



FACILITIES CONNECTION REQUIREMENTS

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A. GENERAL

1. Introduction

This document outlines the requirements for generation, transmission, and end-use facilities of Members to be connected to grid through the electric cooperative distribution system. Its purpose is to promote the safety of people and equipment, ensure compatibility between member-owned generation and the cooperative distribution system, and maintain the reliability of the regional electric grid system. The document complies with the requirements of National Electric Reliability Council (NERC) Planning Standard I C "Facility Connection Requirements".

This General section describes requirements for projects involving generation, transmission, and end use facilities. The Generation section describes additional requirements specific to projects involving generating facilities.

All connections will require the member-owner to file an application with the electric cooperative for each project they would like to initiate. The size, connection voltage level, and degree of complexity of the proposed connection will determine the extent of detail, engineering, and related studies needed for approval. Large loads, generators, and higher voltage interconnections will need more comprehensive study and protective design. The Cooperative will have the right of approval of certain aspects of a project that could potentially impact the cooperative electric system.

All connections will require an Agreement specifying the legal rights and obligations of the Member-owner and the Electric Cooperative.

The member-owner's access to and conditions of use of the applicable Transmission Provider's (TP) system for transmission service may be governed by the TP's Open Access Transmission Tariff (OATT) filed with the Federal Energy Regulatory Commission (FERC). If the member-owner intends to deliver electricity to an entity other than the electric cooperative, a Request for Transmission Service must be made, as required in the applicable Transmission Provider's tariff, and in accordance with terms specified in the Tariff.

2. Application & Modifications

Member-owners must make application to the cooperative for proposed generation, or end use projects and associated connections to the distribution system. Applications must include sufficient information for the cooperative to conduct the necessary

inspections, evaluations, studies and approvals, and for discussions and changes as necessary.

Sufficient lead-time considering project scope (complexity, size, location, etc.) is required prior to starting construction to assure a thorough and orderly review process and construction schedule.

The Application will include:

- Member owner name & address
- Contact person, with phone, fax, and e-mail
- Project and connection site description
- Design and test specifications
- Schedule for the design and construction of the member's project and connection
- Operation and maintenance plans, including staffing, to the extent coordination with the cooperative is required
- Electrical schematics, which will include but not be limited to:
 - one line diagram showing the connections between the Member's project and the cooperative distribution system
 - three-line diagrams showing current and potential circuits for protective relays;
 - relay tripping and control schematic diagram.

The Cooperative reserves the right to approve the proposed settings for relays. If requested by the member, the Cooperative will provide system data needed to determine the relay settings.

- Communication and control schemes
- Generator and load specifications
- Schedules of intended generation, transfers, and load levels that will affect the cooperative's distribution system

The member will also provide to the cooperative any other information or documents related to the project which are necessary for the purpose of ensuring the safety, reliability, security, and protection of the distribution system and the regional electric system. Examples of such information are detailed in this document.

The member will provide prior written notice to the cooperative of any material modification or change to the project during construction or operation which may affect the distribution system. The Cooperative may require modifications to the member's project, when necessary, for the integrity of its system. Members will not make any major modifications to the project without the prior written consent of the Cooperative. Proposed member modifications to existing facilities must be mutually planned, coordinated, and integrated into the distribution system.

3. Confidentiality

It is recognized that certain information relating to the project may be confidential, proprietary or of competitive value. The Cooperative will disclose member information designated as confidential only to its officers, directors, employees, agents and affiliates who need to know such information in order to address the cooperative's rights and responsibilities related to the project.

Additional disclosures may be made to the extent required by regulatory or legal authorities and proceedings, or as required for evaluations by NERC, MISO an Independent System Operator ("ISO"), or PJM a Regional Transmission Operator ("RTO"). If the cooperative is required to disclose confidential information, the Cooperative will give the member prompt notice of such requirement.

4. Agreement

An Agreement will be required to specify the legal rights and responsibilities of the Member and Cooperative related to the Project. The Agreement will include: cost and work responsibilities, reasonable security deposits, communications, liability, insurance, penalties for non-performance, responsibilities under normal and emergency conditions, and other provisions as required.

The Member will be responsible for any and all costs which the Cooperative incurs as a direct or indirect result of the Project. This includes installation, operating and maintenance expenses, engineering and other study costs, and administrative costs which would not have been incurred but for the Member's Project. A [\\$1,500](#) deposit is required with executed agreement. The deposit will be based on the size and complexity of the proposed Project.

Member will reimburse the Cooperative for all costs incurred by the Cooperative resulting from the Project and will pay all other charges or amounts payable by Member under the Agreement.

5. Adherence to Standards

All facilities designed and installed by Member and the Cooperative must be designed, installed, maintained and operated in accordance with the Agreement, good utility practices, the National Electrical Code ("NEC"), the National Electrical Safety Code ("NESC"), the practices and guidelines of the Cooperative, NERC, MISO, PJM and an ISO/RTO, and all applicable laws and regulations.

If applicable, Member will comply with all practices, methods, policies, procedures, guidelines, criteria, tariffs and other requirements of the TP's Open Access Transmission Tariff and/or an ISO/RTO with respect to the construction, installation, maintenance and operation of the Member's Facility, delivery of energy to the Cooperative system and access to and use of the TP's system.

During construction and start-up, the Cooperative will monitor construction of the Member's Facility to assure compliance with the Cooperative safety and construction standards. The Cooperative reserves the right during system start-up and operation to witness all service checks, protection and control device calibrations, settings and routine testing. The Cooperative's review process does not relieve the Member of its obligation to perform and document these activities.

The Cooperative may periodically review pertinent aspects of the Project's operation, maintenance, and condition during the Project's life, in order to assure continuing safety and reliability of the Cooperative's system.

If the Member's testing and maintenance program is not performed to the satisfaction of the Cooperative or at the required maintenance interval (i.e. in accordance with good utility practice), the Cooperative reserves the right to inspect, test, or maintain devices required for the protection of the Cooperative's bulk transmission system at the Member's expense. If the Member's protective equipment is determined to be unsatisfactory, the Cooperative reserves the right, at its sole discretion, to disconnect the Member from the Cooperative system until the protective equipment is brought into conformance at the Member's expense.

6. Reliability Studies

The Cooperative will evaluate the impact of the Member's Project on its system, and on the electric system in the region. Studies will be made before Project startup and periodically during its operation. Studies may include load flow, short circuit, stability, torsional oscillations, and power quality impacts. The types and extent of necessary studies will be determined by the nature and size of the Project.

The studies may identify system problems and alternative solutions. Modifications to the Project may be required. If the cooperative system modifications are needed, these system facilities will be provided only if they are acceptable to the applicable regulatory authorities and the cooperative believes the improvements are a prudent business decision.

The Member's Project may require other design, planning, or operational studies to assure the desired performance of the integrated facilities, depending upon size, location and type of Facility characteristics and systems. Such studies may be done jointly with entities responsible for regional reliability, such as MISO, PJM, an RTO or an ISO.

Studies, analyses, reviews, testing, witness checks or audits, requested by or required due to the Project, whether performed or contracted by the cooperative will be at the Member's expense.

7. Regional Review

Review of the Project's impact on the regional electric system may be required. Projects that are large, and/or have characteristics that may have potentially significant effects on the system of the cooperative or the region, will be reviewed by appropriate NERC, MISO, PJM, RTO, or ISO technical assessment panels prior to startup, and ongoing thereafter.

8. Governmental Approvals

Filings at, and approvals from, regulatory agencies may be required for interconnection facilities associated with the Project. Possible agencies include FERC, RUS, local governmental agencies, and environmental agencies, depending on the nature of the Project and associated cooperative facilities.

Member and the cooperative will assist one another and use all reasonable efforts in making necessary filings and obtaining any necessary approvals of the Agreement as promptly as practicable. In the event any agency requires changes in the Agreement as a condition to its acceptance or, if applicable, approval of the Agreement, the Parties will negotiate in good faith with respect to revising the Agreement to reflect such changes.

9. Technical Requirements

a. System Protection and Coordination

The Member's protection and control systems must be designed, installed, operated, and maintained to coordinate properly with the cooperative protection and control systems for all normal and potential abnormal power system conditions. These systems must prevent or limit damage to the Project and to the cooperative system. They must provide acceptable redundancy; be easily maintained; accurate; fast; reliable (dependable and secure); sensitive; selective; meet the cooperative, IEEE, MISO, PJM, and NERC guidelines; protect the general public; minimize damage to facilities; prevent cascading outages; minimize unnecessary outages; and provide the flexibility for rapid restoration of service.

The cooperative will have the right to review and accept or reject the Member's proposed grounding design and voltage transformations to avoid adverse impact upon the cooperative and Member facilities, operations and safety.

The Member's interconnection protective devices should conform to ANSI/IEEE Standard C37.90 "Relays and Relay Systems Associated with Electric Power Apparatus," have appropriate test plugs/switches for testing the operation of the relay and have targets to indicate relay operation.

The cooperative will review and approve relay settings for the Member's relays to assure coordination between the Member's protective equipment and the cooperative system relays. It is the Member's responsibility to determine that their other protective equipment coordinates with the required cooperative protective equipment and is adequate to meet all applicable standards to which the Project is subject. The cooperative further reserves the right to modify interconnection relay settings when deemed necessary to avoid safety hazards to utility personnel or the public and to prevent any disturbance, impairment, or interference with the cooperative's ability to serve other members.

b. Metering

All electrical energy delivered at the Connection will be measured by suitable metering equipment. The metering interface equipment must be compatible with the data acquisition systems of both the cooperative and the Member. The cooperative may install, own, operate and maintain all metering equipment at Member's expense. Member will provide suitable accessible space for the installation of the metering equipment at no cost to the cooperative. These meters will measure and record peak and integrated real and reactive power in and out of the interconnection. As each application may be unique, metering requirements will be determined on a case-by-case basis.

Member may, but will have no obligation to, install, own, operate and maintain at its own expense meters and associated equipment used to back up metering equipment maintained by the cooperative.

If, for any reason, any metering equipment is out of service or malfunctioning, the electrical energy delivered during the period of outage will be estimated using the best data available. The correction and compensation for metering errors and losses will be covered contractually in the Agreement.

c. Telemetering

If, at the discretion of the cooperative, the Member's Project necessitates real-time telemetry to the cooperative control center, the Member will install and operate at its expense the necessary supervisory control and data acquisition equipment, communication channel, the telemetry equipment and all associated devices. This

equipment shall be compatible with the cooperative's data collection systems and must be approved by the cooperative prior to generation interconnection.

Telemetry equipment will include transducers, remote terminal units, modems, telecommunication lines, and any other equipment necessary to transmit information necessary for the proper operation of the cooperative system. The remote terminal unit, or equivalent device, may need to have multiple communication ports to allow simultaneous communications with third parties, such as ISOs, RTOs, or other regional reliability control centers. That device will accommodate data communication requirements specified by each Parties' control center, including communication protocol, rate and mode (either synchronous or asynchronous).

All metered values provided to the telemetry equipment will originate from common metering equipment. All transducers used for telemetry will meet industry standard accuracy. As part of real-time data to be provided, the cooperative has the right to require the status and remote control of switching devices at the Project.

d. Visual Disconnect

Member will furnish a manual disconnect device whose open condition is visibly verifiable to separate Member's Connection and related equipment and facilities from interconnection with the cooperative system. This device will have a means for padlocking in the open position. The location of this device will be determined by mutual agreement and be readily accessible to the cooperative at all times. Where the disconnect device is a part of or directly connected to the cooperative System, the disconnect device will be operated only after authorization from the cooperative's dispatcher or its designated representative.

The cooperative reserves the right without liability to open this disconnecting device or other devices under its control, isolating Member's Connection and related equipment and facilities, if in its sole judgment an Emergency has occurred or is imminent.

Except in the case of an Emergency, the cooperative will provide to Member verbal or written notice prior to any disconnection. As soon as reasonably practicable after occurrence of an Emergency, the cooperative will provide to Member verbal or written notice of the nature thereof, together with the expected duration of the disconnection from the cooperative System.

e. Insulation Coordination

The Member must coordinate its switching surge and lightning protection systems with the cooperative lightning protection systems. Careful attention needs to be given to the proper insulation levels and grounding techniques employed. If switching surges are expected to be a problem, circuit breakers may need to be equipped with closing and/or opening resistors and/or zero crossing switching capability.

f. Voltage, Reactive, and Power Factor Control

The Member will not cause excessive voltage excursions and will remain within +/- 5% of nominal voltage ratings during normal and single contingency operation. Further restriction may be necessary to prevent harm to other members' equipment. Other requirements for Members with generation are outlined in Section B.

g. Power Quality Impacts

In cases where it is determined by the cooperative in its sole reasonable judgment that starting of induction motors or load changes on other equipment at the Facility could have an adverse impact on the cooperative system voltage, Member will take such action as reasonably required by the cooperative to bring voltage changes to acceptable levels.

Members with unusual load characteristics which create damaging torsional oscillations on motors and generators shall install the requisite electrical equipment (filtering and/or damping) needed to modify their load characteristic so their resulting load characteristic at the point of interconnection does not harm the cooperative or its members.

The maximum voltage wave distortion caused by the Member will be less than 5.0% (Including a 1.0% phase voltage unbalance). Voltage unbalance is defined as the maximum phase deviation from average as specified in ANSI C84.1, "American National Standard for Electric Power Systems and Equipment – Voltage Ratings, 60 Hertz."

The member shall limit harmonic voltage and current distortion and/or voltage flicker (objectionable low voltage fluctuation) caused by the Project. Limits for harmonic distortion (including inductive telephone influence factors) are consistent with those published in the current version of ANSI/IEEE 519, "Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems." Flicker occurring at the point of interconnection shall remain below the Borderline of Visibility curve on the IEEE/GE curve for fluctuations less than 1 per second or greater than 10 per second. However, in the range of 1 to 10 fluctuations per second, voltage flicker shall remain below 0.4%. Depending upon the nature of the Project and its location, the cooperative may require the installation of a monitoring system to permit ongoing assessment of compliance with these criteria. The monitoring system, if required, will be installed at the Member's expense.

h. Equipment Ratings

The Member's Project should be consistent with the cooperative ratings, and be able to operate in its expected mode without undue maintenance or life reduction.

i. Maintenance Coordination

The Member's Project should be designed to permit safe, routine, and emergency maintenance on all components. Redundancy levels should be consistent with the Project's operational obligations.

Project maintenance schedules should be provided to the cooperative with enough lead time to resolve coordination issues.

Except in the case of an Emergency, the Parties will use commercially reasonable efforts to schedule planned and unplanned inspection and maintenance of interconnection facilities. Planned and unplanned clearance and maintenance of equipment that requires disconnection of the Facility from the cooperative System will be, to the extent feasible, at mutually agreed upon times designed to avoid disruption of the operation of the Facility and the cooperative's operations and service to its other members.

j. Emergency Conditions

The cooperative reserves the right (without consultation when time does not permit) to open the interconnecting facilities or curtail flows for compliance with safety and reliability standards, abnormal operating conditions or characteristics (including system disturbances, open conductors, etc.), and operating emergencies until such time as compliance is achieved. The direction of the Cooperative and in the Cooperative's sole discretion, the Member may be required to interrupt or curtail service under the operating authority of the cooperative to avoid injury to life or property.

Member will not energize or maintain energization to disconnected cooperative facilities unless directed to do so by the cooperative. Normal energization and manual restoration of service to the cooperative and Member interconnected facilities will be directed by the cooperative. The Member's protection and control schemes must recognize the loss of source(s) at the interconnection point and initiate automatic disconnection from the point of interconnection.

Member transactions may be curtailed if the cooperative or regional facilities become overloaded, in accordance with established line loading relief practices.

10. Inspections

Before the Facility is interconnected with the cooperative System, Member will provide the cooperative with reasonable notice and opportunity to inspect and test Member's interconnection facilities. This inspection and testing may include, but need not be limited to:

- the acceptance testing of all Protective Equipment according to the cooperative minimum requirements;
- the placement of in-service relay taps according to settings;
- the operability of the Protective Equipment; and
- the phasing and synchronizing checks of all related equipment.

Member will provide the cooperative with test and maintenance data as reasonably required by the cooperative.

11. COMMUNICATIONS

The Member will establish voice communication channels with the cooperative so that responsible and authorized personnel can issue requests and/or orders that may impact Project reliability as well as the security and stability of the cooperative System. The Member will be expected to notify the cooperative of the occurrence or expectation of any event that may affect the cooperative system.

The Member will maintain redundant communication links to the cooperative. Standard telephone lines may be used for communications. The telephone numbers to be used are as follows:

The cooperative office: Wabash District 800-563-2146; Markle District 800-542-6339

OR

The cooperative after normal business hours: 866-336-2492

An alternate office for the cooperative dispatch center may be used as a backup in the event that the normal office is not operational. Contact information for a backup office will be provided in these events. The cooperative may change these numbers as needed from time to time by providing written notice to Member.

Member will notify the cooperative as soon as possible of any disruption, malfunctioning or unavailability of the communication link.

12. AVAILABLE CAPACITY

Distribution facility connection requirements are for balanced three phase 60 Hertz alternating current connections. The cooperative system includes nominal 12.47 kV distribution voltage. Network power flows with normal and emergency conditions may be made to determine system capability at particular locations. Site specific limitations affect the available distribution system capacities. These include the electrical characteristics and use of facilities already connected or being planned for connection to the distribution system. Other examples of site specific issues include: availability or proximity of the cooperative facilities; local zoning and other ordinances; environmental regulations; availability of permits, easements and rights-of-way; member electrical characteristics; pre-existing and projected line loading in the area; and margins to provide for abnormal system conditions.

B. GENERATION

1. Size Considerations

When the Member's Project includes generation, the size and other characteristics of the Project will determine the extent of the requirements for connection to the cooperative system. In general, small generators will have fewer or less exhaustive study and technical requirements. However, safety and coordination dictate certain minimum standards for all facilities.

For small generators, protection requirements are outlined in the cooperative document "Protection Requirements For Members With Small Generating Facilities Operating In Parallel With Utility's System", Attached as Appendix II to this document.

2. Application Requirements

The Member will provide to the cooperative electrical static and dynamic characteristics of the Facility's generators and associated control systems and transformers, including generator capability curves and all turbine, generator step-up, voltage regulator and governor data. Member will notify the cooperative promptly in writing of any change to such characteristics.

3. Studies

The cooperative may perform, or cause to be performed, stability analyses in order to verify that the generating units at the Facility meet the cooperative system stability requirements. If any such analysis shows that such equipment loses or could lose synchronization under any reasonable scenario, Member will install at its expense out-of-step protection or special generator trip schemes as reasonably required by the cooperative. If detailed stability simulations are required, Member will provide data

pertaining to the generator(s) and related control systems. Stability studies performed by or for the cooperative will not evaluate the risk to the Facility or equipment of Member due to unstable operation of Member's generator(s). It is the responsibility of Member to assess these risks and protect accordingly.

4. Integration into the Control Area

Member will operate the Facility with its speed governors and voltage regulators in operation whenever the Facility is connected to or operated in parallel with the cooperative System. If the Facility's voltage regulators are out-of-service, the Member will immediately notify the cooperative's dispatch center or its designated representative and will maintain voltage as prescribed by the cooperative's dispatcher or its designated representative and ensure that generator MVar levels are within the capability of the Facility's generators and steady state stability limits. Member will not cause the Facility to disconnect automatically or instantaneously from the cooperative System or trip any generating unit comprising the Facility for an under or over frequency condition unless the abnormal frequency condition persists in time beyond the limits set forth in ANSI/IEEE Standard C37.106.

Member will be solely responsible for properly synchronizing with the cooperative System all generator(s) that are a part of the Facility in accordance with the synchronization procedures provided by Member and approved by the cooperative for generators interconnected to the cooperative System. The cooperative will have the right to review, approve and monitor such synchronization procedures.

Member will not energize a de-energized any circuit owned by the cooperative except in accordance with all the cooperative safety and operational protocols, as in effect from time to time.

The Member with generation will provide the cooperative with immunity from consequences of torsional oscillations resulting from transmission system operations and insure that the turbine-generator is not excited into resonance by normal system operations.

5. Protection Systems and Controls

Member will install and maintain protective equipment that will open the connection of Member's facilities to the cooperative System prior to the action of the cooperative's protective equipment, upon the occurrence of a disturbance on or at the Facility.

6. Abnormal System Conditions

It is the sole responsibility of Member to protect its equipment from excessive negative sequence currents, system faults, voltage or frequency excursions or other abnormal system conditions, and the cooperative will have no responsibility or liability to Member for any consequence thereof.

Upon loss of the cooperative supply the Member will separate from the cooperative's distribution system. The member will coordinate synchronization and operation of the Facility with the Cooperative. The Member is solely responsible for all synchronizing damages that may ensue from improperly synchronizing their generation to the cooperative distribution system.

Abnormal frequency relays may be required. Settings will be reviewed with the cooperative. The Member will consult with the turbine manufacturer to assure this capability.

Large generating Facilities may be required to maintain some amount of spinning reserve during normal operation, to allow its participation in area load balancing.

7. Voltage, Reactive, and Power Factor Control

The Member will provide automatic reactive control and coordinate its control with the cooperative's system.

The Facility's generating unit(s) will not cause voltage excursions outside of the range of 95% to 105% nominal. Member will operate the Facility to maintain voltage levels reasonably prescribed by the cooperative. Without limiting the generality of the foregoing, the generating units at the Facility will be capable of operating at a power factor of 90% lagging and 95% leading when the generating units are at full gross power output, as measured on the low side of the Facility's main transformer, it being understood that steady state stability limits may restrict leading power factor operation to levels higher than 95% leading power factor. So that voltage levels are maintained at the levels prescribed by the cooperative, Member will monitor and adjust the reactive output of the generators at the Facility to maintain such voltage levels. Such adjustment will be subject to the limitations imposed by line voltages, generator capability curves and other in-plant system limitations.

All generating unit(s) on the cooperative's system will conform to the cooperative's Generating Control and Protection Requirements document(s).

8. Flicker, Harmonics & Interference

Power output at the Facility will be in accordance with the power quality standards contained in IEEE Standard 519, and the Facility will not introduce any distortion of the cooperative's waveform, telephone or carrier interference that is inconsistent or conflicts with such standard.

Projects including inverters to convert DC output to AC connected to the cooperative system shall comply with the IEEE Standard 929-2000. In cases where it is determined by The cooperative in its sole reasonable judgment that starting of induction motors or load changes on other equipment at the Facility could have an adverse impact on the cooperative System voltage, Member will take such action as reasonably required by the cooperative to bring voltage changes to acceptable levels.

9. Frequency

All Energy delivered at the Interconnection Point will be in the form of three-phase alternating current having a nominal frequency of sixty cycles per second, and a harmonic content consistent with the requirements of IEEE Standard No. 519.

Member will provide and maintain operable governor systems that are responsive to system frequency deviations. Overspeed protection in the event of load rejection is the responsibility of the Member.

10. Reporting Requirements

Member will report generation schedules to the cooperative as needed for area operational control.

At the discretion of the cooperative, generation control facilities and supervisory control and data acquisition of specific electrical devices may be necessary to integrate the Member's generation into the cooperative's control area. Such facilities, including required communication channels, will, if required, be furnished and installed at the Member's expense. The requirement for data acquisition and control will depend on the generation capacity, system location and voltage, and the net generation delivered at the point of interconnection to the cooperative's distribution system.

For the cooperative and regional planning purposes, historical and projected long-term future capability, output, availability, and other records may need to be compiled and reported.

APPENDIX I

DEFINITIONS:

Agreement	The document specifying the legal rights and responsibilities of the Parties regarding a particular Project
ANSI	The American National Standards Institute
Application	Member information provided to the cooperative, data necessary for the evaluation and coordination of a Project with the cooperative's system
Connection	The electrical interconnection of the Project to the cooperative's system, including auxiliary equipment such as controls and protective devices necessary for proper operation of the interconnection
Member	The entity owning and controlling a Project connected or proposed to be connected to the cooperative's system
Emergency	An event or condition in which safety or the reliability of the local or regional electric system has or may imminently be compromised
The cooperative	Heartland REMC
FERC	The Federal Energy Regulatory Commission
IEEE	The Institute of Electrical and Electronic Engineers
ISO	An Independent System Operator...an organization concerned with the reliability, operation, and use of the transmission systems of its members
MISO	The Midwest Independent System Operator. One of ten Regional Reliability councils comprising NERC; the region in which The cooperative's system is located
NERC	The North American Electric Reliability Council, or its successors and any regional entity delegated authority by NERC
Party(ies)	The Member and/or The cooperative

PJM PJM Interconnection, LLC. One of ten Regional Reliability councils comprising NERC; the region in which The cooperative's system is located

Project A facility including an electrical interconnection to the cooperative's system, generation and/or load, and associated auxiliary equipment including controls and protective devices

RTO Regional Transmission Operator
RUS The Rural Utility Services. A Federal agency concerned with power Cooperatives, including the cooperative

TP Transmission Provider

APPENDIX II

Protection Requirements for Members with SMALL GENERATING FACILITIES Operating in Parallel with The Cooperative's System

Heartland REMC (The cooperative) does not assume any responsibility for protection of the member's generator(s), or any other portion of the member's electrical equipment. The member is solely responsible for protecting his equipment in such a manner that faults or other disturbances on the The cooperative system do not cause damage to the member's equipment.

To protect the integrity of The cooperative's system and to maintain a safe operating condition, the member shall provide, install, own, and maintain protective and control equipment capable of:

- immediately deactivating the generating equipment or disconnecting it from the utility's system in event of partial or total disruption of the utility's normal source supply;
- protecting utility's equipment from damage due to overload or fault conditions;
- preventing re-energizing of the utility's system by member's generating facilities; and
- preventing out-of-synchronization generation into the utility's system.

The actual equipment required to accomplish these functions depends on many factors including:

- Type of generator – induction, synchronous, DC plus inverter,
- Size of generator – A small generator is defined as any generator 300 kW or smaller; however, the deciding factor in interconnection protection would be the size of the generator relative to the member's load and the amount of load that could be isolated with the generator,
- Voltage of The cooperative system to which generator is connected,
- Grounding of member's system or transformer at interconnection point and configuration of The cooperative/Distribution system.

Induction Generator

Induction generators receive their excitation from the utility stem and, therefore, usually will not function when disconnected from the utility system. However, if the

power factor correction capacitors are present which will supply excess VARS of 1 to 5 times the induction generator excitation requirements, the generator is capable of self-excited operation of the connected load is within the capability of the prime mover. The voltage and frequency are determined by the load and excitation, not the speed of the generator, and may be far outside of normal limits.

If capacitors are used with the generator and associated facilities, they should be connected on the utility side of the generator circuit breaker. The protective equipment should be the same as normally used for an induction-motor of the same size. In addition, if the generator may become isolated by disconnection either in the member's or utility's system with load and capacitors that may permit self-excited operation, over and under voltage (59) (27) and over-and-under frequency (81) relaying should be included.

Most distribution three-phase distribution circuits employ single-phase relaying and fault-clearing. Where a three-phase generator is served from a distribution circuit, one phase may be disconnected due to a fault. The generator will continue to receive excitation from the unfaulted phases and supply fault or load current to the isolated phase. The generator should be provided with a phase failure, voltage or current balance (60), or negative sequence voltage (47) or current (46) relay, which will detect the isolated phase condition and immediately disconnect the generator.

DC Generator and Invertor

The invertor used with a DC generator must be line commutated, if operated in parallel with the utility system, so that it is not capable of energizing a circuit that becomes disconnected from the utility system. Some invertors have an output current, which is high in harmonic content. This must not cause any adverse effect to the other The cooperative members. The invertor manufacturer should supply information on harmonic content which will be needed to assess system impact.

Synchronous-Generators

Synchronous-generators are capable of supplying fault current to the The cooperative/Distribution power system and supplying the connected load within the capability of the prime mover, if it becomes isolated from the The cooperative/Distribution system.

The method of relaying the utility-member interconnection will vary substantially with the size of the generator, the amount of the member's load, the method of connecting

the generator into the member's electric system, and the method of connecting the member's system to the utility system.

If the generator is small compared to the total member load, relaying may be provided to separate the member's system upon loss of the utility service to allow the generator to continue serving part of the member's load. This may be accomplished by directional overcurrent (67) and underfrequency (81) relays.

If the member is served by a single line, relaying and circuit breaker are required to clear faults on the member's system from the utility system and to disconnect the generator from an isolated or faulted utility line. This may include any of the following:

- Phase an ground time and instantaneous overcurrent 50/51) (50/51N) relays,
- Directional overcurrent (67) relay,
- Voltage relays to detect a ground fault on undergrounded system (59) 27),
- Underfrequency (81) relay,
- Undervoltage (27) or voltage balance (60) relay.

If the member's transformer is delta-connected on the utility side, the generator will supply no fault current after the utility terminals have opened for a ground-fault on the line. The generator terminal may be relayed by:

- Voltage relays if the fault remains, or
- By directional overcurrent, undervoltage, or underfrequency relays if other utility loads remain on the isolated line, or
- By a directional relay detecting the excited current of the transformer if the generator is able to maintain voltage and frequency.

The member must sense a de-energized utility line and trip the interconnection breaker. The breaker must not reclose until voltage is restored to the line by the utility. The interconnection breaker should only reclose when the member bus is dead and the utility source (The cooperative transformer) is hot. The member will be responsible for the necessary precautions before the breaker is reclosed, including synchronization of the cogenerator with the The cooperative system.

If service is from a bus with two or more supply lines, the utility will specify the relaying required depending on the line and system configuration and member requirements.

Other Requirements

Member shall provide, install, own, and maintain a switch capable of disconnecting the member's generator from the utility's system without damage to the member's or utility's equipment. This switch shall be accessible to and capable of exclusive control by The cooperative at all times.

The cooperative may elect to install, own, operate, and maintain circuit breaker and protective relaying associated with the interconnection. If the member is backfeeding a considerable amount of its excess power into The cooperative, other system changes to the utility's facilities may be necessary. The member shall bear that portion of the costs resulting from the additional equipment that must be installed to allow for parallel operation.

The cooperative maintains the right to review the member's interconnection plans to insure compliance with the stated requirements. The member must submit such plans to The cooperative for review prior to construction. The cooperative should also be informed of the member's construction schedule, including any changes thereto, and in the initial testing of the generator and relays.