GREAT RIVER ENERGY	**Transmission Division Operating Guidelines**	**Generation Interconnection Guideline TDOG202**	Page 1 of 27
Document approved by: Priti Patel, Vice President Transmission		Effective date: August 15, 2023	
Revision number: 9.0			

OBJECTIVE: Provide a reference document for generation interconnection customers that are connecting to the GRE transmission system. These Guidelines are intended as a convenience for the interconnection customer in understanding GRE's requirements.

SCOPE: The Great River Energy Generation Interconnection Guideline (the "Interconnection Guideline" or "Guidelines") are intended to serve as a reference for interconnection customers to follow in interconnecting generation projects with the Great River Energy ("GRE") transmission system or within GRE's balancing authority. These Guidelines are intended to supplement and be consistent with the requirements of the Midcontinent Independent System Operator, Inc. ("MISO"). As the Transmission Provider, MISO administers the generator interconnection process. As the Transmission Owner, GRE sets the technical standards that must be met by an interconnection customer when interconnecting to the GRE transmission system.

Reference documents

Name of document, not version

TDOG 108 Transmission Planning Procedures and Planning Criteria
MISO BPM-015 Generation Interconnection

Document review history

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Versions reviewed annually, not to exceed 15 months.

GREAT RIVER ENERGY

GENERATION

INTERCONNECTION

GUIDELINES

Revision 9.0

August 10, 2023

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I. INTRODUCTION

A. Objectives

The Great River Energy Generation Interconnection Guidelines (the "Interconnection Guidelines" or "Guidelines") are intended to serve as a reference for Interconnection Customers to follow when interconnecting new generation projects or materially modifying an existing facility to the portion of the transmission system owned by Great River Energy ("GRE"), or within GRE's Local Balancing Authority Area, or when GRE is the Transmission Operator. These Guidelines are intended to supplement and be consistent with the requirements of the Midcontinent Independent System Operator, Inc. ("MISO"). As the Transmission Provider, MISO administers the generator interconnection process. As the Transmission Owner, GRE sets the technical standards that must be met by an Interconnection Customer when interconnecting to the GRE transmission system. In addition to the technical standards included in this document, GRE TDOG 108 (Transmission Planning Procedures and Planning Criteria) includes planning procedures, requirements and criteria that must be met prior to approving the interconnection.

These Guidelines are intended to describe GRE's requirements for the planning of a new or materially modified generation interconnection through project start-up and operation. However, GRE'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")

Midcontinent Independent 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 GRE'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, GRE may revise this document at any time and without notice. GRE will make every effort to post updated versions of this document on GRE's website or otherwise inform users of any changes to this document. Nevertheless, it is the Interconnection Customer's responsibility to work closely with GRE, MISO, and others to ensure compliance with all applicable interconnection requirements.

B. Applicability

These Guidelines may not address every situation an Interconnection Customer may encounter. It is the responsibility of the Interconnection Customer to consult GRE 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 GRE 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 Open Access Transmission, Energy and Operating Reserve Markets Tariff (the "MISO Tariff"), or other relevant MISO documents.

C. Company contacts

All questions related to these Interconnection Guidelines should be addressed to:

Matt Nitschke
Great River Energy
12300 Elm Creek Boulevard
Maple Grove, MN 55369-4718
763-445-6027
mnitschke@grenergy.com

GRE contact information for unusual or emergency operations conditions:

Great River Energy Operations Control Center
763-241-2340

II. TRANSMISSION LEVEL GENERAL REQUIREMENTS

A. MISO Interconnection Requirements

All Interconnection Customers are required to comply with the MISO generator interconnection process and requirements as set forth in the MISO Tariff, including its Attachment X, Generator Interconnection Procedures, and the applicable Business Practice Manuals, specifically BPM-015 "Generation Interconnection". The generator interconnection process includes Pre-Queue, Application Review, Mandatory Scoping Meetings, Definitive Planning Phase, and Generator Interconnection Agreement stages. MISO will contact and involve the appropriate Transmission Owners, including GRE, as applicable.

The MISO generator interconnection requirements are described here:

https://www.misoenergy.org/planning/generator-interconnection/

B. Project Requirements & Design

These Guidelines describe the operating, metering, and equipment protection requirements for generators interconnecting with GRE'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 which can be located in BPM-015 "Generation Interconnection" sections 5, 6 and appendix D, 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 at their facilities for connection to the GRE 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 GRE for review and written approval prior to construction of the interconnection facilities. Written approval by GRE does not indicate or ensure acceptance by local code authorities. GRE's requirements are designed to protect the transmission system facilities and equipment; they are not designed to protect the Interconnection Customer's generators. GRE 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.

In the design of grounding, insulation coordination and the electrical safety clearances, the Interconnection Customer shall comply with NESC as well as other applicable industry standards and codes.

C. Financial Obligations Associated with Interconnection to the GRE System

All financial obligations are set forth in the Interconnection Agreement or (Multi-Party) Facility Construction Agreement between the applicable Transmission Owner(s), the Interconnection Customer(s) and MISO. GRE may make provisions to recover costs including, but not limited to the following:

- Meter installation, tests, maintenance, and parts and related labor
- Meter data management and scheduling
- Telemetry installation, tests, maintenance, parts, and related labor
- Operating expenses, including telecommunication circuits
- Study analysis and related expenses
- Securing regional reliability organization or equivalent acceptance
- Modifications to the GRE System and related labor/engineering
- Protective device installation/equipment cost and related labor
- Protective device settings review and coordination
- Review of design, inspection, and testing costs
- Programming costs to incorporate generation and tie-line data into GRE's energy management system
- Land, rights-of-way, licensing, engineering, etc.
- Balancing authority area services costs

D. Transmission Service for Station Power

The Interconnection Customer is required to arrange for and obtain station power service required for its facilities, and the associated transmission service, if applicable. If the Interconnection Customer takes station power service, normal or back-up, from the Transmission Owner, the Interconnection Customer is required to comply with Schedule 20 of the MISO Tariff. Schedule 20 only applies to the Transmission Service for the station power, not for the actual energy consumed. For each hour when the facility has negative net output, actual energy will be settled at the MISO hourly LMP. A Generation Owner may choose to arrange for Transmission

Service with a Transmission Owner. In this case, the Transmission Owner shall be responsible for taking Transmission Service under the MISO Tariff. The Generator Owner shall notify MISO of their station power service provider. The "Application To Provide Station Power Service Under Schedule 20" can be requested via email from a MISO Customer Relations Representative at clientrelations@misoenergy.org.

E. Construction

There are two components to the construction process. One component is the construction of the Interconnection Facilities. The other component is the construction of the Network Upgrades, if any, that are required on the transmission system of GRE 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 GRE'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.

F. Approval to Operate

The Interconnection Customer must receive the prior written approval of GRE to operate interconnected to the GRE system. To receive the approval of GRE, 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 GRE, including insurance certificates, as required by the Generation Interconnection Agreement.
- Interconnection Customer provides notice to GRE 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, along with requirements of Section I, GRE will notify the Interconnection Customer and MISO that they may begin operating.

G. 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. GRE may also require additional capacity and energy reports. GRE must also be given notice of scheduled maintenance periods.

The Interconnection Customer shall maintain a daily operations log and make it available to GRE 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.

H. Generator Required Documentation

Per the MISO GIA/FCA milestone schedule, the Interconnection Customer shall submit the following documents to GRE during initial design, final design, and the as-built process:

- One-line diagram which includes metering, relaying, and protection devices
- Interconnection transmission line positive and zero sequence impedance, conductor type and length from POI to station transformer
- Interconnection transformer positive and zero sequence impedances (three winding transformers require impedances for high to low, high to tertiary, and low to tertiary windings)
- Station transformer nameplate and test report
- Collector system equivalent impedance
- Pad mount turbine transformer nameplate and test report (verify if there is one per turbine or shared)
- Generator nameplate and data sheets, shall include data required for short circuit modeling
- Converter information for short circuit modeling (current limit, sequence current injection characteristics, etc.)
- Generator PSSE dynamics model raw data file (*.dyr format; contact GRE for required PSSE version)
- Generator site reactive power compensation (e.g. cap bank, reactors, STATCOM, synchronous condenser)

If a modification is made to the generator that would affect parameters used for generator modeling, updated parameters shall be provided to Great River Energy. A list of example parameters affected by physical changes to the generator is provided below:

- Time constants
- Damping
- Inertia
- Transient and subtransient reactances
- Leakage reactances
- Saturation values
- Converter current limit
- Converter interfaced resource sequence dynamic reactive-current injection characteristics

Generation Owner shall provide Great River Energy with all information required in R1 – R3 of the NERC standard MOD-025. The data submittal should comply with the periodicity and due date requirements identified in the standard. Note: This NERC standard is amended from time to time.

As required in NERC standards, MOD-026 and MOD-027, if any changes are made at a generation plant that affect the control settings or operation of the exciter, governor or power system stabilizer (PSS), Great River Energy Transmission Planning should be notified and provided with updated models. These models will be compatible with Siemens PTI's PSSE software (contact Great River Energy Transmission Planning for appropriate

version). The data submittal should comply with the periodicity and due date requirements identified in the standard.

III. 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 75 MVA 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 (per FERC Order 827). Any generator providing such service to the Transmission System 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 GRE's System Operations Department per the NERC VAR-001 standard. Generator Operator requirements for maintaining network voltage schedules are specified in the current version of the NERC VAR-002 standard.

C. Equipment Ratings

Part of the MISO Interconnection Process includes filling out Appendix 1 "Interconnection Request for A Generating Facility" which is part of Attachment X "Generator Interconnection Procedures". Specifically, Attachment A includes equipment rating data of the Interconnection Customer's equipment.

D. Local Balancing Authority Area Operations

The GRE transmission system is located within several different Local Balancing Authority (LBA) Areas. The LBA operator of the transmission system 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. MISO is the Balancing Authority (BA) for Great River Energy. If the point of interconnection (POI) for the pending project is within a non-GRE Local Balancing Authority Area, GRE will notify the affected LBA of the pending interconnection project during the interconnection study.

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.

E. Transmission Operator Area

The GRE owned transmission system is located within several different Transmission Operator Areas. The Transmission Operator(s) affected will be determined based on the location of the interconnection request. If the point of interconnection (POI) for the pending project is within a non-GRE Transmission Operator Area, GRE

will notify the Transmission Operator (TOP) of the point of interconnection of the pending interconnection project during the interconnection study.

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.

IV. PHYSICAL INTERCONNECTION

The configuration of the facilities that GRE 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.
All GRE Network Upgrades or Interconnection Facilities that are needed will be designed to GRE standards. GRE transmission lines will be designed using GRE standard conductor size and temperature rating criteria per "TDIV-14 Transmission Line Design Criteria." Such standards and guides will be supplied to the Interconnection Customer upon request.

GRE standards require the following:
- Any generation interconnection that is connected at 200 kV or above will require a breaker station.
- Any generation interconnection that is 20 MW or greater and connecting to transmission at any voltage will require a breaker station.
- 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.
- 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.
- 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 GRE Transmission Line

1. GRE Requirements

A disconnect device, operated by GRE or other 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 GRE and/or other Transmission Operator safety rules and practices. A disconnect device shall be located at the point of interconnection (ownership change) with GRE. GRE's standard is to design, install, own and maintain a gang operated, 3-way, full load break switch mounted on a galvanized steel full dead-end structure with GRE designated switch number plate per GRE's specifications. The switch may be required to be motor

operated. These requirements will be determined during the Facility Study phase based on Transmission Operator requirements in the area.

The switch must not be used to make or break parallels between the GRE system and the generator(s). Only GRE 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 GRE or other Transmission Operator padlocks.

2. GRE 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.

B. Interconnect to a GRE Substation

1. GRE Requirements

GRE'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. GRE 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 current levels and have a 3-cycle interruption capability or faster depending on system stability requirements.

GRE will own the first line structure outside of the substation. This structure will be a full dead-end owned and designed by GRE. The Interconnection Customer will own hardware and insulators for their circuit and GRE will own the structure, hardware, and insulators for the circuit between the structure and the substation.

C. Double Circuiting GRE Transmission Lines

GRE reserves the right to review any interconnection customer's request to double circuit GRE transmission lines. GRE does not permit double circuiting of GRE 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 GRE transmission line, the installation must meet all applicable GRE design standards and adhere to safety, operational, and maintenance concerns. Any allowed double circuit will be on GRE owned

structures in connection with a GRE power purchase agreement and adhere to a GRE approved structure sharing agreement.

V. INTERCONNECTION FACILITY OPERATING LIMITS

A. Voltage

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 ± 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.

Part of the MISO Interconnection Process includes filling out Appendix 1 "Interconnection Request for A Generating Facility" which is part of Attachment X "Generator Interconnection Procedures". This document includes generating facility data for your interconnection request.

B. Flicker

Voltage fluctuations may be noticeable as visual lighting variations (flicker) and can damage or disrupt the operation of electronic equipment. Interconnections to the transmission system are not allowed to produce flicker to adjacent customers that exceeds the guideline shown below in Figure 1. The Interconnection Customer will be responsible and liable for corrections if the interconnecting facility is the cause of objectionable flicker levels.

IEEE Recommended Practice for the Analysis of Fluctuating Installations on Power Systems

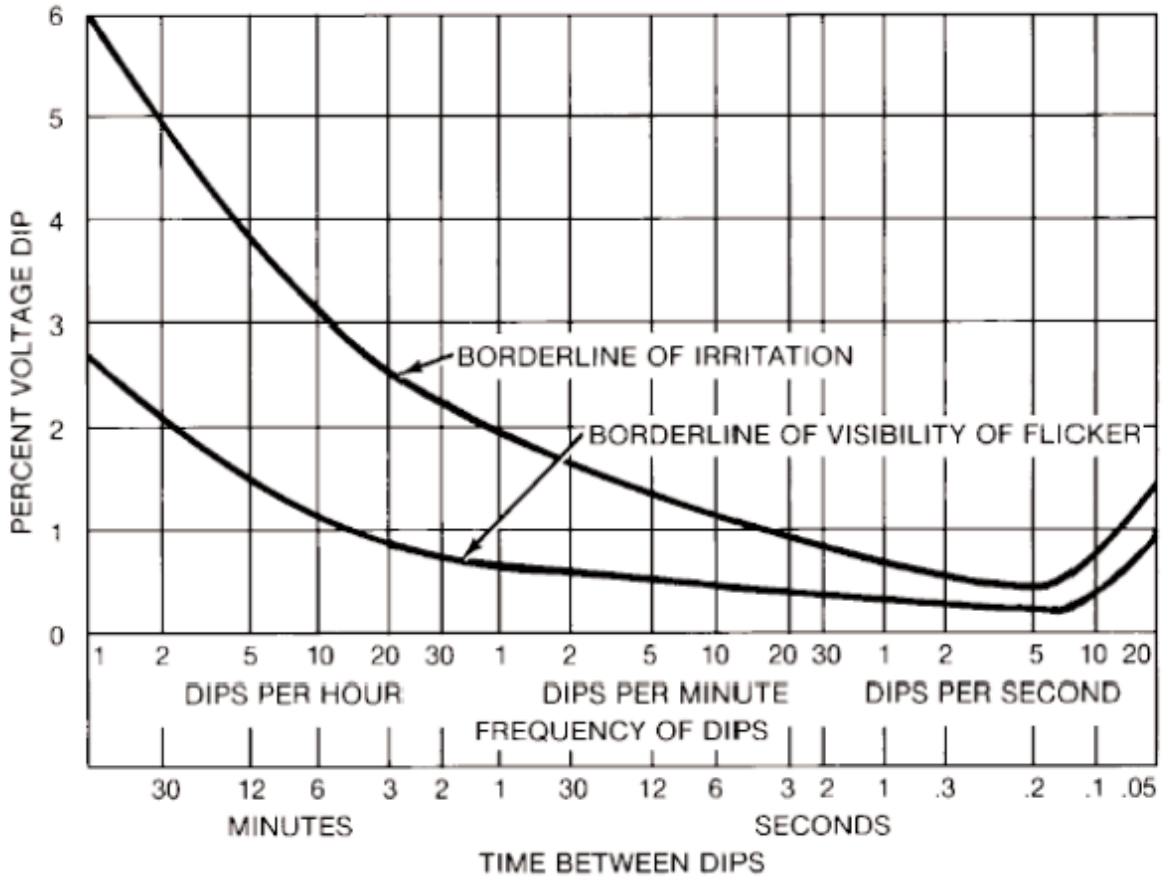

Figure 1. GRE Voltage Flicker Guideline

C. 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.

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. GRE 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 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 Harmonics)						
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 2						

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 the generator. These are often related to generator grounding, and to the type of transformer connections that may be involved. It is to the Interconnection Customer's advantage to work these problems out early enough so that Interconnection Customer and transmission system equipment can be acquired to achieve proper control.

D. Fault Current

The combined available fault current of the transmission system and the Interconnection Customer's facilities must not overstress the transmission system equipment. The Interconnection Customer shall provide any necessary equipment to satisfy this requirement.

If the installations of the Interconnection Customer's equipment causes fault current limits to be exceeded, the Interconnection Customer will be required to install equipment to limit the fault current on the transmission system or compensate the transmission owners for the additional costs of installing equipment that will safely operate within the available fault current. The exact value of available fault current depends upon location and circuit configuration and will be determined in the interconnection studies. The Interconnection Customer must work closely with GRE at the time of interconnection design to determine the available fault current at the specific location of interconnection.

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 online 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 to 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 (IEEE 1547).

VI. 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. 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. GRE shall have the right to approve those portions of the Interconnection Customer's protection system and equipment that may affect the transmission system.

GRE'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.

VII. METERING AND SCADA/TELEMETERING REQUIREMENTS

A. General

The purpose of this section is to assist Interconnection Customers in accommodating any GRE 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 GRE's transmission system.

GRE to own, operate, and maintain the SCADA, metering, and telemetry equipment at the expense of the Interconnection Customer.

B. Summary of Billing Metering Requirements

- Metering equipment (CTs, PTs, meter, etc.) shall adhere to ANSI standards C12.1 and IEEE standard C57.13.

- Minimum Instrument transformer accuracy per GRE Requirements:
  CTs (all ratios): High accuracy, extended range class 0.15B1.8
  PTs (all ratios); High accuracy class 0.15Y

- Instrument transformer test reports shall be provided to GRE.

- 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 offline.

- Metering for revenue billing should have the following requirements: MV90 compatible device, minimum 15-minuteinterval data for KWh and KVarh both delivered and received quantities, and sufficient memory for at least 45 days of data. GRE requires an internet protocol connection to the revenue meter. GRE does not allow a communication connection to our device. Alternate data sharing arrangements will be made.

- Metering current transformers shall be dedicated for metering purposes only. Connecting other equipment to the CT metering circuitis not permitted. PTs/CCVTs may be shared for metering, relaying, and controls, so long as the connected burden remains below the rated burden of the PT/CCVT.

- 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.

C. Summary of Telemetering/SCADA Requirements

The requirements for telemetry are based on the need of the GRE 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 GRE, 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 should 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.

VIII. 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 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 GRE 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. Interconnection Customer should follow Article 10 "Maintenance" of Attachment X "Generator Interconnection Procedures".

D. Testing & Inspection

Testing and Inspection requirements for new or modified facilities shall comply with Article 6 "Testing & Inspection" of Attachment X "Generator Interconnection Procedures" including special requirements of the Transmission Operator.

E. Interconnection and Synchronization with the Transmission System

Interconnection Customer is required to work directly with the Transmission System Operator who in turn will work with other Transmission Owners as necessary. Interconnection Customer should follow Article 9 "Operations" of Attachment X "Generator Interconnection Procedures".

F. 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 GRE 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 GRE 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 incapable of following its voltage schedule per the NERC VAR-001 standard (if non-exempted) or is otherwise contributing to the abnormal voltage performance of the transmission system, GRE or the Transmission Operator reserves the right to disconnect the customer or require VAR compensation.

The failure of GRE 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.

IX. GLOSSARY

Ampere (AMP): The unit of current flow of electricity. 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; for a generator, turbine, the URGE rating.

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 GRE 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) regulates interstate transmission of electricity, natural gas, and oil, and also regulates hydropower projects and natural gas terminals.

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 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.

Kilowatt hour (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 MISO and MISO Balancing Authorities for their local area within the MISO Balancing Authority Area.

Local Balancing Authority (LBA) 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: Midcontinent Independent 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, regulates interstate transmission of electricity, natural gas, and oil, and also regulates hydropower projects and natural gas terminals.

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 GRE 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 (TOP): The entity responsible for the reliability of its "local" transmission system, and that operates or directs the operations of the transmission facilities.

Transmission Operator (TOP) Area: The collection of Transmission assets over which the Transmission Operator is responsible for operating.

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.

X. REFERENCES

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“IEEE Requirements for Instrument Transformers”, IEEE Standard C57.13.

“ANSI Code for Electricity Metering”, ANSI C12.1.

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