

Appendix B to Kingston Hydro's Conditions of Service

Guide for Distributed Generators

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Introduction

Kingston Hydro has been providing the residents of Kingston safe, reliable utility services for more than 100 years. Over this time our name and corporate structure have changed, but one thing has remained constant - we are a city-owned company accountable to citizens of Kingston.

As such, Kingston Hydro is committed to improving the economic and environmental sustainability of our community. As the entity responsible for supplying, distributing and metering electricity in central Kingston, Kingston Hydro has prepared this information package for those parties interested in learning more about connecting distributed electricity generation facilities to our grid. Kingston Hydro services most electricity customers in the city's centre, south of McAdoo's Lane to Lake Ontario and east of Catarauqui Creek to the Catarauqui River (including Barriefield and CFB Kingston). Residents in the city's east, west, and north are serviced by Hydro One. Those interested in distributed energy generation in these areas should contact Hydro One.

Currently, most of our electricity comes from large, centralized generation facilities connected to the high voltage provincial transmission grid. Local energy generation connected to Kingston Hydro's electricity grid can help keep energy dollars within our community, reduce energy losses created by transmission over long distances, and create opportunities for homeowners, businesses, and institutions to earn revenue while helping Ontario meet its energy needs. Electricity generation that is connected to local distribution grids is called "Distributed Generation".

Technological improvements, regulatory reform, increased environmental consciousness, and Ontario's Green Energy Act have allowed increased contributions from wind, solar, bioenergy, and small hydro generation systems into the provincial energy mix. In order to encourage development of renewable electricity generation facilities, the Ontario Power Authority administers the Feed In Tariff program offering a premium, guaranteed price for electricity produced by grid connected renewable energy generators. Renewable energy generators may also connect to the grid and be paid the Hourly Ontario Electricity Price (HOEP) through Ontario's wholesale market for electricity.

The challenge of meeting Ontario's increasing energy demand means that there are also opportunities for other technologies play an increased role in our energy supply mix. Prospective distributed generators of non-renewable energy responding to requests from the Ontario Power Authority for electricity supply or who plan to become suppliers in Ontario's wholesale market for electricity may also connect to Kingston Hydro's electricity distribution grid. Other distributed generators may not wish to connect to the Kingston Hydro grid and use their generation facilities for backup generation or off-grid electrification.

This information package contains the following information:

- A description of the way electricity is typically generated, transmitted, and distributed in Ontario and the resulting technical considerations for prospective distributed generators.
- An overview of the options available for connecting different types of electricity generation facilities to Kingston Hydro's grid and the different programs in Ontario through which generators can sell their electrical output.
- An overview of the technical, safety, and regulatory considerations that prospective distributed generators must be aware of.
- A description of the administrative process for connecting electricity generation facilities to Kingston Hydro's grid.

- The Initial Consultation Request form that starts the connection process and other helpful resources for distributed generators.

Read through this information package carefully. If you are interested in connecting a distributed electricity generation facility to Kingston Hydro's distribution grid, or have any questions about the content of this package, please contact Kingston Hydro's Service Advisors at (613)546-1181 x2285.

This information package is intended as a starting point for those interested in connecting distributed generation facilities to Kingston Hydro's electrical grid. It provides high level outlines and simplifications of processes and regulations that are described in detail in a number of publicly available documents, the content of which will change from time to time. A list of some of these documents and the agencies that publish them is available in Appendix A. It is recommended that anyone interested in connecting an electricity generation system to Kingston Hydro's grid read all relevant documentation carefully. Should there be a conflict between this information package and the rules, regulations, and specific information as laid out in relevant documents regarding the connection of electricity generation facilities to a distribution system in Ontario, the rules, regulations, and specific documents shall take precedence.

Kingston Hydro's electricity distribution system

Currently, Ontario's electricity transmission system consists primarily of large, centrally located generating stations linked over long distances by high voltage transmission wires. Higher voltages (over 50 kV capacity) are efficient for transmitting large quantities of power, but the voltage must be reduced to supply end users of electricity such as homes and businesses. Lower voltage wires (under 50 kV capacity) connected to the transmission system at transformer stations are owned and operated by "local distribution companies" (LDC's). Kingston Hydro is a local distribution company.

The Kingston Hydro electricity distribution system, or "grid" moves electricity around central Kingston for delivery to end users through 44 kV primary distribution lines, 5 kV secondary distribution lines, and less than 5 kV (usually around 1 kV) sub-distribution lines. These lines deliver electricity to large (industrial scale), medium (institutional scale) and small (home scale) consumers, respectively.

For those unfamiliar with electricity transmission and distribution systems, it can help to compare them to our community's system of roads. The transmission system is analogous to Highway 401, carrying large numbers of "electron cars" to our area. The exits off the 401 into our community represent transformer stations that allow "electron cars" to travel safely onto our City's main arterial roads. These main arterial roads are like primary and secondary transmission lines that in turn are linked to quiet residential streets and deliver small numbers of "electron cars" to our residential neighborhoods.

Like the roads in our community, Kingston Hydro's grid is not only a one way street. While the system is designed primarily to deliver electricity from the transmission grid to end users, it is possible for electricity generators to feed electricity into the grid to be distributed around the city and, in some cases, all the way back to the transmission grid. Just as a quiet residential street can't handle a large volume of traffic without disturbing the local residents, lower voltage distribution lines cannot take on large amounts of electricity generation without disrupting electricity service to other customers.



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In general the maximum amount of distributed generation that can be connected to Kingston Hydro's electricity distribution lines is as follows:

1 kV lines	-	small amounts of distributed generation
5 kV lines	-	between 500 kW and 1 MW
44 kV lines	-	between 15 MW and 20 MW

While these are general guidelines, it is important to remember that 44 kV lines are connected to 5 kV lines, which are in turn connected to 1 kV lines. The capacity of a 44kV line may be reduced by the cumulative distributed generation on the 5kV and 1kV feeder lines connected to it.

Due to the complexity of the Kingston Hydro's grid, the actual capacity of a specific distribution line to accept electricity generation at a given point can only be determined by an engineering review. Protection systems or modifications to Kingston Hydro's network of distribution lines may be necessary to protect the grid and other customers from events that can be triggered by distributed generation facilities. Studies to determine the impact of a generation facility connected at a given location and modifications to the grid required to mitigate these impacts are paid for by either Kingston Hydro or the generator according to the Ontario Energy Board's Distribution System Code.

Maps of the distribution system are available to assist prospective generators at:

www.utilitieskingston.com/electric/generation/index.htm.

Size classifications for distributed generation facilities

Those interested in connecting distributed generation to a local distribution grid should first determine the size of the facility they are planning to develop. The connection process, technical considerations for connection, connection costs, and regulatory issues each vary depending on the size of your generation facility under consideration.

Micro

A Micro generation facility is defined as an electricity generation system with a nameplate generation capacity of 10kW or less. All but the very largest of home or small business-based energy generation systems will fit into this category. Micro generation facilities are subject to a simplified connection process. If the generation facility is non-renewable, its owners can receive financial benefits by displacing energy consumption from the grid. If it is a renewable energy generation facility, its owners can participate in either Net Metering or the Feed in Tariff program. The technical and financial requirements of other financial settlement options are often too onerous for Micro generators to consider. Micro generation is subject to a simplified connection process due to its relatively minimal impacts on the electricity distribution system when installed according to Electrical Safety Authority specifications.

Under the Ontario Power Authority's Feed In Tariff Program, renewable micro-generators are subject to simplified contracts, registration processes, and rules. For more information, visit <http://microfit.powerauthority.on.ca/>

Small

Small generation facilities are defined as having a nameplate capacity of 500 kW or less when connected to distribution system voltages less than 15 kV, or as having a nameplate capacity of 1 MW or less when connected to distribution system voltages of more than 15 kV. These facilities can include larger solar arrays, small biogas, wind, and co-generation facilities, commercial scale wind

turbines, or industrial sized backup electricity generators. If eligible, small generators can participate in any one of the financial settlement options listed in this guide. Depending on the results of an Initial Consultation with Kingston Hydro staff, prospective Small Generators may be subject to a simplified connection process.

Mid-Sized

Mid-sized generation facilities have nameplate capacities of more than 500 kW when connected to a distribution system voltage of under 15 kV or more than 1 MW when connected to distribution system voltages over 15 kV. In all cases, they will have a nameplate generation capacity of no more than 10MW. Mid-Sized generation facilities are typically commercial or industrial scale endeavours. The capital cost for these facilities can range from thousands of dollars to the multi-million dollar range. Mid-sized projects can experience complex technical and financial issues and should only be considered if a generator has access to considerable expertise in the area of mid to large scale generation. In order to connect mid-sized generators, system upgrades may be required. These upgrades may result in additional costs or time delays for prospective generators. Mid-size generators are not eligible for Net Metering, but can participate in all other financial settlement mechanisms.

Large

Large distributed generators are those with nameplate capacities of over 10 MW. These facilities are typically only connected to the highest distribution voltages, are subject to the most complex and costly connection process, and typically generate financial returns by supplying very large energy consumers with power, taking the wholesale Hourly Ontario Energy Price, or by bidding into tenders by the Ontario Power Authority for electricity supply. Large distributed generation projects are multi-million dollar initiatives requiring a high level of technical and financial sophistication. Large sized generators are not eligible for Net Metering or the Standard Offer Program.

Non-Capacity Allocation Exempt

Renewable electricity generators larger than 250 kW connected to distribution feeders with capacity less than 15 kV, larger than 500 kW connected to distribution feeders with capacity between 15 kV and 50 kV, and all generators connected to the transmission system are non-capacity allocation exempt. As these generators are large enough to have regional impacts on the local transmission and distribution systems, the Ontario Power Authority and Local Distribution Companies perform Transmission and Distribution Availability Tests to determine which generators can fit on the local system and can be offered Feed In Tariff contracts and which must await require grid upgrades. Those that do not receive Feed in Tariff contracts due to lack of grid capacity are considered when the OPA develops long term distribution and transmission system capacity upgrade plans to accommodate renewable energy generators. Renewable electricity generators that are non-capacity allocation exempt face a more complex, lengthy, and risky connection process than smaller generators.

Capacity Allocation Exempt

Renewable electricity generation projects that have a nameplate capacity less than 250 kW connected to distribution feeders with a capacity of less than 15 kV or less than 500 kW connected to distribution feeders with capacity between 15 kV and 50 kV are classified as "Capacity Allocation Exempt" by the OPA and OEB. Capacity Allocation Exempt projects are not subject to Transmission and Distribution System Availability Tests before being offered Feed In Tariff contracts.

Earning revenue from distributed generation facilities

Ontario's electricity market offers a number of different methods for financial settlement with distributed electricity generators depending on their individual choices of generator size, fuel source, technical sophistication, and financial risk tolerance. Each of these options carries with it differing connection costs and requirements, as well as different opportunities for earning revenue from distributed generation. There are many industry associations that provide assistance to distributed generators using various technologies. Prospective distributed generators should consult with these associations in order to develop realistic financial forecasts for the costs and revenues that can be associated with their preferred technology. Combinations of these configurations are also possible.

Load displacement

Load displacement facilities are eligible to receive payments from Kingston Hydro, the Ontario Power Authority, or the wholesale market for the electricity they produce. Their function is to reduce the amount of electricity purchased by an electricity load customer from an electricity distributor. Load displacement facilities may qualify to receive compensation under other government programs such as the Ontario Power Authority's "Demand Response" initiatives. Please visit the Ontario Ministry of Energy and Ontario Power Authority's websites for more information. Web links to these sites are contained in Appendix B.

Hourly Ontario Energy Price – The Wholesale Market

In Ontario, there is an open wholesale market for electricity administered by the Independent Electricity System Operator (IESO). Throughout the day and night, Ontario electricity suppliers submit offers to sell electricity and wholesale buyers submit bids to buy electricity. The IESO then uses these offers and bids to match electricity supply with demand, establishing the Hourly Ontario Energy Price (HOEP) paid by wholesale customers. This spot market energy price changes from hour to hour, day to night, from season to season, and for short periods in response to high levels of demand or sudden changes on the IESO-controlled grid. Every five minutes, the IESO calculates a new spot market price by balancing the supply of electricity with demand. As demand increases, more expensive offers from generators are accepted, which raises the price of electricity. As demand drops, only the less expensive offers are accepted, which reduces the price.

Once a distributed generator is connected to Kingston Hydro's distribution system through the applicable connection process determined by the facility's size and technology, and acquires the appropriate licenses and certifications from a number of provincial agencies, it can offer its energy for sale in the wholesale market for electricity. Those offering energy for sale on the wholesale market should be very advanced in their understanding of Ontario's energy market and prepared to undertake increased levels of risk corresponding with acceptance of a system in which there is no guarantee of a long term contract for energy supply and no fixed pricing.

Provincial RFP's for energy supply or conservation measures

The Ontario Power Authority (OPA) is responsible for conducting the planning and procurement necessary to ensure Ontario has a reliable and economical supply of electricity to fuel its future growth. From time to time the OPA will issue "Requests for Proposals" (RFPs) for energy supply, renewable energy supply, or conservation initiatives related to specific technologies or geographic locations. These RFPs invite energy project developers to submit bids to the province in order to win long term, fixed price contracts. Generators who are responding to OPA requests for proposals

and plan to connect to Kingston Hydro's distribution system have to follow the same connection processes that all other generators are subject to. Depending on the type of RFP issued, they may be subject to financial settlement directly with the OPA, or through some combination of the OPA, the Wholesale Market, and Kingston Hydro. More information on past, current, and future RFP's for Energy and Conservation can be found on the OPA's website listed in Appendix B.

Financial settlement options for renewable electricity generators

Renewable Electricity Generation is defined as electricity generated from any one or a combination of the following sources: wind, solar thermal, solar photovoltaic; renewable biomass; bio-gas, bio-fuel, landfill gas, or water (hydro) power. Increasing the proportion of renewable energy in our province's electricity generation mix can have a positive impact on our health by lessening air, water, and soil contamination while addressing climate change. By becoming a leader in the implementation of renewable energy systems, Ontario can develop economic strength in a growing worldwide industry. As such, renewable electricity generation facilities are eligible to participate in Net Metering and Feed In Tariff programs developed by Ontario's government. Some renewable electricity sources are eligible for additional federal incentives and can generate emission reduction credits for their owners if certified through programs such as EcoLogo™.

Net Metering

Net Metering is a simplified financial settlement process for those who are interested in generating a portion of their own energy needs with distributed renewable electricity generation. Net metering is handy for those who are looking to avoid the need for expensive batteries or backup generators often necessary for off-grid renewable electricity systems. Net metering may also be a option for those not interested in the more complex application process required to participate in the Standard Offer Program. Net metering is only available to those who are installing renewable distributed electricity generation systems up to 500 kW nameplate capacity.

Once a net metered generator is connected to Kingston Hydro's system, they will only be billed for the difference between the value of the electricity exported to the grid and the value of the energy taken from the grid each month. Regulated electricity charges will only apply to the net consumption of electricity. If the difference reflects zero energy consumption or a net export of electricity by the customer, only the fixed monthly customer charge will apply and a credit for the value of the energy exported will appear on the net metered customer's bill. Energy credits can be carried forward for one year and will be applied to future bills.

Since credits can only be carried forward for one year, there is no incentive for installing generation facilities that consistently export more power to the grid than is consumed by the net metered customer. Net metering customers cannot participate in other forms of financial settlement, although a net metering customer can cancel a net metering agreement with 90 days notice if they wish to expand their systems and/or participate in other programs. If the prospective generator decides to be net metered after an initial consultation with Kingston Hydro staff, a simplified connection process may be applicable. For those electricity customers that have electricity supply contracts with licensed retailers other than Kingston Hydro, consultation with and a sign-off from the retailer will be required before any net-metering arrangement can be made.

Feed In Tariff Program

In order to encourage distributed renewable electricity generation, the Government of Ontario introduced the Feed In Tariff (FIT) program in late 2009. The goal of this program is to encourage development of a renewable energy industry in the province by giving renewable energy developers

long term financial security and a right to connect their generators to the grid. The program avoids the complexity, costs, and administrative burdens of a competitive bidding process for provincial power purchase agreements, providing Ontario businesses, individuals, community power groups, farmers, and others the ability to contribute towards our province's energy needs by becoming generators of electricity.

To be eligible to receive a 20-year Feed In Tariff power purchase contract, a generator must:

- Generate electricity from wind, solar photovoltaic (PV), renewable biomass, biogas, bio-fuel, landfill gas or water power.
- Be located in Ontario and connected to an eligible electricity distribution system.
- Meet the applicable "domestic content" regulations described in the Feed In Tariff rules.

Once a Feed In Tariff generator completes the appropriate connection process as described below, Kingston Hydro will pay the distributed generator the appropriate Feed In Tariff price for all the electricity produced by the generator. If the generator is located at a premises that is also a Kingston Hydro electricity customer, these customers will be billed for all the electricity they consume, regardless of whether it comes from the grid or directly from the generator. Both the generator and the electricity customer will have their own revenue meter and billing accounts with Kingston Hydro, and will be subject to monthly service charges according to Kingston Hydro's Ontario Energy Board Rate Order.

Prospective generators interested supplying electricity under the Standard Offer Program should carefully review the program rules, contracts and pricing available from the Ontario Power Authority (OPA) at <http://fit.powerauthority.on.ca/>. In some areas of the province, the Ontario Power Authority (OPA) may impose limits on eligible projects because of transmission system constraints.

Other considerations

Costs and risks for prospective distributed generators are not limited to the purchase, installation, and operation of generation equipment. There are costs and risks associated with technical considerations listed below, connection to Kingston Hydro's grid, obtaining regulatory approvals, gaining the necessary licenses and contracts associated with their preferred financial settlement option, and potential tax and business structuring issues. Prospective distributed generators are advised not to purchase or install electricity generation equipment until they have fully appraised themselves of these and any other costs and risks.

It is wise to check with business professionals such as an accountant about the tax implications of becoming a distributed generator. Businesses may be required to charge GST for the energy they produce, and homeowners may experience property tax implications. There is a growing industry in Ontario of professionals that have experience with distributed generation. While micro and small sized distributed generation projects can often be handled by homeowners or small businesses, professional engineering and consulting help may be required for most small, medium, and large sized projects. It is wise to be sure that one has carried out a realistic analysis of potential costs, revenues, and risks before undertaking distributed generation projects.

Technical considerations for distributed generators

All distributed generation facilities will have impacts on the local electricity distribution system and almost all electricity generation systems have the potential to harm people and property. Depending on the type, size, and location of a distributed generation facility, it may encounter any one of the technical or safety considerations outlined in this section. Any one or a combination of these considerations can affect an application to connect to a distribution system. To find out if any of the following issues apply to the generation facility you may be considering, contact the manufacturer of the generation system or refer to materials outlining the requirements prepared by relevant provincial and federal agencies including the Ontario Energy Board, Institute of Electrical and Electronics Engineers, the Canadian Standards Association and the Electrical Safety Authority. Information on these organizations is available in Appendix B. The following is by no means a complete list of the issues that may arise. It is intended to give prospective generators a high level understanding of typical technical issues related to distributed generation.

Static inverters, induction generators, and synchronous generators

There are a number of distinct types of electricity generators. These include static inverters, induction generators, and synchronous generators. Many smaller renewable energy systems produce grid quality AC power through an inverter. Induction and synchronous generators, on the other hand, are generally grouped together as “rotating machines,” but their different configurations give them different start-up and operational characteristics. Induction machines cannot begin operating without an initial supply of startup energy from the grid and normally have a lagging “power factor” (defined below). Synchronous machines on the other hand can operate without the grid and can have a zero or leading power factor. In general, inverter based systems are less likely than induction or synchronous generators to have detrimental impacts to the local electricity grid and often require little or no additional protection equipment.

Safety

Islanding

Islanding is one of the most important safety concerns for distributors when connecting distributed generation. Islanding occurs when a portion of the distribution system that contains both electricity consumers and generators becomes separated from the remainder of the distribution system for safety reasons but remains energized. Often, portions of the distribution system become separated from the rest of the system in order to clear temporary faults. It is essential that a generator disconnects from the distribution system before its portion of the system becomes separated. If the distributed generation facility does not disconnect fast enough it may make the temporary fault worse, damaging distribution equipment or the generation equipment itself.

From time to time, Kingston Hydro needs to isolate and de-energize sections of a distribution system for maintenance purposes. If a distributed electricity generator exists in a de-energized section of the distribution system, it too must be shut down and de-energized to ensure the safety of Kingston Hydro personnel.

Grounding

Distributed generators must be grounded in accordance with equipment manufacturers and relevant agency guidelines. Distributed generation must not disrupt any coordination of ground fault

protection or cause over-voltages that exceed the rating of equipment connected to the distribution system or part of the distribution system.

Protection of a distributed generation facility

A distributed generator is responsible for protecting their own equipment in such a manner that distribution system faults - such as outages, short circuits, automatic separation of distribution circuits or other disturbances - do not damage the distributed generation facility. The equipment protection shall also prevent the distributed generation facility from adversely affecting the distribution system's capability of providing reliable service to other customers.

Standardized or certified equipment

It is a requirement that the design for a distributed generation installation be approved by a professional engineer and that all equipment be Canadian Standards Association (CSA) approved and inspected by the Electrical Safety Authority. If the connection equipment used is a standard package or certified for use by the CSA or some other recognized agency, this will expedite and simplify the connection process. The safety, power quality and reliability of interconnected distributed generations is ensured through design standards, inspection, testing and the provision of switches, breakers and other protective equipment as required.

Some common types of equipment that may be required depending on the type and size of distributed generation under consideration include:

- A device capable of interrupting the maximum available fault current at the generation facility.
- An interconnection device that is manual, lockable, accessible, and visible disconnection.
- A generator disconnect device.
- Anti-islanding protection.
- A protective relay that will operate the load interruption device with an Over and Under voltage trip.
- An Over/under frequency trip.
- Over current protection.
- Ground fault protection.
- Reclosing co-ordination to ensure that the generator ceases to energize the grid when necessary.
- Power Factor correction (if required).
- Synchronizing equipment that will limit voltage fluctuation, frequency variation and phase angle when the distributed generation parallels with the distribution system.
- A Transfer Trip.
- Feeder Relay Directioning to prevent inadvertent tripping of a protective device.

At the initial consultation stage of the interconnection process, Kingston Hydro will provide information to the generator that will help determine the equipment required. For further information

about all safety requirements, please refer to the Ontario Energy Board's Distribution System Code Appendix F.2.

Power quality

Power quality is another significant technical concern for Kingston Hydro and distributed generators. Electricity must be supplied at a standard voltage and frequency. In North America, residences receive single-phase alternating current (AC) power at 120/240 Volts at 60 cycles per second (60 Hz), and commercial buildings typically receive either 120/240 Volts single phase or three-phase power depending on the size of the building and the types of electrical loads in the building.

Power quality is important because electronic devices and appliances have been designed to receive power at or near rated voltage and frequency. Deviations may cause equipment and appliance malfunction or damage. Additional power quality considerations include harmonics, power factor, DC injection, and voltage flicker.

Each type of distributed generation device has its own output characteristics based on its technology. Some will have more power quality issues than others. For more information, please refer to the Ontario Energy Board's Distribution System Code App. F.2 and Electrical Safety Association guidelines.

Voltage fluctuations, regulation, unbalance and frequency

Voltage fluctuations can result from a distributed generator connecting to or disconnecting from the distribution system or because of its individual operating characteristics. The presence of distributed generation must have no detrimental impact on the ability to regulate these voltages. Distributed generation must follow the distribution voltage and disconnect for any abnormality. Kingston Hydro tries to operate its three phase lines with voltages balanced as closely as possible. The presence of a distributed generator should not contribute to additional voltage unbalance. As with voltage fluctuations, frequency variations are a reliability and power quality issue. Distributed generation shall operate within the range of 59.3 to 60.5 Hz and disconnect for any abnormality.

Harmonics

Harmonics generically refer to distortions in the voltage and current waveforms caused by the overlapping of the standard waveforms at 60 hertz (Hz) with waves at multiples of 60 Hz. Harmonics can be caused by the electronic equipment used in some distributed generators such as "soft start" units and inverters. Harmonics can cause equipment to fail or overheat and can also degrade electricity service to other customers. Distributed generators must not impose harmonic distortions on Kingston Hydro's distribution system in excess of applicable standards.

Power factor

Power factor is a measure of apparent power delivered when the voltage and current waveforms are out of synch. Power factor is the ratio of true electric power, as measured in kilowatts (kW), to the apparent power, as measured in kilovolt-amperes (kVA). The power factor can range from a worst case of zero when the current and voltage are completely out of synch to the optimal value of 100% when the current and voltage are entirely in synch. The terms "leading" and "lagging" refer to whether the current wave (in this case from a distributed generator) contributes to or is detrimental to the efficiency of Kingston Hydro's electricity distribution system. Distributed generators connected to the distribution system must operate between a 0.9 lagging to 0.95 leading power factor.

DC injection

DC Injection is a potential issue for inverter-based systems. It occurs when an inverter passes unwanted DC current into the AC or output side. This can be prevented by the incorporation of equipment and design to prevent or limit the effect.

Voltage flicker

Somewhat like voltage fluctuations, voltage flicker refers to short-lived spikes or dips in line voltage. Voltage flicker can be noticeable to the eye and annoying to customers. For example, it can create a pulse in the light coming from a light bulb. Voltage flicker can occur when the outputs from a distributed generator vary over time. This can happen with small wind turbines if the wind is gusting or turbulent or with other intermittent sources of power.

Monitoring

For distributed generation with a capacity of greater than 250 kW Kingston Hydro may require remote monitoring of the distributed generation connection status, real power output, reactive power output and voltage at the point of generator connection. For distributed generation with nameplate capacity greater than 10 MW, the monitoring must be in real time.

Other regulatory approvals

In addition to satisfying applicable technical requirements listed above for connecting to the distribution system, generators also have to obtain regulatory approvals for their generation facilities as may be required by relevant municipal, provincial, or federal agencies. It is the prospective distributed generator's responsibility to obtain all required approvals, licenses, certifications, or other clearances necessary to operate their facilities.

In order to connect to the distribution system the owner or developer of a distributed generation facility must demonstrate that it has the necessary legal rights to build and operate an electricity generation facility at the location it proposes. This may include proof of ownership or permission and/or leased rights to use the land, buildings, and behind-the-meter electricity system in question for distributed generation purposes.

Regardless of the financial settlement method chosen it is the sole responsibility of the distributed generator to ensure that it is in compliance with all municipal zoning and land use by-laws. This can be done by contacting the City of Kingston's Planning and Building Inspection Departments.

The Ministry of the Environment may require the prospective generator to carry out an environmental screening or assessment depending on the type and size of generation facility it plans to build. Distributed generators should consult the Ministry of the Environment directly to determine if the potential requirements and costs to fulfill them. Contact information for the Ministry is included in Appendix B.

If you are planning to seek funding from federal government sources, or if your facility falls under federal jurisdiction (ex – small hydro may require approval by Fisheries and Oceans) you may also be required to complete a federal environmental screening and/or assessment. It is the sole responsibility of the distributed generator to ensure compliance with relevant provincial and federal legislation. Environmental screenings and/or assessments can become time consuming and costly endeavors. Be sure that you have a good understanding of the potential costs and timelines for these processes before approaching Kingston Hydro to start the connection process.

All distributed generators, with the exception those operating micro-sized load displacement facilities, must apply to the Ontario Energy Board for a generator's license. Obtaining a generator's license from the OEB entails filling out an application and payment of a licensing fee. For smaller generators, there is a \$100, one-time fee. For larger generators, the fee is \$800 per year. A link to information on generator licensing is included in Appendix B.

One of the key regulatory agencies to consult very early on in the development of a distributed generation facility is the Electrical Safety Authority (ESA). ESA approval will also be required before a distributed generator is allowed to connect, and may be required for the engineering design of larger connections. The distributed generator is responsible for the cost of inspections and approvals, which can vary with facility type and size. A link to the ESA's website and a booklet for electricity generators is included in Appendix B.

This is by no means an exhaustive list of requirements for every prospective distributed generator. Please consult with one of the industry associations listed in Appendix B or the agencies listed above to learn more about the approvals, licenses, certifications, or other clearances necessary to operate distributed electricity generation facilities.

Metering

Depending on the size and desired financial settlement options chosen by a distributed generator, different electricity metering configurations are required to measure the amount and value of electricity delivered to and from the Kingston Hydro grid. While efforts will be made to keep the cost and complexity of metering arrangements to a minimum, Kingston Hydro has the right to determine what type of metering arrangement is required for accurate measurement and billing in accordance with the Ontario Energy Board's Distribution and Retail Settlement Codes. Metering options will also depend on the physical setup of the current or proposed connection. Metering requirements for those who choose to sell their electricity on the wholesale market or whose generation facilities are deeply embedded in a load customer's distribution system can be quite complicated.

In most cases, Kingston Hydro is required to measure not only the amount of electricity delivered to its system by distributed generators, but also the time at which it is delivered. This enables Kingston Hydro to settle its accounts through the Independent Electricity System Operator. Depending on the metering configuration, Kingston Hydro may apply loss factors to the metered electricity supply that reflect line or voltage transformation losses before electricity is delivered to Kingston Hydro's grid. All meters must be Measurement Canada approved and connected in accordance with Measurement Canada and OEB policies and procedures. Metering and communications hardware required for measurement and settlement of electricity delivered by a distributed generator to Kingston Hydro's system shall be paid for by the prospective generator and owned by Kingston Hydro.

Other Technical Information

Hydro One has published a comprehensive technical guide for distributed generators of various sizes and technologies. While Kingston Hydro's connection standards may vary from those outlined in this guide on a case by case basis, in general connection standards will conform to these industry standard practices.

<http://www.hydroone.com/Generators/FITmicroFIT/Documents/Hydro%20One%20Networks%20Inc.%20DG%20Technical%20Interconnection%20Require.pdf>

Connecting Distributed Generators to Kingston Hydro's Grid

If you are planning to connect a distributed generation facility to Kingston Hydro's electricity distribution system, the first step is to read this guide, and contact Kingston Hydro to chat about your application. While information requests and initial consultations are typically free to the generator, the engineering studies required to safely connect a distributed generation facility to the Kingston Hydro system are provided at cost to the generator. Where required, Kingston Hydro will furnish the generator with reasonable estimates of the costs involved throughout each step of the connection process.

The scope and complexity of the process will depend on the size and type of generation facility to be connected. No matter which settlement option the distributor wishes to participate in, they will be subject to this process. The process that Kingston Hydro will follow for connecting a distributed generator to the LDC's distribution system is detailed in the Ontario Energy Board's Distribution System Code. It is highly recommended that a prospective distributed generator review the interconnection process guidelines for their size of facility as outlined in Appendix F.1 of the Ontario Energy Board's Distribution System Code.

Information requests

In order to help prospective distributed generators determine the feasibility of a potential project, Kingston Hydro can provide the following information upon request, without charge, and within 15 days for up to three locations to the prospective generator:

- A description of the relevant portion of the distribution system
- Schematics showing major transmission, distribution and sub-distribution lines
- Transformer and distribution stations
- Distribution voltage levels
- Geographic references compatible with a road map
- Information on voltage level, fault level, and minimum/maximum feeder loadings

Most of the information listed above is publicly available at: www.kingstonhydro.com/generators

If a prospective generator requests information for more than 3 locations, Kingston Hydro will recover the costs of providing such information from the prospective generator and provide such information within 30 days of receiving the request. Kingston Hydro may withhold certain information if it is commercially sensitive to another customer of the distribution system. Most information requests will be handled by a conference call with the generator and required staff, but some larger generators or unique requested connections may be handled through an in-person meeting.

Grid-connected Micro Generators (<10kW)

If a micro generator plans to participate in the Feed In Tariff Program, it should first apply to the Ontario Power Authority for microFIT contract. Once the generator receives and accepts a Conditional Offer of a microFIT contract from the Ontario Power Authority, it should ensure it returns a completed "Request for Initial Consultation" form, along with a single line diagram of their proposed installation, any manufacturer specifications available for their generation and inverter equipment, and photographs of their electricity service entrance and panel to Utilities Kingston's

service advisors. This form is available at www.kingstonhydro.com/generators. Non-FIT program microgenerators can apply for an Initial Consultation as soon as they have their preliminary design completed.

Within 15 days of receiving the completed form, Kingston Hydro will arrange an in-person meeting between the prospective distributed generator and its staff to discuss the proposed generation facility, provide preliminary information on the connection options, and explain the connection process, and provide information about billing and settlement.

Kingston Hydro will provide the prospective generator with a connection agreement or provide reasons for refusing to connect the facility within 15 days of the initial consultation. The prospective generator may suggest modifications to the connection agreement, but a connection agreement must be executed with Kingston Hydro within 30 days of receipt by the generator. There is no cost to the prospective generator up to this point.

Once the prospective generator and Kingston Hydro have executed a connection agreement, the generator is responsible for obtaining all necessary approvals from municipal, provincial, or federal agencies, including authorization to connect from the Electrical Safety Authority and performing any work required to meet the terms of the connection agreement. In addition, the generator must pay Kingston Hydro for the costs of any required metering changes. Once the generator has completed all the tasks listed above and provided Kingston Hydro with any documentation required in the connection agreement, the facility will be connected to the distribution system within 5 days.

All Other Grid Connected Generators (>10kw)

Initial Consultation or Pre-FIT Consultation

The Initial Consultation offers the prospective generator the opportunity to ask questions of Kingston Hydro regarding the connection process and potential facility location, connection, and metering options and related costs. The goal of the initial consultation is to provide the prospective generator with enough information to evaluate the financial, technical, and time risks so as to determine the feasibility of the desired connection.

The Initial Consultation will also provide Kingston Hydro staff with the information they will need to determine whether or not a generator requires a formal Connection Impact Assessment, or whether it can be connected by a simplified process analogous to that of microgenerators. If it is likely that the prospective generator will have to go through an impact assessment with a Transmitter or another distributor, Kingston Hydro will let the prospective generator know.

Generators intending to apply for Feed In Tariff Contracts MUST request and attend an initial consultation before applying for their FIT contracts. It is at the initial consultation that the generator will be given the Transformer Station ID and Feeder number that they require to apply for a FIT contract. An Initial Consultation sets up the rest of the connection process, providing important information up-front to the generator and Kingston Hydro that will allow processing of applications within regulated timelines. Should a generator apply for a FIT contract before conducting an initial consultation, Kingston Hydro can make no guarantee as to the accuracy of the information the generator has submitted to Ontario Power Authority, and may not have the details regarding the prospective generator needed to confirm distribution system availability to the Ontario Power Authority.

Connection Impact Assessment

Once the prospective generator has decided to proceed with its project based on the results of the initial consultation, or if it has received a conditional offer of a Feed In Tariff Contract, it must complete an application form requesting a Connection Impact Assessment. The application forms will require the generator to provide much more detailed technical information on the proposed facility including diagrams and descriptions of the proposed facility and its connection certified by a licensed professional engineer and any other information required by Kingston Hydro staff to complete their engineering review. Forms are available upon request. A completed application for a Connection Impact Assessment includes:

A complete CIA application consists of:

- Completed and signed CIA Form
- Payment in full by cheque or money order payable to "Hydro One Networks Inc." (see Connection Impact Assessment Fee Schedule below)
- Signed Study Agreement
- Single Line Diagram (SLD)

Kingston Hydro has the right to require that technical submissions for projects greater than 10 kW must be signed and sealed by a licensed Ontario Professional Engineer (P.ENG).

A Connection Impact Assessment (CIA) will establish the exact requirements for the connection and operation of the proposed generation facility. CIA's are carried out by Kingston Hydro at the prospective generator's cost. The prospective generator must pay Kingston Hydro the estimated cost for the CIA when it submits its application. Once it is determined that the application form is complete and that the appropriate payment has been made, Kingston Hydro will perform the assessment setting out the impact of the proposed facility on the distribution system, other Kingston Hydro customers, and neighboring distribution and transmission systems. Distributed generation facilities with a nameplate capacity greater than 1 MW connected to the Kingston Hydro system may require consultation with other electricity distributors connected to our grid or, for large projects, a separate impact assessment by the local transmitter, Hydro One.

Kingston Hydro is required to ensure that the safety, reliability, and efficiency of the distribution and transmission systems are not materially adversely affected by a distributed generation facility. It must also ensure that the proposed facility is in compliance with the technical requirements of the Distribution System Code and other applicable regulations. The CIA will set out the necessary design parameters of the connection, any necessary equipment to be installed by the generator, and outline any upgrades or modifications necessary to distribution or transmission systems. It should also outline necessary metering configurations and operational parameters for the generation facility.

The costs and timelines for the Connection Impact Assessment will vary greatly depending on the size, function, and financial settlement choices made by the prospective generator. In general, the smaller the output of the proposed facility, the less complex and costly the Connection Impact Assessment will be. Depending on the size and complexity of the CIA, it must be delivered to the prospective generator within either 60 or 90 days of the date Kingston Hydro receives the application and initial CIA payment. If the actual cost of the CIA differs from the estimated cost, a final settlement between Kingston Hydro and the prospective generator will be made upon completion of the CIA. Once settlement is completed, the prospective generator will be offered a connection agreement including a Connection Cost Estimate or given reasons for a refusal to connect.

Connection Agreements

Once the CIA is complete, a connection agreement may be offered to the generator by Kingston Hydro. The connection agreement contains the results of the CIA along with two legal agreements titled “Offer to Connect” and “Connection Cost Agreement”. The goal of the legal agreements is to set out the roles and responsibilities of the both prospective generator and Kingston Hydro throughout the remainder of the connection process and the operating life of the generator. The complexity of this process varies based on the size of the prospective generator and the complexity of the connection as outlined in the CIA.

The generator may propose changes to the final design, work schedule, costs, milestones, and other requirements proposed by Kingston Hydro. If Kingston Hydro and the generator are able to come to an agreement, it will include, at a minimum:

- A commitment by the generator to cover all connection costs incurred by Kingston Hydro and a payment schedule.
- A commitment by both the generator and Kingston Hydro to work schedules, information exchange, and the scope of work to be performed by both parties.
- A commitment by the generator to obtain regulatory approvals or agreements within a certain timeframe.
- Final detailed engineering drawings including a single line diagram, interface protection, metering, and other required design parameters.
- An outline of any upgrades, line extensions, changes to transformer capacity or switching hardware, or any other modifications to the distribution system necessary to connect the distributed generation.
- A commitment by Kingston Hydro to perform the work required to connect the generator within a reasonable timeframe.
- Other legal covenants standard to this type of agreement (ex. Force Majure clauses).
- A commitment as to the costs that must be borne for any necessary grid upgrades or connection components by both Kingston Hydro and the prospective generator.

There are two categories of costs that a generator may be asked to contribute towards. The first are connection assets, including the physical connection and protection equipment needed to physically connect the generator to the grid, the metering and communications equipment necessary for billing, and any other costs to cover connection elements solely devoted to a particular generator. Upstream or green energy enabling costs apply to upgrades or modifications to the distribution system necessary to ensure the continued safety and reliability of the system. If the generator is a renewable electricity producer with a FIT contract, Kingston Hydro will cover upstream costs up to \$90/kW of installed capacity required to enable connection of renewable electricity producers.

Once the prospective generator has this agreement signed with Kingston Hydro, they can proceed together with the design and building of the distributed generation facility. The prospective generator is not guaranteed a connection before this agreement is signed. Kingston Hydro has a requirement to connect the generator within a reasonable timeframe once the facility has obtained regulatory approvals. If the prospective generator does execute and return the connection agreement negotiated with Kingston Hydro within 12 months of completing a CIA, or if there are material technical changes to the design of the facility or connection, the generator will lose its position in the connection queue and may have to perform another CIA.

Standard form connection agreements between Kingston Hydro and generators of various sizes are available in Appendix F of the Ontario Energy Board's Distribution System Code.

Commissioning & Ongoing Monitoring

Once Kingston Hydro and the prospective generator have completed the work and made the payments called for in the Offer to Connect, it is time to commission the distributed generation facility. The prospective generator must obtain authorization from the ESA to connect the system. Kingston Hydro staff has the right to be present at the commissioning of the system and perform testing of the generation facility, connection and metering equipment, and any modifications to the distribution system. Once the ESA, Kingston Hydro, and other distributors or transmitters impacted by the facility are satisfied with the tests, the generator will be allowed freedom to operate and earn revenue for the production from its distributed generation facility.

Non-Grid Connected Distributed Generation

For those planning to install a generator for isolated operation, with no connection to the Kingston Hydro distribution system, please refer to the following information and determine any applicable requirements for notifying or working with Kingston Hydro on such installations. This type of installation is primarily used for emergency backup purposes. Please contact Tom Brackenbury at (613) 546-1181 x2394 or tbrackenbury@utilitieskingston.com to fulfill any notification obligations or contact the customer service centre at (613)546-0000.

Backup Generators

Be sure to notify Kingston Hydro of any backup generation or battery banks that are connected to loads also serviced by Kingston Hydro's grid. This responsibility is included as a customer's covenant in Kingston Hydro's Conditions of Service, and as such, failure to notify Kingston Hydro of the existence of or plans for a backup generator could result in disconnection of your electricity service. If the proposed distributed generation facility is intended to be used for emergency backup generation or to charge a battery bank and also to be connected to the grid taking advantage of financial settlement options, there may be additional technical requirements to ensure proper isolation of your backup generator or battery bank. Feed In Tariff generators are not allowed to be connected to battery backup systems.

Small isolated generators - less than 5 kW

While small isolated generators, typically emergency generators that run on gasoline or diesel fuel oil, are not typically interconnected to Kingston Hydro's grid, it is important that any installation is safe to the user, safe to other customers, and safe for utility workers. It also should not interfere with Kingston Hydro's reliable supply of electric power to your premises. To accomplish this, a generator must either only start up to serve your entire electrical load after full disconnection from Kingston Hydro's grid, or only serve isolated electrical loads while they are disconnected from circuits connected to the Kingston Hydro grid. Kingston Hydro staff are available to help review installation plans to help ensure that small emergency generators are installed properly. If your generator has a capacity of 5 kW or less, there is no charge for Kingston Hydro engineers to review your installation plans.

Mid-sized isolated generators – 5 to 30 kW

If installing a mid-size isolated generator of 5 to 30kW capacity intended for emergency backup or electrical load supply purposes at a location that is serviced by Kingston Hydro, one must notify

Kingston Hydro of its plans. The prospective generator may be required to fill out an application form or meet with Kingston Hydro engineering staff. There may be requirements for inspection of the system or notification of its operation. There may be a nominal fee for some components of the Kingston Hydro's engineering review.

Large isolated generators - Greater than 30 kW

Installation of larger generators within a Kingston Hydro serviced customer's facilities has the potential to impact our community's distribution grid. If you are planning to install a large generator, you must contact Kingston Hydro and submit any information required to perform an engineering review of the system. There may be a nominal fee associated with this engineering review. Kingston Hydro will need to ensure that the planned generation facility is not interconnected with grid tied circuits, while also ensuring that the facility's operation will not endanger the safety or reliability of Kingston Hydro's grid. In most cases, Kingston Hydro can process such engineering reviews within 15 days if it is provided with complete and accurate information about the planned generation facility.

Conclusion

Distributed electricity generation from conventional and renewable energy generation technologies can help Ontario meet its electricity needs while mitigating the environmental effects of traditional electricity production and consumption methods. With the advent of provincial government policies that support increasing amounts of distributed generation connected to local electricity distribution systems, there are many opportunities for individuals, businesses, institutions, or co-operatives to supply electricity to the grid while generating financial returns.

Those interested in becoming a distributed generator must first decide upon the size and financial settlement options that fit their individual goals, technical and financial resources, and risk tolerances. There are many technical and safety issues that must be taken into consideration before connecting to the grid. The process for connecting distributed generators varies greatly depending on the size and financial settlement options chosen by the prospective generator. In order to fill out the Initial Consultation Request Form and start the connection process with Kingston Hydro, a prospective generator must decide upon the technology, location, size, and financial settlement options it wishes to use. Information is available from Kingston Hydro's Customer Service Centre to help prospective generators make these decisions, and individuals with further questions can contact Kingston Hydro service advisors Todd Lyon or Katie Simoes at (613)546-1181 x2285 or by email at microfit@utilitieskingston.com

Ontario's energy market is very complex. There are a number of agencies that have some jurisdiction in the process of connecting distributed generation. There are also a great number of resources that one can turn to for help in understanding the ins and outs of distributed generation. Appendix B – Additional Resources for Distributed Generators contains web links and contact information for documents and organizations that can help preparations to become a distributed electricity generator.

Kingston Hydro supports distributed generation and we are here to help guide you through the connection process. If you have any questions regarding the information presented in this guide, please feel free to contact Kingston Hydro.



P.O. Box 790
Kingston, ON, Canada, K7L 4X7
Phone: 613.546.1181
Fax: 613.546.5391
www.kingstonhydro.com

Resources For Distributed Generators

The Ontario Energy Board - <http://www.oeb.gov.on.ca>

Distribution System Code & Retail Settlement Code

<http://www.oeb.gov.on.ca/OEB/Industry/Rules+and+Requirements/Rules+Codes+Guidelines+and+Forms#electricity>

Information for Generators

<http://www.oeb.gov.on.ca/OEB/Industry/Rules+and+Requirements/Information+for+Generators>

Green Energy Initiatives

<http://www.oeb.gov.on.ca/OEB/Industry/Regulatory+Proceedings/Policy+Initiatives+and+Consultations/Green+Energy+Initiatives>

The Ontario Power Authority - <http://www.powerauthority.on.ca/>

FIT and MicroFIT program information

<http://fit.powerauthority.on.ca/>

Electrical Safety Authority - <http://www.esa-safe.com/>

Information for FIT program generators

http://www.esa-safe.com/GeneralPublic/cgi_001.php?s=22

Industry Associations and Other Vital Resources

SWITCH – Kingston’s Sustainable Energy People – www.switchkingston.ca

The City of Kingston – <http://www.cityofkingston.ca>

Ontario Sustainable Energy Association – www.ontario-sea.org

Canadian Solar Industries Association - www.cansia.ca

Canadian Wind Energy Association – www.canwea.ca

Ontario Water Power Association – www.owa.ca

Association of Power Producers of Ontario – www.appro.org

Canadian Standards Association – www.csa.ca

The Ontario Ministry of Energy - <http://www.energy.gov.on.ca/>

Information on Ontario’s electricity markets, government programs, and the Green Energy and Green Economy Act

Independent Electricity System Operator - <http://www.ieso.ca/>

Ontario's wholesale market operator – information about selling distributed energy generation to the grid at the Hourly Ontario Electricity Price.

Ontario Ministry of the Environment - <http://www.ene.gov.on.ca/index.htm>

Guide to Environmental Assessment Requirements for Electricity Projects

<http://www.ene.gov.on.ca/envision/gp/4021e.pdf>

Generator Request for Initial Consultation & MicroGenerator Connection Application Form

Instructions

Completion and submission of this form is the first step for distributed generators interested in connecting to Kingston Hydro's electricity distribution system. Please ensure that this form is filled out completely and accurately. It is recommended that prospective distributed generators read Kingston Hydro's "Guide for Distributed Generators" and relevant documents listed in its Appendix B before requesting an Initial Consultation.

In order to assist prospective distributed generators in determining the feasibility of a generation facility at a given location and filling out the Initial Consultation Request Form, the following information is available upon request for a maximum of 3 potential locations per applicant:

- A description of the relevant portion of the distribution system
- Schematics showing major transmission, distribution and sub-distribution lines
- Transformer and distribution stations
- Distribution voltage levels
- Geographic references compatible with a road map
- Information on voltage level, fault level, and minimum/maximum feeder loadings

The purpose of an initial consultation is to assist the prospective distributed generator in determining the basic feasibility of the proposed facility for a given location, provide information on connection options and the connection process, and furnish the prospective generator with estimates of the timeline and cost for completing a connection.

If you have any questions regarding this form or the process for connecting distributed generation to the Kingston Hydro distribution system, please contact Utilities Kingston's Service Advisors at (613) 546-1181 ext 2285. or microfit@utilitieskingston.com

Date: _____
(dd / mm / yyyy)

1. Generation Facility Location:

Street Address: _____

Postal Code: _____

Description: _____

Kingston Hydro Account #: _____

Residential

Commercial

Industrial

2. Generation Facility Owner:

Contact Name: _____

Company: _____

H.S.T. # _____

Mailing Address: _____

Telephone: _____

Fax: _____

E-mail: _____

3. Generation Facility Developer (if not the same as Generation Facility Owner):

Contact Name: _____

Company: _____

H.S.T. # _____

Mailing Address: _____

Telephone: _____

Fax: _____

E-mail: _____

4. Generation Facility Description:

Fuel Source:

Conventional

Gas engine

Diesel engine

Micro turbine

Other _____

Renewable

Photovoltaic

Wind

Hydro

Biogas /
Biomass

Other _____

Total Inverter(s) nameplate rating (kW): _____

Total Collector(s) nameplate rating (kW): _____

Number of Phases (one or three): _____



P.O. Box 790
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Phone: 613.546.1181
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www.kingstonhydro.com

Please attach any other information on your prospective distributed generation facility that you feel may assist Kingston Hydro staff in evaluating the technical feasibility of connecting your facility to Kingston Hydro's grid. Include single line diagrams or engineering diagrams of the facility, equipment manufacturer specifications, photographs of your existing electricity service including the meters and Kingston Hydro grid connection, or anything else you feel may be of interest to Kingston Hydro in evaluating your connection: