



CAMBRIDGE AND NORTH DUMFRIES HYDRO INC.



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# **CAMBRIDGE AND NORTH DUMFRIES HYDRO INC.**

## **GENERAL REQUIREMENTS FOR EMBEDDED GENERATION**

**Revised: May 2010**

## REVISION HISTORY

Date	Version	Comments
December 2007	Rev 0	Original Report - R. Sinclair
November 2009	Rev 1	Included FIT – S. Jackson
March 2010	Rev 2	Updated metering information – S. Jackson
May 2010	Rev 3	Removed In-Series Option and Delta/Wye Configuration Requirement – S. Jackson

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GENERAL REQUIREMENTS  
FOR EMBEDDED GENERATION**

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**Appendixes**

Appendix 1: Micro-Embedded Generation Application Form

Appendix 2: Micro-Embedded Generation Facility Connection Agreement

Appendix 3: New Generation Account Application Form

Appendix 4: Preliminary Meeting Application Form

Appendix 5: Connection Impact Assessment Application Form

## **CAMBRIDGE AND NORTH DUMFRIES HYDRO INC.** **GENERAL REQUIREMENTS FOR EMBEDDED GENERATION**

### **1 INTRODUCTION**

Cambridge and North Dumfries Hydro Inc., referred to herein as “CNDHI” is a corporation incorporated under the laws of the Province of Ontario and a Distributor of electricity.

This document describes the general requirements for connecting an embedded generator to the CNDHI distribution system. These requirements are regulated by the Ontario Energy Board (OEB) ([www.oeb.gov.on.ca](http://www.oeb.gov.on.ca)) and are partially detailed in the OEB’s Distribution System Code (DSC). The DSC sets the minimum obligations that a licensed electricity distributor must meet in carrying out its obligations to distribute electricity within its Service Area under its license and the *Energy Competition Act*.

This document is in addition to the requirements of CNDHI’s Conditions of Service and all other requirements of CNDHI. The Generator agrees to comply with all requirements as amended by CNDHI from time to time.

For inquiries relating to the connection of embedded generation facilities, please contact:

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[sjackson@camhydro.com](mailto:sjackson@camhydro.com)

If at any time the Generator feels that CNDHI is not being fair and reasonable, the Generator may request a review by CNDHI using the dispute resolution process outlined in CNDHI’s Conditions of Service (section 1.8).

### **2 GENERAL REQUIREMENTS**

The following general requirements must be met by the Generator:

1. The health and safety of the general public, utility personnel (or its agents) and the Generator’s personnel must not be compromised or adversely affected in any way.
2. The Generator must not adversely affect or compromise equipment owned or operated by CNDHI (and Hydro One who is our transmitter, where applicable) nor the security, reliability and the quality of electrical supply of other customers connected to the CNDHI distribution system.

3. The Generator must meet all of CNDHI's requirements (and any Hydro One and/or IESO ([www.ieso.ca](http://www.ieso.ca)) requirements (if applicable)) and comply with the Electrical Safety Code (as administered by the Electrical Safety Authority (ESA)). Projects under the Feed-In Tariff (FIT) Program ([www.fit.powerauthority.on.ca](http://www.fit.powerauthority.on.ca)) and the Micro Feed-In Tariff (microFIT) Program ([www.microfit.powerauthority.on.ca](http://www.microfit.powerauthority.on.ca)) must meet the requirements of the Ontario Power Authority (OPA). Refer to section 7 of this document for further details.

Under no circumstances will the Generator be allowed to connect to the CNDHI distribution system unless CNDHI's requirements are met. If at any time these requirements are not met, CNDHI will have the right to refuse connection or to immediately disconnect the Generator from the CNDHI distribution system.

The Generator shall be responsible for ensuring that:

1. Appropriately certified and rated equipment is correctly installed;
2. Personnel involved in operating and maintaining the embedded generator are qualified (i.e. knowledgeable and properly trained in operation and safe working procedures);
3. Maintenance is carried out on a regular basis by qualified personnel;
4. All necessary and required care is taken to protect the public, utility personnel (or its agents) and the Generator's personnel from hazards associated with the generation system of the embedded generator;
5. The Generator's Facilities are inspected and approved by the ESA;
6. The installations, connections and operations meet all the requirements of Hydro One (our transmitter), the IESO, the OPA (if applicable), federal, provincial, and municipal statutes, regulations, bylaws, and codes, that pertain to the embedded generator; and
7. It obtains the necessary licences and permits to install and operate the embedded generator.

### **3 CONNECTION PROCESS**

Subject to all applicable laws, regulations and codes, CNDHI will make all reasonable efforts to promptly connect a generation facility to its distribution system.

If the Generator has not applied under the FIT Program and has not obtained a FIT contract from the OPA, each application for connection (other than micro generation,

which will be handled when received, but including an increase in output of an existing embedded generation facility) will be placed in a first-come, first-served queue upon completion of the connection impact assessment (CIA) for the embedded generation facility. CNDHI will notify the applicant of its queue position. An application will be removed from the queue if a connection cost agreement (CCA) has not been signed in relation to the connection of the embedded generation facility within 12 months of the date on which the application was placed in the queue. CNDHI will provide the applicant with two months advance notice of the expiry of the 12 month period prior to removing the application from the queue. An application will be removed from the queue if there are material revisions to the design, planned equipment or plans for the generation facility which require preparation of a new CIA.

### **3.1 MICRO-EMBEDDED GENERATION (<=10kW)**

The connection process for Micro-Embedded Generation (<= 10kW) is greatly simplified as compared to larger generators. The connection process is as follows:

#### **3.1.1 Request for Information**

The Generator proposing the installation of a Micro-Embedded generation facility contacts CNDHI and the ESA for information. The Generator may contact the OPA if the Generator is interested in the microFIT Program.

#### **3.1.2 Provision of Information**

CNDHI provides a copy of this document to the Generator to outline the connection process, required approvals, technical requirements (including metering), application form and contractual requirements.

The ESA is responsible for provision of information on electrical safety requirements. The ESA can be contacted at 1-877-ESA- SAFE (1-877-372-7233). The ESA's web site is [www.esainspection.net](http://www.esainspection.net). The ESA has published a booklet entitled "Electrical Guidelines for Inverter-Based Micro-Generating Facility (10kW and Smaller)" which is a useful guide.

The OPA is responsible for providing information on the MicroFIT program and its requirements.

#### **3.1.3 Generator Develops Plan**

The Generator reviews the relevant information from CNDHI and the ESA and puts together an installation plan. If a Generator wishes to participate in the OPA's microFIT Program, the Generator is required to register with the OPA on-line and should receive a "conditional offer of MicroFIT contract" prior to applying to CNDHI.

#### **3.1.4 Application Process**

The Generator submits an application to CNDHI, located in Appendix 1: Micro-Embedded Generation Application Form.

### **3.1.5 ESA Electrical Inspection Application**

The Generator submits plans and specific information to the ESA for inspection. Step 3.1.5 runs in parallel with Step 3.1.6.

### **3.1.6 CNDHI Review of Application**

#### **3.1.6.1 For Generator at Existing Customer Connection**

- CNDHI will make an Offer to Connect or provide reasons for refusing to connect the proposed generation facility within 15 calendar days.
- Typical requirement is a new meter.
- CNDHI will check if a service upgrade is required based on Generator supplied information.
- CNDHI will check if there are any issues associated with a significant amount of generation already on the supply feeder.
- CNDHI will inform the Generator of any requirements specific to the connection (typically requirements for metering), costs and timing to implement.
- CNDHI will make an Offer to Connect which will be good for 30 calendar days. The Generator shall indicate their intent within this time frame.
- CNDHI will not charge for preparation of the Offer to Connect.

#### **3.1.6.2 For Generator Not at Existing Customer Connection**

A Customer Connection must first be established before an agreement can be made for connection of generation to CNDHI's system. This new connection process can be done at the same time as the proposed generation connection process but the time lines will likely be extended since more work may be required.

### **3.1.7 Decision to Proceed**

If the Generator decides to proceed, the Generator will:

- Commit to paying CNDHI for connection assets (including metering);
- Complete, sign and return the Micro-Embedded Generation Facility Connection Agreement (Appendix 2) to CNDHI;
- Complete, sign and return the New Generation Account Application Form (Appendix 3) to CNDHI;
- Begin to install the generation;
- Work closely with CNDHI, the ESA, the OPA (if participating in the microFIT Program) and any other organizations from which work, inspections, approvals or licences are required to prevent delays;
- Plan activities in coordination with project milestones and initiate actions at

- required times; and
- Apply for electrical inspection with the ESA.

### **3.1.8 Final Connection**

The Generator will contact CNDHI after completing the ESA inspection process and receiving an Authorization to Connect. CNDHI will respond within 5 business days to make any necessary metering changes and connect the Generator's Micro-Embedded generation facility to CNDHI's distribution system. CNDHI will check to ensure that all Generator commitments have been satisfied (i.e. ESA Authorization to Connect, Signed Connection Agreement, receipt of any required payment, etc.) prior to final connection. The Generator must ensure that all OPA obligations are met if participating in the microFIT Program in order to ensure OPA contract payment for the generated electricity.

## **3.2 GENERATION > 10kW**

Generation greater than 10kW is classified into three categories as follows:

Small:           <= 500kW connected on distribution system voltage < 15kV  
                    <= 1MW connected on distribution system voltage >=15kV

Mid-Sized:      <= 10MW but > 500kW connected on distribution system voltage < 15kV  
                    > 1MW but <= 10MW connected on distribution system voltage >= 15kV

Large:           > 10MW

The connection process is as follows:

### **3.2.1 Initial Contact**

The Generator proposing the installation of a generation facility contacts CNDHI and the ESA. The transmitter (Hydro One) may need to become involved. If power is to be sold to the grid under a FIT Program contract, the Generator must contact the OPA to determine its requirements. If power is to be sold to the grid outside of a FIT Program contract, the Generator must contact the OEB regarding licence applications. For all projects over 10MW, the IESO must be involved.

### **3.2.2 Provision of Information**

CNDHI provides a copy of this document to the Generator to outline the connection process, required approvals, technical requirements (including metering), contractual requirements (Connection Agreement), application form and the potential involvement of the transmitter (Hydro One), the IESO and the OEB.

The ESA is responsible for provision of information on electrical safety requirements and its plan approval process.

The OPA is responsible for providing information on its FIT program and its requirements.

### **3.2.3 Generator Develops Plan**

The Generator reviews the relevant information from CNDHI and the ESA and puts together an installation plan.

### **3.2.4 Initial Consultation (No Charge)**

The Generator requests a preliminary meeting and submits the Preliminary Meeting Application Form (Appendix 4), including the following information:

- The name-plate rated capacity of each unit of the proposed generation facility and the total name-plate rated capacity of the proposed generation facility at the connection point;
- The fuel type of the proposed generation facility;
- The type of technology to be used; and
- The location(s) of the proposed generation facility including address and account number with CNDHI where available.

Within 15 business days of receipt of the Preliminary Meeting Application Form and a request for a meeting, CNDHI will meet with the Generator to review the plans at a basic level including:

- Location of existing distribution facilities in reference to proposed generation facility;
- The CNDHI distribution system technical information required to be provided by sections 6.2.9.1 and 6.2.9.3 of the Distribution System code, if this has been requested by the Generator
- Rough estimate on time and costs which could be associated with the project; and
- Basic feasibility of the project.

The Generator should also indicate if they will be participating in the Net Metering Program (refer to section 5) or the OPA's FIT Program (refer to section 7). If the Generator wishes to participate in the FIT Program then they are required to submit an application to the OPA and must receive a FIT contract in order to proceed to the next step of applying for a CIA.

### **3.2.5 Application for Connection Impact Assessment**

The Generator applies for a CIA by completing and submitting the Connection Impact Assessment Application Form (Appendix 5) and makes payment with the application. A CIA will also be required from the transmitter (Hydro One), the host distributor, if the Generator is not directly connected to CNDHI's distribution system or a distributor

whose distribution system is directly connected to CNDHI's distribution system. Projects greater than 10MW will also require a System Impact Assessment (SIA) by the IESO. CNDHI will collect payment from the Generator and forward all necessary payments and applicable information on behalf of the Generator to the transmitter, the host and/or connected distributor and the IESO as required.

Please note that all technical submissions associated with the CIA Application Form, including the form itself, must be signed and sealed by a licensed Ontario Professional Engineer (P.Eng).

### **3.2.6 Connection Impact Assessment**

CNDHI performs an impact assessment of the proposed generation on the distribution system and customers considering:

- Voltage impacts;
- Current loading;
- Fault currents; and
- Connection feasibility and identification of lines/equipment upgrades required, distribution or transmission system protection modifications, and metering requirements.

Where necessary, CNDHI receives an impact assessment from the transmitter (Hydro One), any host/connected distributor and the IESO.

For Small generation, an Offer to Connect will be made at the end of the impact assessment. For Mid-Sized generation, an overview of cost implications will be made at the end of the impact assessment. For Large generation, all costing will be addressed at a later step.

#### **3.2.6.1 Timing**

The time to review and inform the Generator about the results of the impact assessment is as follows from the date of receipt of payment and application:

- Small: up to 60 calendar days where no distribution system reinforcement or expansion is required to facilitate generator connection, up to 90 calendar days where a distribution system reinforcement or expansion is required to facilitate generator connection
- Mid-Sized: up to 60 calendar days
- Large: up to 90 calendar days

### **3.2.7 Decision to Proceed**

If the Generator decides to revise the original plans based on results of the impact assessment, the plans must be re-submitted for another review by going back to Step 3.2.5. Any change in design, equipment or plans requires notification to the ESA.

### 3.2.7.1 Small

If the Generator is satisfied and decides to proceed:

- Both parties sign a CCA;
- Generator commits to payments;
- Both parties commit to schedules, information exchange, scope of work of the Generator and of CNDHI;
- CNDHI initiates the work to be done to facilitate the connection;
- Generator initiates the required activities; and
- Generator must work closely with CNDHI, the ESA, the OPA (if applicable) and any other organizations from which work, inspections, approvals or licences are required to prevent delays.

### 3.2.7.2 Mid-Sized and Large

If the Generator feels that the results of the CIA are manageable, the Generator will request a meeting to develop a scope so that CNDHI can prepare an estimate and an Offer to Connect.

If the Generator decides to proceed:

- both parties agree to, and sign, scope of project; and
- Generator pays for preparation of estimate by CNDHI, host/connected distributor (if applicable), transmitter (Hydro One, if applicable), and IESO (if applicable).

CNDHI will notify the transmitter (Hydro One) and/or host/connected distributor and/or IESO as required within 10 business days of receiving payment and notification that the Generator has decided to proceed and that an estimate is to be prepared.

CNDHI will prepare a detailed estimate of the project based on the agreed upon scope.

CNDHI will prepare its Offer to Connect within 90 calendar days of receipt of payment from the Generator. In any event, CNDHI has up to 30 calendar days from date of receipt of comments from a transmitter, a host /connected distributor and/or IESO to incorporate them into the estimate.

If the Generator decides to proceed after reviewing the Offer to Connect:

- All parties agree to, and sign, a CCA
- Generator agrees to payment schedule for work required by CNDHI and/or transmitter (Hydro One), host/connected distribution system or IESO;
- All parties commit to schedules, information exchange, scope of work; and
- The generator must work closely with CNDHI, the ESA, the OPA (if applicable) and any other organizations from which work, inspections, approvals or licences

are required to prevent delays.

### **3.2.8 Implementation**

Both parties commit to obtain required approvals:

- Generator prepares detailed engineering drawings;
- Generator submits all detailed plans to ESA for Plan Approval process (includes detailed single line diagram and interface protection); and
- Generator submits the following information to CNDHI for design review (three copies certified by a licensed Ontario Professional Engineer (P.Eng.)):
  - Project Summary containing:
    - site location
    - prime mover type (internal combustion engine, gas turbine etc.)
    - anticipated generator output (including any seasonal and daily variations)
    - proposed installation schedule
    - future expansion plans (if applicable)
  - Single line electrical diagrams containing:
    - generator connections
    - voltage levels
    - transformer connections
    - isolating devices
    - fusing
    - protective relaying
    - metering
  - Nameplate data on:
    - protective relays (including descriptive bulletins)
    - synchronizing devices (including descriptive bulletins)
    - load interrupter switches (including reactance levels)
    - generator(s) (including reactance levels)
    - transformer(s) (including reactance levels)
    - circuit breakers (including descriptive bulletins)
  - Protection system design and operating procedures.
  - AC and DC protection schematics.
  - Fault calculations, protective relay settings, fuse selection and co-ordination study.
  - Station service and battery system details.
  - Grounding studies and results.
  - Commissioning procedures and schedule.
  - Operating procedures.
  - Maintenance procedure and record keeping.

It is recommended that this information be provided within 30 days of signing the CCA to allow for a timely design review.

CNDHI performs design review to ensure that the detailed engineering is acceptable. It

is recommended that this review be complete before equipment purchase by the generator. CNDHI will not be held liable for any costs incurred for equipment or services ordered before the design review is complete.

The Generator receives the design review from CNDHI. The Generator can then order equipment, begin construction, obtain ESA approvals, etc. CNDHI can begin connection work and complete any necessary line/equipment upgrades.

The Generator completes construction and applies for ESA electrical inspection for an Authorization to Connect (necessary for connection by CNDHI).

### **3.2.9 New Account Application and Connection Agreement**

If the Generator is not applying under the Net Metering Program then they must complete and submit a New Generation Account Application Form (Appendix 3) at least 15 days prior to the proposed date of connection. One piece of a valid photo ID is required to set up the account.

The Generator and CNDHI agree to, and sign, the Connection Agreement. If necessary, CNDHI and the transmitter (Hydro One) and/or a host/connected distributor will review existing agreements for required revisions.

The form of the Connection Agreement is contained in Appendix E of the OEB Distribution System Code.

A temporary Connection Agreement for the purpose of connection for commissioning and verification may be signed at this point while negotiating the final Connection Agreement.

### **3.2.10 Commissioning and Verification**

The Generator arranges for commissioning and testing of the facility. CNDHI witnesses and verifies the commissioning process. The transmitter (Hydro One) and any host/connected distributor witnesses and verifies the commissioning process as required. A final Connection Agreement is signed if a temporary one was used for commissioning and verification.

### **3.2.11 Completion**

If everything is satisfactory, the generation facility is fully connected and operational. The Generator must ensure that all OPA obligations are met if participating in the FIT Program in order to ensure payment for the generated electricity.

## **4 GENERAL TECHNICAL REQUIREMENTS**

The Generator shall ensure that the connection of its generation facility to the

distribution system does not materially adversely affect the safety, reliability and efficiency of CNDHI's distribution system. Generation facilities must meet the technical requirements specified in the OEB's Distribution System Code, Appendix F.2 of the OEB's Distribution System Code and the requirements of CNDHI.

Generation facilities will vary significantly in size, complexity and details. The following sections describe some general technical requirements that may or may not apply to a specific installation. Specific technical requirements will be provided to each applicant for new generation based on the specifics of the project.

#### **4.1 CONNECTION POINT**

##### **4.1.1 Interconnection Switch**

Three-phase, gang-operated, lockable, visible opening load interrupting switch(es) with provision for grounding shall be installed at the interface point between the CNDHI distribution system and the Generator's Facilities. The use of the switch(es) will be to isolate the embedded generator in case of emergency and for work protection. The switch(es) shall be provided, installed and maintained by the Generator unless other arrangements are made and approved by CNDHI. CNDHI will have operating control of the interconnection switch(es).

##### **4.1.2 CNDHI Access**

Immediate access to the interconnection switch(es) as well as the rest of the Generator's Facilities where other operating devices, relays, control switches, metering equipment, etc. associated with the embedded generator may be located must be provided on a 24 hour, 7 days a week basis for CNDHI personnel or its agents.

##### **4.1.3 Fault Interrupting Devices**

Suitable three-phase fault interrupting devices (circuit breakers acceptable to CNDHI) shall be provided to immediately interrupt and isolate faults in the utility or faults in the Generator's Facilities and handle other abnormal conditions such as "islanding".

##### **4.1.4 Generation Connection Point**

A generating unit may be connected to the Generator's existing electrical system. The generation connection point is often not at the service entrance, but downstream at one of the Generator's switchboards. In the latter case, an alternate type of load break switch may be acceptable to CNDHI. The generator connection switch must still meet functional requirements outlined above and pass ESA inspection. A mechanical interlock between the generator connection switch and the generator breaker will be required. The generator connection switch must have visible isolation.

##### **4.1.5 Point Of Isolation**

For the work protection of CNDHI crews, a point of isolation is *always* required to isolate the embedded generator. For micro-generation, a local disconnect must be installed between the generation meter and the generator and must be located within 2.0m of the load meter.

#### **4.1.6 Supervisory Control**

Supervisory control may be required for the control and monitoring of the load interrupting switches and circuit breakers, annunciation of the interface protection failure and telemetry of generator power outputs. If CNDHI determines supervisory control is required, the Generator will be required to cover all costs associated with the installation of a Generator owned RTU (Remote Terminal Unit) and associated hardware compatible with the CNDHI Control Centre SCADA system and initial and ongoing communication costs. If the Generator is a renewable energy generation facility, some or all of these costs may be covered by CNDHI.

### **4.2 VOLTAGE**

#### **4.2.1 Primary Distribution Voltage Level**

CNDHI primary distribution voltages are 4.16 kV, 8.32kV and 27.6 kV depending on the geographical area. The distribution circuits are effectively grounded for 4-wire distribution (phase to neutral connected loads).

There are size limitations with respect to connecting embedded generators to 27.6kV underground residential distribution systems that primarily supply residential and low-density commercial areas.

No “Mid-Size” or “Large” generation connections may be made on the 4.16 kV or 8.32kV system since this system is being converted to 27.6 kV. “Small” connections to the 4.16kV or 8.32kV system will be considered on an individual basis. “Micro” connections are acceptable on the 4.16kV, 8.32kV and 27.6kV systems.

#### **4.2.2 Interface Transformer**

An interface transformer will be required to transform the Generator’s system voltage to a higher voltage suitable to connect to a CNDHI distribution 27.6 kV distribution circuit. The interface transformer shall be grounded wye primary and grounded wye secondary for connection to CNDHI’s four wire distribution system.

#### **4.2.3 Voltage Regulation**

Adequate voltage regulation shall be maintained under a variety of operating conditions. An off-load tapchanger is normally used for voltage matching. The loading/unloading rate of the generator, the starting current of induction generator and auxiliary motors should be regulated to protect the CNDHI distribution system from voltage swings. Where necessary, system power flow studies must be submitted to CNDHI to confirm

voltage regulation requirements.

### **4.3 PROTECTION SYSTEM**

#### **4.3.1 Protection System Goals**

Protective relaying must be designed to provide maximum safety and reliability. The Generator's protective relaying shall co-ordinate with the existing CNDHI protective devices (and Hydro One's, where applicable). The protective system shall be capable of automatically isolating the embedded generator from the CNDHI distribution system in the following situations:

- Internal faults within the generator.
- Faults occurring in the Generator owned switchgear.
- External faults in the CNDHI distribution system.
- Certain abnormal system conditions (such as over/under voltage, over/under frequency) that could result in "islanding".

To meet protection system goals, the Generator must provide adequate protective relaying for interface protection between the CNDHI distribution system and the Generator's Facilities. Routine verification shall be required to ensure that the protections will respond to various fault conditions.

Protective equipment specified by CNDHI is for the protection of the CNDHI distribution system (and Hydro One equipment, if applicable) only. Additional protection will be required for the generation system.

The Generator should be aware that certain conditions in the utility system may affect the generator. It is the sole responsibility of the Generator to protect the equipment from conditions on the utility system.

Where modifications to existing distribution protection systems are required (and permitted), the Generator shall be responsible for all associated costs unless the Generator is a renewable energy generation facility, where some of these costs may be covered by CNDHI..

#### **4.3.2 Interface Protection Requirements**

Interface protection shall be provided to detect any faults in the CNDHI distribution system and any abnormal conditions in the Generator's system and to trip the generator/interface breaker to isolate the generator from the CNDHI distribution system.

The interface protection shall include:

##### **4.3.2.1 Ground Fault Protection**

Ground overcurrent relay (50N & 51N), or distance relay (21N) is required to detect ground faults.

#### 4.3.2.2 Phase Fault Protection

To detect phase faults, one or more of the following protective relays must be installed by the Generator:

- Distance relay (21), phase to phase
- Phase directional overcurrent relay (67)
- Voltage-restrained overcurrent relay (51V)
- Overcurrent relay (51)

#### 4.3.2.3 Protection for Islanding/Abnormal conditions

Voltage, frequency and reverse power protective relays are required to separate the embedded generator from the CNDHI distribution system in an islanding condition. This is when the utility breaker is opened and the generator is still connected to the CNDHI distribution system.

- Overvoltage relay (59)
- Undervoltage relay (27)
- Overfrequency (81o)
- Underfrequency (81u)
- Reverse power relay (32)

### 4.3.3 Relay Types and Settings

All the utility-generator interface protective relays shall be utility grade (not industrial grade). The types and settings of the protective relays shall be approved by CNDHI. The relays shall be equipped with self-checking features. A dedicated locked cabinet, panel with locked cover or sealable relay covers shall be provided to ensure the relay settings are not tampered with or adjusted without CNDHI's approval. A backup protection scheme may be required. A separate DC supply to the protective relays is required.

### 4.3.4 Fault Levels and Protection Coordination

CNDHI will provide present three-phase fault levels which are always subject to change. Typical maximum available three-phase faults are 800 MVA for 27.6 kV systems. A protection co-ordination study will be required for all installations. All installations may be supplied from more than one CNDHI feeder (at various times). These feeders may have different fault levels and originate from different transformer stations or transformers within the same transformer station. The protection scheme and protection co-ordination must account for these possibilities.

The additional fault current contribution from the generator will result in an increase in

fault level that may have an impact on the CNDHI distribution system. CNDHI may require the Generator to limit the generator fault current contribution to protect CNDHI equipment (i.e. breaker, switches) if the fault current is expected to be greater than design limits.

#### **4.3.5 Generator/Interface Circuit Breaker**

An automatic circuit interrupting device (usually a circuit breaker within switchgear) initiated by protective relays shall be provided by the Generator for generator/interface protection. The device must have adequate fault current interrupting capability.

#### **4.3.6 Synchronizing**

Synchronizing check shall be provided for the interface and generator breakers of the generation system that can produce electrical energy without being connected to the CNDHI distribution system. All breakers and devices (i.e. switches) between the generator and the CNDHI distribution system shall be interlocked with the synchronizing breakers.

#### **4.3.7 CNDHI Breaker Reclosing Scheme**

Most short circuits on overhead feeders are temporary. The CNDHI distribution system incorporates an automatic reclosing scheme to reclose the circuit breakers on such feeders typically within less than a half second after they have been automatically tripped by the feeder protections. This improves continuity of service to all customers.

The Generator must provide a reliable means of disconnecting the embedded generator from the distribution system prior to the feeder breaker reclosing. CNDHI is not liable for the damage to the Generator's generation facility due to the reclosure of a feeder breaker.

The Generator must disconnect the embedded generator from the CNDHI distribution system when system power is lost or when an electrical fault occurs, and remain disconnected.

#### **4.3.8 Remote Trip Protection Requirement**

Depending on the generation system connected to the feeder and the minimum feeder load, a remote trip facility between the transformer station and the Generator's Facilities will be considered. If the generation system can operate successfully in an islanded mode (i.e. maintain normal voltage and frequency) then the remote trip must be provided to isolate the generation system of the Generator's Facilities.

If the generation system connected to the feeder is less than 50% of the minimum feeder loading, a remote trip is generally not required. However, the Generator is required to provide redundant islanding protection timed to ensure that the interface breaker is tripped prior to the feeder breaker reclosing. The remote trip protection may

be required if the auto reclose time on the feeder breaker is less than the anticipated generator protection system fault clearing time.

A ground potential rise study may be required at the Generator's Facilities for the installation of telephone wires as the communication channel(s) between the transformer station and the Generator's Facilities. The study is to ensure the new electrical facilities do not present a safety hazard or adversely affect telecom and protection facilities. The Generator shall assure that the need for ground potential rise study is reviewed.

#### **4.3.9 Protection System Failure**

If at any time the protection system, including remote trip protection when installed, is not functioning or out of service or the DC supply is lost, the generator/interface breaker must be opened to isolate the generator from the CNDHI distribution system. This breaker must remain open until the protection system is returned to service.

### **4.4 TYPE OF GENERATION**

Depending upon the type of generation, the following additional design criteria will be required.

#### **4.4.1 Induction Generator**

The induction generator requires a source of external excitation before the machine can produce any power. As a result, the chance of external islanding is remote. The protection and control systems for this type of machine can be somewhat simpler than those required for a synchronous machine. It is, however, essential to have a reverse-power relay to ensure that the machine cannot operate as a motor.

Induction generators, by the nature of their design, run at lagging power factor. CNDHI requires the overall power factor to be equal to or greater than 0.9 lagging. As a result, suitable power-factor correction capacitor banks are recommended, and will likely be required on generation over 200kVA capacity. If capacitors are used, they must automatically be isolated whenever the generator breaker is open and must be sized carefully to avoid the risk of self-excitation of the generator. The self-excited induction generator can produce abnormally high voltages that can cause damage to the equipment of other CNDHI Generators.

The Generator shall furnish generator starting data to CNDHI for review. System power flow studies may be required to evaluate the impact of generator starting to voltage regulation.

#### **4.4.2 Synchronous Generator**

Since the synchronous generator can produce electrical energy without being connected to the CNDHI distribution system, a more advanced protection and control

system is required. The control system shall be provided with equipment necessary to establish a synchronous condition. In the event of a utility outage of even momentary duration, an automatic synchronization device shall prevent reconnection of the generator to the utility system until synchronism is re-established.

Synchronous generators can produce power at both leading and lagging power factors. The production of power at an excessive leading power factor can cause over-voltages in the distribution system. The generator can be run at leading power factor to offset lagging loads in the Generator's Facilities, however, overall plant power factor must remain between 0.9 lagging and unity.

#### **4.4.3 Inverter Type Generator**

Utility-interactive inverters do not require separate synchronizing equipment. Non-utility-interactive or stand-alone inverters shall not be used for embedded generation with the CNDHI distribution system.

An inverter type generator connected to the CNDHI distribution system shall operate with the power factor between 0.9 lagging and unity.

The utility-interactive inverters must include filters to minimize the harmonic output (see section 4.5) so as not to disturb the CNDHI distribution system or other customers in any way.

Generators with less than 100kW total capacity, such as micro-turbine generators without black start capability, may automatically restart following automatic reclosing of the feeder breaker. Generators that automatically restart must have an adjustable time delay on restart up to 5 minutes. CNDHI will co-ordinate the settings of generator restart time-delays such that generators on any feeders do not restart all at once to avoid voltage flicker.

### **4.5 POWER QUALITY**

#### **4.5.1 Design Goals**

Negative effects on power quality must be prevented. These include: objectionable harmonics, voltage distortion, voltage flicker or poor power factor on the CNDHI distribution system or on other customers' electrical and communication systems.

#### **4.5.2 Power Quality Requirements**

The Generator's Facilities shall meet the guidelines set out in the IEEE Standard 519 (latest edition) titled "Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems".

The total harmonic distortion (THD) voltage shall not exceed 5% of the fundamental frequency (60Hz), or 3% of the fundamental frequency for any individual voltage

distortion when measured on the distribution system side of the interconnection switch.

#### **4.5.3 Future Requirements**

If at any time before or after the in-service date, additional filters, other equipment, or modifications are needed to meet these specifications or future specifications, the Generator shall take the necessary steps to meet CNDHI's requirements. The Generator shall pay all costs associated with modifications deemed necessary by CNDHI to achieve acceptable power quality or the generator must be disconnected from the CNDHI distribution system.

#### **4.5.4 Phase Unbalance**

Unbalances in phase current and phase voltage can occur on CNDHI's four wire distribution system. Specific unbalancing varies by feeder. The embedded generator connected to the distribution system must be capable of operating under these conditions and shall not make worse the existing unbalanced conditions.

#### **4.5.5 Frequency**

The generator shall be operated within the range 59.3Hz to 60.5Hz. 60 hertz is the normal electrical system frequency.

#### **4.5.6 Voltage Flicker**

Voltage flicker is described as an increase or decrease in voltage over a short period of time, normally associated with fluctuating load. The characteristics of a particular flicker will depend on the characteristics of the corresponding load (percentage voltage dip, frequency of occurrence). This type of problem may arise during the start-up of an induction generator as the large starting current may cause the voltage to dip considerably. The Generator must take steps to minimize flicker problems to the acceptable level.

#### **4.5.7 Power Factor**

When the actual Generator load approaches the output level of the generator, the net power factor may be adversely affected. The Generator shall ensure that the net generator/load power factor remains between 0.9 lagging and unity.

### **4.6 METERING**

#### **4.6.1 Metering Requirements**

Metering requirements are to be determined by CNDHI and dependent on the type and size of generator and the total demand of the Generator's Facilities. The installation of these meters may require additional metering cabinets, metering cells, a dedicated 120 Volt AC supply to each meter cabinet and possibly a telephone connection. The

Generator shall be required to cover the costs of additional equipment and monthly telephone charges, if applicable. CNDHI shall own, and have safe access to all metering equipment, including instrument transformers at all metering locations.

The Generator will also be required to comply with all the metering requirements specified in CNDHI's Conditions of Service and CNDHI's Metering Specifications (both as amended from time to time). Depending upon the size of the generator, the Generator may also be required to install IESO compliant metering equipment.

The generation meter must be located within sight and within 2.0m of the existing load meter. The only exception to this rule would be if placing the meter somewhere else would be technically or economically advantageous to CNDHI and will be determined on a case-by-case basis.

Where the Generator will be exporting power onto the distribution system, a bi-directional meter with four-quadrant interval measurement capability will be required.

Where export of power is not required, such as back-up capability or generation for load displacement, but not including the FIT and microFIT program, the metering requirement will be the same manner as other load customers. A reverse power relay shall also be installed to ensure blocking of any power exports.

Should the Generator receive pulses or data from regular CNDHI metering for monitoring or load management purposes, and the meter fails to deliver the data due to failure or breakdown, CNDHI will not be responsible for any damage to or additional operational requirements of the Generator's Facilities.

At some locations, additional metering required for the generator may introduce a need for multiple telephone circuits, or circuits in addition to those already present. It will be the Generator's obligation to provide, operate and maintain additional phone lines, or approved line sharing or call managing equipment.

#### **4.6.2 Metering Instrument Transformers**

The point of connecting metering instrument transformers is critical and must be approved by CNDHI.

CNDHI will not share any metering instrument transformer circuits for non-revenue metering applications or any other purposes. All metering equipment that is part of the instrument transformer circuits must have Measurement Canada approval for billing and be inspected in accordance with Measurement Canada regulations.

For a customer owned 27.6kV substation, the Generator must include a CNDHI revenue metering cell.

#### **4.7 SYSTEM CHANGE**

If at any time the Generator proposes changes, modifications or additions to the Generator's Facilities or protection and control system including relay settings, the Generator must give CNDHI the opportunity to review and approve of these modifications before they are implemented. The Generator shall not arbitrarily or unilaterally implement any changes, modifications or additions to the Generator's Facilities. Where changes require re-testing or commissioning, CNDHI reserves the right to witness such testing. Reasonable notice shall be provided to CNDHI.

#### **4.8 SYSTEM DOCUMENTATION**

Documentation on the Generator's Facilities, as built, shall be provided to CNDHI before the in-service date. This documentation shall include a detailed single line diagram, AC and DC elementary, relay types, protection co-ordination studies and setting sheets.

#### **4.9 WARNING NOTICES AND DIAGRAMS**

In addition to ESA requirements, the following notices shall be provided:

A warning notice indicating the presence of an embedded generation system shall be installed, prior to commissioning. The following sign shall be posted at the door of the switch room and the door of the generator room, one sign per door at the Generator's Facilities.

### **CAUTION EMBEDDED GENERATION**

A single line, permanent and legible diagram of the switching arrangement, shall also be placed at the Generator's control room and the switch room to indicate the position of the embedded generator(s) and isolation points with their interlocking arrangements.

Operating designations will be assigned to the switching equipment of the generation system as required by CNDHI. The Generator shall update 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.

#### **4.10 VERIFICATION OF PROTECTION SYSTEM**

Routine verification of the utility-generator interface protective relays and protective devices shall be performed on a scheduled basis. Testing intervals for protection systems should not exceed four (4) years for microprocessor-based systems and two (2) years for electro-mechanical based systems.

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

The Generator shall make available to CNDHI records of relay calibration and protection

verifications so that records of the interface protective relays can be maintained. The specific records shall be identified in the Connection Agreement.

#### **4.11 INSPECTION REQUIREMENTS**

The Generator shall allow CNDHI and/or its agent(s) free and unrestricted access to the Generator's Facilities for inspection and safety checks, given reasonable notice. The Generator shall demonstrate the correct operation of the generation system including the protection and control equipment as may be required by CNDHI.

#### **4.12 PERFORMANCE UNDER THIS SPECIFICATION**

1. If at any time the Generator fails to perform any obligation under this Agreement or any other written requirements of CNDHI, CNDHI may give notice to the Generator or the Generator's designate, as documented in the Operations Schedule, which notice may be given by telephone, to immediately remedy the failure. In all cases, CNDHI will attempt to give the Generator notice and ample time to remedy any problems and comply with this specification, however, CNDHI will always have the right to immediately disconnect the embedded generator without any notice.
2. CNDHI may require the disconnection of the generation system, or discontinue the supply of electricity to the Generator for any good and substantial cause in the opinion of CNDHI, acting reasonably, including but not limited to the following reasons:
  - (a) for safety of persons, plant, or equipment;
  - (b) to perform planned or unplanned maintenance on CNDHI equipment;
  - (c) when work protection is required on the CNDHI distribution system or the Generator's Facilities;
  - (d) when the CNDHI distribution system is in an abnormal or emergency operating condition;
  - (e) when the Generator's Facilities are operating abnormally or are adversely affecting the CNDHI distribution system by way of frequency and voltage fluctuations; and
  - (f) when Hydro One load shedding is required.

CNDHI will give the Generator as much notice as possible before disconnecting the supply of electricity; however, CNDHI will always have the right to immediately disconnect the embedded generator without any notice.

3. Neither party shall be held responsible or liable for any loss, damage, detention, delay, failure or inability to meet any of its obligations specified in this requirements or any documents referred to herein because of events beyond its reasonable control, including without limitation, acts of God, acts of a public enemy, war, hostilities, invasion, insurrection, riot, the order of any civil or military government, explosion, fire, strikes, lockouts, labour disputes,

malicious acts, vandalism, failure of equipment, accident to the Generator's Facilities or the CNDHI distribution system (or the Hydro One system, if applicable), storms or other adverse weather conditions or other causes of a similar nature.

#### **4.13 LIABILITY**

As part of installing and operating the Generator's Facilities, the Generator shall:

1. Assume all risk, liability or obligation in respect to all loss, damage or injury to:
  - (a) property of the Generator, property of CNDHI and Hydro One, if applicable, or property of any third party on the lands and premises on the Generator's side of the Delivery Point. The Delivery Point is defined as CNDHI's disconnection device on the distribution line connecting the Generator's Facilities to CNDHI's distribution system as identified in the Operations Schedule.
  - (b) any person or persons (including loss of life) on the said lands and premises on the Generator's side of the Delivery Point, which loss, damage or injury was due to power supplied by CNDHI to the Generator to the extent used to supply power to the Generator, except to the degree that such loss, damage injury was due to the negligence of CNDHI, its servants or agents. Without limiting the generality of the foregoing, the Generator shall be responsible, except to the degree that such is caused by the negligence of CNDHI, for the cost of any damage to the Generator's equipment and transformers or any damage to equipment of a third party that may occur due to the operation of the Generator's Facilities or of CNDHI's distribution system.
  - (c) all actions, causes of action, suits, proceedings, claims, demands, losses, damages, penalties, fines, costs, expenses, obligations and liabilities arising out of a discharge of any contaminant into the natural environment on the Generator's lands and premises and any fines or orders of any kind that may be levied or made pursuant to the Environmental Protection Act (Ontario), the Ontario Water Resources Act, or the Dangerous Goods Transportation Act (Ontario), or other legislation or legal requirements whether federal, provincial or municipal, except to the degree that such discharge was due to the negligence of CNDHI, its servants or agents.
2. Indemnify CNDHI, and Hydro One, and save each harmless from all risk, liability, and obligation assumed by the Generator and all claims and demands in connection therewith, save and except such loss, damage or injury due to the negligence of CNDHI, Hydro One, or their respective servants or agents.

3. Assume all risk for the existence of all distribution lines, plant, meters and equipment of CNDHI on or in the lands and premises on the Generator's side of the Delivery Point. If any of this equipment is destroyed or damaged other than by ordinary wear and tear or due to the fault of CNDHI or defect to the equipment, the Generator shall pay to CNDHI the cost of repairing or replacing this equipment as determined by CNDHI.
4. The Generator shall add Cambridge and North Dumfries Hydro Inc. onto their liability insurance policy as an additional insured. A Certificate of Insurance shall be provided to CNDHI by the Generator evidencing this fact prior to the in-service date of the generator and this Certificate of Insurance shall be appropriately filed with CNDHI and renewed each year thereafter. The Generator's liability policy shall have a minimum limit of insurance of \$10 million per occurrence.

## **5 NET METERING**

As a way to encourage conservation, CNDHI welcomes eligible customers wishing to participate in the Ontario Ministry of Energy's Net Metering program.

### **5.1 What is Net Metering?**

Ontario's net metering regulation allows you to send electricity generated from renewable sources to the electrical grid for a credit toward your energy costs. CNDHI will subtract the value of electricity you supply to the grid from the value of what you take from the grid. What you'll see on your bill is the "net" difference between those two amounts. If you supply power that is worth more than what you take from the grid over the billing period, you'll receive a credit that can help lower future energy bills. The more electricity you produce, the greater your savings.

### **5.2 How will your hydro bill be calculated?**

CNDHI will continue to read your meter just as we do now. The bill you see will reflect the difference between the value of the energy you exported to the grid and the value of the energy you needed to take from the grid. All of the regulated charges apply only to your net consumption - if that portion of your bill is zero, or a credit, your bill will include only CNDHI's fixed monthly access charge. If you have more credit than you can apply to one bill you can carry the balance forward for up to one year to offset future costs. To cancel a net metering agreement, all you need to do is provide CNDHI with 90 days written notice.

### **5.3 Who is eligible?**

Net metering is available from CNDHI to any customer who generates electricity primarily for their own use from a renewable source (wind, water, solar or agricultural

biomass), using equipment of maximum cumulative output of 500kW in size.

#### **5.4 How do you get started?**

In order to participate, you must meet all the requirements for embedded generation as outlined in this document for the proposed size of generation. You may also want to contact the Electrical Safety Authority (ESA) at 1-877-ESA- SAFE (1-877--372-7233) or on-line at [www.esainspection.net](http://www.esainspection.net). The ESA must inspect and approve your system. The Ontario Ministry of Energy has published a booklet entitled “Net Metering in Ontario” which is a useful guide. The Ministry of Energy can be reached at 1-888-668-4636 or on-line at [www.energy.gov.on.ca](http://www.energy.gov.on.ca).

## **6 ONTARIO POWER AUTHORITY RENEWABLE ENERGY STANDARD OFFER PROGRAM**

The OPA’s Renewable Energy Standard Offer Program (RESOP) has been discontinued and is no longer available. Any projects that had a contract with the OPA under this program will still be under contract with the OPA as per the RESOP rules. RESOP has been replaced by the FIT Program.

## **7 ONTARIO POWER AUTHORITY FEED-IN TARIFF PROGRAM**

### **7.1 What is the FIT Program?**

Ontario’s FIT Program has a number of key features. It:

- provides a straightforward way to contract for generation
- is open to various renewable energy technologies, including biogas, biomass, landfill
- gas, solar photovoltaic (PV), wind and waterpower
- allows all types of generators, from homeowners to large developers, to participate
- has different prices for different technologies and different project sizes
- has prices that are intended to cover total project costs and provide a reasonable rate of return over a 20-year contract (40 years for waterpower)
- provides incentives for First Nation and Métis projects
- provides incentives for community-based projects
- offers long-term price guarantees to increase investor confidence and access to financing
- drives the expansion of the distribution and transmission systems, which allows generators to connect to the grid.

### **7.2 Who is eligible to participate in FIT?**

Projects must meet the eligibility requirements specified by the OPA. The specific

requirements can be obtained from the OPA by calling them at 1-800-797-9604 or by using their web site ([www.powerauthority.on.ca](http://www.powerauthority.on.ca)). In general, the projects must generate electricity from wind, solar photovoltaic (PV), renewable biomass, biogas, landfill gas or waterpower. There are two streams to the program: MicroFIT ( $\leq 10\text{kW}$ ) and FIT ( $>10\text{kW}$ ). The maximum size of the installed capacity is determined by the type of renewable energy. The generation must be connected to CNDHI's distribution system.

### **7.3 What is the process for participating in FIT?**

In order to participate, you must meet all the requirements for embedded generation as outlined in this document for the proposed size of generation. You will also have to submit an application to the OPA under the FIT or MicroFIT program and meet all the requirements of the FIT programs. You may also want to contact the Electrical Safety Authority (ESA) at 1-877-ESA- SAFE (1-877-372-7233) or on-line at [www.esainspection.net](http://www.esainspection.net). The ESA must inspect and approve your system.

You should check with other regulatory authorities regarding the various codes and regulations that may be in place in this area to govern this type of installation (i.e. City of Cambridge, Township of North Dumfries, Region of Waterloo, Grand River Conservation Authority, Ontario Ministry of Environment, Ontario Ministry of Natural Resources, etc.).



CAMBRIDGE AND NORTH DUMFRIES HYDRO INC.

**Micro-Embedded Generation Application Form**

**Applicant Information**

Company/Owner Name: \_\_\_\_\_

Contact Name: \_\_\_\_\_

Mailing Address: \_\_\_\_\_

Phone Number: \_\_\_\_\_ Fax Number: \_\_\_\_\_

E-Mail Address: \_\_\_\_\_

Existing Cambridge & North Dumfries Hydro Inc. Customer:  Yes  No

If yes, Account Number: \_\_\_\_\_

**Proposed Generation Location Information**

Site Address: \_\_\_\_\_

City/Town/Township: \_\_\_\_\_

Lot Number: \_\_\_\_\_

Concession Number: \_\_\_\_\_

**Program Type**

Load Displacement  Net Metering

MicroFIT, Reference Number: \_\_\_\_\_

Other: \_\_\_\_\_

**Project Information**

Proposed In-Service Date (dd/mm/yy): \_\_\_\_\_

Incremental Project:  Yes  No

If yes, Existing Generation Nameplate Capacity (kW): \_\_\_\_\_

Proposed Total Generation Nameplate Capacity (kW): \_\_\_\_\_

Generation Connection Type:  Single Phase  Three Phase

*Fuel Type:*

Wind  Water  Biomass  Bio-gas  Landfill Gas

Solar (Rooftop)  Solar (Ground Mounted)  Other: \_\_\_\_\_

**Generator/Inverter Information**

Manufacturer: \_\_\_\_\_

Model Number: \_\_\_\_\_

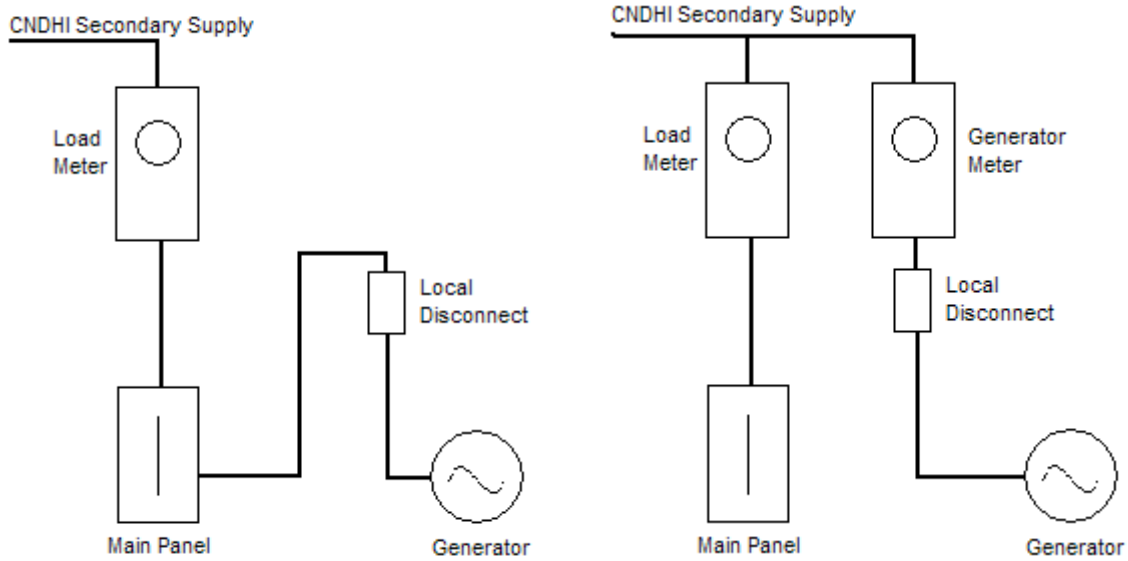
Number of Phases:  Single Phase       Three Phase

Type:  Synchronous       Induction       Inverter

Nameplate Rating (kW): \_\_\_\_\_      Output Voltage (V): \_\_\_\_\_

**Metering Connection Setup**

Net Metering/Load Displacement       Indirect Parallel Connection



**Please Return Completed Application to:**

Cambridge & North Dumfries Hydro Inc.  
Attn: Shawn Jackson, Engineering Supervisor - Distribution  
1500 Bishop Street  
P.O. Box 1060  
Cambridge, ON  
N1R 5X6

OR

Fax Number: (519) 621-5779  
Attn: Shawn Jackson, Engineering Supervisor - Distribution

OR

[sjackson@camhydro.com](mailto:sjackson@camhydro.com)



CAMBRIDGE AND NORTH DUMFRIES HYDRO INC.

## **Micro-Embedded Generation Facility Connection Agreement**

In consideration of Cambridge and North Dumfries Hydro Inc. (CNDHI) agreeing to allow you to connect your 10kW name-plate rated capacity or smaller generation facility to CNDHI's distribution system, you hereby agree to the following terms and conditions.

### **1.0 Eligibility**

1.1 You agree that your generation connection shall be subject to all applicable laws and bound by the terms and conditions of CNDHI's Conditions of Service, which have been filed with the OEB and are available on request.

### **2.0 Technical Requirements**

- 2.1 You represent and warrant that you have installed or will install prior to the connection of your generation facility to CNDHI's distribution system, an isolation device satisfying Section 84 of the Ontario Electrical Safety Code and agree to CNDHI's staff operation of this as required for the maintenance and repair of the distribution system.
- 2.2 You agree to perform regular scheduled maintenance to your generation facility as outlined by the manufacturer in order to assure that connection devices, protection systems, and control systems are maintained in good working order and in compliance with all applicable laws.
- 2.3 You agree that during a power outage on the CNDHI system your generation facility will shut down, unless you have installed special transfer and isolating capabilities on your generation facility. You agree to the automatic disconnection of your generation facility from CNDHI's distribution system, as per the generator protective relay settings set out in this Agreement, in the event of a power outage on CNDHI's distribution system or any abnormal operation of CNDHI's distribution system.
- 2.4 You covenant and agree that the design, installation, maintenance, and operation of your generation facility are conducted in a manner that ensures the safety and security of both the generation facility and CNDHI's distribution system.
- 2.5 Due to CNDHI's obligation to maintain the safety and reliability of its distribution system, you acknowledge and agree that in the event CNDHI determines that your generation facility (i) causes damage to; and/or (ii) is producing adverse effects affecting other distribution system customers or CNDHI's assets, you will disconnect your generation facility immediately from the distribution system upon direction from CNDHI and correct the problem at your own expense prior to reconnection.

### **3.0 Liabilities**

- 3.1 You and CNDHI will indemnify and save each other harmless for all damages and/or adverse effects resulting from either party's negligence or willful misconduct in the connection and operation of your generation facility or CNDHI's distribution system.
- 3.2 CNDHI and you shall not be liable to each other under any circumstances whatsoever for any loss of profits or revenues, business interruptions 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.

### **4.0 Compensation and Billing**

- 4.1 If you are not an embedded retail generator, you agree that, subject to any applicable law:
  - a) CNDHI will not pay you for any excess generation that results in a net delivery to CNDHI between meter reads; and
  - b) there will be no carryover of excess generation from one billing period to the next unless you are, at the relevant time, a net metered generator (as defined in section 6.7.1 of the

Distribution System Code).

4.2 If you are an embedded retail generator selling output from the embedded generation facility to the Ontario Power Authority under contract, you agree that CNDHI will pay you for generation in accordance with the Retail Settlement Code.

4.3 If you are an embedded retail generator delivering and selling output to CNDHI, you agree that CNDHI will pay you for generation in accordance with the Retail Settlement Code.

**5.0 Termination**

5.1 You understand that you have the right to terminate this agreement at any time, and that by doing so you are required to disconnect your generation facility and notify CNDHI of such action.

**6.0 Assignment**

6.1 You may assign your rights and obligations under this Agreement with the consent of CNDHI, which shall not withhold its consent unreasonably. CNDHI shall have the right to assign its rights and obligations under this Agreement without your consent.

I understand, accept and agree to comply with and be bound by the above terms and conditions governing the connection of my generation facility to CNDHI's distribution system.

Generator Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Print name and LDC account number: \_\_\_\_\_

I confirm that the following information is true and accurate:

Nameplate rating of Generator: \_\_\_\_\_ kW Total installed generation \_\_\_\_\_ kW

Type:  Wind Turbine  Photovoltaic (Solar)  Hydraulic Turbine  Fuel Cell  
 Other \_\_\_\_\_

Inverter Utilized:  Yes  No

Inverter Certification:  C22.2 #107.1  UL 1741  Site Certified by the ESA

**Generator Protective Relay Settings**

**Table 1: Inverter Based Generation**

The following relay settings shall be used for inverters built to the CSA standard:

Source: CSA C22.2 No. 107.1-01 Table 16

System Voltage Vn = V nominal <b>V (Volts)</b>	Frequency <b>F (Hertz)</b>	Maximum number of cycles to disconnect	
		Seconds	Cycles
<b>V &lt; 0.5 Vn</b>	60	0.1	6
0.5 Vn <= <b>V &lt; 0.88 Vn</b>	60	2	120
1.10 Vn <= <b>V &lt; 1.37 Vn</b>	60	2	120
<b>V &gt; 1.37 Vn</b>	60	0.033	2
Vn	<b>F &lt; 59.5*</b>	0.1	6
Vn	<b>F &gt; 60.5</b>	0.1	6

\* The UL1741 & IEEE P1547 Standards use F < rated-0.7 i.e. 59.3 Hz. To update if CSA C22.2 No. 107.1-01 is changed.

**Table 2: Non Inverter Generation**  
**CNDHI's minimum requirements, for other generation are as follows:**

System Voltage Vn = V nominal <b>V (Volts)</b>	Frequency <b>F (Hertz)</b>	Maximum clearing time*	
		Seconds	Cycles
<b>V &lt; 0.5 Vn</b>	60	0.16	9.6
<b>0.5 Vn &lt;= V &lt; 0.88 Vn</b>	60	2	120
<b>1.10 Vn &lt;= V &lt; 1.20 Vn</b>	60	1	120
<b>V &gt; 1.20 Vn</b>	60	0.16	9.6
Vn	<b>F &lt; 59.3</b>	0.16	9.6
Vn	<b>F &gt; 60.5</b>	0.16	9.6

\*Clearing time is the time between the start of the abnormal condition and the generation ceasing to energize Cambridge and North Dumfries Hydro's distribution system.

- If you are uncertain about your generation equipment's protective relay settings, please check with your generating equipment supplier.
- Automatic reconnect setting time for your generator is after 5 minutes of normal voltage and frequency on CNDHI's distribution system.



CAMBRIDGE AND NORTH DUMFRIES HYDRO INC.

**New Generation Account Application Form**

**Applicant Information**

Load Customer Account Number: \_\_\_\_\_

Title:  Mr.  Miss  Mrs.  Ms.

First Name: \_\_\_\_\_ Last Name: \_\_\_\_\_

Driver's Licence OR Social Insurance Number: \_\_\_\_\_

Date of Birth (dd/mm/yyyy): \_\_\_\_\_

Home Phone Number: \_\_\_\_\_ Work Phone Number: \_\_\_\_\_

Employer: \_\_\_\_\_

Email Address: \_\_\_\_\_

Previous Account Number (if applicable): \_\_\_\_\_

**Service Information**

Date Service Required (dd/mm/yyyy): \_\_\_\_\_

Street Address: \_\_\_\_\_

City: \_\_\_\_\_ Postal Code: \_\_\_\_\_

**Billing Address (if different from service address)**

Street Address: \_\_\_\_\_

City: \_\_\_\_\_ Postal Code: \_\_\_\_\_

**Second Adult Living at Address Information (if applicable)**

Title:  Mr.  Miss  Mrs.  Ms.

First Name: \_\_\_\_\_ Last Name: \_\_\_\_\_

Driver's Licence OR Social Insurance Number: \_\_\_\_\_

Date of Birth (dd/mm/yyyy): \_\_\_\_\_ Work Phone Number: \_\_\_\_\_

Employer: \_\_\_\_\_

Email Address: \_\_\_\_\_

\_\_\_\_\_  
Owner's/Tenant's Signature

\_\_\_\_\_  
Date (dd/mm/yyyy)



CAMBRIDGE AND NORTH DUMFRIES HYDRO INC.

**Preliminary Meeting Application Form**

**Applicant Information**

Company/Owner Name: \_\_\_\_\_

Contact Name: \_\_\_\_\_

Mailing Address: \_\_\_\_\_

Phone Number: \_\_\_\_\_ Fax Number: \_\_\_\_\_

E-Mail Address: \_\_\_\_\_

**Proposed Generation Location Information**

Site Address OR Closest Location Description: \_\_\_\_\_

**Program Type**

Load Displacement       FIT

**Project Information**

Proposed Total Generation Nameplate Capacity (kW): \_\_\_\_\_

Proposed Service or Sub-Service Size (A): \_\_\_\_\_

Generation Connection Type:  Single Phase     Three Phase

*Fuel Type:*

Wind     Water       Biomass     Bio-gas       Landfill Gas

Solar (Rooftop)       Solar (Ground Mounted)     Other: \_\_\_\_\_

**Please Return Completed Application to:**

Cambridge & North Dumfries Hydro Inc.  
Attn: Shawn Jackson, Engineering Supervisor - Distribution  
1500 Bishop Street  
P.O. Box 1060  
Cambridge, ON  
N1R 5X6

OR

Fax Number: (519) 621-5779  
Attn: Shawn Jackson, Engineering Supervisor - Distribution

OR

[sjackson@camhydro.com](mailto:sjackson@camhydro.com)



CAMBRIDGE AND NORTH DUMFRIES HYDRO INC.

**Connection Impact Assessment Application Form**

Note: All technical submissions, including this form, must be signed and sealed by a licensed Ontario Professional Engineer (P.Eng.).

Date (dd/mm/yyyy): \_\_\_\_\_

Generation Account Number (if applicable): \_\_\_\_\_

**Project Information**

Project Name: \_\_\_\_\_

Proposed In-Service Date: \_\_\_\_\_

*Project Size:*

Number of Units: \_\_\_\_\_ Nameplate Rating of Each Unit (kW): \_\_\_\_\_

Generation Connection Type:  Single Phase  Three Phase

Proposed Total Generation Nameplate Capacity (kW): \_\_\_\_\_

**Proposed Generation Location Information**

Site Address: \_\_\_\_\_

City/Town/Township: \_\_\_\_\_

Lot Number: \_\_\_\_\_

Concession Number: \_\_\_\_\_

**Project Information**

*Developer Information:*

Company/Person: \_\_\_\_\_

Contact Person: \_\_\_\_\_

Mailing Address: \_\_\_\_\_

Telephone Number: \_\_\_\_\_ Fax Number: \_\_\_\_\_

Email Address: \_\_\_\_\_

*Owner Information (if different from Developer):*

Company/Person: \_\_\_\_\_

Contact Person: \_\_\_\_\_

Mailing Address: \_\_\_\_\_

Telephone Number: \_\_\_\_\_ Fax Number: \_\_\_\_\_

Email Address: \_\_\_\_\_

*Engineering Consultant:*

Company/Person: \_\_\_\_\_

Contact Person: \_\_\_\_\_

Mailing Address: \_\_\_\_\_

Telephone Number: \_\_\_\_\_ Fax Number: \_\_\_\_\_

Email Address: \_\_\_\_\_

**Project Type**

Load Displacement       Net Metering       FIT

**Fuel Type**

Wind Turbine               Hydraulic Turbine       Steam Turbine               Solar/Photovoltaic

Diesel Engine               Gas Turbine               Fuel Cell                       Biomass

Co-Generation/Combined Heat & Power       Bio-Diesel                       Anaerobic Digester

Other: \_\_\_\_\_

**Location and Site Plan**

Provide Site Plan with approximate line routings for connection to nearby CNDHI's facilities. The Site Plan should include roads, concession and lot numbers, and nearby power lines.

Drawing/Sketch Number: \_\_\_\_\_ Rev: \_\_\_\_\_

**Connection to CNDHI's Distribution System**

Proposed Connection Voltage (kV): \_\_\_\_\_

Station: \_\_\_\_\_

Feeder: \_\_\_\_\_

**Single Line Diagram**

Provide a Single Line Diagram (SLD) of the Generating Facility including the PCC to CNDHI's distribution system.

SLD Drawing Number: \_\_\_\_\_ Rev: \_\_\_\_\_

**Protection Philosophy**

Provide a document describing the protection philosophy for detecting and clearing:

- Internal faults within the Generation Facility
- External phase and ground faults (within CNDHI's distribution system)
- Certain abnormal system conditions such as over/under voltage, over/under frequency, open phase(s)
- Islanding

Include a tripping matrix or similar information in the document

Drawing Number: \_\_\_\_\_ Rev: \_\_\_\_\_

Note: The Generator shall install utility grade relays for the interface protection. The protection design shall incorporate facilities for testing and calibrating the relays by secondary injection.

**Generator Characteristics**

Number of Generating Unit(s): \_\_\_\_\_

Manufacturer: \_\_\_\_\_

Model Number: \_\_\_\_\_

Rated Capacity of Each Unit (kW/kVA): \_\_\_\_\_ / \_\_\_\_\_

Rated Frequency (Hz): \_\_\_\_\_

Generation Connection Type:  Single Phase     Three Phase

Type of Generating Unit:  Synchronous     Induction     Inverter     Other: \_\_\_\_\_

*For Synchronous Unit(s):*

Nominal Machine Voltage (kV): \_\_\_\_\_      Rated Current (A): \_\_\_\_\_

Rated Power Factor of Generating Unit(s) (p.u.): \_\_\_\_\_

Minimum Power Limit for Stable Operation (kW): \_\_\_\_\_

Unsaturated Reactances On:    kVA Base: \_\_\_\_\_      kV Base: \_\_\_\_\_

- Direct Axis Subtransient Reactance,  $X_d''$  (p.u.): \_\_\_\_\_
- Direct Axis Transient Reactance,  $X_d'$  (p.u.): \_\_\_\_\_
- Direct Axis Synchronous Reactance,  $X_d$  (p.u.): \_\_\_\_\_
- Zero Sequence Reactance,  $X_0$  (p.u.): \_\_\_\_\_

Limits of Range of Reactive Power:

- Lagging (Over-excited) (kVAR): \_\_\_\_\_
- Leading (Under-excited) (kVAR): \_\_\_\_\_

Provide a plot of generator capability curve (MW vs. MVAR).

Drawing Number: \_\_\_\_\_      Rev: \_\_\_\_\_

*For Induction Unit(s):*

Nominal Machine Voltage (kV): \_\_\_\_\_      Rated Current (A): \_\_\_\_\_

Rated Power Factor of Generating Unit(s) (p.u.): \_\_\_\_\_

Unsaturated Reactances On:    kVA Base: \_\_\_\_\_      kV Base: \_\_\_\_\_

- Direct Axis Subtransient Reactance,  $X_d''$  (p.u.): \_\_\_\_\_
- Direct Axis Transient Reactance,  $X_d'$  (p.u.): \_\_\_\_\_

Total Power Factor Correction Installed (kVAR): \_\_\_\_\_

- Number of regulating Steps: \_\_\_\_\_
- Power Factor Correction Switched Per Step (kVAR): \_\_\_\_\_
- Power Factor Correction Capacitors are Automatically Switched Off When Generator Breaker Opens:  Yes     No

For Inverter Unit(s):

Terminal Voltage (kV): \_\_\_\_\_ Power Factor (%): \_\_\_\_\_

Line-Interactive Type:  Yes  No

Battery Backup Provided:  Yes  No

Maximum Fault Current (kA): \_\_\_\_\_

**Interface Step-Up Transformer Characteristics**

Transformer Rating (kVA): \_\_\_\_\_

Nominal Voltage of High Voltage Winding (kV): \_\_\_\_\_

Nominal Voltage of Low Voltage Winding (kV): \_\_\_\_\_

Transformer Type:  Single Phase  Three Phase

Impedances On: kVA Base: \_\_\_\_\_ kV Base: \_\_\_\_\_

R (p.u.): \_\_\_\_\_ X (p.u.): \_\_\_\_\_

High Voltage Winding Connection:  Delta  Wye or Star

- Grounding Method of Wye Connected High Voltage Winding Neutral:

Solid  Ungrounded  Impedance: R (ohms): \_\_\_\_\_ X (ohms): \_\_\_\_\_

Low Voltage Winding Connection:  Delta  Wye or Star

- Grounding Method of Wye Connected Low Voltage Winding Neutral:

Solid  Ungrounded  Impedance: R (ohms): \_\_\_\_\_ X (ohms): \_\_\_\_\_

Note: The term "High Voltage" above refers to the connection voltage to CNDHI's distribution system and "Low Voltage" above refers to the generation or any other intermediate voltage

**Intermediate Transformer Characteristics (if applicable)**

Transformer Rating (kVA): \_\_\_\_\_

Nominal Voltage of High Voltage Winding (kV): \_\_\_\_\_

Nominal Voltage of Low Voltage Winding (kV): \_\_\_\_\_

Transformer Type:  Single Phase  Three Phase

Impedances On: kVA Base: \_\_\_\_\_ kV Base: \_\_\_\_\_

R (p.u.): \_\_\_\_\_ X (p.u.): \_\_\_\_\_

High Voltage Winding Connection:  Delta  Wye or Star

- Grounding Method of Wye Connected High Voltage Winding Neutral:

Solid  Ungrounded  Impedance: R (ohms): \_\_\_\_\_ X (ohms): \_\_\_\_\_

Low Voltage Winding Connection:  Delta  Wye or Star

- Grounding Method of Wye Connected Low Voltage Winding Neutral:

Solid  Ungrounded  Impedance: R (ohms): \_\_\_\_\_ X (ohms): \_\_\_\_\_

Note: The term "High Voltage" above refers to the input voltage to the Interface Step-Up Transformer and "Low Voltage" above refers to the generation voltage

Appendix 5

**Load Information**

Maximum Load of the Facility (kW/kVA): \_\_\_\_\_ / \_\_\_\_\_

Maximum Load Current (A): \_\_\_\_\_ Maximum Inrush Current (A): \_\_\_\_\_

**Attached Documents**

Item Number	Description	Reference Number	Number Of Pages
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			

**Attached Drawings**

Item Number	Description	Reference Number	Number Of Pages
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Appendix 5

**Please Return Completed Application to:**

Cambridge & North Dumfries Hydro Inc.  
Attn: Shawn Jackson, Engineering Supervisor - Distribution  
1500 Bishop Street  
P.O. Box 1060  
Cambridge, ON  
N1R 5X6

OR

Fax Number: (519) 621-5779  
Attn: Shawn Jackson, Engineering Supervisor - Distribution

OR

[sjackson@camhydro.com](mailto:sjackson@camhydro.com)