TORONTO HYDRO

DISTRIBUTED ENERGY RESOURCE REQUIREMENTS

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CERTIFICATE OF APPROVAL

THIS TECHNICAL SPECIFICATION MEETS THE SAFETY REQUIREMENTS OF SECTION 4 OF ONTARIO REGULATION 22/04

BENSON LO, PROFESSIONAL ENGINEER	January 1, 2027 **DATE**

PREFACE

Toronto Hydro's Conditions of Service requires the inclusion of terms and conditions of interconnecting distributed energy resource (DER) facilities to the Toronto Hydro distribution system. This reference document titled "Toronto Hydro DER Requirements" is to be read along with the Conditions of Service.

The purpose of this document is to provide information on various types of DER facilities interconnections available to the Customers, Consumers and Suppliers within Toronto Hydro's service area and how the interconnection will be facilitated to such Customers, Consumers and Suppliers. Further, this reference document will outline the processes of interconnection and settlement to the Customers, Consumers and Suppliers, whether IESO or Toronto Hydro managed program.

This reference document on DER does not yet include DER facilities owned and operated by Toronto Hydro.

Comments and inquiries can be e-mailed to: DER@torontohydro.com

Customers without e-mail access can submit through regular mail to:

DER Connections
Toronto Hydro-Electric System Limited
3rd Floor
500 Commissioners Street
Toronto, Ontario
M4M 3N7

Attn: DER Connections

To contact Toronto Hydro e-mail at: DER@torontohydro.com

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Section 1 – Introduction

1. INTRODUCTION

1.1 Identification of Distributed Energy Resource and DER Operator

A distributed energy resource (DER) is any source of electric power that is connected to the distribution grid of a Local Distribution Company (LDC) that distributes electrical power to Customers and Consumers. A DER operator shall be a Customer, Consumer or Supplier within the Toronto Hydro service area which is generating electricity for exporting power to the Toronto Hydro distribution grid or to displace their own load.

Toronto Hydro may only connect DER facilities within its Licensed Territory as defined in Section 1.1 of the Conditions of Service.

1.2 Related Codes and Governing Laws

DER facilities owned by the Customer, Consumer or Supplier shall be subject to various laws, regulations, and codes as listed in Section 1.2 of the Conditions of Service.

1.3 Interpretations

The rules for interpretation of the Toronto Hydro DER Requirements adhere to the rules listed in Section 1.3 of the Conditions of Service.

1.4 Contact Information

Toronto Hydro can be contacted via e-mail at DER@torontohydro.com or such other e-mail addresses as Toronto Hydro may advise through its website or invoices.

The mailing address is

DER Connections
Toronto Hydro-Electric System Limited
3rd Floor
500 Commissioners Street
Toronto, Ontario
M4M 3N7

Attn: DER Connections

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2. DISTRIBUTED ENERGY RESOURCE CONNECTION

2.1 Types of Distributed Energy Resource Classification

DER classification set forth in the Distribution System Code (DSC) are outlined in the table below:

Distributed Energy Resource Classification	Rating
Micro	≤ 12 kW
Small	(a) ≤ 500 kW connected on distribution system voltage < 15 kV (b) ≤ 1 MW connected on distribution system voltage ≥ 15 kV
Mid-Sized	(a) > 500 kW but ≤ 10 MW connected on distribution system voltage < 15 kV (b) > 1 MW but ≤ 10 MW connected on distribution system voltage ≥ 15 kV
Large	> 10 MW

A DER operator may propose a larger generator to be derated in order to be considered for a certain DER classification by Toronto Hydro. Toronto Hydro shall accept statically derated capacity, achieved through configured power rating control, of a DER unit or inverter instead of nameplate rated capacity if it has been derated at the factory. If the DER unit or inverter has been derated in the field by either the installer or manufacturer, Toronto Hydro shall accept the derated capacity if the following conditions are met:

1. The derated capacity is clearly indicated on the equipment, adjacent to the nameplate,
2. Proper labeling must specify site-specific power and current values,
3. Documentation provided by the inverter manufacturer must state the maximum continuous derated output current in amperes. Alternatively, the programmed limit can be demonstrated to Toronto Hydro's satisfaction, such as through certification from a licensed electrician, and
4. A restricted access protocol must be in place to prevent unauthorized capacity changes.

2.2 Connection Process (Information Package) and Timing

Subject to all applicable laws, Toronto Hydro will make all reasonable efforts in accordance with the provisions of Section 6.2 of the DSC to promptly connect to its distribution system a DER facility, which is the subject of an application for connection.

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As per Section 6.2.1 of the DSC, the connection process (information package) and timing outlined in Section 2.2 of this reference document does not apply to the connection or operation of an Emergency Backup DER facility.

2.2.1 Preliminary Meeting

A DER operator who is considering applying for the connection of a DER facility to the Toronto Hydro distribution system may submit a Preliminary Consultation Information Request (PCIR) to Toronto Hydro. Toronto Hydro will provide a Preliminary Consultation Report (PCR) within 15 days of receiving a complete PCIR submission.

For PCIR, the customer must provide the following information:

i. The total name-plate rated capacity of the DER facility at the connection point;
ii. the DER type for the proposed DER facility;
iii. the resource technology to be used; and
iv. the location of the proposed DER facility including address and account number with the distributor where available.

A DER operator who is considering applying for the connection of a DER facility to the Toronto Hydro distribution system may request a preliminary meeting with Toronto Hydro prior to submitting PCIR. Toronto Hydro will provide a time when it is available to meet with the person within 15 days of the person requesting the meeting.

At the preliminary meeting, Toronto Hydro will discuss the basic feasibility of the proposed connection including discussing the location of its existing distribution facilities in relation to the proposed DER facility and can provide an estimate of the time and costs necessary to complete the connection if requested. Toronto Hydro will not charge for its preparation for and attendance at the preliminary meeting.

2.2.2 Capacity Allocation Process

Toronto Hydro will establish and maintain a capacity allocation process under which Toronto Hydro will process applications for the connection of embedded DER facilities, except for the applications of a micro-embedded DER facility, a capacity allocation exempt small embedded DER facility or a net metered DER facility.

2.2.2.1 Capacity Allocation

The capacity allocation will meet the following requirements:

(a) each application for connection, including an application to increase the output of an embedded DER facility, will be allocated capacity only upon completion of Toronto Hydro's Connection Impact Assessment (CIA), and any required review of Transformer Station (TS) supply capability for the embedded DER facility;

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(b) a CIA will not be completed for a proposed connection that cannot be completed within the feeder and/or substation technical capacity limits of Toronto Hydro's distribution system or the supply TS and transmission system, including capacity additions contained in any OEB approved plans to increase the capacity of one or more of Toronto Hydro's distribution system, any host distributor's distribution system or the supply TS and transmission system;
Note: *CIA completed means completed with satisfactory results to connect as in the DSC.*

(c) a CIA will not be completed unless the embedded DER facility which is the subject of the application meets the following requirements at the time the application is made:
   i. demonstrated site control over the land on which the embedded DER facility is proposed to be located and any required adjacent or buffer lands in the form of property ownership (deed), long term lease (lease agreement) or an executed option to purchase or lease the land.
   ii. a proposed in-service date for the embedded DER facility which is no later than 5 years for water power projects or 3 years for all the other types of projects from the initial date of application for connection or in accordance with the timelines in an executed IESO contract.

2.2.2.2 Removal of Capacity Allocation

An application shall have its capacity allocation removed if:

a) an OTC/CCA has not been signed in relation to the connection of the embedded DER facility within:
   i. Subject to 2 and 3 below, 6 months of the date on which the applicant received a capacity allocation for the proposed embedded DER facility;
   ii. Subject to 3 below, 9 months of the date on which the applicant received a capacity allocation for the proposed large embedded facility if a transmission system impact assessment is required; or
   iii. 17 months of the date on which the applicant received a capacity allocation for the proposed large embedded DER facility if transmission upgrades are required in order to connect the large embedded DER facility;

b) a new CIA is prepared for a proposed embedded DER facility, any material revisions to the design, planned equipment or plans for the proposed embedded DER facility and connection shall be filed with Toronto Hydro and Toronto Hydro prepares a new CIA within the relevant time period. If the new CIA differs in a material respect from the original CIA for the project, the project shall have its capacity allocation removed.

c) any required deposit payable to Toronto Hydro in accordance with OTC/CCA has not been received by the date specified by Toronto Hydro;

d) Toronto Hydro is informed by the IESO that the applicant has defaulted on an executed IESO contract; or

e) the applicant defaults on an executed OTC/CCA and fails to correct the default within 30 calendar days.

Toronto Hydro will provide the applicant with two (2) months' advance notice of the expiry of the applicable time period referred to in Section 2.2.2.2(a) prior to removing the capacity allocated to the applicant.

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If any applicant has its capacity allocation removed in accordance with Section 2.2.2.2. (a)-(e) (Section 6.2.4.1. (e) in the DSC), the amount of any deposit paid pursuant to the OTC/CCA requirements shall be forfeited by the applicant and retained by Toronto Hydro in a deferral account for disposition by OEB. The amount of any unspent connection cost deposit will be returned to the applicant in accordance with the requirements of Section 6.2.18G in the DSC.

Toronto Hydro will, no later than 30 days after the applicant has its capacity allocation removed, refund to the applicant the amount of any remaining connection cost deposit provided by the applicant to Toronto Hydro pursuant to a OTC/CCA, provided that if Toronto Hydro has incurred costs associated with the connection of the applicant's embedded DER facility to Toronto Hydro's distribution system in accordance with the relevant OTC/CCA, Toronto Hydro will subtract the amount of any such incurred costs from the total connection cost deposit amount provided by the applicant prior to remitting any refund to the applicant.

2.2.3 Connection Process

Refer to OEB's Distributed Energy Resource Connection Procedures (DERCP) Version 2.0 Section 5.3 & 5.4

2.2.4 Connection of Micro-Embedded DER Facilities

A DER operator who wishes to connect a micro-embedded DER facility to the Toronto Hydro distribution system shall submit an application to Toronto Hydro providing the following information:

i. name-plate rated capacity of each unit of the proposed DER facility and the total name-plate rated capacity of the proposed DER facility at the connection point;
ii. the DER type for the proposed DER facility;
iii. the resource technology to be used; and
iv. location of the proposed DER facility including address and account number where available; and

Where the proposed micro-embedded DER facility is:

i. located at an existing Customer connection and a site assessment is not required, Toronto Hydro shall, within 15 days of receiving a complete application, make a Connection Agreement (CA) or provide reasons for refusing to connect the proposed DER facility;
ii. located at an existing Customer connection and a site assessment is required, Toronto Hydro shall, within 30 days of receiving a complete application, make a CA or provide reasons for refusing to connect the proposed DER facility; or
iii. located other than at an existing Customer connection, Toronto Hydro shall, within 60 days of receiving a complete application, make a CA or provide reasons for refusing to connect the proposed DER facility.

Toronto Hydro's CA will include an estimate of the charges that the Customer can expect to pay for connection. The charges will include design, inspection, meter installation and administrative costs.

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In all cases, Toronto Hydro shall give the Customer at least 30 days to accept the CA and Toronto Hydro shall not revoke the CA until this time period has expired.

If the connection of the micro-embedded DER facility will not require a site assessment, then Toronto Hydro shall not charge for the preparation of the CA.

If the connection of the micro-embedded DER facility will require a site assessment, then Toronto Hydro may collect a connection deposit for the preparation of the CA. The connection deposit shall not be more than $500 per CA.

The connection deposit shall be provided in the form of cash, cheque, letter of credit from a bank as defined in the Bank Act, electronic fund transfer (EFT) or surety bond. Toronto Hydro shall allow the Customer to select the form of the connection deposit.

If Toronto Hydro refuses to provide a CA the micro-embedded DER facility due to technical limits or constraints, the connection deposit shall be refunded to the Customer. Toronto Hydro shall return the connection deposit to the Customer no later than 30 days after refusing to provide the CA.

If the Customer does not accept Toronto Hydro's CA the micro-embedded DER facility, or if the Customer withdraws its application, then Toronto Hydro shall retain the connection deposit.

Toronto Hydro will make any necessary metering changes and connect the applicant's micro-embedded DER facility to its distribution system within 5 business days, or at such later date as agreed to by the applicant and Toronto Hydro, of the applicant completing the following:

i. informing Toronto Hydro that it has satisfied all applicable service conditions and received all necessary approvals;
ii. providing Toronto Hydro with a copy of Connection Authorization from the ESA;
iii. enter into a Connection Agreement with Toronto Hydro in the form set out in Schedule B1 of Appendix 2; and
iv. paying Toronto Hydro for the connection costs, including costs for any necessary new or modified metering.

2.2.5 Connection of Small, Mid-sized and Large DER Facilities

This section applies to the connection to the Toronto Hydro distribution system of a DER facility, which is not a micro-DER facility.

A DER operator that applies for the connection of a DER facility to the Toronto Hydro distribution system shall submit a completed application form in Appendix 3 to Toronto Hydro providing the following information:

i. name-plate rated capacity of each unit of the proposed DER facility and total name-plate rated capacity of the proposed DER facility at the connection point;
ii. fuel type of the proposed DER facility;

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iii. type of technology to be used;
iv. location of the proposed DER facility including address and account number where available: and
v. single line diagram of the proposed DER facility and connection to the Toronto Hydro distribution system.

A DER operator will be required to pay the CIA cost, applicable to mid-sized and large DER facilities or small DER facilities, as per the price schedule set by Toronto Hydro and submit a completed request for impact assessment form in Appendix 3 providing the following information:

i. evidence that the requirements set out in Section 2.2.2.1(c) have been met;
ii. the proposed point of common coupling with Toronto Hydro distribution system;
iii. any of the "initial set of information" which has not yet been provided to Toronto Hydro;
iv. a single line diagram of the proposed DER facility and connection to the Toronto Hydro distribution system sealed and signed by a professional engineer licensed in Ontario;
v. a preliminary design of the proposed interface protection; and
vi. all necessary technical information required by Toronto Hydro to complete the CIA.
vii. a copy of the lease agreement between Developer and Landlord (if applicable)

Once the applicant has entered into an OTC/CCA with Toronto Hydro and has provided Toronto Hydro with engineering drawings with respect to the proposal, Toronto Hydro will conduct a design review to ensure that the detailed engineering plans are acceptable.

When the connection proposal is approved, assuming that capacity on the distribution system and transmission system is available, DER project will proceed to the next stage. The connection will be completed after a commissioning report is approved by Toronto Hydro and a final connection agreement is executed between the DER operator and Toronto Hydro.

2.2.6 Connection Impact Assessment (CIA)

For all small, mid-sized and large embedded DER facilities, Toronto Hydro will perform a CIA. Toronto Hydro will advise the Customer of the costs to conduct any required impact assessment.

The impact assessment will specify the impact of the proposed embedded DER facility on the Toronto Hydro distribution system and any of its Customers including, but not limited to:

i. any voltage impacts, impacts on current loading settings and impacts on fault currents;
ii. the connection feasibility;
iii. the need for any line or equipment upgrades;
iv. the need for transmission system protection control modifications;
v. any metering requirements;
vi. any Supervisory Control and Data Acquisition (SCADA) monitoring requirements; and
vii. operating schedule requirements;

The Customer shall submit any material revisions to the design, planned equipment or plans for the proposed embedded DER facility and connection with Toronto Hydro. Toronto Hydro will then prepare a new impact assessment within the relevant time period as set out below in Sections

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2.2.6.1 and 2.2.6.2. If the new impact assessment differs in a material respect from the original CIA for the project, the project shall have its capacity allocation removed in accordance with Section 2.2.1.2 (b) of this document.

When Toronto Hydro issues the applicant with the technical requirements for the proposed connection as a result of a CIA, a cost estimate for the connection shall be provided.

When anticipating needing additional time to carry out a cost estimate for a mid-sized or large generation facility, Toronto Hydro may assess whether the project meets the criteria for a timeline extension per guideline in DERCP Version 2.0 section 5.9.1.

Upon receipt of the CIA with the cost estimate for the connection, the applicant for mid-size or large generation facility has the option to request a more detailed cost estimate prior to entering into a Connection Cost Agreement per guideline in DERCP Version 2.0 section 5.9.2.

2.2.6.1 CIA for Small Embedded DER Facility

Toronto Hydro will provide an applicant proposing to connect a small embedded DER facility with its results of its impact assessment of the proposed embedded DER facility, a detailed cost estimate of the proposed connection, and an OTC within:

i. sixty (60) days of the receipt of the application where no distribution system reinforcement or expansion is required;
ii. seventy-five (75) days of the receipt of the application where no distribution system reinforcement or expansion is required and where a host distributor/transmitter CIA is needed; or
iii. ninety (90) days of the receipt of the application where a distribution system reinforcement or expansion is required.

An OTC made to an applicant proposing to connect a small embedded DER facility may be revoked by Toronto Hydro if not accepted by the applicant within sixty (60) days.

2.2.6.2 CIA for Mid-sized and Large Distributed Energy Resource Facilities

Subject to Sections 2.2.2.1 (b) and (c), Toronto Hydro will provide the Customer with its impact assessment of the proposed DER facility within sixty (60) days of the receipt of the application of a mid-sized embedded DER facility and within ninety (90) days of the receipt of the application of a large embedded DER facility. When a transmitter (Hydro One) CIA is also required, Toronto Hydro shall provide the Customer with its impact assessment of the proposed DER facility within sixty (75) days of the receipt of the application of a mid-sized embedded DER facility and within ninety (105) days of the receipt of the application of a large embedded DER facility.

In the case of an application for the connection of a mid-sized or large embedded DER facility, after receiving from Toronto Hydro the connection impact assessment and payment made to Toronto Hydro for the cost for preparing a detailed cost estimate, Toronto Hydro will provide a

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detailed cost estimate based on an agreed upon project scope with the customer. Toronto Hydro will provide the applicant a detailed cost estimate and an OTC by the later of ninety (90) days after the receipt of payment from the applicant and thirty (30) days after the receipt of comments from a transmitter or other distributor that may have been advised under the Section 4.6.1.

2.3 Offer-to-Connect and Other Agreement

2.3.1 Offer to Connect

Toronto Hydro's Offer to Connect (OTC) is notice to the DER operator that the proposed DER will be considered for connection to the Toronto Hydro distribution system provided that the conditions and requirements set forth in the OTC are met by the applicant for connection.

The OTC will be attached as an appendix to and form part of the connection cost agreement referred to in Section 2.3.2 for small, mid-sized and large embedded DER facilities. For micro-embedded DER facilities, Toronto Hydro's OTC will be sent with the connection agreement.

2.3.2 Connection Cost Agreement

An applicant shall enter into a connection cost agreement (CCA) with Toronto Hydro in relation to any small, mid-sized or large embedded DER facility. The CCA will include the following:

i. a requirement of connection cost deposit equal to 100% of the total estimated allocated cost of connection at the time the CCA is executed;
ii. any requirements relating to the applicant's acceptance of Toronto Hydro's OTC and the connection costs;
iii. a requirement that the in-service date of the DER is no later than five (5) years for water power projects or three (3) years for all other types of projects from the initial date of application for connection or in accordance with the timelines in an executed IESO contract;
iv. a requirement that the applicant completes engineering design and provide detailed electrical drawings to Toronto Hydro at least six (6) months prior to the specified in-service date or as reasonably required by Toronto Hydro; and
v. the timing of connection.

Where connection of a renewable energy generation facility requires distribution system expansion, the CCA will include a requirement for payment of the cost of the distribution system expansion in excess of $90,000/MW of the name-plate rated capacity of renewable energy generation facility that are not an expansion project as described in 3.2.5B of the DSC.

2.3.2.1 Payment, Refunds and Settlement

Any connection cost deposit, distribution system expansion cost deposit, required to be obtained by Toronto Hydro pursuant to the DSC shall be in the form of letter of credit from a bank as defined in the Bank Act, or surety bond.

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The connection cost deposit will be used by Toronto Hydro to pay for costs allocated to the applicant and related to the connection of the embedded DER facility to the distribution system in accordance with the terms of the relevant CCA.

If, following the connection of an embedded DER facility to Toronto Hydro's distribution system, Toronto Hydro determines that the amount of the connection cost deposit provided by the applicant exceeded the costs allocated to the applicant and related to connecting the DER facility to Toronto Hydro's distribution system, Toronto Hydro will at the time of connection, refund to the applicant the amount by which the connection cost deposit exceeded the costs related to connecting the embedded DER facility.

Where any connection cost deposit is provided by an applicant to Toronto Hydro in the form of letter of credit and where Toronto Hydro refunds all or any portion of such connection cost deposit to the applicant in accordance with the DSC, the return of such deposit or deposits shall be in accordance with the following conditions:

i. interest shall accrue monthly on the deposit amounts commencing on the receipt of the deposit required by the distributor; and
ii. the interest rate shall be at the Prime Business Rate set by the Bank of Canada less two (2) percent.

2.3.3 Connection (Operating) Agreement

All Customers with an existing embedded DER facility shall enter into a Connection Agreement with Toronto Hydro. All Customers proposing to construct a new DER facility must also enter into a Connection Agreement with Toronto Hydro prior to the facility being connected to the distribution system.

DER Facilities	**Connection Agreement Form – Appendix 2**
Micro	Schedule B1
Small and mid-sized	Schedule B2
Large	Schedule B3

Where Toronto Hydro does not have a Connection Agreement with an existing Customer that has a DER facility connected to the Toronto Hydro distribution system, the Customer shall be deemed to have accepted and agreed to be bound by all of the Connection Agreement Terms and Conditions attached to this reference document as Schedules B1, B2 B3 in Appendix 2 (depending on the size of the DER facility) as well as the terms of any operating schedule delivered to the Customer from time to time by Toronto Hydro.

A Customer wishing to become a Wholesale Market Participant shall enter into a Connection Agreement in a form acceptable to Toronto Hydro prior to proceeding with IESO Registration. Until such time as an existing Wholesale Market Participant executes such a Connection Agreement with Toronto Hydro, the Wholesale Market Participant shall be deemed to have accepted and agreed to be bound by all of the Connection Agreement Terms and Conditions

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attached in Schedule C of Appendix 2 and the terms of any operating schedule delivered to it from time to time by Toronto Hydro.

If there is a conflict between the Connection Agreement with a DER operator or Wholesale Market Participant and the Conditions of Service, the Connection Agreement shall govern. An Operating Agreement may be used instead of Connection Agreement for complex DER projects involving multiple feeder operational scenarios.

2.4 Connection Cost and Meter Charges

Toronto Hydro will recover costs associated with the installation of connection assets. Connection costs and Meter charges vary with the type and size of DER facility.

2.5 Metering

Metering requirements vary with the type and intent of the DER facility. Please consult the IESO Market Rules and Section 5.2 of the Distribution System Code (OEB) for details.

Metering provided and installed by Toronto Hydro for DER facility will be subject to the following Toronto Hydro metering requirements:

1) Metering Requirements for 13.8 kV & 27.6 kV Customer-Owned Substation
2) Metering Requirements 750 Volts or Less

2.6 Expansions, Renewable Improvements, Enhancements and Connection Assets

This section provides information on expansion and renewable enabling improvements with respect to DER of renewable energy sources.

2.6.1 Expansion

As described in Section 3.2.30 in the DSC, an expansion of the main distribution system includes:

i. building a new line to serve the connecting Customer;
ii. rebuilding a single-phase line to three-phase to serve the connecting Customer;
iii. rebuilding an existing line with a larger size conductor to serve the connecting Customer renewable energy generation facility;
iv. rebuilding or overbuilding an existing line to provide an additional circuit to serve the connecting Customer renewable energy generation facility;
v. converting a lower voltage line to operate at higher voltage;
vi. replacing a transformer to a larger MVA size;
vii. upgrading a voltage regulating station transformer or station to a larger MVA size; and

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viii. adding or upgrading capacitor banks to accommodate the connection of the connecting Customer

2.6.1.1 Expansion Charges to DERs

Where an expansion is undertaken in response to a request for the connection of a renewable energy generation facilities, Toronto Hydro will charge the requesting Customer as capital contribution any cost of expansion that exceeds renewable energy expansion cost cap. Renewable energy expansion cost cap is $90,000/MW of the total name-plate rated capacity of all renewable energy generation facilities proposed to be connected to the expansion. If the expansion is in an OEB approved plan filed with the OEB by Toronto Hydro pursuant to the deemed condition of the Toronto Hydro's licence referred to in paragraph 2 of subsection 70(2.1) of the *Ontario Energy Board Act, 1998*, then the full costs will be covered by Toronto Hydro.

When an expansion is undertaken in response to requests for the connection of a renewable energy generation facilities by more than one DER operator, Toronto Hydro will apportion the amount of the capital contribution among the requesting DER operators on a pro-rata basis based on the total name-plate rated capacity of the renewable energy generation facility of each DER operator.

Toronto Hydro will not charge a DER operator to construct an expansion to connect a renewable energy generation facility,

(a) if the expansion is in a Board-approved plan filed with the Board by the distributor as in Section 3.2.5A of the DSC; or
(b) if costs of the expansion are at or below the renewable energy generation facility's renewable energy expansion cost cap as in Section 3.2.5B of the DSC.

Section 2.6.1.1(a) also applies to a request for the connection of more than one renewable energy generation facility. Section 2.6.1.1 (b) applies to any of the requesting DER operators to construct the expansion, when expansion costs are at or below the amount that results from adding the total name-plate rated capacity of each renewable energy generation facility in MW and then multiplying that number by $90,000.

2.6.1.2 Expansion Cost Share and Rebate

As per Section 3.2.27 in the DSC, unforecasted Customers that connect to the distribution system during the Customer connection horizon as defined in Appendix B of the DSC will benefit from the earlier expansion and should contribute their share. In such an event, the initial contributors shall be entitled to a rebate from the distributor.

When the unforecasted Customer is a renewable energy generation facility to which Section 2.6.1.1 (a) or Section 2.6.1.1 (b) applies and the Customer entitled to a rebate is a load Customer or a DER Customer to which neither Section 2.6.1.1 (a) nor Section 2.6.1.1 (b) applies, the initial contributors shall be entitled to a rebate. The amount of rebate is determined in accordance with Section 3.2.27 in the DSC. Toronto Hydro refunds or collects from the unforecasted Customers

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and pays an amount equal to the rebate to the initial contributor, depending on whether the expansion cost is at or below the expansion cap or else the unforecasted Customer is required to share the expansion cost respectively.

When an unforecasted renewable energy generation facility to which Section 2.6.1.1 (a) or Section 2.6.1.1 (b) applies (the "unforecasted renewable DER operator") connects to the distribution system during the Customer connection horizon as defined in Appendix B and benefits from an earlier expansion made on or after October 21, 2009 to connect another renewable energy generation facility to which Section 2.6.1.1 (a) or Section 2.6.1.1 (b) applies (the "initial renewable DER operator"), the initial renewable DER operator shall be entitled to a rebate. If the cost of the earlier expansion exceeded the initial renewable DER operator's renewable energy expansion cost cap, Toronto Hydro will pay to the initial renewable DER operator a rebate and collect a share from the unforecasted renewable DER operator. The calculation of rebate and share will be on pro-rata basis based on the total name-plate rated capacity of the renewable energy generation facility of each DER operator.

2.6.2 Renewable Improvements and Enhancements

As per Section 3.3.2 in the DSC, renewable enabling improvements to the main distribution system to accommodate the connection of renewable energy generation facilities are limited to the following:

i. modifications to, or the addition of, electrical protection equipment;
ii. modifications to, or the addition of, voltage regulating equipment transformer controls or station controls;
iii. the provision of protection against islanding (transfer trip or equivalent);
iv. bidirectional reclosers;
v. tap-changer controls or relays;
vi. replacing breaker protection relays;
vii. Supervisory Control and Data Acquisition (SCADA) system design, construction and connection;
viii. any other modifications or additions to allow for and accommodate 2-way electrical flows or reverse flows; and
ix. communication systems to facilitate the connection of renewable energy generation facilities.

Subject to Section 3.3.4 in the DSC, Toronto Hydro will bear the cost of constructing an enhancement for accommodating 2-way electrical flows in the existing electrical distribution system or making a renewable enabling improvement, and therefore will not charge:

i. a Customer a capital contribution to construct an enhancement; or
ii. a Customer that is connecting a renewable energy generation facility a capital contribution to make a renewable enabling improvement.

2.6.3 Distributed Energy Resource Facility Connection Assets

Bypass Compensation

Section 2 – Distribution Energy Resource Connection

Toronto Hydro shall require bypass compensation from a Customer, with a non-coincident peak demand that meets or exceeds 5 MW, if:

(a) the Customer disconnects its load facility from Toronto Hydro's distribution system and connects that facility to a generation facility (excluding embedded renewable generation) or to another load facility that is not owned by Toronto Hydro such that Toronto Hydro will no longer receive rate revenues in relation to that disconnected facility; or

(b) the Customer, while retaining its connection to Toronto Hydro's distribution system, also connects its load facility to a generation facility (excluding embedded renewable generation) or to another load facility that is not owned by Toronto Hydro such that the Customer reduces its load served directly by Toronto Hydro's distribution system, and Toronto Hydro's rate revenues in relation to that facility will be reduced.

Toronto Hydro shall calculate bypass compensation using the methodology set out in the DSC

2.7 Permission to Operate and Project Completion

Toronto Hydro shall provide permission to operate to an applicant in accordance with Section 7.1 of the DERCP Version 2.0 and section 6.2.18F of the DSC. Toronto Hydro shall carry out a review to ensure all connection work items have been completed, and all connection requirements have been satisfied

As described in step 15 of section 7.1 of the DERCP Version 2.0, Toronto Hydro may provide permission to operate before the applicant has completed its portion of connection work items or executed all planned commissioning and verification activities. The applicant must meet the terms and conditions for operation before full completion of their connection work, and, Toronto Hydro reserves the right to revoke or refuse permission to operate until the applicant fulfils these terms and conditions.

The applicant operates and maintains the proposed DER after the connection process is completed.

Section 3 – Technical Requirements

3. TECHNICAL REQUIREMENTS

The Customer shall ensure that the connection of its DER facility to the distribution system does not materially and adversely affect the safety, reliability and efficiency of the Toronto Hydro distribution system.

New or significantly modified DER facilities shall meet the following technical requirements:

i. Technical requirements specified in DERCP Version 2.0 of the DSC;
ii. Ontario Electrical Safety Code (OESC) and applicable Canadian Standards Association (CSA) and IEEE Standards;
iii. Toronto Hydro Parallel DER Requirements in Appendix 1 of this reference document; and
iv. Electrical Safety Authority (ESA) Electrical Guidelines for Inverter-Based Micro-DER facilities (12kW and smaller).

3.1 General Technical Requirements

In general, the connection agreement with a Customer for a DER facility connected to the Toronto Hydro distribution system shall include a requirement that the Customer shall have and provide upon request by Toronto Hydro a regular, scheduled maintenance plan that ensures that the DER's connection devices, protection systems and control systems are maintained in good working condition.

All equipment that is connected, operated, procured or ordered before May 1, 2002 is deemed to initially be in compliance with the technical requirements of the DSC.

Toronto Hydro may determine that equipment that was deemed to be in compliance with the technical requirements of the DSC as noted in the immediately preceding paragraph is not in **actual** compliance with the technical requirements due to any of the following conditions:

i. a material deterioration of the reliability of the distribution system resulting from the performance of the DER's equipment; or
ii. a material negative impact on the quality of power of an existing or a new Customer resulting from the performance of the DER's equipment; or
iii. a material increases in DER capacity at the site where the equipment deemed compliant is located.

In such a case, Toronto Hydro will provide the Customer with rules and procedures for requiring such equipment to be brought into actual compliance. The Customer shall then bring its equipment into actual compliance with the technical requirements and within a reasonable time period specified by Toronto Hydro.

When a Customer with an embedded DER facility is connected to the Toronto Hydro distribution system, the Customer shall provide an interface protection that is capable of automatically isolating the DER facility from the Toronto Hydro distribution system under the following situations:

Section 3 – Technical Requirements

i. internal faults within the DER
ii. external faults in the Toronto Hydro distribution system
iii. certain abnormal system conditions, such as over/under voltage, over/under frequency.

The Customer shall disconnect the embedded DER facility from the Toronto Hydro distribution system when:

i. a remote trip or transfer trip is included in the interface protection, and
ii. the Customer effects changes in the normal feeder arrangements other than those agreed upon in the operating agreement between Toronto Hydro and the Customer.

3.2 Emergency Backup DER Facility Technical Requirements

3.2.1 Commercial and Industrial Customers

Emergency backup DER is a DER facility installed by Customers for backup of load when utility power supply is not available. A Customer with portable or permanently connected emergency backup DER shall comply with all applicable criteria of the Ontario Electrical Safety Code (OESC) and in particular, shall ensure that its Emergency Backup DER Facility does not back feed into the LDC's system or back feed through the revenue meter.

A Customer with an Emergency Backup DER Facility in Open-Transition mode shall further ensure that its facility does not parallel with, nor adversely affect Toronto Hydro's distribution system.

Customers who consider installing a Closed-Transition switch shall notify Toronto Hydro and shall submit documentation that satisfies Toronto Hydro's technical requirements. Customers shall obtain written authorization from Toronto Hydro prior to commissioning the switch in Closed-Transition mode. Closed-Transition switches must not operate the DER in parallel with Toronto Hydro's distribution system for longer than 100ms. A backup timer shall monitor the parallel duration and automatically open the main or DER contacts within 500ms if the maximum parallel duration is exceeded. The backup timer shall also provide visual indication and lockout the transfer system.

Closed transition transfer of the emergency backup DER facility shall not cause a voltage fluctuation of more than 5% at the PCC. Closed transition transfer from utility to DER and retransfer shall take place only when the two sources have a maximum voltage difference of 5%, frequency difference of 0.2 Hz and phase angle difference of 5 electrical degrees. For emergency backup DER facilities with an aggregate capacity greater than 5 MVA, active synchronization shall be used.

In order to operate Closed-Transition switches of emergency backup-DERs, the Customer must also submit to Toronto Hydro:

i. an ESA Plan review report
ii. a Short Circuit Coordination Study
iii. a Sequence of operation in descriptive format
iv. a simplified one-line drawing of the power distribution at the proposed site; and
v. monitoring requirements as per section 3.4

Section 3 – Technical Requirements

Where multiple emergency backup DERs with Closed-Transition transfer are planned to be installed at a single location, the design and configuration shall minimize the impact to the distribution grid including fault contribution by using techniques such as sequencing the Closed-Transition transfer and DER units, or using a high impedance design or other equivalent method.

The Customer shall notify Toronto Hydro a minimum of fifteen (15) working days in advance of scheduled commissioning tests to enable Toronto Hydro to witness the commissioning tests. Toronto Hydro may elect to accept a commissioning test report certified by a Professional Engineer. The commissioning verification report shall confirm the installation, configuration, upstream protection, co-ordination devices and sequence of operation as per submitted design requirements. The commissioning report shall be submitted for approval before the operation of the emergency backup DER facility.

customers with a permanently connected emergency backup DER facility operating in parallel shall notify Toronto Hydro regarding the presence of such equipment and shall enter into a connection agreement as required in Section 4 of this document. Contact information is as listed in Section 1.4.

3.2.2 Residential Customers

For customer with emergency backup DER that is operated in closed-transition, or installed with a meter base plug-in transfer device shall submit an application to Toronto Hydro. For portable emergency backup DER, residential Customers can install a Toronto Hydro approved meter base plug-in transfer device onto a 200 A, 4-jaw meter socket that is installed outdoors. All installations must meet Toronto Hydro approval requirements and will only be considered for residential Customers with 120/240 V, single-phase and up to a 200 A service. Customers must initially contact Toronto Hydro to begin the installation process for the meter base plug-in transfer device. Following a Toronto Hydro field visit at the Customer's residence to determine the feasibility of the installation, the Customer will be advised whether to proceed to make arrangements for the meter base plug-in transfer device installed by an electrical contractor that is licensed by the Electrical Safety Authority. In addition, during the time of installation or removal of the meter base plug-in transfer device, a service disconnection /reconnection and breaking/resealing of the revenue meter will be required and shall be performed by Toronto Hydro.

The installation of a meter base plug-in transfer device is not permitted where a Customer location has a DER installation (i.e. MicroFIT, FIT, Net Metering, Load Displacement, and RESOP).

3.3 Net Metered Distributed Energy Resource Technical Requirements

In order to participate in the Net Metering program, Customers will be required to meet all the parallel DER requirements for Connecting micro-DER facilities (12 kW or less) or other DER facilities (greater than 12 kW).

The Customer must have a bi-directional revenue meter that records energy flow in both directions.

Section 3 – Technical Requirements

3.4 Control and Monitoring

All DER facilities regardless of size will be required to have control and monitoring capability in place. For program specific requirements, please refer to Appendix 4(ii).

4. DISTRIBUTED ENERGY RESOURCE ACTIVITIES (GENERAL)

4.1 Design Review

After the applicant has entered into a CCA with Toronto Hydro and has provided the detailed engineering drawings with respect to the proposal, Toronto Hydro will conduct a design review to determine if the design engineering plans are acceptable.

4.2 Inspections before Connections

All DER facility installations shall be inspected by both the ESA and Toronto Hydro. The DER facility must be approved by the ESA and must also meet Toronto Hydro's requirements. Toronto Hydro requires notification from the Electrical Safety Authority of this approval prior to the DER facility connection and energizing. DER facilities that have been disconnected for a period of six months or longer must also be re-inspected and approved by the Electrical Safety Authority, prior to reconnection.

Provision for metering will be inspected and approved by Toronto Hydro prior to energizing

4.3 Commissioning and Testing

Toronto Hydro has the right to witness the commissioning and testing of the connection of DER facilities greater than 12kW to its distribution system. The Customer shall notify Toronto Hydro no later than fifteen working days prior to any commissioning tests to enable Toronto Hydro to witness the commissioning tests. Toronto Hydro may elect to accept a commissioning test report certified by a Professional Engineer.

Whether Toronto Hydro attends the testing or not, the Customer shall submit a commissioning verification report, as per Appendix 1 (ii), which will include, at a minimum:

i. confirmation of installation and configuration;
ii. a single line electrical drawing which identifies the as-built Connection Point (must be signed, dated and sealed by a Professional Engineer); and
iii. confirmation of posted warning signs on vault doors and switchgear.

In addition to requirements listed above, commissioning reports for solar photovoltaic (PV) DER facilities shall include:

i. confirmation that equipment and installation meet CSA and/or other applicable electrical safety standards (conducted by an Independent Professional Engineer);
ii. protection device co-ordination;
iii. inverter trip settings as per CSA 107.1 with grid interactive mode and anti-islanding protection; and
iv. PV string tests.

The commissioning report shall be submitted for approval before the operation of the DER facility.

Toronto Hydro will permit the operation of the DER facility in parallel to its distribution system in accordance with these conditions once:

Section 4 –Distributed Energy Resource Activities (General)

i. the applicant has informed Toronto Hydro that it has received all necessary approvals;
ii. the applicant has provided Toronto Hydro with a copy of the Certificate of Acceptance from the ESA;
iii. the applicant has entered into the appropriate Connection Agreement;
iv. Toronto Hydro has received the Connection Authorization from ESA; and
v. Toronto Hydro has received a satisfactory commissioning report sealed by a P.Eng.

Subject to any delays in commissioning and testing of the DER facility, which may be beyond the control of Toronto Hydro, Toronto Hydro will permit the operation a proposed small embedded DER facility in parallel to its distribution system within:

i. Sixty (60) days of the applicant taking the steps set out above, where no distribution system reinforcement or expansion is required; and
ii. One hundred and eighty (180) days of the applicant taking the steps set out above, where a distribution system reinforcement or expansion is required.

Information on the process for connecting a DER facility to a distribution system is set out in DER Connection Procedure (DERCP Version 2.0) of the DSC.

4.4 Settlement

Each DER program, other than emergency backup DER, is administered and settled by the respective organization based on the metered quantities.

4.5 Billing

Billing by Toronto Hydro for the applicable DER is performed with the regular cycle. Billing and Settlement is made with the owner of the DER facility. A new account will be opened, where the DER operator is not the load Customer of the service address. An OEB-approved monthly administration charge will also apply.

4.6 Mandatory Reporting Requirements

4.6.1 Notice to Transmitter and other Distributors

Toronto Hydro will, no later than five (5) days after the receipt of a complete application for connection of embedded DER facilities, provide notice in writing to the transmitter and/or distributor whose transmission and distribution systems are impacted by an application to connect an embedded DER to Toronto Hydro's distribution system.

Toronto Hydro will, within 10 days of initiating a CIA study, advise in writing any transmitter or distributor whose transmission or distribution system is directly connected to the specific feeder or substation to which the proposed embedded DER facility is proposing to connect. Toronto Hydro will include in the written communication, at a minimum, the proposed in-service date, the rated capacity and type of technology of the proposed embedded DER facility.

Section 4 –Distributed Energy Resource Activities (General)

Toronto Hydro will file an application with a transmitter or host distributor to complete a Transformer Station (TS) review study or CIA where necessary. Toronto Hydro will also inform the transmitter and/or host distributor in writing on an ongoing basis of any change in status of the project including removal of capacity allocation of the project, material changes in the projected in-service date of the project or placing the project in service.

Where Toronto Hydro is preparing a detailed cost estimate in accordance with Section 4.4.4.2 with respect to a proposed mid-sized or large embedded DER facility, Toronto Hydro will advise any transmitter and/or distributor whose transmission or distribution system is directly connected to Toronto Hydro's distribution system that it is preparing an estimate, within 10 days of receiving payment from the applicant.

Where Toronto Hydro is preparing a detailed cost estimate in accordance with Section 4.4.4.1 with respect to a proposed small embedded DER facility, Toronto Hydro will advise any transmitter or distributor whose transmission or distribution system is directly connected to Toronto Hydro's distribution system that it is preparing an estimate, within 10 days of receiving payment from the applicant.

4.6.2 Information to be made Publicly Available

Toronto Hydro will maintain a list of restricted feeders that it owns that have no additional short circuit capacity to accommodate a DER connection, whether the constraint is within Toronto Hydro's distribution system or Hydro One's transmission system. Toronto Hydro will update the restricted feeder list if the system changes or at least every 3 months by informing the public via its website or email to interested customers.

When Toronto Hydro removes a feeder from the list of restricted feeders, Toronto Hydro shall notify the public of this change on its website and notify by email those customers who have expressed an interest in receiving information on the status of the feeder. The notification shall be given as soon as possible and at least one month prior to accepting new applications for the connection of DERs to the feeder.

Section 5 –Net Metering Program

5. NET METERING PROGRAM

In order to encourage conservation, Toronto Hydro has established a Net Metering Policy for eligibility of Customers and Consumers who wish to participate in the Net Metering program. Eligible Customers and Consumers with renewable energy generation facilities may reduce their energy costs by exporting surplus generated energy back onto the utility distribution system for credit against the energy the Customer consumes from the distribution system.

In accordance with the Net Metering Regulation, Toronto Hydro has established a Net Metering Program for netting of surplus generated energy with energy consumed from the Toronto Hydro supply. The program information is posted on the Toronto Hydro website and can be downloaded from: https://www.torontohydro.com/grid-connections/net-metering

Eligibility for participation in the Net Metering Program is set out in Net Metering, O. Reg 541/05.

Section 6 – Embedded Market Participation

6. EMBEDDED MARKET PARTICIPATION

Under the Market Rules for the Ontario Electricity Market, Chapter 2, Section 1.2.1:

"No persons shall participate in the IESO-administered markets or cause or permit electricity to be conveyed into, through or out of IESO-controlled grid unless that person has been authorized by the IESO to do so".

All embedded market participants, including Wholesale Market Participants, within the service area of Toronto Hydro, once approved by the IESO, are required to inform Toronto Hydro of their approved status in writing, thirty (30) days prior to their participation in the Ontario electricity market.

Section 7 – Embedded Distributor

7. EMBEDDED DISTRIBUTOR

Toronto Hydro will make reasonable efforts to respond promptly to an Embedded Distributor's written request for Connection to the Distribution System and will comply with the requirements of Connection identified in Section 6.3 of the Distribution System Code. On occasion, a Distributor may wish to connect to Toronto Hydro's distribution system for the purposes of obtaining additional transmission connection capacity. In such cases, Toronto Hydro will follow the approval process for such connections required by Section 3.1.8 of the DSC.

The Embedded Distributor is a Customer of Toronto Hydro. Metering at the supply point to the Embedded Distributor will comply with Toronto Hydro's requirements for a Customer in the applicable rate class. Toronto Hydro is not involved in metering the Customers of the Embedded Distributor

Section 8 – Appendices

8. APPENDICES

8.1 Appendix 1 - Requirements

i. Toronto Hydro Parallel Distributed Energy Resource Requirements

ii. DER Commissioning Requirements and Reports

8.2 Appendix 2 – Agreements

i. Schedule B1:
   - Micro-Embedded DER Facility Connection Agreement

ii. Schedule B2:
   - Form of Connection Agreement for a Small Embedded DER Facility or a Mid-Sized Embedded DER Facility

iii. Schedule B3:
   - Connection Agreement for an Embedded DER Facility Larger than 10 MW

iv. Schedule C:
   - Wholesale Market Participant Connection Agreement Terms and Conditions

8.3 Appendix 3 – Application Forms

i. Distributed Energy Resource (DER) Application Form

ii. Mirco Distributed Energy Resource (DER) Application Form

iii. Pre-assessment Application Form

8.4 Appendix 4 - Charges, Standards, Sketches and Availability

i. Standard for Net Metering – Residential Service

ii. Distributed Energy Resource (DER) Monitoring and Control Requirements

TORONTO HYDRO-ELECTRIC SYSTEM

PARALLEL DISTRIBUTED ENERGY RESOURCE REQUIREMENTS

FIRST EDITION: April 14, 2004

REVISION #1: February 10, 2006

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REVISION #5: January 1, 2027

SECTION 8 - REFERENCE #3

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Introduction

The technical requirements for parallel DER are in place to ensure public and employee safety, protect the integrity of Toronto Hydro's system, and guarantee reliable and quality service to Toronto Hydro customers. The technical requirements in this document are for the protection of Toronto Hydro's facilities, and the DER operator should satisfy itself as to any requirements for the protection of its own facilities.

The requirements below are primarily from Institute of Electrical and Electronics Engineers ("IEEE") Standard 1547, and CAN/CSA C22.2 No. 257-06. DER operators are encouraged to consult the listed references for more details about every item. In situations where modifications are required to the incoming supply arrangement, the DER facility shall also satisfy the following: "Toronto Hydro Requirements for Design and Construction of Customer-Owned Substation High Voltage Substations". It is the DER operator's responsibility to ensure that all requirements are met. Additional requirements may be necessary to address unique situations, and DER operators will be advised of any additional requirements at the appropriate assessment stage.

Toronto Hydro accepts no responsibility or liability for any of the information provided in this document, which has been provided for informational purposes only. Meeting these requirements does not necessarily constitute an acceptable facility design. Toronto Hydro reserves the right to amend any of these requirements at any time.

1 Connection Impact Assessment – Initial Review

Technical requirements for interconnection of the DER facility with Toronto Hydro are checked during the Impact Assessment stage. This initial review is intended to determine the viability of the DER operator's project and to provide the applicant an opportunity to evaluate the situation before making further investments.

1.1 Facility Design Overview

1.1.1 Single Line Diagram ("SLD")

For the initial review, a high-level single line diagram of the proposed facilities is required. Major equipment such as the transformer, disconnection device, and the DER and their respective ratings should be included. Please see the *Distributed Energy Resource (DER) Application Form* for information to be submitted.

A typical arrangement of a DER facility connected to the utility distribution system is shown below in Figure 1. Various configurations, however, are possible in accordance with design requirements and DER facility use.

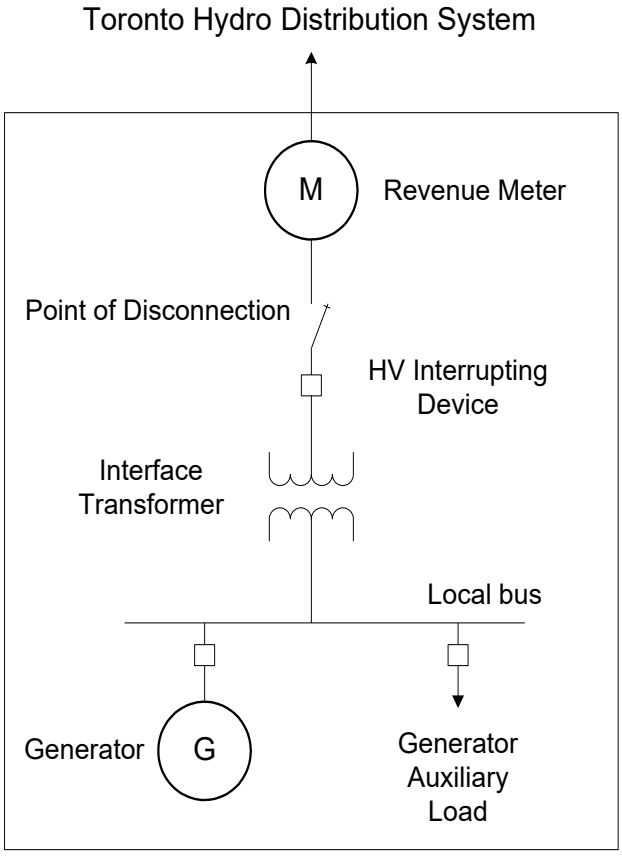


Figure 1 Typical Single Line Diagram Required at the Connection Impact Assessment Stage

1.1.2 Point of Disconnection - Safety

A point of disconnection is required to isolate the DER for the purpose of work protection for Toronto Hydro crews. Switching, lockout and tagging procedures shall be coordinated with Toronto Hydro.

The disconnecting device shall be lockable, have a visually verifiable break and be accessible by Toronto Hydro personnel 24 hours a day, 7 days a week. For additional information, refer to Conditions of Service main document 1.7.1 on Access to Customer Property.

For single residential Micro-Embedded and Small Size DERs, if multiple DERs are on site, there shall be one main disconnect on site capable of disconnecting all DERs simultaneously. The use of circuit breakers, control switches or air conditioner style disconnect switches are not acceptable for use as the main DER disconnect switch. The main disconnect shall be located within 2m of the main revenue meter as per Toronto Hydro Distribution Construction Standard 17-2670. If the revenue meter is located at the basement of the house, an additional disconnect in series shall be installed at the exterior wall of the house, accessible to Toronto Hydro crew.

For multiple residential/condominium or commercial buildings, the DER main disconnect shall be located at an outdoor location on ground level in a visible location if the electrical room for the building is not accessible by Toronto Hydro crew on a 24-hour basis, 7 days a week, basis. If the disconnect switch is not within direct line of sight from the Toronto Hydro meter, a lamicoid indicating its location shall be installed on the Toronto Hydro meter.
.
For Mid-Size and Large DERs, the disconnecting device shall be accessible 24 hours a day, 7 days a week for Toronto Hydro personnel either in an indoor or outdoor location. If the disconnect switch is not within direct line of sight from the Toronto Hydro meter, a lamicoid indicating its location shall be installed on the Toronto Hydro meter.

For electrical rooms with restricted access, the customer shall provide Toronto Hydro the appropriate access keys or magnetic cards to enable entry from outside to the electrical room. Toronto Hydro shall supply and install a key box at a suitable location to safekeep the key(s), as required.

If the location of the main disconnect cannot meet the requirements stated in this document, the customer must obtain written approval from Toronto Hydro Engineering for the deviation.

Two Lamicoid labels shall be mounted on the disconnect with the following text.

- **MAIN DG DISCONNECT**
- **WARNING**

TWO POWER SOURCE

PARALLEL SYSTEM

Reference codes and standards that apply to the disconnect or isolation device are as follows: Ontario Electrical Safety Code (“OESC”) rule 84-026, IEEE Standard 1547 Clause 4.1.7 and CAN/CSA-C22.2 No. 257-06 Clause 5.3.4 .

1.1.3 Preferred Interface Transformer Configuration and HV Interrupting Device

Preferred configurations for the DER facility interface transformer are outlined in Table 1. The interface transformer connection significantly affects the DER facility interaction with the distribution system under steady state and fault conditions. Careful selection and design are required to mitigate adverse effects.

Selecting an appropriate configuration is dependent on the local distribution system at the point of connection. The configurations suggested in table 1 are only general guidelines that are applicable for the majority of connections. Toronto Hydro will assess each connection individually to determine the required configuration based on the local conditions. In situations where DER neutral impedance or a grounding transformer may be required, effective grounding criteria of the distribution system shall be maintained. This will ensure the maximum overvoltage on the distribution system is within 125% of the nominal voltage. The suggested HV interrupting device is a breaker capable of withstanding 220% of the interconnection system rated voltage.

Table 1

System Voltage	Distribution System Grounding Impedance (Low , High)	Preferred Interface Transformer (HV:LV)
27.6, 13.8 kV	Low (effectively grounded)	Wye Ground / Delta
13.8 kV	High (downtown)	Delta / Wye Ground
27.6,13.8 kV, 4.16 kV	Low (effectively grounded)	Wye Ground / Wye Ground (DER < 1MW)

1.2 Equipment Rating and Requirements

Requirement	Reference
The DER facility interface equipment shall be compatible with Toronto Hydro equipment design and ratings under all operating conditions. During both on-line and off-line interconnection scenarios of the DER equipment, the distribution equipment shall be within its operating rating. Equipment ratings to be reviewed shall be as follows: - Equipment **thermal loading limits.** This equipment includes feeder conductor/cable, station breaker and transformer ratings. - Impact of DER facility **fault contribution** on equipment rating - If power is to be exported to the distribution system then all **metering devices** shall be suitable for ***bi-directional flow***.	Toronto Hydro Requirements

1.3 Voltage Regulation

Requirement	Reference
Voltage variations at the point of common coupling (“PCC”) are limited to **+/- 6%** of the nominal voltage.	CSA CAN3-C235 IEEE 1547 Clause

The DER facility should not actively regulate the voltage at the PCC. During normal operation, the DER facilities must be **loaded and unloaded gradually** to allow adequate time for regulating devices to respond and avoid excessive voltage fluctuation. The DER facility shall not cause objectionable voltage and current **unbalance** conditions. The DER facility shall not cause voltage unbalance beyond 3% and current unbalance beyond 10% at the PCC.	4.1.1 CAN CSA C22.2 No. 257-06 Section 5.2.3

1.4 Synchronization

<table>
<tr><th>Requirement</th><th>Reference</th></tr>
<tr><td>The DER facility shall parallel with the distribution system without causing a voltage fluctuation of more than 5% at the PCC.

Interconnection shall take place only when the differences in frequency, voltage and phase angle are within the limits shown below.

<u>Table 2</u>
<table>
<tr><td>Total DR System Capacity</td><td>Frequency Difference</td><td>Voltage Difference</td><td>Phase Angle Difference</td></tr>
<tr><td>0-500 kVA</td><td>0.3 Hz</td><td>10 %</td><td>20°</td></tr>
<tr><td>>500-1500 kVA</td><td>0.2 Hz</td><td>5 %</td><td>15°</td></tr>
<tr><td>> 1500 kVA</td><td>0.1 Hz</td><td>3 %</td><td>10°</td></tr>
</table>
</td><td>CAN CSA C22.2 No. 257-06 Section 5.3.21
IEEE 1547 Clauses 4.1.3, 5.1.2
OESC rule 84-006</td></tr>
</table>

1.5 Feeder Relay Directional

Requirement	Reference
To prevent sympathetic tripping of the DER feeder due to faults on adjacent feeders, breaker protection may need a directional feature for reverse fault current conditions.	Toronto Hydro Requirements

1.6 Monitoring

Requirement	Reference
A DER facility with total capacity rated greater than 50 kVA, shall have at a minimum monitoring items a) to e) below. a) Connection status (Breaker or Contactor Status) b) Real power output c) Reactive power output (Typically on non-inverter DERs) d) Voltage at PCC or aggregate connection e) Current per phase For a generation facility with total capacity rated 2.5 MW or greater, items a) to d) shall be actively monitored. In this case, monitoring typically includes status of load interrupting switches, circuit breakers and interface protection annunciation. Communication media options will be mutually agreed upon.	IEEE 1547 Clause 4.1.6 CAN CSA C22.2 No. 257-06 Clause 5.3.22 Toronto Hydro Requirements

1.7 DER Voltage Ride-Through

Requirement	Reference
The DER shall comply with voltage ride-through on capabilities as per table below **Table 3**	CSA C22.3 No.9-20

Voltage range (% of nominal voltage)	Minimum ride-through time (s) (design criteria)	Maximum response time (s) (design criteria)	Response
V > 120	N/A*	0.16	Cease to energize
117.5 < V ≤ 120	0.2	N/A	Mandatory operation
115 < V ≤ 117.5	0.5	N/A	Mandatory operation
110 < V ≤ 115	1	N/A	Mandatory operation
88 ≤ V ≤ 110	infinite	N/A	Continuous operation
70 ≤ V < 88	Linear slope of 4 s/1p.u. voltage starting at 0.7 s @ 0.7 p.u.: $T_{VTR} = 0.7s + \frac{4s}{1p.u.}(V - 0.7\ p.u.)$	N/A	Mandatory operation
50 ≤ V < 70	0.16	N/A	Mandatory operation
V < 50	N/A*	0.16	Cease to energize

** Cessation of current of DER in not more than the maximum specified time and with no intentional delay. This does not necessarily imply disconnection, isolation, or a trip of the DER.*

1.8 DER Frequency Ride-Through

Requirement	Reference
The DER shall comply with frequency ride-through capabilities as per table below **Table 4**	CSA C22.3 No.9-20

Frequency range (Hz)	Minimum ride-through time (s) (design criteria)
f > 62.0	N/A
61.2 < f ≤ 62	299
58.8 ≤ f ≤ 61.2	infinite*
57.0 ≤ f < 58.8	299
f < 57.0	N/A

** Applicable only for a per-unit ratio of voltage/frequency limit of V/f ≤ 1.1.*

1.9 Minimum DER system reactive power capabilities

Requirement	Reference
The DER should be capable of reactive power sourcing and consumption as per table below. **Table 5** DER system interconnection Q capability grade / Sourcing (capacitive) capability as % of as nameplate apparent power, S (kVA) rating / Consumption (inductive) capability as % of as nameplate apparent power, S (kVA) rating baseline grade / 44% at PCC nominal voltage / 25% at PCC nominal voltage supplemental grade / 44% over +/- 5% of PCC nominal voltage range / 44% over +/- 5% of PCC nominal voltage range **Note:** *44% is equivalent to a power factor range of ± 0.9 (i.e., 0.9 lagging and leading) at rated output.*	CSA C22.3 No.9-20

1.10 Electromagnetic Interference (EMI)

Requirement	Reference
The protection, control, and communication functions of the interconnection system shall not fail, operate improperly, or provide misinformation as a result of EMI and shall comply with the following, where applicable: a) CAN/CSA-CEIKIEC 61000-4-3, using Level X, 35 Wm, in accordance with IEEE C37.90.2; or b) IEEE C37.90.2. The power producer shall provide documentation of compliance with Item a) or b).	CSA C22.3 No.9-20

1.11 Surge Withstand

Requirement	Reference
The protection, control, and communication functions of the interconnection system shall not fail, operate improperly, or provide misinformation as a result of voltage of current surges and comply with clause 7.4.15 of the CSA C22.3 No.9-20 standard.	CSA C22.3 No.9-20

1.12 Harmonics

Requirement	Reference
The DER harmonic levels should comply with table **Table 6** Harmonic order / Odd / Even 2nd through 10th: 4.00% / 1.00% 11th through 16th: 2.00% / 0.500% 17th through 22nd: 1.50% / 0.375% 23rd through 34th: 0.600% / 0.150% 35th through 40th: 0.300% / 0.075%	CSA C22.3 No.9-20

1.13 Power Factor

Requirement	Reference
The DER facility operation shall not adversely affect voltage at the PCC. The preferred power factor range of operation is ±0.9. This range may be narrower if required in some situations. Systems of 30 kW or less are generally not required to be capable of adjusting power factor. For large facilities that are IESO impactive, the DER units shall have sufficient reactive power compensation such that there is no material increase at the transmission system terminal station.	CAN CSA C22.2 No. 257-06 Clause 5.3.13

1.14 Maximum Power Transfer & Synchronous Stability

Requirement	Reference
To ensure distribution system stability and prevent adverse effects on the steady state voltage profile of the feeder, the maximum power export of a generating facility shall be limited so as to not exceed 10° phase shift between line ends. For typical distribution feeders on Toronto Hydro's system at 27.6 kV and 13.8 kV the limit is 50 MW and 20 MW, respectively. Other distribution constraints well below these limits however may govern the maximum power transfer such as feeder rated capacity.	Toronto Hydro Requirement

2 Design Review

The design review ensures detailed engineering is in compliance with Toronto Hydro requirements. It is recommended that this review be completed before proceeding with equipment purchase.

A sample single line diagram below provides the details required at this stage.

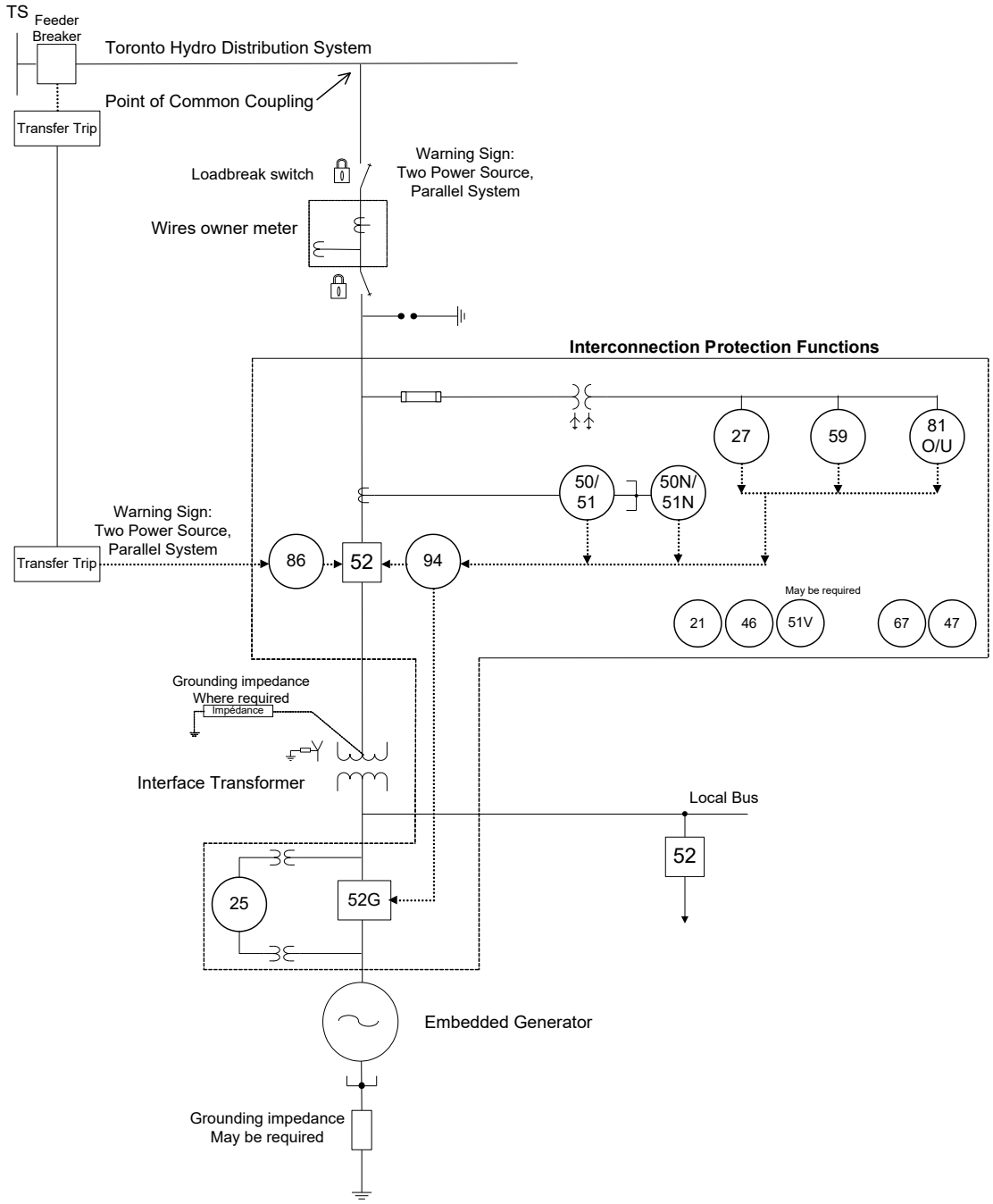


Figure 2 Typical Single-Line Diagram Required at the Design Review Stage

2.1 Case to Energize

<table>
<tr><th>Requirement</th><th>Reference</th></tr>
<tr><td>2.1.1 Distribution System Faults and Customer Facility Faults
Interface protection of the DER facility shall cease to energize Toronto Hydro's distribution system under the following conditions:
Internal Faults at the Customer's Facility.
External Faults on the Toronto Hydro Distribution System.
Equipment and Conductors energized from both directions shall have suitable protection from each supply source.</td><td>DSC Appendix F.2 Section 6.4
IEEE 1547 Clause 4.2.1
OESC 84-014
CAN CSA C22.2 No. 257-06
Clause 5.3.8</td></tr>
<tr><td>2.1.2 Feeder Breaker Reclosing Coordination
The DER facility shall cease to energize Toronto Hydro's feeder before automatic reclosing of the breaker takes place.
Toronto Hydro's 27.6 kV feeders incorporate an autoreclose operation typically half a second in duration. Underground 13.8 kV feeders in the downtown area do not have an automatic reclosing scheme.</td><td>IEEE 1547 Clause 4.2.2
DSC Appendix F.2 Section 6
CAN CSA C22.2 No. 257-06
Clause 5.2.9</td></tr>
<tr><td>2.1.3 Over-Voltage and Under-Voltage Protection
The typical range of protection settings shall comply with the following table:
Response to abnormal voltages
<table>
<tr><th>Voltage at PCC</th><th>Clearing Time Range</th></tr>
<tr><td>V<50%</td><td>Instantaneous to 0.16 s</td></tr>
<tr><td>50% ≤ V < 88%</td><td>Instantaneous to 2 s*</td></tr>
<tr><td>106% < V ≤ 110%</td><td>0.5 s to 2 minutes</td></tr>
<tr><td>110% < V ≤ 120%</td><td>Instantaneous to 2 minutes</td></tr>
<tr><td>120% < V < 137%</td><td>Instantaneous to 2 s*</td></tr>
<tr><td>137% ≤ V</td><td>Instantaneous</td></tr>
</table>
* To satisfy system requirements 2 over-voltage and under-voltage set points may be required.
The actual clearing times may vary within the above range due to distribution system conditions and DER facility protection design.</td><td>IEEE 1547 Clause 4.2.3
CAN CSA C22.2 No. 257-06
Clause 5.3.9
Toronto Hydro Requirement</td></tr>
</table>

<table>
<tr>
<td>2.1.4 Over-Frequency and Under-Frequency Protection

The DER facility shall cease to energize Toronto Hydro's distribution system at the frequency set points and clearing times outlined in the table below.

Response to abnormal frequency
<table>
<tr><th>Adjustable Set Point</th><th>Clearing Time</th></tr>
<tr><td>59.3 to 55.5 Hz</td><td>0.1 to 300 s</td></tr>
<tr><td>60.7 to 63.5 Hz</td><td>0.1 to 180 s</td></tr>
</table>
To satisfy system requirements 2 over-frequency and under-frequency set points may be required.</td>
<td>IEEE 1547 Clause 4.2.4

CAN CSA C22.2 No. 257-06
Clause 5.3.10

Toronto Hydro Requirement</td>
</tr>
<tr>
<td>2.1.5 Interface Protection System

The interface protection study shall include coordination of key interface protection elements, along with the proposed relays and settings to be used at the point of common coupling. The protection study submission shall include required AC & DC schematics and wiring diagram.</td>
<td>Toronto Hydro Requirement</td>
</tr>
</table>

2.2 Connection to Toronto Hydro System

Requirement	Reference
Connection to Toronto Hydro's System following a grid disturbance shall take place only when the voltage at the PCC is within 6% and frequency between 59.3 and 60.5 Hz. The DER facility shall reconnect no less than 5 minutes after the system has stabilized within the above voltage and frequency ranges. Where multiple units on the same feeder are involved, staggering the reconnection times may be required. For mid-sized generating facilities that incorporate transfer trip protection, a lockout relay (86) shall prevent resynchronization until enabled by Toronto Hydro System Control.	IEEE 1547 Clause 4.2.6 Toronto Hydro Requirement

2.3 Anti-Islanding Protection and Transfer Trip Requirements

Requirement	Reference
The DER facility shall disconnect from Toronto Hydro's System upon the loss of utility supply voltage in one or more phases. For mid-sized DER facilities with capacity greater than 50% of the minimum feeder load, the design shall include a Transfer Trip scheme to prevent islanding. In this case, Embedded Generator End Open (EGEO) logic is to be included to supervise the autoreclose operation of the feeder breaker.	IEEE 1547 Clause 4.4.1 OESC rule 84-008 CAN CSA C22.2 No. 257-06 Clause 5.3.11 Toronto Hydro Requirement

2.4 Grounding at the DER Facility

Requirement	Reference
The DER facility's grounding scheme shall not cause over voltages that exceed the rating of Toronto Hydro equipment. The distribution system primarily consists of effectively grounded feeders with surge arresters suitably rated. To meet these requirements at the point of connection the following criteria shall be met: $X0 / X1 \leq 3$, $R0/X1 \leq 1$. The DER facility shall not disrupt the coordination of ground fault protection on Toronto Hydro's distribution system. Wind DER facilities shall not connect to the distribution system neutral.	IEEE 1547 Clause 4.1.2 OESC rule 84-030 CAN CSA C22.2 No. 257-06 Clause 5.3.6 Toronto Hydro Requirement

3 Warning Signs and Diagrams

The following warning sign shall be posted on the point of disconnection, DER feeder cell and switch room door to warn people of the presence of DER:

WARNING
TWO POWER SOURCE
PARALLEL SYSTEM

As well, a single line, permanent and legible diagram of the switching arrangement shall be placed at the **Customer**'s control room and the switch room to indicate the position of the DERs and isolation points with their interlocking arrangements.

Operating designations will be assigned to the switching equipment of the DER system as required by Toronto Hydro. The **Customer** shall update the single line electrical diagram and operating diagram to include the assigned operating designations, and the switching equipment shall be identified by the operating designations as well.

Where an emergency backup generator is installed by a Customer, the following warning signs shall be provided to warn people of the presence of emergency backup generation:

(1) CAUTION
EMERGENCY BACKUP GENERATOR FEEDER
(2) CAUTION
EMERGENCY BACKUP GENERATOR

The first warning sign is to be posted at the generator feeder cell, and the second warning sign is to be posted at the door of the switchroom, one sign per door.

4 Commissioning and Witnessing Requirements

The **Customer** shall apply for **ESA** electrical inspection and provide Toronto Hydro with the Certificate of Inspection once requirements are satisfied. Following this Toronto Hydro will also receive a copy of the Connection Authorization from ESA.

Prior to commencing with commissioning and placing DER facility in-service, Toronto Hydro shall be given an opportunity to review and confirm the proposed commissioning plan meets system requirements.

In addition, before the DER is brought into synchronization, as per the Conditions of Service 4.3 and the DSC 6.2.19, Toronto Hydro will require a utility representative to:

- Witness successful tests of the protection system as far as it affects the Interconnection of the DER to the Toronto Hydro distribution system.
- Verify interface equipment and test associated interlocking facilities.

The customer shall advise Toronto Hydro a minimum of fifteen working days in advance of scheduled commissioning tests, exclusive of Saturday, Sunday and Statutory Holidays, to enable Toronto Hydro to witness the commissioning tests. All testing shall be completed during Toronto Hydro's normal working hours with the Customer being responsible for all costs incurred for time spent beyond said hours.

Alternatively, Toronto Hydro may elect to accept a commissioning test report certified by a Professional Engineer. The commissioning verification report shall contain all interface protection settings and confirm key protective functions and interlocking requirements as previously agreed to by Toronto Hydro Policy & Standards Department. The commissioning report shall be submitted for approval before the operation of DER facility.

On small generating units (less than 500 kVA), Toronto Hydro may elect to forego witness testing. All results shall be documented and a copy forwarded to Toronto Hydro.