Revision 4.0

Generating Facility Interconnection Guide

AMERICAN TRANSMISSION COMPANY

Generating Facility Interconnection Guide

(An ATC Business Practice)

Revision 4.0
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American Transmission Company
W234 N2000 Ridgeview Parkway Court
Waukesha, WI 53188-1022

American Transmission Company (ATC) is a member of the Midwest Independent Transmission System Operator (MISO)[1]. ATC owns, plans, constructs, operates, maintains and will expand its transmission facilities to provide adequate and reliable transmission of power. ATC provides nondiscriminatory service to all customers, supporting effective competition in energy markets without favoring any market participant. ATC owns approximately 9, 400 miles of transmission lines and 520 substations in portions of Wisconsin, Michigan, Minnesota and Illinois and is interconnected with more than 60 Generating Facilities owned by municipalities, cooperatives, independent power producers and investor-owned utilities. In general, ATC accommodates additions or modifications for generation customers according to the requirements of Attachment X of MISO's Open Access Transmission, Energy and Operating Reserve Markets Tariff. ATC will collaborate with MISO and the Customer in development and implementation of the appropriate interconnection solution in response to the Customer's requested need. The Customer is directed to MISO for formal submittal of an Interconnection Request for a Generating Facility for each of the following types of projects:

1. Interconnection of new generating capacity to the Transmission System.
2. Modifications[2] to existing interconnected Generating Facilities, as defined by MISO.

This Generating Facility Interconnection Guide is intended to supplement MISO requirements and address ATC's role within that process.

Any questions or requests for additional information concerning Generating Facility interconnection to the Transmission System should be directed to:

gioanotices@atcllc.com
ATC Interconnection Services
262-506-6700

[1] Capitalized terms are defined in the Glossary in Appendix A of this Guide or in Attachment X of MISO's Open Access Transmission and Energy Markets Tariff.

[2] It is possible that the Customer may have a proposed modification that MISO would not consider a "Material Modification" or "substantive modification to the operating characteristics of an existing Generating Facility" according to Section 2.1 of Attachment X of the MISO Tariff, but may otherwise have an impact on the Transmission System or generation-transmission interconnection. Consult Section 7.0 and Appendix B of this Guide for ATC's requirements pertinent to such proposed modifications.

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1 Introduction

1.1 Purpose

As a transmission-only utility, ATC partners with its interconnected and interconnecting Customers for long-term, successful Generating Facility Interconnections. This Generating Facility Interconnection Guide describes the minimum requirements for the connection of generation to the Transmission System. Additional specific requirements will be identified during studies conducted in connection with the particular Customer-proposed project. The Federal Energy Regulatory Commission (FERC) set forth the process for interconnection of generation to the Transmission System in its Order No. 2003 and, for non-synchronous generation, in its Orders No. 661 and 661-A.[3] This process is administered by the Midwest Independent Transmission System Operator (MISO) according to the Attachment X Generator Interconnection Procedures (GIP) of its Open Access Transmission, Energy and Operating Reserve Markets Tariff (Tariff). The GIP govern the interconnection of new or increased generating capacity to the transmission facilities subject to MISO Tariff, including ATC's Transmission System.

New Generation

The primary application of this Guide is to the interconnection of new generating capacity. New interconnections at existing substations will be designed utilizing this Guide while accommodating previous interconnection requirements and limitations.

Existing Generation

It is essential that the Customer and ATC maintain updated detail on the characteristics of Generating Facilities interconnected to the Transmission System. Modification of an existing Generating Facility may impact the Transmission System, the interconnection service provided to the Customer or other Customers at other locations. Therefore, the Customer is to notify ATC of planned or proposed modification according to Section 7 of this Guide and ATC will provide guidance on how to proceed.

Distribution-Connected Generation

This Guide does not apply to generation connected to distribution systems that are themselves interconnected to the Transmission System (generally those operating at voltages below 50 kV). For information concerning such distribution-connected generation, reference the *ATC Load Interconnection Guide* on the ATC Web site at http://www.atcllc.com/customer-relations/connecting-to-the-grid/.

1.2 ATC's Role

The ATC Interconnection Services group coordinates ATC's collaboration with the Customer and MISO throughout the following processes.

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[3] *Standardization of Generation Interconnection Agreements and Procedures*, Order No. 2003 *et seq,* Fed. Reg. Vol. 68, No. 160 (August 19, 2003), Order 661, 111 FERC ¶ 61,353 (June 2, 2005) and Order 661-A, 113 ¶ 61,254 (December 12, 2005).

New Generation

As coordinated with MISO, ATC performs the Interconnection System Impact Study within the GIP System Planning and Analysis Phase and the System Impact Study and Facilities Study within the GIP Definitive Planning Phase. ATC also performs verification analysis prior to commercial operation of the Generating Facility using the Customer's final as-built information to ensure that the Generating Facility characteristics, as were provided by the Customer for the interconnection studies, are consistent with the Facility, as installed. Additionally, ATC will review the role of any proposed Generating Facility in ATC's Black Start Plan.

Existing Generation

For Customer planned or proposed modifications to existing Generating Facilities that may potentially impact the Transmission System or interconnection, ATC will perform analysis as described in Section 7 of this Guide to determine impacts and the time and costs of associated upgrades.

1.3 Legal and Regulatory Requirements

1.3.1 FERC

Throughout the interconnection process, ATC adheres to the FERC Standards of Conduct[4] as well as the rules relating to critical energy infrastructure information.

1.3.2 State

The states in which ATC operates have their own requirements for generator siting and construction. This Guide is not intended to describe those requirements. The Customer will be responsible for compliance with the specific state requirements and processes. Further information regarding these requirements and processes is available from the pertinent state regulatory agency:

- Public Service Commission of Wisconsin - http://www.psc.wi.gov/
- Michigan Public Service Commission - http://www.michigan.gov/mpsc/
- Minnesota Public Utilities Commission - http://www.puc.state.mn.us/
- Illinois Commerce Commission - http://www.icc.illinois.gov/

1.3.3 NERC

ATC is registered as a Transmission Owner, Transmission Operator, Transmission Planner, and Planning Coordinator with both the Midwest Reliability Organization (MRO) and ReliabilityFirst Corporation (RFC) under the requirements of the electric reliability organization, the North American Electric Reliability Corporation (NERC).

ATC and the Customer will plan, design, construct, own, operate, and maintain their respective facilities within the Transmission System, Interconnection Facilities, and Generating Facility consistent with Applicable Reliability Standards.

[4] Order No. 888, 61 FR 21540 (May 10, 1996)

2 New or Modified Generating Facility Interconnection Process

The specific steps and requirements of the process for interconnecting new generating capacity to ATC's Transmission System are set forth in detail in MISO's Generator Interconnection Procedures (GIP). This guideline is intended to provide further information concerning how ATC can assist the Customer throughout this process.

2.1 Initiation and Development

A Customer request for interconnection to MISO begins the MISO Pre-Queue and Application Review process. The specific requirements of the interconnection request are available on the MISO website Generator Interconnection page at https://www.midwestiso.org/Planning/GeneratorInterconnection/Pages/GeneratorInterconnection.aspx. In addition to the formal mechanisms, ATC encourages communication throughout the process and offers meeting with prospective generator Customers prior to and during the development of the interconnection request.

2.2 Interconnection Studies

ATC will work with the Customer throughout the study process. The basic process involves:

a. Application Review

b. System Planning & Analysis (the SPA)

- Interconnection System Impact Study includes short circuit, stability and power flow analysis to determine the appropriate Network Upgrades and Interconnection Facilities necessary to accommodate the Customer interconnection request.

c. Definitive Planning (DPP)

- Interconnection System Impact Study or Restudy may be required to support transition to Definitive Planning.
- Interconnection Facilities Study is an engineering report with scope, schedule and cost estimates for design and construction of the Network Upgrades and Interconnection Facilities.

The Customer may consult the MISO GIP for further details on milestones and the scope, timeframe and deposits required for each of the Interconnection Studies.

2.3 Data Requirements

Information is required from the Customer during the interconnection study process under the GIP and throughout the life of the interconnected operation of the Generating Facility. Generally, the information required during the GIP is noted in Table 2-1 below. Additional details are included in Appendix B of this Guide. Section 7 of this Guide addresses ATC's process for working with Customers to manage and maintain accurate data once new generating capacity achieves Commercial Operation.

Table 2-1: Midwest ISO Generator Interconnection Process Summary

Process	Components	Required Information
Pre-Queue and Application Review	- Pre-Queue Discussions - Application to MISO - Meet Milestone 1 (M1) - Feasibility Study - G-T Study Process Path Decision (SPA or Definitive Planning)	Generic stability model; Point of Interconnection (POI); impedance to POI; one-line diagram; generation output; step-up transformer data; proof of site control
System Planning & Analysis (SPA)	- System Impact Study	Generating Facility unit ratings, exciter data, reactance, time constants and curves; step-up transformer data; governor data; excitation system data; Wind Farm specific data.
Definitive Planning	- Meet Milestone 2 (M2) - SPA Review and Potential Restudy (if SPA path taken) - Abbreviated System Impact Study (if SPA path not taken) - Meet Milestone 3 (M3) - Facilities Study - IA Negotiation	M2 - Detailed stability model; definitive POI; definitive one-line diagram: definitive generation output; proof of site control; necessary permits; regulatory approval; board approval; M2 deposit M3 – one of three: (1) Deposit equal estimated cost of Network Upgrades, (2) Power purchase agreement or evidence of inclusion in state resource adequacy plan, or (3) Evidence of turbine order.
Construction		Any required technical data, including: - Interconnection substation location and detail - Preliminary and final design

2.4 Interconnection Agreement

After the Interconnection Studies are completed and prior to design and construction of any required Network Upgrades, the Customer, ATC and MISO will execute a Generator Interconnection Agreement (GIA). The GIA sets forth a schedule of milestones for the construction of the Interconnection Facilities and Network Upgrades necessary to interconnect the proposed new generating capacity, as determined by the Interconnection Studies. The schedule reflects the expected time to obtain all necessary governmental and regulatory approvals and permits required for the construction and operation of the Generating Facility, Interconnection Facilities, and Network Upgrades.

The GIA also establishes the terms and conditions for the interconnected operation of the Generating Facility including, among other things, operational coordination, outage scheduling, coordination of planned and emergent maintenance, future modifications, billings and payments and other communications and coordination procedures. Some additional detail in this regard is provided in Section 7 of this Guide.

2.5 Coordination with Local Utilities

Generating Facility interconnection projects require significant coordination with other local utilities. As a transmission-only company, ATC does not provide local distribution utility services, but as a business partner, ATC supports the integration of new generation into its territory. The Customer is responsible for compliance with the requirements of the local distribution utilities and while this Guide is not intended to describe those requirements in detail, there are a number of typical issues that warrant consideration early in the interconnection process.

a. Facilities locations and potential conflicts
    - Overhead distribution facilities
    - Underground distribution facilities
    - Delivery route for large equipment, including "crane-walk" plans for equipment installation

b. Metering
    - Balancing authority metering[5]
    - Revenue metering

c. Temporary (construction) and permanent service
    - Auxiliary power

[5] Consult ATC's Coordination of Balancing Authority Business Practice for guidance on the coordination of Balancing Authority Area (BAA) facilities associated with generator interconnections.

3 Design Requirements

3.1 Interconnection Configuration

3.1.1 Minimum Configuration

The configuration of the interconnection substation will depend on several factors including, but not limited to the number and size of generating units connected, the nominal voltage of the transmission facilities to which the generation is being interconnected, the number of transmission outlets either existing or required and whether or not any of the transmission lines are part of a black-start restoration path. The configuration of the Interconnection Facilities will be determined through the study process. However, the exact transmission line and substation locations may be modified during the detailed design and regulatory process.

As shown in Figure 3-1, for interconnection to the Transmission System at voltages of 100 kV and above, the minimum configuration for the ATC interconnection substation will be a three-position ring bus. Straight bus configurations may be considered for interconnection at voltages below 100 kV, subject to the provisions of Section 7.6 of this Guide. As shown in Figure 3-2, an ATC-owned circuit breaker and disconnect switch in series with the Customer's transformer circuit breaker as part of the ATC Interconnection Facilities will be required for any straight bus configuration. As shown in both Figure 3-1 and Figure 3-2, for all interconnections, the Customer will, at minimum, procure, install, own and maintain a circuit breaker and disconnect switch between the Point of Change of Ownership (PCO) and the Customer's transformer (step-up or auxiliary) to transmission voltage to be located in the Customer's substation.

Figure 3-1: Minimum configuration for interconnection at 100 kV and above

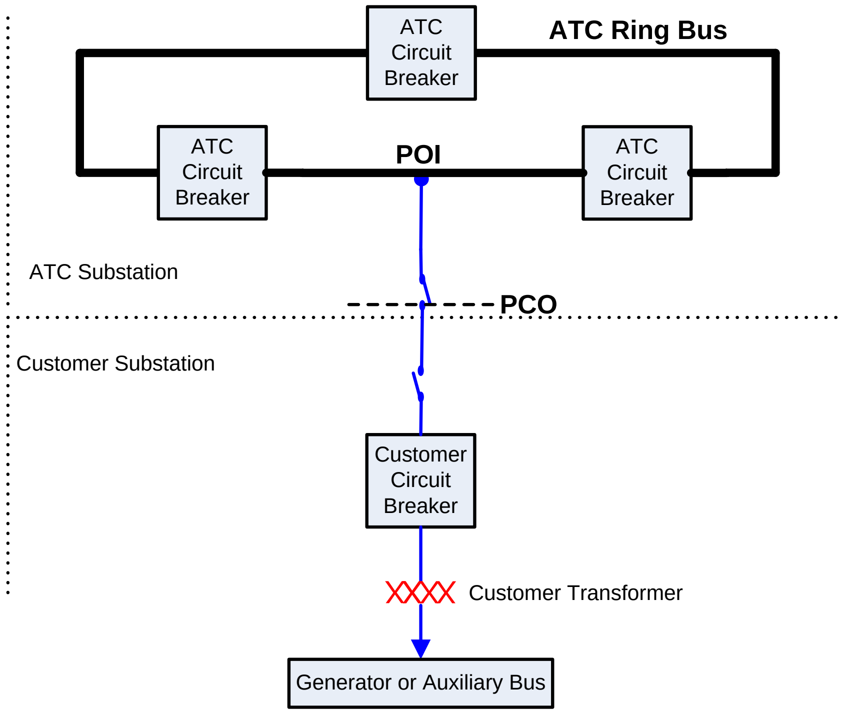
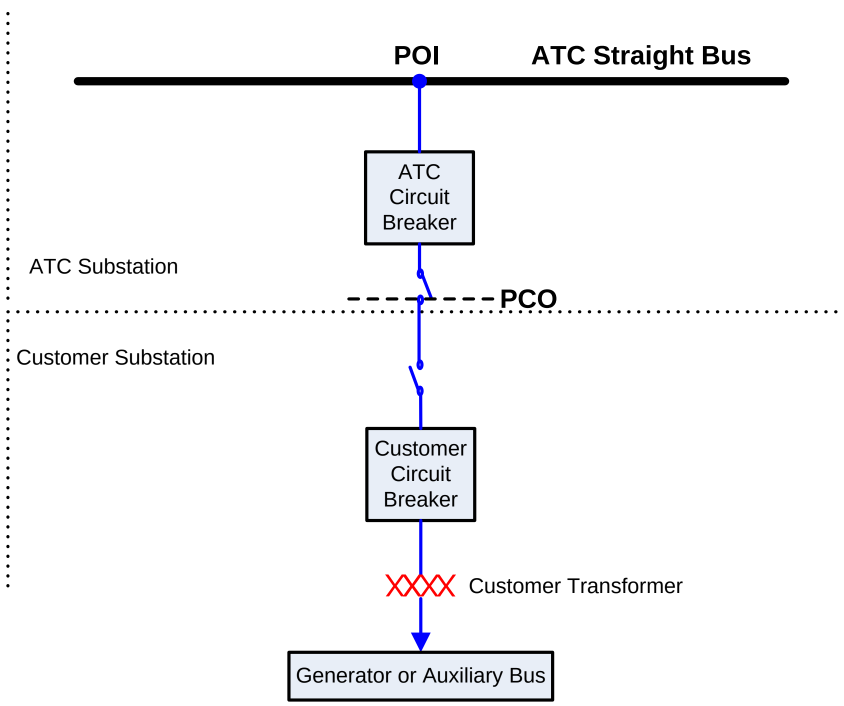


Figure 3-2: Straight bus configuration



3.1.2 Proximity of ATC and Customer Substations

For an ATC interconnection substation built adjacent to the Customer's substation, the connection between the ATC network bus and the Customer's substation will be considered by ATC as a bus extension and a bus protection scheme will be required. However, if the substations are not adjacent, the connection will be considered a line, not a bus extension, and a line protection scheme will be employed by ATC.

3.2 Demarcation and Ownership

The Point of Interconnection (POI) will be the point at which the ATC Interconnection Facilities connect to the ATC interconnection substation bus. The PCO will be at the point at which the strain bus from the Customer's substation connects to the dead end structure of the ATC Interconnection Facilities located in the ATC interconnection substation. In the event that the interconnection is via rigid bus conductor, the PCO will be the terminal connection of ATC's switch in the ATC interconnection substation.

3.3 Substation Site

ATC's interconnection substation will be designed as an entirely separate substation from the Customer's substation. The Customer will be required to provide a suitable site for the ATC interconnection substation. The Customer will be required to convey to ATC all necessary easements, in a form acceptable to ATC, over all property owned, leased or otherwise controlled by the Customer, including easements for ingress and egress to permit ATC access to all of the ATC Interconnection Facilities and Network Upgrades, which are on the property of the Customer. Additionally, the site that the Customer provides to ATC must be sufficiently large enough to accommodate the present and future uses of ATC and meet the rough grading requirements of ATC. The Customer will be responsible for obtaining all necessary zoning, building, environmental, storm water retention or detention and other permits or approvals. The specific real estate requirements will be determined during the detailed design. If the Customer's substation is adjacent to the ATC interconnection substation, a fence separating them will be required. ATC will design, own and maintain this common fence according to its standards.

3.4 Power Factor

ATC's standard power factor range for synchronous and non-synchronous (e.g., wind turbines) generation is 0.95 leading (when a Generating Facility is consuming reactive power from the Transmission System) to 0.90 lagging (when a Generating Facility is supplying reactive power to the Transmission System)[6]. The Generating Facility must be capable of maintaining a composite power delivery at the Point of Interconnection across ATC's standard power factor range at all power output levels between 10% and the Generating Facility's maximum rated power output. Continuous dynamic operation by non-synchronous machines throughout the power factor design range as measured at the Point of Interconnection may be required if the Interconnection Studies identify this requirement. Such operation will account for the net effect of all energy production devices on the Customer's side of the PCO.

dynamic generator response.

[6] These values have been approved by the FERC for use by ATC. (cf. FERC Orders ER05-1475 and ER06-866)

3.5 Low Voltage Ride-Through Capability

All generators connected to the Transmission System must be capable of "riding through" disturbances that depress system voltages, as required by FERC Orders 661-A and 693. All generators must communicate the low voltage as-built ride-through capability of the Generating Facility following the Commercial Operation Date.

3.6 Generation Voltage, Reactive Power and/or Power Factor Control

The Customer must design the Generating Facility such that controls are included on each generating unit to be interconnected to control voltage, reactive power, and/or power factor consistent with the requirements of the GIA and Section 7.2 of this Guide. Additionally, the Customer must design the Generating Facility to include provisions for power system stabilizers, except where exempted by the FERC. Depending on the size and location of the generator, a power system stabilizer may be required for interconnection.

3.7 Power Quality, Voltage Flicker and Harmonics

The design, energization and operation of any Generating Facilities must be consistent with ATC's Tariff-required Planning Criteria and Operating Instructions 04-01 and 04-02 regarding power quality including harmonics; permissible voltage deviations, flicker and distortion; and distortion of current waveforms as measured at the Point of Interconnection. ATC's Planning Criteria and Operating Instructions are available upon request.

3.8 Frequency

The interconnected Transmission System has a nominal operating frequency of 60 Hz. The Customer will install both generation controls and protective relaying equipment necessary to maintain proper Transmission System frequency (cf. Section 4.2).

3.9 Fault Current

Customer facilities connected to ATC's Transmission System can be subjected to fault levels that are largely the product of system characteristics and interconnection impedance. The Customer's facilities must possess sufficient fault interrupting and momentary withstand ratings to meet the maximum expected fault current, with appropriate margin for future system growth. ATC will provide the transmission contribution to the fault current levels at the Point of Interconnection in the System Impact Study report and otherwise at the request of the Customer.

3.10 Auxiliary Power

The Customer shall procure its own primary and secondary sources of auxiliary power for its substation. ATC shall procure its own primary source of auxiliary power for the ATC interconnection substation. ATC may require the Customer to provide, at Customer's expense, a secondary source of auxiliary power to the ATC interconnection substation off of the Customer's substation equipment.

3.11 Voltage Level

New interconnections must effectively address the voltage requirements of both this section and Section 7.2. ATC operates transmission facilities predominantly at nominal system voltages of 69, 138, 345 kV. For the purposes of this guide, any reference to 138 kV voltage levels shall also encompass interconnections to ATC's 115 kV system as well. ATC will discuss with the Customer on a case-by-case basis requirements associated with interconnections to the relatively small amount of 161 and 230 kV facilities owned and operated by ATC.

3.12 Basic Impulse Insulation Level

ATC and the Customer must ensure that all equipment is adequately protected from excessive system over-voltages. This includes selection of equipment Basic Impulse Insulation Level (BIL) and protective devices (e.g. surge arresters) to achieve proper insulation coordination across the interconnection.

ATC designs its transmission facilities for the BILs shown in Table 3.1 below. Interconnections at 230kV or 161kV will be reviewed on an exception basis. New substations energized at 115 kV will be built to 138 kV system BIL. Additions to existing substations energized at 115 kV or 138 kV; with 550 kV BIL construction will be continued similar to their original design. In all other cases consideration will be given to the existing substation design.

Table 3.1: Basic Impulse Insulation Levels (BIL)

Nominal Operating Voltage (phase-to-phase)	345 kV	138 kV	69 kV
Basic Insulation Level (BIL)	1300 kV[1]	650 kV[2]	350 kV
1. In some remote locations and transformers a 1050 kV BIL may be acceptable. 2. In some remote locations and transformers a 550 kV BIL may be acceptable.			

3.13 Recommended Customer Step-Up Transformer Configuration

ATC recommends that the Customer install a generator step-up or substation transformer with a high-side, nominal center tap, with two taps above and two taps below, each set at 2.5% of the nominal voltage. ATC also recommends a high-side grounded wye, transformer bank for interconnection of a generating unit. Any other transformer configuration may require enhanced protection, as determined by ATC.

4 Protection

4.1 General

All Generating Facility interconnections to the Transmission System shall be designed to avoid safety hazards or to avoid adversely affecting the quality of electric transmission service to ATC customers. Protective equipment may need to be added to standard ATC facilities to provide adequate protection of the Transmission System. Requirements for additional protective equipment will vary depending upon the amount of generating capacity being added and on the nature of ATC's local system.

4.1.1

As part of the protection facilities, ATC will design and construct a protective relaying scheme to protect the Transmission System from faults occurring on the Customer's

Interconnection Facilities, the Generating Facility, ATC Interconnection Facilities, or the Transmission System. The Customer will be responsible for protecting the Generating Facility and all Customer Interconnection Facilities from faults occurring on its facilities or the Transmission System.

4.1.2

The Customer will design, install, set, and maintain all protective devices necessary to protect the Generating Facility in accordance with ANSI/IEEE standards, Good Utility Practice(s), Applicable Reliability Standards, the Interconnection System Impact and Facilities Studies and applicable standards and guides. Protective devices, including those performing the protective functions required by ATC in accordance with this Guide, will be installed by the Customer to disconnect the Generating Facility from the Transmission System whenever a fault, abnormal operating condition or equipment failure occurs. The Customer will ensure that such protective devices and related equipment properly coordinate with ATC protective equipment, both locally and remotely, and provide a comparable level of protection to the Generating Facility and the Customer Interconnection Facilities as is provided by ATC for the ATC Interconnection Facilities and Transmission System. The specific requirements and specific protective devices to be installed will be determined in the Interconnection Studies.

4.1.3

The Customer will allow ATC to review the Generating Facility protection, control design and settings, and their coordination, where applicable, with the ATC protective devices prior to and after the Commercial Operation Date. ATC reserves the right to refuse to allow the Customer to initiate the tender of energy to the Transmission System if, in the judgment of ATC, the Generating Facility protection devices, controls or overall protection methods do not adequately prevent the Generating Facility from introducing or causing an adverse impact on the Transmission System.

4.1.4

Protective relays utilized by the Customer shall:

a. Meet or exceed ANSI/IEEE standards for protective relays (i.e., C37.90-1989, C37.90.1, C37.90.2, and C37.90.3).

b. Have the appropriate documentation covering application, testing, maintenance, and service.

c. Give positive indication of what has caused a trip (targets).

d. Have a means of testing that does not require disturbance to wiring (e.g. a draw-out case, test-blocks, test switches, etc.).

The Customer shall use microprocessor-based protective relays that include self-diagnostic abilities, sequence of events, event-recording capabilities, and operating flexibility.

4.2 Frequency Protection (IEEE 81)

The design of the Generating Facility relating to over-frequency protection of the Generating Facility is discretionary with the Customer. However, the over-frequency protection used by the Customer will be provided to ATC. Under-frequency protection will be in accordance with the Applicable Reliability Standards.

4.3 Customer Breaker Failure Protection (IEEE 50BF)

The Customer shall install a local dedicated 50BF breaker failure protective relay on its breaker on the high-side of the generator step-up transformer. The 50BF relay will be coordinated with ATC in order to trip adjacent substation breakers, in the event the generator breaker fails to successfully open for any reason.

4.4 Synchronism Check Relay (IEEE 25)

The Customer will synchronize the Generating Facility to the Transmission System across the Customer-owned breaker installed on the high-side of the generator step-up transformer. The Customer shall provide a synchronism-check relay to supervise the automatic or manual synchronization of the Generating Facility to the Transmission System. Automatic synchronism-check relays will contain the manufacturer's optional voltage monitoring functions and supervise the closing of the circuit breaker. ATC will be entitled to review the settings and operation of the Generating Facility's synchronism check relay.

4.5 Bus Differential Protection (IEEE 87)

The Customer shall provide a dedicated current transformer input to the ATC bus differential protection scheme to provide coordinated bus differential protection of ATC's bus. This current transformer shall be placed in a manner to ensure that the bus differential protection overlaps the generator bus or step-up transformer protection.

4.6 Reverse Power (IEEE 32)

The protection system for all combustion turbine generators connected to the Transmission System and the reverse power relay pickup shall be set no more than -7% of the machine rated MVA to protect the Transmission System from a possible voltage collapse due to the gas turbine high power consumption during motoring.

4.7 Power Transformer Ground Time Overcurrent Protection (IEEE 51N)

The Customer shall install ground time overcurrent protection for all generator step-up and auxiliary power transformers to protect them from internal ground faults. Such protection will be coordinated with the backup ground time overcurrent protection.

4.8 Protection Redundancy

In accordance with Good Utility Practice, the Customer shall design protection schemes such that no single component failure will prevent the isolation of faults and/or failed equipment. This may require providing redundant or backup protective schemes with separate sensing sources, separate trip paths, dual trip coils on breakers, separate control power supplies, etc.

4.9 Generator Tripping

Each generating unit of the Generating Facility must be capable of disconnecting itself from ATC's Transmission System in the event of a system fault, abnormal operating condition or equipment or system failure. If the Generating Facility is a wind farm, it must be disconnected at the collector bus to remove the ground source of the collector to eliminate its contribution to a system fault, abnormal operating condition or equipment or system failure.

4.10 Recommended Generator Protection Functions

ATC recommends the following protective functions, which may provide the Generating Facility with additional backup protection from transmission relaying malfunctions, misoperations, equipment or system failure.

4.10.1 Phase Distance (Impedance) Protection (IEEE 21)

The Customer's distance relay zone that extends into the Transmission System should be time-coordinated with line protective relays to assure transmission protection operates first. The time delay will be set higher than a second zone clearing time for a line fault (typically 20 cycles). Impedance protection is provided for a generating unit when transmission line(s) that connect it to the Transmission System are protected with phase distance relays.

4.10.2 Time Overcurrent with Voltage Control/Restraint (IEEE 51V)

The Customer's overcurrent relays that are voltage-controlled or voltage-restrained should be set below load current for adequate sensitivity to Transmission System faults while restraining operation under emergency overload conditions. To prevent miscoordination with transmission relaying, overcurrent relays should be sufficiently time-delayed. The time-delay setting should be based on the worst-case coordination with ATC protective relays, which is usually a delayed trip with breaker failure clearing times. Backup time overcurrent protection is provided for a Generating Facility when transmission line(s) that connect it to the transmission grid are protected by overcurrent relays.

4.10.3 Backup Ground Time Overcurrent Protection (IEEE 51N)

It is recommended that any backup ground time overcurrent protection operate for ground faults at the end of all transmission lines coming out of the Generating Facility and be set to coordinate with the slowest ground fault protection on the Transmission System. This relay is typically installed in the high-side neutral of the generator step-up transformer.

4.10.4 Negative Sequence Current (Unbalanced Load) Protection (IEEE 46)

The Customer should apply a negative sequence time overcurrent relay to protect the Generating Facility from external unbalanced conditions such as system phase-to-phase faults and open conductors that can damage a generating unit(s).

4.10.5 Out-of-Step (Loss of Synchronism) Protection (IEEE 78)

The Customer shall ensure that each generating unit is capable of separating from the Transmission System before an "out-of-step condition" or loss of synchronism can occur.

4.10.6 Voltage Balance (IEEE 60)

The Customer should ensure the following voltage-dependent protective functions are blocked when a loss of fuse is detected to prevent relaying misoperation:

a. Phase distance (impedance) protection (IEEE 21);

b. Under-voltage protection (IEEE 27);

c. Loss of field (under-excitation) protection (IEEE 40);

d. Time overcurrent with voltage control/restraint (IEEE 51V);

e. Under-frequency protection (IEEE 81).

4.11 Transmission Line Automatic Reclosing Near Generating Facility

The automatic re-closing of breakers on ATC transmission lines can be potentially damaging to Customer equipment that is in close electrical proximity to the lines. As a general policy, ATC will not eliminate automatic reclosing of overhead transmission lines near a Generating Facility because that could significantly affect the reliability of service to transmission customers. In order to mitigate possible negative effects of line automatic reclosing on generating facilities, ATC typically will not reclose lines for the most severe three-phase faults on the Transmission System and will reclose a line first at a terminal remote from the Generating Facility bus, followed by synchronism check reclosing of the breaker at the Generating Facility bus. Automatic reclosing is single-shot and is blocked should a fault be of a permanent nature. ATC may install additional equipment to minimize the potentially adverse effects of automatic reclosing. This usually consists of communication and/or control equipment to disconnect the Generating Facility (or to confirm that it is disconnected) before an ATC line is reclosed.

In cases where the ATC interconnection substation has two transmission outlets, a line side single-phase voltage-sensing potential device shall be installed at the remote terminal of each line. Additionally, the automatic reclosing scheme at the remote terminal of each line shall support disabling automatic reclosing via supervisory control.

4.12 Grounding

The Customer must design, install, and maintain grounding facilities to ground the Customer's Interconnection Facilities. ATC reserves the right to approve the grounding system design to ensure that the grounding system properly protects ATC's Interconnection Facilities. Additionally, ATC will determine the required short circuit ratings for all of the ATC Interconnection Facilities and Network Upgrades during the detailed design of such facilities. The Customer shall provide appropriately sized or short circuit-rated Interconnection Facilities comparable to those required by ATC.

The Customer and ATC will design their respective substations' ground grids separately for the maximum available fault current as specified by ATC. The ground grids of both substations will then be connected together at several locations along the common fence before the substations are placed in-service. The Customer and ATC's designs shall address safe touch and step potential not only for their respective ground grids, but also for along the fence line with the connection of the ground grids.

4.13 Equipment Ratings

ATC shall determine the individual equipment ratings for the ATC Interconnection Facilities and Network Upgrades during the detailed design of the facilities in accordance with its design standards and the Interconnection Studies. The Customer shall size its Interconnection Facilities to appropriately coordinate with the ATC Interconnection Facilities. ATC and the Customer shall exchange information before the Commercial Operation Date or implementation of any future modifications, including identification of the most limiting piece of equipment, to achieve common understanding of each party's respective Interconnection Facilities' normal and emergency ratings.

5 Telemetry and Metering Requirements

5.1 Telemetry

The Customer shall provide ATC with real-time analog and digital Generating Facility data. The method in which the signals shall be transmitted to the ATC location will be specified during the detail design of the Interconnection Facilities and Network Upgrades. The Customer shall provide the data in a format acceptable to ATC. If the Customer cannot supply the data in an acceptable format like ICCP, then ATC will install an RTU at the Generating Facility to collect this information. Additionally, the Customer will install and maintain interconnection metering and status data for the connection of each generating unit, except as noted below.

In general, ATC requires continuous telemetry of the following:

5.1.1 Status of Circuit Breakers

5.1.1.1 Capable of disconnecting the Generating Facility from the Transmission System.

5.1.1.2 Capable of disconnecting any auxiliary load from the Transmission System.

5.1.1.3 Capable of disconnecting any device that is required to be in service to meet the unit(s) requirements for reactive power compensation as part of the Interconnection Agreement.

5.1.2 Status of Relay Equipment

Status of relay equipment is required when the Customer's relay equipment is protecting, as primary or backup, any of ATC's Transmission System equipment.

5.1.3 Instantaneous Real and Reactive Power Data

Instantaneous real and reactive power data are required for each generating unit at the generator terminal or compensated to the generator terminal. For wind farms, aggregated real and reactive power data at the collection substation are required.

5.1.3.1 For all Generating Facility auxiliary loads connected between the generator terminal and the Point of Interconnection with the Transmission System.

5.1.3.2 For all Generating Facility auxiliary loads connected directly to the Transmission System.

5.1.3.3 For all third-party loads supplied from the Generating Facility of Customer Interconnection Facilities.

5.1.4 Instantaneous Voltage Data

5.1.4.1 At the terminal of each generator. For wind farms, at the collection substation bus.

5.1.4.2 At the terminal of any device installed to provide static or dynamic reactive power compensation.

5.1.5 In-service Status and Readiness of:

5.1.5.1 Any power system stabilizer installed.

5.1.5.2 Automatic voltage regulator (AVR).

5.1.5.3 Any special protection system (SPS).

5.1.5.4 Any reactive power compensation, whether static or dynamic.

5.2 Local Balancing Authority Metering

The Customer is responsible for working with an appropriate Local Balancing Authority to install necessary metering facilities, including instrument transformers within the Customer's interconnection substation. Prior to energizing the interconnection via the Transmission System, the Customer must provide evidence of a Balancing Authority Agreement to ATC. See ATC's Coordination of Local Balancing Authority Metering Boundary Modifications Business Practice for additional information:

http://www.atcllc.com/customer-relations/business-practices/

6 Testing, Inspection and Commissioning

6.1 Testing and Inspection

Before ATC provides final approval for energization of the interconnection, the Customer must demonstrate to ATC, through witnessed tests and/or certified test documentation, that the Generating Facility, and each generating unit, will not have adverse impact on the operation of the Transmission System. Such tests and inspections will include pre-energization testing of equipment connected to the transmission bus, protection and control systems and pre-commercial testing of the governor, excitation and/or power system stabilizer controls. Protection and control systems include, but are not limited to, AC auxiliary, DC systems, relaying systems, potential and current circuits, and communication systems.

6.2 Initial Transformer Energization

Installation and commissioning of a new Customer transformer will require the initial energization to occur from the Transmission System. Prior to initial energization of a new Customer transformer at a new or existing Generating Facility and if determined necessary by ATC, the Customer must permanently install mitigation equipment (e.g., pre-insertion resistors on the high-side transformer circuit breaker) or commission a technical study of the initial energization event to ensure that the initial energization of the transformer will not result in any unacceptable impact to the Transmission System or any other interconnected customers. If the Customer commissions a technical study for this purpose, a final report must be submitted to ATC for review no less than ten (10) business days prior to the Customer's planned date for initial energization.

6.3 Reduction of DC Residual Flux

The Customer will perform an excitation current test to determine if the core of any new Customer transformer is magnetized. If the test establishes that the core is magnetized, the Customer will perform the transformer manufacturer's recommended procedures to reduce the residual DC flux on the core. The Customer will then re-perform the excitation current test to verify that the core has been de-magnetized. The Customer will provide documented results of these procedures to ATC prior to energization of the Customer transformer.

6.4 Generating Facility Synchronization

Unless otherwise permitted by ATC, the Generating Facility shall be synchronized to the Transmission System at the Customer's step-up transformer's high-side circuit breaker installed at the Point of Interconnection. ATC shall furnish Transmission System bus potentials that may be used by the Customer for synchronizing the Generating Facility to the Transmission System.

7 Requirements after Commercial Operation

The GIA (per Section 2.4) establishes the terms and conditions for the interconnected operation of the Generating Facility after achieving Commercial Operation, especially procedures for communication and coordination among the Customer, ATC, and MISO. ATC sees such effective communication and coordination as essential to planning, operating, and maintaining a safe and reliable Transmission System and Generating Facility Interconnection. This section provides summary guidance on certain Interconnection Agreement provisions that may impact the Customer's decision-making in the design of new or modified Generating Facilities for interconnection to the Transmission System. The Customer should consult the Interconnection Agreement for additional detail on requirements pertinent to ongoing interconnected operations.

7.1 Operating Guidelines

The specific requirements of each interconnection will dictate the establishment of mutually agreeable interconnection and/or operating guidelines applicable to each Generating Facility, if necessary.

7.2 Generating Facility Voltage Schedule

NERC Mandatory Reliability Standards VAR-001 and VAR-002 set forth the requirements Transmission Operators and Generator Operators/Owners must follow to maintain network voltage schedules. VAR-001 requires that the Transmission Operator specify a voltage schedule at the Point of Interconnection "and direct the Generator Operator to comply with the schedule in automatic voltage control mode (AVR in service and controlling voltage)." VAR-002 requires that the Generator Operator maintain the voltage schedule set by ATC and operate each generator in automatic voltage control mode, among other requirements.

VAR-001 provides that "[t]he voltage schedule is a voltage target that must be maintained within a tolerance band during a specified period." ATC's standard voltage schedule is a target voltage of 102% of the nominal voltage at the Point of Interconnection within a maximum permissible range of 95% to 105% until ATC specifies a new voltage schedule. The Generating Facility must be designed and operated for this voltage schedule unless directed otherwise. In addition, operation within a desired tolerance band of 100% to 105% is recommended to ensure efficient and reliable operation of the bulk electric system due to real time system conditions that may not have been specifically modeled in the planning horizon.

7.3 Unit Stability

The Customer shall operate the Generating Facility in accordance with the operating requirements of ATC, MISO, NERC, and any applicable regional entity in addition to the stability requirements identified in the Interconnection System Impact Study report, or its equivalent, prepared for the interconnection and which have been posted on the Transmission Provider's OASIS at:

http://oasis.midwestiso.org/OASIS/ATC/

7.4 System Restoration (Black Start)

The Customer is not required to operate as a Black Start Unit unless designated by a separate Black Start Service agreement. However, in accordance with Good Utility Practice, Customer will participate, when called upon by MISO or ATC, in ATC's Black Start Plan for the Generating Facility and ATC's Transmission System, as well as any verification testing. The Customer is required to supply to ATC its facility black out plans. These plans shall include the equalized impedance of the systems within the Generating Facility auxiliary system to large motors expected to be started during emergency conditions along with the appropriate time-domain modeling assumptions for each large motor to be used by ATC to confirm ATC's Black Start Plan. ATC will use this information to study the ability of a degraded system to start large motors, such as fans, pumps, and other equipment during system black outs and restoration. The Customer will also be expected to participate in any Black Start Plan verification testing.

7.5 Maintenance Testing

After commissioning of the Generating Facility, periodic maintenance, testing, modification or troubleshooting of Customer equipment shall be done with consideration of the impact to the Transmission System. Protective relay testing that can trip any element of the Transmission System shall be discussed and approved by the ATC system operator 10 business days prior to testing of equipment.

7.6 Detection of and Tripping for an Electrical Island Condition

In circumstances where the Generating Facility has no governor controls and the transmission system design could result in an islanding condition for the outage of two transmission elements, ATC requires the Customer to implement additional protection systems as mutually agreed by the Customer and ATC to prevent generation from being isolated or islanded with interconnected load. Alternatively, ATC will require the Customer to curtail their generation for circumstances that could result in an island condition with the next contingency.

7.7 Generating Facility Modifications

It is of critical importance for reliable interconnection service and operation of the Transmission System that the Generator Owner communicate to ATC proposed and planned changes to the Generating Facility, Interconnection Facilities and related equipment. Communication of changes should occur as early as possible using the ATC Generating Facilities Modification Notification (GFMN) form found at:

http://www.atcllc.com/documents/GFMNForm.doc

The GFMN form may be sent to ATC via email at:

gioanotices@atcllc.com

The GFMN is to be used to communicate events including, but not limited to, the following:

- Plant/Unit modifications due to emergency changes.
- Planned/Proposed plant/unit modifications.
- Plant/unit retirements – note that the GFMN does not replace other notification requirements; it is in addition to those requirements.
- Plant/unit development
- The submittal of unit verification data created as a result of periodic testing.
- The submittal of generator data/information, as required, for reporting data related to NERC and/or Regional Entity standards.
- The submittal of generator data/information as required reporting due to MISO transmission and/or energy market needs.

If proposed modifications are determined to have an impact on the Transmission System, ATC and the Customer will collaborate on the appropriate solution(s) to enable successful implementation of the proposed unit modification.

7.7.1 The Annual Review

ATC performs an Annual Generator Review to ensure the accuracy of its information for Generating Facilities connected to the Transmission System. Information obtained via the

Annual Review also contributes to ATC filings made to RFC, MRO and NERC. The primary ATC functions using the Annual Review results are Planning, System Protection and Real Time Operations.

ATC will send an email communication to Generator Owners requesting the following information to initiate the Annual Review process:

- Any planned retirements of plants/units
- Any planned development of new plants/units
- Any modifications made in the prior year for which ATC is unaware
- Any modifications planned or proposed for the future
- Special data reviews such as capability curve confirmations

7.7.2 Generating Unit Testing

ATC desires to support and take part in the Generator Owner's generator reactive power capability verification testing. Coordination between the Generator Owner and ATC will provide a better test environment. ATC encourages the Generator Owner to use the NERC MOD 25 format to report the results, the same format Generator Owners use to report this data to NERC. Appendix C, Generating Unit Test Requirements, contains detailed information for coordinating testing.

Effective Date: 1/14/2013		**Revision: 4.0**
TITLE:	Generating Facility Interconnection Guide Approved by: Tom Finco	**Page 20 of 46** Tom Finco, Director External Relations

Revision History

Revision	Author	Date	Section	Description
1.0	Andrew Cotter	12-16-08	All	New / first publication
2.0	Andrew Cotter	10-12-09	2.5 3.1.1 3.3 4.12 App. B	- Added section "Coordination with Local Utilities" - 3-position ring bus as minimum configuration for most interconnections - Substation site must meet ATC rough-grade requirements - Synchronism checking devices required in certain instances - Added generator data requirement detail
2.1	Andrew Cotter	12-21-09	App. B	- Updated Black Start unit data requirements
3.0	Andrew Cotter	6-28-10	3.1.1 3.12 3.13 7.6 App. B App. B	- Updated Figure 3.2 - Added section "Voltage Level" - Added section "Basic Impulse Insulation Level" - Added section "Detection of and Tripping for an Electrical Island Condition" - Added corresponding NERC reliability standard reference to B.13
4.0	Andrew Cotter Randy Lange	12-07-12	3.13 7.7 App. B App. C	- Added section "Recommended Customer Step-Up Transformer Configuration" - Added section 7.7 "Generating Facility Modifications" - Modified Generator Data Inventory Matrix - Added Appendix C "Generating Unit Test Requirements"

8 Appendix A: Glossary of Terms

Any capitalized terms not defined herein will have the meanings set forth in the MISO Tariff.

Applicable Regional Reliability Organization: the reliability organization of NERC applicable to the Balancing Authority of the Transmission System to which the Generating Facility is directly interconnected. ATC is a registered member of both the Midwest Reliability Organization (MRO) and ReliabilityFirst Corporation (RFC).

Applicable Reliability Standards: the requirements and guidelines of NERC, the Applicable Regional Reliability Organization, and the Balancing Authority of the Transmission System to which the Generating Facility is directly interconnected.

ATC Interconnection Facilities: all facilities and equipment owned by ATC from the Point of Change of Ownership to the Point of Interconnection as identified in the GIA. The ATC Interconnection Facilities are sole-use facilities and do not include Network Upgrades or the Customer's Interconnection Facilities.

Balancing Authority: an entity responsible for managing an electric system area (a Balancing Authority Area) bounded by interconnection metering and telemetry; and capable of controlling generation to maintain its interchange schedule with other Balancing Authority Areas and contributing to frequency regulation and which has received certification by NERC or a Regional Reliability Council of NERC.

Commercial Operation: the status of a Generating Facility that has commenced generating electricity for sale, excluding electricity generated during Trial Operation.

Customer: any entity that already has interconnected or proposes to interconnect a Generating Facility with the Transmission System.

Customer's Interconnection Facilities: all facilities and equipment, as identified in the GIA, that are located between the Generating Facility and the Point of Change of Ownership, including any equipment necessary to physically and electrically interconnect the Generating Facility to the Transmission System.

Electric Reliability Organization: the North American Electric Reliability Corporation authorized by the FERC to promulgate, seek approval for, and enforce Mandatory Reliability Standards.

Electrical Island: An isolated operating condition which couples a generator(s) to local load with no external connection to the Transmission System.

Emergency Condition: a condition or situation: (1) that in the reasonable judgment of the Party making the claim is imminently likely to endanger, or is contributing to the endangerment of, life, property, or public health and safety; or (2) that, in the case of either Midwest ISO or ATC, is imminently likely (as determined in a non-discriminatory manner) to cause a material adverse effect on the security of, or damage to the Transmission System, the ATC Interconnection Facilities or the electric systems of others to which the Transmission System is directly connected; or (3) that, in the case of the Customer, is imminently likely (as determined in a non-discriminatory manner) to cause a material adverse effect on the security of, or damage to, the Generating Facility or the Customer's Interconnection Facilities. System restoration and black-start will be considered Emergency Conditions; provided that the Customer is not obligated by this LGIA to possess black-start capability. Any condition or situation that results from lack of sufficient generating capacity to meet load requirements or that results solely from economic conditions will not constitute an Emergency Condition, unless one of the enumerated conditions or situations identified in this definition also exists.

Federal Power Act: the Federal Power Act, as amended, 16 U.S.C. §§ 791a *et seq*.

FERC: the Federal Energy Regulatory Commission or its successor.

Generating Facility: the Customer's device(s) for the production of electricity consisting of one or more generating units identified in the Interconnection Request, but not including the Customer's Interconnection Facilities.

Generating Facility Capacity: the aggregate net capacity of the Generating Facility where it includes multiple generating units at the Point of Interconnection.

Generator Interconnection Agreement (GIA): the interconnection agreement in the form of Appendix 6 of MISO's Generator Interconnection Procedures.

Generator Interconnection Procedures (GIP): the interconnection procedures that are included in the MISO Tariff and applicable to an Interconnection Request pertaining to a Generating Facility.

Generator Upgrades: the additions, modifications, and upgrades to the electric system of an existing generating facility or of a higher queued Generating Facility at or beyond the Point of Interconnection to facilitate interconnection of the Generating Facility and render the transmission service necessary to affect the Customer's wholesale sale of electricity in interstate commerce.

Good Utility Practice: any of the practices, methods and acts engaged in or approved by a significant portion of the electric industry during the relevant time period, or any of the practices, methods and acts which, in the exercise of reasonable judgment in light of the facts known at the time the decision was made, could have been expected to accomplish the desired result at a reasonable cost consistent with good business practices, reliability, safety and expedition. Good Utility Practice is not intended to be limited to the optimum practice, method, or act to the exclusion of all others, but rather to be acceptable practices, methods, or acts generally accepted in the region.

Governmental Authority: any federal, state, local or other governmental regulatory or administrative agency, court, commission, department, board, or other governmental subdivision, legislature, rulemaking board, tribunal, or other governmental authority having jurisdiction over the Parties, their respective facilities, or the respective services they provide, and exercising or entitled to exercise any administrative, executive, police, or taxing authority or power; provided, however, that such term does not include the Customer, Midwest ISO, ATC, or any Affiliate thereof.

Initial Synchronization Date: the date upon which the Generating Facility is initially synchronized and upon which Trial Operation may begin.

In-Service Date: the date upon which the Customer reasonably expects it will be ready to begin use of the ATC Interconnection Facilities to obtain backfeed power.

Interconnection Agreement: the agreement executed or to be executed by ATC, the Customer, and MISO and filed at the FERC; representing mutually agreeable terms and conditions pertinent to the interconnection of the Generating Facility to the Transmission System. The form of this agreement not only acceptably includes MISO's pro forma Generator Interconnection Agreement (GIA), but also agreements executed and filed for Generating Facilities whose interconnection preceded the existence of the GIA.

Interconnection Facilities: all facilities and equipment between the Generating Facility and the Point of Interconnection, including any modification, additions or upgrades that are necessary to physically and electrically interconnect the Generating Facility to the Transmission System. Interconnection Facilities do not include Generator Upgrades or Network Upgrades.

Interconnection Facilities Study: a study conducted by MISO, or its agent, for the Customer to determine a list of facilities (including the ATC Interconnection Facilities, System Protection Facilities, and if such upgrades have been determined, Network Upgrades, Distribution Upgrades, Generator Upgrades, and upgrades on Affected Systems, as identified in the Interconnection System Impact Study), the cost of those facilities, and the time required to interconnect the Generating Facility with the Transmission System. The scope of the study is defined in Section 8 of MISO Generator Interconnection Procedures.

Interconnection Feasibility Study: a preliminary evaluation of the system impact of interconnecting the Generating Facility to the Transmission System, the scope of which is described in Section 6 of MISO Generator Interconnection Procedures.

Interconnection Request: a Customer's request, in the form of Appendix 1 to the Generator Interconnection Procedures, to interconnect a new Generating Facility, or to increase the capacity of, or make a Material Modification to the operating characteristics of, an existing Generating Facility that is interconnected with the Transmission System.

Interconnection Study: any of the following studies: the Interconnection Feasibility Study, the Interconnection System Impact Study, and the Interconnection Facilities Study, or the Restudy of any of the above, described in the Generator Interconnection Procedures.

Interconnection System Impact Study: an engineering study that evaluates the impact of the proposed interconnection on the safety and reliability of Transmission System and, if applicable, an Affected System. The study will identify and detail the system impacts that would result if the

Generating Facility were interconnected without project modifications or system modifications, focusing on the Adverse System Impacts identified in the Interconnection Feasibility Study, or to study potential impacts, including but not limited to those identified in the Scoping Meeting as described in the Generator Interconnection Procedures.

Mandatory Reliability Standards: those standards promulgated and approved by NERC as the ERO, or any Regional Entity authorized to do so, as ratified and approved by the FERC that are applicable to ATC and the Customer.

MISO: the Midwest Independent Transmission System Operator, Inc., the Regional Transmission Organization that administers the tariff and provides transmission and energy market services over the transmission facilities of its transmission-owning members in interstate commerce.

NERC: the North American Electric Reliability Corporation or its successor organization.

Network Upgrades: the additions, modifications, and upgrades to the Transmission System required at or beyond the point at which the Interconnection Facilities connect to the Transmission System to accommodate the interconnection of the Generating Facility to the Transmission System.

Point of Change of Ownership (PCO): the point, as set forth in Appendix A to the GIA or Exhibit 1 of an Interconnection Agreement, where the Customer's Interconnection Facilities connect to the ATC Interconnection Facilities.

Point of Interconnection (POI): the point at which the ATC Interconnection Facilities connect to the ATC interconnection substation bus.

Regional Entity: the entity or entities that have entered into a delegation agreement with NERC and that have responsibility for the audit and investigation of the compliance with Mandatory Reliability Standards.

Tariff: MISO Tariff through which open access transmission service and Interconnection Service are offered, as filed with the FERC, and as amended or supplemented from time to time, or any successor tariff.

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

Transmission System: the facilities owned by ATC and controlled or operated by MISO and ATC at voltages ≥69 kV and are used to provide transmission service or Wholesale Distribution Service under the Tariff.

Trial Operation: the period during which the Customer is engaged in on-site test operations and commissioning of the Generating Facility prior to Commercial Operation.

9 Appendix B: Generator Data Requirements

New Generating Facility Interconnections

ATC requires the following minimum information from the Customer to properly model any Generating Facility connected to the Transmission System. The Customer will submit most of the information below during Interconnection Studies, but some of the information is not available until later in the design of a Generating Facility. In addition, during design and operation, changes in design information may occur when systems are manufactured, finalized or upgraded in the field. If information has changed since the Customer's last communication with ATC regarding any particular Generating Facility's characteristic data, the Customer will provide to ATC updated information to ensure ATC effectively models the Generating Facility.

The Customer will resubmit data outlined in the Generator Data Inventory Matrix below whenever any of the data changes (*e.g.*, from typical/estimated to approved/final or due to a design modification).

Existing Generating Facility Interconnections

ATC's effective modeling of the transmission system is also impacted by modifications to existing, already-interconnected Generating Facilities and/or generating units. The generator data requirements of Appendix B are not only applicable to new Generating Facility Interconnections but also to any proposed modifications made to existing Generating Facilities (*e.g.*, exciters, governors, protection systems, main or auxiliary transformers, etc). Such modifications will be communicated to ATC according to the terms of the Interconnection Agreement and using ATC's Generating Facilities Modification Notification (GFMN) form available online;

http://www.atcllc.com/documents/GFMNForm.doc

ATC will review the Customer's proposed modification(s) and ascertain the impact of such modifications on the transmission system. If proposed modifications are determined to have an impact on the transmission system, ATC and the Customer will collaborate on the appropriate solution(s) to enable successful implementation of the proposed generator modification.

The Customer will also utilize the GFMN form for submittal of generator data/information updated as a result of periodic testing, especially as required by NERC or Regional Entity standards.

Use the GFMN to communicate any questions about proposed modifications to an existing Generating Facility and send this to ATC using the following e-mail address:

gioanotices@atcllc.com

10 Generator Data Inventory Matrix

	Customer Name:	
	Generator Location:	
	Date of Change:	

The Generator Owner shall communicate any planned generator modifications to the plant that would impact any of the parameters listed on this sheet. The Generator Owner shall notify ATC as soon as they become aware of a planned or emergent change. For further details please refer to the corresponding section in Appendix B. Please use the Generating Facilities Modification Notification (GFMN) form to communicate this using the email address gioanotices@atcllc.com.
http://www.atcllc.com/documents/GFMNForm.doc

Notes:

1. Comments highlighted in green indicate critical elements needed for successful Real Time Operation of the Transmission System.
2. Regulatory Requirements identified are the most primary requirement for that data element; many of the data elements are tied to additional regulatory requirements.

Index	Data Type and NERC reliability standard reference	Data Types	Comment	Specific Data Elements	ATC Functional Use	Data Location (Ex: Manufacture's Sheet, Calculated, Typical)
	Generator / Turbine Data		**The Customer will provide the following information regarding the generator or turbine itself**			
A.1	Generator / Turbine Data (MOD-012)	Manufacturers' data sheets	For Example, machine time constants, impedances, total inertia in WR2 [generator, exciter, and turbine combined], inertia constant, voltage base, etc.), grounding information (impedance) , integrator gains and limits)	Time constants (T'do, T'qo, T"do, T"qo, T'd3, T'd2, T'd1,T"d, T'q, T"q, Ta3, Ta2, Ta1); Unsaturated (Xdi, X'di X"di Xqi, X'qi, X"qi, Xli, X2i, X0i) Saturated (Xdv X'dv, X"dv, Xqv, X'qv, X"qv, Xlv, X2v, X0v) impedances; Sequence resistance data (R1, R2 and R0) or Rg or Ra resistances if sequence data not	Planning and System Protection	Manufacture Data sheet

				available; either total inertia WR^2 or inertia constant (H); Grounding information (neutral or phase reactor)		
A.2	Generator / Turbine Data	Normal and emergency high and low voltage limitations for the generator	**Note: This data is critical for successful Real Time Operation of the Transmission System.**	Maximum and minimum generator terminal voltage limitations for normal and emergency conditions.	Planning and Operations	Manufacture data sheets or design data publication.
A.3	Generator / Turbine Data (**MOD-010**)	Machine design	Generator type for induction machines, i.e.: direct connected generator, generator with controlled external resistor, doubly-fed induction generator or generator with power convertor	Round rotor (nuclear, fossil CT's), salient rotor (hydro units-some slow CT's), induction (wind); design configuration delta or Wye.	Planning and Operations	Manufacture data sheets or design data publication.
A.4	Generator / Turbine Data (**MOD-010**)	Generator capability curve	**Note: This data is critical for successful Real Time Operation of the Transmission System.** • Variations for factors that affect generator capability such as ambient temperature, gas temperature, and hydrogen pressure. • Excitation limiter curves including over and under-excitation limits	Reactive capability curves for at least rating of machine. Several curves usually provided for several hydrogen pressures or cold gas temperatures. VEE curves for at least base capability.	Planning and Operations	Manufacture reactive capability curves (usually several curves on same sheet). Manufacture VEE curve sheet.
A.5	Generator / Turbine Data (**MOD-012**)	Generator saturation curves		Air gap line curve, No-load saturation curve, Synchronous impedance curve, Saturation at rated armature current curve, Saturation at rated armature current curve-rated pf and Saturation at rated armature current curve-0 pf.	Planning	Manufacture Saturation and synchronous impedance curves (usually all curve on same sheet)
A.6	Number of turbines installed (for Wind Farms Only) **(MOD-010 and MOD-012)**	Number of turbine units being installed at plant/wind farm	List of each turbine manufacturer and the number of identical turbine/generator units from each manufacturer being installed at plant/wind farm	Customer design plan and G-T interconnection application (one-line, and collector system)	Planning	Customer layout plan and G-T interconnection application
A.7	Generator / Turbine Data (**MOD-012 & PRC-001**)	List of installation protection with settings / time	• Out of Step • Tabular over-frequency • Tabular under-frequency • Voltage and frequency volts/hertz	• Under and over frequency tabular data provided frequency limits and time duration. • Over Frequency – electrical and	Planning, Operations and System Protection	Manufacture data sheet Customer or consultant

<table>
<tr>
<td></td>
<td></td>
<td>delays</td>
<td>Turbine rated and maximum (P_{rated} and P_{max})
Over-speed
Reverse Power
Synchronizing, along with a notation on the one-line on which breaker(s) this is located
Generator Protection responding to faults that require coordination with transmission relaying (any relaying that would require coordination with the transmission relaying)
Coordination primary and secondary clearing times associated with step-up transformer and generator faults</td>
<td>mechanical turbine trips), highest steady state high frequency operating point (In the case of a wind generator, high frequency (step) ride through relay settings are also needed. Please see the Over-Frequency Format Table example below:
<table>
<tr><th>Generator terminal frequency</th><th>Time Delay for Trip</th></tr>
<tr><td>57.5 < Hz < 61.5</td><td>Continuous Operation</td></tr>
<tr><td>61.5 < Hz < 62.5</td><td>30 seconds</td></tr>
<tr><td>Hz > 62.5</td><td>0.02 seconds</td></tr>
</table>
Under Frequency - electrical and mechanical turbine trips), lowest steady state low frequency operating point (In the case of a wind generator, low frequency (step) ride through relay settings are also needed. Please see the Under-Frequency Format Table example located below:
<table>
<tr><th>Generator terminal frequency</th><th>Time Delay for Trip</th></tr>
<tr><td>Hz < 56.5</td><td>0.02 seconds</td></tr>
<tr><td>56.5 < Hz < 57.5</td><td>10 seconds</td></tr>
<tr><td>57.5 < Hz < 61.5</td><td>Continuous Operation</td></tr>
</table>
Turbines: Turbine rated (P_{rated}) and maximum (P_{max}) real power capability (ideally as a vertical line superimposed on the generator capability curve), including a description of blades (e.g., multi stage, high, intermediate and low pressure, etc), as well as total power (kVA) at rated conditions
Type and use of generating voltage and frequency relays installed.
Turbine normal and maximum power ratings (Prated and Pmax).</td>
<td></td>
<td>protection relays and settings</td>
</tr>
<tr>
<td></td>
<td colspan="2">Excitation System</td>
<td>The Customer will provide</td>
<td></td>
<td></td>
<td></td>
</tr>
</table>

	Design/Electrical Model Data		**the following information regarding the Excitation System**			
B.1	Excitation System Design Data (MOD-012)	Excitation control block diagram		Control block diagram for the excitation system indicating the type of exciter model and parameter designations. This will vary depending on the type of exciter installed.	Planning & Operations	Exciter manufacturer provided data sheet.
B.2	Excitation System Design Data (MOD-012)	Excitation system settings / parameters		Table or list showing the values for the parameter designations. This will vary depending on the type of exciter model.	Planning & Operations	Exciter manufacturer provided data sheet.
B.3	Excitation System Design Data (MOD-012)	Automatic voltage regulator calculation		Voltage regulator calculation if equipped with line drop compensation to schedule a voltage at the POI. Based on R and X of compensator.	Planning & Operations	Exciter manufacturer provided data sheet.
B.4	Excitation System Design Data (MOD-012)	Automatic voltage regulator available operating modes		Constant voltage control, Constant power factor control or Constant Reactive power flow (MVAR) control.	Planning & Operations	Exciter manufacturer provided data sheet or manual.
	Governor Design Data		**The Customer will provide the following information regarding the Generator Governor**			
C.1	Governor Design Data (MOD-012)	Governor control block diagram		Control block diagram for the governor system indicating the type of governor model and parameter designations. This will vary depending on the type of governor installed.	Planning & Operations	Governor manufacturer provided data sheet.
C.2	Governor Design Data (MOD-012)	Governor settings / parameters, including regulation		Table or list showing the values for the parameter designations. This will vary depending on the type of exciter model. Operation modes (Isochronous control, standard droop control or constant settable droop).	Planning & Operations	Governor manufacturer provided data sheet.

<table>
<tr><td>C.3</td><td>Governor Design Data (MOD-012)</td><td>Expected Real Power response for a range of deviations in frequency (0.05 Hz drop, 0.1 Hz drop, .5 Hz drop, 1.0 Hz drop and 1.5 Hz drop) (a.k.a. Droop)</td><td></td><td>Specify droop characteristics, usually provided as percent regulation, but can also be provided as Hz drop. Please see the Governor Design Data Format Table example located below:<table><tr><th>Delta Frequency</th><th>MW Change</th></tr><tr><td>-0.05 Hz</td><td>1.6</td></tr><tr><td>-0.10 Hz</td><td>3.3</td></tr><tr><td>-0.50 Hz</td><td>16.4</td></tr><tr><td>-1.00 Hz</td><td>32.7</td></tr><tr><td>-1.50 Hz</td><td>54.5</td></tr></table></td><td>Planning & Operations</td><td>Governor manufacturer provided data sheet.</td></tr>
<tr><td></td><td colspan="2">Power System Stabilizer Data</td><td>The Customer will provide the following information regarding the PSS</td><td></td><td></td><td></td></tr>
<tr><td>D.1</td><td>Power System Stabilizer Data (MOD-012)</td><td>Explicit indication of the installation of a Power system stabilizer (PSS) (Ex: Installed and On, Not Installed, Installed and Off)(&(Type)</td><td></td><td>Is a PSS installed, yes or no?
If yes, is the PSS device operating on-line, yes or no?
Type of PSS unit installed - manufacturer and model designation (e.g. IEE2ST, IEEEST, PSS1A, PSS2A, PSS2B, PSS3B, PSS4B, etc.)</td><td>Planning & Operations</td><td>Owner to provide status and use of PSS based on manufacture provided information.</td></tr>
<tr><td>D.2</td><td>Power System Stabilizer Data (MOD-012)</td><td>Power system stabilizer control block diagram</td><td></td><td>Control block diagram for the PSS system indicating the type of PSS model and parameter designations. This will vary depending on the type of PSS installed.</td><td>Planning & Operations</td><td>PSS manufacturer provided data sheet.</td></tr>
<tr><td>D.3</td><td>Power System Stabilizer Data (MOD-012)</td><td>Power system stabilizer settings / parameters</td><td></td><td>Table or list showing the values for the parameter designations. This will vary depending on the type of exciter model.</td><td>Planning & Operations</td><td>PSS manufacturer provided data sheet.</td></tr>
<tr><td>D.4</td><td>Power System Stabilizer Data (MOD-012)</td><td>Tuning study</td><td></td><td>Final or As built setting parameters PSS/exciter are usually provided in tuning study report.</td><td>Planning & Operations</td><td>Manufacturer or consult hired to perform tuning study</td></tr>
</table>

D.5	Power System Stabilizer Data (MOD-012)	Whether or not the PSS can be taken out of service or is an integral part of the functioning excitation system.		Is the PSS a separate device or equipment that can have a separate status or is it an integral part of the exciter system that can only be taken out of service with the excitation system?	Planning & Operations	Manufacturer design data or installation information.
	Transformer Data		**The Customer will provide information for the following transformers on the Customer's side of the POI.**			
E.1	Transformer Data (MOD-010)	Transformer factory test report for rewind, replacement, and modification, etc.	For: - Generator step up (i.e. main station) transformer(s) - transformers between generator and transmission system - Unit / main system / reserve (i.e. station service transformer) auxiliary power transformer(s) - Substation transformer(s) primarily applicable to wind farms but would be true of any site where a collector system less than the POI transmission voltage is used)	No load loss watts, % Exciting current at 100% of rated voltage, Load loss watts, % impedance (provided for each group of windings if more than two-winding transformer) along with winding voltage and MVA rating for test, No Load Tap Changer (NLTC) setting, Rated voltages and MVA ratings for each winding, zero impedance test (applicable for multiply winding transformer) under load tap changing range and step size, 3-phase unit or bank of 3 single phase units, serial number.	Planning, Operations & System Protection	Manufacturer test report. Field setting of No Load Tap Changer (NLTC) position
E.2	Transformer Data (MOD-010)	Nameplate drawing and data		Winding configurations (delta, Wye, zig-zag) for each winding, winding voltages, winding MVA ratings, % impedance, available NLTC positions, available under load tap changer (ULTC) positions, serial number.	Planning, Operations & System Protection	Manufacturer nameplate drawing diagram or picture of attached nameplate.
E.3	Transformer Data (MOD-010)	Impedance and X/R ratio and base MVA		% impedance , X/R ratio and Base MVA for impedance	Planning, Operations & System Protection	Specifications or nameplate if test report not available.
E.4	Transformer Data (MOD-010)	Ratings including exceptions from nameplate		OA/FA/FA, OA/FOA/FOA, or ONAN/ONAF/ONAF as well as whether based on 55 ° or 65 ° C or values for both if available, as well as other equipment rating limitations (e.g. CT's bushings, etc.).	Planning, Operations & System Protection	Test report and/or Nameplate

E.5	Transformer Data (MOD-010)	Nameplate voltages		Voltages for each winding.	Planning, Operations & System Protection	Test report and/or Nameplate
E.6	Transformer Data (MOD-010)	Available fixed taps and any under-load tap changing data	**Note: This data is critical for successful Real Time Operation of the Transmission System.**	Available No load Tap Changer (NLTC) positions and available Under Load Tap Changer (ULTC) if applicable with range and step size (e.g. +/-10% in 16 steps or +/-5/8% in 16 steps.	Planning, Operations & System Protection	Test report and/or Nameplate
E.7	Transformer Data (MOD-010)	Proposed or existing no load (fixed) tap setting and any under-load tap changing data		Expected or field setting of No Load Tap Changer (NLTC) position. Under Load Tap Changer (ULTC) data ((e.g. +/-10% in 16 steps or +/-5/8% in 16 steps).	Planning, Operations & System Protection	Transformer field checks of NLTC tap position or setting records. ULTC data either on nameplate and/or test report.
E.8	Transformer Data (MOD-010)	Normal and emergency high and low voltage limitations for all windings		Normal and emergency voltage limitations for each winding including other associated equipment (PT's, bushings etc.).	Planning & Operations	Test report and/or Nameplate
E.9	Transformer Data (MOD-010 & PRC-001)	Any Relaying on the step-up transformer that will respond to system faults		Impedance of Overcurrent Relay types and set points	Planning & System Protection	Customer relay setting data
E.10	Transformer Data (MOD-010)	Winding Configurations		Configuration (delta, Wye, zig-zag) for each winding.	System Protection	Nameplate and/or test report
	One Line Diagrams					
F.1	One-line diagram of the Customer's equipment (MOD-010)		The Customer will provide one-line diagrams of the interconnection configuration (breakers, switches, etc.) including system auxiliary power facilities and collector bus systems. These one-lines must include information on synchronization location, alternate paths for serving auxiliary loads, current transformer information for step-up transformer and associated breakers (including ratio, accuracy class, and	One-line diagram showing the connection and layout of the customer equipment (Generators, transformers, breakers, disconnect switches, potential transformers, current transformers, etc.) and point of interconnection to ATC.	Planning, Operations and System Protection	Customer one-line diagram

			burden) and relevant system protection information.			
	Generator Real and Reactive Power Output Levels		**The Customer will provide the following Generator Gross and Net Real Power Information**			
G.1	Generator/MW Output Level (**MOD-010**)		**Note: This data is critical for successful Real Time Operation of the Transmission System.**	Gross and net maximum and minimum power output based on operating pressures or ambient temperatures including corresponding real and reactive auxiliary load.	Planning & Operations	Customer to provide either test data or commissioning data or design data.
G.2	Generator/MVAR Output Level (**MOD-025**)		**Note: This data is critical for successful Real Time Operation of the Transmission System.**	Gross and net maximum and minimum reactive output based on operating pressures or ambient temperatures including corresponding real and reactive auxiliary load.	Planning & Operations	Customer to provide test data, commissioning data or design data.
G.3	Real Power Output Levels		The Customer will provide generator gross and net real power output levels by season. Data will be provided as measured gross at the generator terminals and net at the POI. Auxiliary peak loads and running power factor at the POI should also be provided. The data will be supplied for both minimum and nominal generation levels. The following table is an example of what will be completed for each new generating unit to be connected. If the Generating Facility is a combined cycle facility, output levels for both “1 on 1” and “2 on 1” operation will be supplied. Note: This table may look different by generation type. Please see the Generator Provided Real Power Output Level Format Table example located below:			

<table>
<tr>
<td></td>
<td></td>
<td></td>
<td>
<table>
<tr><th rowspan="3">Ambient Temp (deg F)</th><th rowspan="3">Two Operating Points for Each Generator</th><th>Generator Gross Output</th><th>Auxiliary Load</th><th>New Plant Output</th></tr>
<tr><th></th><th>Aux T1</th><th></th></tr>
<tr><th>P (MW)</th><th>P (MW)</th><th>P (MW)</th></tr>
<tr><td>95</td><td>Nominal
Minimum</td><td>200.0
100.0</td><td>15</td><td>185.0
85.0</td></tr>
<tr><td>59</td><td>Nominal
Minimum</td><td>210.0
110.0</td><td>14</td><td>196.0
96.0</td></tr>
<tr><td>30</td><td>Nominal
Minimum</td><td>220.0
120.0</td><td>13</td><td>207.0
107.0</td></tr>
<tr><td>0</td><td>Nominal
Minimum</td><td>230.0
130.0</td><td>12</td><td>218.0
118.0</td></tr>
</table>
The customer must also specify if all or a portion of the auxiliary load is not served from the generator terminals.
</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G.4</td>
<td>Reactive Power Output Levels</td>
<td></td>
<td>The Customer will provide generator gross and net reactive power output levels by season. Data will be provided as measured gross at the generator terminals and net at the POI. Auxiliary peak loads and running power factor at the POI should also be provided. The data should be supplied for both minimum and nominal generation levels. The following table is an example of what should be completed with each new generating unit to be connected. If the Generating Facility is a combined cycle facility, output levels for both “1 on 1” and “2 on 1” operation should be supplied. Note: This table may look different by generation type.

Please see the Generator Provided Reactive Power Output Format Level Table example located below:</td>
<td></td>
<td></td>
<td></td>
</tr>
</table>

<table>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Ambient Temp (deg F)</th><th>Two Operating Points for Each Generator</th><th>Generator Gross Output
Q (MVAR)</th><th>Auxiliary Load
Aux T1
Q (MVAR)</th><th>New Plant Output
Q (MVAR)</th></tr>
<tr><td>95</td><td>Nominal
Minimum</td><td>60.0
40.0</td><td>3.0</td><td>57.0
37.0</td></tr>
<tr><td>59</td><td>Nominal
Minimum</td><td>70.0
50.0</td><td>2.0</td><td>68.0
48.0</td></tr>
<tr><td>30</td><td>Nominal
Minimum</td><td>80.0
60.0</td><td>1.5</td><td>78.5
58.5</td></tr>
<tr><td>0</td><td>Nominal
Minimum</td><td>90.0
70.0</td><td>1.5</td><td>88.5
68.5</td></tr>
</table>
The Customer must also specify if all or a portion of auxiliary load is not served from the generator terminals.</td><td></td><td></td><td></td></tr>
<tr><td></td><td colspan="2">Unit Start-Up Requirements</td><td>The Customer will provide the following Unit Start-up Information</td><td></td><td></td><td></td></tr>
<tr><td>H.1</td><td>Unit Start-Up Requirements (EOP-005)</td><td>The sequence and size of the motors to be started for unit start-up</td><td></td><td>Motor size, impedance, load and torque data of largest motors to be started including the number and sequence of motors to be started. (Information also used in black start studies as well)</td><td>Operations</td><td>Customer to provide specific plant data.</td></tr>
<tr><td>H.2</td><td>Unit Start-Up Requirements (EOP-005)</td><td>The transmission voltage requirement necessary for successful unit start-up</td><td></td><td>Minimum transmission system bus voltage at POI for the successful unit start-up which relates to the in plant auxiliary voltages based on motor starting limits.</td><td>Operations</td><td>Motor manufacturer data and customer start-up operating procedure.</td></tr>
<tr><td></td><td colspan="2">Reactive Compensation</td><td>The Customer will identify any additional reactive power compensation installed to meet the requirements of the Interconnection Agreement</td><td></td><td></td><td></td></tr>
</table>

I.1	Reactive Compensation System Design (MOD-010, MOD-012)		The one-line diagrams shall indicate the connection of this additional reactive power compensation. The Customer shall supply the reactive compensation control scheme, such as control block diagrams, logic diagrams, parameters and settings, and the electrical parameters of each reactive compensation device. The design of the Customer's reactive power compensation shall be consistent with the requirements of the Interconnection Agreement (e.g., if a STATCOM is needed).	Usually associated with wind generation installations to supplement the reactive capability of the wind generators to meet system requirements as specified in IA.	Planning & Operations	Manufacturer or consult design data.
	Voltage Schedule and Automatic Voltage Regulator					

J.1	Voltage Schedule and Automatic Voltage Regulator (MOD-012)		The Customer will maintain the voltage set point as communicated by ATC (see Section 7.2 of the ATC Generating Facility Interconnection Guide). Generating units are required to have a functional and in-service automatic voltage regulator unless specifically exempted by ATC. If the automatic voltage regulator fails or is out of service, this information must be communicated to ATC in accordance with national, interconnection-wide and regional reliability standards and the Interconnection Agreement. Generating units may not operate without an automatic voltage regulator without approval by ATC.	Customer will maintain the voltage set point as communicated by the Transmission Operator. Units are required to have a functional and in-service automatic voltage regulator unless specifically exempted by the Transmission Operator. If the automatic voltage regulator fails or is out of service, this information must be communicated to the Transmission Operator. Units may not operate without an automatic voltage regulator without approval by the Transmission Operator	Planning & Operations	Interconnection Agreement and customer communications
	Low Voltage Ride-Through Capability					
K.1	Low Voltage Ride-Through Capability (MOD-012)		Per FERC Order no. 693 paragraph 1787, all generation connecting to the transmission network must be able to ride through disturbances that depress system voltage as described in FERC Order 661-A. The Customer must communicate the low voltage ride-through capability of the Generating Facility, as described by a voltage magnitude for a certain duration (see example in table below). (Please see the Low Voltage Ride Through Capability Table Format Example located at the end of the Appendix B).	Usually associated with wind generation and refers to the voltage ride through specifications of generating unit LVRT option 1 or option 2 or ZVRT, but in future could also apply to all new generating units.	Planning	Manufacture data information or sheet.`

<table>
<tr><td></td><td></td><td></td><td><table><tr><th>Generator Terminal Voltage (p.u.)</th><th>Time Delay for Trip</th></tr><tr><td>V > 1.15</td><td>1.0 seconds</td></tr><tr><td>0.90 < V < 1.15</td><td>Continuous operation</td></tr><tr><td>0.85 < V < 0.90</td><td>15.0 seconds</td></tr><tr><td>0.80 < V < 0.85</td><td>1.00 seconds</td></tr><tr><td>0.15 < V < 0.80</td><td>0.50 seconds</td></tr><tr><td>V < 0.15</td><td>0.25 seconds</td></tr></table></td><td></td><td></td><td></td></tr>
<tr><td></td><td colspan="2">Black Start Unit Specific Data</td><td colspan="2">A Blackstart-capable resource is any generating unit(s) and its associated set of equipment which has the ability to be started without support from the System or is designed to remain energized without connection to the remainder of the System. Only the subset of Blackstart-capable resources which are included in the Transmission Operator’s restoration plan will be designated as Blackstart Resources, as defined in the NERC Glossary of Terms. Supplying the following information for a Blackstart-capable resource does not place any additional compliance burden on the Generator Owner.</td><td></td><td></td></tr>
<tr><td>L.1</td><td>Isochronous Operation: Please answer YES or NO</td><td></td><td>• Can the generating unit(s) operate in isochronous mode?
• Can the generating unit(s) be placed in isochronous mode remotely?
• Can the generating unit(s) be switched from isochronous mode to normal droop mode while online?</td><td></td><td></td><td></td></tr>
<tr><td>L.2</td><td>Start-up Characteristics</td><td></td><td>Please indicate the black start-capable resource staffing conditions.
• Entirely remotely controllable
• Other (please specify):</td><td></td><td></td><td></td></tr>
</table>

L.3	Minimum Unit Output		Please provide the minimum stable net output for the black start-capable resource over the first 30 minutes. Include any applicable environmental restrictions. Assume that the unit is synchronized to the grid at 0 minutes. _____ MW for 0 – 30 minutes			
L.4	Unit Loading Capability		• What reasonable incremental load increase (largest load block) can the black start-capable resource initially energize? • List the maximum MW/min ramp up rate in isochronous mode? • List the maximum MW/min ramp down rate in isochronous mode?			
L.5	Reactive Power Characteristics		Please provide the maximum leading and lagging capability of the black start-capable resource when operating at 50% of the rated capacity. See the following format example: 90 degrees F _____ MVAR lead _____ MVAR lag 10 degrees F _____ MVAR lead _____ MVAR lag	Please note that this section is not necessary if D-curves with all limit identified are required elsewhere in the document.		
	Modeling Data		**The Customer will provide the following Information.**			

M.1	Mechanical Model Data	The Customer will provide following information regarding the mechanical model:	• Total inertia constant • Damping factor • Turbine inertia fraction • Torsional resonant frequencies • Shaft damping factor • Aerodynamic gain factor Blade pitch at twice rated speed			
M.2	Wind Pitch Model Data	The Customer will provide following information regarding the wind pitch model:	All data parameters, e.g. time constants, gains, pitch angle limits and angle rate limits			

11 Appendix C: Generating Unit Test Requirements

This Appendix contains detail to guide Generator Owners in scheduling generating unit testing with ATC as well as sets forth the communication requirements for the data derived from such testing.

11.1 Scheduling Generating Unit Testing

The Generator Owner will contact ATC using the ATC Operations Outage Coordinator phone numbers listed below to schedule generating unit testing at least 2 weeks prior to the test. The Generator Owner is to use the number below that corresponds with the area that the generating unit is located:

We Energies/Cloverland – 262-506-6971
We Energies South – 262-506-6969
WPS/UPPCo – 262-832-8705
Alliant East Southern Portion/MG&E – 608-877-8252
Alliant East Northern Portion – 608-877-8241

i) The Generator Owner will provide to ATC a list of any assumptions made related to the expected impact of the test to any other units at the Generating Facility.
ii) The Generator Owner and ATC will together complete a Generator Testing Request Form. The information on the completed form will be used to manage the test. ATC will initiate and then provide a draft copy of the completed form to the Generator Owner.

iii) ATC Assistance:
ATC will support unit testing up to physical reactive power limits by:
(1) Removal of nearby static reactive power elements, such as capacitor banks, from service to allow the unit to approach physical reactive power limits.
(2) Coordination with other local Generator Owners to absorb reactive power in order to allow the unit testing to approach physical reactive power limits.
(3) Temporarily allowing units to exceed ATC's standard 1.02 p.u. voltage target in order to approach physical reactive power limits.

11.2 Communication of Generating Unit Test Data

The Generator Owner will supply unit test results to ATC using the MRO/RFC format and the ATC Generator Owner Modification Notification (GFMN). Following are links to MRO and RFC documents:

RFC:
https://rsvp.rfirst.org/MOD025RFC01/Supporting%20Documents/Board_Approved_030311/MOD-025-RFC-01.pdf
MRO:
http://www.midwestreliability.org/03_reliability/06_gtrtf/Documents/MRO_Generator_Testing_Guidelines.pdf

11.2.1 Real-Time Operations Data

(1) The following information is required within one month after the test takes place. ATC will continue to operate to the prior capabilities until the new test results are received at ATC from the Generator Owner.
- (a) Net and gross real power capability for the Generating Facility as a whole and for each generating unit.
- (b) Net and gross reactive power capability for the Generating Facility as a whole and for each generating unit. That is, the modified D Curve. Please see Exhibit C.1 for an example of a Capability Curve.
- (c) The step-up transformer no-load tap setting.
- (d) A photo of the step-up transformer nameplate data.
- (e) A statement indicating that the generator terminal voltage operating limits are within 0.95 to 1.05 or, if this is not the case, an explanation of what the limits are and why they are not within 0.95 and 1.05.

(2) The Generator Owner will also provide gross unit capability data (real and reactive power) at various real power output levels using the capability curve data. This represents a percentage verification of the peak real power data. The Generator Owner will provide the following to ATC within 1 month of the generator test.
- (a) The Generator Owner is not expected to actually test at all output levels. Instead, the Generator Owner may use engineering judgment to extrapolate results for output levels using the actual results.
- (b) The Generator Owner will communicate the levels at which the unit is ideally capable of performing; if the unit were the only unit online and was not limited by steam availability, status of other generating facility units, etc.
- (c) The Generator Owner needs to ensure that other limitations do not exist related to over and under excitation of the unit.
- (d) The Generator Owner will provide this data in a table format similar to the example provided below.

Gross MW			
Operating Point	Gross MW	Min Gross MVAR	Max Gross MVAR
0 %	0.0	-230.0	240.0
50 %	193.0	-220.0	210.0
60 %	231.0	-205.0	195.0
70 %	270.0	-185.0	180.0
80 %	308.0	-170.0	155.0
90 %	347.0	-140.0	130.0
95 %	366.0	-125.0	110.0
98 %	377.0	-80.0	100.0
Maximum MW	385.0	0.0	0.0

(a) Note: As an alternative to data points, the Generator Owner can provide a copy of the capability curve with the limiting lines for URAL, etc. drawn in (see Examples 1 and 2 below). ATC could use this to determine the unit capability. With this, the Generator Owner does not need to calculate any points.

11.2.2 Planning Data

(1) The Generator Owner will submit the following data to ATC within 30 working days of the Generator Owner recording the test results, but no later than December 15 of the calendar year the test is done. This will enable ATC to process any new real and reactive capabilities for inclusion in the next scheduled MRO series model build and the corresponding ERAG-MMWG (NERC) model build:

(e) Qmax
  (3) The detailed data requirements for this verification are specified within NERC MOD-025 Verification of Generator Gross and Net Reactive Power Capability.
  (4) The verification of the maximum lagging (producing) reactive power capability at the seasonal (i.e. summer and winter) real power generating capabilities reported in accordance with NERC MOD-024.
  (5) Verified Reactive Power of auxiliary loads.

b) Qmin
  (1) The detailed data requirements for this verification are specified within MOD-025.

(2) The verification of the maximum leading (absorbing) reactive capability at the Seasonal (summer and winter) Real Power generating capabilities reported in accordance with MOD-024.
(3) Verified Reactive Power of auxiliary loads.

c) Pmax
(1) The detailed data requirements for this verification as specified within NERC MOD-024 Verification of Generator Gross and Net Real Power Capability.
(2) Seasonal (i.e. summer and winter) generating unit gross and net real power capability.
(3) A tabular listing by month of Pmax for those units that have variable output dependent on either ambient temperature (combustion turbines) or water levels or run of river dependency (hydro units).
(4) Verified real power requirements of auxiliary loads at Pmax.

b) Pmin
(1) The lowest gross real power generation level at which the unit will be dispatched.
(2) Verified real power levels of auxiliary loads if different than communicated for Pmax.

11.3 Exhibit C.1. Example Capability Curve