

# Manitoba Hydro Generator Interconnection Operating Requirements

March 29, 2007



## Document History

Version	Reason for Issue	Date
0	Initial publication of document	29/03/2007

## Table of Contents

1.0	Introduction and Interpretation.....	5
1.1	Definitions.....	5
1.2	Transmission Owner Personnel .....	6
2.0	Financial Obligations .....	7
3.0	Generation and Operational Control .....	7
3.1	Generation Normal Operations .....	7
3.2	Transmission Owner Obligations .....	8
3.3	Generator Obligations.....	8
3.4	Generation Unit Operations .....	9
3.5	Unit Stability Requirements.....	9
3.6	Generation Forecasting .....	9
3.7	Wind Generation Forecasting .....	10
3.8	Forebay / Spillway Operations.....	11
3.9	Facility Infrastructure Security .....	11
3.10	Black Start Operations .....	11
3.10.1	Performance Requirements .....	12
3.10.2	Certification and Testing.....	13
4.0	Limitation of Operations .....	14
4.2	Re-dispatch for Congestion Management.....	14
4.3	Transmission Line Outages and Operating Restrictions.....	15
4.4	Equipment Outages & Work Requests .....	15
4.5	Operating Orders for Clearance/Restoration of Equipment.....	17
4.5.1	Operating Order Preparation.....	17
4.5.2	Outages involving Transmission Owner Equipment .....	17
4.5.3	Outages involving Generator Equipment.....	18
5.0	Safety .....	18
5.1	Switching and Tagging Rules .....	18
5.2	Transmission Owner Key Switching and Tagging Definitions .....	19
5.3	Tagging Procedures .....	20
5.3.1	Protection Cards.....	20
5.4	Training.....	21
6.0	Emergency Operations .....	22
6.1	Restoration of Service.....	22
6.2	Emergency Response .....	22
7.0	Interconnection Facilities Equipment.....	22
7.1	Energization, Inspection and Testing Requirements .....	22
7.2	Grounding Requirements .....	23
7.3	Facility Nomenclature.....	23
8.0	System Protection Facilities .....	24
9.0	Metering Requirements .....	24
9.1	SCADA Metering .....	24
9.2	Meter Seals.....	24
9.3	Testing of Metering Equipment .....	24
9.3.1	Notification .....	24
9.3.2	Metering Equipment Tests.....	24
9.4	Metering Installation Security Audit .....	25

10.0	Testing and Maintenance.....	26
10.1	Transmission Owner Equipment.....	27
10.1.1	Protective Relaying.....	27
10.1.2	Metering.....	27
10.1.3	Disconnects.....	27
10.1.4	Motor Operated Disconnects.....	27
10.1.5	Capacitive Voltage Transformer.....	28
10.1.6	Transmission Lines.....	28
10.1.7	High Voltage Circuit Breaker.....	28
10.1.8	Communication Equipment.....	29
10.2	Generator Equipment.....	29
10.2.2	High Voltage Breakers.....	30
10.2.3	Main Power Transformer.....	30
10.2.4	Coupling Capacitor Voltage Transformers.....	30
10.2.5	Lightning Arresters.....	31
10.2.6	PT's and Station Service Transformers.....	31
10.2.7	Station Batteries.....	31
10.2.8	Protective Relays and Controls.....	31
10.2.9	Power Fuses.....	31
10.2.10	HV Bus and Connectors.....	32
11.0	Notifications.....	32
11.1	Operational Notice.....	32
11.2	Transmission Owner Curtailment Notification.....	32
11.3	Voice Recording.....	32

## 1.0 Introduction and Interpretation

*The Manitoba Hydro Act* authorizes Manitoba Hydro to set, coordinate and enforce standards and rules for the security, reliability and quality control of the transmission and distribution facilities of any person, other than Manitoba Hydro, whose facilities are interconnected with the transmission and distribution lines of Manitoba Hydro. Pursuant to this legislative authority, Manitoba Hydro has established the following Generator interconnection operating requirements for facilities interconnected to the Manitoba Hydro Transmission System, which may be revised from time to time.

Manitoba Hydro has established these Generator interconnection operating requirements (the “Operating Requirements”) to identify the operating requirements for interconnection of Generator Facilities to the Manitoba Hydro Transmission System. This document is intended to provide Facility Owners who have signed Interconnection and Operating Agreements with Manitoba Hydro (Transmission and Distribution Business Unit) with the operational requirements for interconnected Generation Facilities and will be incorporated by reference into each individual Generator Interconnection and Operating Agreement. Operational requirements specific to individual Generators will be addressed in the Appendix D to the individual Generator Interconnection and Operating Agreement. In the event of a conflict between the provisions of these Operating Requirements and the individual Generator Interconnection and Operating Agreement, the provisions of the individual Generator Interconnection and Operating Agreement shall prevail.

### 1.1 Definitions

The following capitalized terms shall have the meanings specified in this section. Capitalized terms not otherwise defined herein shall have the meanings given to them in the IOA and if no definition is given in the IOA but the terms have well known and generally accepted technical meanings, those terms are used herein in accordance with such recognized meanings.

“Black Start Unit” shall have the meaning set out in section 3.10 (a).

“Current System Operating Instructions or CSOI” shall mean the current operating instructions that the Transmission Owner has developed for the operation of the Facility as the Facility relates to the System.

“Customer Metering Standards” shall refer to the Transmission Owners document that lists the requirements and standards for quality, installation and location for the electrical power metering for all customer connections.

“Emergency Outage” shall mean an outage requiring immediate attention in real time and equipment shall be removed from service as soon as possible.

“IOA” shall mean the Interconnection and Operating Agreement entered into between the Generator and Manitoba Hydro.

“MOD” shall mean Motor Operated Disconnect.

“NERC” shall mean the North American Electrical Regulatory Council.

“NERC-certified System Operator” shall mean the person who has been certified by NERC through its System Operator Certification Program, for the operational control and monitoring of the Transmission System.

“Station Operator” often the Operational Contact for the Generator, shall mean the person responsible for the operational control of the Facility in relation to generation, auxiliary equipment and on site electrical switching.

“Operational Notices” shall have the meaning given in Section 11.1.

“Operating Orders” shall mean a set of instructions prepared by the Transmission Owner to isolate or restore electrical equipment from or to a source of electricity in accordance with the Transmission Owner Safety Rule Book.

“SCADA” shall mean Supervisory Control and Data Acquisition.

“SCC” shall mean the Transmission Owners System Control Centre.

“TSD” shall mean the Transmission Owners Transmission Services Department.

“Urgent Outage” shall mean an equipment outage requiring attention within the next 24 hour period and allows a short planning horizon.

“Work Request” shall refer to the outage request or work request form that the Transmission Owner uses to plan and coordinate system outages. A Work Request Form shall be supplied by the Transmission Owner.

## 1.2 Transmission Owner Personnel

The following capitalized terms used herein refer to the titles of specific personnel of the Transmission Owner:

District Operator;  
Generation Outage Coordinator;

Generation Reliability Officer (“GRO”);  
Generation System Operator; and  
Transmission System Operator.

## **2.0 Financial Obligations**

The Generator shall reimburse the Transmission Owner fully for all expenses the Transmission Owner incurs to connect the Generator to the Transmission System including all associated maintenance. Interconnection expenses which the Generator shall be responsible for include, without limitation, the following:

- a. Operating Study analyses and related expenses;
- b. Preparation and presentation of study results to regional oversight committees or planning groups;
- c. Operation and maintenance of dedicated transmission facilities including taxes and insurance;
- d. The Generator’s Interconnection Facilities;
- e. The Transmission Owners Interconnection Facilities cost, identified in the Interconnection Facilities Study;
- f. The Transmission Owners system upgrades costs, identified in the Interconnection Facilities Study;
- g. Meter installation, testing, and maintenance, including all parts and related labor;
- h. Meter reading and scheduling;
- i. Telemetry installation, testing, and maintenance, including all parts and related labor;
- j. Generation forecasting or required meteorological tower data;
- k. Operating expenses, including communication circuits;
- l. Transmission Owner protective device installation, testing, equipment cost, and related labor;
- m. Generator’s protective device and interlock review of design, inspection, and test witnessing; and
- n. Costs to incorporate generation data into the Transmission Owner’s Energy Management System.

## **3.0 Generation and Operational Control**

### **3.1 Generation Normal Operations**

Operation of all interconnected transmission equipment shall be under the direction of a NERC-certified System Operator.

## 3.2 Transmission Owner Obligations

Transmission Owner shall exercise functional control over the operation of the Facility, insofar as is necessary to carry out the rights, duties, and obligations of the Transmission Owner, shall be free from the control and management of the Generator. Functional control shall include, but not be limited to, the following:

- a) Generation dispatch for the Generator Facility under normal and emergency conditions to meet Network Load, sales of capacity and energy, and reserve requirements based upon the Generators Network Resource cost data for determining least cost redispatch;
- b) Transmission Owner shall dispatch the Facility in accordance with Facility regulatory licenses. Upon request, collect and provide the Generator with SCADA and metering data permitted under the Manitoba Hydro Standards of Conduct; and
- c) All Facilities shall be dispatched in a non-discriminatory manner with respect to all other Facilities interconnected with the Transmission System.

## 3.3 Generator Obligations

The Generator shall provide Facility control and technical support 24 hours a day, 365 days a year.

The Generator shall, at all times, employ Station Operator(s) with a minimum of five years relevant electrical utility operating experience. For communication and safety purposes, the Station Operator shall be the only Generator personnel communicating operational and switching instructions with SCC. The Generator Station Operator shall maintain an operating log at the Facility indicating changes in operating status (generation unit operational status, automatic voltage regulator status or any limitations of generation output capability), maintenance outages, trip indications, or other unusual conditions.

The Generator shall provide the Transmission Owner with all information as is reasonably necessary for the Transmission Owner to exercise functional control over the facility, including but not limited to, the following:

- a) License limits for the Facility;
- b) Fuel availability limitations;
- c) Generating unit pricing data or generation schedules if applicable;
- d) Real time and projected operating data including generation unit operational status, automatic voltage regulator status and any limitations of generation output capability;

- e) SCADA operational status data;
- f) Daily and weekly operation planning data;
- g) Temporary equipment ratings or restrictions at the Facility; and

### 3.4 Generation Unit Operations

Each generating unit shall have its own control systems that automatically monitor and adjust the generating unit operations, utilizing inputs such as voltage, frequency, generating unit output, generator speed, and mechanical status.

In addition, the control systems shall automatically adjust the output of the generating unit in response to electrical and mechanical events. Adjustments in response to electrical events shall include adjustment of generating unit output due to fluctuations in voltage or frequency and initiating a shutdown of the generating unit due to electrical protection signals.

The control systems shall monitor the generating unit's vital functions which could cause damage or jeopardize its safe operation and initiate a shut down sequence for events which could damage the generator turbine.

### 3.5 Unit Stability Requirements

The Generator shall operate the Facility in accordance with the stability requirements identified in the Interconnection Facilities Study associated with the Generator, NERC standards and the standards provided by the Transmission Owner.

### 3.6 Generation Forecasting

The Transmission Owner requires the output forecast of the Facility to enable the operation of the Transmission System in accordance with Good Utility Practice. The Generator shall provide the following data to the Transmission Owner prior to the energization of the Facility and continually thereafter:

- Availability of generation in MW for any prime mover fuel limitations, for example, seasonal natural gas limitations or hydraulic limitations due to low water conditions.
- Generation Unit data; unit identification, date/time, power and status.
- At a minimum once per week by 12:00 noon on Wednesday of each and every week, the generation plan that relates to the hourly capacity of the

Facility for the upcoming week. The generation plan shall identify the number of units and the expected generation capacity of the Facility. The generation plan shall be submitted to the Generation Outage Coordinator seven days prior to date of dispatch.

- Generator shall update the Transmission Owner on a timely basis as to site conditions which may reduce the accuracy of the forecast. Site conditions which reduce the accuracy of the forecast include, but are not limited to: a change in the number of generation units in service, weather conditions (icing), equipment de-rates, testing, equipment failure or emergencies. The real time notification shall be made to the Generation System Operator.

### 3.7 Wind Generation Forecasting

Prior to the energization of the Facility and on a continual basis, the Generator shall provide the following data to the Transmission Owner to enable the Transmission Owner to forecast the output of the Facility to enable the operation of the Transmission System in accordance with Good Utility Practice:

- Meteorological Data - date/time, tower identification, wind speed average, wind speed variance, wind direction average, wind direction variance, temperature, pressure, relative humidity and short wave radiation.
- Turbine data; date/time, tower identification, wind speed average, wind speed standard deviation, wind direction average, wind direction standard deviation, power and status

Generator shall supply data in 10 minute intervals via a file in CSV format to a mutually agreed secure Transmission Owner data server.

The Generator shall provide the Transmission Owner at a minimum once per week by 12:00 noon on Wednesday of each and every week with the generation plan that relates to the hourly capacity of the Facility for the upcoming week. The generation plan shall identify any changes from the expected generation capacity. The generation plan shall be submitted to the Generation Outage Coordinator through the dedicated ftp site. If the ftp site is not available the Generator shall submit an Excel spreadsheet identifying the seven day, 24 hour capacity of the facility to the GRO.

Generator shall update the Transmission Owner on a timely basis as to site conditions which may reduce the accuracy of the forecast during system Peak conditions. Site conditions which reduce the accuracy of the forecast include but are not limited to: a change in the number of wind turbines in service, weather conditions (icing), equipment de-rates, testing, equipment failure or emergencies. The real time notification shall be made to the Generation System Operator.

### 3.8 Forebay / Spillway Operations

If applicable, the Generator shall follow any and all operational instructions from SCC and operate the Facility to maintain forebay schedules and plant discharge schedules. The forebay schedules and plant discharge schedules shall be operated within the license limits of the Facility. The Generator may impose additional limitations or requirements on forebay operations and plant discharge schedules upon providing notice to the Transmission Owner. Spillway operations shall be performed locally by Generator personnel.

### 3.9 Facility Infrastructure Security

Infrastructure security of equipment and operations, as applicable, and control hardware and software is essential to ensure day-to-day System reliability and operational security. The Generator shall comply with current NERC “critical infrastructure protection” standards.

### 3.10 Black Start Operations

If applicable, Generator shall:

- a) Install and maintain a supplemental generator, with sufficient capacity to start one generating unit (“Black Start Unit”) which shall then be used to energize transmission lines and restart other generating units for Black Start Service;
- b) Ensure that the supplemental generator, controls, and communications have backup power supplies so full communications and functionality is maintained in the event that grid power is lost;
- c) Submit a planned outage schedule for all outages on Black Start Units and the standby units used to provide Black Start Service for generating units;
- d) Either: (i) have trained operating staff on site; or (ii) have remote Black Start Service capability installed to provide the following operations:
  - Start and control the standby unit (standby diesel, house unit, battery etc.);
  - Start the Black Start Unit (from standby unit or battery);
  - Start the other generating units at the Facility from the Black Start Unit;

- Disable the generation automatic load feature;
- Adjust the governor droop settings;
- Control of generator unit governor to raise/lower frequency set point; and
- Control of generator unit automatic voltage regulation set point.

### 3.10.1 Performance Requirements

Generator's Facility or Black Start Unit(s) shall demonstrate the capability to:

- a) Start the generating units while isolated from all power sources and auxiliaries not expected to be available under actual black start conditions. All key operating aids and auxiliary systems used in the Black Start Service tests such as voice communications and control systems shall be verified to operate adequately without dependency on the interconnected power system or other unrelated generation support. The test shall include starting the generating unit(s) from a shutdown state with the head gates closed and the governor system depressurized to the alarm state;
- b) Energize an initially dead station and auxiliary bus condition and shall be able to safely withstand the sudden and unplanned loss of synchronization with the Transmission System and maintain generating capacity for a specified period of time. All auxiliary loads shall be isolated from the power system. Black Start Units shall be capable of re-energizing the plant auxiliaries to start one or more additional units;
- c) Energize a dead bus within 30 minutes from receipt of a start signal. This includes being isolated from any other unrelated unit support except that of a supplemental generator designated specifically for Black Start Service;
- d) Increase MW output to external loads by 5% to 7% of the unit(s) capacity during each 5 minute period to the maximum continuous operating level;
- e) Provide reactive reserve component for the energization of the required transmission line(s). The reactive reserve capacity shall be a minimum of 160% of the required transmission line(s);
- f) Provide adequate fault current to support proper relay protection for faults during the restoration process (e.g.: Generating units or facilities connected to the transmission network through any Delta electrical configuration may not qualify as useable facilities) unless special provisions have been made and agreed upon by the Transmission Owner.

- g) Operate at accredited capacity for a minimum of 20 hours and/or at 50% of accredited capacity for 40 hours. Fuel supplies shall be maintained in sufficient quantity to operate for the above duration.

### 3.10.2 Certification and Testing

In order for Generator to receive compensation for Black Start Service, the Transmission Owner must certify the Generator's Facility and Black Start Unit. Four certification tests are required to be conducted jointly by Transmission Owner and Generator as follows:

- (i) Black Start Service facilities shall be tested annually. Service facility test shall be comprised of the following sequence:
  - Verification of communications between Transmission Owner and Generator;
  - Startup of the supplemental generator;
  - Startup of the Black Start Unit.
- (ii) Line energizing test shall be performed once every 3 years for a minimum 30 minute period or otherwise tested by steady state and dynamic computer simulation;
- (iii) Load carrying test determines the ability of the Black Start Service facilities to remain stable and to control voltage and frequency while supplying restoration power to the generator or load that the restoration plan calls for. This is to be conducted at least every 5 years for a minimum 30 minute period, but if this is impractical, test may be conducted by steady state and dynamic computer simulation; and
- (iv) Any supplemental generators (diesel generators, batteries, etc.) and auxiliary equipment that may be required for support of the Black Start Service process shall be tested at least monthly.

The scope of certification testing for the Black Start Service performed shall include the following components:

- a) Black Start Service facilities;
- b) Back up power supplies;
- c) Any facilities used to control and / or protect main or supplemental generating units such as computers, programmable logic controllers or protective relaying;
- d) Local service facilities to ensure critical plant loads (lighting, heating, air conditioning) are available during black start conditions; and
- e) Communication systems.

For the purposes of this Section, “critical plant loads” shall mean the plant infrastructure necessary for a plant operator to perform Black Start Service obligations.

Black Start Service tests shall be verified by the Transmission Owner through steady state and dynamic computer simulations. Simulations to verify load carrying ability shall be conducted at least every five years.

Any supplemental generating unit shall be started, synchronized and carry load for at least 15 minutes per month. The Black Start Service facilities shall demonstrate the ability to deliver acceptable voltages and frequency values for a minimum of thirty minutes at both no load and during load pickup. The reactive supply and voltage control shall maintain system voltage within emergency voltage limits over a range from no external load to full external load.

## **4.0 Limitation of Operations**

### **4.1 Abnormal Operations**

The Transmission Owner reserves the right to disconnect from the interconnection for, without limitation, the following reasons:

1. Transmission Owner line maintenance work on the Transmission Owners System.
2. Transmission Owner System emergency.
3. Inspection of a Generator's generating equipment and protective equipment reveals a hazardous condition.
4. Failure of the Generator to provide maintenance and testing reports when required.
5. Generator's generating equipment interferes with the Transmission Owner System.
6. The Generator has modified the generating equipment that affects Transmission Owner equipment without the knowledge and approval of the Transmission Owner or has not installed protective devices required by the Transmission Owner.
7. Parallel operation of any unapproved generating equipment.
8. Personnel or public safety are threatened.
9. The Generator fails to comply with the applicable Transmission Owner Safety Tagging and Lockout requirements.

### **4.2 Re-dispatch for Congestion Management**

The Generator shall comply with the congestion management policies and procedures of the Transmission Owner.<sup>1</sup> Upon verbal notification given by the Transmission Owner, the Generator shall adjust the output of the Facility as directed by the Transmission Owner.

### 4.3 Transmission Line Outages and Operating Restrictions

- a) At least thirty (30) days prior to the Operation Date, Transmission Owner shall issue operating guides to Generator governing planned and unplanned transmission line outages of equipment and/or facilities on the Transmission System.
- b) The Transmission Owner may issue temporary operating instructions to Generator in accordance with the aforesaid guides which limit the output of the Facility. In the event of an unplanned line outage, if the line cannot be restored to service by Transmission Owner within thirty (30) minutes through implementation of operating guides, Transmission Owner has the right to direct Generator to further curtail the output of the Facility.

### 4.4 Equipment Outages & Work Requests

All switching involving Transmission Owner equipment or requiring isolation from the bulk electrical system shall be directed by the SCC. All operation and switching shall be coordinated through the SCC in cooperation with the Generator. Normal switching involving the Transmission Owner equipment or requiring isolation from the bulk electrical system shall require the following:

- Outage planning and coordination through the TSD GRO;
- The Transmission Owner approved Operating Orders, detailed in section 4.5 of this Appendix D;
- Strict adherence to the Transmission Owner switching and tagging rules as defined by the Transmission Owner Safety Rule Book; and
- All tags and locks shall be placed by the Transmission Owner authorized personnel, in cooperation with Generator personnel inside of the Facility.

- 4.4.1 Exchange of Planned Outage Schedules. On or before September 15th of each year and subject to confidentiality provisions of Article 20 of the IOA, the Parties shall exchange non-binding schedules of planned outages for the following five calendar-year period for those facilities that could be expected to have a material effect upon the other Party with respect to operations or performance under this Agreement. Such schedules shall be developed in accordance with Good Utility Practice and shall be presented in a format agreed upon by the Parties. Such

---

<sup>1</sup> Section 5.9 of the IOA  
Manitoba Hydro Generator Interconnection Operational Requirements  
Issued by: E. Tymofichuk  
Issued March 29, 2007

schedules shall include all applicable information including the following:<sup>2</sup>

- (a) year, month, day and time of requested outage;
- (b) facilities impacted (such as unit number and description);
- (c) duration of outage;
- (d) purpose of outage;
- (e) amount of electrical capacity (in MWs) which is expected to be derated or off-line;
- (f) special conditions and remarks;
- (g) interaction/switching required;

4.4.2 Review of Planned Outage Schedule. Transmission Owner shall have the right, on a non-discriminatory basis, to review and to request modification of such schedules by September 15th of each year, consistent with the terms of this Agreement. The Parties shall use Reasonable Efforts to reach agreement on any such requested modifications by October 15th of each year.<sup>3</sup>

- (a) Each Party shall use Reasonable Efforts to accomplish all planned outages in accordance with the agreed upon schedule.
- (b) Subsequent changes to the agreed upon planned outage schedule may be requested and Transmission Owner shall use Reasonable Efforts to accommodate such changes but without any obligation to agree to revise the planned outage schedule.

4.4.3 A minimum of two (2) weeks notification is required if either Party desires to change the maintenance plan on the interconnection facilities. Change requests shall be accommodated if practicable and shall be processed in accordance with Sections 6.11 and 6.12 of the IOA.

4.4.4 To optimize operations, the Generator shall follow the weekly generation plan. If the Generator requires modification of the weekly generation plan, the Generator shall request an Emergency Outage or Urgent Outage.

4.4.5 Emergency Outages can be arranged with SCC on-shift staff as required and shall be accommodated if practicable processed with Sections 6.11 and 6.12 of the IOA.

4.4.6 Urgent Outages may be arranged with one day's notice depending upon the urgency of the outage and prevailing System conditions and shall be

---

<sup>2</sup> Section 6.9 of the IOA

<sup>3</sup> Section 6.10 of the IOA

accommodated if practicable and processed in accordance with Sections 6.11 and 6.12 of the IOA.

## 4.5 Operating Orders for Clearance/Restoration of Equipment

### 4.5.1 Operating Order Preparation

All Operating Orders shall detail the step-by-step procedure to clear and restore the equipment or device. A separate step shall be used whenever it is necessary to visually check a normally open device or change the status of a switching device. Individual switching steps shall be numbered consecutively and numbers shall not be repeated on the same operating order. Once clearance to work is issued, all de-energized high voltage lines and apparatus must be grounded with approved working grounds before work proceeds. Switching start times, contact information and any switching or outage related requirements shall be listed in the beginning of the Operating Order.<sup>4</sup>

### 4.5.2 Outages involving Transmission Owner Equipment

At the request of the Generator, the Transmission Owner shall accommodate Generator outages. For Facility outages involving isolation from the System, the Transmission Owner shall prepare and provide Operating Orders detailing step-by-step switching instructions to the Generator. The following procedure shall apply:

- a) Generator shall forward a written request form to GRO. The written request form shall be in the form supplied by Transmission Owner and may be revised from time to time;
- b) The GRO shall review the request. The Transmission Owner and Generator shall cooperate to identify the time and duration of the outage. The GRO shall enter the request into Transmission Owner's outage coordination program;
- c) Transmission Owner shall prepare a detailed Operating Order and submit the Operating Order to the Generator prior to the outage;
- d) On the date of the outage the Generator and Transmission Owner shall cooperate to isolate the equipment or device as per the Operating Order;
- e) Work proceeds as planned; and
- f) Equipment or device is returned to service as detailed in the Operating Order.

---

<sup>4</sup> For complete definition see section 6 of the Transmission Owner Safety Rule Book  
Manitoba Hydro Generator Interconnection Operational Requirements  
Issued by: E. Tymofichuk  
Issued March 29, 2007

### 4.5.3 Outages involving Generator Equipment

At the request of the Transmission Owner, the Generator shall accommodate Facility outages for the purpose of Transmission Owner equipment maintenance. Outage clearances may extend into the Facility for Transmission Owner equipment including but not limited to metering, protection and communication maintenance. The following procedure shall apply:

- a) The GRO shall request an outage with the Generator. The Transmission Owner and Generator shall cooperate to identify the time and duration of the outage;
- b) The GRO shall enter the request into Transmission Owner's outage coordination program;
- c) Transmission Owner shall prepare a detailed Operating Order and submit the Operating Order to the Generator prior to the outage;
- d) On the date of the outage the Generator and Transmission Owner shall cooperate to isolate the equipment or device as per the Operating Order;
- e) Work proceeds as planned; and
- f) Equipment or device is returned to service as detailed in the Operating Order.

## 5.0 Safety

When the Transmission Owner is involved with switching activity at the Facility, the Generator, in cooperation with the Transmission Owner, shall use the Transmission Owner's switching and tagging rules and procedures for interconnection Facilities.

### 5.1 Switching and Tagging Rules

- 5.1.1 All switching procedures on the Transmission Owner Interconnection equipment and at the Facility shall strictly adhere to the Transmission Owner's switching and tagging rules as defined in sections 6 and 7 of the Transmission Owner Safety Rule Book.
- 5.1.2 Permission shall be obtained from the SCC before any switching or clearing is done on live or de-energized Interconnection equipment at the Facility.

- 5.1.3 Switching shall not be performed nor working clearances issued on any Interconnection Facilities without an Operating Order prepared by the Transmission Owner, detailing a step by step switching procedure except for emergency line or equipment switching where the safety of personnel or equipment is involved.
- 5.1.4 The Generator shall conduct training to ensure that Generator personnel authorized to perform switching functions on the Facilities are trained on the safety rules of both the Transmission Owner and the Generator.

## 5.2 Transmission Owner Key Switching and Tagging Definitions

For the safety of personnel and equipment, the Generator personnel shall have a thorough understanding of the Transmission Owner Safety Rule Book<sup>5</sup>. Without limiting the generality of the foregoing, the following terms from the Transmission Owner's Safety Rule Book will be frequently used at the Facility during switching operations;

- a) "Clearing" - The procedure of de-energizing lines and equipment and immobilizing machinery, for example, preparing to issue a "Clearance to Work".
- b) "Clearance to Work" - A general term used to describe the accomplished procedure of de-energizing electrical lines and equipment or immobilizing mechanical equipment to permit "hands-on" work. For high voltage it involves isolating workers from all sources of energy which may be hazardous to the worker including the draining of "trapped" electrical or mechanical energy which may have been retained or built-up.  
Clearance to Work may be issued at the discretion of the System Operator, once the System Operator is satisfied the section of high voltage lines and equipment is cleared from the System with visual open isolation points, switching devices immobilized and protective cards have been placed as required by the Transmission Owner Safety Rule Book.
- c) "Permission to Further Isolate" - When a permission to further isolate is issued by System Operator this means all possible energizing points from the System are opened with visual isolation and have protective cards installed. The Generator must further isolate all other connection points that could energize the equipment on which work is to be performed.
- d) "Safety Hold Off" - Effecting a precaution to prohibit re-energizing (by either automatic or manual means) in case of a trip-out.

---

<sup>5</sup> For complete definitions see section 1 of the Transmission Owner Safety Rule Book  
Manitoba Hydro Generator Interconnection Operational Requirements  
Issued by: E. Tymofichuk  
Issued March 29, 2007

Transmission Owner has line safety hold off procedures in place which permit the Transmission Owner personnel to work on energized 230 kV transmission lines. This procedure involves the disabling of reclosing devices and the placing of Caution cards on all closing device switches.

+ **NOTE:** *In the event of a trip-out on a circuit bearing a “Caution” – safety hold off card, the circuit shall not be re-energized until assurance is received from the hold off protection holder that workmen are clear and the equipment or circuit is safe to be re-energized. Safety hold off protection must be surrendered immediately upon completion of work or when no longer required. This includes times such as lunch periods and overnight.*

## 5.3 Tagging Procedures

The Generator shall, in cooperation with the Transmission Owner, use the Transmission Owners tagging and lockout procedures for the Facility. The Generator personnel shall be familiar with the following provisions from the Transmission Owner Safety Rule Book.<sup>6</sup>

### 5.3.1 Protection Cards

The Transmission Owner’s protection cards shall be placed on electrical conductors and equipment, mechanical equipment, hydraulic systems, pneumatic systems, vehicles and other equipment or facilities as may be required to prevent unauthorized operation or to ensure that certain precautions are observed. All required information shall be filled out on the protection card. Protection cards should be removed as soon as practical but shall not be removed until the purpose for which they were placed has been achieved. The protection card shall not be removed until the person for whom the card was placed authorizes its removal.

The following protection cards from the Transmission Owner’s Safety Rule Book will be frequently used at the Facility during switching and maintenance operations;

- a) Hold Cards (Do Not Operate) - “Hold” cards are used to prevent unauthorized operation. Electrical conductors and equipment, mechanical equipment, hydraulic systems, pneumatic systems, vehicles and other equipment or facilities on which a “Hold” card has been placed shall not be operated by any person (including the person for whom the hold card was placed) until the person for whom the card was placed authorizes its removal. All lines apparatus and equipment must be considered energized or operative

---

<sup>6</sup> For complete definitions see section 7 of the Transmission Owner Safety Rule Book  
Manitoba Hydro Generator Interconnection Operational Requirements  
Issued by: E. Tymofichuk  
Issued March 29, 2007

until “Hold” cards are placed on all visual open points or lockout points are required to provide working clearance.

- b) Test and Operate Cards - “Test and Operate” cards shall be completed in full and limited to use on equipment or a portion of equipment that requires a change in status in order to perform tests and shall be limited to that purpose only. A Test and Operate card cannot be placed on any device that has a Hold card associated with the device. Only the owner of the Test and Operate card may operate the device.
- c) Caution (Safety Hold-Off Cards) - When workers are working on or in the immediate vicinity of energized high voltage conductors “CAUTION”- cards must be used to provide a “safety hold-off” in case of a trip out. Auto reclosing devices or automatic transfers that would energize the line or equipment must be blocked.

## 5.4 Training

### 5.4.1 Generation Facility Safety Orientation

Prior to the Operation Date and after which at the request of the Transmission Owner, the Generator shall provide a safety orientation for Transmission Owner personnel at the earliest opportunity agreeable to both Parties. The orientation shall include:

- o The Facility physical layout;
- o The physical switching and lockout procedures for all 230 kV equipment in the Facility;
- o The location and switching procedures for metering equipment at the Facility; and
- o The Facility electrical or mechanical apparatus that contain or may contain environmental contaminants or risks to personal health and safety.

### 5.4.2 Transmission Owner Safety Orientation

Prior to the Operation Date and after which at the request of the Generator, the Transmission Owner shall provide a safety orientation for Generator personnel, at the earliest opportunity agreeable to both Parties. The orientation shall include:

- o An overview of the Transmission Owner Safety Rule Book (copies of Safety Rule Book will be provided to Generator personnel);
- o A detailed description of Transmission Owner standard switching procedures in relation to the Safety Rule Book;
- o A detailed description of Transmission Owner tagging and lockout procedures in relation to the Safety Rule Book; and

- A detailed description of Transmission Owner standard switching procedures in relation to the Facility.

## **6.0 Emergency Operations**

### **6.1 Restoration of Service**

In the event the Facility is isolated from the System, the restoration of service shall be as follows:

- a. SCC and the Generator shall contact one another to determine if the problems occurred on the System or the Facility.
- b. If the problems occurred on the System, the Transmission Owner shall use reasonable efforts to advise the Generator when service shall be restored as per IOA Section 7.4.
- c. If the problems occurred at the Facility, the Generator shall use reasonable efforts to advise Transmission Owner when the Facility shall become available as per IOA Section 7.5.
- d. Once the problems have been rectified, SCC shall direct restoration efforts and connect the Facility to the Transmission System.

### **6.2 Emergency Response**

If called upon to respond to an emergency at the Facility by a local emergency response agency (Fire, Police), the Transmission Owner personnel shall:

- a) In cooperation with the Generator de-energize equipment as required; and
- b) If necessary and at the discretion of the Transmission Owner, arrange for the immediate de-energization of the Facility via SCC;
- c) If necessary control access to the Facility until, Generator personnel arrive at the scene.

## **7.0 Interconnection Facilities Equipment**

### **7.1 Energization, Inspection and Testing Requirements**

Before initial Facility energization, and the final approval to acquire Commercial Operation Date as per Appendix C, the Generator shall demonstrate, at each stage, to the satisfaction of the Transmission Owner, through witnessed tests and/or certified test documentation, that the Facility to be energized will not have

adverse impact on the operation of the System. Such tests and inspections shall include, without limitation, pre-energization testing of equipment connected to the transmission bus, protection and control systems and pre-commercial testing of the governor, excitation controls and the latest Transmission System Interconnection Requirements. Specific test requirements and documentation need to be arranged with Transmission Owner prior to tests being performed.

## 7.2 Grounding Requirements

The Generator shall design, install, and maintain grounding facilities to ground the Generator's Interconnection Facilities, in accordance applicable standards and Good Utility Practice. The Generator shall be responsible for detailed modeling and evaluation of the interconnected grounding system at the location of the Transmission Owner Interconnection Facilities and the Facility. At the sole discretion of the Transmission Owner, the Transmission Owner shall have the right to approve the grounding system design to insure that the grounding system properly protects the Transmission Owner Interconnection Facilities.

## 7.3 Facility Nomenclature

Facility identification nomenclature shall be installed on all devices and controls that may be used for switching, before initial facility energization and on each device installed thereafter.

The Generator shall install identification nameplates for all electrical equipment controls, protection devices, relays and meters in the Facility control room. The nameplates shall have a black background, white lettering and be mounted as close as practical to the device or actuator.

The Generator shall install identification nameplates for all electrical equipment and devices that may be identified in an Operating Order for switching at the Facility. The nameplates shall have a black background and white lettering and be no smaller than nine inches wide and five inches high. Nomenclature shall be installed as close as practical to the manual operator for the device, equipment structure or the equipment itself and shall be roughly at eye level. Nomenclature shall be installed on, but not limited to, the following equipment:

- Transmission and feeder lines;
- Transmission and feeder breakers;
- Transmission and feeder disconnects and MODs;
- Power transformers;
- Potential transformers and isolating secondary fuses;
- Current transformers;
- Capacitor banks; and
- Power fuses.

## 8.0 System Protection Facilities

The Generator shall ensure protection settings are coordinated with the Transmission Owner and tested in accordance with all applicable standards in the Province of Manitoba, before initial Facility energization and in all aspects and levels of operation afterward.

## 9.0 Metering Requirements

Metering installed shall conform to the Transmission Owners customer metering standards as revised from time to time. Customer metering standards can be found at the following internet address;

[http://www.hydro.mb.ca/your\\_service/customer\\_metering\\_standards.pdf](http://www.hydro.mb.ca/your_service/customer_metering_standards.pdf).

### 9.1 SCADA Metering

SCADA reading shall be taken in four (4) second intervals. SCADA readings are stored on-line for seven (7) days; readings in excess of 7 days are stored utilizing off-line media storage.

Transmission Owner SCADA readings shall include: MWatts, MVars, and voltage on Bus; status of the line MOD and Facility Breaker. And any other readings required by the Transmission Owner to maintain functional control.

### 9.2 Meter Seals

Meters shall be sealed and the seals may be broken only by an inspector or accredited meter verifier appointed under the *Electricity and Gas Inspection Act*, R.S.C. 1985, c.E-4 and then only for the purposes of inspection, verification, testing, re-verification or adjustment in accordance with provisions of the *Electricity and Gas Inspection Act*.

### 9.3 Testing of Metering Equipment

#### 9.3.1 Notification

The Transmission Owner shall provide a minimum of one week advance notification for the time of the test.

#### 9.3.2 Metering Equipment Tests

Metering equipment tests shall include, but not be limited to, the following:

- a) Instrument Transformers - Confirm nameplate details against registration details; connections and secondary wiring; ratios are consistent with meter rating and with the ratios applied to the meter; polarity check; magnetization curves; measured or calculated burdens are within rating of instrument transformers; burden tests on instrument transformers; test certificates;
- b) Meters/data Loggers - Confirm nameplate details against registration and MV90 standing data (where applicable); conformance to an agreed upon standard; voltage, current and load checks; meter multipliers, pulse multipliers and instrument transformer multipliers are correctly applied; accuracy test of meter and data logger as applicable; recorded time is within limits; data logging channels are correctly allocated; any error correction and/or loss compensation factors that have been applied to the meter are correct;
- c) Alarms and Monitoring Facilities - Where applicable, confirm that alarms and monitoring facilities are functioning correctly;
- d) Communications Test - Confirm that the remote communications facilities are functioning correctly;
- e) General Quality - Inspect general quality of installation (e.g. labeling, test facilities, fusing) and the security of the installation;
- f) Site Documentation - Check the records of the metering installation including commissioning results, test certificates, registration details, security & sealing details, Measurement Canada replacement dates and other maintenance details;
- g) Error Correction Factors - Compensation factors for instrument transformer errors and burdens have been correctly applied and registered. The supporting documentation is current and appropriately approved; and
- h) Loss Adjustments - Power transformer and line loss factors are correctly calculated applied and registered. The supporting documentation is current and appropriately approved.

## 9.4 Metering Installation Security Audit

The Transmission Owner shall have the right, upon 48 hours written notice, to audit the site security of the metering installation. The security audit shall include, but not be limited to, the following:

### 9.4.1 Instrument Transformers

- a) Confirm any potential fuses at the voltage transformer are sealed and the serial numbers correctly recorded.

- b) Confirm that any secondary wiring terminal boxes on-route to the metering panel is adequately secured & sealed and the serial numbers correctly recorded.

#### 9.4.2 Meters/Data Loggers

- a) Confirm that Measurement Canada seals are intact and have a valid date.
- b) Confirm the metering panel is sealed and the serial numbers correctly recorded and is locked with an individually keyed lock.
- c) All testing facilities, isolating links/fuses, meter/data logger terminal covers, etc. are adequately secure, or are sealed and the serial numbers correctly recorded, so as to prevent unauthorized access to any part of the metering installation.

## 10.0 Testing and Maintenance

Interconnection protective devices owned by the Generator shall be maintained and inspected according to manufacturer recommendations and/or industry standards. Procedures shall be established for visual and operational inspections. Provisions shall be established for equipment maintenance and testing.

The Transmission Owner maintains the right to review the maintenance, calibration, and operation data of all protective equipment. The Generator is responsible for providing the necessary test accessories (such as relay test plugs, instruction manuals, wiring diagrams, etc.) required to test these protective devices. If the Transmission Owner performs work on the premises of the Generator, Transmission Owner operating personnel may make an inspection of the work area. If hazardous working conditions are detected, the Generator must correct the unsafe conditions before Transmission Owner personnel will perform their work.

The Transmission Owner and Generator shall make reasonable efforts to test and maintain their respective equipment in accordance with the following provisions.

## 10.1 Transmission Owner Equipment

Maintenance outages shall be based on the following timeframes on, but not limited to, the following equipment;

### 10.1.1 Protective Relaying

Task	Electro-mechanical	Solid State	Digital Not Monitored	Digital Monitored
Function Check	72 months (6 yrs)	96 months (8 yrs)	96 months (8 yrs)	108 months (9 yrs)
Calibration Check	72 months (6 yrs)	96 months (8 yrs)	96 months (8 yrs)	108 months (9 yrs)
Load Readings	72 months (6 yrs)	96 months (8 yrs)	96 months (8 yrs)	108 months (9 yrs)
Functional Check	Visual inspection/remote interrogation, Trip test relay electrically or mechanically			
Calibration Check	Check relay calibration point, including operating characteristics of relay as per maintenance standards			
Load Readings	On site readings (verify with local board meters and SCADA)			

### 10.1.2 Metering

Task	Frequency	Description
Functional Check	12 months (1 yr)	Visual inspection/remote interrogation
Calibration Check	24 months (2 yrs)	Check relay calibration point, including operating characteristics of meter as per maintenance standards

### 10.1.3 Disconnects

Task	Frequency	Description
Integrity Check	12 months (1 yr)	Visual inspection of disconnect and associated equipment such as arc restrictors, arc interrupters, insulators, operating mechanism, structure, grounds, identification security or auxiliary switches. The visual inspection is performed without removing disconnect from service or interfering with its operation.

### 10.1.4 Motor Operated Disconnects

Task	Frequency	Description
Integrity	12 months	Visual inspection of motor operated disconnect

Check	(1 yr)	and associated equipment such as motor housing, thermostat, heaters, drive chain, arc restrictors, arc interrupters, insulators, operating mechanism, structure, grounds, identification security or auxiliary switches. The visual inspection is performed without removing motor operated disconnect from service or interfering with its operation.
Functional Check	60 months (5 yrs)	Ensure proper operation of the motor operated mechanisms' basic components. The inspection includes an electrical open and close. The inspection may be performed when the MOD is operated as a step in a switching order intended for clearing apparatus other than the MOD.

#### 10.1.5 Capacitive Voltage Transformer

Task	Frequency	Description
Voltage Check	6 months	Secondary voltage readings
Integrity Check	12 months (1 yr)	Visual inspection, porcelain condition, oil leaks, primary connection, riser tension, frame ground connection
Insulation Check	60 months (5 yrs)	Model GR1615 bridge test of CVT

#### 10.1.6 Transmission Lines

Task	Frequency	Description
Aerial Patrol	3 months (4 x 1 yr)	Visual Inspection for broken insulators, vegetation growth, downed conductors, public incursion into transmission right of way
Ground Patrol & Inspection	12 months (1 yr)	Tower inspections, verify elevations of tower footings, and verify dimensions of tower spacing, visual examination of conductor & hardware.

#### 10.1.7 High Voltage Circuit Breaker

Task	Frequency	Description
Integrity Check	6 months	A visual inspection of the foundation, frame, frame grounds, CT cables and supports, bushings, primary bus, gas pressure, control cabinet, breaker operations and fault operations.
Functional Check	< 1 operation in 24 months	Validate the operation of a circuit breaker which has remained static in the open or

		closed period.
Density Monitor Check	60 months (5 yrs)	Validate the operation of the switch contacts used to indicate low gas pressure in the circuit breaker and to activate a safety lock-out if the gas pressure drops below a predefined level. Each density monitor on the circuit breaker is to be tested. This is an out of service test.
Main Contact Check	60 months (5 yrs)	Determine the percentage of erosion of the circuit breaker's main arcing contact and to evaluate the condition of the circuit breaker's main contacts. This is an out of service, non-invasive test.
Mechanism Check	60 months (5 yrs)	Evaluate the performance of the operating mechanism utilized to drive the circuit breaker's main contacts.

### 10.1.8 Communication Equipment

Task	Frequency	Description
Functional Check	12 months (1 yr)	Visual inspection/remote interrogation
Calibration Check	24 months (2 yrs)	Check relay calibration point, including operating characteristics of meter as per Transmission Owner maintenance standards

The foregoing information represents the Transmission Owner's current maintenance practices, which may be amended from time to time without notice.

## 10.2 Generator Equipment

The Generator shall maintain the equipment and devices in the Generator Interconnection Facilities based on the following;

### 10.2.1 Disconnect Switches and Motor Operators

Task	Frequency	Description
Integrity Checks	Monthly	In-service visual check for contacts making properly and everything normal. Look for any broken porcelain, loose parts, etc.
Integrity Checks	Annual	Perform an in-service infra-red inspection for any temperature differentials on switch live parts.
Functional Checks	Five (5) years.	Remove from service - Operate switch. Visual check for proper operation with contacts making properly and operator working smoothly. Perform maintenance on motor operators. Look

		for any broken porcelain, loose parts, etc.
--	--	---

### 10.2.2 High Voltage Breakers

Task	Frequency	Description
Integrity Checks	Monthly	In-service visual check for any obvious damage. Inspect mechanism, record operation counter and observe that breaker SF6 pressures are normal.
Integrity Checks	Annual	In-service Infra-red inspection for any temperature differentials on breaker particularly the bushings and the HV connectors.
Functional Checks	As the breaker is operated in the protection scheme or for normal switching	Observe for proper operation and relay targets. Take appropriate action as required.
Minor Maintenance	Five (5) years	Out of service checks. Check dashpot oil level, SF6 densimeter, counter operation, contact wear, etc as per manufacturer's recommendations.
Major Maintenance	Five (5) years <u>and</u> after 2,500 switching operations.	Out of service checks. As per manufacturer's recommendations, but includes timing, ductor, power factor, SF6 moisture check, contact wear.

### 10.2.3 Main Power Transformer

Task	Frequency	Description
Integrity Checks	Monthly	In-service visual check for any obvious damage. Inspect LTC mechanism, record counter, and record transformer temperature and pressure readings.
Integrity Checks	Annual	In-service dissolved gas in oil test. Infra-red inspection of electrical connections, LTC and main tank.
LTC Maintenance	Five (5) Years or 50,000 operations whichever occur first	Remove from service - Perform LTC maintenance per manufacturer's recommendation.
Transformer Testing	Five (5) Years	Remove from service – Perform Power factor tests, ratio, and excitation tests. Perform an oil screen test.

### 10.2.4 Coupling Capacitor Voltage Transformers

Task	Frequency	Description
Integrity Checks	Monthly	In-service visual check for any visible damage.

Integrity Checks	Annual	In-service infra-red inspection, check secondary voltage.
CCVT Testing	Five (5) Years.	Remove from service - Perform power factor and capacitance tests on the CCVT.

#### 10.2.5 Lightning Arresters

Task	Frequency	Description
Integrity Checks	Monthly	In-service visual check for any obvious damage.
Integrity Checks	Annual	In-service infra-red inspection
Arrester Testing	Five (5) Years.	Remove from service - Perform a watts loss test on the arrester

#### 10.2.6 PT's and Station Service Transformers

Task	Frequency	Description
Integrity Checks	Monthly	In-service visual check for any visible damage.
Integrity Checks	Annual	In-service infra-red inspection, check secondary voltages
VT Testing	Five (5) Years.	Remove from service - Perform a power factor and ratio test.

#### 10.2.7 Station Batteries

Task	Frequency	Description
Integrity Checks	6 months	In-service visual check for any visible damage.
Battery Maintenance	24 Months	Conductance and specific gravity check
Battery Maintenance	Five (5) Years.	Remove from service - Perform a discharge test.

#### 10.2.8 Protective Relays and Controls

Task	Frequency	Description
Integrity Checks	Monthly	In-service visual check for any obvious problems.
Relay Maintenance	Five (5) Years	Remove from service - Check calibration and functional performance

#### 10.2.9 Power Fuses

Task	Frequency	Description
Integrity Checks	Monthly	In-service visual check for any visible damage.
Integrity	Annual	In-service infra-red inspection

Checks		
--------	--	--

#### 10.2.10 HV Bus and Connectors

Task	Frequency	Description
Integrity Checks	Monthly	In-service visual check for any obvious damage.
Integrity Checks	Annual	In-service infra-red inspection

## 11.0 Notifications

### 11.1 Operational Notice

Article 23 of the IOA identifies the Generator contact to which all written notices shall be issued. However, there are Operational Notices necessary for the coordinated and reliable operation of the Facility and Transmission System.

“Operational Notice” shall mean any written notice, demand or request required pertaining to the day to day operations of the Facility or Transmission System, except for a breach of the agreement, between the Transmission Owner Contacts and Generator Contacts as identified in the Appendix D specific to the Generators IOA.

### 11.2 Transmission Owner Curtailment Notification

Transmission Owner SCC shall provide verbal notification to the Generator whenever it is necessary to curtail the output of the Facility.

During unplanned events, the Generator shall only be verbally notified of the special conditions of operation, required for the Generator to operate to and an anticipated duration if available. The Transmission Owner SCC Operator shall provide verbal notification to the Generator once conditions have returned to normal.

### 11.3 Voice Recording

The Generator acknowledges that and consents to all voice communications between Generator’s operations personnel and the Transmission Owner SCC Operators are recorded.