

INTERCONNECTION STANDARDS FOR COGENERATORS
AND SMALL POWER PRODUCERS

LA PLATA ELECTRIC ASSOCIATION, INC.
DURANGO, COLORADO

SEPTEMBER 2006

Introduction

The purpose of this document is to set forth the requirements of La Plata Electric Association, Inc. (LPEA) regarding interconnection with, purchases from, sales to, and wheeling for qualifying cogenerating and small power producing facilities. A Qualifying Facility (QF) is a generating facility which meets the requirements for QF status under the Public Utility Regulatory Policies Act of 1978 (PURPA) and part 292 of the Commission's Regulations (18 C.F.R. Part 292), and which has obtained certification of its QF status. There are two types of QFs: cogeneration facilities and small power production facilities. A Cogeneration Facility is a generating facility that sequentially produces electricity and another form of useful thermal energy (such as heat or steam) used for industrial, commercial, residential or institutional purposes, and otherwise meets the requirements of 18 C.F.R. §§ 292.203(b) and 292.205 for operation, efficiency and use of energy output. A Small Power Production Facility is a generating facility whose primary energy source is renewable (hydro, wind, solar, etc.), biomass, waste, or geothermal resources, and that otherwise meets the requirements of 18 C.F.R. §§ 292.203(a), 292.203(c) and 292.204.

LPEA is one of several distribution cooperatives (Members) of Tri-State Generation and Transmission Association, Inc. (Tri-State). LPEA provides retail service in all of La Plata and Archuleta Counties as well as in parts of Mineral and Hinsdale counties of Colorado and a small portion of San Juan County, New Mexico.

LPEA purchases all of its power and energy requirements from Tri-State under a long-term contract. Therefore, the rates which will be paid to the owners of the QF are based on Tri-State's costs. Power and energy from QFs with nameplate ratings of 25 kW or less will be purchased under LPEA's Net Metering Tariff. Purchases from QFs with a nameplate rating over 25 kW will be through contractual agreements between Tri-State and the owner of the QF, even though QFs will, in most cases, be directly interconnected with LPEA rather than Tri-State.

LPEA will assist cogenerators and small power producers with respect to interconnection of the QF to the LPEA's power system. QF owners should initially contact LPEA for basic information regarding interconnection. Detailed interconnection studies and contractual development for QFs over 25 kW will generally involve both Tri-State and LPEA.

If the QF wishes to sell to another utility, LPEA and Tri-State will assist by wheeling to the other utility. The term wheeling is used to denote the transmission of power by one utility for the account of another or, in this case, the transmission of QF power over one utility system for delivery to a different utility.

Under the regulations implementing PURPA, the directly interconnected utility has both the obligation and the right to purchase power and energy from a QF. However, if the directly interconnected utility agrees, a QF may wheel energy to another utility. The other utility must purchase such energy at its avoided costs, less transmission losses, if any. All electric utilities subject to the jurisdiction of the Public Utilities Commission of the State of Colorado (PUC) have been required to file certain information regarding avoided costs with the PUC. Nonregulated utilities, and utilities in other states, are required to provide similar information. In order to assist QFs in obtaining the best price for their power and energy, LPEA and Tri-State will wheel QF power and energy over its system to other utilities at cost, at the option of the QF owner.

LPEA will permit interconnection and parallel operation with a QF in accordance with the terms and conditions set forth in this document and the rules and regulations of the PUC.

Some of the information contained in this policy statement and attachments is technical in nature. QF owners should contact LPEA if assistance is needed to understand any such information. Inquiries concerning interconnection of QF may be directed to:

Dan Harms
Systems Engineer
La Plata Electric Association, Inc.
P.O. 2750
Durango, CO 81302
(970) 382-3514

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 LPEA from damage attributable to a QF.

For systems of 10 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 10 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 LPEA and shall reflect the size of the installation and the potential for system damage.

Except for QFs installed on a residential premise which have a design capacity of 10 kW or less, LPEA shall be named as an additional insured by endorsement to the insurance policy and the policy shall provide that written notice be given to LPEA 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 LPEA 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 LPEA prior to the Date of Interconnection of the Generation System. LPEA 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 LPEA or produce solely for its own use. LPEA 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.

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 LPEA; LPEA 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.

STANDARDS FOR INTERCONNECTION AND PROTECTION OF
COGENERATORS AND SMALL POWER PROCEDURES

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 LPEA and Tri-State. Small power producer and cogenerator personnel and LPEA 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 LPEA before purchasing or installing equipment.

LPEA will assist any small power producer or cogenerator in its efforts to generate electric power and energy. LPEA encourages the development of small power projects which can supplement LPEA's existing generating resources whenever this can be done without adverse effects on the general public or to LPEA's equipment or personnel. To help achieve the maximum reliability and use of small power projects, LPEA 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 LPEA must be installed at locations where the customer wishes to operate generating facilities in parallel with LPEA's system. The purpose of this equipment is to ensure safe and reliable power system operation and to allow prompt disconnection of the 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. LPEA will assist QF owners in determining interconnection requirements. This document gives general information about parallel operation; however, LPEA 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 LPEA's system. All costs associated with interconnection, necessary system additions, and modifications to accommodate the QF will be borne by the QF.

LPEA requires that the customer design, construct and operate their equipment in a manner which will not degrade the quality of service to other LPEA 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. LPEA 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.

LPEA 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 LPEA's system. LPEA 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 10 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 LPEA'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 10 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.

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 LPEA requirements and with reasonable interconnection safety and design standards and prudent electrical practices. The QF agrees to hold the LPEA 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 LPEA'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 LPEA'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 LPEA 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.

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 LPEA 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. LPEA 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 LPEA circuit is limited by the ability of that circuit to regulate voltage and maintain adequate quality of service to other LPEA customers. LPEA 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.

Capacitors installed at the generator may be required to limit the adverse effects of excess var flow on LPEA's system. Installation of capacitors at or near an induction generator increases the risk that the machine may become self-excited if it is completely isolated from or isolated with a relatively small portion of LPEA's system. A self-excited induction generator can produce power of abnormal voltage and frequency. This unregulated power may damage equipment of other customers who are electrically connected to the isolated generator.

To minimize the risk of self-excited operation, the compensation installed at or near an induction generator should be limited to that value necessary to correct the no-load power factor to 95 percent. Over and under-frequency relays and voltage regulation relays will also be required on all induction generators to protect against self-excited operation. Other protective equipment such as voltage restrained overcurrent relays may be required to reduce the possibility of damage to LPEA equipment or the equipment of other customers. Where self-excitation problems appear likely, it may be necessary to rearrange the distribution network to avoid isolating the induction generator with a small attached load. Costs of power factor correction equipment, protective equipment and any LPEA system changes must be borne by 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 LPEA's side. The cost of this transformer and associated equipment shall be borne by the QF.

Inverter systems require a significant reactive power flow to ensure proper operation. LPEA 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 LPEA'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 LPEA customers, LPEA must be concerned with the manner in which QF are connected to the existing LPEA system. The LPEA's concerns are fourfold:

- 1) The QF must promptly disconnect from LPEA 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 LPEA line; and
- 4) The QF must not significantly degrade the quality of service to other LPEA 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 LPEA load becomes separated from the LPEA 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 LPEA 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.

In instances where LPEA'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, LPEA requires the installation of voltage and frequency relays, even on the smallest QFs. For installations with rated capacity of greater than 10 kW, specific devices are required to detect faults on LPEA's system as well as voltage and frequency relays to detect isolated operation. Equipment may also be required on LPEA'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.

2.5.2 Qualifying Facility Disturbances

To prevent loss of service to other LPEA 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 LPEA's equipment to ensure proper operation in the event of a fault. LPEA will assist the QF to properly coordinate the protective equipment.

2.5.3 Backfeed to Utility System

The QF's generators provide an additional source of power for LPEA's network. The QF must provide protective equipment sufficient to give positive assurance that the generators cannot be connected to an otherwise de-energized LPEA line. This prevents a potential hazard to LPEA personnel who may be in contact with the line for maintenance purposes. In addition to an automatic fail-safe device, LPEA 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 LPEA to visibly indicate isolation of the QF. Other equipment such as undervoltage, synchronizing, voltage phase sequence or reclosure relays may also be required.

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

2.5.4 Power Quality

The QF will not be allowed to degrade the quality of power delivered to other LPEA customers. The QF will be expected to operate within the limits on voltage, frequency and harmonic content as outlined in Appendix II.

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 LPEA customers or interference with the operation of LPEA equipment occurs, LPEA 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 LPEA'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 LPEA for each application. LPEA 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, LPEA herein lists potential hazards to the Qualifying Facility equipment which might occur as a result of interconnection with LPEA'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.

The QF generator can be damaged by interconnection with LPEA'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. LPEA'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 LPEA's circuit was opened, the generator and LPEA'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 LPEA's system if LPEA's voltage is of abnormal magnitude or phase sequence. Modifications to LPEA'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 LPEA 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 LPEA with a completed Application for Interconnection on a form supplied by LPEA for review and acceptance.

- 2) The QF has obtained a certificate of code compliance from a Colorado State Electrical Inspector;
- 3) LPEA has made any necessary modifications to its system to accommodate the QF;
- 4) LPEA 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.

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

The QF must notify LPEA prior to any modifications made to the QF or to the interconnection between the QF and LPEA. The QF must receive approval from LPEA prior to proceeding with such modifications. The QF must permit LPEA, 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 LPEA 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 LPEA'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 LPEA:

- 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 LPEA'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 LPEA to maintain the interconnection. In this case, LPEA 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 LPEA and for material procurement by LPEA. 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.

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

QFs that generate electrical energy for on-site use only and are interlocked or otherwise prevented from feeding energy into the LPEA 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 LPEA system.

3.0 SPECIFIC REQUIREMENTS FOR INTERCONNECTION

LPEA 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. LPEA shall be the sole judge of what equipment is necessary to ensure a safe, reliable interconnection with LPEA's system.

The size classes for QF parallel generation are:

- 1) 10 kW and below;
- 2) 10-25 kW;
- 3) Greater than 25 kW;

3.1 QUALIFYING FACILITIES OF 10 KW OR LESS (SINGLE OR THREE PHASE)

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

The QF of 10 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.

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. LPEA shall provide the reactive power requirements of the QF to avoid the potential for self-excitation.

3.2 QUALIFYING FACILITIES OF 10-25 KW (THREE PHASE ONLY)

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

The QF of 10-25 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 ONLY)

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

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

SUMMARY OF INTERCONNECTION PROCEDURE

- 1) Customer with potential Qualifying Facility contacts LPEA and obtains Application for Interconnection (Application).
- 2) The QF submits the Application to LPEA. If QF's nameplate capacity is greater than 10 kW, the Qualifying Facility Design Data Requirements show in Appendix III are also required.
- 3) LPEA 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, LPEA conducts preliminary engineering studies, if warranted, to determine the effect the QF might have on existing LPEA customers and equipment.
- 5) Provided all the criteria in the Interconnection Standards for Cogenerators and Small Power Producers are met, unless LPEA determines and demonstrates that the Small Generating Facility cannot be interconnected safely and reliably, LPEA approves and executes the Application and returns it to the Customer.
- 6) LPEA designs and constructs the interconnection and modifies the existing LPEA 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 LPEA. Prior to parallel operation, LPEA will inspect the QF for compliance with standards within ten business days of the receipt of the Certificate of Completion. LPEA will inspect the QF for compliance with standards, and may schedule appropriate metering replacement, if necessary.
- 9) LPEA 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, LPEA 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.

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
- UL 1741 Inverters, Converters, and Controllers for Use in Independent Power Systems
- IEEE1547 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"

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

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

QUALIFYING FACILITY DESIGN DATA REQUIREMENTS

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

LPEA 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 LPEA'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 LPEA'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.

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