Appendix B:
Guide for DER Applicants

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Introduction

If you are interested in connecting a DER facility to Kingston Hydro's distribution grid, please contact Utilities Kingston Services Advisors or Utility Engineering Department:

by email: serviceadvisors@utilitieskingston.com or DER@utilitieskingston.com

by telephone: 613-546-1181 ext 2285.

The Ontario Energy Board's Distributed System Code (DSP) is available to view at: https://www.oeb.ca/regulatory-rules-and-documents/rules-codes-and-requirements/distribution-system-code-dsc

The Ontario Energy Board's Distributed Energery Resource Connection Procedure (DERCP) is available to view at: https://www.kingstonhydro.com/LocalGeneration

This guide 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 DER 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 DER proponents must be aware of.
- A description of the administrative process for connecting DER to Kingston Hydro's grid.

This information is intended as a starting point for those interested in connecting Distributed Energy Resources (DER), including battery storage facilities, to Kingston Hydro's electrical grid. 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. 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.

All DER applicants that are over 10kW are subject to requiring SCADA Monitoring and Control. Some applications may be subject to either a UK Transfer Trip, a HONI Transfer Trip, or both. That requirement will be outlined in the CIA. Further information on restricted feeders can be found at the Kingston Hydro, Local generation website: https://www.kingstonhydro.com/LocalGeneration

Size classifications for DER facilities

Those interested in connecting DER facility 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 DER facility under consideration.

Micro -Embedded Generation Facility

A Micro-Embedded Generation is defined as an electricity generation system with a nameplate capacity of 10kW or less. MicroDER facilities are subject to a simplified connection process. Please refer to the process flowchart in the DERCP for further information on the connection process. Please note that ESA authorization will be required prior to connection.

Small Embedded Generation Facility

Small DER facilities are defined as not being a Micro-Embedded Generation facility and 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. Please refer to the process flowchart in the DERCP for further information on the connection process.

Mid-Sized Embedded Generation Facility

Mid-sized Embedded Generation Facilities means an embedded generation facility with a name-plate rated capacity of 10 MW or less and:
(a) more than 500 kW in the case of a facility connected to a less than 15 kV line; and
(b) more than 1 MW in the case of a facility connected to a 15 kV or greater line.
Please refer to the process flowchart in the DERCP for further information on the connection process.

Large Embedded Generation Facility

Large Embeded Generation Facilities are those embedded generation facilities with a name-plate rated capacity of more than 10 MW. Please refer to the process flowchart in the DERCP for further information on the process.

Earning revenue from DER facilities

Ontario's electricity market offers a number of different methods for financial settlement with DER facilities depending on their individual choices of DER 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 the DER facility. There are many industry associations that provide assistance to DER proponents using various technologies. Prospective DER applicants 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 may also possible.

Load displacement

Load displacement facilities may be eligible to receive payments from Kingston Hydro, the Independent Electricity System Operator, 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.

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 DER facility 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.

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 their DER facility.

Once a net metered DER facility 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 (12 months) and will be applied to future bills.

Since credits can only be carried forward for one year, there is no incentive for installing DER 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. 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.

Other considerations

Costs and risks for prospective DER facilities are not limited to the purchase, installation, and operation of DER related 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 apprised 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/HST 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 DER 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 DER facilities

All DER facilities will have impacts on the local electricity distribution system and almost all DER systems have the potential to harm people and property. Depending on the type, size, and location of a DER 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 DER 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.

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 DER site 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

DER facilities 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 DER facility

A DER proponent 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 DER 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 DER installation be approved by a professional engineer and that all equipment be Canadian Standards Association (CSA) approved and inspected by the Electrical Safety Authority. The safety, power quality and reliability of interconnected DERs 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 the DER under consideration include:

- A device capable of interrupting the maximum available fault current at the DER facility.
- An interconnection device that is manual, lockable, accessible, and visible disconnection.
- A DER facility 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 DER 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 DER project 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 DER proponents. 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 DER facility 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 DER facility connecting to or disconnecting from the distribution system or because of its individual operating characteristics. The presence of DER facility 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 DER facility should not contribute to additional voltage unbalance. As with voltage fluctuations, frequency variations are a reliability and power quality issue. DER facilities connected to the grid 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. DER facilities 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. DER facilities 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 DER facilities with a capacity of greater than 10 kW Kingston Hydro will require remote monitoring of the distributed generation connection status, real power output, reactive power output and voltage at the point of generator connection. For DER facilities 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, DER facilities also have to obtain regulatory approvals for their site 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 DER facility must demonstrate that is 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 DER facility purposes.

Regardless of the financial settlement method chosen it is the sole responsibility of the DER facility 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 DER facility to carry out an environmental screening or assessment depending on the type and size of DER facility it plans to build. DER facilities should consult the Ministry of the Environment directly to determine if the potential requirements and costs to fulfill them.

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. More information can be found on the OEB website located here:
https://www.oeb.ca/applications/how-file-application/application-process

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 DER facility is allowed to connect, and may be required for the engineering design of larger connections. The DER proponent is responsible for the cost of inspections and approvals, which can vary with facility type and size.

Metering

Depending on the size and desired financial settlement options chosen by a DER proponent, 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. Kingston Hydro will require all DER facilities to have a 'generator meter' installed on site. 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 DER 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 DER facilities, 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 and 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 DER proponent and owned by Kingston Hydro.

Connecting DER Facilities 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 discuss your proposed application via the Preliminary Consultation Information Request (PCIR). While information requests and initial consultations are typically free to the generator, the engineering studies required to safely connect a DER facility to the Kingston Hydro system are provided at cost to the DER proponent. Please refer to the CIA fee schedule on the Kingston Hydro website for more details on the cost to process a CIA.

The scope and complexity of the process will depend on the size and type of DER facility to be connected. No matter which settlement option the DER facility 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 DER proponent review the interconnection process guidelines for their size of facility as outlined in Ontario Energy Board's DERCP.

Information requests

In order to help prospective DER proponent; Kingston Hydro has information on the Kingston Hydro website for local generators, and DER proponents can send questions to the Service Advisors or teh Utility Engineering Department at: ServiceAdvisors@utilitieskingston.com and DER@utilitieskingston.com

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 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 best handled with an in-person site meeting.

Micro-Embedded Generation Facilities (<10kW)

For the process on connecting a MicroDER facility, please refer to the relevant section of the Ontario Energy Board's DERCP document.

All Other Embedded Generation Facilities (>10kw)

For the process on connecting a DER facility, please refer to the relevant sections of the Ontario Energy Board's DERCP document, and the Kingston Hydro CIA Instructions .

Connection Impact Assessment

Once the prospective DER proponent has decided to proceed with the project based on the results of the initial consultation, the DER proponent must complete an Connection Impact Assessment Form. The form and the instructions for the form are avalable on the Kingston Hydro webpage.

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.

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.

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 the timeframes set out in the Distribution System Code 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 on Kingston Hydro's website