

<b>STANDARDS FOR INTERCONNECTION AND PROTECTION FOR COGENERATORS AND SMALL POWER PROCEDURES</b>	

**1.0 - INTRODUCTION**

These standards have been established to assist small power producers and cogenerators in planning and designing an electrical interconnection with the system of Morgan County Rural Electric Association (MCREA) and Tri-State Generation and Transmission. Small power producer and cogenerator personnel and MCREA personnel may be guided by this document when planning, installing and operating customer-owned generating equipment. The following requirements are general in nature and may not cover all details of a specific installation. Potential small power producers and cogenerators should discuss project plans with MCREA before purchasing or installing equipment.

MCREA will assist any small power producer or cogenerator in its efforts to generate electric power and energy. MCREA encourages the development of small power projects which can supplement MCREA's existing generating resources whenever this can be done without adverse effects on the general public or to MCREA's equipment or personnel. To help achieve the maximum reliability and use of small power projects, MCREA will provide the potential small power producer with information, technical assistance, and other aid the small power producer might require in the evaluation of the technical and economic feasibility of the project.

**2.0 - GENERAL REQUIREMENTS FOR INTERCONNECTION**

Certain protective equipment (relays, circuit breakers, etc.) specified by MCREA must be installed at locations where the customer wishes to operate generating facilities in parallel with MCREA's system. The purpose of this equipment is to ensure safe and reliable power system operation and to allow prompt disconnection of the Qualifying Facility (QF) in the event of short circuit or other malfunction. Other changes, such as revisions to the electrical system configuration and/or modifications to protective equipment at other locations, may also be required in order to accommodate parallel operation. MCREA will assist QF owners in determining interconnection requirements. This document gives general information about parallel operation; however, MCREA may impose additional restrictions or require additional equipment when the particular installation so warrants. Each QF must be reviewed individually, since interconnection requirements vary with the type of generation equipment and the proposed location on MCREA's system. All costs associated with interconnection, necessary system additions, and modifications to accommodate the QF will be borne by the QF.

MCREA requires that the customer design, construct and operate their equipment in a manner which will not degrade the quality of service to other MCREA customers. This requires that the QF equipment be designed, specified and installed in a manner appropriate to its intended service and in accordance with all applicable standards regulating design, construction and operation of such equipment. MCREA reserves the right to specify the quality and determine the adequacy of customer equipment, installation and operation in any respect which affects safety, reliability or quality of service.

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MCREA will not assume responsibility for protection of the QF's generator(s) or any other portion of the QF's electrical equipment. The QF is fully responsible for properly protecting its equipment. Equipment which is not properly protected may be damaged as the result of normal system operation or disturbances on MCREA's system. MCREA will, however, aid the QF in determining conditions to which its equipment is likely to be subjected as a result of probable system operation, malfunctions or disturbances, insofar as it is possible to determine these conditions in advance.

A permanent and weather proof sign indicating the location of the QF Generation Disconnect shall be clearly displayed at the point of service connection (generally at the customer meter). For QFs greater than 25 kW of capacity, a one-line electrical diagram and the names and current telephone numbers of at least two persons that are authorized to provide access to the QF and who have authority to make decisions regarding the QF interconnection and operation shall be included with or attached to the sign. This telephone listing shall be updated as needed to maintain its usefulness.

For interconnection of a QF to a radial distribution circuit, the aggregated generation, including the proposed QF, on the circuit shall not exceed 15% of the line section annual peak load as most recently measured at the substation or calculated for the line section. A line section is that portion of MCREA's electric system connected to a customer bounded by automatic sectionalizing devices or the end of the distribution line.

The QF, in aggregation with other generation on the distribution circuit, shall not contribute more than 10% to the distribution circuit's maximum fault current at the point on the distribution feeder voltage (primary) level nearest the proposed point of change of ownership.

The QF, in aggregation with other generation on the distribution circuit, shall not cause any distribution protective devices and equipment (including, but not limited to, substation breakers, fuse cutouts, and line reclosers), or QF equipment on the system to exceed 87.5 % of the short circuit interrupting capability; nor shall the interconnection be proposed for a circuit that already exceeds 87.5 % of the short circuit interrupting capability.

If the QF is to be interconnected on single-phase shared secondary, the aggregate generation capacity on the shared secondary, including the QF, shall not exceed 25 kW.

If the QF is single-phase and is to be interconnected on a center tap neutral of a 240 volt service, its addition shall not create an imbalance between the two sides of the 240 volt service of more than 20% of the nameplate rating of the service transformer.

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**2.1 - CODES, STANDARDS AND REGULATORY AGENCIES**

The QF must ensure that the facility and all equipment connected therewith comply with the National Electrical Code, the National Electrical Safety Code, and/or any applicable local, state, and federal government requirements, whichever are stricter. For QFs with a design capacity greater than 25 kW, the QF must submit a statement from a registered Professional Electrical Engineer currently licensed in the state of Colorado certifying that the design of the QF and its interconnection equipment complies with MCREA requirements and with reasonable interconnection safety and design standards and prudent electrical practices. The QF agrees to hold the MCREA harmless for any damage to person or loss to property arising out of the QF's failure to comply with such codes or legal requirements. The QF's installation must be inspected and certified by a Colorado State Electrical Inspector before the generation equipment may be energized or interconnected. Inspection and startup procedures will conform to Colorado Public Utilities Commission rules. Grounding shall be in accordance with applicable sections of the National Electrical Code and the National Electrical Safety Code and shall conform to IEEE Standard 142, "IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems" and RUS Bulletin 65-1, "Guide for the Design of Substations," where applicable. For a summary of applicable codes and standards, see Appendix II.

**2.2 - SYNCHRONOUS GENERATORS**

Synchronous generators have several features which make them desirable from a utility system standpoint, but the excitation and synchronization equipment required often make these generators economically unfeasible, except in the larger sizes. The synchronous generator with associated excitation equipment is able to supply its own reactive power and hence may operate at unity or lagging power factor. QFs are required to supply sufficient generator reactive power capability to withstand normal voltage variations on MCREA's system and to maintain essentially unity power factor. This operation enhances generator stability and alleviates the need for supplemental power factor correction equipment.

Synchronous generators require automatic synchronization equipment and supervisory relays to prevent closure into MCREA's network when the QF generator is improperly synchronized. Reclosure of an isolated synchronous generator onto the system may cause damage to that generator or associated equipment if the generator and system are not properly synchronized. Automatic reclosure of circuit breakers or circuit reclosers is commonly used on distribution and subtransmission lines in order to increase the system reliability. Changes to existing MCREA equipment may be required to prohibit reclosure into a synchronous generator. Other protective relaying may be required to account for overspeed, excitation overvoltage, loss of excitation, loss of synchronism, frequency deviation, field ground, neutral overvoltage and reclosure control. Suggested minimum protective equipment requirements for synchronous generator installations are given in Section 3 by class of QF.

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**2.3 - INDUCTION GENERATORS**

Induction generator installations are in many respects simpler than synchronous generator systems but they pose additional problems. The induction generator may be started as a motor if current inrush, voltage regulation and lamp flicker are not serious problems. If the quality of service to other MCREA customers is degraded due to induction generator starting, reduced voltage starting or other special procedures may be necessary to relieve the situation.

The induction generator cannot maintain constant voltage and frequency operation without an outside source of reactive power. MCREA must supply this power under all operating conditions. The size and type of induction generator which may be interconnected at a given point on an existing MCREA circuit is limited by the ability of that circuit to regulate voltage and maintain adequate quality of service to other MCREA customers. MCREA reserves the right to limit the application of induction generators on existing circuits and to specify modifications, if any, to the existing system to accommodate the QF. All such modifications will be made at the expense of the QF.

Reclosure of a distribution line after a utility system disturbance may cause damage to the customer's induction generator if adequate protective equipment is not installed to mitigate the adverse effects.

**2.4 - INVERTER SYSTEMS**

Inverter systems are used to transform direct current to alternating current. The resulting waveform may be rich in harmonics. These nonstandard waveforms may cause radio and television interference on other customers' equipment as well as producing objectionable audible noise. Excessive harmonic content may also cause overheating in electrical equipment.

The inverter system should be designed and operated in accordance with UL1741. This standard ("Inverters, Converters, and Controllers for Use in Independent Power Systems") addresses the electrical interconnection design of various forms of generating equipment. Many manufacturers submit their equipment to a Nationally Recognized Testing Laboratory (NRTL) that verifies compliance with UL1741. This "listing" is then marked on the equipment and supporting documentation.

All three-phase inverter installations shall be served by a dedicated transformer which is connected delta on the customer side and ground wye on MCREA's side. The cost of this transformer and associated equipment shall be borne by the QF.

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Inverter systems require a significant reactive power flow to ensure proper operation. MCREA requires the customer to provide equipment to correct the power factor. However, care must be taken to ensure that an inverter system which is electrically close to capacitors cannot drive an isolated load. Self-commutated inverters as well as line-commutated inverters connected to rotating machines may operate in a self-excited mode. In order to protect MCREA’s equipment and other customers' equipment, the QF shall install protective relays to prevent isolated operation. For the purpose of preventing service to isolated loads, inverter systems shall conform to standards outlined in IEEE 929.

**2.5 - PROTECTION OF THE UTILITY SYSTEM**

In order to be assured of continuing safe, reliable service to MCREA customers, MCREA must be concerned with the manner in which QF are connected to the existing MCREA system. The MCREA’s concerns are fourfold:

- 1) The QF must promptly disconnect from MCREA in the event of a utility system disturbance;
- 2) The QF must disconnect in the event of a malfunction or disturbance on the QF equipment;
- 3) The QF must not backfeed a de-energized MCREA line; and
- 4) The QF must not significantly degrade the quality of service to other MCREA customers.

**2.5.1 - Utility System Disturbances**

In the event of a utility line fault or other system disturbance, protective equipment will promptly act to de-energize the affected line section. A QF connected to this portion of line represents an additional source of power to energize the line. Thus, the QF’s equipment must also automatically act to disconnect the generator(s) to avoid contributing to the severity of the fault, to avoid isolated operation and to protect the QF equipment.

Isolated operation occurs when a portion of the MCREA load becomes separated from the MCREA source but is still connected to the parallel generation. If the isolated load is sufficiently large with respect to the rated output of the QF generators, the voltage will collapse and protective relays will take the machines off line. When the generator rating is greater than or comparable to the size of the isolated load, sustained independent operation becomes possible. This situation is intolerable, since the voltage and frequency on the isolated network are likely to be poorly regulated and damage to MCREA equipment, or that of other customers, is likely to result. Restoration of normal service to this island is also hampered by the presence of an isolated energy source.

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<p>In instances where MCREA's system arrangement is such that it is possible that the generators will not always be isolated with a sufficiently large load to prevent independent operation, MCREA requires the installation of voltage and frequency relays, even on the smallest QFs. For installations with rated capacity of greater than 25 kW, specific devices are required to detect faults on MCREA's system as well as voltage and frequency relays to detect isolated operation. Equipment may also be required on MCREA's system to provide additional assurance that islanded operation does not continue. The need for such equipment will be determined on a case-by-case basis.</p> <p><b>2.5.2 - Qualifying Facility Disturbances</b></p> <p>To prevent loss of service to other MCREA customers, the QF must provide protective equipment to promptly disconnect the QF's generators in the event of a fault or other disturbance on the QF's installation. The protective equipment must be coordinated with MCREA's equipment to ensure proper operation in the event of a fault. MCREA will assist the QF to properly coordinate the protective equipment.</p> <p><b>2.5.3 - Backfeed to Utility System</b></p> <p>The QF's generators provide an additional source of power for MCREA's network. The QF must provide protective equipment sufficient to give positive assurance that the generators cannot be connected to an otherwise de-energized MCREA line. This prevents a potential hazard to MCREA personnel who may be in contact with the line for maintenance purposes. In addition to an automatic fail-safe device, MCREA will require an accessible disconnect device that is visibly marked "Generation Disconnect" and has the capability of isolating the energy generated by each QF. This device must be lockable in the open position and may be operated by either party at any time in order to maintain safe operating conditions. At a minimum, this protection can be provided by an isolation switch which can be locked in the open position by MCREA to visibly indicate isolation of the QF. Other equipment such as undervoltage, synchronizing, voltage phase sequence or reclosure relays may also be required.</p> <p>If it is discovered that any equipment connected to the MCREA system is in MCREA's judgment problematic or is considered to be unsafe it will be disconnected immediately from the MCREA system.</p> <p><b>2.5.4 - Power Quality</b></p> <p>The QF will not be allowed to degrade the quality of power delivered to other MCREA customers. The QF will be expected to operate within the limits on voltage, frequency and harmonic content as outlined in Appendix II.</p>	

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The QF synchronous generation is expected to operate at as nearly unity power factor as is practical to prevent voltage flicker upon switching. The generator and associated equipment are expected to be engineered to allow stable unity power factor operation without exceeding the voltage regulation limits outlined in RUS Bulletin 169-4, "Voltage Levels." Power factor limits on QF induction generators are discussed in Section 2.3. Should voltage regulation or lamp flicker become a problem, then operational restrictions may be imposed until the situation can be corrected.

Excess harmonic content or unnecessary service interruptions will not be allowed. If degradation in quality of service to other MCREA customers or interference with the operation of MCREA equipment occurs, MCREA will disconnect the QF generators until such time as the problem is resolved.

**2.5.5 - Protective Equipment**

The type and quality of protective equipment required will depend on the size and type of the QF generation equipment as well as the electrical characteristics of MCREA's interconnection. At a minimum, this equipment will consist of a circuit breaker with associated relaying, a disconnect switch, and voltage and frequency regulation relays. Additional equipment may be necessary for a given installation. The equipment specified above may be part of a vendor-supplied control package, providing the desired level of protection is ensured. Any such protective equipment must be approved by MCREA for each application. MCREA shall be the only judge of adequacy and suitability of protective equipment for QF installations.

**2.6 - PROTECTION OF QUALIFYING FACILITIES**

The QF is solely responsible for protection of its equipment. To facilitate its design, MCREA herein lists potential hazards to the Qualifying Facility equipment which might occur as a result of interconnection with MCREA's system. The probable hazards are of three types: those that occur as a direct result of a faulted transmission or distribution line, synchronism problems, and voltage surges.

Transmission and distribution lines are susceptible to both short circuits and ground faults. Both of these line faults may produce excessive phase currents, single-phased supply and excessive negative sequence currents. Typical equipment to sense and protect against these hazards are listed in Section 3 by class of QF.

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The QF generator can be damaged by interconnection with MCREA’s system if the voltage, phase sequence or phase angle of the machine does not match that of the system. For synchronous generators the customer must provide either automatic synchronizing equipment or a synchronizing relay to supervise manual closure. Unsupervised manual synchronizing is not permitted. Induction starting will be allowed if the inrush current is not excessive. Should voltage dip or lamp flicker problems result from induction starting, other steps must be taken to eliminate these problems.

Damage may result to a QF generator as a result of automatic reclosure unless proper protection is provided. MCREA’s transmission and distribution lines are usually equipped with circuit reclosures which, after a time delay, attempt to restore a circuit which has been tripped due to a fault. If the fault was temporary, the reclosure is successful and the circuit is restored to service; if not, the circuit is locked out until manual reclosure is attempted. The recloser may attempt to restore the circuit several times before lockout occurs. If the QF generator was not taken off-line when MCREA’s circuit was opened, the generator and MCREA’s system may not reclose in synchronism. Voltage surges and damaging torque may occur upon reclosure. Protective devices should be installed to trip the generator before reclosure is attempted and to prohibit reclosure into MCREA’s system if MCREA’s voltage is of abnormal magnitude or phase sequence. Modifications to MCREA’s recloser or addition of other equipment may be required to protect the QF. The cost of such modifications will be charged to the QF.

Transient voltage surges may occur on MCREA lines due to switching operations or lightning strikes. The QF should have protective devices to mitigate the effects of these surges as well as direct lightning strikes. Inverter systems and other solid state components are particularly susceptible to damage by voltage surge.

Details of typical protective equipment to sense and mitigate the potential hazards described above are given in Section 3 by class of QF.

**2.7 - INSPECTION AND MAINTENANCE**

The QF shall not commence interconnected operation, until:

- 1) The QF has supplied MCREA with a completed Application for Interconnection on a form supplied by MCREA for review and acceptance.
- 2) The QF has obtained a certificate of code compliance from a Colorado State Electrical Inspector;
- 3) MCREA has made any necessary modifications to its system to accommodate the QF;
- 4) MCREA has inspected and tested the QF and certified, in writing, that the QF has complied with all requirements for interconnection; and
- 5) The QF has submitted proof of adequate insurance.

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The completed installation will be subject to a final inspection and test by MCREA for compliance before parallel operation is permitted. MCREA will determine satisfactory performance.

The QF must notify MCREA prior to any modifications made to the QF or to the interconnection between the QF and MCREA. The QF must receive approval from MCREA prior to proceeding with such modifications. The QF must permit MCREA, at any time, to install or modify any equipment, facility, or apparatus to protect the safety of its employees and insure the accuracy of its metering equipment. These costs will be borne by the QF.

The QF must permit MCREA employees to enter its property at any time for the purpose of inspecting and/or testing the interconnection facilities to ensure their continued safe operation and the accuracy of MCREA’s metering equipment, but such inspection does not relieve the QF of the obligation to maintain the facilities in satisfactory operating condition.

The QF shall discontinue parallel operations when requested by MCREA:

- 1) To facilitate maintenance, test or repair of utility facilities;
- 2) During system emergencies;
- 3) When the QF’s generating equipment is interfering with other customers on the system;
- 4) When an inspection of the QF reveals a condition likely to be hazardous to MCREA’s system; and
- 5) When an inspection of the QF reveals that the generating equipment is operating outside allowable limits on voltage, frequency, power factor or harmonic content.

The QF shall operate and maintain the interconnection equipment at its cost unless previous arrangements have been made with MCREA to maintain the interconnection. In this case, MCREA will operate and maintain the interconnection and bill the QF for these services.

In all other respects, inspection and maintenance of the QF shall conform to applicable Colorado Public Utilities Commission regulations.

**2.8 - IMPORTANT CONSIDERATIONS FOR INTERCONNECTION**

The QF should allow adequate time in the design and construction schedule for design interface meetings with MCREA and for material procurement by MCREA. This time will vary depending on the QF’s location, size, design, specific operating and system requirements, and the availability of materials needed to accomplish the interconnection.

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If it is discovered that any equipment connected to the MCREA system is in MCREA's judgment problematic or is considered to be unsafe it will be disconnected from the MCREA system.

QF's that generate electrical energy for on-site use only and are interlocked or otherwise prevented from feeding energy into the MCREA system are special cases and may not be required to meet all of the requirements of this document. However, they are required to show by design and by operation that they cannot feed energy into the MCREA system.

**3.0 - SPECIFIC REQUIREMENTS FOR INTERCONNECTION**

MCREA has established guidelines for the protection and interconnection of parallel generators by size classes. These guidelines represent the minimum requirements for interconnection and recommended practice for QF equipment protection. The QF shall be the sole judge of what equipment is necessary to protect the QF generators and associated electrical equipment. MCREA shall be the sole judge of what equipment is necessary to ensure a safe, reliable interconnection with MCREA's system.

The size classes for QF parallel generation are:

- 1) 25 kW and below;
- 2) Greater than 25 kW

**3.1 - QUALIFYING FACILITIES OF 25 KW OR LESS (SINGLE PHASE)**

The following requirements for small generators assume a low density of parallel generation customers on the service circuit. MCREA may impose additional requirements if necessary for safe, reliable service to other MCREA customers.

The QF of 25 kW or less shall be required to provide:

- 1) A disconnect switch (AC or DC) which may be locked in the open position and which provides visual indication of isolation;
- 2) A circuit breaker rated for the service to which it is applied;
- 3) A line voltage relay which will prevent the generator from being connected to a de-energized source;
- 4) A dedicated delta-wye transformer (if the QF is a three-phase inverter installation);
- 5) Undervoltage and overvoltage relays;
- 6) Underfrequency and overfrequency relays; and
- 7) Surge arrestors rated for the applied service.

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In addition, the QF should consider installation of:

- 1) Thermal cutouts to protect the generator from excessive currents or single phasing (if applicable); and
- 2) An overspeed relay, if applicable.

For QF of this size, the customer shall not install capacitors at the QF for power factor correction. MCREA shall provide the reactive power requirements of the QF to avoid the potential for self-excitation.

**3.2 - QUALIFYING FACILITIES OF 25 KW OR LESS (THREE PHASE)**

The following requirements represent the minimum equipment necessary for safe, reliable interconnection. MCREA may require additional equipment if the individual application warrants.

The QF of 25 kW shall be required to provide:

- 1) An isolation switch;
- 2) A circuit breaker;
- 3) Surge arrestors;
- 4) A dedicated transformer; and
- 5) Protective relaying to provide the following functions:
  - A) Short circuit protection (Devices 52, 51V);
  - B) Isolation protection (Devices 27/59, 81);
  - C) Breaker closing/reclosing control (Devices 25, 47); and
  - D) Under and overspeed control (Device 15) for induction generators.

Section 3.4 gives a description of protective devices referred to in the preceding requirements.

**3.3 - QUALIFYING FACILITIES GREATER THAN 25 KW (THREE PHASE)**

QFs greater than 25 kW in capacity will be studied on a case-by-case basis by MCREA and Tri-State to determine specific requirements.

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**3.4 - PROTECTIVE DEVICE DESCRIPTIONS**

Device Numbers for Protective Equipment

- 15 - Tachometer Relay
- 25 - Synchronizing Relay
- 27 - Undervoltage Relay
- 32 - Directional Power Relay
- 40 - Generator Field Failure Relay
- 46 - Phase-Balance (Reverse-Phase) Relay
- 47 - Phase-Sequence Relay
- 51 - Time-Overcurrent Relay
  - A) 51GB -Ground Bank Time-Overcurrent
  - B) 51T -Transformer Time-Overcurrent
  - C) 51V -Voltage-Restrained Time-Overcurrent or  
Voltage-Controlled Time-Overcurrent
- 52 - Circuit Breaker (52G - Generator Circuit Breaker)
- 59 - Overvoltage 64G -Ground Relay
- 67 - Directional Overcurrent
- 81 - Frequency Relay
- 87 - Differential Relay
  - A) 87G - Generator Differential
  - B) 87T - Transformer Differential
- 90 - Field Voltage Regulator
- S.A. - Surge Arrestor

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APPENDIX I

**SUMMARY OF INTERCONNECTION PROCEDURE**

- 1) Customer with potential Qualifying Facility contacts MCREA and obtains Application for Interconnection (Application).
- 2) The QF submits the Application to MCREA. If QF's nameplate capacity is greater than 25 kW, the Qualifying Facility Design Data Requirements show in Appendix III are also required.
- 3) MCREA evaluates the Application for Interconnection for completeness and notifies the Customer QF within ten business days of receipt that the Application is or is not complete and, if not, advises what material is missing.
- 4) Within 15 business days, MCREA conducts preliminary engineering studies, if warranted, to determine the effect the QF might have on existing MCREA customers and equipment.
- 5) Provided all the criteria in the Interconnection Standards for Cogenerators and Small Power Producers are met, unless MCREA determines and demonstrates that the Small Generating Facility cannot be interconnected safely and reliably, MCREA approves and executes the Application and returns it to the Customer.
- 6) MCREA designs and constructs the interconnection and modifies the existing MCREA network as necessary to accept the QF.
- 7) The QF provides notice of insurance coverage. The QF should investigate liability insurance coverage early in the planning stage.
- 8) After installation, the Customer returns the Certificate of Completion to MCREA. Prior to parallel operation, MCREA will inspect the QF for compliance with standards within ten business days of the receipt of the Certificate of Completion. MCREA will inspect the QF for compliance with standards, and may schedule appropriate metering replacement, if necessary.
- 9) MCREA notifies the Customer in writing or by fax or e-mail that interconnection of the QF is authorized within five business days. If the witness test is not satisfactory, MCREA has the right to disconnect the QF. The customer has no right to operate in parallel until a witness test has been performed.
- ~~10) Interconnection and startup.~~

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APPENDIX II

**SUMMARY OF CODES AND STANDARDS**

General

- NFPA 70 (2005), National Electrical Code
- IEEE Std 929-2000 IEEE Recommended Practice for Utility Interface of Photovoltaic (PV) Systems
- 1741 Inverters, Converters, and Controllers for Use in Independent Power Systems
- IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems (including use of IEEE 1547.1 testing protocols to establish conformity)
- National Electrical Safety Code
- Local Building Codes
- NEMA MG 1-1998, Motors and Small Resources, Revision 3
- NEMA MG 1-2003 (Rev 2004), Motors and Generators, Revision 1
- ANSI C84.1-1995 Electric Power Systems and Equipment – Voltage Ratings (60 Hertz)
- IEEE Std 100-2000, IEEE Standard Dictionary of Electrical and Electronic Terms

Grounding

- REA Bulletin 65-1, "Design Guide for Rural Substations"
- IEEE Standard 142, "Recommended Practice for Grounding of Industrial and Commercial Power Systems"

Voltage Drop

- REA Bulletin 169-27, "Voltage Regulator Application on Rural Distribution Systems"
- REA Bulletin 169-4, "Voltage Levels on Rural Distribution Systems"

Phase Balance

- <3% (three phase difference)

Frequency

- +0.1 (for Qualifying Facility of rated capacity greater than 5 kW)

Harmonics

- IEEE Standard 519, "IEEE Guide for Harmonic Control and Reactive Compensation of Static Power Converters"

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- Flicker
  - REA Bulletin 160-3, "Engineering and Operations Manual - Service to Induction Motors"
  
- Surge Control
  - IEEE Std C62.41.2-2002, "IEEE Recommended Practice on Characterization of Surges in Low Voltage (1000V and Less) AC Power Circuits"
  - IEEE Std C37.90.1-1989 (R1994), "IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems"
  - IEEE Std C62.45-1992 (R2002), IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits
  
- Interference
  - IEEE Std C37.90.2 (1995), IEEE Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transmitters
  
- Service Reliability
  - Qualifying Facility shall not cause loss of service to other customers.
  
- Other (may be required)
  - City/County Zoning or Building Permit
  - Section 404 Clean Water Act Permit -Colorado Department of Health
  - Emission Permit/Fugitive Dust Permit
  - Special Use Permit/Conditional Use Permit from County
  - FAA Approval for tower

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APPENDIX III

**QUALIFYING FACILITY DESIGN DATA REQUIREMENTS**

Morgan County Rural Electric Association (MCREA) reviews all proposals for interconnection by a QF for compliance with MCREA guidelines and Colorado Public Utilities Commission Rules. MCREA attempts, insofar as is reasonable, to determine whether a design will create problems on MCREA's system but cannot comment or make assurances on the technical prudence or economic feasibility of a proposed project.

MCREA cannot review your facility design until a complete design package is submitted. Typically, a complete design package would include:

- (1) A complete site plan, detailing physical locations of all equipment to be installed from MCREA's supply line to the powerhouse. This plan should show sufficient detail to determine physical clearances between pieces of equipment and between any piece of equipment and an adjacent permanent structure. The site plan should show the location of proposed metering, disconnecting and circuit protective devices. Particular detail should be given to physical location of equipment in the powerhouse, and provisions for grounding of powerhouse equipment.
- (2) A system one-line diagram which states wire sizes and types, as well as ratings and types of circuit protective devices. This diagram should include all equipment which has been installed or which will be installed up to MCREA's connection.
- (3) A relay control diagram which clearly indicates relay contact arrangements and which indicates functionally the operation of all relays, protective devices and interlocks.
- (4) Device types, sizes, model numbers, settings and manufacturer's data on all circuit protective devices and relays.
- (5) The location, ratings, impedances, time constants and manufacturer's data for the generator and all associated control equipment, including but not limited to exciters, governors, voltage regulators and synchronizers, where applicable.
- (6) The location, ratings and switching arrangement for power factor correction capacitors, if any.
- (7) Proposed operating procedures for startup, shutdown and restart functions. The procedures should include all operational parameters and appropriate limits of operation.
- (8) Anticipated peak power production and monthly energy production figures.

MCREA recommends not purchasing equipment or beginning construction of facilities until a design review is completed and MCREA gives final written design approval.

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APPENDIX IV

**LIABILITY INSURANCE REQUIREMENTS**

In accordance with the Colorado Public Utilities Commission Rules Implementing Sections 201 and 210, PURPA, Small Power Production and Cogeneration Facilities, a QF operating in parallel with a utility in Colorado must maintain in effect at all times comprehensive bodily injury and property damage insurance coverage. This insurance is to protect the public and MCREA from damage attributable to a QF.

For systems of 25 kW or less, the small power producer, at its own expense, shall secure and maintain in effect while interconnected liability insurance with a combined single limit for bodily injury and property damage of not less than \$300,000 for each occurrence. For systems above 25 kW and up to 2 MW, the small power producer, at its own expense, shall secure and maintain in effect during the term of the Agreement liability insurance with a combined single limit for bodily injury and property damage of not less than \$2,000,000 for each occurrence. Insurance coverage for systems greater than 2 MW shall be determined on a case-by-case basis by MCREA and shall reflect the size of the installation and the potential for system damage.

Except for solar QFs installed on a residential premise which have a design capacity of 25 kW or less, MCREA shall be named as an additional insured by endorsement to the insurance policy and the policy shall provide that written notice be given to MCREA at least thirty (30) days prior to any cancellation or reduction of any coverage. Such liability insurance shall provide, by endorsement to the policy, that MCREA shall not by reason of its inclusion as an additional insured incur liability to the insurance carrier for the payment of premium of such insurance. For all QFs, the liability insurance shall not exclude coverage for any incident related to the subject generator or its operation.

Certificates of Insurance evidencing the requisite coverage and provision(s) shall be furnished to MCREA prior to the Date of Interconnection of the Generation System. MCREA shall be permitted to periodically obtain proof of current insurance coverage from the generating customer in order to verify proper liability insurance coverage. The QF will not be allowed to commence or continue interconnected operations unless evidence is provided that satisfactory insurance coverage is in effect at all times.

The cost of the required insurance may be a factor in a QF's decision to become a power producer and, if so, whether to sell its power to MCREA or produce solely for its own use. MCREA recommends that the QF consult its insurance agent at an early stage in its planning so that this cost may be properly incorporated into that planning.

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No Warranty - Any inspections, reviews of plans, specifications and/or sites and any approvals, written or oral, are conducted or provided solely for the use and purposes of MCREA; MCREA makes no warranty, direct or indirect, and provides no assurances, direct or indirect, as to the adequacy or safety of any plans, specifications, sites, installations or other characteristics of the QF. The owners of QF are solely responsible for determining and ensuring the adequacy and safety of all plans, specifications, sites, installations and other characteristics of the QF.

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