincial regulations and OSHA 1926.1408 and CSA 462-18.

**Note 2:**

Above Table is TC Energy best practice. In the event that above clearance distances are unable to be adhered to based upon site conditions, the Variance procedure is required to be followed in order to utilize Utility distances that may prove to be less conservative than Table above. The Variance shall include a letter on Utility letterhead, signed and authorized by an appropriate person from the respective Utility detailing the minimum clearance distances to be utilized for the respective overhead powerline.

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**APPENDIX B: SAFETY MEASURES APPLICABLE TO SPECIFIC ACTIVITIES REFERENCED TO RESPECTIVE SECTION OF SPECIFICATION**

Activity	Applicable Safety Measures
Clearing, stripping, grading, trenching	Section 2.2, Safety Requirements to Mitigate Risk of Powerline Contact and Capacitive Coupling Hazards
Pipe transport, stringing	Section 2.2, Safety Requirements to Mitigate Risk of Powerline Contact and Capacitive Coupling Hazards Section 2.3, Safety Requirements for Handling Pipe Outside Trench
Personell in contact with aboveground pipe contact above ground	Section 2.2, Safety Requirements to Mitigate Risk of Powerline Contact and Capacitive Coupling Hazards Section 2.3, Safety Requirements for Handling Pipe Outside Trench
Lowering pipeline into ditch	Section 2.2, Safety Requirements to Mitigate Risk of Powerline Contact and Capacitive Coupling Hazards Section 2.3, Safety Requirements for Handling Pipe Outside Trench Section 2.4, Safety Requirements for Buried Pipe & Pipe in Trench
Welding long section inside the ditch	Section 2.2, Safety Requirements to Mitigate Risk of Powerline Contact and Capacitive Coupling Hazards Section 2.3, Safety Requirements for Handling Pipe Outside Trench Section 2.4, Safety Requirements for Buried Pipe & Pipe in Trench
Backfilling	Section 2.2, Safety Requirements to Mitigate Risk of Powerline Contact and Capacitive Coupling Hazards Section 2.3, Safety Requirements for Handling Pipe Outside Trench Section 2.4, Safety Requirements for Buried Pipe & Pipe in Trench
Hydrostatic testing	Section 2.2, Safety Requirements to Mitigate Risk of Powerline Contact and Capacitive Coupling Hazards Section 2.4, Safety Requirements for Buried Pipe & Pipe in Trench
Conventional boring or horizontal directional drilling (HDD)	Section 2.2, Safety Requirements to Mitigate Risk of Powerline Contact and Capacitive Coupling Hazards Section 2.3, Safety Requirements for Handling Pipe Outside Trench Section 2.4, Safety Requirements for Buried Pipe & Pipe in Trench
Tie-ins and cut-offs	Section 2.2, Safety Requirements to Mitigate Risk of Powerline Contact and Capacitive Coupling Hazards Section 2.4, Safety Requirements for Buried Pipe & Pipe in Trench
Overhead Powerline Crossing	Section 2.2, Safety Requirements to Mitigate Risk of Powerline Contact and Capacitive Coupling Hazards

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**Note:** all tasks require development of a Powerline Safety Procedure (Section 2.1.1) and completion of the other requirements of Section 2.1.

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**APPENDIX C CLARIFICATIONS**

This section provides additional clarification and indicates whether a specific requirement is regulatory or mandated by TC Energy above and beyond the regulation. All other directives, not noted, are best industry practice.

References	Clarifications
1	<p>Glossary/Proximity: As specified in the first paragraph of section PURPOSE, this Specification is applicable to pipelines in Proximity to overhead powerlines. Subsequently, the rules for determining applicability of the specification detailed in 2.1.1 shall be seen as rules to determine Proximity to overhead powerlines, when Proximity to powerlines is referenced in this document. For example: 2.1.1 states, "For all pipelines in Proximity to powerlines, the Site Owner shall designate a Qualified person as the Powerline Safety Coordinator". To determine Proximity, the Site Owner shall apply the rules in 2.1.1.</p> <p>Glossary/Qualified: In this context, Qualified is based on the definition of "qualified" in CSA Z462-18 and is compatible with the definition of "competent" from OSHA.</p>
2.1.1.1	The requirements in this section are established by CAN/CSA-C22.3 No. 6-13 and are included for reference. For practical application of these requirements, refer to Section 2.1.1.2
2.1.1.1 b)	The 300 m limit for High Voltage Powerlines is established in Clause 1.1 of CAN/CSA-C22.3 No. 6-13 Standard.
2.1.1.1 c)	To determine applicability for laterals and extensions tied to an existing pipeline, the condition detailed in 2.1.1.2 c) shall be used.
2.1.4.6	<p>2nd bullet Switching operations on High Voltage Powerlines may result in over-voltages that cannot be mitigated by temporary or permanent grounding, therefore it is critical to stop work during switching operations</p> <p>4<sup>th</sup> bullet the values indicated in Appendix A may be used if the utility does not provide the safe clearance limit.</p>
2.1.5.1	Formal training could be incorporated into site-specific safety orientations and/or toolbox meetings.
2.1.6	The work stoppage for High Voltage Powerlines is mandated under Clause 7.9 of CAN/CSA-C22.3 No. 6-13 Standard. The 30/30 rule was adopted by TCE as best industry practice.
2.1.7	The measurement of the AC voltage for High Voltage Powerlines is mandated under Clause 7.1 of CAN/CSA-C22.3 No. 6-13 Standard.
2.1.7.3	The timing of AC induced voltage measurements for High Voltage Powerlines is mandated under Clause 7.3.1 of CAN/CSA-C22.3 No. 6-13 Standard.
2.1.7.4	The use of grounding to reduce the voltage below the 15 V safe limit for High Voltage Powerlines is mandated under Clause 7.2.3 of CAN/CSA-C22.3 No. 6-13 Standard.



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2.1.7.6	The data to be recorded during a measurement of AC induced voltage is detailed in Clause 7.3.3 of CAN/CSA-C22.3 No. 6-13 Standard.
2.1.8	<p>Mitigation of induced voltage to safe levels and specifically pipeline grounding for voltages of 15 V or greater, is mandated for High Voltage Powerlines under Clause 7.1 of CAN/CSA-C22.3 No. 6-13 Standard.</p> <p>If mitigation of hazardous pipe-to-ground voltages is required, the Grounding Crew will generally follow this protocol:</p> <ol style="list-style-type: none"> <li>1. Install grounding rod(s). Remeasure the voltage.</li> <li>2. If the voltage still exceeds the limit, add more ground rods and/or bare cable to interconnect them. Remeasure the voltage.</li> <li>3. If the voltage still exceeds the limit, the PSC shall determine whether to use additional mitigation (i.e. repeat step 2), to mandate the use PPE per Section 2.1.9, or to mandate the use of Gradient Control Mats as per Section 2.1.11.</li> </ol>
2.1.8.1	Use of a designated and trained Grounding Crew is mandated for High Voltage Powerlines under Clause 7.2.1 of CAN/CSA-C22.3 No. 6-13 Standard.
2.1.9	The requirements to be met when using PPE are mandated by OSHA 1910.137.
2.1.10.2	<ol style="list-style-type: none"> <li>1. The conditions to be satisfied by an adequate and safe pipe-grounding system are mandated for High Voltage Powerlines under Clause 7.2.3 of CAN/CSA-C22.3 No. 6-13 Standard.</li> <li>2. The use of PPE during grounding and bonding operations is mandated for High Voltage Powerlines under Clause 7.2.2 of CAN/CSA-C22.3 No. 6-13 Standard.</li> <li>3. The required quantities of cables and ground rods will need to be estimated by the PSC based on expected conditions. For example, a pipeline integrity excavation would require a much smaller quantity of equipment than would a new pipeline installation.</li> </ol> <p>The bare cable is used for interconnecting ground rods.</p> <p>The insulated cable is used for temporary bonds or from pipe to ground.</p>
2.1.10.5	The sequence for completing connections to grounding is mandated under Clause 7.2.4 of CAN/CSA-C22.3 No. 6-13 Standard.
2.1.10.6	The sequence for completing disconnections from grounding is also mandated under Clause 7.2.4 of CAN/CSA-C22.3 No. 6-13 Standard.
2.1.10.10	The requirement to prevent workers or public access to temporary grounding installations is mandated under Clause 7.2.5 of CAN/CSA-C22.3 No. 6-13 Standard.
2.1.10.11	Temporary grounding not exceeding 300 m (985 ft.) recommended under paragraph 5.3.3. of NACE SP0177-2019.

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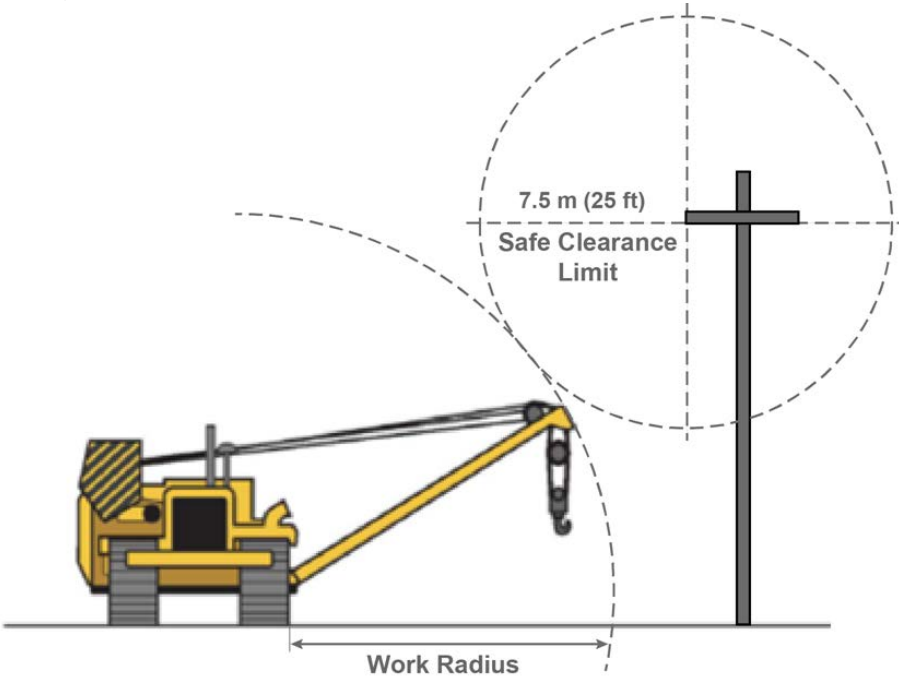

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2.1.9.12	Bonding prior to making tie-ins or performing cut-outs is mandated for High Voltage Powerlines under Clause 7.5.1 of CAN/CSA-C22.3 No. 6-13 Standard
2.1.11	Gradient Control Mats are typically used when regular grounding is not sufficient to reduce the voltage below the safety limit, as shown in the clarification to Section 2.1.8. The conditions to be satisfied by an adequate and safe Gradient Control Mat as shown in sections 2.1..1 and 2.1..2 are mandated for High Voltage Powerlines under Clause 7.7 of CAN/CSA-C22.3. The requirement to use rubber boots when leaving the Gradient Control Mat as per section 2.1.11.3 is good practice to avoid hazardous step potentials introduced by the Gradient Control Mat.
2.2.2.1	<p>The safe clearance limit (SCL) shall be provided by the electric utility, as requested by PSC per Section 2.1.4.5, and shall meet or exceed the distances in Appendix A.</p> <p>Figure C-1 shows the various parameters to be considered in evaluating the risk of encroachment when the equipment operates close to a powerline structure (pole or tower).</p>  <p><b>Figure C-1 Evaluation of risk of encroachment close to a powerline structure</b></p> <p>Any part of the equipment, if operated up to its maximum work radius in the work zone shall not get inside the safe clearance limit.</p> <p>Figure C-2 shows the various parameters to be considered in evaluating the risk of encroachment when the equipment operates near or crosses a powerline between two structures and only the conductors are clearly visible.</p>

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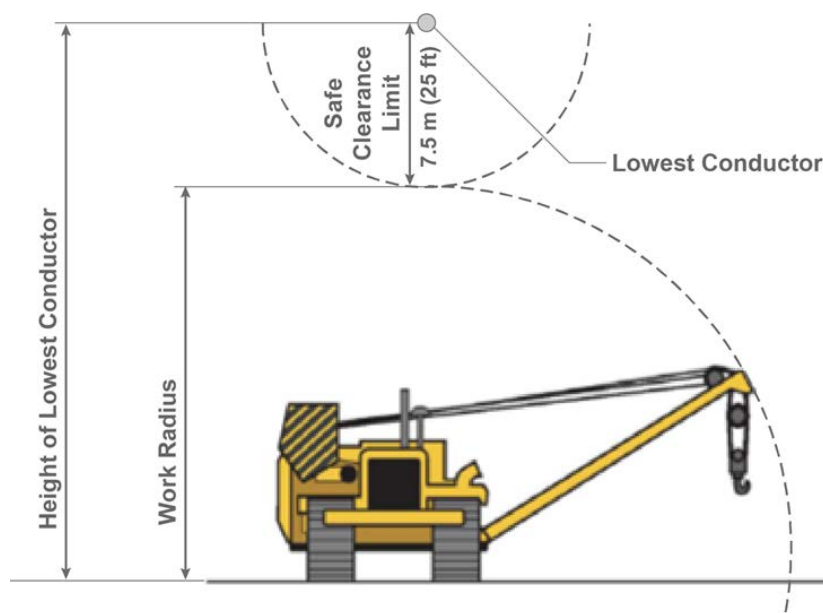

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**Figure C-2 Evaluation of risk of encroachment between two powerline structures**

The height of any part of the construction vehicle or equipment shall not exceed the maximum available height, as provided by the electric utility, as requested by PSC per section 2.1.4.5. If maximum available height was not provided, it may be determined from Figure C-2 based on the height of the lowest conductor and the SCL. Specialized survey contractors may be used to verify crossing heights, if required.

Note that this Specification does not apply to travel or transport of machinery on developed road allowances. However, operators are expected to be aware of municipal over-dimensional restrictions and are responsible for completion of permitting and notifications for over-dimension loads as applicable. Nevertheless, if any portion of a developed road allowance becomes an active worksite for the purposes of offloading equipment, road restoration, etc. this procedure will apply.

2.2.2.5	Bonding to fueling facility prior to fueling on a High Voltage Powerline ROW is mandated under Clause 7.6.2 of CAN/CSA-C22.3 No. 6-13 Standard.
2.2.2.6	Grounding of rubber-tired construction vehicles parked in the ROW of High Voltage Powerlines is mandated under Clause 7.6.1 of CAN/CSA-C22.3 No. 6-13 Standard. Significantly lower static charges may affect equipment parked close to a Distribution Powerline; however, the requirements in Section 2.2..6 could be used to avoid a build-up of static electricity.

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2.4.4	For work involving replacement or modification of equipment or piping cathodically protected, bypassing the location using a temporary conductor sized for the maximum available current is permitted instead of turning off the rectifier, as per Rule 80-014, Subrule 3 of C22.1-18 (Canadian Electrical Code).
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## APPENDIX D: FLOWCHART TO ASSIST WITH DETERMINING THE REQUIREMENTS OF SECTION 2.1.7 MONITORING OF HAZARDOUS VOLTAGES.

