Distribution System Customer Load Interconnection Requirements (750–100,000 V)

Manitoba Hydro

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LEGISLATIVE AUTHORITY

Section 15.0.3(1) of *The Manitoba Hydro Act* (C.C.S.M. c. H190) authorizes Manitoba Hydro to: (a) make rules, set terms and conditions, or issue directions respecting (i) the interconnection of the works of others with the corporation's works, and (ii) the operation of the works of others that are interconnected with the corporation's works; and (b) carry out studies to evaluate the effects of a proposed interconnection. Works is defined as including all roads, railroads, plant, machinery, buildings, structures, erections, constructions, installations, materials, devices, fittings, apparatus, appliances, equipment, and other property for the development, generation, transmission, distribution, or supply of power. In addition, pursuant to Section 10 of Regulation 186/90 – Electric Power Terms and Conditions and Supply, Manitoba Hydro is authorized to determine the voltage, frequency, phasing and other characteristics of power, the determination of which is final and binding on the user.

Pursuant to this legislative authority, Manitoba Hydro has established the following Distribution System interconnection requirements for the facilities of third parties interconnected to Manitoba Hydro's distribution system.

IMPORTANT

Available in accessible formats upon request.

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1.0 Introduction

This document defines technical requirements for customers wishing to connect to the Manitoba Hydro distribution system at voltages exceeding 750 V and less than 100 kV.

1.1 Definitions

This section defines the terms used in this document. The definitions used herein may be different from definitions of similar terms used in other documents and are exclusive to this document. The definitions used herein are not to be used in any fashion to interpret, modify or explain in any way a definition of a similar term in any other agreement.

Applicable Laws: Canadian federal, provincial and local laws, ordinances, rules, codes, standards and regulations, and all duly promulgated orders and other duly authorized actions of any governmental authority having jurisdiction over the customer and the customer facility, included but not limited to the Canadian Electrical Code.

Customer: A person or entity proposing to interconnect its customer facility to the Manitoba Hydro distribution system or to make a substantial modification to an existing customer facility.

Customer Facility: A facility with electrical load that receives power from the Manitoba Hydro distribution system.

Emergency Condition: Any condition or situation that is likely to endanger life or property, violate any environmental law; or is likely to cause a material adverse effect on the security of, or damage to the customer facility, or the Manitoba Hydro distribution system.

Distributed Resource: A collective term referring to all sources of real electric power that are not directly connected to the bulk power transmission system. This includes both generators and energy storage devices.

Emergency Operating Guides: May be referred to as temporary operating instructions or temporary operating guides. Emergency Operating Guides are developed to address an unforeseen Emergency Condition. Emergency Operating Guides will be documented and made available to Manitoba Hydro's system control operators, however if time is of the essence, these guides may only be transmitted verbally to the Customer.

Interconnection Studies: Studies to determine the impacts and requirements for interconnection of the customer facility to the Manitoba Hydro distribution system, including any interconnection system upgrades, as needed to comply with the technical requirements of this document and Manitoba Hydro's planning and design requirements.

Manitoba Hydro Distribution System: A portion of the electrical system used to distribute power to Manitoba Hydro's customers. For the purposes of this report it will refer to the portion of the electrical system operating at voltages exceeding 750 V to less than 100 kV.

Manitoba Hydro Transmission System: Transmission facilities, generally 100 kV and above, owned and operated by Manitoba Hydro. Interconnections to the Transmission system are covered in the Transmission System Interconnection Requirements [1] technical document.

Operating Procedures: A set of operating instructions carried out by the Manitoba Hydro system operator when certain events occur on the distribution system that may compromise security and reliability if no action is taken.

Point of Interconnection: The location of the electrical connection between the customer and Manitoba Hydro's distribution system. Normally, this is the point where ownership changes from Manitoba Hydro to the customer.

Substantial Modification: A modification to a customer facility shall be considered substantial if it results in a change in:

- Demand above contract demand;
- The reactive power facilities (e.g. reactors, capacitors, synchronous condensers);
- The protection system of the customer facility;
- Load characteristics (e.g. Addition of harmonic loads, variable speed drives or changes in motor starts);
- Load or motor size increases above the limits specified in table 1 below based on connection voltage level;
- Facts devices such as SVCs, STATCOMS, etc.

System Voltage (kV)	Demand (kVA)	Motor Size (hp)
4.16	100	5
8.32	100	5
12.47	167	10
24.00	167	10
24.94	167	15
33.00	500	125
66.00	1000	250

Table 1: Demand and Motor Size limits for Substantial Modification by System Voltage

1.2 Revisions

The requirements of this document are subject to revisions at any time to ensure the reliability of the Manitoba Hydro distribution system and to comply with changes from distribution standards, or criteria established by Manitoba Hydro or outside bodies such as CSA. The customer wishing to interconnect with the Manitoba Hydro distribution system, or substantially modify its facility must comply with the latest revision of this document in effect at the time of connection.

1.3 Applicability

This document specifies the technical requirements for interconnecting a customer facility to the Manitoba Hydro distribution system and is applicable:

- For interconnection of a new facility;
- For a substantial modification to an existing facility;
- Where the reliability of the Manitoba Hydro distribution system is jeopardized due to events associated with the customer facility, Manitoba Hydro reserves the right to enforce the requirements;
- Where regulators, governments, or other external entities impose new obligations on Manitoba Hydro, which require the customer to provide data, introduce new actions or processes, or add facilities in order to comply.

This document does not cover requirements for customers wishing to interconnect distributed resources to the Manitoba Hydro distribution system which are covered in the Interconnection Guideline for Connecting Distributed Resources to the Manitoba Hydro Distribution System [2].

1.4 Objectives

This document lays out a common set of practices and design criteria that must be met by all customers seeking to interconnect or are already interconnected to the Manitoba Hydro distribution system, subject to Section 1.3. It is not the purpose of this document to define and summarize the customer facility's equipment design requirements. Rather, this document defines the interface between the Manitoba Hydro distribution system and the customer facility.

Manitoba Hydro's objective is to ensure the distribution system will operate reliably and safely when the customer facility is interconnected.

Some of the technical requirements cannot be precisely defined until the location and some basic information on the proposed new facility is provided to Manitoba Hydro. The final technical requirements will be determined by interconnection studies carried out by Manitoba Hydro. The customer will provide information, as described in Section 4.0, to Manitoba Hydro for carrying out such studies.

1.5 Distribution System Load Interconnection Inspection and Review

A new or modified customer facility may be subject to inspection by Manitoba Hydro prior to initial energization. Manitoba Hydro reserves the right to require additional information and investigate as deemed necessary to ensure that the requirements outlined in this document are fulfilled.

All customer facilities may be subject to periodic review and inspection by Manitoba Hydro to ensure that compliance with this document is being maintained. Manitoba Hydro will provide reasonable notification as to the time and date of the inspection visit.

1.6 Electrical Code Requirements

All electrical installations shall comply with the requirements of the Authority having jurisdiction which are:

- Manitoba Hydro: Electrical installations within the jurisdiction of the Manitoba Hydro Inspection Department must comply with the current edition of the Manitoba Electrical Code;
- City of Winnipeg: Electrical installations within the jurisdiction of the City of Winnipeg Inspection Department must comply with the City of Winnipeg Electrical By-Law.

1.7 Failure to Comply

Manitoba Hydro reserves the right to take whatever measures are necessary in its sole discretion to ensure that customers and customer facilities comply with the requirements of this document. Where the customer and customer facilities fail to comply with the requirements of this document, the following consequences may occur:

1. The customer is directed to perform remedial work to make the facility compliant.
2. Manitoba Hydro may disconnect the facility in accordance with *The Manitoba Hydro Act*.
3. The customer may be liable for any damages occurring to the Manitoba Hydro distribution system and/or any third party facilities.

1.8 Disclaimer

The customer is, at all times, solely responsible for the design, construction and operation of their own facility.

2.0 Manitoba Hydro Distribution System – System Information and Design Practice

This section provides system information, operating limits and performance criteria applicable to the Manitoba Hydro distribution system. It also provides information on some aspects of Manitoba Hydro's normal design practice related to equipment interconnected to or used on the Manitoba Hydro distribution system.

The customer facility shall be designed to operate within the operating limits defined in this document.

The information in this section 2 is provided to assist the customer in the planning and design of the facility only and is subject to revision as noted in section 1.2. The customer must contact Manitoba Hydro to obtain data for the specific point of interconnection.

2.1 Voltage Levels

Nominal voltage levels on the Manitoba Hydro distribution system at which interconnection is possible are 4.16, 8.32, 12.47, 24.00, 24.94, 33.00, and 66.00 kV. All values given are line to line voltages.

2.2 Voltage Variations

Manitoba Hydro will provide steady state voltage at the point of interconnection of +/−6% of the nominal voltage levels.

2.3 Frequency and Frequency Variations

The nominal system frequency is 60 Hz.

The normal variation is within +/−0.02 Hz of 60 Hz, and the maximum variation is within +/−0.5 Hz of 60 Hz.

The frequency may drop below 57.5 Hz or rise to 63.5 Hz for up to 10 seconds immediately following a major disturbance on the Manitoba Hydro transmission system. Following the initial 10 seconds, the frequency variations could be up to +/−0.1 Hz for 10 to 15 minutes.

During extreme events, the frequency may drop below 57.5 Hz with an initial frequency decay rate of 1 Hz/s to 10 Hz/s.

Customer equipment must be capable of withstanding the following dynamic frequency performance criteria listed below:

Criteria	Bus Frequency (Hz)	Duration (seconds)
Low Frequency	57.5	10
Low Frequency	57.5 to 59.5	30
Nominal Frequency	59.5 to 60.5	Continuous
High Frequency	60.5 to 63.5	30
High Frequency	63.5	10

Table 2: Dynamic Frequency Requirement

2.4 Protection Systems

Protection systems on the Manitoba Hydro distribution system are to be implemented so as to ensure reliable clearing of system faults.

Manitoba Hydro may automatically reclose on the distribution system.

2.5 System Grounding

At voltages 25 kV and below the Manitoba Hydro distribution system is a three phase four wire multi grounded system.

At voltages 33 kV and above the distribution system is a three phase, three wire system that typically uses grounding transformers at the source station to provide grounding for protective relaying purposes. These systems have increased ground impedance which results in line to ground voltage rise on the unfaulted phases during single line to ground faults. Manitoba Hydro specifies insulation levels for line to line voltages.

The above are standard practices. There may be exceptions to these practices which Manitoba Hydro will notify the customer as applicable.

3.0 Customer Load Interconnection Requirements

This section defines the requirements that are applicable for customers applying to interconnect to the distribution system or existing customers applying to substantially modify their load facility.

3.1 Interconnection Location and Voltage Level

The voltage level and point of interconnection to the Manitoba Hydro distribution system shall be determined by Manitoba Hydro in consultation with the customer. Manitoba Hydro will be the final authority in determining the point of interconnection and voltage level.

3.2 Sealing of Technical Reports, Drawings, Memos, etc.

All reports, memos, drawings, equipment specifications, and modeling data of technical nature provided by the customer (excluding manufacturing drawings) shall be sealed by a Professional Engineer certified to practice in the Province of Manitoba in accordance with *The Engineering and Geoscientific Professions Act of Manitoba*.

3.3 Operating Procedures

The customer shall abide by any operating procedures imposed by Manitoba Hydro.

3.4 Voltage and Frequency at Point of Interconnection

The customer facility shall be capable of operation over the range of voltage and frequency variation that may occur at the point of interconnection, as defined under sections 2.2 and 2.3.3.5 Voltage Regulation.

Manitoba Hydro reserves the right to operate the Manitoba Hydro distribution system voltage anywhere within the voltage operating limits specified in section 2.2. The customer shall provide any additional voltage regulation required by the customer facility.

3.6 Power Factor

Operation of the customer facility at or near unity power factor is recommended to reduce load-factor demand revenue billing.

3.7 Power Quality

The customer facility shall be designed and operated such that its power quality levels are within the limits specified in Manitoba Hydro's Power Quality Specification, (PQS2000) [3].

3.8 Protection Requirements

The customer must design and install a protection system for their facility. There are two conditions that the customer must consider:

1. Faults that occur on the customer facility.

   The customer is solely responsible for providing a protection system that senses and reacts to faults at their facility including any customer owned transformers connected at the supply voltage. To achieve this the customer shall provide overcurrent protection at the point of interconnection. The customer must not rely on Manitoba Hydro's upstream protection systems to provide protection for the customer facility.

   The customer's protection must properly coordinate with Manitoba Hydro's upstream protection to ensure faults at the customer's facility do not result in outages to neighbouring customers.

The customer must provide information about their protection system to allow Manitoba Hydro to review the customer's protection to ensure proper coordination with Manitoba Hydro's protection systems. To complete this Manitoba Hydro requires the following information:

- For customers that use power fusing to protect transformers connected at the supply voltage, fuse size and type, along with transformer size, voltage, impedance, and ratings and a summary of loads connected must be provided.
- For customers that use breakers and relays to protect transformers connected at the supply voltage, a protection report must be provided which should include a summary of all protection equipment to be installed including relay make and models, protection settings and logic for all relays including electronic setting files, a description on how the settings were determined, a system single line diagram, and a protection schematic diagram showing how the protection equipment functions at the facility. Manitoba Hydro requests that the protection report be provided 60 days prior to energization to allow adequate time to review, follow up, and in some cases apply new Manitoba Hydro protection settings.

Manitoba Hydro reserves the final authority on establishing or requesting changes on customer protection that could impact the reliability of the Manitoba Hydro system.

2. De-energization of the Manitoba Hydro distribution system.

   The customer must consider loss of supply from Manitoba Hydro caused by any one of the following conditions:

   - System faults including three phase system faults, line to line faults, line to line to ground faults, or single line to ground faults;
   - Manual operation of the distribution protection devices for testing or maintenance purposes;
   - Open phase(s) or loss of phase scenarios due to blown fuses or conductors breaking.

All customer protection equipment shall have adequate fault interrupting and momentary withstand ratings to satisfy existing system fault levels and future fault levels based on expected upgrades to Manitoba Hydro's system.

Manitoba Hydro reserves the right to require customers to add additional protection systems to ensure stability or improve reliability of the Manitoba Hydro system.

3.9 Line Auto-Reclosing

Line auto-reclosing may be employed on the Manitoba Hydro distribution system. Customer protection systems must be able to withstand reclose operations. Manitoba Hydro will provide information on whether auto reclosing is employed at the customer's request.

3.10 Revenue Metering

All metering shall be installed in accordance with the current addition of the Manitoba Hydro Customer Metering Standard [4].

3.11 Short Circuit Levels

The customer facility shall be designed for operation at short circuit levels that take into account future development of the Manitoba Hydro system. The short circuit levels to be used in the design depend on the point of interconnection and future planned development and are available on request from Manitoba Hydro.

3.12 Design Standards

The customer facility shall be designed to comply with requirements of all Applicable Laws.

3.13 Isolation

The customer shall provide an isolating device to provide visual electrical isolation at a location defined by Manitoba Hydro at or near the point of interconnection.

The isolation device shall simultaneously operate all phases (i.e. gang-operated open/close). Provision shall also be made for Manitoba Hydro to padlock this device securely in the open position.

3.14 Transformer Connection

Manitoba Hydro requires that customers connected to the Manitoba Hydro distribution system at 33 and 66 kV voltage use a delta transformer connection on the high voltage winding. Manitoba Hydro recommends but does not require a delta transformer connection at other voltage levels.

3.15 Standby Generators

Manitoba requires all standby generators that can be operated in parallel with the Manitoba Hydro system (connection to the generator is made before connection to Manitoba Hydro is broken) to follow Manitoba Hydro's processes and technical requirements for distributed resources interconnection.

Refer to reference [2] for more details.

3.16 Testing and Maintenance

Manitoba Hydro shall be given advance notification of planned outages for scheduled test and maintenance work.

4.0 Technical Data to be Provided by the Customer

General technical data, including steady-state and dynamics data, is required by Manitoba Hydro to enable evaluation of the customer facility. The following information is typically required:

1. Name and location of customer facility.
2. Map showing facility location.
3. Electrical single line diagram.
4. Site layout plan.
5. Facility scheduled in-service date.
6. Load information:
   - 6.1 Total connected load (MW and MVAR);
   - 6.2 Load composition and load data.
7. Motor information:
   - 7.1 Motor size as required from table 1 in section 1.1;
   - 7.2 Number of planned starts per day;
   - 7.3 Motor electrical characteristics such as power factor, rated start and running current (nameplate data) characteristics;
   - 7.4 Motor resistances and reactances;
   - 7.5 Method of starting such as Variable Frequency Drives, reduced motor start inrush technology.
   - 7.6 Standby Generators. Refer to reference [2] for details.
8. Step down transformer information:
   - 8.1 Voltages of each winding;
   - 8.2 MVA ratings including base and ultimate;
   - 8.3 Winding configuration;
   - 8.4 Impedances including R and X;
   - 8.5 Available on and off load taps.
9. Protection:
   - 9.1 Protection report describing the customer protection functionalities
   - 9.2 Detailed protection device information such as model number and firmware version
   - 9.3 List of protection and control settings
   - 9.4 Breaker or fuse models, interrupting ratings, continuous ratings and interrupting or clearing times
10. Capacitor Installation (if applicable):
    - 10.1 Size;
    - 10.2 Number and size of steps;
    - 10.3 Configuration;
    - 10.4 Size of reactors (if applicable).
11. Harmonic load characteristics:
    - 11.1 Voltage and current full load nameplate rating;
    - 11.2 Total and individual harmonic current profile.

A specific data request will be made by Manitoba Hydro prior to performing an interconnection study.

5.0 References

[1] Manitoba Hydro Transmission System Interconnection Requirements, TSIR
http://www.oasis.oati.com/woa/docs/MHEB/MHEBdocs/MH_transmission_interconnection_requirements_July2016-final.pdf

[2] "Interconnection Guideline for Connecting Distributed Resources to the Manitoba Hydro Distribution System,"
https://www.hydro.mb.ca/environment/customer_owned_generation/pdf/connecting_distributed_resources.pdf

[3] "Power Quality Specification for Interconnection to Manitoba Hydro's Electrical System,."
https://www.hydro.mb.ca/your_business/large_business_solutions/power_quality/PQS2000_01.pdf

[4] "Manitoba Hydro Customer Metering Standards."
https://www.hydro.mb.ca/accounts_and_services/permits_and_inspections/pdfs/customer_metering_standards.pdf

6.0 Document Change History

Version	Date	Changes
1.0	September 2017	Document published