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Ontario

October 19, 2016

NOTICE OF PROPOSAL TO AMEND THE TRANSMISSION SYSTEM CODE

BOARD FILE NO.: EB-2016-0299

To: All Licensed Transmitters
All Licensed Generators
Independent Electricity System Operator
All Other Interested Parties

The Ontario Energy Board has issued, for stakeholder comment, proposed amendments to the Transmission System Code (TSC) pursuant to section 70.2 of the *Ontario Energy Board Act, 1998* (OEB Act). The purpose of the proposed amendments is to remove certain provisions from the TSC which are duplicative of, or out of date with, the mandatory reliability standards enforced by the Independent Electricity System Operator (IESO) through its Market Rules.

The OEB will not be granting cost awards in this matter.

A. Background

Reliability standards are intended to ensure the integrity of the interconnected North American bulk electricity system. Reliability standards are those standards which have been adopted by the North American Electric Reliability Corporation (NERC) including any amendment or revision thereto, and any standard or criteria that is developed by the Northeast Power Coordinating Council Inc. (NPCC) and that is adopted by NERC or NPCC, as well any amendment or revision thereto.

The TSC sets out the obligations of electricity transmitters with respect to transmission

customers, including performance standards, technical requirements, and expansions and connections to the IESO-controlled grid. When the TSC was first issued in July 2000, it incorporated a small number of reliability standards. This is because compliance with the reliability standards at that time was voluntary and expected only as a matter of good utility practice. However, since the 2003 Northeast blackout, Ontario, as well as a number of other North American jurisdictions, have taken steps to make the reliability standards mandatory and enforceable.

B. Reliability Standards

In Ontario, the IESO is the entity accountable to NERC and NPCC for compliance with the reliability standards. The IESO's market participants are subject to compliance with reliability-related Market Rules, which include reliability standards. As well, by the terms of their OEB licences, electricity transmitters are required to adhere to the Market Rules and, by extension, the reliability standards.

The reliability standards have, from time to time, undergone amendment since they were first made mandatory and enforceable in Ontario. In this light, the OEB has reviewed the TSC against the reliability standards. The OEB has identified certain provisions within the TSC which the OEB now considers duplicative of, or out of date with, the reliability standards. The OEB considers it advisable at this time to remove these provisions from the TSC in order to better align the TSC with the current reliability framework.

The OEB is requesting interested persons to review the provisions of the TSC proposed for deletion and to provide comments. The OEB is interested in receiving comments relating to the transition to greater reliance on the reliability standards and, in particular, whether such transition will pose difficulty for those who have been relying primarily on the provisions of the TSC that are proposed for deletion.

C. Design Standards

The TSC also contains, in sections 8 through 10, a number of prescriptive provisions that are derived from the design standards of the former Ontario Hydro. The OEB is interested in hearing from interested persons with respect to whether or not the OEB should continue to prescribe these legacy design standards through the TSC. Later this year, the OEB intends to constitute a working group, to be led by OEB staff, tasked with addressing this question. The working group will be asked to make recommendations to

the OEB on whether these legacy design standards remain relevant in Ontario and, if so, whether their enforceability should remain with the OEB through the TSC (or otherwise) or be transferred to another authority such as the IESO, the Electrical Safety Authority, or the Canadian Standards Association, for example.

D. Proposed Amendments to the TSC

Attachment A to this Notice contains the proposed amendments to the TSC. In effect, the OEB proposes to delete much of Section 8.0 “General Technical Requirements”, Section 9.0 “Technical Requirements for Tapped Transformer Stations Supplying Load”, and Section 10.0 “Protection System Requirements”.

More specifically, the sections of the TSC identified for deletion, together with the corresponding rationale, are as follows:

- **Section 8.1** is proposed for deletion because it is duplicative of the requirements of section 5.1.2 of the TSC, the Market Rules, and section 4 of the OEB’s electricity transmitter licence.

- **Section 8.2** is proposed for deletion because it has been replaced with criteria in NPCC Directory 4.

- **Section 9.1** is proposed for deletion because it is duplicative of the Market Rules, Chapter 5, section 9.

- **Sections 10.2, 10.3, 10.4.1 and 10.4.2** are proposed for deletion because they have been replaced with the requirements in PRC-005.

- **Section 10.6** is proposed for deletion because it has been replaced with the criteria in NPCC Directory 4.

- **Section 10.7** is proposed for deletion because it has been replaced by the combination of the requirements in PRC-004, PRC-005 and criteria in NPCC Directory 4.

- **Appendix 1, Schedule E** is proposed for deletion because it has been replaced with the criteria in NPCC Directory 4.

E. Anticipated Costs and Benefits

The OEB believes that the proposed amendments to the TSC are necessary in order to better align the TSC with the reliability standards, the Market Rules, and the OEB's electricity transmitter licence. It is intended that the proposed amendments will allow for more efficient functioning of the sector, at no material cost to stakeholders.

F. Coming into Force

The OEB proposes that the final TSC amendments, which will be determined after stakeholder comments have been received and considered, come into force on the date that the final TSC amendments are published on the OEB's website.

G. Invitation to Comment

All interested parties are invited to submit written comments on the proposed TSC amendments, as set out in Attachment A, by **December 7, 2016**.

Three (3) paper copies of each filing must be provided, and should be sent to:

Kirsten Walli
Board Secretary
Ontario Energy Board
P.O. Box 2319
2300 Yonge Street, Suite 2700
Toronto, Ontario M4P 1E4

The OEB requests that interested parties make every effort to provide electronic copies of their filings in searchable/unrestricted Adobe Acrobat (PDF) format, and to submit their filings through the OEB's web portal at https://www.pes.ontarioenergyboard.ca/eservice/. A user ID is required to submit documents through the Board's web portal. If you do not have a user ID, please visit the "e-filings services" webpage on the Board's website at www.ontarioenergyboard.ca, and fill out a user ID password request.

Additionally, interested parties are requested to follow the document naming conventions and document submission standards outlined in the document entitled "RESS Document Preparation – A Quick Guide" also found on the e-filing services

webpage. If the Board's web portal is not available, electronic copies of filings may be filed by e-mail at boardsec@ontarioenergyboard.ca.

Those that do not have internet access should provide a CD containing their filing in PDF format.

Filings to the Board must be received by the Board Secretary by **4:45 p.m.** on the required date. They must quote file number **EB-2016-0299** and include your name, address, telephone number and, where available, your e-mail address and fax number.

If the written comment is from a private citizen (i.e., not a lawyer representing a client, not a consultant representing a client or organization, not an individual in an organization that represents the interests of consumers or other groups, and not an individual from a regulated entity), before making the written comment available for viewing at the Board's offices or placing the written comment on the Board's website, the Board will remove any personal (i.e., not business) contact information from the written comment (i.e., the address, fax number, phone number, and e-mail address of the individual). However, the name of the individual and the content of the written comment will be available for viewing at the Board's offices and will be placed on the Board's website.

This Notice, including the proposed amendments to the code set out in Attachment A, and all written comments received by the Board in response to this Notice will be available for public viewing on the Board's web site at www.ontarioenergyboard.ca and at the office of the Board during normal business hours.

If you have any questions regarding the proposed code amendments described in this Notice, please contact Laurie Reid at Laurie.Reid@OntarioEnergyBoard.ca or at 416-440-7623. The Board's toll free number is 1-888-632-6273.

DATED OCTOBER 19, 2016

ONTARIO ENERGY BOARD

Original signed by

Kirsten Walli
Board Secretary

Attachment: Attachment A – Proposed Amendments to the TSC

Attachment A – Proposed Amendments to the Transmission System Code

Note: The text of the proposed amendments is set out in italics below, for ease of identification only.

1. Delete Section 8.1 in its entirety.

~~8.1 Guidelines of Reliability Organizations~~

~~8.1.1 A transmitter shall ensure compliance with the standards of all applicable reliability organizations.~~

~~8.1.2 A transmitter shall provide to a customer, upon request, the name and address of a contact person for each applicable reliability organization.~~

2. Delete Section 8.2 in its entirety.

~~8.2 Protection and Control~~

~~8.2.1 A transmitter shall install and maintain protection systems that are capable of minimizing the severity and extent of disturbances to the transmission system while themselves experiencing a first order single contingency as the failure of a relay protection system to operate or the failure of a breather to trip. In particular:~~

~~(a) the facilities designed by the transmitter or the IESO as essential to system reliability and security shall be protected by two protection systems. Each system shall be independently capable of detecting and isolating all faults on those facilities. Those facilities shall also have breaker failure protection but breaker failure protection need not be duplicated. Both protection systems shall initiate breaker failure protection;~~

~~(b) to reduce the risk of bother protection systems being disabled simultaneously by a single contingency, the two protection systems shall not use common components;~~

~~(c) the use of two identical protection systems should be avoided to reduce the risk of simultaneous failure of both systems due to design deficiencies or facilities problems;~~

~~(d) the protection systems shall be designed to isolate only the faulted facilities. For faults outside the protected zone, each protection system shall be designed either not to operate or to operate selectively in coordination with other protection systems;~~

~~(e) protection settings at tapped transformer stations owned by the transmitter, for protection of system elements affected by conditions on the transmission system, shall be coordinated with other system elements of the transmission system;~~

~~(f) protection systems shall not operate to trip for stable power swings following contingencies that are judged by protection system designers as not harmful to the transmission system or its customers;~~

~~(g) the components and software used in all protection systems shall be of proven quality for effective utility application and follow good utility practice;~~

~~(h) critical features associated with the operability of protection systems and the high voltage interrupting device (HVI) shall be annunciated or monitored;~~

~~(i) the design of protection systems shall facilitate periodic testing and maintenance. Test facilities and procedures shall not compromise the independence of the redundant protection systems. Test switches shall be used to eliminate the need to disconnect wires during testing.~~

~~(j) the two protection systems shall be supplied from separate secondary windings on one voltage transformer or potential device and from separate current transformer secondary windings (using two current transformer – one current transformer for each protection system; and~~

~~(k) protection system circuitry and physical arrangements shall be designed to minimize the possibility of incorrect operations from personnel error.~~

~~8.2.2 A transmitter shall follow the specific protection and control practices and facilities requirements which are set out in Schedule G of the applicable version of the connection agreement set out in Appendix 1.~~

~~8.2.3 A transmitter should apply protection systems using the typical tripping matrix for transmission system protection shown in Exhibit E.2, Schedule E of the applicable version of the connection agreement set out in Appendix 1.~~

3. Delete Section 9.1 in its entirety.

~~9.1 Supply Considerations~~

~~9.1.1 A transmitter shall ensure that tapped transformer stations, excluding those that are deemed compliant under section 4.6 of this Code, have adequate on load tap changer or other voltage regulating facilities to operate continuously within normal variations on the transmission system as set out in the Market Rules and to operate in emergencies with a further transmission system voltage variation of 6%.~~

4. Delete Section 10.2 in its entirety.

~~10.2 Test Schedule for Relaying Communication Channels~~

~~10.2.1 A transmitter shall test communication channels associated with protective relaying at periodic intervals to verify that the channels are operational and that their characteristics are within specific tolerances. Testing should include signal adequacy tests and channel performance tests.~~

~~10.2.2 Signal adequacy testing for unmonitored channels shall be done at one month intervals. Signal adequacy testing for monitored channels shall be done at twelve month intervals.~~

5. Delete Section 10.3 in its entirety.

~~10.3 Verification and Maintenance Practices~~

~~10.3.1 A transmitter shall use the maximum verification intervals established by reliability organizations and in accordance with applicable reliability standards: (a) four years for most 115kV elements, most transformer stations, and certain 230kV elements: (b) two years for all other high voltage elements. All newly commissioned protection systems shall be verified within six months of the initial in service date of the system.~~

~~10.3.2 Routine verification shall ensure with reasonable certainty that the protection systems respond correctly to fault conditions.~~

~~10.3.3 A transmitter shall use an electrically initiated simulated fault clearing check to verify new protection systems, after any wiring or component changes are made to an existing protection system, and for the routine verification of a protection system.~~

6. Delete Clauses 10.4.1 and 10.4.2.

~~10.4.1 For direct current circuitry checks, a transmitter shall thoroughly check the logic of the auxiliary circuitry with the direct current applied and the initiating devices suitably energized to initiate the process. When primary relays are the initiating device, the initiation shall be achieved by secondary injection of appropriate electrical quantities to the measuring elements. In cases where the sequence of operation is critical, monitoring by a portable sequence of events recorder may be required for proper analysis. Operation or tripping of any interrupting or isolating device shall always be verified, as well as annunciation and target operation.~~

~~10.4.2 A transmitter shall ensure that "on potential" checks shall follow all necessary preliminary procedures. The main equipment shall be energized but not placed on load. At its tapped transformer stations, the transmitter shall check all readings of potentials, including determination of correct phasing/phase rotation. The test must also demonstrate that all equipment performs as expected when energized and is in a condition to have primary load applied.~~

7. Delete Section 10.6 in its entirety.

~~10.6 Instrument Transformers~~

~~10.6.1 A transmitter shall ensure that current transformer output remains within acceptable limits for all anticipated fault currents and for all anticipated burdens connected to the current transformer.~~

~~10.6.2 A transmitter shall ensure that current transformers are connected so that adjacent relay protection zones overlap.~~

~~10.6.3 A transmitter shall ensure that voltage transformers and potential devices have adequate volt ampere capacity to supply the connected burden while maintaining their accuracy over the specified primary voltage range.~~

~~10.6.4 For each independent protection system, a transmitter shall ensure that separate current and voltage transformer or potential device secondary windings are used, except on low voltage devices.~~

~~10.6.5 A transmitter shall ensure that interconnected current transformer secondary wiring and voltage transformer secondaries are each grounded only at a single point.~~

8. Delete Section 10.7 in its entirety.

~~10.7 Battery Banks and Direct Current Supply~~

~~10.7.1 The customer shall ensure that if either the battery charger fails or the AC supply source fails, the station battery bank shall have enough capacity to allow the station to operate for at least eight hours for a single battery system or at least six hours for each of the batteries in a two battery system.~~

~~10.7.2 Critical DC supplies shall be monitored and annunciated such as relay protection circuits and high voltage interrupters (HVIs).~~

~~10.7.3 For all generating facilities connected to the transmission system, two separately protected (fuse/breaker) and monitored DC station battery systems are required.~~

10.7.4 For tap transformer stations, one protected (fuse/breaker) monitored DC station battery system is required unless two systems are specified by the Transmitter.

10.7.5 Where two battery systems are required, there shall be a battery transfer scheme.

10.7.6 Where the use of a single battery system is allowed, the following conditions shall be met:

(a) it can be tested and maintained without removing it from service;

(b) each protection system shall be supplied from physically separated and separately fused direct current circuits; and

(c) no single contingency other than failure of the battery bank itself shall prevent successful tripping for a fault.

9. Delete Appendix 1, Schedule E in its entirety.

SCHEDULE E - GENERAL TECHNICAL REQUIREMENTS

1.1. Guidelines of Reliability Organizations

1.1.1. Customers and Transmitters shall follow all reliability organizations= standards as they may be amended from time to time.

1.1.2. The Transmitter shall provide to Customers upon request, the address and contact persons at the relevant reliability organization.

1.2. Isolation from the Transmission System

1.2.1. The Customer shall provide an isolating disconnect switch or device at the point or junction between the Transmitter and the Customer, i.e., at the point of the interconnection, which physically and visually opens the main current-carrying path and isolates the Customer=s facility from the transmission system.

1.2.2. The isolating disconnect switch shall meet the following criteria:

1.2.2.1. it shall simultaneously open all phases (i.e., group-operated open/close) to the connection;

1.2.2.2. it shall be lockable in the open and closed positions;

1.2.2.3. when the device is used as part of the HVI failure protection system, it shall be motor-operated and equipped with appropriate control circuitry; and

1.2.2.4. it shall be suitable for safe operation under the conditions of use.

1.3. Protection and Control

1.3.1. The protection systems, which protects transmission system elements, shall be capable of minimizing the severity and extent of disturbances to the transmission system while themselves experiencing a first-order single contingency such as the failure of a relay protection system to operate or the failure of a breaker to trip. In particular:

1.3.1.1. the elements designated by the Transmitter as essential to system reliability and security shall be protected by two protection systems. Each system shall be independently capable of detecting and isolating all faults on those elements. These elements shall have breaker failure protection, but breaker failure protection need not be duplicated. Both protection systems shall initiate breaker failure protection;

1.3.1.2. to reduce the risk of both systems being disabled simultaneously by a single contingency, the protection system designs shall not use components common to the two systems;

1.3.1.3. the use of two identical protection systems is not generally, recommended, because it increases the risk of simultaneous failure of both systems due to design deficiencies or equipment problems;

1.3.1.4. the protection systems shall be designed to isolate only the faulted element. For faults outside the protected zone, each protection system shall be designed either not to operate or to operate selectively in coordination with other protection systems;

1.3.1.5. Customer protection settings for protections affected by conditions on the transmission system shall be coordinated with those of the transmission system;

1.3.1.6. protection systems shall not operate to trip for stable power swings following contingencies that are judged by protection system designers as not harmful to the transmission system or its Customers;

1.3.1.7. the components and software used in all protection systems shall be of proven quality for effective utility application and following good utility practice;

1.3.1.8. critical features associated with the operability of protection systems and the high voltage interrupting device (HVI) shall be annunciated or monitored;

1.3.1.9. the design of protection systems shall facilitate periodic testing and maintenance. Test facilities and procedures shall not compromise the independence of the redundant protection systems. Test switches shall be used to eliminate the need to disconnect wires during testing;

1.3.1.10. the two protection systems shall be supplied from separate secondary windings on one voltage transformer or potential device and from separate current transformer secondary windings, i.e., from two separate current transformers;

1.3.1.11. separately fused and monitored DC sources shall be used with the two protection systems. For all generating Facilities connected to the transmission system, two separate DC station battery banks shall be required to provide the required degree of reliability; and

1.3.1.12. protection system circuitry and physical arrangements shall be designed to minimize the possibility of incorrect operations from personnel error.

1.3.2. Specific protection and control practices and equipment requirements are set out in Schedule G of this Agreement.

1.3.3. Transmitters and Customers should apply protection systems, using the typical tripping matrix for transmission system protection shown in Exhibit E.2, of this Schedule E.

1.4. Insulation Coordination

1.4.1. Equipment connected to the transmission system shall be protected against lightning and switching surges. This shall include station shielding against direct lightning strokes, surge protection on all wound devices, and cable/overhead interfaces.

1.4.2. A tap connected to a shielded transmission circuit shall also be shielded.

1.4.3. The Transmitter shall review surge arrester ratings.

1.4.3.1. The Transmitter shall provide all relevant Information, e.g., ratings, to Customers upon request. The Transmitter, however is not responsible for the adequacy of design or correctness of the operation of any equipment or apparatus including the surge arrester(s).

1.5. Grounding

1.5.1. Grounding installations shall be capable of carrying the maximum foreseeable fault current, for the duration of such fault currents, without risking

~~safety to personnel that may be present on site when a fault occurs, damage to equipment, or interference with the operation of the transmission system.~~

~~1.5.2. Each transformer, switching, or generating station shall have a ground grid on which all metallic structures, metallic equipment and non-energized metallic equipment are solidly connected. The size, type and requirements for the ground grid are site-specific, depending on such factors as soil conditions, station size, and short-circuit level.~~

~~1.5.3. The Transmitter shall review the ground potential rise (GPR) study submitted by the Customer at the Customer=s cost. The Customer shall comply with the Bell System Practices as they may be amended or modified from time to time and the IEEE standard 487 as it may be amended or modified from time to time for providing special high- voltage protection devices on metallic communication cables. The Transmitter assumes no responsibility for the adequacy of design or correctness of the operation of any equipment or apparatus associated with the Customer=s installation.~~

~~1.5.4. The placement of any additional grounding points on the transmission system shall require the approval of the Transmitter. The Transmitter shall give its approval if it is satisfied that the reliability of its transmission system is not affected.~~

~~1.6. Telemetry, Monitoring, and Telecommunications~~

~~1.6.1. Transmitters shall advise Customers of the performance and details of required telemetering facilities that serve them. Some requirements depend on the size and specific location of the connection to the transmission system. As a minimum, telemetry shall be required for the flow of real and reactive power through circuits and transformers, the voltages at selected points, and the status (open or closed) of switching elements.~~

~~1.6.2. A Transmitter may require a Customer to install monitoring equipment to track the performance of its facilities, identify possible protection system problems, and provide measurements of power quality. The responsibility for costs will be as determined by the Board. As required, the monitoring equipment shall perform one or several of the following functions:~~

~~1.6.2.1. sequence of events recording (SER) to record protection related events at a connection;~~

~~1.6.2.2. digital fault recording (DFR) to permit analysis of transmission system performance under normal and abnormal conditions; or~~

1.6.2.3. power quality monitoring (PQM) to record voltage transient surges, voltage sags and swells, voltage unbalance, supply interruptions, frequency variations and other voltage and current waveform monitoring.

1.6.3. Customers= telecommunications facilities shall be compatible with those of the Transmitter and have similar reliability and performance characteristics. At the Transmitter=s discretion, some or all of the following functions may require telecommunication: protective relaying; system control and data acquisition (SCADA); voice communication; and special protection systems (e.g., generation rejection or runback).

1.6.4. Telecommunication facilities, design details, and performance requirements, associated with Customers= facilities, shall be provided at the Customer=s expense.

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1.6.5. The Customer shall bear all costs, without limitation, of providing the same telemetry data required under the Market Rules, associated with its facilities to the Transmitter and providing all required connection inputs to the Transmitter=s disturbance-monitoring equipment, except:

1.6.5.1. where the connection inputs to the Transmitter=s disturbance-monitoring equipment are of mutual benefit to the Customer and the Transmitter, in which circumstance the Customer and Transmitter shall share the cost of providing the data in proportion to the benefits received; or

1.6.5.2. where the connection inputs to the Transmitter=s disturbance-monitoring equipment are required only for the Transmitter=s benefit, in which case the transmitter shall pay all of the costs associated with providing the data.

1.7. Inspecting and Commissioning Procedures

1.7.1. Customers shall ensure that any new or replacement equipment that they own is inspected and tested before initial connection to the transmission system. The initial verification tests shall confirm that the connection of the Customer=s facility to the transmission system:

1.7.1.1. does not pose any safety hazards;

1.7.1.2. does not adversely affect operation of the transmission system in a material manner; and

1.7.1.3. does not violate any requirement of the Code or this Agreement.

~~1.7.2. The Transmitter has the right to inspect the Customer=s facility and witness commissioning tests related to any new or replacement equipment that could reasonably be expected to adversely affect the transmission system. The initial verification shall include high-voltage interrupting devices, line disconnect switches, the line and bus connections from the dead-end structure to Customer=s facility, power transformers, surge arresters, DC batteries, and station service systems, protection, metering, and communication systems. The Customer shall have the right to the inspection reports relating to such facility.~~

~~1.7.3. The Transmitter assumes no responsibility for the adequacy of design or correctness of the operation of any equipment or apparatus associated with the Customer=s installation. The Transmitter shall notify the Customer of its findings regarding any potential problems or limitation of such equipment or apparatus owned by the Customer, without any responsibility.~~

~~1.7.4. The Customer shall advise the Transmitter of the commissioning program in writing, thirty business days before it proposes to begin the commissioning tests. The written notice shall include the connection commissioning schedule, the proposed test procedure, the test equipment to be used, and the transmission system conditions required, and also the name of the individual responsible for coordinating the proposed tests on the Customer=s behalf.~~

~~1.7.5. Within fifteen business days of receiving the notice, the Transmitter shall notify the Customer that it:~~

~~1.7.5.1. agrees with the proposed connection commissioning program and test procedures; or~~

~~1.7.5.2. requires changes in the interest of safety or maintaining the reliability of the transmission system, and that such changes shall be sent to the Customer promptly.~~

~~1.7.6. If the Transmitter requires changes, then the Parties shall act in good faith to reach agreement and finalize the commissioning program within a reasonable period.~~

~~1.7.7. The Customer shall submit the results of the commissioning tests to the Transmitter and must demonstrate that all its equipment complies with the Code and this Agreement.~~

~~1.7.8. If the commissioning test reveals non-compliance with one or more requirements of the Code or this Agreement, the Customer whose equipment~~

~~was tested shall promptly meet with the Transmitter and agree on a process aimed at achieving compliance.~~

~~1.7.9. The Transmitter may withhold permission to complete the commissioning and subsequent connection of the Customer to the transmission system if the relevant equipment fails to meet any technical requirement stipulated in the Code or this Agreement.~~

~~1.7.10. All reasonable costs incurred or associated with Transmitter=s witnessing of the verification tests shall be borne by the Customer.~~

~~1.8. Procedures for Maintenance and Periodic Verification~~

~~1.8.1. The Transmitter, using good utility practice, may specify the maintenance criteria and the maximum time intervals between verification cycles for those parts of Customers= facilities that may materially adversely affect the transmission system. The obligations for maintenance and performance re-verification shall be stipulated in the appropriate schedule to this Agreement.~~

~~1.8.2. Test switches shall be provided to isolate current and potential transformer input to the relays as well as a set of switches to isolate the relays tripping outputs from the power equipment control circuitry.~~

~~1.8.3. The reasonable cost of conducting maintenance and verification tests shall be borne by the Customer.~~

~~1.8.4. The Transmitter may appoint a representative to witness relevant maintenance and verification tests and the Customer shall permit the representative to be present while those tests are being conducted.~~

~~1.8.5. To ensure that the Transmitter=s representative can witness the relevant tests, the Customer shall submit the proposed test procedures and a test schedule to the Transmitter not less than ten business days before it proposes to carry out the test. Following receipt of the request, the Transmitter may delay for technical reasons the testing for as long as ten business days. The Transmitter will use best efforts to make the required test date.~~

~~1.8.6. The reasonable costs associated with the witnessing of verification tests by the Transmitter=s representative shall be borne by the Customer.~~

~~1.8.7. If a verification test reveals that the electrical equipment or protective relay system covered under the operations schedule does not comply with requirements, the Customer shall:~~

~~1.8.7.1. promptly notify the Transmitter of that fact;~~

~~1.8.7.2. promptly advise the Transmitter of its proposed remedial steps and its timetable for their implementation;~~

~~1.8.7.3. diligently undertake appropriate remedial work and provide the Transmitter with monthly reports on progress; and~~

~~1.8.7.4. conduct further tests or monitoring on completing the remedial work, to confirm compliance with the relevant technical requirements.~~

~~1.8.8. The Transmitter=s reasonable costs associated with witnessing the performance tests following remedial work shall be borne by the Customer.~~

~~1.8.9. Customers shall make their maintenance records and verification test results, including up-to-date as-built drawings, available to the Transmitter upon request.~~

~~Exhibit E.1 Protection System Symbols and Devices~~

Protection Systems - Symbols and Device Functions

51B	Transformer Phase Backup
50 / 51	Instantaneous / Timed Overcurrent
51V	Voltage Controlled Overcurrent
64	Line Ground Protection
79-25	Synchronizing Relay
A21 / B21	Line Phase Protection - A&B Group
A27 / B27	Undervoltage - A&B Group
A59 / B59	Overvoltage - A&B Group
A64-27 / B64-27	Ground Undervoltage - A&B Group
A64-59 / B64-59	Ground Overvoltage - A&B Group
A81U / B81U	Underfrequency - A&B Group
A81O / B81O	Overfrequency - A&B Group
A87 / B87	Transformer Differential - A&B Group
F	Failure Protection
L1, L2	Supply Line
T1, T2	Power Transformer
RT/TT	Remote or Transfer Trip for HVI Device Failure Protection
	Circuit Breaker
	Circuit Breaker with Reclosure
HVI	HV Interrupting Device a) Circuit Breaker b) Circuit Switcher c) Vacuum Interrupter
	Motor Operated Disconnect Switch
H	HV Transformer Bushing
X	LV Transformer Bushing

~~Exhibit E.2 Typical Transmission System Protection Tripping Matrix~~

~~The following is a simplified tripping matrix showing the breakers that trip for different protection systems on the transmission system based on a single line supply to a Customer station or a transmitter=s tapped transformer station operating, at the high voltage side, above 50 kV 50kV. The type of Customer (i.e., load or Generator) station configuration and other site- specific factors will influence the desired tripping matrix. The same approach can be applied to large 44-kV developments. In some applications, it may be desirable to trip the MV breaker for Line ZI/T operations instead of the HV Breaker.~~

	INITIATING PROTECTION							
PROTECTION FUNCTION	LINE ZI	LINE ZT	TTR LOCAL	XFRM	BUS	B/F HV	FRAME LEAK *	B/F MV
TRIP HV BREAKERS	T	T		T	T	T	T	T
HV BREAKER FAILURE	I	I		I	I			
HV AUTO-RECLOSE	C	C		C	C	C	C	C
TRIP MV BREAKERS			T	T	T	T	T	T
MV BREAKER FAILURE			I	I	I		I	
MV AUTO-RECLOSE					C	C	C	C
TTT	S					S	S	
OPEN XFR DISC				I				
RIP ADJACENT HV ZONES						I		
RIP ADJACENT MV ZONES								I

T B trip breakers
I B initiate
C B cancel
S B send signal
HV B high voltage

TTR/T B transfer trip receive/transmit
ZI/T B impedance instantaneous/timed
B/F B breaker failure

MV B medium voltage

~~* - Frame leakage protection is normally associated with 500kV breakers~~

~~All transmission system elements, including breakers, in the zones of protection shall be fitted with redundant protection systems if devices operated at more than 50 kV, except as noted.~~

~~All breakers in the zone of protection that includes devices operated at more than 50 kV shall be fitted with the non-redundant breaker failure-protection systems. Transmission system reliability, as determined by the IESO, may require breaker failure protection on the transformer MV breaker.~~

~~The Customer must be able to isolate (self-contain) his internal problems without having a major impact on the transmission system. Under certain circumstances, HV breakers may not be required for load Customer step-down transformers, provided that a motorized disconnect switch and redundant communication channels and paths are provided to isolate the transformer at the terminal stations if a fault occurs in the transformer zone of protection.~~

~~Medium-voltage buses require either duplicated differential protection or a single differential protection with an overcurrent backup.~~