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## Embedded Generation Connection Guideline

## REVISION SHEET

<b>Revision</b>	<b>Description</b>	<b>Date</b>	<b>Initial</b>
0	Original Document	2002-11-09	fk/df
1	Schematic Revision (All figures) Addition of Introduction section Addition of Group III Connection Process Document format standardization Integrate with Distribution System Code (OEB) (revised September 9 <sup>th</sup> , 2004)	2005-02-02	fk/csm

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## 1.0 Introduction

This guideline is intended to assist the Customer in understanding the connection process that results in the connection of the Customer's generation facility to Hydro Ottawa's distribution network. This guideline does not provide all the details of costs or responsibilities that the Customer may assume; such details will be evaluated for each specific request.

As set by the Ontario Energy Board (latest revision) generation connections to distribution systems have been divided into four categories as follows;

Table 1.1

Category	Description	Category Criteria
1	Micro generation	All generation less than or equal to 10 kW
2	Small Generation	1.) All generation less than or equal to 500 kW for connections at voltages less than 15 kV 2.) All generation less than or equal to 1 MW for connections at voltages greater than 15 kV
3	Mid-Sized Generation	1.) All generation greater than 500 kW for connections at voltages less than 15 kV 2.) All generation greater than 1 MW but less than 10 MW for connections at voltages greater than 15 kV
4	Large Generation	All generation greater than 10 MW

In order to clarify the process and requirements this document has been divided into four main sections based on the four main categories of generation. For an outline of the connection process, contractual and technical requirements please refer to the following guide;

- For Category 1 – Micro Generation refer to Section 4.0
- For Category 2 – Small Generation refer to Section 5.0
- For Category 3 – Mid-Sized Generation refer to Section 6.0
- For Category 4 – Large Generation refer to Section 7.0

## 2.0 Reference

The following documents are referred to in this guideline:

CEA 128 D 767	Connecting Small Generators to Utility Distribution Systems, Canadian Electrical Association, 1994
IEEE 929	Recommended Practice for Utility Interface of Photovoltaic (PV) Systems
IEEE 519	IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
IEEE 1374	IEEE Guide for Terrestrial Photovoltaic Power System Safety
IEEE/ANSI C37.93	Guide for Power System Protective Relay Applications of Audio Tones over Telephone Circuits
IEEE/ANSI C37.102	Guide for AC Generator Protection

IEEE/ANSI C37.101	Guide for Generator Ground Protection
IEEE/ANSI C37.106 OEB	Guide for Abnormal Frequency Protection for Power Generating Plants Ontario Energy Board – Distribution System Code (last revised on February 3, 2004)
UL 1741-1999	Standard for Static Inverters and Charge Controllers for Use in Photovoltaic Power Systems

### 3.0 Definitions

“Agreement” means the Hydro Ottawa Embedded Generation Connection Agreement as amended from time to time by Hydro Ottawa.

“Backup Capacity” means the electrical capacity made available by Hydro Ottawa to replace output from the embedded generator facility.

“Backup Capacity Charge” means the cost, as approved by the Ontario Energy Board, of the backup capacity as defined above.

“Closed Transition Transfer Switch” means a switch that *momentarily or permanently* connects the generating unit(s) to the distribution system by making parallel and then breaking parallel.

“Connection Facility” means the point at which the generating unit(s) or generating unit transformer(s) is connected to the electrical system through a circuit breaker or disconnect switch.

“Demarcation Point” means a point at which the distributor’s ownership of distribution equipment ends at the customer.

“Electricity Act” means the Electricity Act, 1998, S.O. 1998, C.15 Schedule 15

“Embedded Generation Facility” means the generator(s) and all equipment associated with the generation unit(s) at the Embedded Generator premises, and all equipment required for the operation, protection, control, metering, and monitoring of this unit.

“Embedded Generation” means a generator whose generation facility is not directly connected to the (IMO) controlled grid but is instead connected to a local distribution system.

“Embedded Retail Generator” means an embedded generator as defined above that settles through a distributor’s retail settlements system and is not a wholesale market participant.

“Embedded Wholesale Generator” means an embedded generator as defined above that is a wholesale market participant.

“Emergency “ means a situation where there is an imminent or existing interruption or loss of stability or reliability of electrical distribution system, the condition of equipment poses an imminent

danger or threat to the safety, property, security or welfare of an individual, the public or environment, and/or a situation declared as such by a public safety government authority.

“Hydro Ottawa Distribution System” means the electrical distribution system of Hydro Ottawa and all other associated systems required for operation, maintenance and protection of the system.

“IMO” means the Independent Market Operator in the Province of Ontario

“Island Operation” means the operating condition of a generating unit or generating units when it (they) is (are) supplying a load (loads) that is (are)not paralleled and synchronized with the Hydro Ottawa distribution system.

“Isolating Device” means a circuit breaker or disconnect switch of appropriate rating, which may be locked in the open position and whose configuration provides a clear visible point of disconnection between the generating unit and the Hydro Ottawa distribution system.

“LDC” means local electrical distribution company licensed with the OEB to distribute electricity

“Momentarily” means less than or equal to 100 milliseconds

“OEB” means the Ontario Energy Board

“Open Transition Transfer Switch” means a switch that disconnects load from the distribution system by breaking parallel and then making parallel with the load and an alternate source.

“Parallel Operation” means the connection and operation of the embedded generation facility in electrical parallel with the Hydro Ottawa distribution system.

“Permanently” means greater than 100 milliseconds

“Synchronism” means the condition that exists when the voltage magnitudes, phase rotation, and phase angles of the Hydro Ottawa distribution system are identical to that of the generator(s) or the generator transformer(s) at the point where the units are synchronized.

## **4.0 Connection Of Micro Generation**

### **4.1 Introduction**

The following section describes the connection process for micro generation rated 10 kW or less.

### **4.2 Connection Process**

#### **Step 1: Request for Information**

The customer that is considering or proposing the generation installation should contact Hydro Ottawa and the Electrical Safety Authority.

#### **Step 2: Provision of Information**

Hydro Ottawa provides the customer proposing the generation with a copy of the process.

#### **Step 3: Customer Develops Plan**

Generator reviews all information and develops an integration plan.

#### **Step 4: Application Process**

The generator submits an Application to Hydro Ottawa, which includes the following information:

- The name-plate rated capacity of each generating unit
- Fuel type of the proposed generation
- Type of technology to be used (inverter type, islanding vs. non-islanding, UL 1741 approval listing)
- UL1741 Inverter approval number, make and model.
- CSA Approved disconnect ratings, make and model.
- Single Line Diagram (electrical schematic) showing how generator is to be integrated into service connection.
- Civic address of the proposed generation connection and Hydro Ottawa account number if available.
- 

The Application should be in the form of a letter to Hydro Ottawa requesting the review of the installation details. The letter should be addressed to the following:

Hydro Ottawa Limited  
Generation Connection Review Application  
c/o Asset Manager  
PO Box 8700  
3025 Albion Road  
Ottawa, ON K1G 3S4



### **Step 5: Electrical Safety Authority Application**

Generator submits plans to Electrical Safety Authority for review.

### **Step 6: Distributor Application Review**

Hydro Ottawa will review the installation details and provided there are no outstanding issues with respect to the connection, will provide an offer to connect within 15 calendar days (of the receipt of the Application).

### **Step 7: Decision to Proceed**

The offer to connect will be valid for 30 calendar days and is subject to proof of ESA inspection and approval; the customer will provide Hydro Ottawa with written intent to proceed within the 30-day timeframe.

### **Step 8: Installation**

Generator proceeds with installation and informs Hydro Ottawa of installation schedule.

### **Step 9:**

Generator provides Hydro Ottawa with a copy of the Electrical Safety Authority Inspection Certificate (Authorization to Connect).

### **Step 10:**

Generator enters into Embedded Generation Connection Agreement with Hydro Ottawa.

# Micro-Generation Connection Process

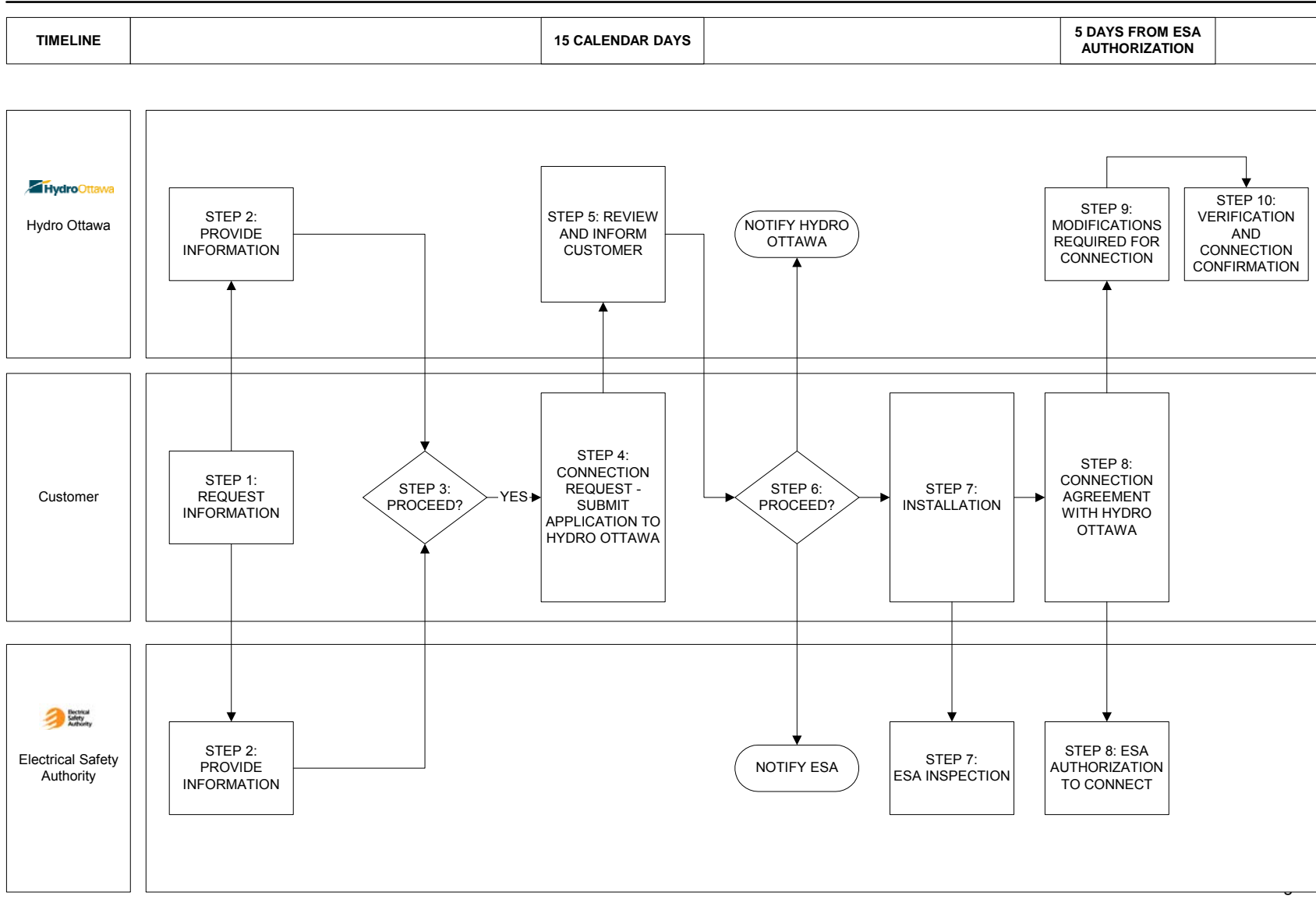


Table 4.1

## 4.3 Technical Requirements

### 4.3.1 Operating Frequency and Voltage

The embedded generator must operate at a nominal frequency of 60 Hz.

The voltage of the embedded generator must be maintained with Canadian Standards Association (CSA) CSA-CAN3-235.

### 4.3.2 CSA Approved Disconnect Switch

The utility requires the ability to isolate all parts of the electrical system in order to satisfy safety and safe working procedures. In order to comply with these requirements the customer (generator) must install a CSA approved disconnect switch that can be opened, locked and tagged by the utility. This switch should be a “load-break” switch with the appropriate ratings.

The switch must be mounted outside and accessible by the utility at all times in addition to being clear from any obstructions. The switch must be capable of providing a visible point of disconnect either through a viewing window or by opening the front cover.

### 4.3.3 Metering

The customer (generator) must install metering as required by Hydro Ottawa, the Independent Market Operator, The Ontario Energy Board or any other governing body. The cost of the installation will be the responsibility of the customer (generator).

### 4.3.4 Harmonics

In order to minimize any impacts on the power quality of the utility distribution system the following table defines the allowable limits for the generation of harmonic currents from the embedded generator. If the embedded generation facility exceeds these limits corrective action will be required unless otherwise determined by Hydro Ottawa. All costs required to mitigate problems due to harmonic generation will be the responsibility of the embedded generator.

Table 4.2 Maximum Allowable Limits of Harmonic Distortion

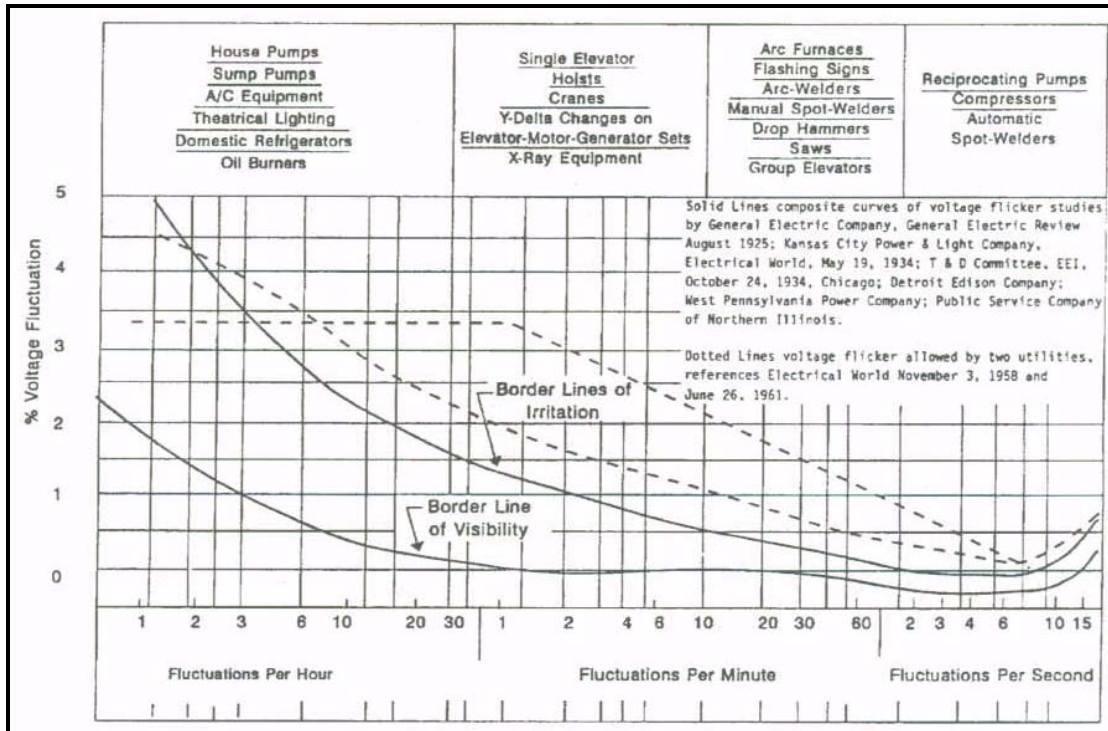
Odd Harmonics	Harmonic Distortion Limit
3 <sup>rd</sup> to 9 <sup>th</sup>	< 4.0 % of fundamental
11 <sup>th</sup> to 15 <sup>th</sup>	< 2.0 % of fundamental
17 <sup>th</sup> to 21 <sup>st</sup>	<1.5 % of fundamental
23 <sup>rd</sup> to 33 <sup>rd</sup>	<0.6 % of fundamental
Above the 33 <sup>rd</sup>	<0.3 % of fundamental

Taken from IEEE Std929 – IEEE Recommended Practice for Utility Interface of Photovoltaic (PV) Systems

### 4.3.5 Voltage Flicker

In the event that voltage variations are present due to the presence of the embedded generator, Hydro Ottawa will require the owner of the embedded generation equipment to remedy the problem or disconnect the equipment. The following Figure will be used as a determination of the magnitude of the problem. If the number of fluctuations and the corresponding percent fluctuation are above the “Border Line of Irritation” curve then corrective action will be required unless determined otherwise by Hydro Ottawa. All costs required to mitigate problems due to voltage flicker will be the responsibility of the embedded generator.

Table 4.3 Maximum Allowable Limits of Voltage Variations



Taken from IEEE Std519 – IEEE Recommended Practices and Utility Requirements for Harmonic Control in Electrical Power Systems

### 4.3.6 Power Factor

To prevent the embedded generation from significantly influencing system voltages the allowable operating range is from 0.85 lagging to 0.95 leading unless otherwise stated by Hydro Ottawa. A lagging power factor is interpreted as the generator supplying reactive power to the distribution system.

### 4.3.7 Protection

For all systems paralleled to the utility, the inverter must be a non-islanding inverter tested in accordance with Underwriters Laboratory UL-1741. The customer must provide Hydro Ottawa Limited with a copy of the UL-1741 test report for the specified inverter

model. In the event that the generator wishes to operate under conditions where the utility supply is not available, an open transition transfer switch must be installed between the load and the normal utility supply. Under such a condition the switch described in 4.3.2 is not required.

For islanding inverter based generation, the embedded generator must be able to sense and cease to energize the utility supply when the voltage or frequency under three different conditions:

- 1.) When the voltage or frequency are outside of the limits stated in 4.3.1 Operating Frequency and Voltage.
- 2.) When the utility supply is not available (i.e. an islanding condition exists)
- 3.) When an over current condition exists.

### 4.3.8 Tripping Times Associated With Abnormal System Voltages

The embedded generator must trip within the following limits;

Table 4.4 Required Response Times to Abnormal System Voltages

Voltage at inverter	Maximum Trip Time
$V < 50 \%$	6 cycles
$50 \% \leq V \leq 88 \%$	120 cycles (2 seconds)
$88 \% \leq V \leq 110 \%$	Normal Operation
$110 \% \leq V \leq 137 \%$	120 cycles (2 seconds)
$V > 137 \%$	2 cycles

Taken from IEEE Std929 – IEEE Recommended Practice for Utility Interface of Photovoltaic (PV) Systems

After an interruption and following the restoration of the utility supply the embedded generator must wait 15 minutes prior to reconnecting the embedded generation unit. The reason for the time delay is to allow the system to return to a normal operating state once a disturbance has occurred.

## 4.4 Contractual Requirements

The customer is required to enter into a Micro-Embedded Load Displacement Generation Facility Connection Agreement, a sample of which has been provided in Appendix A – Micro-Generation Facility Connection Agreement.

## **5.0 Connection Of Small Generation**

### **5.1 Introduction**

Small Generation Facilities have been divided into two categories,

**Category A** – No Distribution System reinforcements or expansion required to facilitate generation connection

**Category B** - Distribution System reinforcements or expansion required to facilitate generation connection

The process for the two categories is the same however the time lines will differ.

### **5.2 Connection Process**

#### **Step 1: Request for Information**

The customer that is considering or proposing the generation installation should contact Hydro Ottawa and the Electrical Safety Authority.

#### **Step 2: Provision of Information**

Hydro Ottawa provides the customer proposing the generation with a copy of the process.

#### **Step 3: Customer Develops Plan**

Generator reviews all information and develops an integration plan.

#### **Step 4: Initial Consultation Meeting with Hydro Ottawa**

Generator requests preliminary meeting and submits basic information. Information required includes:

- Nameplate rated capacity of each unit of the proposed generation facility and the total nameplate rated capacity of the proposed generation facility.
- The fuel type of the generation facility
- The type of generation technology used
- The location of the proposed generation facility including address and account number with the distributor where available

Within 15 days of receipt of basic information and request for meeting, the distributor meets with the generator to review plans at basic level:

- Location of existing distribution facilities in reference to proposed generation facility
- Rough estimate on time and costs, which could be associated with project
- Basic feasibility of project.

### **Step 5. – Application for Impact Assessment**

The generator applies for an impact assessment by the distributor and makes payment with application.

The Application should be in the form of a letter to Hydro Ottawa requesting the review of the installation details. The letter should be addressed to the following:

Hydro Ottawa Ltd.  
 Generation Connection Review Application  
 c/o Asset Manager  
 PO Box 8700  
 3025 Albion Road  
 Ottawa, ON K1G 3S4

Information required includes:

- Size of generation facility (each unit and total at connection point)
- Type of generation facility
- Type and details of technology
- Fuel type
- Single line diagram
- Location (address, account number)
- Preliminary generator/consultant design of proposed interface protection.

Generator wants to know:

- Connection feasibility and cost
- Metering requirements
- ESA requirements

### **Step 6. Offer to Connect (Impact Assessment and ESA Approval Process)**

The distributor performs an impact assessment of proposed generation facility on the distribution system and customers, including:

- Voltage impacts
- Current loading
- Fault currents
- Connection feasibility and identification of line/equipment upgrades required, distribution or transmission system protection modifications/requirements, metering requirements, detailed cost estimate and offer to connect.

Time to review and inform from receipt of payment and application:

- Small (a) - up to 60 days
- Small (b) - up to 90 days

### **Steps 7 & 8 Decision to Proceed and Install**

If the generator decides to revise the original plans based on results of impact assessment, the plans must be re-submitted for another review by going back to step 5. Any change in design, equipment or plans requires notification to the ESA.

If the generator feels that the offer to connect is not fair and reasonable, the generator should request distributor review using the dispute resolution process as defined in the distributor's Conditions of Service.

If the generator decides to proceed:

- Both parties sign Connection Cost Agreement
- Generator commits to payments
- Both parties commit to schedules, information exchange, scope of work of the generator and of the distributor
- Distributor initiates the work to be done to facilitate the connection
- Generator initiates the required activities
- Generator must work closely with the distributor, the ESA and any other organizations from which work, inspections, approvals or licenses are required to prevent delays.

### **Steps 9 & 10 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, interface protection);
- Submits information to distributor for design review (includes detailed single line diagram, interface protection and metering details). It is recommended that generators provide this information to the distributor within 30 days of signing to allow for a timely design review.

The distributor performs design review to ensure detailed engineering is acceptable and informs generator:

- Interface protection design review;
- Distributor reviews detailed single line diagram and interface protection to ensure acceptability; and
- Recommend that this review be complete before equipment purchase by generator.
- Generator receives interface protection design review from the distributor:



- Generator tenders and awards contracts for equipment;
- Build - including ESA and other approvals;
- Connection work; and
- Line/equipment upgrades are completed.

Generator constructs facility and applies for ESA Electrical Inspection to receive Authorization to Connect.

### **Step 11 Authorization to Connect**

The generator arranges for and receives Authorization to Connect from ESA.

### **Step 12 Connection Agreement**

The generator and the distributor agree to, and sign, Connection Agreement.

Note: A temporary connection agreement for the purpose of connection for Commissioning and Verification may be signed at this point while negotiating final Connection Agreement.

### **Step 13 & 14 Commissioning & Verification**

Generation facility commissioning and testing:

Generator arranges for commissioning and testing of the generation facility; and  
Distributor witnesses and verifies the commissioning process.

Time from completion of step 9 to final connection:

- Small (a) – up to 60 days; and
- Small (b) – up to 180 days.

### **Step 15 Completion**

Process Complete – generation facility fully connected and operational.

## **5.3 Technical Requirements**

### **5.3.1 Operating Frequency and Voltage**

The embedded generator must operate at a nominal frequency of 60 Hz.

The voltage of the embedded generator must be maintained in accordance with the Canadian Standards Association (CSA) CSA-CAN3-235.

### **5.3.2 Metering**

For all embedded generators an approved meter must be installed on the output of the embedded generating unit. For all embedded generation above 1 MW, IMO (The Independent Electricity Market Operator) approved metering installations is required.

The meter, current transformers and potential transformers will be specified and supplied by Hydro Ottawa. The costs associated with the metering installation will be the responsibility of the embedded generator.

All metering current transformers and potential transformers must be dedicated to only metering equipment.

The embedded generator will allow for provision in the generating facility equipment to install the current transformers and potential transformers so that they are in a lockable/sealable enclosure that is accessible to the Hydro Ottawa Metering Dept.

The embedded generator must provide space for Hydro Ottawa to mount a 4 foot by 3 foot by 18 inch deep, wall mounted NEMA enclosure for the meters. Hydro Ottawa will provide the NEMA enclosure. This space should be as close as possible to the location of the current transformers and potential transformers.

### **5.3.3 Voltage Flicker**

In the event that voltage variations are present due to the presence of the embedded generator, Hydro Ottawa will require the owner of the embedded generation equipment to remedy the problem or disconnect the equipment. b. Table 4.3 Maximum Allowable Limits of Voltage Variations will be used as a determination of the magnitude of the problem. If the number of fluctuations and the corresponding percent fluctuation are above the “Border Line of Irritation” curve then corrective action will be required unless otherwise determined by Hydro Ottawa. All costs associated with the remedial action will be the responsibility of the embedded generator.

### 5.3.4 Power Factor

To prevent the embedded generation from significantly influencing system voltages the allowable operating range is from 0.85 lagging to 0.95 leading unless otherwise stated by Hydro Ottawa. A lagging power factor is interpreted as the generator supply reactive power to the distribution system.

Generation excitation equipment must be capable to operate in an automatic voltage control mode as well as power factor control mode. The normal operating scheme should be in power factor control mode (with set point of 1.0 at the Utilities Customer Supply Facility (Demarcation Point) unless otherwise directed by the utility.

### 5.3.5 Protection

The following tables are a listing of the required protection equipment for the generator and the interconnection.

Table 5.1 Generator Protection Requirements for Small Generation

ANSI Device ID#:	Description	Less than 500 kW (unit or aggregate)	Greater than 500 KW (unit or aggregate)	Greater than 5000 KW (unit or aggregate)
21	Distance Relay	To be determined separately for each project		X
25	Synchronizing Check	X	X	X
27	Under-Voltage	X	X	X
32	Reverse Power	X	X	X
46	Negative Sequence	X	X	X
50/51V	Voltage Controlled Over current	X	X	X
50 N	Neutral current Over	X	X	X
59	Over voltage	X	X	X
80/81	Over/Under frequency	X	X	X

### 5.3.6 Connection Limitations

Based on the impacts of generation to short circuit levels, voltage deviations and operational issues, Hydro Ottawa will limit connections to any circuit or substation according to the following:

Table 5.2

Nominal Circuit Voltage (kV)	Circuit Maximum Allowable Unit Capacity (kVA)	Circuit Maximum Allowable Aggregate Capacity (kVA)	SubStation Bus Maximum Allowable Aggregate Capacity (kVA)
4.16			
8.32			
12.4			
13.2			
27.6			
46.0			

To Be Completed

For interpretation purposes, Hydro Ottawa will limit generation connections to the following criteria:

**Column 2 – Circuit Maximum Allowable Unit Capacity:** Means the largest unit greater than or equal to the Allowable Unit Capacity

**Column 3 – Circuit Maximum Allowable Aggregate Capacity:** Means the combined generation installation on the circuit aggregated in either one facility or throughout numerous facilities connected to the circuit.

**Column 4 – Substation Maximum Allowable Aggregate Capacity:** Means the combined generation installation connected to the substation bus in either one facility or throughout numerous facilities connected to the circuits that originate from the substation bus.

## 5.4 Contractual Requirements

The customer is required to enter into a Generation Facility Connection Agreement, a sample of which has been provided in Appendix B –Generation Facility Connection Agreement.

## **6.0 Connection Of Mid-Sized Generation**

### **6.1 Introduction**

The following section describes the connection process for mid sized generation.

### **6.2 Connection Process**

#### **Step 1. – Initial Contact**

Customer proposing the installation of a generation facility contacts the distributor and ESA for information. The distributor may also guide the generator to contact the transmitter for additional connection information. Since it is likely that the generator may be planning on selling power to the grid, the generator may also need contact the OEB regarding license applications.

#### **Step 2. – Provision of Information**

The distributor to make the information available to the proponent in a timely manner.

Information Package includes:

- Description of the connection process (basis is in DSC - this incorporates the distributor's specifics - contact numbers etc. and reiterates/stresses the need for ESA Plan Approval and authorization to connect);
- Approvals needed by the distributor for connection (ESA);
- Technical requirements including metering;
- Contractual requirements (Connection Agreement);
- Application forms; and
- Generator is informed of the potential need to contact transmitter and OEB.

ESA provides information on Electrical Safety Requirements and their Plan Approval process.

#### **Step 3. – Generator Develops Plan**

Generator reviews relevant information from distributor, ESA, transmitter, and OEB, and puts together a development plan:

- Size/type of generation facility;
- Load displacement/net metering/isolated from the distribution system; and
- Project plan - who needs to be included/when.

#### **Step 4. – Initial Consultation (No Charge)**

Generator requests preliminary meeting and submits basic information. Information required includes:

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 of the proposed generation facility including address and account number with the distributor where available.

Within 15 days of receipt of basic information and request for meeting, the distributor meets with the generator to review plans at basic level:

- Location of existing distribution facilities in reference to proposed generation facility;
- Rough estimate on time and costs which could be associated with project; and
- Basic feasibility of project.

#### **Step 5. – Application for Impact Assessment**

Generator applies for an impact assessment by the distributor and makes payment with application. Impact assessment may also be required from transmitter or host distribution system. The distributor will forward applicable information on behalf of generator.

In addition to the information provided in step 4, the following information is also required:

- A single line diagram of the proposed connection
- A preliminary design of the proposed interface protection.

The Application should be in the form of a letter to Hydro Ottawa requesting the review of the installation details. The letter should be addressed to the following:

Hydro Ottawa Ltd.  
Generation Connection Review Application  
c/o Asset Manager  
PO Box 8700  
3025 Albion Road  
Ottawa, ON K1G 3S4

## **Step 6. Impact Assessment**

The distributor performs an impact assessment of proposed generation facility on the distribution system and customers:

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

Time to review and inform from receipt of application:

- Up to 60 days.

The distributor requests and receives an impact assessment of proposed generation facility on transmitter/host distribution system and customers. Transmitter/host distributor will prepare impact assessment as required. The geographic distributor; and is only responsible for timely delivery of information specific to their distribution system.

Generator wants to know:

- Connection feasibility and cost
- Metering requirements.

Assumes generator/consultant will design generation facility, including interface protection to achieve the required functionality. The distributor will review this design within 1 month of signing CCA.

Generator also provides information to ESA for inspection to begin Plan Approval process.

## **Steps 7 & 8 Decision to Proceed and Establish Scope of Project**

If the generator decides to revise the original plans based on results of the impact assessment, the generator must re-submit the revised plans for another review by going back to step 5. Any change in design, equipment, or plans requires notification to the ESA.

If the generator feels that the results of the impact assessment are manageable, the generator will request a meeting to develop a scope so that the distributor can prepare an estimate and an Offer to Connect.

If the generator decides to proceed

Both parties agree to, and sign, scope of project

Generator pays for preparation of estimate by the distributor, host distribution system and transmitter as required.

### **Steps 9, 10, 11 Prepare Estimate and Present Offer to Connect**

The distributor must notify the transmitter and/or host distribution system (as required) within 10 days of receiving payment and notification that the generator has decided to proceed and an estimate is to be prepared.

The distributor shall prepare a detailed estimate of the project based on the scope defined in step 8.

The distributor must prepare their portion of the Offer to Connect within 90 days of receipt of payment from the generator. In any event, the distributor has up to 30 days from date of receipt to incorporate the estimate of the transmitter or host distribution system.

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

- All parties agree to, and sign, Connection Cost Agreement (CCA)
- Generator agrees to payment schedule for work required by the distributor and/or transmitter/host distribution system
- All parties commit to schedules, information exchange, scope of work
- The generator must work closely with the distributor, the ESA and any other organizations from which work, inspections, approvals or licenses are required to prevent delays

### **Steps 11, 12, 13, 14 – Implementation**

Timing:

Time from commitment to proceed to final connection to be negotiated in Connection Cost Agreement;

- Distributor initiates the work to be done to facilitate the connection;
- Generator initiates the activities identified as it's responsibility; and
- Transmitter and/or host distributor initiates the work to be done to facilitate connection.

Both parties committed to project and generator commits to obtain required approvals:

- Generator prepares detailed engineering drawings;
- Generator submits all detailed plans to ESA for Plan Approval process (including detailed single line diagram, interface protection); and
- Generator submits information to distributor for design review (including detailed single line diagram, interface protection and metering details) (Recommend that



generator provide this information to distributor within 30 days of signing CCA so that design review can be done in a timely manner).

Distributor performs design review to ensure detailed engineering is acceptable and informs generator:

- Interface protection design review;
- Distributor reviews detailed single line diagram and interface protection to ensure acceptability; and
- Recommend that this review be complete before equipment purchase.

Generator receives interface protection design review from distributor:

- Generator tenders and awards contracts for equipment;
- Build - including ESA and other approvals;
- Connection work; and
- Line/equipment upgrades are completed.

Generator constructs facility and applies for ESA Electrical Inspection to receive Authorization to Connect.

### **Step 15 - Connection Agreement**

The generator and the distributor agree to, and sign, Connection Agreement.

The distributor and transmitter/host distribution system review existing agreements for required revisions.

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

### **Step 16 Commissioning and Verification**

Generation facility commissioning and testing:

- generator arranges for commissioning and testing of the generation facility;
- distributor witnesses and verifies the commissioning process; and
- transmitter/host distributor witness and verify the commissioning process as required.

### **Step 17 Completion**

Process Complete – generation facility fully connected and operational.

## **6.3 Technical Requirements**

### **6.3.1 Operating Frequency and Voltage**

The embedded generator must operate at a nominal frequency of 60 Hz.

The voltage of the embedded generator must be maintained in accordance with the Canadian Standards Association (CSA) CSA-CAN3-235.

### **6.3.2 Metering**

For all embedded generators an approved meter must be installed on the output of the embedded generating unit. For all embedded generation above 1 MW, IMO (The Independent Electricity Market Operator) approved metering installations are required.

The meter, current transformers and potential transformers will be specified and supplied by Hydro Ottawa. The costs associated with the metering installation will be the responsibility of the embedded generator.

All metering current transformers and potential transformers must be dedicated to only metering equipment.

The embedded generator will allow for provision in the generating facility equipment to install the current transformers and potential transformers so that they are in a lockable/sealable enclosure that is accessible to the Hydro Ottawa Metering Dept.

The embedded generator must provide space for Hydro Ottawa to mount a 4 foot by 3 foot by 18 inch deep, wall mounted NEMA enclosure for the meters. Hydro Ottawa will provide the NEMA enclosure. This space should be as close as possible to the location of the current transformers and potential transformers.

### **6.3.3 Voltage Flicker**

In the event that voltage variations are present due to the presence of the embedded generator, Hydro Ottawa will require the owner of the embedded generation equipment to remedy the problem or disconnect the equipment. b. Table 4.3 Maximum Allowable Limits of Voltage Variations will be used as a determination of the magnitude of the problem. If the number of fluctuations and the corresponding percent fluctuation are above the "Border Line of Irritation" curve then corrective action will be required unless otherwise determined by Hydro Ottawa. All costs associated with the remedial action will be the responsibility of the embedded generator.

### **6.3.4 Power Factor**

To prevent the embedded generation from significantly influencing system voltages the allowable operating range is from 0.85 lagging to 0.95 leading unless otherwise stated by Hydro Ottawa. A lagging power factor is interpreted as the generator supply reactive power to the distribution system.

Generation excitation equipment must be capable to operate in an automatic voltage control mode as well as power factor control mode. The normal operating scheme should be in power factor control mode (with set point of 1.0 at the Utilities Customer Supply Facility (Demarcation Point) unless otherwise directed by the utility.

### **6.3.5 Protection Requirements**

The following minimum generator protective functions are required;

<b>ANSI No.</b>	<b>Description</b>
25	Synchronizing verification
27	Under voltage
32	Directional (Reverse) Power
40	Loss of Excitation
46	Negative Sequence Over current
51V	Voltage Controlled Over current
59	Over voltage
60*	Loss of potential
81	Over frequency and under frequency
87	Differential protection

\*Note: Loss of potential protection is required where there are upstream fuses used as protective devices (such as for transformer protection). The loss of potential relays shall consist of three single-phase relays.

The following minimum interconnection protective functions are required;

<b>ANSI No.</b>	<b>Description</b>
60*	Loss of potential
67	Directional over current
69	Reclose Blocking (Specified by utility where applicable)
85	Transfer trip (Specified by utility where applicable)

\*Note: Loss of potential protection is required where there are upstream fuses used as protective devices (such as for transformer protection). The loss of potential relays shall consist of three single-phase relays.

All relays shall be utility grade relays, moulded case circuit breaker relaying will not be considered acceptable for generation protections. As indicated the above listing is are minimum requirements. Upon specific reviews of the project Hydro Ottawa may require additional protection.

### **6.3.6 Synchronizing Facilities**

The generation connection must be supplied with adequate synchronizing facilities to properly operate and commission installation.

All breakers that are equipped with synchronizing abilities will include the following aspects in their design:

1. Synchronizing relay that has a visual indication on the front of the relay in the form of lights or light emitting diodes (LEDs) that indicate when the two voltages are in phase.
2. The synchronizing breaker cell will be equipped with an analog or digital synchronizing scope (“Sync. Scope”) with two lights that indicate the voltage across the synchronizing voltage transformers (bus and line).

For the case of generation that is embedded in existing connection facilities (i.e. building or campus vaults etc.) that employ load break switches the following design details are required;

1. All load break switches that are able to make or break parallel either by design or incidentally shall be upgraded to circuit breakers with 125 VDC (DC – direct current) trip and close solenoids. The breakers will be equipped with synchronizing facilities as described in this section.

**or**

2. Load break switches will be modified to include a Kirk-key interlocking scheme that is linked to the generator circuit breaker. The scheme will be designed such that the Kirk key will be released when the generator circuit breaker is in the open position at which point all load break switches can be operated. When the generator circuit breaker is in the closed position then it will not be possible to operate the load break switches.

If this is not possible then an isolating disconnect switch will be installed upstream of the generator breaker and the disconnect switch will be equipped with the Kirk-key interlock.

3. All load break switches or breakers will be equipped with auxiliary status contacts (IEEE 52a) indicating the position of the load break switch or circuit breaker. The contacts will be rated for operation at 125 VDC, 5 Amps.

### **6.3.7 Circuit Breaker Requirements**

All circuit breakers must be sized to adequately carry the rated full load current of the specific load or generator. In addition they should be rated to interrupt the total available fault current from the generator and the utility.

The circuit breakers will be equipped with 125 VDC trip and close coils as well as sufficient auxiliary contacts (rated minimum 125 VDC, 5A) for customer use and Hydro Ottawa use.

Circuit breakers must be of a “draw-out” type so that they can be completely removed from the metal-clad cabinet.

In the event that the circuit breaker is equipped with manual breaker operating control (example: pushbuttons on the front of the breaker), the manual “Close” function will be physically disabled or removed.

### **6.3.8 Continuous Monitoring Requirements**

Hydro Ottawa will install equipment that will allow integration of the generation installation in Hydro Ottawa supervisory control system.

Provision will be made from the customer to provide the following;

1. Status of all breakers or load break switches that parallel the generator to the utility.
2. Generator current transformer circuit (three phase). Hydro Ottawa will install telemetering equipment for real-time monitoring purposes.

Hydro Ottawa’s equipment shall be installed on it’s own set of dedicated current transformers.

#### **or**

For the case of joint use current transformers (i.e. relaying and panel metering) provision will be made for Hydro Ottawa’s equipment after the last customer device. It is the customer’s responsibility to properly size the current transformers so that they can support the additional burden.

3. Generator potential transformer circuit (three phase) shall be provided as per the requirements of item 2.
4. Provision will be made to all of the synchronizing breaker close coil circuits to allow Hydro Ottawa to install a “close-blocking” relay so that hold offs can be secured from the generating facility.

### **6.3.9 Connection Limitations**

Based on the impacts of generation to short circuit levels, voltage deviations and operational issues, Hydro Ottawa will limit connections to any circuit or substation according to the following:

Table 6.1

Nominal Circuit Voltage (kV)	Circuit Maximum Allowable Unit Capacity (kVA)	Circuit Maximum Allowable Aggregate Capacity (kVA)	SubStation Bus Maximum Allowable Aggregate Capacity (kVA)
4.16			
8.32			
12.4			
13.2			
27.6			
46.0			

To Be Completed

For interpretation purposes, Hydro Ottawa will limit generation connections to the following criteria:

**Column 2 – Circuit Maximum Allowable Unit Capacity:** Means the largest unit greater than or equal to the Allowable Unit Capacity

**Column 3 – Circuit Maximum Allowable Aggregate Capacity:** Means the combined generation installation on the circuit aggregated in either one facility or throughout numerous facilities connected to the circuit.

**Column 4 – Substation Maximum Allowable Aggregate Capacity:** Means the combined generation installation connected to the substation bus in either one facility or throughout numerous facilities connected to the circuits that originate from the substation bus.

## 6.4 Contractual Requirements

The customer is required to enter into a Generation Facility Connection Agreement, a sample of which has been provided in Appendix B –Generation Facility Connection Agreement.

## **7.0 Connection Of Large Generation**

### **7.1 Introduction**

The following section describes the connection process for large generation.

### **7.2 Connection Process**

#### **Step 1. – Initial Contact**

Customer proposing the installation of a generation facility contacts the distributor and ESA for information. The distributor may also guide the generator to contact the transmitter for additional connection information. The distributor should inform the generator that IMO involvement is required for all projects over 10 MW. Since it is likely that the generator may be planning on selling power to the grid, the generator may also need contact the OEB regarding license applications.

#### **Step 2. – Provision of Information**

Distributor shall make the information available to the proponent in a timely manner. Information Package includes:

- Description of the connection process (basis is in DSC - this incorporates the distributor's specifics - contact numbers etc. and reiterates/stresses the need for ESA authorization to connect);
- Approvals needed by the distributor for connection (ESA);
- Technical requirements including metering;
- Contractual requirements (Connection Agreement);
- Application forms; and
- Informs generator of need to contact transmitter, IMO, and OEB.

ESA provides information on Electrical Safety Requirements and their Plan Approval process.

#### **Step 3. – Generator Develops Plan**

Generator reviews relevant information from distributor, ESA, transmitter, IMO, and OEB, and puts together an installation plan:

- Size/type of generation facility;
- Load displacement/isolated from distribution system/grid connection; and
- Project plan - who needs to be included/when.

#### **Step 4. – Initial Consultation (No Charge)**

Generator requests preliminary meeting and submits basic information. Information required includes:

- 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 of the proposed generation facility including address and account number with the distributor where available.

Within 15 days of receipt of basic information and request for meeting, the distributor meets with the generator to review plans at basic level:

- Location of existing distribution facilities in reference to proposed generation facility;
- Rough estimate on time and costs which could be associated with project; and
- Basic feasibility of project.

#### **Step 5. – Application for Impact Assessment**

Generator applies for an impact assessment from the distributor and makes payment with application. Impact assessment may also be required from transmitter and/or host distribution system. Projects greater than 10MW will also require a System Impact Assessment by the IMO. The distributor will collect payment from generator and forward both payments and applicable information on behalf of generator to transmitter, host distribution system, and IMO as required.

In addition to the information provided in step 4, the following information is also required:

- A single line diagram of the proposed connection; and
- A preliminary design of the proposed interface protection.

#### **Step 6. Impact Assessment**

The distributor performs an impact assessment of proposed generation on the distribution system and customers:

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



Time to review and inform from receipt of application:

- Up to 90 days.

The distributor requests and receives an impact assessment of proposed generation on transmitter, host distribution system, and customers. Transmitter/host distributor will prepare impact assessment as required. The geographic distributor is only responsible for timely delivery of information specific to their distribution system.

Generator wants to know:

- Connection feasibility and cost;
- Metering requirements; and
- ESA requirements.

Assumes generator/consultant will design generation facility, including interface protection to achieve the required functionality. Distributor will review this design within one month of CCA signing.

### **Steps 7 & 8 Decision to Proceed and Establish Scope of Project**

If the generator decides to revise the original plans based on results of impact assessment, the generator must re-submit the revised plans for another review by going back to step 5. Any change in design, equipment, or plans requires notification to the ESA.

If the generator feels that the results of the impact assessment are manageable, the generator will request a meeting to develop a scope so that the distributor 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 the distributor, host distributor, transmitter and IMO as required.

### **Steps 9, 10, 11 Prepare Estimate and Present Offer to Connect**

The distributor must notify the transmitter and/or host distribution system (as required) within 10 days of receiving payment that the generator has decided to proceed and an estimate is to be prepared.

The distributor shall prepare a detailed estimate of the project based on the scope defined in step 8.

The distributor must prepare their portion of the Offer to Connect within 90 days of receipt of payment from generator. In any event, the distributor has up to 30 days from date of receipt to incorporate the estimate of the transmitter or host distributor.

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

- All parties agree to and sign, Connection Cost Agreement (CCA);
- Generator agrees to payment schedule for work required by distributor and/or transmitter/host distribution system or IMO;
- All parties commit to schedules, information exchange, scope of work; and
- The generator must work closely with the ESA and any other organizations from which work, inspections, approvals or licenses are required to prevent delays.

### **Steps 12, 13, 14 - Implementation**

Timing

Time from commitment to proceed to final connection to be negotiated in Connection Cost Agreement;

- Distributor initiates the work to be done to facilitate the connection;
- Generator initiates the activities identified as its' responsibility; and
- Transmitter/host distributor/IMO initiates the work to be done to facilitate connection.

Both parties committed to project and generator commits to obtain required approvals:

- Generator prepares detailed engineering drawings;
- Generator submits all detailed plans to ESA for Plan Approval process (including detailed single line diagram, interface protection); and
- Generator submits information to distributor for design review (including detailed single line diagram, interface protection and metering details) (Recommend that generator provide this information to the distributor within 30 days of signing CCA so that design review can be done in a timely manner).

Distributor performs design review to ensure detailed engineering is acceptable and informs generator:

- Interface protection design review;
- Distributor reviews detailed single line diagram and interface protection to ensure acceptability; and
- Recommend that this review be complete before equipment purchase.

Generator receives interface protection design review from distributor:

- Generator tenders and awards contracts for equipment;

- Build - including ESA and other approvals;
- Connection work; and
- Line/equipment upgrades are completed.

Generator constructs facility and applies for ESA Electrical Inspection to receive Authorization to Connect.

### **Step 15 - Connection Agreement**

The generator and the distributor agree to, and sign, Connection Agreement. The distributor and transmitter/host distributor review existing agreements for required revisions.

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

### **Step 16 Commissioning and Verification**

Generation facility commissioning and testing:

- Generator arranges for commissioning and testing of the facility;
- Distributor witnesses and verifies the commissioning process; and
- Transmitter/host distributor/IMO witness and verify the commissioning process as required.

### **Step 17 Completion**

Process Complete – generation facility fully connected and operational.

## **7.3 Technical Requirements**

### **7.3.1 Operating Frequency and Voltage**

The embedded generator must operate at a nominal frequency of 60 Hz.

The voltage of the embedded generator must be maintained in accordance with the Canadian Standards Association (CSA) CSA-CAN3-235.

### **7.3.2 Metering**

For all embedded generators an approved meter must be installed on the output of the embedded generating unit. For all embedded generation above 1 MW, IMO (The Independent Electricity Market Operator) approved metering installations are required.

The meter, current transformers and potential transformers will be specified and supplied by Hydro Ottawa. The costs associated with the metering installation will be the responsibility of the embedded generator.

All metering current transformers and potential transformers must be dedicated to only metering equipment.

The embedded generator will allow for provision in the generating facility equipment to install the current transformers and potential transformers so that they are in a lockable/sealable enclosure that is accessible to the Hydro Ottawa Metering Dept.

The embedded generator must provide space for Hydro Ottawa to mount a 4 foot by 3 foot by 18 inch deep, wall mounted NEMA enclosure for the meters. Hydro Ottawa will provide the NEMA enclosure. This space should be as close as possible to the location of the current transformers and potential transformers.

### **7.3.3 Voltage Flicker**

In the event that voltage variations are present due to the presence of the embedded generator, Hydro Ottawa will require the owner of the embedded generation equipment to remedy the problem or disconnect the equipment. b. Table 4.3 Maximum Allowable Limits of Voltage Variations will be used as a determination of the magnitude of the problem. If the number of fluctuations and the corresponding percent fluctuation are above the “Border Line of Irritation” curve then corrective action will be required unless otherwise determined by Hydro Ottawa. All costs associated with the remedial action will be the responsibility of the embedded generator.

### **7.3.4 Power Factor**

To prevent the embedded generation from significantly influencing system voltages the allowable operating range is from 0.85 lagging to 0.95 leading unless otherwise stated by Hydro Ottawa. A lagging power factor is interpreted as the generator supply reactive power to the distribution system.

Generation excitation equipment must be capable to operate in an automatic voltage control mode as well as power factor control mode. The normal operating scheme should be in power factor control mode (with set point of 1.0 at the Utilities Customer Supply Facility (Demarcation Point) unless otherwise directed by the utility.

### **7.3.5 Protection**

The following tables are a listing of the required protection equipment for the generator and the interconnection.

The following minimum generator protective functions are required;

<b>ANSI No.</b>	<b>Description</b>
25	Synchronizing verification
27	Under voltage
32	Directional (Reverse) Power
40	Loss of Excitation
46	Negative Sequence Over current
51V	Voltage Controlled Over current
59	Over voltage
60*	Loss of potential
81	Over frequency and under frequency
87	Differential protection

\*Note: Loss of potential protection is required where there are upstream fuses used as protective devices (such as for transformer protection). The loss of potential relays shall consist of three single-phase relays.

The following minimum interconnection protective functions are required;

<b>ANSI No.</b>	<b>Description</b>
21	Impedance relaying (Applied at the discretion of the utility)
60*	Loss of potential
67	Directional over current
69	Reclose Blocking (Specified by utility where applicable)
85	Transfer trip (Specified by utility where applicable)

\*Note: Loss of potential protection is required where there are upstream fuses used as protective devices (such as for transformer protection). The loss of potential relays shall consist of three single-phase relays.

All relays shall be utility grade relays, moulded case circuit breaker relaying will not be considered acceptable for generation protections. As indicated the above listing are minimum requirements. Upon specific reviews of the project Hydro Ottawa may require additional protection.

### **7.3.6 Synchronizing Facilities**

The generation connection must be supplied with adequate synchronizing facilities to properly operate and commission.

All breakers that are equipped with synchronizing abilities will include the following aspects in their design:

1. Synchronizing relay that has a visual indication on the front of the relay in the form of lights or light emitting diodes (LEDs) that indicate when the two voltages are in phase.
2. The synchronizing breaker cell will be equipped with an analog or digital synchronizing scope (“Sync. Scope”) with two lights that indicate the voltage across the synchronizing voltage transformers (bus and line).

For the case of generation that is embedded in existing connection facilities (i.e. building or campus vaults etc.) that employ load break switches the following design details are required;

1. All load break switches that are able to make or break parallel either by design or incidentally shall be upgraded to circuit breakers with 125 VDC (DC – direct current) trip and close solenoids. The breakers will be equipped with synchronizing facilities as described in this section.

**or**

2. Load break switches will be modified to include a Kirk-key interlocking scheme that is linked to the generator circuit breaker. The scheme will be designed such that the Kirk key will be released when the generator circuit breaker is in the open position at which point all load break switches can be operated. When the generator circuit breaker is in the closed position then it will not be possible to operate the load break switches.

If this is not possible then an isolating disconnect switch will be installed upstream of the generator breaker and the disconnect switch will be equipped with the Kirk-key interlock.

All load break switches or breakers will be equipped with auxiliary status contacts (IEEE 52a) indicating the position of the load break switch or circuit breaker. The contacts will be rated for operation at 125 VDC, 3 Amps.

### **7.3.7 Protective Relaying**

The following tables are a listing of the required protection equipment for the generator and the interconnection.

The following minimum generator protective functions are required;

<b>ANSI No.</b>	<b>Description</b>
25	Synchronizing verification
27	Under voltage
32	Directional (Reverse) Power
40	Loss of Excitation
46	Negative Sequence Over current
51V	Voltage Controlled Over current
59	Over voltage
60*	Loss of potential
81	Over frequency and under frequency
87	Differential protection

\*Note: Loss of potential protection is required where there are upstream fuses used as protective devices (such as for transformer protection). The loss of potential relays shall consist of three single-phase relays.

The following minimum interconnection protective functions are required;

<b>ANSI No.</b>	<b>Description</b>
21	Impedance relaying (Applied at the discretion of the utility)
60*	Loss of potential
67	Directional over current
69	Reclose Blocking (Specified by utility where applicable)
85	Transfer trip (Specified by utility where applicable)

\*Note: Loss of potential protection is required where there are upstream fuses used as protective devices (such as for transformer protection). The loss of potential relays shall consist of three single-phase relays.

All relays shall be utility grade relays, moulded case circuit breaker relaying will not be considered acceptable for generation protections.

### **7.3.8 Continuous Monitoring Requirements**

Hydro Ottawa will install equipment that will allow integration of the generation installation in Hydro Ottawa supervisory control system.

Provision will be made from the customer to provide the following;

1. Status of all breakers or load break switches that parallel the generator to the utility.
2. Generator current transformer circuit (three phase). Hydro Ottawa will install telemetering equipment for real-time monitoring purposes.

Hydro Ottawa's equipment shall be installed on it's own set of dedicated current transformers.

**or**

For the case of joint use current transformers (i.e. relaying and panel metering) provision will be made for Hydro Ottawa's equipment after the last customer device. It is the customer's responsibility to properly size the current transformers so that they can support the additional burden.

3. Generator potential transformer circuit (three phase) shall be provided as per the requirements of item 2.
4. Provision will be made to all of the synchronizing breaker close coil circuits to allow Hydro Ottawa to install a "close-blocking" relay so that hold offs can be secured from the generating facility.

### 7.3.9 Connection Limitations

Based on the impacts of generation to short circuit levels, voltage deviations and operational issues, Hydro Ottawa will limit connections to any circuit or substation according to the following:

Table 7.1

Nominal Circuit Voltage (kV)	Circuit Maximum Allowable Unit Capacity (kVA)	Circuit Maximum Allowable Aggregate Capacity (kVA)	SubStation Bus Maximum Allowable Aggregate Capacity (kVA)
4.16			
8.32			
12.4			
13.2			
27.6			
46.0			

To Be Completed

For interpretation purposes, Hydro Ottawa will limit generation connections to the following criteria:

**Column 2 – Circuit Maximum Allowable Unit Capacity:** Means the largest unit greater than or equal to the Allowable Unit Capacity

**Column 3 – Circuit Maximum Allowable Aggregate Capacity:** Means the combined generation installation on the circuit aggregated in either one facility or throughout numerous facilities connected to the circuit.

**Column 4 – Substation Maximum Allowable Aggregate Capacity:** Means the combined generation installation connected to the substation bus in either one facility or throughout numerous facilities connected to the circuits that originate from the substation bus.

### 7.4 Contractual Requirements

The customer is required to enter into a Generation Facility Connection Agreement, a sample of which has been provided in Appendix B –Generation Facility Connection Agreement.



## **8.0 Connections Using Closed Transition Transfer Switches**

### **8.1 Introduction**

Generation connections using closed transition transfer switches will be treated similarly to all other generation connections and will classify as Small Generation, Mid-Sized Generation or Large Generation.

Despite the manufacturers product literature descriptions (particularly pertaining to “Utility Approved), a full review of the generation integration from an operational and engineering standpoint is required. For technical integration requirements, Hydro Ottawa will match the technical abilities of the proposed installation.

### **8.2 Connection Process**

Please refer to the applicable section within the document based on the size of the installation.

### **8.3 Technical Requirements**

Please refer to the applicable section within the document based on the size of the installation.

### **8.4 Contractual Requirements**

The customer is required to enter into a Generation Facility Connection Agreement, a sample of which has been provided in Appendix B –Generation Facility Connection Agreement.

# Appendix A – Micro-Generation Facility Connection Agreement

## Micro-Embedded Load Displacement Generation Facility Connection Agreement

In consideration of the Local Distribution Company (LDC) agreeing to allow you to connect your 10 kW name-plate rated capacity or smaller generation facility to the LDC'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 the LDC's Conditions of Service, which have been filed with the OEB and are available on request.

**1.2** You agree that the power produced by this generation facility shall be only for your own use.

### **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 the LDC's distribution system, an isolation device satisfying Section 84 of the Ontario Electrical Safety Code and agree to the LDC'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 LDC 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 the LDC's distribution system, as per the generator protective relay settings set out in this Agreement, in the event of a power outage on the LDC's distribution system or any abnormal operation of the LDC'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 the LDC's distribution system.

**2.5** Due to the LDC's obligation to maintain the safety and reliability of its distribution system, you acknowledge and agree that in the event the LDC determines that your generation facility (i) causes damage to; and/or (ii) is producing adverse effects affecting other distribution system customers or the LDC's assets, you will disconnect your generation facility immediately from the distribution system upon direction from the LDC and correct the problem at your own expense prior to reconnection.

### **3.0 Liabilities**

**3.1** You and the LDC will 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 the LDC's distribution system.

**3.2** The LDC 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** Subject to any applicable law, you agree that the LDC will not pay you for any excess generation that results in a net delivery of energy to the LDC between meter reads.

**4.2** Subject to any applicable law, you acknowledge and agree that there will be no carryover of excess generation from one billing period to the next.

**5.0 Termination**

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 the LDC of such action.

**6.0 Assignment**

You may assign your rights and obligations under this Agreement with the consent of the LDC, which shall not withhold its consent unreasonably. The LDC 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 the LDC's distribution system.

Customer 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**   or    **UL 1741**   or    **Site Certified by the ESA**

## **Appendix B –Generation Facility Connection Agreement**

### **1.1 Disclaimers**

All references to embedded generator(s), embedded generation facility(s) or embedded generation is to include but not be limited to the following; the operator, owner, leasee or leasor, contractor, facility manager.

Hydro Ottawa will not be held liable for any damage to the property or equipment of any embedded generator(s) or embedded generation facility resulting from the parallel or nonparallel operation with the Hydro Ottawa Distribution System notwithstanding the Terms and Conditions of this Connection Agreement.

All references to Hydro Ottawa in this document refers to Hydro Ottawa Limited, their contractor(s) or representative(s).

### **1.2 Purpose of Connection Agreement**

The Purpose of this Agreement is to set forth the following;

Minimum requirements that a generator shall meet in designing, maintaining and operating an embedded generating facility;  
Communication protocols and procedures between the embedded generator and Hydro Ottawa;  
Ownership of equipment and property; and  
Terms and conditions of financial penalties and settlements.

### **1.3 Term and Termination of Connection Agreement**

#### **1.3.1 Term of Agreement**

The Term of the Connection Agreement shall begin on the later of either the execution date of this Agreement by both parties as set out in, or September 29, 2000 (as per DSC). The Agreement shall remain in full force and effect until terminated in accordance with this Agreement.

#### **1.3.2 Termination of Agreement**

Either non-defaulting Party may terminate the Connection Agreement at any time during the Term by giving the other Party a minimum of six (6) months written notice.

The Notice of Termination must be signed by the Signing Authority (or equivalent) in the Form of Connection Agreement and must include a date of Termination of the Connection Agreement.

### **1.3.3 Disconnection of non-defaulting party**

If the non-defaulting party has submitted a Notice of the Termination of Agreement, Hydro Ottawa will disconnect the connection facility on the date specified in the Termination of Agreement.

## **1.4 Terms and Conditions for Disconnection and Reconnection**

### **1.4.1 Voluntary Disconnection**

The embedded generator may permanently disconnect their facilities from the Hydro Ottawa distribution system at their discretion in accordance with the procedures set out in this Agreement/

### **1.4.2 Penalties and Fees for Voluntary Disconnection**

The embedded generator shall pay all associated costs, including the decommissioning, disconnection, and removal of Hydro Ottawa property that are attributable to the voluntary disconnection.

### **1.4.3 Involuntary Disconnection**

Hydro Ottawa may disconnect the embedded generator,

- Upon Termination of this Agreement.
- If the embedded generator is a defaulting party.
- If directed by an order from the IMO, OEB an independent arbitrator or any other governing body.
- During an emergency.

### **1.4.4 Penalties and Fees for Involuntary Disconnection**

*{THIS SECTION INTENTIONALLY LEFT EMPTY}*

### **1.4.5 Re-connection After Voluntary Disconnection**

Hydro Ottawa will re-connect the embedded generator after a voluntary disconnection provided there exists a Connection Agreement. All costs associated with the reconnection of an embedded generation facility will be paid by the embedded generation facility.

### **1.4.6 Re-connection After Involuntary Disconnection**

Hydro Ottawa will re-connect the embedded generator after an involuntary disconnection provided that

a) Hydro Ottawa is satisfied that the reason for disconnecting has been remedied to their satisfaction.

b) The embedded generating facility has taken all reasonable steps to prevent the disconnection from reoccurring.

#### **1.4.7 Right to Remove Assets**

The Owner of the embedded generator agrees that if this Agreement were terminated for any reason whatever, Hydro Ottawa reserves the right to enter the premises to remove all assets belonging to Hydro Ottawa.

In the event that Hydro Ottawa does not remove their assets within a certain period of time this does not constitute a forfeit of the ownership of the assets nor does it constitute a forfeit of the right to remove the assets at a later date.

### **1.5 Access to Connection Facilities and Right To Connect**

#### **1.5.1 Hydro Ottawa Access to Embedded Generator Facility**

Unconditional and unobstructed access to the connection facility shall be available to Hydro Ottawa, seven (7) days a week, twenty-four (24) hours a day.

#### **1.5.2 Right to Connect the Embedded Generation Facility to Hydro Ottawa Distribution Network**

The embedded generator shall have the right to connect the embedded generation facility to the Hydro Ottawa Distribution Network, subject to the Terms and Conditions set forth in this Agreement.

### **1.6 Circumstances Requiring Re-negotiation of Connection Agreement**

#### **1.6.1 Change in Ownership of Generating Facility**

If at any time the Ownership of the Equipment and/or Property changes from that identified in, the Connection Agreement will become null and void as of the date of the change of Ownership and will require re-negotiation with the new Owners.

#### **1.6.2 Ownership of Equipment and Property**

Identification of Ownership of all Equipment and Property can be found in Access to Connection Facilities and Right To Connect

## **1.7 Equipment Requirements and Equipment Standards**

### **1.7.1 Equipment Standards**

Without limiting Section 3.1.2 of the OEB Distribution System Code, all electrical equipment in the embedded generation facility shall be provided, installed and maintained in accordance with the Electrical Safety Authority in the Province of Ontario.

The embedded generation facility shall maintain all necessary inspection records from the Electrical Safety Authority and provide a copy upon request to Hydro Ottawa within seven (7) calendar days.

### **1.7.2 Equipment Requirements**

Without limiting Section 6.2.9 of the OEB Distribution System Code, the embedded generator shall provide, install, and maintain at its expense all equipment that shall be necessary from time to time during continuance of this Agreement.

The embedded generation facility shall install at their cost any equipment necessary to correct any operation of the embedded generation facility that may adversely affect the quality of supply, reliability of supply or the physical equipment of the Hydro Ottawa distribution system, including but not limited to, the safety of Hydro Ottawa employees, its contractors, agents and the public.

## **1.8 Licenses, Permits and Approvals**

The embedded generation facility shall comply with all applicable laws and regulations and shall obtain and maintain all necessary licenses, permits, authorizations and approvals for the embedded generation facility.

## **1.9 Operational Standards**

The embedded generating facility shall operate to prevent any disturbance, fluctuation, surge or interference with the Hydro Ottawa distribution system.

### **Operation While in Default of Agreement**

The embedded generator shall not operate the connection point in parallel with the Hydro Ottawa distribution system if the embedded generator is in default of this Agreement.

### **Permission to Synchronize**

The embedded generator shall not operate in parallel with the Hydro Ottawa system except with the express permission of Hydro Ottawa and the embedded generator shall obtain such permission from the Hydro Ottawa System Operator prior to every attempt to synchronize and operate.

### **Operational Status of Hydro Ottawa Distribution System**

The embedded generator shall only operate in parallel during normal operating conditions on the Hydro Ottawa system. The Hydro Ottawa System Operator (s) shall make the decision of normal system operating conditions.

### **Emergency Operations**

Without limiting Section 4.5.6 of the OEB Distribution System Code, the embedded generator shall participate in emergency plans as developed by Hydro Ottawa.

In the event that changes to the embedded generation facility are required to allow the facility to participate in emergency operations the allocation of costs shall be in accordance with IMO & OEB requirements.

### **Operating Voltage**

The embedded generation facility shall operate with the excitation system of the generator in power factor control mode, with a set point 100% or 1.0 per unit, unless instructed otherwise by the Hydro Ottawa System Operator.

### **Operating Frequency**

The embedded generation facility shall operate at a frequency of 60 Hertz (Hz).

## **1.10 Worker Protection, Safety to the Public and the Environment**

### **Right to Disconnect**

Without limiting Section 3.1 of the OEB Distribution System Code, Hydro Ottawa reserves the right to physically disconnect and remove all Hydro Ottawa assets from the embedded generators facility (including overhead lines, underground cables, disconnects, metering equipment etc.) if at any time the actions of the embedded generator jeopardizes the safety of any human life, the safety of the public or the environment.



## **Hold-offs**

Hydro Ottawa reserves the right to apply secure hold-offs on any distribution circuits with or without parallel, embedded generation.

The embedded generator shall allow for provision in their circuit breaker control circuitry to permit Hydro Ottawa to remotely block the closing signal for the generating unit(s) synchronizing breaker(s).

If at any time it is not possible for Hydro Ottawa to apply a hold-off from an embedded generator's connection facility, the embedded generator shall discontinue operating in parallel with the Hydro Ottawa distribution system until such time that the hold-off is removed by the Hydro Ottawa System Operator.

## **Requirements for System and Generating Plant Protection**

The embedded generator shall install at their cost all equipment necessary to automatically disconnect the generator(s) from the Hydro Ottawa Distribution System in the event of abnormal conditions.

## **1.11 Requirements for Reporting Equipment Characteristics or Configurations**

### **Engineering Documentation**

The embedded generator shall provide Hydro Ottawa with two (2) copies of the following documentation

- a) Accurate single line diagram of the station as finally built and approved for service.
- b) Three line diagram(s) of protective relaying system as finally built and approved for service.
- c) Control Diagram(s) for generator circuit breaker(s) and/or paralleling circuit breaker(s) as finally built and approved for service.
- d) Protection tripping logic diagram as finally built and approved for service.
- e) Protective Relay settings as finally built and approved for service.
- f) Equipment Data Sheets. (Attached as Schedule E – Notice of Project Submission, Parts A, B, C, and D)

Hydro Ottawa reserves the right to request additional information at any time from the embedded generation facility.

### **Changes in Equipment Characteristics**

Hydro Ottawa shall approve any changes to the equipment characteristics or layout prior to the modifications being made.

In the event the original equipment characteristics are modified, the embedded generator shall provide updated copies of documentation to Hydro Ottawa.

### **Changes in Equipment Electrical Configurations**

Hydro Ottawa shall approve any changes to the equipment electrical configurations or layout prior to the modifications being made.

In the event the original equipment electrical configuration is modified, the embedded generator shall provide updated copies of all documentation to Hydro Ottawa.

## **1.12 Generation Output Metering Requirements**

Without limiting the generalities of Hydro Ottawa, the embedded generator shall install at their cost all metering required by the Ontario Energy Board Distribution System Code Section 5.2.

## **1.13 Inspection, Maintenance and Testing of Equipment**

The embedded generator shall inspect, maintain and test its equipment accordance with recognized, safe work practice.

## **1.14 Requirements for Communication with Hydro Ottawa Distribution Network**

### **Day to Day Communications**

The embedded generator shall provide Hydro Ottawa with a means to communicate with the operational staff of the embedded generation facility for Normal Day-to-Day Communications.

If required, the embedded generator shall supply, install and maintain dedicated communication lines for remote tripping capabilities.

### **Emergency Communications**

The embedded generator shall provide Hydro Ottawa with a means to communicate with operational staff of the embedded generation facility for Emergency Communications.

An operational contact from the embedded generator will be available twenty (24) hours per day, seven (7) days per week using the communication means as specified by Hydro Ottawa.

Hydro Ottawa reserves the right to specify the communication platform, hardware, bandwidth, wavelength and/or protocol if the system provided by the embedded generator is not sufficient to meet the needs of an Emergency Communication system.

Hydro Ottawa shall determine the reasonable requirements of the Emergency Communication system.

The cost to supply, install and maintain the communication equipment shall be the responsibility of the embedded generator.

SAMPLE

## Schedule A - Form of Connection Agreement

This Connection Agreement is made this \_\_\_\_\_ day of \_\_\_\_\_  
\_\_\_\_\_ in the year \_\_\_\_\_, **BETWEEN, Hydro Ottawa Limited**, a corporation  
incorporated pursuant to the laws of the Province of Ontario, (the “Distributor”) and \_\_\_\_\_  
\_\_\_\_\_ licensed by the Ontario Energy Board.

### **PARTY OF THE FIRST PART;**

**and** \_\_\_\_\_, a corporation  
incorporated pursuant to the laws of the Province of Ontario, (the “Customer”)

### **PARTY OF THE SECOND PART.**

#### RECITAL

In accordance with its license and the Market Rules, the Distributor has agreed to offer, and the  
Customer has agreed to accept the terms and conditions of this Connection Agreement

IN WITNESS WHEREOF the parties hereto have caused this Agreement to be executed by the  
signatures of their proper officers duly authorized in that behalf.

Hydro Ottawa Limited

Generator

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

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

Title:

Title:

## Schedule B – Ownership of Equipment and Property

### Ownership of Equipment and Property

-Hydro Ottawa Limited - The “Distributor” owns the following listed equipment and/or property	The “Embedded Generator” owns the following listed equipment and/or property
Land:	Land:
Disconnect:	Disconnect:
Circuit Breaker:	Circuit Breaker:
Metering Installation:	Metering Installation:
Transformer:	Transformer:
Overhead Line:	Overhead Line:
Underground Cable:	Underground Cable:
Fuse holders and fuses:	Fuse holders and fuses:
SCADA RTU	SCADA RTU

## Schedule C – Facility Contact Information

	Embedded Generation Facility	Hydro Ottawa
	Facility Name:	
	Facility Location	
1.0	Contact Name:	Contact Name:
	Position:	Position:
	Telephone (days):	Telephone (days):
	Telephone (nights):	Telephone (nights):
	Cellular phone:	Cellular phone:
	Fax:	Fax:
	Email:	Email:
2.0	Contact Name:	Contact Name:
	Position:	Position:
	Telephone (days):	Telephone (days):
	Telephone (nights):	Telephone (nights):
	Cellular phone:	Cellular phone:
	Fax:	Fax:
	Email:	Email:
3.0	Contact Name:	Contact Name:
	Position:	Position:
	Telephone (days):	Telephone (days):
	Telephone (nights):	Telephone (nights):
	Cellular phone:	Cellular phone:
	Fax:	Fax:
	Email:	Email:
4.0	Contact Name:	Contact Name:
	Position:	Position:
	Telephone (days):	Telephone (days):
	Telephone (nights):	Telephone (nights):
	Cellular phone:	Cellular phone:
	Fax:	Fax:
	Email:	Email:
5.0	Contact Name:	Contact Name:
	Position:	Position:
	Telephone (days):	Telephone (days):
	Telephone (nights):	Telephone (nights):
	Cellular phone:	Cellular phone:
	Fax:	Fax:
	Email:	Email: