DISTRIBUTED ENERGY RESOURCES TECHNICAL INTERCONNECTION REQUIREMENTS

EFFECTIVE: September 1, 2023

FORWARD

The following technical requirements are for distributed energy resources interconnected with Tillsonburg Hydro Inc.'s (THI's) distribution system up to 50kV line to line. Information may be amended at any time without notice, to meet changing industry regulations and requirements. This document has been developed with reference to the Distribution System Code, Distributed Energy Resources Connections Procedures, Ontario Electrical Safety Code, CSA C22.2 No. 257-06 Interconnecting inverter-based micro-distributed resources to distribution systems, CSA C22.3 No. 9-08 Interconnection of distributed resources and electricity supply systems and IEEE 1547 IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems.

LIMITATION OF LIABILITY AND DISCLAIMER

THI shall only be liable to a customer and a customer shall only be liable to THI for any damages which arise directly out of the willful misconduct or negligence:

i) Of THI in providing distribution services to the customer;
ii) Of the customer in being connected to THI's distribution system; or
iii) Of THI or customer in meeting their respective obligations under the Distribution System Code, their licenses and any other applicable law.

Neither THI nor the customer shall be liable under any circumstances whatsoever for any loss of profits or revenues, business interruption losses, loss of contract or loss of goodwill, or for any indirect, consequential, incidental or special damages, including but not limited to punitive or exemplary damages, whether any of the said liability, loss or damages arise in contract, tort or otherwise.

The Customer or Embedded Generator shall indemnify and hold harmless THI, its Directors, Officers, Employees, and Agents from any claims made by any Third Parties in connection with the construction and installation of a generator by or on behalf of the Customer or Embedded Generator.

THI's "Distributed Energy Resources Technical Interconnection Requirements, including any updates of technical interconnection requirements in the form of bulletins and/or amendments that are published periodically by THI on its website (the "TIR"), identifies minimum requirements for generation projects connecting to THI's distribution system or the distribution system of Host or Embedded THIs. Additional requirements may need to be met by the owner of the generation project to ensure that the final connection design meets all local and national standards and codes and is safe for the application intended. The requirements outlined in the TIR are based on a number of assumptions, only some of which have been identified. Changing system conditions, standards and equipment may make those assumptions invalid. Use of the TIR and the information it contains is at the user's sole risk. THI, nor any person employed on its behalf, makes no warranties or representations of any kind with respect to the TIR, including, without limitation, its quality, accuracy, completeness or fitness for any particular purpose, and THI will not be liable for any loss or damage arising from the use of the TIR, any conclusions a user derives from the information in the TIR or any reliance by the user on the information it contains. THI reserves the right to amend any of the requirements at any time. Any person wishing to make a decision based on the content of the TIR should consult with THI prior to making any such decision.

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CONTACT

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1. INTRODUCTION

When planning, designing, and operating distributed energy resource systems, the power producer shall consult all applicable provincial, and Canadian electrical codes, and all other applicable federal, provincial and municipal laws, regulations, codes and by-laws, to ensure compliance with applicable requirements. Where THI's Distributed Energy Resources Technical Interconnection Requirements (TIR) conflicts with any applicable provincial, and Canadian electrical codes, or all other applicable federal provincial or municipal laws, regulations, codes and by-laws, the latter shall take precedent over this document.

The interconnection of distributed energy resources shall ensure safety, power quality, reliability and the operability of THI's distribution system.

1.1 DISTRIBUTED ENERGY RESOURCE

Distributed Energy Resource (DER) means, for the purpose of the Technical Interconnection Requirements (TIR), an electricity source or load that is connected to the distribution system for the purpose of generating electricity, for non-exporting use by the customer, exporting to the distribution system or for emergency backup generation.

The following terms shall have the same meaning in reference to DER facilities: "distributed generation", "embedded generation facility", "energy storage facility", "generation facility", "generator connection", "interconnected power production", "renewable energy system".

1.2 CONNECTION PROCESS REQUIREMENTS

The Distribution System Code requires THI to provide a process for connecting a DER facility to the distribution system and follow *the Distributed Energy Resources Connection Procedures* to process a request for connection of a DER facility.

Refer to document *TH I- DER Connection Process* for details, required information and applications.

- Preliminary Consultation
- Connection Impact Assessment
- Project Development
- Build & Energization

1.3 DEFINITIONS

The following definitions shall apply to this document:

"can" is used to express an option or capability;

"distributor" means a person who owns or operates a distribution system;

"disconnecting" means shall have the same definition as "isolation switch";

"eligible generator" in respect of a distributor means a customer of a distributor that meets the definition of;

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“eligible customer” or “eligible generator” as set out in section 1 of the Net Metering Regulation;

“embedded distributor” means a distributor that is provided electricity by a host distributor;

“embedded generation facility” means a generation facility which is not directly connected to the IESO-controlled grid but instead is connected to a distribution system, and has the extended meaning given to it in section 1.9;

“embedded retail generator” means a customer that:

(a) is not a wholesale market participant or a net metered generator (as defined in section 6.7.1);
(b) owns or operates an embedded generation facility, other than an emergency backup generation facility; and
(c) sells output from the embedded generation facility to the Ontario Power Authority under contract or to a distributor;

“exporting” injecting power in to the distribution system through the PCC

“generate”, with respect to electricity, means to produce electricity or provide ancillary services, other than ancillary services provided by a transmitter or distributor through the operation of a transmission or distribution system;

“generator” means a person who owns or operates a generation facility;

“islanding” means the operation of utility-interconnected inverter and part of the utility load while isolated from the remainder of the electric utility system;

“isolation switch” shall open all ungrounded conductors of the circuit to which it is connected;

“load displacement” means, in relation to a generation facility that is connected on the customer side of a connection point, that the output of the generation facility is used or intended to be used exclusively for the customer’s own consumption;

“may: is used to express an option or that which is permissible within the limits of the standard;

“net metered generator” means an eligible generator to whom net metering has been made available by a distributor;

“net metering regulation” means the Net Metering Regulation, O. Reg. 541/05;

“non-exporting connection” means a connection through which power flow is only from the distribution system to the customer’s premises (the connection is considered to be supplying a load);

“point of common coupling” means the point where the load facility or distributed energy resource facility assets connect to THI’s distribution system, refer to Figure 1;

“point of connection” means the point where the distributed energy resource units connect to the DER facility assets, refer to Figure 1;

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"point of supply", with respect to an embedded generation facility, means the connection point where electricity produced by the generation facility is injected into the distribution system;

"renewable energy generation facility" means a generation facility that generates electricity from a renewable energy source and that meets such criteria as may be prescribed by regulation and includes associated or ancillary equipment, systems and technologies as may be prescribed by regulation, but does not include an associated waste disposal site, unless the site is prescribed by regulation for the purposes of this definition;

"renewable energy source" means an energy source that is renewed by natural processes and includes wind, water, biomass, biogas, biofuel, solar energy, geothermal energy, tidal forces and such other energy sources as may be prescribed by the regulations, but only if the energy source satisfies such criteria as may be prescribed by the regulations for that energy source;

"shall" is used to express a requirement or a provision that the user is obligated to satisfy in order to comply with the standard;

"should" is used to express a recommendation or that which is advised but not required;

"standard supply voltage" means the voltage level and electrical configuration of the DER facility or load facility service defined in THI's Conditions of Service.

"uninterruptible power supply"; an uninterruptible power supply that provides power to the protected load from the ac input (bypass source) during normal mode of operation, and from the power conversion portion (inverter) upon failure of the bypass source.

Note: Additional definitions can be found in the documents listed in Standards and Reference Documents.

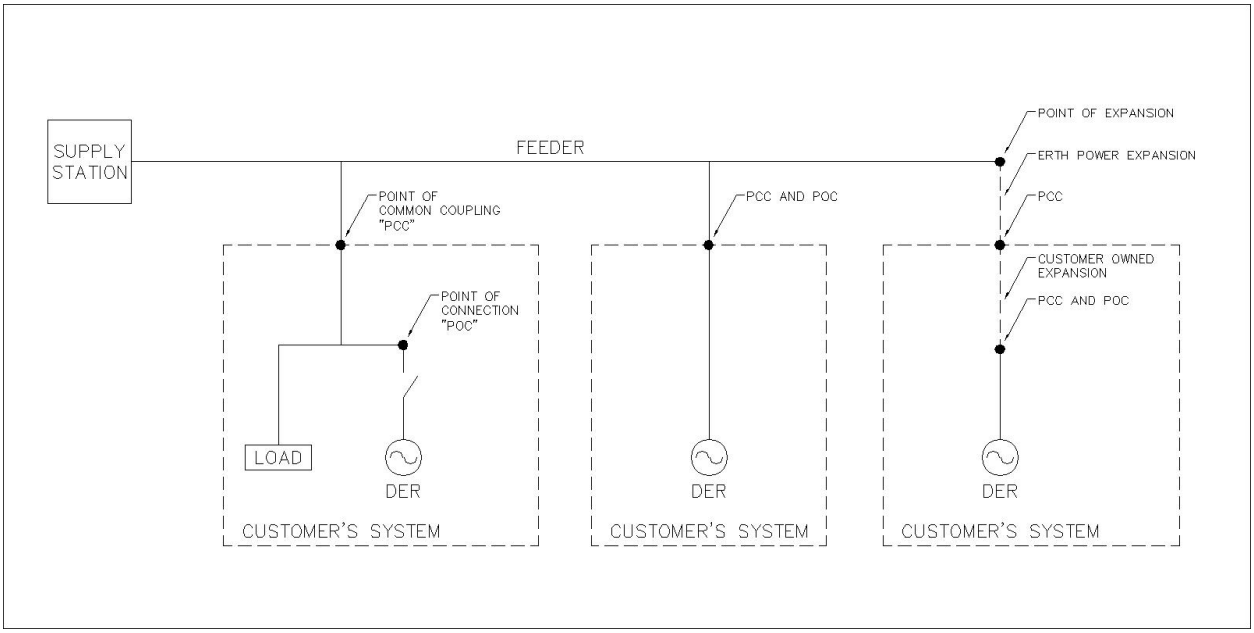

Figure 1. PCC and POC

1.4 TIR BULLETINS

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Bulletins may be published at any time to ensure expedient updates to the TIR between revision releases. Document updates and revisions are made available on THI's website or by requesting the information in paper form from THI's Operations Department addressed in the Contact section.

1.5 GENERATION CLASSES

Micro-embedded generation facility, means an embedded generation facility with a name-plate rated capacity of 10 kW or less;

Small embedded generation facility, means an embedded generation facility which is not a micro-embedded generation facility with a name-plate rated capacity of 500 kW or less in the case of a facility connected to a less than 15 kV line and 1MW or less in the case of a facility connected to a 15 kV or greater line;

Mid-sized embedded generation facility, means an embedded generation facility with a name-plate rated capacity of 10 MW or less and:

i) more than 500 kW in the case of a facility connected to a less than 15 kV line; and
ii) more than 1 MW in the case of a facility connected to a 15 kV or greater line;

Large embedded generation facility, means an embedded generation facility with a name-plate rated capacity of more than 10 MW;

Emergency backup generation facility, means a standby power system that is installed on a customer site for the sole purpose of providing electrical power if the primary or system power has been interrupted or is unavailable;

Storage facility, means, for the purpose of connections, a facility that uses electrical energy (i.e. charges), and then stores such energy for a period of time, and then provides electrical energy as an output, minus any losses (i.e. discharges);

1.6 PROJECT TYPES

1.6.1 Load displacement

Load displacement projects, in relation to a DER facility that is connected on the customer side of a connection point, that the output of the generation facility is used or intended to be used exclusively for the customer's own consumption. The DER facility is non-exporting to the distribution system.

1.6.2 Net Metering

Net metering is defined by O.Reg. 541/05 Net Metering Regulation and related laws. Net metering is intended to allow customers to generate electricity for their own consumption at their site and to allow eligible generators to convey eligible electricity into the distribution system for a credit.

1.6.3 Feed-in Tariff, Micro Feed-in Tariff

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Feed-in Tariff and Micro Feed-in Tariff are programs to allow renewable distributed energy resources a standard connection to the distribution system under contract with the Independent Electricity System Operator.

1.6.4 Emergency Backup Generation

An Emergency Backup Generation (EBG) facility is a standby power system that is installed on a customer site for the sole purpose of providing electrical power if the primary or system power has been interrupted or is unavailable. All EBG shall be Open Transition or Closed Transition. All Closed Transition EBG shall require an application to THI for review. All Open Transition EBG shall be declared to THI.

1.6.5 Other Project Types

Federal, Provincial or Municipal commitment to distributed energy resources may bring addition project types into force in the form of regulations or code changes. New project types will be addressed as they come into force in the form of a TIR revisions or bulletins.

2. TECHNICAL INTERCONNECTION REQUIRMENTS

2.1 GENERAL REQUIRMENTS

DER facilities shall ensure that the safety, reliability and efficiency of the distribution system is not materially adversely affected by the connection of a DER facility to the distribution system. All DER connections shall meet the technical requirements specified in CSA C22.3 No. 9-08 Interconnection of distributed resources and electricity supply systems and IEEE 1547 IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems. All DER facilities shall meet applicable provincial, and Canadian electrical codes, or all other applicable federal provincial or municipal laws, regulations, codes and by-laws

DER facilities shall comply with the Ontario Electrical Safety Code. ESA inspection and Connection Authorization is required prior to connecting any DER.

Proponents connecting a DER facility to THI's distribution system shall meet all technical, metering and connection process requirements. THI shall witness and review all DER facility installations, testing and final documentation prior to an Authorization to Generate is provided, placing the DER in service.

DER facilities shall be constructed, operated and maintained in accordance with THI's technical interconnection requirements.

2.2 HOST DISTRIBUTOR

DER facilities require compliance with the technical interconnection requirements of THI's host distributor. THI's host distributor is typically Hydro One Networks Inc. The host distributor shall be identified in the Preliminary Consultation Report.

2.3 SAFETY

The installation, operation and maintenance of all distributed energy resources shall not create a safety hazard to THI's personnel, customers, general public and personnel working in the DER facility.

2.4 STANDARDS

This document does not address all of the possible distribution system requirements for power quality and operating conditions. All DER facilities connected to THI's distribution system shall meet all applicable provincial, and Canadian electrical codes, or all other applicable federal provincial or municipal laws, regulations, codes and by-laws.

2.4.1 Distribution System Expansion or Enhancement

Distribution system expansions or enhancements required to connect a DER shall be provided and cost apportioned in accordance with the Distribution System Code and THI's Conditions of Service.

2.4.2 Standard Service Supply Voltages

DER facilities shall interconnect to THI's distribution system at the standard supply voltages stated in THI's Conditions of Service. Where the generator output voltage is not that of THI's standard supply voltage, the generator is responsible for interconnecting the generator at the standard supply voltage with an interface transformer owned and maintained by the generator.

Standard secondary supply voltages;

- 120/240V Single Phase 3 Wire;
- 208Y/120V Three Phase 4 Wire, grounded wye;
- 600Y/347V Three Phase 4 Wire, grounded wye.

Standard primary supply voltages;

- 27,600Y/16,000V Three Phase 4 Wire, grounded wye;
- 8,320Y/4,800V Three Phase 4 Wire, grounded wye;
- 4,160Y/2,400V Three Phase 4 Wire, grounded wye.

All primary voltages are location dependent, based on available primary feeders and specified by THI in the Preliminary Consultation Report.

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2.4.3 **Voltage**

DER facilities connected to THI's distribution system up to 1000V shall operate within ±6% for Normal Operating Conditions and ±8% for Extreme Operating Conditions.

CSA Standard CAN3-235-83 Table 3				
Normal System Voltages	Recommended Voltage Variation Limits for Circuits up to 1000V, at Service Entrance			
	Extreme Operating Conditions	Normal Operating Conditions		Extreme Operating Conditions
Single Phase				
120/240	106/212	110/220	125/250	127/254
240	212	220	250	254
480	242	440	500	508
600	530	550	625	635
Three Phase 4-Wire				
120/208Y	110/190	112/194	125/216	127/220
240/416Y	220/380	224/388	250/432	254/440
277/480Y	245/424	254/440	288/500	293/508
347/600Y	306/530	318/550	360/625	367/635
Three Phase 3-Wire				
240	212	220	250	254
480	424	440	500	508
600	530	550	625	635

Source: CSA CAN3-C235 Table 3

DER facilities connected to THI's distribution system greater than 1000V and up to 50,000V shall operate within ±6% of nominal voltage.

DER facilities shall operate with a voltage unbalance less than 3%.

2.4.4 **Phasing**

DER facilities shall ensure the connection of all equipment and rotating machines match the phase and sequence of THI's distribution system.

2.4.5 **Grounding**

DER facilities shall require grounding in accordance with the Ontario Electrical Safety Code and Canadian Standards Association requirements. Grounding shall not impact THI's distribution system, customers or protections negatively.

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2.4.6 Fault Levels

Maximum fault levels must be maintained within limits set by the Transmission System Code. The connection of the DER facility shall not cause these limits to be exceeded.

Fault Levels Maximum fault values are symmetrical fault values. Higher values may exist for short times during switching	**Requirement**		
	Nominal Voltage (kV)	Maximum Three-Phase Fault (kA)	Maximum SLG Fault (kA)
	44	20	19 (limited to 8kA)
	27.6 (4-wire)	17	12
	27.6 (3-wire)	17	0.45
	13.8	21	10

Source: Transmission System Code, Appendix 2

2.4.7 Generation Output

DER facilities shall restrict their generator KVA output to the project capacity which was applied for and assessed in the Connection Impact Assessment. Generator output is typically considered to be the name-plate rating of the generating unit(s).

2.4.8 Flicker

DER facilities shall not create objectionable flicker on to the distribution system. Flicker is considered objectionable when it either causes a modulation of light level of lamps sufficient to be irritating to humans or cause equipment mis-operation.

2.4.9 Harmonics

DER facilities shall not inject harmonic current into the distribution system beyond the point of common coupling. Harmonic current shall not exceed the table below. Harmonic current injection shall be exclusive of any harmonic currents due to harmonic voltage distortion present with the DER connected.

Maximum harmonic current distortion in percent of current

Individual harmonic order h (odd harmonics)	H<11	11≤h<17	17≤h<23	23≤h<35	35≤h	Total demand distortion (TDD)
Percent (%)	4.0	2.0	1.5	0.6	0.3	5.0

Note: Even harmonics are limited to 25% of the odd harmonic limits.
Source: IEEE 1547, Table 3

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Maximum harmonic voltage distortion in percent of rated voltage for synchronous machines

Individual harmonic order h (odd harmonics)	H<11	11≤h<17	17≤h<23	23≤h<35	35≤h	Total harmonic distortion (THD)
Percent (%)	4.0	2.0	1.5	0.6	0.3	5.0

Sources: IEEE 1547 - Table 6, IEEE Std. 519-1992 – Table 10-3

2.4.10 **Power Factor**

DER facilities shall operate with a power factor at unity or within ± 0.5 leading or lagging.

2.4.11 **System Frequency**

Nominal electrical system frequency operates at 60 ± 0.6 Hz. All DER connections to THI's distribution system shall operate at synchronous frequency within range and disconnect with the following clearing times;

Interconnection system response to abnormal frequencies

DER Size	Frequency Range (Hz)	Clearing Times (s)
≤ 30 kW	> 60.5	0.16
	< 59.3	0.16
> 30 kW	> 60.5	0.16
	< (59.8 – 57.0) adjustable set point	Adjustable 0.16 to 300
	< 57.0	0.16

Source: IEEE 1547 Table 2

2.4.12 **Power Quality**

DER facilities shall be designed, installed, operated and maintained to ensure the facility operates within the power quality limits as specified in CSA C22.3 No. 9.

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2.4.13 Synchronization

DER Facilities capable of generating its own voltage while disconnected from THI's distribution system shall require proper synchronizations facilities before connection is permitted. Synchronous generators, self-excited, inductions generators or inverters-based generators that produce fundamental voltage before the paralleling device is closed shall only parallel with THI's distribution system when frequency, voltage and phase angle differences are within the ranges in the table below at the moment of synchronization.

Aggregate Rating of DER units (kVA)	Frequency difference (Δf, Hz)	Voltage difference (ΔV, %)	Phase angle difference (ΔΦ, °)
0 - 500	0.3	10	20
> 500 – 1 500	0.2	5	15
> 1 500 – 10 000	0.1	3	10

Source: IEEE Std 1547-2003, Table 5 – Synchronization parameters limits for synchronous interconnections to an EPS, or an energized local EPS to an energized Area EPS.

DER facilities shall ensure generators operate in synchronous to the distribution system and not cause a voltage fluctuation greater than ± 5%.

2.5 GENERAL TECHNICAL REQUIREMENTS

The following technical requirements are specific to DER connections. These requirements may clarify existing provincial, and Canadian electrical codes, or all other applicable federal provincial or municipal laws, regulations, codes and by-laws with regard to DER facilities.

2.5.1 Single Phase and Three Phase Generator Limits

The maximum aggregate name-plated rating of a DER facility for a single-phase generator is less than 150 kVA. The maximum aggregate name-plated rating of a DER facility for a three-phase generator shall be determined by the capacity of the connecting transformer station, municipal station, primary distribution line, interconnecting transformer or any other technical condition that would limit generation.

2.5.2 Generator Isolation Switch

2.5.2.1 Definition

For the purpose of this standard, an "isolation switch" shall disconnect simultaneously all ungrounded conductors supplied from an energy source.

The following terms shall have the same meaning as an isolation switch; "disconnecting means", "disconnect switch".

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2.5.2.2 General Requirements

DER facilities shall have an isolation switch located at the point of common coupling, at the point of connection or both as designated by THI. The isolation switch shall simultaneously disconnect all ungrounded conductors from any distributed energy resource. All isolation switches shall be installed in accordance with the Ontario Electrical Safety Code and THI's requirements and at minimum have the following provisions:

i) be capable being energized from both sides;
ii) plainly indicate whether it is in the open or closed positions;
iii) the operator handle shall be in the "up" position when open;
iv) have contact operation verifiable by direct visible means;
v) have provisions for being locked in the open position;
vi) conform to OESC Sections 14, 28 and 36 if it includes an overcurrent device;
vii) be capable of being opened at rated load;
viii) disconnect all ungrounded conductors of the circuit simultaneously;
ix) bear a warning to the effect that inside parts can be energized when the disconnecting means is open; and
x) be readily accessible;
xi) Located outside as designated by THI.

Note: Breakers or relays shall not be considered acceptable for use as an isolation switch.

2.5.2.3 Interconnection Arrangement

DER facility(s) point of connection(s) will depend on the project type and electrical arrangement of the load facility and DER facility.

a) DER facility point of connection shall be designated and approved by THI;
b) DER facility interconnections shall be at THI supply voltages;
c) DER facility isolation switches shall be installed at the point of connection;
d) Where DER facilities are not directly connected to THI's distribution system, the isolation switch shall only disconnect the DER facility;
e) DER facility isolation switches shall not disconnect load facilities, revenue metering for load facilities or affect other critical or non-critical loads;
f) Electrical arrangements and physical locations may require multiple isolation switches to be present as per the Ontario Electrical Safety Code. The isolation switch at the point of DER facility interconnection shall meet all of THI's requirements;
g) DER facilities with multiple generating units shall provide an isolation switch to disconnect simultaneously all the electric power production sources from the supply authority or at the point of connection;
h) Where multiple DER facility generators are present for different applications, THI shall approve the individual point of connection and isolation switch location and requirements;

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2.5.2.4 Isolation Switch Location

The generator isolation switch shall be located as specified by THI and be readily accessible to THI personnel at all times for operation and control of the DER facility connection.

Micro-embedded generation (≤ 10 kW) shall have an isolation switch located within 1 meter of the revenue meter.

2.5.2.5 Visible Break Isolation Switch

DER facilities greater than 10 kW shall install a visible break isolation switch in accordance with OESC at the generator point of connection to either THI's distribution system or the customers electrical system. The isolation switch shall have contact operation verifiable by direct visible means under normal operation. All DER connections less than or equal to 10 kW are not required to have an isolation switch with contact operation verifiable by direct visible means under normal operation.

2.5.2.6 Transfer Switches (Automatic and Manual)

Transfer switch point of connection will depend on the project type and electrical arrangement of load and DER facility.

a) Transfer switch point of connection shall be designated and approved by THI;
b) Transfer switches shall have the same interconnection requirements as isolation switches;
c) Transfer switches approved for use with emergency backup generation shall not allow the generator to parallel with THI's distribution system (open transfer scheme);
d) Refer to Emergency Backup Generation for closed transition scheme requirements;
e) Transfer switches integral to backup generating units shall not be accepted as a dedicated transfer switch;

2.5.2.7 Metering Equipment Isolation

DER Facilities greater than 10 kW shall have isolation switches on the line and generator side of metering equipment. The generator side isolation switch shall be located within 3.0 meters of the metering equipment cabinet.

2.5.2.8 Electrical Safety Authority Inspection and THI Review

All isolation switch installations shall have Electrical Safety Authority inspection. THI personnel shall review the location and installation of isolation switches for compliance with this standard prior to operation.

2.5.2.9 Operation of Isolation Switch

THI personnel shall have safe access to the operation of isolation switches designated for operation by THI personnel. The isolation switch shall not be interlocked with any other device that would prevent THI's personnel from operating the isolation switch.

2.5.2.10 **Nomenclature and Labelling**

All isolation switches shall have THI identification and switch nomenclature installed. Nomenclature will be provided by THI. Switch nomenclature shall be permanent, 2" high visibility, yellow on block lettering. All isolation switches shall bear a permanent, legible single line diagram as per OESC.

2.5.3 **DER Interconnection Transformer**

DER facilities shall interconnect to THI's distribution system or load customers electrical system at standard supply voltages. Where the generator output is not of the standard supply voltage an interconnection transformer shall be installed. Interconnection transformers shall have overcurrent protection in accordance with the OESC.

2.5.4 **Distirbution System Neutral**

DER facilities shall require the distribution system neutral to be connected to the DER facility ground grid regardless of the service supply voltage. Where a DER facility is interconnected to a customer owned station transformer, the station ground grid shall be connected to the distribution system neutral.

2.5.5 **Generator Equipment**

All generator and electrical equipment installed in the construction, operations and maintenance of a DER facility shall meet all CSA, IEEE and OESC requirements. Equipment rating shall not exceed the design limits applied for in the connection process of the DER facility.

2.5.6 **Automatic Reclosing**

Automatic reclosing of the DER facility's interface protection may be permitted upon THI's review and acceptance of the reclosing scheme and settings.

Reclosing conditions after disconnection for abnormal condition on the distribution system:

i) voltage is present and stabilized within 6% of nominal;
ii) frequency is between 59.5Hz and 60.5Hz; and
iii) automatic reconnection delay of 5 minutes of conditions i) and ii).

Automatic reclosing of the DER facility's interface protection shall be disabled when the primary supply feeder has not been re-established for normal operating conditions within a period of fifteen (15) minutes. The DER facility owner must contact THI for authorization to reconnect the DER facility.

2.5.7 **Emergency Backup Generation - Open Transition**

Open transition emergency backup generation (EBG) shall only be for the purposes of generating electricity when the there is a loss of utility supply. The transition to EBG from utility supply is with a transfer switch that operates in **break-before-make** mode. Once utility supply returns, reconnection to THI's distribution system through a transfer switch again operates in **break-before-make** mode. At no time is the EBG to operate in parallel with THI's distribution system. Customers with EBG must submit the Declaration of Emergency Backup Generation Facility form. An isolation switch is required in the event of automatic/manual transfer switch failure.

2.5.8 Emergency Backup Generation - Closed Transition

Closed transition emergency backup generation (EBG) shall only be for the purposes of generating energy when the there is a loss of utility supply. The transition to EBG from utility supply shall use a dedicated transfer switch that operates in the **break-before-make** mode. Once utility supply returns, reconnection to EP's distribution system, the transfer switch shall operate in the **make-before-break** mode. Customers with closed transition emergency backup generation shall submit a Closed Transition Emergency Backup Generation Application. An isolation switch is required in the event of automatic/manual transfer switch failure.

Upon return to normal system supply CTEBG shall only remain in parallel with THI's distribution system for a maximum of six cycles (100 milliseconds).

The following protections are required for a CTEBG facility:

i) Under-voltage protection, which shall ensure the embedded generation facility is not capable of energizing a de-energized distribution system;
ii) A maximum 100 millisecond delay timer, to ensure that the power producer's paralleling device and the embedded generation facility's paralleling device do not maintain a closed position for more than 100 milliseconds;
iii) Manual or automatic synchronization check.

2.5.9 Capacity Limits on Supply Transformer

Allowable limit of micro-embedded DER connections (≤ 10 kW) is equal to 90% of the nameplate KVA rating of the transformer. The maximum transformer size for single phase, overhead is 75kVA. The maximum size for single phase, pad-mounted transformers is 100kVA.

Allowable limit of three phase DER connections is equal to 90% of the transformer nameplate kVA rating to a maximum of 300kVA for overhead transformers. Allowable limit of three phase DER connections is equal to 90% of the transformer nameplate kVA rating to a maximum of 1,000kVA for pad-mounted transformers owned by Tillsonburg Hydro. Allowable limits for customer owned transformer stations shall not exceed the station transformer nameplate rating. All maximum connected generation limits must not exceed the host distributor's TIR limits.

Large DER connection limits shall be calculated on an individual project basis and limited to the available transmission or distribution system capacity at the PCC of the DER site connection.

2.5.10 Host Distributor Supply Feeder Limitations

THI's distribution system is connected to a host distributor. Consult the host distributor's technical interconnection requirements for additional feeder limitations.

2.5.11 Distribution Feeders

Distribution feeder capacity limits are specified in THI's DER Feeder and Substation Capacity Limits document.

2.5.12 DER Connections to Exisiting Facilities

Proposed DER connections to existing load or DER facilities shall be reviewed by THI for technical requirements. The addition of a DER connection or increase in capacity shall require the existing load or DER facility to comply with the current Conditions of Service and TIR for supply voltage, wiring, metering or other requirements. Upgrades to existing load or DER facilities shall be the facility owner's responsibility.

2.5.13 Primary Supply Feeder

DER facilities shall be connected to a single, designated primary supply feeder as applied for in the connection impact assessment. DER facilities shall only be allocated capacity to connect on a single designated primary supply feeder. THI may change the designated primary supply feeder to the DER facility as required to perform system switching, maintenance or provide continuity of electrical supply for load facility connections. The DER facility shall disconnect from the distribution system at any time the designated primary supply feeder requires to be switched for an alternate primary supply feeder. The DER facility may reconnect after the designated primary supply feeder has been restored for operation. At no time shall a DER facility restrict THI's operation of the distribution system.

2.5.14 Power Quality Monitoring Device

DER facilities greater than 250 kW shall be equipped with a Power Quality monitoring device capable of providing required reports. The device shall be capable of monitoring harmonics up to the 50th harmonic, impulse transients in the millisecond range and low frequency oscillatory transients less than 5kHz. Power quality monitoring applies to phase voltages, neutral to ground voltage and phase currents.

2.5.15 Provision for Future Requirements

DER facilities shall be aware of and responsible for future requirements. Future requirements may be regulatory as prescribed by the Ontario Energy Board, provincial, federal, codes, regulations, laws, bylaws, safety or technical requirements.

2.6 PERFORMANCE REQUIRMENTS

The connection of the DER facility shall not materially compromise the reliability or restrict the operation of THI's distribution system. Power quality shall be maintained to industry standards with respect to, but not limited to, voltage, current, frequency, power factors, harmonics and all disturbances. The DER facility shall maintain power quality equipment to measure, record and report on performance related events. Should the DER facility negatively affect THI's distribution system, the facility shall disconnect from the distribution system until measures have been take to mitigate the negative impacts.

2.7 PROTECTION REQUIRMENTS

DER facilities shall ensure the distribution system is adequately protected from potential damage or increased operating costs resulting from the connection of a DER facility. If damage to the distribution system, or increased operating cost result from the connection of a DER facility other than micro-embedded generation facility, the distributor shall be reimbursed for these costs by the generator.

Protection devices shall be fail safe, not interlocked with any isolating/interrupting devices, ensure adequate coordination with all DER facility protections, distribution system protection devices and host distributor or transmitter protection devices and schemes.

Protection equipment, schemes and settings shall meet all requirements of THI and the host distributor that supplies THI's distribution system and conform to applicable industry standards.

DER facility protection devices and schemes shall ensure the safe and reliable operation of the DER facility, distribution system, transmission system and personnel working in or around the DER facility.

2.7.1 Distribution System Interface Protection

DER facility connections for non-exporting generation shall install protection relays to ensure no back feed into THI's distribution system. The protection scheme and settings shall be provided in the design details stage of the project and meet all necessary requirements.

DER facilities that do not require Transfer Trip, all generation shall:

i) be disconnected within 200ms of the start of the abnormal condition on the distribution system;
ii) disconnect all sources of generation within 500ms when the DER facility's anti-islanding protection operates;

Refer to the host distributor's technical interconnection requirements for additional details.

2.7.2 Loss of Supply

DER facilities shall automatically disconnect from the distribution system upon loss of voltage on one or more phases of the supply and not reconnect until the normal voltage level has been restored. DER Facilities may reconnect five (5) minutes after return of normal supply voltage. Where the loss of supply voltage is greater than fifteen (15) minutes, DER facilities shall contact THI for authorization to reconnect.

2.7.3 Generator Equipment Protection

All generators are responsible for the protection of generating equipment and any ancillary equipment at the DER facility.

2.7.4 **Minimum Protection Requirements**

All DER connections shall have at a minimum, the following protection functions:

i) under-voltage (27);
ii) over-voltage (59);
iii) under-frequency (81U);
iv) over-frequency (81O);
v) overcurrent, phase/neutral (50/50N);
vi) synchronizing check (25);
vii) Anti-islanding protection.

Additional protection function may be required depending on the generator type and system design.

2.7.5 **Breaker Fail**

DER facilities with an aggregate output rating of > 500 kW shall provide breaker failure protection for the primary interrupting device that is responsible for disconnecting the generator and/or HV ground sources from THI's distribution system.

2.7.6 **Reverse Flow Protection**

DER connections for non-exporting power shall have reverse power protection.
i) directional power (32R);
ii) directional over-current, phase/neutral (67/67N);

2.7.7 **Transfer Trip**

Anti-islanding protection in the form of Transfer Trip may be required by THI or the host distributor to ensure the DER facility does not island in the event of operation of the supply feeder protection breaker.

Where transfer trip is required, the DER facility shall meet the following criteria:

i) cease to energize the distribution system after receiving a transfer trip signal;
ii) cease to energize the distributions system upon transfer trip communication loss;
iii) provide a Distributed Generator End Open signal to the connecting transmission station; and
iv) provide a Low Set Block Signal to the connecting transmission station.

Transfer Trip shall be required on all DER facilities were the aggregate name-plate generation exceeds 1,000 kW. Transfer Trip may also be required as determined by THI at the time of interconnection to THI's distribution system.

Transfer Trip communications and timing shall meet the requirements of the host distributor or transmission station owner the primary supply feeder is connected to.

DER facilities that require Transfer Trip, all generation shall:

v) disconnect immediately upon receipt of the TT signal;

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vi) disconnect within 500ms of when external faults are detected on the distribution system by the DER facility's interconnection protection;

2.7.8 Load Displacement

DER facilities connected for non-exporting, load displacement purposes, shall ensure the design, construction and operation of the DER facility utilize a load following scheme to limit the generation output to 90% of the load facility's consumption. The DER facility shall not export power to the distribution system at any time.

2.7.9 Faults

DER facility connections to THI's distribution system shall protect the distribution system from faults:

i) Protection of the distribution system from fault current supplied by the DER facility;
ii) Protection of the distribution system from faults within the DER facility.

2.7.10 Protection Functions

The list of ANSI protection functions may be required but not limited to the following:

i) 21 Distance relay
ii) 25 Synchronization
iii) 27 Under-voltage
iv) 32 Direction power
v) 46 Negative sequence current
vi) 47 Negative sequence voltage
vii) 50 Overcurrent
viii) 50N Neutral overcurrent
ix) 51 Inverse timed overcurrent
x) 51N Neutral inverse timed overcurrent
xi) 52 AC circuit breaker
xii) 59 Over-voltage
xiii) 67 Directional overcurrent
xiv) 81O Over-frequency
xv) 81U Under-frequency
xvi) 89 Interconnect disconnect device
xvii) Transfer trip
xviii) Distributed generation end open
xix) Low set block signal

The use of protective functions and equipment shall be prepared and approved by a Profession Engineer of Ontario.

2.7.11 Protective Device Settings

DER facilities requiring protection devices shall provide THI with the protection scheme, study and device setting documentation stamped and sealed by P.Eng. licensed in the Province of Ontario.

2.7.12 Protection Changes

DER Facility owner shall be responsible for all protection devices, schemes and settings required to connect the DER facility. The DER facility owner shall obtain THI's written approval for all interconnection equipment replacements, design modifications and protection changes. THI shall witness the commissioning and testing of any changes to the DER facility.

Prior to reconnecting a DER facility after any changes, the DER facility owner shall provide updated documentation stamped and sealed by P.Eng. licensed in the Province of Ontario. Any changes without prior approval shall be deemed a violation of the Connection Agreement and may result in the immediate disconnection of the DER facility to THI's distribution system.

2.8 OPERATING REQUIREMENTS

2.8.1 Maintenance Plan

DER facilities connected to THI's distribution system shall have a regular, scheduled maintenance plan to ensure that the generator's connection devices, protection systems and control systems are maintained in good working order.

2.8.2 Compliance with Technical Requirements

Existing DER facilities connected to THI's distribution system that:

i) cause a material deterioration of the reliability of the distribution system resulting from the performance of the generator's equipment;
ii) cause a negative impact on the quality of power of an existing or new customer resulting from the performance of the generator's equipment; or
iii) propose a material increase in the generator capacity at the site where the equipment deemed compliant is located;

shall be required to meet all criteria of THI's DER Technical Interconnection Requirements at the cost of the generator owner.

The DER facility owner is responsible for correcting all deficiencies in the design, construction and operation of their DER facility at their own expense.

2.8.3 Equipment, Protection or Protection Scheme Failures

In the event the DER facility experiences any equipment, protection or protection scheme failures, the DER facility shall immediately disconnect from the distribution system. The DER facility may reconnect after repairs have been completed and verified by THI. At no time shall a DER facility be permitted to operate in an unsafe manner.

2.9 MONITORING AND CONTROL REQUIRMENTS

2.9.1 Supervisory Control and Data Acquisition (SCADA)

DER facilities with an aggregate name-plate rating greater than 250 kW shall provide real-time monitoring and control from the DER facility to THI and the host distributor.

DER facilities greater than 10 kW and less than 250 kW shall have provisions for real-time monitoring and control. The DER facility owner shall provide real-time monitoring and control at the owner's expense upon request by THI or the host distributor. The DER facility shall provide real-time monitoring and control with sixty (60) days of written notice of the request.

Realtime monitoring shall comply with THI's DER Monitoring Standard, IEEE1547.3 IEEE Guide for Monitoring, Information Exchange, and Control of Distributed Resources Interconnected with Electric Power Systems and host distributor requirements.

All telemetry shall be available to THI and upstream host distributor. The routing of communications and information exchange will be at the requirements of THI and may be subject to change at any time. The cost of installation, operation and maintenance of all real-time monitoring and control infrastructure shall be the responsibility of the DER facility owner.

DER facilities that only require real-time monitoring may be directed to the host distributor's SCADA system. DER facilities that require real-time monitoring and control shall communicate with THI's SCADA system.

DER facilities providing real-time monitoring to the host distributor may be directed to reroute communications to THI's SCADA system at any time. The DER facility owner shall bare all costs of installation, operation and maintenance of all real-time monitoring and control infrastructure.

Where the DER facility providing real-time monitoring and control to THI or host distributor, the two distributors shall share the telemetry through an established Inter-Control Center Communications Protocol (ICCP) connection. The DER facility shall not bear the responsibility or cost of the ICCP communications between distributors.

DER facilities requiring real-time monitoring and/or control shall be provided with the SCADA system technical details for connection.

DER facilities that do not have real-time monitoring and control installed at the time of connection shall ensure the provision of equipment necessary for real-monitoring and control.

DER facilities providing real-time monitoring and control shall have dedicated equipment only shared between the DER facility and THI's or host distributor's SCADA system. Equipment, instrumentation and communications shall not be shared with any other party.

2.9.2 **Monitoring Information**

DER facilities requiring monitoring shall provide the following telemetry:

i) connection status of each generating unit;
ii) real power of the generation facility ;
iii) reactive power of the generation facility;
iv) phase voltages at the point of connection;
v) phase currents at the point of connection;
vi) distributed generation line end open status;
vii) generator protection fail status;
viii) isolation switch(s) status;
ix) protective relay(s) status; and
x) alarm status.

Additional telemetry may be required as identified in the connection impact stage or design details stage of the project.

2.9.3 **Monitoring Equipment**

Where real-time monitoring of a DER connection is required, an approved remote telemetry unit shall be installed for connecting the DER facilities telemetered devices to THI's or host distributor's SCADA system.

Approved power quality metering equipment shall be installed for the provision of real power, reactive power, phase voltages and phase currents. Where the DER connection consist of more than one generating unit, totalized values for monitoring shall be required. Where the DER facility consists of more than one generating unit at different connection voltages, individual monitoring equipment for each generating unit shall be required.

DER facilities connected for exporting to the distribution system shall locate monitoring devices at the point of common coupling or interconnection as identified by THI or host distributor.

Monitoring devices and wiring interconnections shall be provided on the single line diagram. Refer to THI's Monitoring Standard for technical details.

2.9.4 **Monitoring Equipment Backup Supply**

DER facilities with monitoring equipment shall have their telemetry and communications equipment on an uninterruptible power supply (UPS). The UPS shall have sufficient capacity to ensure the DER facility protection functions and monitoring equipment operate upon loss of supply until the supply has been restored.

2.9.5 **Communications Protocol (DNP3.0)**

All monitoring equipment shall be capable of providing telemetry to THI or host distributor's SCADA system using the Distributed Network Protocol 3.0 or other protocol specified during the implementation stage of the project.

A DNP Setting Specification shall be provided to proponents during the construction phase of the project.

2.9.6 Remote Telemetry Units (RTU)

All DER facilities shall provide real-time monitoring and control interconnected to an approved remote telemetry unit. Refer to THI's DER Monitoring Standard.

2.9.7 Telemetry Data

Analog telemetry data shall have an overall end-to-end measurement error no greater than two percent of the nominal rating. The error shall include all primary, secondary, and analog to digital conversions. Resolution shall meet or exceed the accuracy rating of the device performing the analog to digital conversion. Measurement instrumentation interfaced with monitoring devices shall have sufficient accuracy to ensure end-to-end accuracy.

Analog signed values shall be with respect to the DER facility (i.e. positive real power values indicate delivery of energy to the distribution system from the DER facility).

Refer to the following chart for telemetry reporting rates.

Function	Performance
Data measurements	Less than 10s from change in field monitored quantity
Equipment status change	Less than 10s from field status change
Scan period for data measurements	Minimum 4s
Scan period for equipment status	Minimum 4 s

Source: Hydro One TIR, Table 16

2.9.8 SCADA Testing

DER facilities requiring monitoring shall perform end to end testing by injecting instrumentation signals into the monitoring devices. A satisfactory SCADA communications test plan shall be provided prior to all testing. All SCADA testing shall be witnessed by THI.

2.10 TELECOMMUNICATION REQUIRMENTS

Telecommunications Infrastructure is required for DER facilities requiring real-time monitoring, control or Teleportation. All infrastructure shall be fast, secure, reliable and meet THI's DER-Communication Standard or host distributor's technical interconnection requirements. THI shall provide the mode of communication to be used by the DER facility. The DER facility shall be responsible for the cost of all equipment installations, maintenance, operating and upgrades as required to ensure continuity of telemetry to THI or host distributor's SCADA system.

2.10.1 Telecomunication Security

DER facilities shall ensure all telecommunications are secure and meet industry standards for security of telecommunication devices and networks. THI shall maintain control of all security and encryption devices for the telecommunication interconnection of the DER facility to THI or host distributor systems, regardless of ownership. Security and hardware requirements may change at any time to ensure the security of THI's communication and distribution system. DER facilities shall provide all necessary upgrades, firmware or hardware as required by THI or host distributor to maintain security. DER facilities that do not provide or maintain security to THI or host distributor's requirements shall immediately disconnect from the distribution system until security requirements have been completed in compliance with this TIR and industry standards.

2.10.2 Telecommunications for Teleprotection

Telecommunications for Teleprotection shall meet the requirements of the host distributor or the transmission station owner the DER facility is connected to. The DER facility shall be responsible for the cost of all equipment installations, maintenance, operating and upgrades as required for Teleprotection.

2.10.3 Mode of Communication

Technologies for communications will vary based on availability at the DER facility. The mode of communication will typically be cellular based; however, licensed/unlicensed radio, optical fiber, carrier-based leased circuits may be utilized.

2.10.4 Telemetry Data Usage

Telemetry data usage per month will vary by project based on the amount of telemetry data points to be monitored. DER facility owners shall ensure the telemetry mode of communication can support sufficient data bandwidth and usage to ensure the DER facility provides continuous telemetry to THI's SCADA system or upstream transformer station for Transfer Trip. DER facility owners are responsible for all telecommunication equipment, maintenance and operating costs.

2.10.5 Infrastructure Upgrades

Where technologies become unsecure, unavailable or end of life, specifications for a suitable replacement shall be provided to the DER facility owner. The DER facility owner shall bare all costs and responsibility for upgrades, replacements and testing.

2.10.6 Teleprotection Reliability

Telecommunications infrastructure shall meet the following requirements:

i) Provide at least an annual average availability of 99.65%
ii) Meet Teleprotection dependability as defined in IEC 60834-1
iii) Meet Teleprotection security as defined in IEC 60834-1

DER Facilities that require Teleprotection (Transfer Trip) shall disconnect form the distribution system immediately upon loss of communications.

2.10.7 **Real-time Monitoring and Control Reliability**

Real-time monitoring communications shall maintain reliability as follows:

i) MTBF (Mean Time between Failure) of four (4) years; and
ii) MTTR (Mean Time to Repair) of seven (7) days.

DER facilities shall disconnect from the distributions system as follows:

iii) Where real-time monitoring and control is required, shall disconnect from the distribution system after loss of communications for 24 hours; and
iv) Where only requiring real-time monitoring is required, shall disconnect form the distribution system after loss of communications for seven days.

DER facilities shall notify THI immediately upon loss of communications.

2.11 **REPORTING REQUIRMENTS**

DER facilities shall have sufficient infrastructure to comply with the following reporting requirements:

2.11.1 **General Reporting**

DER facilities shall:

i) record protection events;
ii) keep a written or electronic log with date, time and description of the event;
iii) make the log, or copy of the log, available upon request within five (5) business days;
iv) monitor the following:
- connection status of each generating unit;
- real power of the generation facility ;
- reactive power of the generation facility;
- phase voltages at the point of connection;
- phase currents at the point of connection;
- distributed generation line end open status;
- generator protection fail status;
- isolation switch(s) status;
- protective relay(s) status; and
- alarm status.

2.11.2 **Power Quality Recording**

DER facilities shall:

i) provide power quality recording;
ii) report power quality events for the following:
- real power of the generation facility ;
- reactive power of the generation facility;
- phase voltages at the point of connection;
- phase currents at the point of connection;

iii) provide waveform event reports in standard formats.

2.11.3 Sequence of Events Recording

DER facilities shall provide Sequence of Events reports for the following:

i) generator connection status;
ii) isolation switch(s) status;
iii) protective relays(s) status;
iv) Transfer Trips signal status;
v) Distributed Generation End Open (DGEO) signal status;
vi) generator control (from THI) signal status;
vii) communications link status;

2.12 METERING REQUIRMENTS

2.12.1 Metering Standards

DER facilities greater than 250 kW shall have metering equipment installed. Where metering equipment is not installed at the time of connection, provisions for metering equipment shall be installed. DER facilities shall install metering in accordance with THI's metering standards. Refer to EP-DER Metering Standards for technical requirements. All metering installations shall conform to Measurement Canada standards.

2.12.2 Metering for Settlement

DER facilities requiring settlement shall have metering installations and wiring compliant with all applicable regulations and conform to Measurement Canada and Independent Electricity System Operators' requirements. The electrical arrangement will vary based on the DER project type.

2.12.3 Embedded Retail Generator

DER facilities with a gross name-plate capacity greater than 10 MW shall have a four-quadrant interval meter provided by and installed THI at the facility owner's expense. All DER connections with a gross name-plate capacity of 10 MW or less shall have metering installed by THI at the DER facility owner's expense with regard to:

a) The meter data requirement necessary to enable THI to settle amounts owning to or from the embedded retail generator;
b) The type of DER facility or generation technology of the embedded retail generation facility.

2.12.4 Net Metering

Net metering projects shall require bi-direction revenue metering installed to current specifications. Net metering projects with existing retail embedded generation shall maintain an additional revenue meter with the net metered service requiring a bi-directional meter.

2.12.5 Gross Load Billing (GLB)

Gross Load Billing is applicable to all sub-transmission customers with Load Displacement DER facilities and local distribution companies with embedded generation. Gross Load Billing is applied to DER facilities

were any single generating unit at the facility exceeds the following threshold regardless of the cumulative size of the generation facility.

- Equal to or greater than 1 MW with non-renewable generation
- Equal to or greater than 2 MW for renewable generation

Gross Load Billing is a requirement for THI customers whose DER facilities are embedded to Hydro One Networks Inc. GLB may be identified during the connection process of a DER facility or after connection if not identified in the connection process. Customers identified for GLB will require revenue metering to be installed at the customer's expense. Metering will be installed on DER facilities in accordance with THI's metering requirements. Refer to THI's metering standards for installation requirements.

2.12.6 DER Facility Owner Metering

DER facilities connected to ERH Power's distribution system shall install its own meter in accordance with THI's metering requirements and provide THI with the technical details of the meter installation. The DER facility owner metering shall be capable of providing power quality data and event recording.

2.12.7 Metering Generator Output

DER facilities with a generator rating greater than 250 kW, other an embedded retail generator or emergency backup generator, shall require revenue grade metering of the generator. The metering shall be provided by THI at the DER facility owner's expense. The meter shall be installed at the generator output, point of connection or point of common coupling as designated by THI. Metering shall be provided for power quality monitoring and future capacity reserve charge.

DER facilities shall provide THI metering equipment enclosures with a protected 120Vac supply for ancillary equipment as identified by THI. Metering instrumentation shall be dedicated and accessible by THI staff in an approved metering cabinet and location.

2.12.8 Metering at Standard Supply Voltages

DER facilities requiring metering shall provide metering connections at THI's Standard Supply Voltages as stated in THI's Conditions of Service.

2.12.9 Service Supply and Metering Upgrades

DER facilities connecting to existing service connections shall upgrade the existing connection to conform to current service and metering standards and requirements. DER facilities increasing generation capacity shall upgrade the existing connection to conform to current service and metering standards and requirements. The load or DER facility owner(s) requiring service and metering upgrades shall bare the cost of the upgrades.

2.13 COMMISSIONING AND VERIFICATION REQUIRMENTS

THI shall have the right to witness the commissioning and testing of the connection of the DER facility to the distributor's distribution system.

2.13.1 Verification and Testing

Verification of the installation and testing of all equipment at the DER facility to include but not be limited to the following:

i) all equipment and facilities connected to THI's distribution system;
ii) distribution system protection equipment including protection settings;
iii) generator protection equipment including protection settings;
iv) calibration checks of each protective relay shall be performed by using injection of appropriate ac quantities, secondary injection, or set-point adjustment verification;
v) confirmation the isolation switch has contact operation verifiable by direct visible means under normal operation;
vi) polarities, burdens and ratios of field-wired instrument transformers as correct in accordance with the design;
vii) on three phase systems, the phase rotation of the DER facility and distribution system verified compatible;
viii) all monitoring equipment and communications verified as functional;
ix) all other tests and verifications identified by THI through the connection process

A final report of the outcome of verification and testing shall be provided to THI by the DER facility owner prior to connection.

2.13.2 Confirmation of Verification Evidence Report Requirements

Testing shall conform to 1547.1-2005 IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems and Associated Interfaces. THI shall witness testing for protections, monitoring, control and generator output.

The DER facility owner shall have a professional engineer licensed in the Province of Ontario declare (stamp and seal) in the Confirmation of Verification Evidence Report (COVER) that the DER facility has been designed, constructed and tested in accordance with THI's TIR, host distributor's TIR, DER application, connection impact assessment, and all applicable provincial, and Canadian electrical codes, or all other applicable federal provincial or municipal laws, regulations, codes and by-laws.

THI shall provide the COVER form for completion by the DER facility owner.

2.13.3 Documentation

The following documents are required by the DER facility owner for THI to connect the DER facility to the distribution system;

i) Confirmation of Verification Evidence Report (COVER, stamp and sealed by P.Eng. licensed in the Province of Ontario);
ii) Single Line Diagram of the electrical system downstream of the point of common coupling to THI's distribution system (stamp and sealed by P.Eng. licensed in the Province of Ontario); and
iii) Electrical Safety Authority inspection and Connection Authorization.

THI shall provide the host distributor with a Letter of Equivalency (LOE) upon acceptance of the DER facility COVER.

2.14 MAINTENANCE REQUIRMENTS

DER facilities connected to THI's distribution system shall have a regular, scheduled maintenance plan to ensure that the generator's connection device, protection systems and control systems are maintained in good working order. Generators shall maintain facilities in accordance with the Canadian Electrical Code, Part Rule 2-300.

2.14.1 Protection and Control Equipment

The DER facility shall re-verify its interconnected Protection and Control systems to THI distribution system on a periodic basis as follows:

i) whenever any protection and control equipment requires replacement, design modifications, or setting changes;
ii) every 8 years for IED-based protection sub-systems that employ comprehensive self-diagnostic features to detect and provide alarm telemetry to THI for internal sub-system failures;
iii) every 4 years for electromechanical or other non IED-based protection sub-systems that do not employ comprehensive self-diagnostic features to detect and provide alarm telemetry to THI for internal sub-system failures;
iv) as required to restore or sustain the safety or reliability of THI's Distribution System to acceptable levels of performance, as required by the Distribution System Code and the Conditions of Service; and
v) whenever the host distributor requires re-verification.

2.15 EQUIPMENT REPLACEMENT

DER facilities requiring repairs to their equipment shall ensure that all replaced equipment is of the same make, model and manufacturing number as the original installation. Should original materials not be available, a review must be completed to ensure the facility has not materially changed. Equipment replacements may not increase the size of the generator output, reduce safety or alter protection systems originally installed. Where replacement equipment is required, the affected equipment must be installed to updated specifications, tested, inspected by the Electrical Safety Authority and reviewed by THI.

2.16 INSTALLATION MODIFICATION

DER facilities requiring modification or replacement of equipment shall obtain approval prior to making any changes. Where protection system changes are requested a new protection study and protection testing shall be required prior to reconnection of the DER facility.

Any increase of capacity to the existing DER facility shall require the generator to follow the Distributed Energy Resource Connection Procedures to apply for additional capacity.

3. STANDARDS AND REFERENCE DOCUMENTS

This document refers to the following publications, and where such reference is made, it shall be to the latest edition, including all amendments. All distributed energy resources connected to THI's distribution system shall comply with, but not be limited to, the following documents.

- Electricity Act, 1998
- Ontario Energy Board Act, 1998
- O. Reg 541/05 Net Metering Regulation
- O. Reg. 24/17 Net Metering
- O. Reg. 386/22 Net Metering

- Distribution System Code
- Distributed Energy Resources Connection Procedures
- THI Conditions of Service
- THI DER Communication Standards
- THI DER Metering Standards
- THI DER Monitoring Standards

- Hydro One Networks Inc, Distributed Generation Technical Interconnection Requirements – Interconnections at Voltages 50kV and Below (DT-10-15)
- Hydro One Networks Inc., Technical Interconnection Requirements for Distributed Generation, Micro Generation & Small Generation, 3-phase, less than 30kW

- C22.1-06 Canadian Electrical Code, Part 1
- C22.2 No. 107.1 General Use Power Supplies
- C22.2 No. 178.1 Transfer Switch Equipment
- CAN/CSA C22.2 No. 257-06 Interconnecting inverter-based micro-distributed resources to distribution systems
- CAN/CSA C22.3 No. 9 Interconnection of distributed resources and electricity supply systems
- CAN3-C235-83 Preferred voltage levels for AC systems, 0- to 50,000V
- CAN/CSA-C60044-06:07 Instrument transformers – Part 6: Requirements for protective current transformers for transient performance
- CAN/CSA-C61000-2-2:04 Electromagnetic compatibility (EMC) – Part 2-2: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems
- CAN/CSA-C61000-2-12:04 Electromagnetic compatibility (EMC) – Part 2-12: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public medium-voltage power supply systems
- CAN/CSA-CEI/IEC 61000-4-2-01 Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test
- CAN/CSA-CEI/IEC 61000-4-3:07 Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test
- CAN/CSA-CEI/IEC 61000-4-4:06 Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test
- CAN/CSA-CEI/IEC 61000-4-5:08 Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test

- CAN/CSA-CEI/IEC 61000-4-12-01 Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 12: Oscillatory waves immunity test
- IEC 61000-4-15 Part 4-15: Testing and measurement techniques – Flickermeter - Functional and design specifications

- Ontario Electrical Safety Code

- American National Standards Institute (ANSI)
- C84.1-1995 ANSI Electric Power Systems and Equipment – Voltage Ratings (60 Hz)
- Institute of Electrical and Electronics Engineers (IEEE)
- C62.45-2002 IEEE Recommended Practice On Surge Testing For Equipment Connected To Low-Voltage (1000 V and Less) AC Power Circuits
- 1547 IEEE Standard for Interconnecting Distributed Energy Resources with Electric Power Systems
- 1547.1 IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems and Associated Interfaces
- 1547.2 IEEE Applications Guide for IEEE Std 1547, Interconnecting Distributed Resources with Electric Power Systems
- 1547.3 IEEE Guide for Monitoring, Information Exchange, and Control of Distributed Resources Interconnected with Electric Power Systems
- 1547.4 IEEE Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power Systems
- 1547.6 IEEE Recommended Practice for Interconnecting Distributed Resources with Electric Power Systems Distribution Secondary Networks
- 1547.7 IEEE Guide for Conducting Distribution Impact Studies for Distributed Resource Interconnection
- 1547.8 IEEE Draft Recommended Practice for Establishing Methods and Procedures that Provide Supplemental Support for Implementation Strategies for Expanded Use of IEEE Standard 1547
- 1547.9 IEEE Guide for Using IEEE Std 1547 for Interconnection of Energy Storage Distributed Energy Resources with Electric Power Systems
- C37.90.1-2002 IEEE Standard Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- C37.90.2-2004 Standard for Withstand Capability of Relay Systems to Radiate Electromagnetic Interference from Transceivers
- C37.90.3-2001 IEEE Standard Electrostatic Discharge Tests For Protective Relays
- C57.13-1993 IEEE Standard Requirements for Instrument Transformers
- STD 519 IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
- UL 1008 – Transfer Switch Equipment
- UL 1741 – Inverters, Converters, and Controllers for Use in Independent Power Systems
- UL1973 – Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail Applications
- UL9540 – Standard for Energy Storage Systems and Equipment