METROLINX
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Capital Projects Group

Performance Specifications for

Structures Passing Over Electrified Corridors

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An agency of the Government of Ontario

Authorization

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Chapter 1 - General

1.1 Design Criteria Overview

1.1.1 Purpose and Extent

Metrolinx intends to implement electrification over a large portion of their system: USRC, Barrie, Lakeshore West, Lakeshore East, Stouffville and Kitchener corridors. This will consist of a 25kVac system delivering power to trains by the use of an overhead contact system (OCS) in conjunction with power collection via a pantograph mounted on the roof of the vehicles.

This performance specification is provided to establish the necessary measures to ensure the compatibility between current construction projects and the future Metrolinx electrification. The specifications and criteria within are intended to provide both the requirements of any structure passing over the electrified corridor and the recommendations on how to best achieve these requirements. This criteria will cover the requirements for OCS support and electrification grounding and bonding.

1.1.2 Other Metrolinx Electrification Project Documents

1.1.2.1 GO Transit Design Requirements Manual (DRM)

1.1.2.2 GO Track Standards RC-0506-02TRK

1.1.2.1 Performance Specifications for Electric Traction Enabling Works

MX-ELEC TRAC EW-SPEC-2016 REV0

1.1.2.2 GO Electrification Enabling Works ET Standards

MX-ELEC TRAC EW-DW-2016-REV0

1.2 Abbreviations

AAR	Association Of American Railroad	CCZ	Current Collector Zone
ac	Alternating Current	CGWC	Copper Ground Wire (Covered)
ADJ	Adjustment	CL	Center Line
AGWB	Aluminum Ground Wire (Bare)	CLR	Clearance
AGWC	Aluminum Ground Wire (Covered)	CP	Counterpoise
AREMA	American Railway Engineering and Maintenance-of-Way Association	CSA	Canadian Standards Association
ASTM	American Society For Testing And Materials	CW	Contact Wire
ATF	Autotransformer Feeder	CWB	Counterpoise Wire (Buried)
ATFZ	Autotransformer Feeder Zone	CWH	Contact Wire Height
ATM	Along Track Movement		
AWG	American Wire Gage	dc	Direct Current
		°C	Degree Celsius
BWA	Balance Weight Termination Anchor	DG	Down Guy
		DGW	Down Guy Wire
C	Celsius	DIA	Diameter

DIST	Distribution	LG	Long
DRM	Design Requirement Manual	LPS	Lightning Protection System
DVP	Don Valley Parkway	LV	Low Voltage (120V Nominal Voltage)
DWG	Drawing		
		m	Meter
EA	Emergency Alarm	MF	Maintenance Facility
EB	Eastbound	MGB	Main Grounding Bar
EGC	Equipment Grounding Conductor	M/C	Monitor And Control
EN	European Standards	MIN	Minimum
ELEV	Elevation	mm	Millimeter
ET	Electric Traction	MOD	Modified
		MP	Milepost
FDN	Foundation	MPA	Mid Point Anchor
FDRI	Feeder Wire (Insulated)	MPTW	Mid Point Tie Wire
FRA	Federal Railroad Administration	MV	Medium Voltage
FRE	Fiberglass-Reinforced Epoxy	MW	Messenger Wire
FTA	Fixed Termination Anchor		
FW	Feeder Wire	N	Newton
		NFPA	National Fire Protection Association
GALV.	Galvanized	N.O.	Normally Open
GBCW	Grounding And Bonding Wire	NOM	Nominal
GENL	General	NTS	Not To Scale
GTCC	Go Transit Control Center		
		O/LAP	Overlap
H/HT	Height	OCLZ	Overhead Contact Line Zone
HORIZ	Horizontal	OCS	Overhead Contact System
HRL	High Rail	OH	Overhead
		OOR	Out-Of-Running
IEC	International Electrotechnical Commission	OESC	Ontario Electrical Safety Code
IEEE	Institute of Electrical and Electronics Engineers		
IR	In Running	Pa	Pascal
		PITO	Point Of Intersection Of The Turnout
JW	Jumper Wire	PS	Paralleling Station
		PSF	Pound Per Square Foot
kg	Kilogram	PVC	Polyvinyl Chloride
kg/M	Kilogram Per Meter	P.S.	Point Of Switch

		W	Width
RAC	Rail Association of Canada	WP	Working Point
RC	Return Cable		
REINF	Reinforcement		
rms	Root-mean-squared		
ROW	Right-Of-Way		
SCADA	Supervisory Control And Data Acquisition		
SM	Single Mode		
SPD	Surge Protection Device		
SQ	Square		
SS/SST	Stainless Steel		
STA	Station Distance		
STD/(S)	Standard/Standards		
STN	Passenger Station		
SW	Static Wire		
SWS	Switching Station		
T/	Top Of		
TBD	To Be Determined		
TBS	Transmission Backbone System		
TOR	Top Of Rail		
TPF	Traction Power Facility		
TPSS	Traction Power Substation		
TRK	Track		
TRKS	Tracks		
TVM	Ticket Vending Machine		
TWA	Tie Wire Anchor		
TWPC	Traction Wayside Power Control Cubicle		
TYP	Typical		
UP	Union Pearson Express		
V	Volt		
VERT	Vertical		
VLD	Voltage Limiting Device		
VMS	Visual Message Sign		

1.3 Basis of Design

1.3.1 The Metrolinx Electrification system shall be a 2 x 25kVac autotransformer traction electrification system (With the exception of the Guideway to Pearson Airport which shall be a 1x25kVac system). All proposed projects crossing over the electrified corridor shall include provisions to protect public safety and to accommodate bare or insulated autotransformer feeders, OCS wire support and the traction power return system.

1.4 Regulations, Codes, Standards and Guidelines (Latest Version)

1.4.1 Federal and National Regulations and Codes

1.4.1.1 Transport Canada – Standard Respecting Railway Clearances TC E-05

1.4.1.2 Canadian Standards Association (CSA)

1.4.1.3 CAN/CSA C22.1 Canadian Electrical Code, part 1

1.4.1.4 CAN/CSA C22.2 No 0 General Requirements, Canadian Electrical Code, part 2

1.4.1.5 CAN/CSA C22-3 No. 8 Railway Electrification Guidelines.

1.4.1.6 CAN/CSA C2.3 1-10 Overhead Systems

1.4.1.7 CAN/CSA C22.2 NO.0.4 - Bonding and Grounding of Electrical Equipment

1.4.1.8 CAN/CSA C22.3 NO.2 - General Grounding Requirements and Grounding Requirements for Electrical Supply Stations

1.4.1.9 CAN/CSA B72 – M87 (Reaffirmed 2008) – Installation Code for Lightning Protection Systems.

1.4.2 Provincial Regulations and Codes

1.4.2.1 OESC Ontario Electrical Safety Code

1.4.3 Standards and Guidelines

1.4.3.1 American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering (Chapter 33 – Electrical Energy Utilization)

1.4.3.2 Railway Association of Canada (RAC) Standards

1.4.3.3 IEEE 80: Guide for Safety in ac Substation Grounding;

1.4.3.4 EN 50122-1: Railway Applications, Fixed Installations – Protective Provisions Relating to Electrical Safety and Grounding;

1.4.3.5 IEC 60479: Effects of Current on Human Beings and Livestock

1.4.3.6 NFPA 780: Standard for Lightning Protection Systems

1.4.3.7 IEC 60305-1: Protection Against Lightning

1.5 General Design Parameters

1.5.1 Units of Measurement – The Metric system shall be used

1.6 Design Life

1.6.1 Electrification elements (such as Ground Conductors and any provisional OCS attachments) installed within the overbuild shall have a design life that matches or exceeds that of the adjacent structural elements and no less than 30 years.

1.6.2 Electrification elements exposed to climate shall be reasonably protected from the environment in the period before the electrification contractor begins construction and have a design life of no less than 30 years.

1.7 Standardization

1.7.1 Design shall use standard materials and equipment where possible. Standardization ensures ease of procurement and inventory management, minimizes staff training, optimizes maintenance, and avoids long lead times for materials, equipment, and components.

1.7.2 Equipment and materials shall meet industry standards, be available off the shelf, and supplied by established manufacturers. Selection of equipment and materials shall consider long-term costs, ease of construction and maintenance, and readily available technical support.

1.7.3 Effort shall be made to standardize the appearance of all exposed elements, including electrification barriers, such that there is a unified aesthetic between all visible structures. Direction will be given from Metrolinx on final finish.

1.8 Durability

1.8.1 Design shall assess potential for deterioration of materials and assemblies, including deterioration specific to exposure to the environment and future climate. Materials and detail assemblies shall be durable with minimal maintenance and repairs throughout their design life. For surface and assembly for which appearance is important, durability shall include maintenance required to preserve appearance. Design shall take into account the following aspects of durability:

1.8.1.1 Control of moisture

1.8.1.2 Control of corrosion (including material compatibility)

1.8.1.3 Control of exposure to industrial and vehicular pollution

1.8.1.4 Minimize damage from wear and tear

1.8.1.5 Ease of repair; ease of access

1.8.1.6 Protect grounding appurtenances from vandalism

Chapter 2 – Trackway Clearances

2.1 General

2.1.1 Purpose and Extent

This chapter provides specifications for required clearances for the Metrolinx Electrification Project facilities. It includes an allowance for Metrolinx maintenance equipment and other equipment that may be operated within the Metrolinx tracks. Criteria will define static, dynamic, fixed equipment, and structure gauge envelopes. They have been developed to accommodate the following:

2.1.2 The widest and tallest existing Metrolinx rolling stock, and proposed rolling stock currently under contemplation.

2.1.3 Accommodate other passenger train equipment operating in the project area.

2.1.4 Additional freight clearance requirements; Canadian National rolling stock currently under contemplation for each portion of the rail corridor as defined by AAR Plate Equipment Diagrams (Plate 'H').

2.2 Vertical Clearances

2.2.1 Transport Canada's TC E-05 specifies clearance to non-electrified tracks owned or operated by railway companies. Diagram 1 of TC E-05 provides minimum vertical and horizontal clearances that must be provided. However, electrification requires greater vertical clearance between vehicles and overhead structures to account for the space required by OCS conductors and electrical clearances that must be provided for safe operation.

2.2.2 Minimum vertical clearances shall be measured from the Metrolinx top of high rail (TOR). Minimum vertical clearances should be carried to a point 3.5m laterally from the centerline of the most outside track. This minimum vertical clearance shall be no less than shown in table 2-1, unless otherwise approved by Metrolinx. For overhead obstructions which are continuous obstructions longer than 10m along the track, a site specific review and evaluation will be required prior to obtaining Metrolinx approval.

Table 2-1: Minimum Vertical Clearances

Item	Minimum Vertical Clearance
TOR to lowest point of overhead obstruction	7584mm

Note: Only applicable on GO owned territories subjected to double stack or Automax cars. Not applicable to USRC train shed, GO Sub and Uxbridge Sub (Stouffville Corridor).

2.3 Horizontal Clearances

2.3.1 Minimum horizontal clearances shall be measured from the track centerline (TCL) of the closest Metrolinx track to the feature being cleared.

Table 2-2: Minimum Horizontal Clearances

Item	Minimum Horizontal Clearance
TCL to face of OCS Pole	2900[1]mm + 25.4mm*(DOC)

Notes:

1. Where 2900mm cannot be met, a reduced clearance can be submitted to Metrolinx for approval.
2. DOC = Degree of Curve
   SE = Superelevation (mm)
   YD = Vertical height of dynamic envelope (mm)

2.4 Clearance to Third Party Facilities

2.4.1 Where facilities owned and operated by third parties are involved, the clearance requirement of this document and those of the third party shall be compared and the larger dimension used.

Chapter 3 – Traction Power Systems

3.1 General

3.1.1 Purpose and Extent

This section provides the requirements for grounding and bonding of structures passing over Metrolinx corridors for coordination with the future electrification and its traction power return system (TPRS). The TPRS consists of various components (such as running rails, rail bonding cables, aerial static (ground) wire, and earth) to allow current from the electric train vehicle to ultimately return to its supply substation source under both normal operating conditions and under fault conditions.

Due to the presence of electric trains, its open wire distribution and traction return currents in the rails, it is necessary to provide grounding and bonding network at all accessible elements along the right-of-way to: (i) facilitate an equal-potentiality for all normally-non-current-carrying-conductive equipment and structures, and (ii) ensure flow of all fault current (including lightning) towards the earth to protect personnel and equipment from damage.

3.1.2 EMI Protection

The 25kVac overhead catenary wires and auto-transformer feeder wires may produce an electromagnetic field which could affect elements on the overbuild. It is the contractor's responsibility to protect any equipment which could be affected by this electromagnetic field.

3.2 Grounding and Bonding

3.2.1 General

The grounding and bonding system shall provide the means to carry traction electric currents into the earth, under both normal and fault conditions, without exceeding operating equipment limits, without thermal degradation or mechanical breakdown, and without adversely affecting continuity of service or personnel safety. The Contractor shall design, supply, install and test the grounding and bonding system to protect the overbuild components from the electrified rail line.

Adequate bonding shall be designed and installed throughout the entire electrified system to provide proper return circuits for the normal traction power currents and fault currents, with grounding connections as specified herein without affecting life and property.

Ground resistance measurements and detailed design shall be performed to determine the extent of grounding and/or bonding within specific site condition, for coordination with the future electrified system.

All grounding and bonding designs shall be coordinated with the various discipline designs, including civil, architectural, electrical and electronic, mechanical, and plumbing, traction power supply and distribution, communications, and signaling.

All grounding and bonding designs shall be coordinated with electromagnetic compatibility (EMC) and electromagnetic interference (EMI) requirements, so that the respective designs do not conflict and render other systems ineffective.

All grounding and bonding designs shall be coordinated with any neighboring stray current and corrosion control measures for adjacent systems, as well as when in the vicinity of direct current (dc) traction power transit systems.

The grounding electrodes shall be contained within the right of way confines. The bonding material shall be capable of sustaining the short-circuit currents for up to the total switch-off (trip) time imposed on the system without thermal degradation or mechanical breakdown. The traction equipment bonding shall be capable of discharging a 15 kA fault from the OCS within 0.5 seconds

Provisions for an electrification grounding and bonding system shall be implemented within the design of any structure in the Overhead Contact Line Zone (As described in 3.2.3) and any structure passing over electrified territory. Provisions shall be implemented to allow future connection to the traction power return system.

3.2.2 Regulations, Codes, Standards and Guidelines

Grounding and bonding shall be designed and implemented primarily in accordance with the regulations, codes, standards and guidelines as listed in section 1.4.

3.2.3 Overhead Contact Line Zone (OCLZ)

A live broken contact line, or live parts of a broken or de-wired pantograph or energized fragments, may accidentally come into contact with wayside structures and equipment. As derived from European standard EN 50122-1, the overhead contact line zone (OCLZ) is used to define the area in which normally non-current-carrying metallic components in this zone are to be either directly grounded or bonded to the traction power return system to provide for personnel safety. Metallic objects and equipment at structures near or passing over the electrified corridor that are within the OCLZ are to be properly grounded and bonded. The grounding and/or bonding configuration to be employed is dependent upon the equipment involved.

The OCLZ shall be taken as an area 2.0 m horizontally from any electrified part or wire, and vertically from that part to the ground directly below. This zone shall also include a 4.0 m zone horizontally from any overhead catenary wire (Contact or Messenger).

3.2.4 Commercial/Utility Electrical Distribution Systems

It is recommended that the ground of commercial/utility electrical distribution systems not be interconnected with traction return system. This is due to the potential damaging effects if the traction power system were to experience a fault in the overpass area. Under such an event, the commercial/utility system equipment and other low voltage electrical equipment could experience damage.

Non-metallic raceways should be used when routing such commercial/utility power circuits on the overpass structure or in areas within the OCLZ.

3.2.5 3rd Party Utilities in the OCLZ

It is recommended to keep 3rd party utilities outside the OCLZ area whenever possible. New 3rd party utilities may only be installed within the OCLZ with Metrolinx approval. If approval is granted, the means required to properly protect the railroad and the utility are outlined below:

3.2.5.1 Underground Utility Installations

New buried 3rd party utilities under the tracks shall be installed in a steel casing pipe with its ends sealed with non-shrinkable grout. This is to facilitate utility replacement as well as protect the railroad track bed infrastructure.

3.2.5.2 Utility Installations on the Overpass Structure

New 3rd party utilities installed on the overpass structure shall have a carrier pipe enclosed in a steel casing pipe that is isolated from the carrier pipe by approved insulators. The steel casing pipe shall then be bonded to the traction return system (overhead static wire) via #4/0 AWG copper wire.

3.2.5.3 Exposed Utility Installations Parallel the Railroad Right of way within the OCLZ

New exposed 3rd party utilities that run exposed parallel to the railroad right of way inside the OCLZ shall have a carrier pipe enclosed in a steel casing pipe that is isolated from the carrier pipe by approved insulators. The steel casing pipe shall have insulating collars at approximately 305m with each section having its midpoint bonded to the nearest OCS structure via #4/0 AWG copper wire.

3.3 Grounding Overpasses

All overpasses consisting of steel structures including pedestrian walkways, architectural treatments or other metallic structures crossing over the track shall have provisions included for the bonding and grounding of these elements. Concrete overpasses shall be provided with attachment points for future conductive flash plates to be attached to them. The design of these elements shall be coordinated with Metrolinx Electrification.

3.3.1 Structure Grounding

Any metallic structural components installed above the electrified corridor shall be made electrically continuous and shall be bonded and grounded to achieve a maximum 25Ω resistance to ground. For non-roadway structures or structures which are readily used by pedestrians, this maximum ground resistance shall be 5Ω.

Any metallic walkway/catwalk shall be effectively and continuously bonded along its route and to the designated column or structure interaction point for the connection to the traction power return system. This continuity connection shall be a minimum of #4/0 copper in size and conductivity.

3.3.2 Step and Touch Potentials on Walkways of Overpass Structures

An electrical safety analysis shall take into account criteria for the ground potential rise (refer to IEEE Standard – 80). The analysis shall be undertaken to assess which normally non-current carrying conductive parts need to be grounded and bonded, and the appropriate method of implementation shall be identified to ensure that the step and touch potentials are within permissible limits indicated below, which has been derived from EN 50122-1: 2011 section 9.2.2.

Duration of Current Flow (seconds)	Permissible Voltage in V (rms)
0.02	865
0.05	835
0.1	785
0.2	645
0.3	480
0.4	295
0.5	220
0.6	180
< 0.7	155
0.7	90
0.8	85
0.9	80
1.0	75
≤ 300	65
> 300 (where accessible to the public under all power supply feeding)	60
> 300 (in workshops and similar locations)	25

3.3.3 Connection to the Traction Power Return System

The overpass and all bonded elements shall be grounded through their foundations to achieve a maximum 25Ω resistance to ground. In addition to this, the overpass shall be bonded to the Traction Power return system via the OCS static wire. This connection shall be made by the electrification installer and shall be facilitated by leaving an interaction point exposed or by leaving an appropriate length of ground conductor coiled and protected for use of the future electrification installer. This ground conductor shall be a minimum of #4/0 copper in size and conductivity.

3.3.4 Step and Touch Mitigation

Metallic items outside of the OCLZ shall maintain a 2m clearance from objects bonded to the traction power return system. This separation is to mitigate the risk of a person being in contact with both objects during a fault. If this separation cannot be maintained, the additional metallic object shall be bonded to the adjacent object such that they are kept at the same potential. Effort should be made to prevent a knock-on effect of bonding multiple objects outside of the OCLZ.

Chapter 4 – Overhead Contact System (OCS)

4.1 General

4.1.1 Purpose and Extent

An OCS support system of any type may require attachments to an overpass. This can be achieved in several ways, however, the preference is to allow for the greatest amount of flexibility for the electrification installer's future attachment.

4.2 OCS Description and General Performance Requirements

4.2.1 General OCS Arrangement

A typical OCS support structure consists of either a simple OCS pole or a portal structure. All OCS wires, and ancillary wires, including feeders and static wires, are attached to these structures with wire support assemblies.

A typical OCS pole consists of a free-standing pole to which a cantilever assembly is attached to support the contact and messenger wires over the vehicle pantograph. Wire attachment assemblies for ancillary wires are also supported on the OCS poles.

A typical portal consists of two (2) columns with a crossbeam between them which supports catenary assemblies. Each electrified track may have one or more drop pipes from which cantilever assemblies and wire attachment assemblies will be supported.

4.2.2 OCS Support at Overpasses

Where passing under an overpass the OCS may be supported from drop pipes from the superstructure or from OCS structures adjacent to the overpass. OCS attachments to the overpass shall not require cutting or drilling elements of the overpass structure. Exception to this requirement, requires the approval of both Metrolinx and the bridge owner.

4.2.3 Spacing of OCS Supports

Project specific locations of future OCS support shall be coordinated with Metrolinx Electrification. OCS Supports will be placed with a maximum span of 60m between supports in tangent track. An average span of 45m-55m is expected in the provided OCS layout, although this may decrease if site constraints require. Any modifications to the OCS layout requires approval and coordination with Metrolinx Electrification.

4.3 OCS Structural Requirements

4.3.1 General

Provisions for future OCS supports shall be designed with the future OCS considerations included. The intent of these provisions is to allow the future electrification contractor to install the remaining elements required to support the OCS without cutting or drilling elements of the overpass structure.

4.3.2 OCS Support Requirements

Deflection of the support structure shall be kept at a minimum of 75mm in the across-track direction at the height of the future catenary supports. This shall be calculated as the deflection of the steel in addition to any effects of rotation at the top of foundations. This deflection will be calculated at a height of 7000mm above the top of high rail (TOR).

4.3.3 Wire loading

Loading imposed from the OCS to integrated overpass elements shall be provided by Metrolinx Electrification. These loads will include vertical weight, curve pull from tensioned wires and wind-on-wire loading, and shall be assumed to be acting in a condition and orientation as to result in a worst case loading condition combined with overpass element loading.

Chapter 5 – Electrification Barriers

5.1 General

5.1.1 Purpose and Extent

Structures Passing over the Metrolinx corridor in areas of electrification will have to span over electrified catenary wires as well as other electrified parts such as feeder wires and support assemblies. As such it is a matter of public safety that proper isolation from these electrified parts is assured. All accessible surfaces shall be protected by means of an isolation barrier.

5.2 Isolation Barrier Requirements

5.2.1 Any accessible standing surface which passes over an electrified track shall be protected by a barrier to prevent contact with electrified parts. This barrier shall meet the following minimum requirements:

5.2.1.1 This barrier shall extend a minimum of 5.0 m horizontally beyond the centerline of track or 3.0 m horizontally beyond the outermost electrified wire, whichever is further.

5.2.1.2 This barrier shall be solid. There can be no gaps, holes or mesh which would allow a member of the public to intentionally or unintentionally pass an object through the barrier.

5.2.1.3 This barrier shall extend a minimum of 2.0 m vertically from the adjacent standing surface. This barrier shall be reasonably non-climbable and contain no elements which can be readily used as a step. If a railing is employed that could be used as a step then the barrier must extend 2.0 m vertically from that surface.

5.2.1.4 This barrier shall be either metallic or non-conductive.

- If metallic the barrier shall be effectively and continuously bonded along its route for connection to the traction power return system similar to that of the catwalk/walkway requirements (section 3.3.1)
- If non-conductive the barrier shall be provided with tin-plated copper ground strips of 75 mm wide x 6 mm thick minimum, continuous along the perimeter (on the top and ends) which shall be bonded to the traction power return system similar to that of the catwalk/walkway requirements (section 3.3.1)

Chapter 6 – Assurance

6.1 General

6.1.1 Purpose and Extent

This chapter provides requirements for the quality assurance, inspection, record keeping and documentation required during the construction of provisional electrification elements. The intent is to provide assurance for the future electrification installer to utilize these items which have had advanced installation.

6.2 Quality Assurance

6.2.1 Ground resistance test procedures and test results must be submitted to Metrolinx for approval prior to any work being performed.

6.3 Inspection

6.3.1 Cooperate with the Construction Manager and furnish services as may be required for inspecting and obtaining data. Cooperate and Coordinate site inspection with Metrolinx, Metrolinx Electrification Group, their representatives and Electrification Technical Advisor.

6.3.2 Grounding and Bonding

6.3.2.1 Grounding and Bonding elements shall be inspected prior to embedment in concrete and tested as per the requirements in section 6.5.

6.3.2.2 Visual inspection (Photographic or Video) of embedded Grounding and Bonding provisions shall be performed prior to the pouring of any concrete

6.4 Maintenance

6.4.1 Maintenance of the overpass and its associated barriers shall be coordinated with Metrolinx.

6.4.1.1 Any work performed within 8.0 m of an electrified part (including but not limited to: catenary wires, feeder wires, support assemblies and other hardware) will require protection and coordination with Metrolinx Electrification.

6.4.1.2 Any work performed within 3.0 m of an unguarded electrified part will require the de-energization of the system in the area. This de-energization shall be coordinated with and performed by Metrolinx Electrification.

6.5 Testing

6.5.1 Grounding and Bonding

6.5.1.1 Ground resistance testing shall be performed in accordance with a Ground Resistance test Procedures submitted to Metrolinx

6.6 Submittals

6.6.1 Documentation for provisional electrification items shall be provided to Metrolinx as assurance for the future electrification installer. This documentation shall be provided as a single, separate package such that the future electrification installer will have a complete set of documents for assurance.

6.6.2 Grounding and Bonding

6.6.2.1 Shop Drawings: Shall include a layout showing the location and type of each grounding conductor and connection.

6.6.2.2 Installation drawings showing grounding and bonding layout of system with all interconnections.

6.6.2.3 Catalog Cuts shall be provided for all grounding material.

6.6.2.4 Ground Resistance test results and GPR Studies shall be provided.

END OF SECTION