

Interconnection Guidelines For Substation/End Use Customers

Revision 3

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MINNESOTA POWER TRANSMISSION INTERCONNECTION GUIDELINES



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I. INTRODUCTION

A. Objectives

This guide serves as a reference for establishing customer interconnections with the MP Transmission System (MP System). It provides the minimum requirements for safe and effective operation of the interconnection. It provides both administrative and technical guidelines to assist the customer in establishing the interconnection in an efficient and consistent manner. Technical terms used in this guide are expanded in the Glossary.

This document shall not be construed as modifying any existing agreements which establish rights and obligations of both MP and the customer. Descriptions of agreements between MP and a customer to establish provisions for an interconnection are referenced in Appendix A. MP reserves the right to revise this document without notice.

Any customer intending to interconnect with the MP Transmission System is required to complete the attached Application for Transmission Interconnection.

B. Authority

The state and federal regulatory agencies having authority over electric service require MP to provide safe, adequate, efficient and reasonable service. MP's General Rules and Regulations for retail service have been filed with and approved by the state regulatory commissions, which, along with state rules, set forth the requirements for such interconnections. The Federal Energy Regulatory Commission (FERC) has authority over any wholesale service interconnection to the electric power system and has accepted the North American Electric Reliability Corporation's (NERC's) standards and practices. MP is a member of the Midcontinent Independent System Operator (MISO) and is subject to MISO rules and regulations. MP's interconnection requirements encompass all the above standards and practices. Any customer desiring to interconnect within the MP control area is required to comply with MP's requirements.

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II. GENERAL POLICY

The electrical transmission facilities owned and/or operated by Minnesota Power are referred to as "the MP Transmission System". The requirements stated in this guide are applicable for interconnections with the MP Transmission System (including end-use customer substations). The requirements are intended to achieve the following:

- Provide comparable reliability and service to all users of the MP Transmission System;
- Ensure the safety of the general public and MP personnel;
- Minimize any possible damage to electrical equipment;
- Minimize adverse operating conditions on the MP Transmission System;
- Permit the customer equipment to operate in parallel with the MP Transmission System in a safe, reliable and efficient manner; and
- Meet all applicable requirements and regulations.

Any interconnection with the MP Transmission System must comply with the requirements defined herein.

A. Financial Obligation Associated with Interconnections

To the extent allowed under MISO's open access transmission tariff on file with FERC (and/or the appropriate state regulatory agency for retail end-use customer(s)), the customer requesting to interconnect with the MP Transmission System will reimburse MP for costs. FERC and/or state policy will guide the allocation of costs between the customer and MP. The following are examples (but not a complete list) of expenses that may be billable to the customer:

1. Study analysis and related expenses to determine:
 - the feasibility to interconnect
 - the transmission facilities required for interconnection
 - the MP system upgrades required
 - cost estimates and schedules
 - other related information

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2. Land, rights-of-way, licensing, engineering, substation and transmission equipment and construction costs, station development costs, etc., differing from MP's standard service.
3. Transmission line extensions and facility upgrades, or other related modifications in excess of MP's standard provision. The cost allocation of the required interconnection facilities and system upgrades, if any, will be on a case by case basis in order to reflect the unique circumstances of each case of interconnection. FERC or state policy will guide the allocation between the customer and MP.
4. Metering, telemetering, communication circuits and other operating expenses.
5. Maintenance and testing including all parts and other related labor not provided for under MISO's tariff.
6. Obtaining regional approval for the interconnection.

B. Ownership

MP will determine ownership of facilities at the point of interconnection to ensure the integrity and reliability of its transmission network.

If any MP equipment must be upgraded to allow for the interconnection under the guidelines expressed herein, MP will continue to own the upgraded equipment.

C. MP Standard Equipment

Any equipment MP will own, operate, or maintain will be to MP standards. The customer must pay for the training of MP personnel to operate and maintain such equipment. The customer must also maintain and make available to MP maintenance personnel or contract employees a stock of any spare parts necessary (consistent with spare parts MP requires with similar equipment).

All equipment, whose operation or failure to operate would result in the opening of the transmission path through the interconnection, must conform to MP technical specifications.

D. Design and Construction of Interconnection Facilities

MP will approve the design and construction of all interconnection facilities.

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E. Operations and Control Area Obligation

MP will control the operation of all interconnection equipment within the MP control area.

F. Protective Devices

Protective devices must be installed by the owning party to allow for the detection and isolation of faulted equipment and restoration of non-faulted equipment under the practices provided herein. Protective devices must coordinate with existing MP equipment and meet MP protection standards. The specific requirements will be determined in the interconnection and facilities studies. Major factors generally determining the type of protective devices required include:

1. Location of the customer on the MP system;
2. The manner in which the installation will operate (radial, in-and-out service, customer side fault current source, etc.);
3. The stability response required in that part of the MP Transmission System;
4. The voltage level of the interconnection; and
5. Number and size of interconnection transformers.

The addition of the interconnection may require MP to modify the MP Transmission System. Each request for interconnection will be handled individually. The interconnection and facilities studies will determine those MP Transmission System modifications and/or additions required. MP will work with the customer to achieve an installation which meets the requirements of both the customer and MP. The customer may request greater than MP standard service. The customer shall bear all costs of protective devices and MP system modifications in excess of MP standard service.

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G. Responsibility and Approval

MP does not assume responsibility for protection of the customer's equipment or of any other users of the customer's equipment. The customer is solely responsible for protecting their own equipment to prevent damage from faults, imbalances, or other disturbances on their own system or on the MP System. The customer is responsible for damages to the MP system due to faults, imbalances, or other disturbances on their system.

MP will not be responsible for damage to the customer's equipment due to out-of-phase reclosing. Such an event will likely cause damage to the customer's equipment or the equipment of the users of the customer's system and must be addressed by the customer. Technical aspects addressing protection requirements are expanded in **Section VII**.

Interconnection approval implies that MP has reviewed the interconnection to ensure that the MP Transmission System is not adversely affected by operation of the interconnection. **MP will not assume any liability or responsibility for customer-owned equipment through the approval process.**

H. Compliance with Governing Entities' Requirements and Approvals

The requirements set forth by this document are intended to comply with all local, state and federal regulatory agency requirements and, additionally, the applicable requirements of other entities governing the owners and operators of transmission system such as the Midwest Reliability Organization (MRO), Midcontinent Independent System Operator (MISO) and the North American Electric Reliability Corporation (NERC). The customer is expected to work closely with MP to keep abreast of changes in regulatory requirements and to comply with them as they develop.

It is the responsibility of the customer to obtain all permits and approvals of the governing entities to allow siting of their proposed interconnection facilities. MP may, at its option, choose to obtain any or all of those permits and approvals required for MP owned facilities. The customer must comply with all applicable electrical and safety codes, studies, reporting requirements, policies and standards.

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I. NERC and MISO Policies and Standards Compliance

Any substation interconnection requiring the addition or modification of bulk transmission facilities must be reviewed and approved through the MISO planning process. Customers wishing to interconnect equipment with the MP Transmission System will diligently work with MP in completing all study work required to obtain these approvals.

To ensure adequate time for preparation and submittal of the technical studies and to address any unforeseen concerns, it is important that the customer provide timely information to meet the project schedule.

Minnesota Power or MISO may require a separate study to identify special operating restrictions or procedures that may be placed on the operation of the interconnection.

All customers interconnected with the MP Transmission System must satisfy NERC policies and standards. The customer must continue to comply with all such policies and standards, as updated, as long as they remain interconnected with MP.

Any interconnecting customer shall assist MP in determining their compliance with the NERC & MISO policies and standards and provide such information as is required.

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J. Study Requirements

The Transmission system must be planned and constructed to meet the NERC Transmission Planning Standards.

The customer must participate in the joint planning of the transmission and distribution systems, and will execute due diligence in planning the system. "Due diligence" refers to timely and accurate reporting of new load additions, load forecasts, system topology changes, system configuration changes, machine and line parameters and any other items required to accurately plan the system.

Once a party has interconnected with the MP Transmission System, they are expected to continue their Due Diligence in planning the system, through participating in all appropriate future planning studies and the NERC required Annual System Assessments performed on the MP Transmission System.

Studies are necessary to review, design, construct, and approve the requested interconnection. These include, but are not limited to:

1. Preliminary Interconnection Studies (Optional);
2. Interconnection Studies;
3. Facilities Studies; and
4. System Planning Studies.

Other detailed studies may also be required depending on the location and characteristics of the proposed interconnection.

The customer needs to be aware that providing the actual interconnection is subject to the lead times required to perform the necessary studies, secure approvals from regulators, obtain rights-of-way, and construct the required interconnection and transmission facilities. The time frames in which MP is required to provide service are determined under the provisions of MISO's Transmission Tariff.

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K. Customer-Side Generation

A customer who owns and operates a generation facility is required to obtain or provide for ancillary services or portions of such services as required by FERC, NERC, or MISO for any electric load served from the interconnected electric grid. Similarly, a service provider who serves any customers who own and operate generation must obtain or provide equivalent services. Thus, any generation provider operating in long term parallel to the system to serve its own electric load also must provide for:

1. MISO accreditation of the generator;
2. Reserve capacity requirements;
3. Operating reserves (spinning and non-spinning);
4. Load regulating capability;
5. Unit cycling capability to satisfy NERC Control Performance Criteria;
6. The ability to determine actual after-the-fact load and generation; and
7. The delivery system capacity to receive emergency power.

These services can be provided in whole or in part through MP services, by the customer, or by purchases from other utilities. However, the customer must confirm with MP that it is in compliance at all times with these requirements.

L. Interconnecting Customer Rights

An interconnecting customer meeting the requirements of these guidelines only has the right to interconnect with the MP Transmission System. It does not have the right to deliver power and energy over MP's transmission facilities. Nor does meeting these guidelines imply the MP Transmission System can accommodate the delivery of the customer's power and energy over the transmission network.

To use MP's transmission system, the customer must request transmission service under MISO's FERC-approved transmission tariff. Approval is based on the capability of the system to provide the requested service.

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III. INTERCONNECTION PROCESS

The following process applies to an Interconnection customer that proposes to (a) interconnect a distribution substation to the MP Transmission System ("System") or (b) increase the load serving capability of a substation interconnected with the System beyond the existing firm maximum capacity of the substation. These procedures only apply to substation interconnections and establish the facilities and their cost estimates associated with such interconnections.

A request for interconnection is different from a request for transmission service. The studies described herein are not sufficient, nor intended, to determine the capability of the transmission network to deliver the customer's power and energy. A customer desiring transmission service from MP, including a system impact study if one is necessary, shall follow the procedures of the MP Tariff in requesting transmission service. If the customer knows the source of its power and energy, they can request transmission service at the same time and, if needed, incorporate a System Impact Study with the interconnection study.

Existing transmission customers should be involved in ongoing periodic transmission planning studies with MP for both short-term and long-term. If the customer's proposed interconnection has been included in the most recent periodic transmission planning study, the customer can go directly to negotiating the Interconnection and Construction Agreement. (Section III, B.8).

A. Preliminary Interconnection Study Process (Optional)

Parties considering connecting a load-serving substation to the MP Transmission System ("System"), or upgrading an existing substation connected to the System, may request a Preliminary Interconnection Study from MP to examine the feasibility of the interconnection. This optional Preliminary Interconnection Study provides transmission system interconnection and upgrade cost estimates to facilitate a decision to proceed with a potential interconnection project. This is not meant to be an in depth analysis, but rather a brief review of the capability of the transmission system to identify major costs associated with the proposed interconnection. This option is provided as a convenience to the customer exploring a possible substation interconnection. The following is an overview of the preliminary interconnection study process:

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1. Request a Preliminary Interconnection Study.
 - a. Please specify the specific location of the requested interconnection (county, town and street), a 10-year demand forecast (MW and MVAR), the number of transformers and their proposed nameplate capacity in megawatts (MVA), and the proposed in-service date.
 - b. Develop a preliminary one-line electrical diagram, which provides as much information as is available about the proposed interconnection.
 - c. State in the cover letter that you are requesting a Preliminary Interconnection Study, not a formal Interconnection Request. Return both items listed above and the required down payment to the following MP representative:

Power Delivery and
Transmission
Service Specialist Minnesota
Power
30 W. Superior
St. Duluth, MN
55802

2. Preliminary Interconnection Study agreement is prepared by MP and executed after reviews by Parties.
3. MP posts the study request on OASIS as required by FERC.
4. Preliminary Interconnection Study completed.
5. MP posts the study completion on OASIS.

B. Substation Interconnection Process

Parties who want to interconnect a substation with the MP Transmission System must formally request the Interconnection. The following is an overview of the Substation Interconnection Process.

1. Request a Preliminary Interconnection Study.
 - a. Complete the "Application for Substation Interconnection" form, attached. Please specify the specific location of the requested interconnection (county, town and street), a 10-year demand forecast (MW and MVAR), the number of transformers and their proposed nameplate capacity in

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megawatts (MVA), and the proposed in service date.

- b. Develop a preliminary one-line electrical diagram, which provides as much information as is available about the proposed interconnection.
- c. State in the cover letter that you are making a formal Interconnection Request. Return the items listed above and the required down payment for the Interconnection Study to the following MP representative:

Power Delivery and Transmission
Transmission Service Specialist
Minnesota Power
30 W. Superior St.
Duluth, MN 55802

2. Interconnection Letter of Intent

MP will provide a proposed Letter of Intent (LOI). In the LOI, the Applicant acknowledges that interconnection of a substation facility to the System may be subject to regulatory approvals and will be subject to execution of a definitive Interconnection and Construction Agreement. By executing the LOI, the Applicant authorizes MP to perform the Interconnection Study and start engineering work relating to the interconnection of Applicant's substation facility prior to execution of the Interconnection and Construction Agreement, and agrees to reimburse MP for the costs of such work. The LOI also provides for nondisclosure of confidential information by either party. The LOI also provides for an Interconnection Study.

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4. Interconnection Study

The Interconnection Study will determine if the transmission system has adequate load serving capability, and will determine the major components required to interconnect with the MP Transmission System. The Interconnection Study may include: power-flow analysis, fault study, stability study (if required), and impact to other customers on the MP System. The Interconnection Study report will provide the following information:

- a. Notice to neighboring entities
- b. Interconnection facility preliminary cost estimate;
- c. System upgrade requirements for interconnection only, not transmission service related; and
- d. Impacts introduced by the proposed substation on system operating conditions (voltages and thermal limits), as required to determine interconnection facility requirements.

During the analysis, additional details of the proposed facility will be required and will be requested from the customer as necessary.

6. Decision Period

After receiving the Interconnection Study results, Applicant will have 30 days to decide whether to proceed with the requested interconnection ("Decision Period"). During the Decision Period, Applicant's priority in the interconnection queue will not be affected by any lower-priority competing requests.

7. Right of Refusal Period

Following the Decision Period, the Applicant may have a maximum of 90 additional days within which to exercise a right of first refusal (Right of First Refusal Period) against any lower priority competing Requests, and to begin negotiating an Interconnection and Construction Agreement with MP.

The customer confirms it's decision to proceed by submitting a letter to that affect.

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8. Interconnection and Construction Agreement

Before MP initiates procurement, construction or installation of any facilities or equipment related to the interconnection of Applicant's substation facilities to the System, Applicant must execute an Interconnection and Construction Agreement. The Interconnection and Construction Agreement will define the terms and conditions under which MP will construct the facilities to interconnect the new substation to the System and, in some cases, will upgrade existing parts of the System. The Interconnection and Construction Agreement will also allocate the costs of interconnection facilities and System upgrades between the Applicant and MP. The Interconnection and Construction Agreement will also prescribe the design requirements for interconnection of Applicant's substation facility. Once the Interconnection and Construction Agreement is executed, MP will proceed with the interconnection process and the Interconnection and Construction Agreement will be filed with the applicable regulatory agency. The Interconnection and Construction Agreement will incorporate a Facilities Study for detailed engineering design.

9. Facilities Study

The Facilities Study will determine the detailed engineering design and final requirements for the interconnection to proceed, and costs based upon the equipment configuration determined by the customer and MP.

MP and the customer will enter into a Facilities Study Agreement to perform the required detailed engineering. The scope of the study will be detailed in the agreement. MP will charge the customer its costs for this analysis. MP's analysis will be limited to the requirement to protect MP's equipment, personnel, and customers from adverse impacts due to the customer's Interconnection.

The customer should provide all requested items as soon as practical to facilitate completion of necessary studies and agreements. After MP has received all of the required information, an estimate of the time to complete the Facility Study will be provided. To establish installation details, meetings will usually be held with the MP representative, the customer, the customer's consulting engineer, the contractor, and the equipment manufacturer.

The Facilities Study may include: fault study, stability study (if required), harmonic analysis, minimum protection requirements and impact to other customers on the MP System. The Facilities Study does not include studies for MISO acceptance or final engineering, construction, equipment purchase and/or delivery details.

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10. Requests for Transmission Service

The ability to interconnect to the MP system does not mean customer's substation can receive power over MP's facilities at all times and from any location. This determination is made under MP's Tariff and through reservation of transmission service. The customer shall contact the Transmission Systems Account Manager concerning obtaining transmission service.

C. Other Agreements

There are a number of other agreements which may be required of the customer, which cover the ongoing relationship between MP and the customer. Development of these agreements should be started during the Interconnection Agreement phase of the process. Please review Appendix A. Contact the following MP representative to determine which agreements you will need.

Power Delivery and Transmission
Transmission Service Specialist
Minnesota Power
30 W. Superior St.
Duluth, MN 55802

1. *Relay Settings and Coordination Study*

The customer will perform a relay setting and coordination study during final engineering. MP will furnish all necessary MP data to the customer. The customer will submit the completed study to MP along with applicable single-line and three-line AC and DC schematic drawings. MP will review the settings of the relays at the interconnection point. MP will not be responsible to review other customer relay settings.

2. *MISO Study and Approvals*

Substation interconnections to the MP Transmission System may need to obtain MISO approval if transmission system upgrades are required. Interconnections requiring system upgrades or expansion will require approval through the MISO planning process. Such approval is based on demonstrating that the transmission system upgrades will not adversely affect the power system performance. At the customer's request, MP will facilitate the inclusion of such upgrades in the next cycle of the MISO planning process.

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D. Regulatory Approvals

Interconnection facilities and system upgrades required for the interconnection will require regulatory approvals. The customer is responsible for obtaining all required regulatory approvals for its interconnection facilities and is subject to MP obtaining approval for any necessary system upgrades. The schedule for interconnection of new substation is dependent on obtaining regulatory approvals (and construction of required facilities which follows).

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IV. INTERCONNECTION TECHNICAL REQUIREMENTS

The following requirements apply to all Substation/End User interconnections with the MP System.

A. General Requirements

1. Interconnected Generation

If the Interconnecting customer has generation interconnected, directly or indirectly through facilities it owns, the customer must also meet the requirements for generation interconnection outlined in the MP "Safety Standards and Interconnection Requirements Applicable to Generators and/or Small Power Producers"

2. Regulatory Approvals

The customer is expected to take the lead in obtaining all regulatory permits and approvals for locating the interconnecting substation and any required transmission to allow for the interconnection. MP may, at its options choose to obtain any or all of those permits and approvals required for facilities which it will own.

3. Accredited Capacity

Any customer interconnected to the MP electric system resides within the MRO reliability region. Under MRO rules, the customer must own or have under contract "MRO Accredited Generation Capacity' equal to 115% of their peak day actual load at the time the peak loading occurs. This includes any generation interconnected with the customer's distribution system. Any such generators must obtain and retain MRO accreditation.

4. Modeling

The customer must provide the initial MW and MVAR electrical load served via the interconnecting substation, plus a 10-year forecast of such loads. The customer must establish a process to annually update such forecasts to allow for annual MRO data requests for model buildings and system planning analysis.

Along with the customer load data, the customer needs to provide any new interconnections planned along with forecast of generation changes. If the customer has generation, MP may require internal system impedance data including the Distribution Transformer.

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All generator/exciter/governor manufacturer data sheets must be available for modeling in transient/voltage stability, short circuit, and relay setting calculation programs. This includes generator reactive capability curves and exciter saturation curves.

MP will also need to know on a collective substation basis, customers' load shed relay information (See Section IV.B.3).

5. System Planning Studies

As the use of the transmission system continues to grow, MP needs to do detailed system studies (steady-state power flow, dynamic analysis, fault studies, etc.) to plan the expansion of the transmission system. The system must be studied and designed to meet the NERC, MRO, MISO and MP planning and operations criteria.

The NERC Transmission Planning (TPL) standards also require an annual assessment of the transmission system. This may also trigger a detailed study to mitigate non-compliance.

All interconnected customers are expected to participate in MP's detailed system studies upon request from MP. Customers are expected to use Due Diligence in communicating to MP their need to upgrade the capacity of their interconnection, changes in generation internal to their distribution system, or needs for new interconnections, and to provide such information in time for inclusion in the periodic detailed system studies.

Participation in the periodic, detailed studies will reduce the lead times when actual changes or additional interconnections are requested.

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B. Operating Limits

In order to minimize adverse operating conditions of electric service to themselves and to other customers on the MP System, and to allow appropriate design of the interconnecting substation, the following are the operating limits the customer must meet or design to:

1. Voltage

a. Steady State Voltage Range

The majority of the MP Transmission System voltage is normally operated within 100-105% of the nominal voltage. Under Transmission contingencies (outages) this range may extend to 95-110% (not including outage of the direct transmission source to the customer). Voltage levels within this range can be expected, and they will vary on a continuous basis. MP will use due diligence and good utility practice to return the voltage to an acceptable pre-contingent level as soon as possible. The substation customer should make provisions to provide voltage regulation for its distribution service.

If contingencies (outages) on the transmission system exceed certain design criteria for the system as outlined in the NERC Transmission Planning (TPL) standards, MP cannot guarantee the voltages will remain within the above range without shedding of customer load. MP will use due diligence and good utility practice to return service to the customer as soon as possible.

b. Dynamic Voltage Range

the majority of the MP electric transmission system is designed to avoid dynamic voltage dips below 82% of the nominal voltage due to external faults or other disturbance initiators. The customer should allow sufficient dead band in its voltage regulation equipment control to avoid reacting to dynamic voltage dips.

2. Flicker

Minnesota Power has adopted IEC Standard 61,000-3-7 for flicker with Pst = 0.8, using 60 Hz, 120 volt lamp curves. This standard should be met 99% of the time including abnormal system conditions. Special operating procedures may be required during abnormal system conditions.

Flicker is measured at the Point of Common Coupling. Flicker should be measured with a flicker meter compliant with current industry standards which is IEC 61,000 – 4 – 15.

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The customer will be responsible and liable for corrections if they are the cause of objectionable flicker levels.

3. Emergency Load Shed obligation

a. Automatic Load Shed

To comply with NERC and MRO reliability standards, Minnesota Power is obligated to provide automatic emergency load shed capability. This obligation is based on MP's total end-use load within the MRO region. As the customer's end use load is included in MP's total load, part or all of the customer's load must be included in MP's load shedding plan.

MP will perform studies to determine the extent and detailed specification of the customer's load shedding facilities. The customer will provide automatic load shedding facilities to meet the specification provided by MP.

The customer will provide periodic maintenance of its load shedding facilities as specified by Minnesota Power and will provide written evidence there-of to Minnesota Power.

b. Manual Load Shed

10% of the load, but shall not be the same load used to meet the automatic load shedding criteria.

The actual load shed tripping time will be specified by MP. MP will perform the necessary studies to specify the minimum load shed tripping time to coordinate with generator protection systems.

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4. Minimum Power Factor Requirements

The MP Transmission System is designed and operated assuming the power factor at the transmission side of the distribution transformer is 95% when load is within 10% of the forecasted system minimum or peak. Any interconnecting customer is expected to provide sufficient reactive power (leading or lagging) such that during these load periods the high side power factor does not exceed + or - 95%.

If during normal operation (system intact or under transmission contingency conditions) the voltage in a portion of the MP Transmission System deviates from the range described in Section IV.B.1, MP will survey these interconnected substations which, in its opinion, may contribute to the voltage concern and require the customer to demonstrate, (either by metered values or by inventory of installed equipment) that the customer meets its reactive power obligation. Any deviations are to be corrected immediately.

Some portions of the MP power system are in or adjacent to areas where other power suppliers (Municipals or Co-ops) utilize "ripple" load management systems. These systems employ an on off keyed carrier signal (typically in the range of 150-400 Hz) injected into the power systems to address customer site load management devices. Installation of shunt capacitor banks may cause degradation of the ripple signal strength due to shunting to ground of the ripple signal through the capacitor bank(s). To prevent such degradation, appropriately tuned blocking filters may be required.

5. Harmonics

Minnesota Power has adopted the most recent version of IEEE standard 519 for harmonics.

6. Fault Current

The rating of the customer-owned equipment at the interconnection must exceed the maximum fault current available on the MP system. The exact value of available fault depends upon location and circuit configuration and will be determined in the interconnection studies. The customer must work closely with MP at the time of interconnection design to determine the available fault current at the specific location of interconnection.

If the installation of customer -owned equipment causes the fault current limits to be exceeded, the customer must install equipment to limit the fault current on the MP delivery system or compensate MP for the additional costs of installing equipment that will safely operate within the available fault current. Facilities and System Impact Study will determine level of fault current.

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C. Energization of MP Equipment by the customer

The customer shall not energize a de-energized MP circuit. The customer shall have in place the necessary control devices and procedures to prevent the energization of a de-energized MP circuit by the customer.

D. Synchronization of customer Generation

The customer is responsible for synchronization of any generation interconnected to the customer's system. (See MP Safety Standards and Interconnection Requirements Applicable to Generators and/or Small Power Producers)

E. Disconnect

A disconnect device should be installed to isolate the MP system from the customer. This disconnect shall provide a visible air gap to establish required clearances for maintenance and repair work of the MP system. MP may require the design to allow the application of safety grounds on the MP side of the disconnect. OSHA lockout/tag requirements must be followed.

The disconnect must be accessible at all times to MP personnel. Disconnects shall allow for padlocking in the open position with standard MP padlock. The customer shall not remove MP padlocks or MP safety tags. The customer must provide access to disconnect at all times (24/hour day phone number, guard desk, etc.) The disconnecting equipment must be clearly labeled. The disconnecting equipment shall be suitable for the specific application and location. This switch may require a motor operator and remote control for fault isolation.

Protective Relays

Protective relays are required to promptly sense abnormal operating or fault conditions and initiate the isolation of the faulted area. MP requires that the customer use MP approved relays. This requirement applies to any relaying which will interact with MP's protective relaying. See Section VI for a more detailed explanation.

F. Substation Grounding

The customer is responsible for properly grounding their facilities. The customer must adhere to IEEE Standard 80. Customer grounding system shall be compatible with the MP system grounding and shall not cause excessive voltage during normal operation or during faults.

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G. Metering

All customers interconnecting a distribution substation or end use load to the MP Transmission System must provide metering. This metering must be of billing accuracy. The meter must be capable of measuring watts, Vars, volts, amps, and watt hours. It will require an hourly time stamp and recording capabilities with a minimum capability of once per month data retrieval. In general, this is a remote dial-up data retrieval capability. The meter may be located on the distribution (customer) side of the step-down transformer, but must have the ability to compensate the meter readings to the high side of the transformer to account for transformer energy losses.

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H. Supervisory Control and Data Acquisition (SCADA)

1. Telemetry

Telemetry is required when real time visibility is needed for the appropriate operation of the MP EMS system and State estimator model. Facilities study will determine telemetry requirements.

When telemetry is required, the customer must provide the communications medium to MP. If a telephone circuit is used, the customer must also provide the telephone circuit protection and coordinate the RTU addition with MP.

2. Equipment Control and data acquisition

Facility study will determine Equipment Control and Data acquisition requirements.

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V. Substation Configuration

The basic substation configuration requirements are based on the customer's expectation of the ultimate capacity of the substation and the transmission voltage level at the Interconnection. A large substation is one which connects at or above 100 kV or is planned for greater than 10 MVA of transformer connected. Final configuration will be determined in the facilities study.

A. Large Station Configuration

1. Site

The customer must provide a site which, along with their own distribution needs, is capable of an ultimate transmission level layout as determined in the facility study.

2. Interconnection Switch

At a minimum, the customer must provide a manual, gang-operated disconnect device at the interconnection of each transformer as required in Section IV.E.

3. Fault Detection and Clearing

a. Fault Detection

The customer will provide, and maintain in operable condition, protective equipment to detect faults on its equipment and systems. At no time will the customer operate its system without this protective equipment active.

b. Fault Clearing

The customer will provide and maintain in operable condition equipment and systems capable of interrupting maximum fault levels within the customer's transformers busses and equipment.

Fusing of the customer's transformers for large substations is not permitted. Facilities study will determine protection equipment and coordination. The relays must be compatible with, and coordinated with MP's existing transmission service protection equipment.

- Application of ground switches to trigger remote tripping is an unacceptable practice.
- Customer distribution feeder faults must not trip the transmission line as a primary protection method.
- The customer must provide equipment capable of immediately and automatically isolating any faulted or failed equipment from the

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transmission system. This must be compatible with the existing transmission protection equipment.

c. Transmission Line Automatic Reclosing

The customer will experience one automatic reclose operation following a transmission line trip. Such a reclose will be timed to allow all automatic sectionalizing devices to have fully operated.

B. Small Station Configuration

1. Site

The customer must provide a site which, in addition to the customer's own needs, is located where a radial transmission tap from the MP Transmission System is possible.

2. Interconnection Switch

At a minimum, the customer must provide a manual gang-operated disconnect device at the interconnection of the transformer as determined in the Facility Study.

3. Fault detection and Clearing (See Section IV)

a. Fault Detection

The customer will provide and maintain in operable condition protective equipment to detect faults on its equipment and systems.

At no time will the customer operate its system without this protective equipment active.

b. Fault Clearing

The customer will provide and maintain in operable condition equipment and systems capable of interrupting maximum fault levels within the customer's transformers, busses and equipment. This equipment must be capable of identifying and automatically isolating a fault in the customer's equipment. The protective equipment must be, at a minimum, a fuse that coordinates with the MP protective equipment. If other protective devices are chosen, the customer must follow the Large Substation guidelines.

c. Transmission Line Automatic Reclosing

The customer will experience one automatic reclose operation following a transmission line trip. Such a reclose will be timed to allow all automatic sectionalizing devices to have fully operated.

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C. Stations which tap generator outlet lines

When interconnections are required on generator outlet lines, the interconnection must be designed so as not to increase exposure or reduce the reliability of the generator outlet line. In some cases, this means that to connect to a generator outlet line a substation must be built at the tap point which provides two independent paths through the station.

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VI. PROTECTIVE DEVICES FOR THE INTERCONNECTION

Protective devices are required for safe and proper operation of the MP-customer interconnection. MP shall operate all MP-owned protective equipment at the interconnection to ensure that these requirements are met. During interconnection studies, MP will approve the proposed type of interconnection protective devices, ownership, operating details and equipment settings. **Do not confuse interconnection protection in this section with customer station protection. MP is not liable or responsible for customer's protection.**

A. Protective relays

Protective relays are required to promptly sense abnormal operating or fault conditions and initiate the isolation of the faulted area. The customer shall install only MP approved relays on the part of their system which can impact the operation of the MP system. These relays must, at a minimum, meet IEEE Standards C37.90, C37.90.1 and C37.90.2. Customer's shall submit complete control and relaying documentation for MP review. MP will approve only those portions of the document that pertain to protection of the MP system. MP may suggest or comment on other areas; however, the customer is responsible for the design of protection schemes protecting customer facilities.

B. Protection Function Requirements

The following protective relay recommendations are necessary for MP to supply its customer's with a stable, intact electrical system.

1. Typical Requirements Over Current (51) - for faults and overload
2. Other Requirements (Determined in Facilities Study)

The following additional Protection Functions may be suggested or required depending upon the size of the load, nature of interconnection and coordination requirements with MP Protective Systems

- a. Impedance (21) Where over current functions may not be adequate
- b. Out of Step (68) During system disturbance, the tie may have to be separated.

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- c. The customer relay system may have to match the MP relay system when interconnected at the transmission level. MP has various transmission relay systems at various locations. This will have to be determined during the Facilities Study.
 - d. Transfer Trip (TT)
 - e. Directional Overcurrent (67)
3. Back-Up Protection

The failure to trip during fault or abnormal system conditions due to relay or breaker hardware problems, or from incorrect relay settings, improper control wiring, etc. is always a possibility. For this reason, MP may require back-up protection.

C. Interconnection Requirements

In general MP will own, operate and maintain all interconnection devices up to but not including the high-side disconnect switch for the customer transformer.

Gang-operated disconnect switches are required on each side of any interconnection circuit breaker or circuit switcher. These switches are necessary to provide the visible open for worker safety during breaker maintenance. MP does **not** consider the integral switch available on some circuit switchers as a way to meet this requirement.

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D. Substation Design Data

1. Physical Electrical Design Data/Criteria

Environment

Temperature Range -60⁰F to +105⁰F

Ave yearly Temp 40⁰F

Precipitation 30"; Max yearly snowfall 150"

Design Ice ½"

Wind Speed 80mph

Frost depth 90"

Degree Heating Days 9500

Degree Cooling Days 500

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General Criteria

Substation Design Criteria

Codes and Standards

Substation design to meet NESC as well as industry accepted standards such as but not limited to ANSI, IEEE, IEC, NFPA, OSHA

Design Life

40 years

Design Specifics

Bus Design IEEE 605 plus MP standard features

DC System : IEEE 484 and 485 plus MP standard features

8 to 10 hours service for loss of AC, 8 to 10 hours to recharge

Circuit Breakers Application: ANSI C37.010, C37.011, C37.012, C37.015

Transformer Application: ANSI C57.12

Shielding: Electrogeometric: (rolling sphere)

Grounding: IEEE 80 plus MP standard features

Surge Arrester Application: ANSI C62.1

Cable per MP standard CA01PA

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MP system standard basic insulation levels and clearances:

NOMINAL VOLTAGE RATING - kV	7.2 &	14.4	23	34.5	46	69	115	138	161	230	230	345	500
RATED MAX VOLTAGE – kV	8.25	15.5	25.8	38	48.3	72.5	121	145	169	242	242	362	550
FULL WAVE IMPULSE WITHSTAND kV 1.2 x 50 vs WAVE (kV CREST)	95	110	150	200	250	350	550	650	750	900	1050	1300	1800
RECOMMENDED PHASE SPACING FOR HORN GAP SWITCHES, (VERTICAL & SIDE BREAK) AND	36	36	48	60	72	84	120	144	168	192	216	240	336
RECOMMENDED PHASE SPACING FOR VERTICAL BREAK DISC. SWITCHES, BUS SUPPORTS AND	18	24	30	36	48	60	96	108	120	132	156	174	300
SIDE BREAK (HORIZONTAL BREAK) DISC. SW.(S) (INCHES)	30	30	36	48	60	72	108	132	156	192	216	216	-
MINIMUM METAL TO METAL, PHASE TO PHASE DISTANCE FOR ALL DISC. SWITCHES, BUS	7	12	15	18	21	31	53	63	72	89	105	119	*1
RECOMMENDED CLEARANCE - PHASE TO GROUND FOR ALL METAL PARTS OR EQUIPMENT	7.5	10	14	18	22	30	47	52.5	61.5	76	90.5	106	*2
MINIMUM CLEARANCE - PHASE TO GROUND FOR ALL METAL PARTS OR EQUIPMENT (INCHES)	6	7	10	13	17	25	42	50	58	71	83	104	156
CLEARANCE OVER DRIVEWAYS INSIDE SUBSTATION - MINNESOTA POWER NEW CONSTRUCTION	22	22	22	22	22	23	24	25	26	28	30	32	40
MINIMUM OVERHEAD CLEARANCE FROM LIVE PARTS TO GRADE FOR PERSONAL SAFETY (FEET)													
NESC C2 TABLE 124-1	8'-10"	9	9'-3"	9'-6"	10	11	12	13	14	15	16	18	-
RECOMMENDED CLEARANCES FOR NEW CONSTRUCTION	9	9	10	10	10	11	12	13	14	15	16	18'	32
RECOMMENDED CLEARANCES FOR BUS WORK (FEET)	10	10	10	10	12	15	15	16	17	18	18	-	-

REFERENCE DATA: NEMA STANDARDS SG6-8.03 AND HV-1, IEEE/ANSI STD. C37 AND C92, IEEE NESC C2-1993, LAPP INSUL. CAT., EXISTING MP ENGINEERING PRACTICES

*FORBES 500kV SUBSTATION DESIGN FOR 2.8 pu CREST 1250kV (550kV BASE)

*1 RCD TO PLANE 216

*2 RCD TO PLANE 206

2. Civil Design

Determined by facilities study

3. Circuit Breakers, Circuit Switchers and Group-Operated Switches

Interconnection circuit breakers/switchers and group-operated switches shall meet the latest applicable ANSI and IEEE standards and shall be suitable for the local environment and system operating conditions. They must also meet MP approval. MP specifications and materials standards for these devices are available upon request.

Group-operated switches must have provisions for locking in the open position using a standard MP padlock. The motor operator must be equipped with a de-coupler mechanism that allows the switch to be disconnected from the motor operator and locked in the open position.

4. Arresters

In general all MP incoming lines shall be protected with surge arresters located on the line side of disconnect switch. MP specifications for surge arresters are available upon request.

5. Grounding System

The customer shall submit the grounding system study and design for MP review and approval. It is normal MP practice to use 4/0 copperweld wire for the ground grid material with the connections made using exothermic welds. MP connects the substation fence to the ground grid. MP grounding standards are available upon request.

6. Potential Transformers

MP generally uses wound potential transformers at 115 kV and below. Above 115 kV, capacitor coupled voltage transformers are acceptable as long as their response characteristics meet relaying requirements. Any potential devices that are part of the interconnection shall meet MP approval. MP specifications are available upon request.

7. AC Station Service

Typically, substation AC systems are used to supply power to loads such as transformer cooling, oil pumps and LTCs; circuit breaker auxiliaries and control circuits; outdoor equipment heaters, lighting and receptacles; and control house lighting, receptacles, heating, ventilating, air conditioning and battery chargers.

Power supply shall be either a single-phase, 120/240 VAC, three-wire or a three-phase 120/240 VAC four-wire system for lighting, heating, maintenance

and other site specific electrical needs. In order to standardize on equipment, MP does not install 120/208 VAC auxiliary systems. The AC service shall meet the requirements of the National Electrical Code.

In large substations, it is normal to provide both a preferred and emergency station auxiliary with an automatic transfer to the emergency on loss of the preferred.

In some substations, where the transmission connection is critical to restoration after a system blackout, an emergency diesel generator may be required in order to maintain certain station auxiliaries in an operable condition.

8. DC Station Service

The DC system supplies power for the circuit breakers, motor operated switches, instrumentation, emergency lighting, communications, fire protection system, annunciators, protective relaying and fault recorders at substations.

A standard DC system consists of three major components: a battery, a charger, and a distribution system. Normally, the battery is float charged by the battery charger. That is, the battery charger supplies all the continuous DC load connected to the bus and powers the battery in order to maintain it in a full state of charge. Under normal conditions, the battery does not supply any load but is held in the fully charged condition, ready to supply the DC loads for continuous operation or simultaneous tripping events if all AC sources to the battery charger are lost.

MP requires that batteries be sized to handle the normal continuous DC load for twelve hours following the loss of all station AC and still have the capacity left to handle a worst case tripping scenario with secondary trips due to a breaker failure. The battery charger shall be sized to be able to recharge a fully discharged battery within 12 hours while supplying the normal continuous DC station load.

9. Cable

Cables shall be jacketed and insulated with cross-linked polyethylene or ethylene propylene rubber type insulation. Conductors shall be suitable for wet locations, direct burial, insulated and sized all in accordance with the NEC.

10. Lighting

Substation lighting shall meet the requirements of the NESC. Controls for yard and control house lighting shall be accessible to MP at all times. MP

standards for lighting are available upon request.

E. Automatic Reclosing/Voltage Check Schemes

MP normally applies automatic reclosing to all transmission lines. Prior to automatic reclosing, the customer must ensure that any generation is disconnected from MP. It may be necessary to install voltage check schemes at various locations on the MP System to prevent automatic reclosing in the event that a customer generator remains connected to an isolated, unfaulted section of the MP System. These voltage check schemes may be located at the interconnection point. These schemes may also be required on alternate circuits which may be used to feed the customer. Details of any modifications to MP reclosing practices and/or addition of voltage check schemes will be determined during the Facilities Studies.

MP shall assume no responsibility for damage to customer's equipment due to out-of-phase reclosing.

In general, reclosing practices should be as follows:

1. There should be no automatic reclosing for the incoming breaker.
2. The MP substation breaker may have one or more time recloses, with the first set at a minimum of 3 seconds. It is expected that either the generator or the tie breaker will open before reclosing takes place.

F. Communication Channel

MP may require that a communication channel and associated communication equipment be installed as part of the protective scheme. This channel may consist of power line carrier, leased telephone line, pilot wire circuit, fiber optic cable, radio, or other means. The communication channel is required in cases where it is necessary to remotely send a signal to remove the customer's facilities from the MP System due to a fault or other abnormal conditions which cannot be sensed by the protective devices at the customer's location. Some instances may require installation of communication equipment in MP substations to initiate the protective signals. Another communication channel may be needed for monitoring and control purposes. The Facilities Study will determine the specific communication channel requirements. The cost of installation and additional monthly fees for this channel will be the responsibility of the customer.

If a telephone circuit is used, it also must be provided with telephone circuit protection.

G. Customer Owned Interconnection Protective Device

Interconnection protective devices owned by the customer should be maintained and inspected according to manufacturer recommendations and/or industry standards. Procedures must be established for visual and operational inspections; in addition, provisions should be established for equipment maintenance and testing. Equipment should include, but not be limited to:

- Circuit Breakers
- Protective Relays
- Control Batteries

MP maintains the right to review maintenance, calibration and operation data of all protective equipment for the purpose of protecting MP facilities and other MP customers. The customer is responsible for providing the necessary test accessories (such as relay test plugs, instruction manuals, wiring diagrams, etc.) required to allow MP to test these protective devices. Verification may include the tripping of the interconnection breaker.

If MP performs work on the customer's premises, an inspection of the work area may be made by MP operating personnel. If hazardous working conditions are detected, the customer shall be required to correct the unsafe conditions before MP will perform the work.

H. Communication with MP Operations

With interconnected substations, customer equipment events or actions may impact the MP System and MP System events may impact the customer. Consequently, communication between parties becomes very important. The MP representative will provide the customer with the names and phone numbers of the MP Control Center and Operations Coordination personnel who are responsible for the MP System at the interconnection. The customer will provide MP with the names and phone numbers of the customer contact(s) with responsibility for operating the customer's equipment.

Customer contact(s) should include at least one 24 hr/day phone number. Contacts should be able to provide information on equipment status, explanation of events on customer equipment, and relay target and alarm information when asked to do so by MP personnel. Also, the customer should contact MP whenever:

1. Problems with the customer's equipment are detected that could result in misoperation of customer's protection systems or other equipment that could impact the MP system.
2. Customer equipment problems result in an outage to a portion of the MP System.

3. The customer intends to initiate switching to parallel generation with the MP System.
4. The customer experiences unusual operational issues (abnormal frequency and voltages).

MP also recommends that the customer contact MP whenever:

1. The customer intends to initiate switching to energize a transformer with the MP System.
2. The customer intends to initiate switching to open the interconnection between the customer and MP.

MP may choose to waive some of the communications requirements for smaller substation facilities

VII. PRE-PARALLEL REQUIREMENTS AND INSPECTION

Prior to the actual energization of the customer's distribution transformer with the MP System, all pertinent contracts must be signed, and all equipment modifications must be complete. In addition, the customer must have the interconnection installation inspected and certified by a qualified technician for proper installation and operation of the interconnection protective devices. Test and commissioning procedures of interconnection equipment shall be reviewed and approved by MP.

The inspection shall include, but not be limited to:

- Verification that the installation is in accordance with the service contract and the Facilities Study.
- Verification of the proper operation of the protective schemes.
- Verification that the proper voltages and currents are applied to the interconnection protective relays.
- Verification of proper operation and settings of the interconnection protective relays.
- Verification of synchronizing equipment.
- Trip testing of the breaker(s) tripped by the interconnection relays.

MP may waive or add additional test requirements based on the specific conditions of the proposed interconnection.

MP may, at its option, witness the inspection. The customer must give MP at least two weeks notice of upcoming tests and provide their test procedures for MP approval prior to the tests. The certification and test report will be furnished to both the customer and MP as soon as practical.

Upon performance and certification of the pre-parallel inspection, the customer shall be granted approval for operation of the distribution equipment in parallel with the MP System. Neither the inspection nor the granting of approval to the customer shall serve to relieve the customer of any liability for injury, death or damage attributable to the negligence of the customer. The inspection and approval does not constitute a warranty or relieve the customer of responsibility for the operating condition or installation of the equipment and may not be relied upon by the customer for that purpose.

Once the facility is interconnected, MP will retain the right to inspect the facility if the operation is suspected of causing problems or operational issues (abnormal frequency and voltages) for other MP customers, and retains the right to inspect at MP's discretion.

VIII. OPERATING GUIDELINES

The customer shall operate the substation equipment within the guidelines of this document and any special requirements set forth by established agreements.

Normal Conditions

The customer's interconnection is operating to the instructions and approval given by the MP Transmission Control Center personnel:

- All schedules to deliver power over MP's transmission system must be pre-approved prior to implementation. Usually the implementation notification will occur at specified intervals.
- The customer is providing 24-hour support and access to the interconnecting equipment.

Abnormal Conditions

MP reserves the right to open the interconnection circuit breaker or disconnect device for any of the following reasons:

- MP performing line maintenance work on the MP System.
- MP System emergency.
- Inspection of a customer's distribution equipment and protective equipment reveals a hazardous condition.
- Failure of the customer to provide maintenance and testing reports when required.
- The customer's distribution equipment interferes with other customer's or with the operation of the MP System.
- The customer has modified the distribution equipment or protective devices without the knowledge or approval of MP.
- Parallel operation of any unapproved customer generating equipment.
- Personnel and/or public safety is threatened.
- Failure of the customer to comply with applicable OSHA Safety Tagging and Lockout requirements.
- Operational issues (abnormal frequency and voltages).

The failure of MP to open the interconnection circuit breaker or disconnect device shall not serve to relieve the customer of any liability for injury, death or damage attributable to the negligence of the customer.

Changes to the MP System, or the addition of other customers with generation in the vicinity, may require modifications to the interconnection protective devices. If such changes are required, the customer may be subject to future charges for these modifications.

Maintenance Notification

The customer is required to notify MP for any of the following reasons:

- Scheduled outage periods and return to service expectations. Return to service notification must be updated daily to reflect the recent progress or the lack of progress.

Operating Data Submittals

The customer is required to provide operating data and equipment modeling to MP to support the following:

- NERC compliance program(s)
- Regional Reliability Organization compliance program(s)
- Federal, state and local regulatory programs

IX. GLOSSARY

Accredited: Generating capability recognized as meeting MRO requirements to satisfy a portion of a MRO member's generating capacity obligation.

Alternating Current (AC): That form of electric current that alternates or changes in magnitude and polarity (direction) in what is normally a regular pattern for a given time period called frequency.

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

Apparent Power: For single phase, the current in amperes multiplied by the volts equals the apparent power in volt-amperes. This term is used for alternating current circuits because the current flow is not always in phase with the voltage; hence, amperes multiplied by volts does not necessarily give the true power or watts. Apparent power for 3 phase equals the phase to neutral volts multiplied by ampere multiplied by 3.

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

Automatic Reclosing: A circuit breaker has automatic reclosing when means are provided for closing without manual intervention after it has tripped under abnormal conditions.

Automatic Tripping (Automatic Opening; Automatic Disconnecting): The opening of a circuit breaker under predetermined conditions without the intervention of an operator.

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

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

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

Control Area: A control area is an electrical system bound by interconnect (tie-line) metering and telemetry and regulating its generation in order to maintain its interchange schedule with other systems, contributes to frequency regulation of the Interconnection and fulfills its obligations and responsibilities in accordance with NERC and reliability region (such as MRO) requirements.

Control Area Load: Control area load is the entire demand for energy within a specified control area.

Current: A flow of electric charge measured in amperes.

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

Delivered Energy: Energy delivered by MP to the customer.

Delta Connected Circuit: A three phase circuit with three source windings connected in a closed delta (triangle). A closed delta is a connection in which each winding terminal is connected to the end (terminal) of another winding.

Demand: The rate at which electric power is delivered to or by a system; normally expressed in kilowatts, megawatts, or kilovolt-amperes.

Direct Current (DC): An electric current flowing in one direction only and substantially constant in value.

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

Energy Losses: The general term applied to energy lost in the operation of an electrical system. Losses can be classified as Transformation Losses, Transmission Line Losses or System Losses.

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

FERC: Federal Energy Regulatory Commission. (Formerly the Federal Power Commission, or FPC.) FERC is an independent body within the Department of Energy (DOE) regulating interstate transmission, prices of electricity and natural gas. It also licenses hydroelectric projects, interconnections, construction work in progress, rates for wholesale customers, utility accounting practices and procedures.

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

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

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

HCA: Host Control Area. Within MRO, scheduling areas and entities that do not operate a control area must designate a Host Control Area that is responsible for controlling the group's load and for all scheduling errors that are made. MRO will only deal with control areas and holds the control area responsible for all problems within that control area.

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

Incoming Breaker: The customer-owned breaker which connects MP source of power to the customer's bus.

Interconnection: The physical system of electrical transmission between the customer's generation and the utility.

Interrupting Capacity: The amount of current a switch, fuse, or circuit breaker can safely interrupt.

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

Kilovolt (kV): One thousand volts.

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

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

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

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

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

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

MISO: The Midcontinent Independent System Operator, Inc. (MISO) is a non-profit, member-based organization formed to provide customers with valued services, reliable, cost effective systems and operations, dependable and transparent prices, open access to markets, and planning for long-term efficiency.

MRO: Midwest Reliability Organization (MRO): a NERC (North American Electric Reliability Corporation) region. The MRO is a voluntary association committed to safeguarding reliability of the bulk electric power system in the north central region of North America. The essential purposes of the MRO are: (1) the development and implementation of regional and NERC reliability standards; and (2) determining compliance with those standards, including enforcement mechanisms. The MRO also provides other services consistent with its reliability charter.

NERC: North American Electric Reliability Corporation. The FERC appointed Electric Reliability Organization to enforce compliance with mandatory reliability standards.

OASIS: Open Access Same-time Information System. An internet based system designed to allow all participants in the power market to obtain information concerning the capability and use of the transmission system in a non discriminatory manner.

Ohm: The practical unit of electrical impedance equal to the resistance of a circuit in which a potential difference of 1 volt produces a current of 1 ampere.

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

Peak Load: The maximum electric load consumed or produced in a stated period of time.

Point of Energy Exchange: The point in the delivery system where one party takes delivery of the energy from the other party. This point is defined in the contract between MP and the customer. It is often the point where facility ownership changes. This point may also be called the Point of Interchange when dealing with a bi-directional energy exchange or the Point of Delivery if the energy flows in one direction.

Point of Interconnection: The point where the customer's conductors meet MP's (point of ownership change).

Point of Metering: The point where metering equipment (meters, transducers, current transformers, potential transformers, etc.) is or will be installed to measure the power flow and energy exchange between MP and the customer.

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

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

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

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

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

Received Energy: Energy received by MP from the customer.

Reclose: To return a circuit breaker to its closed position after it has opened by relay action.

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

Scheduling Area: A scheduling area is similar to a control area, in that a utility schedules energy and provides capacity for a defined area. The utility will run a 24-hour control center and is recognized as a MRO Scheduling Area. Unlike a control area, a scheduling area does not have generators that can follow the load in their area, and are completely captured within one or more control areas. They must contract for load following services. Within MRO, a scheduling area must identify a Host Control Area.

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

Synchronism: Expresses the condition across an open circuit wherein the voltage sine wave on one side matches the voltage sine wave on the other side in frequency and amplitude without phase angle difference.

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

Transformer: An electric device, without continuously moving parts, in which electromagnetic induction transforms electric energy from one or more other circuits at the same frequency, usually with changes of value of voltage and current.

Voltage: Electric potential or potential difference expressed in volts.

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

VAR: Volt ampere reactive, see Reactive Power.

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

Wheeling: The use of transmission facilities of one utility system to transmit power to another utility system, or between customer facilities within a single utility system or between systems.

Wye or "Y" Connected Circuit (Star Connected): A three-phase circuit in which windings of all three phases have one common connection.

X. REFERENCES

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Version History

Version	Notice Date	Author	Change Description	Change Date
3		Christian Winter	Updated references to MISO and NERC, and associated processes/policies. Removed references to MAPP.	12/15/2014
2		Tom Ernst	Misc editorial changes. Additions to improve coordination with NERC requirements. Reformatted revision history to match corporate standards.	07/01/2011
1		Mike Klopp	Misc updates	02/19/2009
0		Mike Klopp	Initial release	05/10/2007

Appendix A

Agreements Requirements for Substation Interconnections

Agreements Required for Substation Connected Directly to MP's System

Letter Of Intent: The Letter Of Intent (LOI) agreement is the initial agreement in the substation interconnection process. In the LOI, the customer acknowledges that interconnection of its substation facility to the System may be subject to regulatory approvals and will be subject to execution of a definitive Interconnection Agreement. The LOI enables MP to start engineering work and studies relating to the interconnection of Applicant's substation facility by having the customer authorize MP to proceed and agree to reimburse MP for the costs of such work. The LOI may also provide for nondisclosure of confidential information by either party.

Interconnection Agreement: If the substation is to be connected to MP's electric delivery system, the new connection must be identified and subject to MP's reliability requirements in a new or modified Interconnection Agreement. This is a long-term contractual arrangement that is required for the duration of the connection's existence. This also covers the engineering and construction work for which MP is responsible.

Agreements Which May Apply

Construction Agreement: If the customer wishes MP to do connection construction work for which the customer is responsible, a Construction Agreement is required. This contract is in effect until the construction work is complete and payment for work is received. This agreement is often combined with the Connection agreement

Operation and Maintenance Agreement: If the customer wishes MP to perform operation and/or maintenance service for connection facilities for which the customer is responsible, an Operation and Maintenance Agreement is required. This contract can be of any term between the connection's operational start and termination dates.

Interchange Agreement: A substation will result in any interchange of energy between MP's and the customer's respective electric systems. An Interchange Agreement would be required to handle issues such as interchange accounting and services to be rendered by either party to the other. The Interchange Agreement is a long-term contractual arrangement required to be in effect as long as there is a possibility of interchange between the systems, usually for the full duration of the connection's existence. This agreement is often combined with the Interconnection Agreement.

Transmission Service Agreement: In addition to the Interchange Agreement, if the interchange of energy between MP's and the customer's electric systems involves the delivery of energy through MP's Transmission System to or from another entity, a Transmission Service Agreement would be required to define the specifics regarding that wheeling transaction. MP's Transmission Service Agreement under the Transmission Services Tariff covers use of MP's Transmission System. If other MP electric system facilities are used for the wheeling deliveries besides MP's Transmission System, other arrangements would be required besides a Transmission Service Agreement.

Facilities Agreement: A customer's use of certain MP electric system facilities could involve a Facilities Agreement.

Study Agreements

Interconnection Study Agreements: This agreement is used for a variety of system study efforts required for an Interconnection. These may include:

1. Feasibility Study (optional)
2. Interconnection Study

Except for the Interconnection Study, these studies do not necessarily need to be done by MP. Qualified third party engineering firms may perform these studies. Feasibility Studies are optional and precede an interconnection request and will only be done by MP after higher priority studies have been completed. The Letter Of Intent can provide for an Interconnection Study.

System Impact Study Agreement: The right to interconnect to the MP electric grid does not mean that a substation can use MP's electric facilities to deliver power and energy at all times and wherever the customer wants.

When a customer wishes to deliver power and energy over MP transmission facilities, according to FERC rules, the customer must request transmission service via the OASIS. Based on established criteria, MP will approve or deny such a request or indicate the need for a System Impact Study according to tariff timelines. If a study is required to determine the ability of the system to provide the transmission service requested, MP will enter into a System Impact Study Agreement with the customer.

Facilities Study Agreement: This agreement is required once a definite decision by the customer has been made to construct the substation. This agreement covers the design work required to specify MP's equipment for purchase and installation of the interconnect. The Interconnection and Construction Agreement will provide for a Facilities Study.

Summary Agreements Required for Substation Interconnections

Letter of Intent	Yes
Interconnection	Yes
Construction	Optional
Operation and Maintenance	Optional
Interchange	Yes
Transmission Service	Yes
Facilities	Yes
Interconnection Study	Depends
System Impact Study	Depends
Facilities	Depends

Depends means it will depend upon the circumstance

