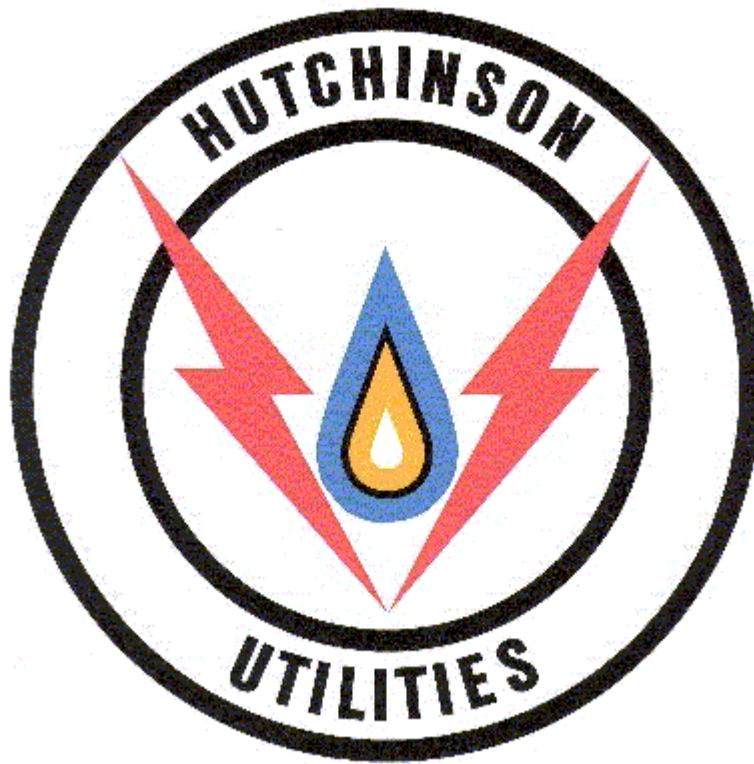


# HUTCHINSON UTILITIES COMMISSION



## GENERATION INTERCONNECTION GUIDELINES

MAY 2013

## **I. TRANSMISSION LEVEL GENERAL REQUIREMENTS**

### **A. Purpose**

The Hutchinson Utilities Commission Generation Interconnection Guidelines (the "Interconnection Guidelines" or "Guidelines") are intended to serve as a reference for interconnection customers to follow when interconnecting generation projects to the portion of the transmission system owned by Hutchinson Utilities Commission ("HUC"). These Guidelines are intended to supplement and be consistent with the requirements of the Midwest Independent Transmission System Operator, Inc. ("MISO"). As the Transmission Provider, MISO administers the generator interconnection process. As the Transmission Owner, HUC sets the technical standards that must be met by an interconnection customer when interconnecting to the HUC transmission system.

These Guidelines are intended to describe HUC's requirements from the planning of a generation interconnection through project start-up and operation. However, HUC's requirements are not the only consideration. The interconnection customer must also comply with the requirements of the following authorities:

- State and federal laws and regulatory requirements, including the Public Utility Regulatory Policies Act ("PURPA")
- Midwest Independent Transmission System Operator, Inc. ("MISO")
- North American Reliability Council ("NERC"), the Midwest Reliability Organization ("MRO"), and any other applicable regional reliability organization.

These Guidelines are intended as a convenience for the interconnection customer in understanding HUC's requirements. These Guidelines are not intended to modify or supersede the requirements of any authority noted above. All interconnection customers are required to comply with the relevant requirements of such authorities, as such requirements may change over time. In addition, HUC may revise this document at any time and without notice. HUC will make every effort to post updated versions of this document on HUC's website or otherwise inform users of any changes to this document. Nevertheless, it is the interconnection customer's responsibility to work closely with HUC, MISO and others to ensure compliance with all applicable interconnection requirements.

These Guidelines may not address every situation an interconnection customer may encounter. It is the responsibility of the interconnection customer to consult HUC when in doubt as to the applicability of any requirement in these Interconnection Guidelines to the proposed interconnection.

The requirements described in this document shall not be construed as modifying or superseding any existing agreements between HUC and the interconnection customer.

All capitalized terms that are used in these Interconnection Guidelines that are not defined herein shall have the meanings given to them in the MISO ASM Tariff or other relevant MISO documents.

## **Contact Information**

For new interconnections or modifications to existing facilities please contact:

Great River Energy  
12300 Elm Creek Boulevard  
Maple Grove, MN 55369-4718  
(763) 445-5000

Contact information for normal or emergency operations:

Great River Energy Operations Control Center  
(763) 241-2340

Hutchinson Utilities Commission System Control  
(320) 587-4745

## **B. MISO Interconnection Requirements**

All interconnection customers are required to comply with the MISO generator interconnection process and requirements as set forth in the MISO Open Access Transmission, Energy and Operating Reserves Markets Tariff (the "ASM Tariff"), including its Attachment X, Generator Interconnection Procedures, and the applicable Business Practice Manuals. The generator interconnection process includes Pre-Queue, Application Review, System Planning & Analysis, Definitive Planning Phase, and Generator Interconnection Agreement stages. MISO will contact and involve the appropriate Transmission Owners, including HUC, as applicable.

The MISO generator interconnection requirements are described here:

<https://www.midwestiso.org/Planning/GeneratorInterconnection/Pages/GeneratorInterconnection.aspx>

## **C. Project Requirements & Design**

These Guidelines describe the operating, metering, and equipment protection requirements for generators interconnecting with HUC's transmission system. The requirements vary according to the size of the generator, the voltage level of the point of interconnection, and the location on the transmission system. These Guidelines are general and may not fully address the circumstances of a specific interconnection request. Additional or different requirements may also be necessary for a specific project as a result of the findings of the studies required by MISO as part of its generator interconnection procedures, in particular the System Impact Study and the Facility Study.

The interconnection customer is responsible for the design, installation, operation and maintenance of all necessary equipment for connection to the HUC system unless otherwise agreed to in writing. The interconnection customer is also responsible for submitting specifications and detailed plans for the design of the control and protective devices to HUC for review and written approval prior to construction of the interconnection facilities. Written approval by HUC does not indicate or ensure acceptance by local code authorities. HUC's requirements are designed to protect the transmission system facilities and equipment; they

are not designed to protect the interconnection customer's generators. HUC is not responsible for the protection of any of the equipment owned by the interconnection customer.

In the design of the control and protective devices, the interconnection customer shall comply with NERC and other applicable industry standards, and such design will conform to Good Utility Practice.

#### **D. Financial Obligations Associated with Interconnection**

All financial obligations are set forth in the Interconnection Agreement or Facility Construction Agreement between the applicable Transmission Owner(s), the interconnection customer and MISO.

#### **E. Station Power Service**

The interconnection customer is required to arrange for and obtain the station power service required for its facilities. Station power service is required to be in compliance with Schedule 20 of the MISO ASM Tariff. Per Schedule 20, a generator owner may choose to receive station power from a local distribution service provider, through on-site self-supply, or by procuring transmission service for remote self-supply or remote third party supply, or through the MISO Market Participant that represents the generation in the MISO market. The "Application To Provide Station Power Service Under Schedule 20" can be requested via email from a MISO Customer Relation Representative at [register@midwestiso.org](mailto:register@midwestiso.org).

#### **F. Construction**

There are two components to the construction process. One is the construction of the Interconnection Facilities. The other is the construction of the Network Upgrades, if any, that are required on the transmission system of HUC and/or other Transmission Owner(s). Both sets of facilities must be complete in order for the interconnection customer to receive approval to operate interconnected to HUC's transmission system.

It is the interconnection customer's responsibility to obtain any required permits and local, state, and federal approvals in order to construct and operate its Interconnection Facilities.

#### **G. Approval to Operate**

The interconnection customer must receive the prior written approval of HUC to operate interconnected to the HUC system. To receive the approval of HUC, the following must be complete:

- Generator Interconnection Agreement and Facility Construction Agreement executed and filed in accordance with FERC requirements.
- All Interconnection Facilities and Network Upgrades complete and in-service.

- Interconnection customer completes all required submittals to HUC, including insurance certificates, as required by the Generation Interconnection Agreement.
- Interconnection customer provides notice to HUC of a contact for scheduling planned outages and a 24 hour x 7 day a week contact in order to address real time operational issues with the generation facility.

Once all of the above requirements are complete, HUC will notify the interconnection customer and MISO that they may begin operating.

## **H. Operation**

The following is a brief description of procedures with which the interconnection customer must comply during operation. Operating procedures are discussed in detail in "Operating Procedure" section below.

The interconnection customer must immediately notify the Transmission Operator of any unusual or emergency conditions, or of any change in the interconnection customer's mode of operation including separating from or interconnecting with the transmission system. HUC may also require additional capacity and energy reports. HUC must also be given notice of scheduled maintenance periods.

The interconnection customer shall maintain a daily operations log and make it available to HUC upon request. The log shall have a record of all communications between the interconnection customer and the Transmission Operator's control center. The log shall note all unusual occurrences and changes in operating mode.

All required equipment must be operable prior to delivering power into the transmission system.

## **I. Generator Required Documentation**

Within three (3) months of placing the generation facilities in-service, the interconnection customer shall submit the following documents to HUC:

- As-built Electrical One-line drawing which includes metering and relaying and protection devices.
- Transformer nameplate data.
- Transformer test reports.
- Generator nameplate data.
- Generator data sheets.

## **II. GENERATOR REQUIREMENTS**

### **A. Power System Stabilizers**

The power system stabilizer (PSS) provides added stability to the electrical system when system power oscillations occur. To comply with Midwest Reliability Organization (MRO) requirements, generators 75MVA and larger must be equipped with Power System Stabilizers to dampen power oscillations. The PSS must be tuned to the electric delivery system mode of oscillation.

## **B. Reactive Supply and Voltage Control from Generation Sources Service**

Reactive Supply and Voltage Control is a FERC defined ancillary service. Any generator providing such service to the balancing authority operator must be able to automatically control the voltage level at the point of interconnection by adjusting the machine's power factor within a continuous range between +95% and -95% power factor based on the plant's sum total nameplate generating capability. The voltage setpoint that the generator needs to maintain will be established and adjusted as necessary by HUC's System Operations Department. Generator Operator requirements for maintaining network voltage schedules are specified in the current version of the NERC VAR-002 standard.

## **C. Voltage Operating Limits**

The interconnection customer's equipment shall not cause excessive voltage excursions. The interconnection customer shall provide an automatic means of disconnecting its equipment from the transmission system within three seconds if the steady state voltage cannot be maintained within the required tolerance.

Transmission systems are not designed to provide precise voltage regulation. In planning the interconnection to the transmission system, the interconnection customer should anticipate voltage levels that deviate  $\pm 10$  percent from nominal. If the interconnection customer's equipment cannot operate within the above range, the interconnection customer may need to provide regulation equipment to limit voltage level excursions at its facilities.

The transmission system is designed to avoid dynamic voltage dips below 0.70 pu due to external faults or other disturbance initiators. The interconnection customer should allow sufficient dead band in its voltage regulation equipment control to avoid reacting to dynamic voltage dips.

## **D. Flicker Operating Requirements**

Voltage fluctuations may be noticeable as visual lighting variations (flicker) and can damage or disrupt the operation of electronic equipment. Applicants are not allowed to produce flicker nor introduce excessive distortion to the sinusoidal voltage or current waves as defined by ANSI Standard C84-1-1989, in accordance with IEEE Standard 519, or any applicable superseding electric industry standard. The Applicant will be responsible and liable for corrections if the interconnecting Facility is the cause of objectionable flicker levels.

## **E. Frequency Control During Disturbances**

Power system disturbances initiated by system events such as faults and forced equipment outages expose the system to oscillations in voltage and frequency. It is important that generators remain on line with governors in service for dynamic (transient) oscillations that are stable and damped. To avoid large-scale blackouts that can result from excessive generation

loss, major transmission loss, or load loss during a disturbance, underfrequency load shedding has been implemented using criteria set by the MRO in order to comply with NERC standards. When system frequency declines, loads are automatically interrupted in steps in an attempt to stabilize the system by balancing available generation to remaining load.

All interconnection customers' generating equipment shall be capable of remaining interconnected to the system and attempting to return system frequency to its 60 Hz nominal value at all frequencies between 58.5 and 61.5 Hz.

## F. Harmonics

Harmonics can cause telecommunication interference, increase thermal heating in transformers, disable solid state equipment and create resonant overvoltages. In order to protect equipment from damage, harmonics must be managed and mitigated. The interconnection customer's equipment shall not introduce excessive distortion to the transmission system voltage and current waveforms per IEEE 519-1992.

The harmonic distortion is defined as the ratio of the root mean square (rms) value of the harmonic to the rms value of the fundamental voltage or current. The harmonic distortion measurements shall be made at the point of interconnection between the interconnection customer and the transmission system and shall be within the limits specified in the tables below. HUC advises the interconnection customer to account for harmonics during the early planning and design stages. Refer to Tables 1 and 2 for voltage distortion limits.

**Table 1. Voltage Distortion Limits**

Bus Voltage at PCC	Individual Voltage Distortion IHD %	Total Voltage Distortion THD %
Below 69 kV	3.0	5.0
69 kV to 115 kV	1.5	2.5
115 kV and above	1.0	1.5

Source: IEEE 519, Table 11.1

**Table 2. Current Distortion Limits For Non-Linear Loads At The Point of Common Coupling (PCC) From 120 to 69,000 Volts**

Maximum Harmonic Current Distribution in % of Fundamental Harmonic Order (Odd Hermonics)						
$I_{(sc)}/I_{(l)}$	<11	11<h<17	17<h<23	23<h<35	35<h	THD
20	4.0	2.0	1.5	0.6	0.3	5.0
20-50	7.0	3.5	2.5	1.0	0.5	8.0
50-100	10.0	4.5	4.0	1.5	0.7	12.0
100-1000	12.0	5.5	5.0	2.0	1.0	15.0
1000	15.0	7.0	6.0	2.5	1.4	20.0

Where:

$I(sc)$  = Maximum short circuit current at PCC

$I(l)$  = Maximum load current (fundamental frequency) at PCC

PCC = Point of Common Coupling between Applicant and utility

Generation equipment is subject to the lowest  $I(sc)/I(l)$  values

Even harmonics are limited to 25% of odd harmonic limits given above

Source: IEEE 519, Table 10.3

A special study will be required for situations when the fault to load ratio is less than 10. Lower order harmonics, particularly the third and ninth harmonics, will often be of more concern to the owner of generator. These are often related to generator grounding, and to the type of transformer connections that may be involved. It is to the Applicant's advantage to work these problems out early enough so that Applicant and HUC equipment can be acquired to achieve proper control.

### **G. Fault Current**

The combined available fault current of the HUC System and the Applicant's facilities must not overstress HUC equipment. The Applicant shall provide any necessary provisions to satisfy this requirement.

If the installation of Applicant-owned equipment causes fault current limits to be exceeded, the Applicant must install equipment to limit the fault current on the HUC delivery system or compensate HUC for the additional costs of installing equipment that will safely operate within the available fault current. The exact value of available fault depends upon location and circuit configuration and will be determined in the interconnection studies. The Applicant must work closely with HUC at the time of interconnection design to determine the available fault current at the specific location of interconnection.

### **H. Local Balancing Authority Area Operations**

The LBA operator of the transmission line where the customer interconnection is located may have additional informational or equipment requirements that are necessary to perform the LBA operations. The interconnection customer will be responsible for associated equipment costs to



meet the additional operational and/or reporting requirements imposed by the LBA operator.

An example of an additional requirement might be the need for a dual-ported remote terminal unit to provide for monitoring and/or control of the customer's equipment by more than one electric utility.

## **I. Transmission Operator Area**

The HUC owned transmission system is located in several different Transmission Operator areas. The Transmission Operator(s) affected will be determined based on the location of the interconnection request.

The Transmission Operator may have additional monitoring and control requirements necessary for the reliable and safe operation of the transmission system. The interconnection customer will be responsible for associated equipment costs necessary to meet the additional requirements of the Transmission Operator.

## **III. Physical Interconnection**

The configuration of the facilities that HUC requires at the point of interconnection will be determined during the Facility Study phase. The configuration will be determined by the combination of the transmission system reliability requirements and the characteristics of the generation being interconnected.

HUC standards require the following:

- 1.) Any generation interconnection that is connected at 200 kV or above will require a breaker station.
- 2.) Any generation interconnection that is 20 MW or greater and connecting to transmission at any voltage will require a breaker station.
- 3.) A breaker station will be required to prevent any generation interconnection from creating a four terminal transmission line. In most cases, a breaker station will also be required to prevent the generation interconnection from creating a three terminal line. This criterion is based on relaying requirements.
- 4.) In a looped transmission system, if the product of the transmission line mileage (between all associated breakers) and the combination of the new generation plus the existing generation and the projected peak load served by the transmission circuit exceeds 1000 MW-miles, a breaker station will be required. The projected peak load will be calculated based on the requested in service date of the generation interconnection.
- 5.) On a radial transmission line, if the product of the transmission line mileage and the combination of the new generation plus the existing generation and peak load exceeds 100 MW-miles, a breaker station may be required. The projected peak load will be calculated based on the requested in service date of the generation interconnection. This criterion is based on the projected system configuration at the time of the requested in service date of the generation interconnection.

## **A. Interconnect to a HUC Transmission Line**

### **1. HUC Requirements:**

A disconnect device, operated by a Transmission Operator, must be provided as a means of electrically isolating the transmission system from the generator. This device will be used to establish visually open working clearance for maintenance and repair work in accordance with HUC and/or other Transmission Operator safety rules and practices. A disconnect device shall be located at the point of interconnection (ownership change) with HUC. At a minimum it shall be a gang operated, 3-way switch. The switch may be required to be motor operated and capable of full load break. These requirements will be determined during the Facility Study phase based on Transmission Operator requirements in the area.

The switch will be located on a HUC owned transmission structure and it will be installed and maintained by HUC designated personnel. The HUC 3-way switch shall be identified with a HUC designated switch number plate per HUC's specifications.

The switch must not be used to make or break parallels between the HUC system and the generator(s). Only HUC or other Transmission Operator designated personnel shall operate the device. For this reason, the device enclosure and operating handle shall be kept locked at all times with HUC or other Transmission Operator padlocks.

### **2. HUC Generation Interconnection Customer Requirements:**

A high side, visible open disconnect device must be installed at the interconnection customer's substation. A visible open disconnect device could be a switch or a fuse.

A high side protection device must also be installed at the interconnection customer's substation. This device must be rated for available fault levels and have a 3-cycle interruption capability in most cases. The protection device could be a circuit switcher, fuse (acceptable only at less than 10 MVA), circuit breaker or transrupter (to name a few).

## **B. Interconnect to a HUC Substation**

### **1. HUC Requirements:**

HUC's substation design will take into account that transmission system reliability will not be impacted by a failure of the interconnection customer's high side interrupting device.

### **2. HUC Generation Interconnection Customer Requirements:**

A high side, visible open disconnect device must be installed at the interconnection customer's substation. A visible open disconnect device could be a switch or a fuse.

A high side protection device must also be installed at the interconnection customer's substation. This device must be rated for fault levels and have a 3-cycle interruption capability in most cases. The protection device could be a circuit switcher, fuse (acceptable only at less than 10 MVA), circuit breaker or transrupter just to name a few.

### **C. Double Circuiting HUC Transmission Lines**

HUC does not permit double circuiting of HUC transmission lines unless the Interconnection Customer is a transmission owning entity. In the event that a transmission owning Interconnection Customer proposes to double circuit a HUC transmission line, the installation must meet all applicable HUC standards. Safety, operational and maintenance concerns will be taken into account at the same time.

## **IV. PROTECTIVE RELAYS**

### **A. Relay Requirements**

An important concern in the delivery of electrical power to the transmission system is the potential hazard to life and property. A unit's ability to go off-line immediately when a fault is detected is the primary safety requirement for generators interconnected to the transmission system.

The interconnection customer must install utility grade protective and control relays. These relays must at a minimum meet IEEE Standards C37.90, C37.90.1 and C37.90.2. HUC or other Transmission Operator shall have the right to approve those portions of the interconnection customer's protection system and equipment that may affect the transmission system.

HUC's protection requirements are designed and intended to protect the transmission system only. It is the interconnection customer's responsibility to protect their system and equipment. Additional protective or connecting devices not mentioned in this document may be required for the interconnection depending on the results of the various studies coordinated by MISO.

## **V. METERING AND SCADA/TELEMETERING REQUIREMENTS**

### **A. General**

The purpose of this section is to assist interconnection customers in accommodating any HUC billing metering, instantaneous metering, and SCADA indication and control requirements for the measurement of electricity supplied to the MISO Balancing Authority and interconnection of the interconnection customer's generator to HUC's transmission system.

HUC prefers to own, operate, and maintain the SCADA, metering, and telemetry equipment. However, the ownership, operation, and maintenance of the metering, SCADA, and telemetry equipment will be determined during the interconnection studies. At a minimum HUC will have the right to:

- Review and approve the metering and telemetry design to meet the requirements for that class of facilities,
- Review and approve the equipment purchased by the interconnection customer,
- Inspect the final installation,
- Participate in jointly testing the metering and telemetry equipment during the installation,
- Participate in subsequent periodic testing, and

- Access the SCADA, metering, and telemetry equipment at any time.

## **B. Summary of Billing Metering Requirements**

- Metering equipment (CTs, PTs, Meter, etc.) shall adhere to ANSI standards C-12.1 and IEEE standard C-57.13.
- Minimum Instrument transformer accuracy per HUC Requirements:  
Current transformers (all ratios): 0.3B0.5  
Potential transformers (all ratios); 0.3Y
- Instrument transformer test reports shall be provided to HUC. Periodic testing and inspection by HUC will be required for metering CTs or PTs.
- Metering instrument transformers shall be dedicated for metering purposes only. Connecting other equipment to the CT and PT metering circuits is not permitted.
- A DC power source will be provided by the interconnection customer to the meter for continuous energization of the meter electronics regardless of whether the generator is on or off line.
- It is desirable to meter the generator at the point of interconnection. If this cannot be accomplished, loss compensation will be incorporated into the billing meter.
- Metering for revenue billing should have the following end of month frozen meter reading and data storage requirements: 15 minute stored pulse data for KWh and KVarh both Delivered and Received quantities; registers must be scaled to ensure that the meter reading does not roll over more than once within a month and that there is sufficient pulse data storage for at least 45 days of data. HUC would prefer an internet protocol connection to the revenue meter but dial up telephone access with a modem is acceptable with proper telephone circuit protection and data security.

## **C. Summary of Telemetry/SCADA Requirements**

The requirements for telemetry are based on the need of the HUC System Operations Control Center, the Transmission Operator, or the Balancing Authority to protect all users of the transmission system from unacceptable disturbances, and fulfill operational and control requirements defined in agreements between HUC, MISO, and the interconnection customer. This includes:

- Status (open/close) of generator and interconnection breaker(s) or other disconnecting devices.
- Instantaneous Generator Net MW and MVar quantities.
- Hourly frozen accumulators for MWh delivered and MWh received. The hourly freeze signal must emanate from a single source; typically an Energy Management System (EMS) or substation RTU with GPS time synchronization.
- Automatic Generation Control (AGC), if plant is not exempt under MISO rules.

- Remote control of breakers, plant generator, line switches, etc., as defined in the Generator Interconnection Agreement/Facility Construction Agreement (if required).

#### **D. Metering, Telemetry, and SCADA Equipment Repair**

The owner of the metering, telemetry, and/or SCADA equipment is responsible for ensuring that the equipment is adequately maintained and is repaired within a reasonable time after a failure is detected. The repair or replacement of a bad meter must be completed within 24 hours after the problem has been detected. If this equipment cannot be repaired within that time, the interconnection customer may be required to cease all generation until the problem has been resolved.

## **VI. OPERATING PROCEDURES**

### **A. Jurisdiction of Transmission Operator**

The interconnection customer's generator(s) while operating interconnected with the transmission system is at all times under the jurisdiction of the Transmission System Operator. In addition to the Generator Interconnection Agreement, under some circumstances, an operating agreement between the interconnection customer and the Transmission Operator may be required.

### **B. Communications**

The interconnection customer shall supply HUC with contacts for emergency and normal operations, including 24 hour x 7 day a week contact information.

#### **1. Telemetry Failure**

When telemetering is inoperative, the interconnection customer shall report hourly the capacity delivered each hour and the energy delivered each day to the Transmission Operator's control center.

#### **2. Interconnecting to and separating from the transmission system**

The interconnection customer will notify the Transmission Operator's control center prior to interconnecting or separating from the transmission system. For unexpected separations from the transmission system the interconnection customer will inform the Transmission Operator's control center of the nature of the problem (i.e. overvoltage, underfrequency, ground fault, etc) and report on relay target operations.

#### **3. Clearances and Switching Requests**

These requests will be handled through the Transmission Operator's control center. The facility shall have an approved disconnect for operation by the Transmission Operator's personnel as a clearance point.

#### **4. Unusual or Emergency Conditions**

Unusual operating conditions or other factors that may affect the capability or the reliability of the interconnection customer's generation must be reported to the Transmission Operator's control center as soon as possible. Conditions imperiling life or property shall be reported to the Transmission Operator's control center immediately. The Transmission Operator's control center shall be notified of any "forced outage" and the Transmission Operator's control center will notify the interconnection customer of any unusual transmission conditions that may affect the interconnection customer's generation.

### **C. Maintenance**

The interconnection customer shall follow applicable NERC standards for maintenance of protection and control equipment.

### **D. Disconnection from the Transmission System**

The Transmission Operator reserves the right to open the intertie circuit breaker or disconnect device for any of the following reasons:

- Personnel safety is threatened.
- Transmission line maintenance.
- System emergency.
- Inspection of the interconnection customer's generating equipment and protective equipment reveals a hazardous condition.
- Failure of the interconnection customer to provide maintenance and testing reports when required by HUC or the Transmission Operator.
- The interconnection customer's generating equipment interferes with other customers or the operation of the transmission system.
- The interconnection customer has modified the generating equipment or protective devices without the knowledge or approval of HUC or the Transmission Operator.
- Interconnection of any unapproved interconnection customer generating equipment.
- Failure of the interconnection customer to comply with applicable OSHA safety procedures including but not limited to tagging and lockout requirements.
- If the interconnection customer's generating equipment is consistently outside the +/- 95% power factor, HUC or the Transmission Operator reserves the right to disconnect the customer or require VAR compensation.

The failure of HUC or the Transmission Operator to open the intertie circuit breaker or disconnect device shall not serve to relieve the interconnection customer of any liability for injury, death, or damage which is attributable to the interconnection customer's operations or equipment.

Changes to the transmission system, or the addition of other interconnections in the vicinity, may require modifications to the interconnection protective devices. If such changes are required, the interconnection customer may be subject to future charges for such modifications.

## X. GLOSSARY

**Ampere (AMP):** The unit of current flow of electricity. It is to electricity as the number of gallons per minute is to the flow of water. One ampere flow of current is equal to one coulomb per second flow.

**Automatic:** Self-acting, operated by its own mechanism when actuated by some impersonal influence as, for example, a change in current strength; not manual; without personal intervention.

**Automatic Generation Control (AGC):** Equipment that automatically adjusts generation in a Balancing Authority Area from a central location to maintain the balancing Authority's interchange schedule plus Frequency Bias. AGC may also accommodate automatic inadvertent payback and time error correction.

**Balancing Authority (BA):** The responsible entity that integrates resource plans ahead of time, maintains load-interchange-generation balance within a Balancing Authority Area, and supports Interconnection frequency real time.

**Balancing Authority Area:** The collection of generation, transmission, and loads within the metered boundaries of the Balancing Authority. The Balancing Authority maintains load-resource balance within this area.

**Capacity:** The number of amperes of electric current a wire will carry without becoming unduly heated; the capacity of a machine, apparatus or device, is the maximum of which it is capable under existing service conditions; the load for which a generator, turbine, transformer, transmission circuit, apparatus, station or system is rated.

**Circuit:** A conducting path through which an electric current is intended to flow.

**Circuit Breaker:** A device for interrupting a circuit between separable contacts under normal or fault conditions.

**Current:** A flow of electric charge measured in amperes.

**Current Transformer (CT):** A transformer intended for metering, protective or control purposes, which is designed to have its primary winding connected in series with a circuit carrying the current to be measured or controlled. A current transformer normally steps down current values to safer levels. A CT secondary circuit must never be open circuited while energized.

**Disconnect:** A device used to isolate a piece of equipment. A disconnect may be gang operated (all poles switched simultaneously) or individually operated.

**EMS:** Energy Management System. The computer system HUC uses to provide real-time status and remote control of its electrical transmission system.

**FERC:** Federal Energy Regulatory Commission. FERC is an independent body within the Department of Energy (DOE) regulating, among other things, interstate transmission and transmission reliability.

**Frequency:** The number of cycles occurring in a given interval of time (usually one second) in an electric current. Frequency is commonly expressed in hertz.



**Fuse:** A short piece of conducting material of low melting point which is inserted in a circuit for the purpose of opening the circuit when the current reaches a certain value.

**Ground:** A term used in electrical work in referring to the earth as a conductor or as the zero of potential. For safety purposes, circuits are grounded while any work is being done on or near a circuit or piece of equipment in the circuit; this is usually called protective or safety grounding.

**Hertz:** The term denoting frequency, equivalent to cycles per second.

**Interconnection Facilities:** The physical system of electrical transmission between the customer's generation and the utility. A more detailed definition is provided in the MISO ASM Tariff, including its Attachment X.

**Interruption:** A temporary discontinuance of the supply of electric power.

**IPP:** Independent Power Producer. An organization, which is not a utility, that operates a power plant, produces energy and then sells it to a utility.

**Island:** A part of an interconnected system may be isolated during a system disturbance and start operating as a subsystem with its own generation, transmission and distribution capability. Then the subsystem becomes an island of the main interconnected system without a tie. In such a case, the islanded system and the main interconnected system will operate at different frequencies and voltages.

**Kilovolt (kV):** One thousand volts.

**Kilovolt-Ampere (kVA):** One thousand volt amperes. See the definition for Apparent Power.

**Kilowatt (kW):** An electric unit of power which equals 1,000 watts.

**Kilowatthour (kWh):** One thousand watts of power supplied for one hour. A basic unit of electric energy equal to the use of 1 kilowatt for a period of one hour.

**Lagging Power Factor:** Occurs when reactive power flows in the same direction as real power.

**Leading Power Factor:** Occurs when reactive power flows in the opposite direction of real power.

**Line Losses:** Electrical energy converted to heat in the resistance of all transmission and/or distribution lines and other electrical equipment.

**Local Balancing Authority (LBA):** An operational entity which is part of a Joint Registration Organization, as defined in the NERC Rules of Procedure, which is responsible for compliance to NERC for the subset of NERC Balancing Authority Reliability Standards defined in the Amended Agreement between Midwest ISO and Midwest ISO Balancing Authorities for their local area within the Midwest ISO Balancing Authority Area.

**Local Balancing Authority Area:** The collection of generation, transmission, and loads within the metered boundaries of the Local Balancing Authority. The Local Balancing Authority maintains load-resource balance within this area.

**Metering Device(s):** The meters, metering equipment and data processing equipment, and related communications equipment, used to measure, record or transmit data relating to the energy output from the facility.

**MISO:** Midwest Independent Transmission System Operator, Inc., also known as the Transmission Provider.

**MRO:** Midwest Reliability Organization

**Network Upgrades:** Upgrades that are needed to the Transmission System in order to accommodate the interconnection customer's generation output/interconnection.

**NERC:** North American Electric Reliability Corporation, or successor organization.

**One-Line Drawing:** A drawing in which several conductors are represented by a single line and in which various devices or pieces of equipment are denoted by simplified symbols. The purpose of such a drawing is to present an electrical circuit or circuits in a simple way so that their function can be readily grasped.

**Point of Interconnection:** The point where the interconnection customer's facilities meet HUC facilities (point of ownership change).

**Potential Transformer (PT):** A transformer intended for metering, protective or control purposes, which is designed to have its primary winding connected to the high voltage circuit and its secondary winding connected to the metering, protective or control equipment at a lower voltage level that is suitable for measurement. A potential transformer normally steps down potential values to safer levels.

**Power: Actual, Active or Real Power:** The time rate of transferring or transforming energy or the power that accomplishes work. Measured in Watts.

**Power Factor:** The ratio of actual power (kW) to apparent power (kVA).

**Power Flow:** One-way power flow is the condition where the flow of power is entirely into the customer's facility. Two-way power flow is the condition where the net flow of power may be either into or out of the customer's facility depending on the operation of the generator and other customer load.

**Power System Stabilizer:** Supplemental excitation device for dampening low-frequency oscillations.

**Protection:** All of the relays and other equipment which are used to open the necessary circuit breakers to clear lines or equipment when trouble develops.

**Reactive Power:** (VAR) The power that oscillates back and forth between inductive and capacitive circuit elements without ever being used. The function of reactive power is to establish and sustain the electric and magnetic fields required to perform useful work.

**Relay:** A device that is operative by a variation in the condition of one electric circuit to affect the operation of another device in the same or in another electric circuit.

**Switch:** A device for making, breaking or changing the connections in an electric circuit.

**System:** The entire generating, transmitting and distributing facilities of an electric company.

**Transformer:** An electric device, without continuously moving parts, in which electromagnetic induction transforms electric energy from one or more other circuits at the same frequency,

usually with changes of value of voltage and current.

**Transmission Owner:** The entity that owns and maintains transmission facilities

**Transmission Operator:** The entity responsible for the reliability of its "local" transmission system, and that operates or directs the operations of the transmission facilities.

**Voltage:** Electric potential or potential difference expressed in volts.

**Volt-Ampere:** A unit of apparent power in an alternating-current circuit.

**VAR:** Volt ampere reactive, see Reactive Power.

**Watt-Hour:** A unit of work or energy equivalent to the power of one watt operating for one hour.